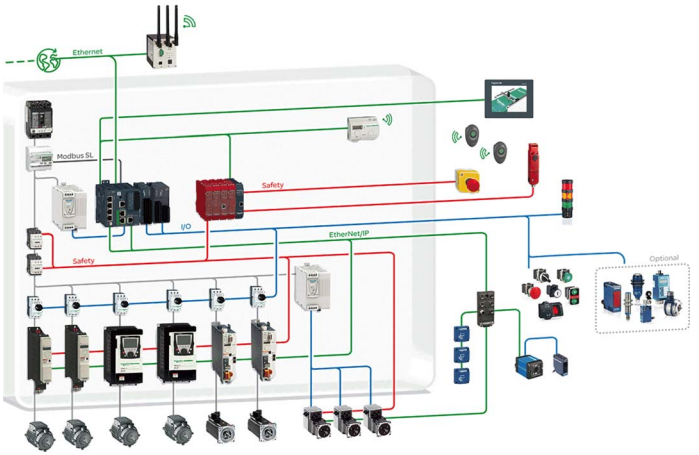
Compact EtherNet/IP Logic Controller M251

System User Guide

09/2016



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The information provided in this documentation contains general descriptions and/or technical characteristics of the performance of the products contained herein. This documentation is not intended as a substitute for and is not to be used for determining suitability or reliability of these products for specific user applications. It is the duty of any such user or integrator to perform the appropriate and complete risk analysis, evaluation and testing of the products with respect to the relevant specific application or use thereof. Neither Schneider Electric nor any of its affiliates or subsidiaries shall be responsible or liable for misuse of the information contained herein. If you have any suggestions for improvements or amendments or have found errors in this publication, please notify us.

All pertinent state, regional, and local safety regulations must be observed when installing and using this product. For reasons of safety and to help ensure compliance with documented system data, only the manufacturer should perform repairs to components.

When devices are used for applications with technical safety requirements, the relevant instructions must be followed.

Failure to use Schneider Electric software or approved software with our hardware products may result in injury, harm, or improper operating results.

Failure to observe this information can result in injury or equipment damage.

Table of Contents

Safety Information

Important Information

NOTICE

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, service, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of this symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER

DANGER indicates a hazardous situation which, if not avoided, **will result in** death or serious injury.

⚠ WARNING

WARNING indicates a hazardous situation which, if not avoided, **could result in** death or serious injury.

⚠ CAUTION

CAUTION indicates a hazardous situation which, if not avoided, **could result** in minor or moderate injury.

NOTICE

NOTICE is used to address practices not related to physical injury.

PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and its installation, and has received safety training to recognize and avoid the hazards involved.

BEFORE YOU BEGIN

Do not use this product on machinery lacking effective point-of-operation guarding. Lack of effective point-of-operation guarding on a machine can result in serious injury to the operator of that machine.

⚠ WARNING

UNGUARDED EQUIPMENT

- Do not use this software and related automation equipment on equipment which does not have point-of-operation protection.
- Do not reach into machinery during operation.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

This automation equipment and related software is used to control a variety of industrial processes. The type or model of automation equipment suitable for each application will vary depending on factors such as the control function required, degree of protection required, production methods, unusual conditions, government regulations, etc. In some applications, more than one processor may be required, as when backup redundancy is needed.

Only you, the user, machine builder or system integrator can be aware of all the conditions and factors present during setup, operation, and maintenance of the machine and, therefore, can determine the automation equipment and the related safeties and interlocks which can be properly used. When selecting automation and control equipment and related software for a particular application, you should refer to the applicable local and national standards and regulations. The National Safety Council's Accident Prevention Manual (nationally recognized in the United States of America) also provides much useful information.

In some applications, such as packaging machinery, additional operator protection such as point-of-operation guarding must be provided. This is necessary if the operator's hands and other parts of the body are free to enter the pinch points or other hazardous areas and serious injury can occur. Software products alone cannot protect an operator from injury. For this reason the software cannot be substituted for or take the place of point-of-operation protection.

Ensure that appropriate safeties and mechanical/electrical interlocks related to point-of-operation protection have been installed and are operational before placing the equipment into service. All interlocks and safeties related to point-of-operation protection must be coordinated with the related automation equipment and software programming.

NOTE: Coordination of safeties and mechanical/electrical interlocks for point-of-operation protection is outside the scope of the Function Block Library, System User Guide, or other implementation referenced in this documentation.

START-UP AND TEST

Before using electrical control and automation equipment for regular operation after installation, the system should be given a start-up test by qualified personnel to verify correct operation of the equipment. It is important that arrangements for such a check be made and that enough time is allowed to perform complete and satisfactory testing.

⚠ WARNING

EQUIPMENT OPERATION HAZARD

- Verify that all installation and set up procedures have been completed.
- Before operational tests are performed, remove all blocks or other temporary holding means used for shipment from all component devices.
- Remove tools, meters, and debris from equipment.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Follow all start-up tests recommended in the equipment documentation. Store all equipment documentation for future references.

Software testing must be done in both simulated and real environments.

Verify that the completed system is free from all short circuits and temporary grounds that are not installed according to local regulations (according to the National Electrical Code in the U.S.A, for instance). If high-potential voltage testing is necessary, follow recommendations in equipment documentation to prevent accidental equipment damage.

Before energizing equipment:

- Remove tools, meters, and debris from equipment.
- Close the equipment enclosure door.
- Remove all temporary grounds from incoming power lines.
- Perform all start-up tests recommended by the manufacturer.

OPERATION AND ADJUSTMENTS

The following precautions are from the NEMA Standards Publication ICS 7.1-1995 (English version prevails):

- Regardless of the care exercised in the design and manufacture of equipment or in the selection and ratings of components, there are hazards that can be encountered if such equipment is improperly operated.
- It is sometimes possible to misadjust the equipment and thus produce unsatisfactory or unsafe operation. Always use the manufacturer's instructions as a guide for functional adjustments. Personnel who have access to these adjustments should be familiar with the equipment manufacturer's instructions and the machinery used with the electrical equipment.
- Only those operational adjustments actually required by the operator should be accessible to the operator. Access to other controls should be restricted to prevent unauthorized changes in operating characteristics.

About the Book

At a Glance

Document Scope

This document describes a generic architecture based on Modicon M251 Logic Controller.

This document is intended to provide a quick introduction to the described system.

It is not intended to replace any specific product documentation, nor any of your own design documentation. On the contrary, it offers additional information to the product documentation for installing, configuring, and implementing the system.

The architecture described in this document is not a specific product in the normal commercial sense. It describes an example of how Schneider Electric and third-party components may be integrated to fulfill an industrial application.

A detailed functional description or the specification for a specific user application is not part of this document. Nevertheless, the document outlines some typical applications where the system could be implemented.

Your specific application requirements may be different and will require additional and/or different components. In this case, you will have to adapt the information provided in this document to your particular needs. To do so, you will need to consult the specific product documentation of the components that you are substituting in this architecture.

Pay particular attention in conforming to any safety information, different electrical requirements, and normative standards that would apply to your adaptation.

There are some major components in the architecture described in this document that cannot be substituted without completely invalidating the architecture, descriptions, instructions, wiring diagrams, and compatibility between the various software and hardware components specified herein.

Be aware of the consequences of component substitution in the architecture described in this document as substitutions may impair the compatibility and interoperability of software and hardware.

Validity Note

This document has been updated for the release of SoMachine V4.2.

Related Documents

Title of Documentation	Reference Number
PowerPact Multistandard, Catalogue	LVPED212023EN
The essential guide for power supplies and transformers	DIA3ED2070412EN

Title of Documentation	Reference Number
C60 Multi-Standard Range, Catalog	CM909003E
Phaseo power supplies and transformers, Catalogue Pages	14082-EN
iEM3100 series / iEM3200 series, Energy Meters, User Manual	DOCA0005EN
Control and protection components	MKTED210011EN
Preventa solutions for efficient machine safety - catalogue	MKTED2140201EN
Modular Safety Controller, User Guide	EIO0000001987
ATV32 - Safety integrated functions manual	S1A45606
Magelis GTO, User Manual	EIO0000001133 (ENG)
Magelis XBT GC/XBT GK/XBTGT, SoMachine - Combo and Network Drivers	EIO00000000219 (ENG)
Harmony XB5R, ZBRN1/ZBRN2, User Manual	EIO0000001177 (EN)
Harmony XB5R, Expert Instruction Sheet	EIO0000000812 (EN)
Control and signaling components	MKTED208031EN
Modicon M251 Logic Controller, Hardware Guide	EIO0000001486
Modicon M251 Logic Controller, Programming Guide	EIO0000001462
Modicon TM3, Digital I/O Modules, Hardware Guide	EIO0000001408
Modicon TM3, Expert I/O Modules, Hardware Guide	EIO0000001420
Modicon TM3, Expansion Modules Configuration, Programming Guide	EIO0000001402
ConneXium Industrial Ethernet Cabling System, 5TX IP67 Switch, TCSESU051F0	31006691
Transparent Ready, User Guide	31006929
SoMachine Industrial EtherNet, User Guide	EIO0000002215
ATV32 - Safety integrated functions manual	S1A45606
Altivar 32, Variable speed drives for synchronous and asynchronous motors, Installation manual	S1A28686 (ENG)
Altivar 32, Variable speed drives for synchronous and asynchronous motors, Programming manual	S1A28692 (ENG)
Altivar 32 Variable speed drives for synchronous and asynchronous motors, Modbus TCP - EtherNet/IP, Communication Manual	S1A28701
Altivar 61/71 EtherNet/IP card – User manual	AAV68822 (ENG)
ILA2K EtherNet/IP Lexium Integrated Drive, Product manual	0198441113670
ILE2K EtherNet/IP Lexium Integrated Drive, Product manual	0198441113676
ILS2K EtherNet/IP Lexium Integrated Drive, Product manual	0198441113682
LXM32M AC servo drive, Product manual	0198441113767
LXM32M, EtherNet/IP module, Fieldbus manual	0198441113802

Title of Documentation	Reference Number
BMH, Servo motor, Motor manual	0198441113749 (ENG)
BSH, Servo motor, Motor manual	0198441113837 (ENG)
Detection for automation solutions OsiSense	MKTED210041EN
RFID OsiSense XG, Ethernet Smart Antenna, User Manual	EIO0000001601
XUWSA••• Vision Sensors - Standard, User Manual	EIO0000001325
XUWAA••• Vision Sensors - Advanced, User Manual	EIO0000001328
The essential guide of Detection	DIA4ED2041203EN
Modbus Serial Line, Planning and Installation Guide	33003925
SoMachine Programming Guide	EIO0000000067 (ENG)
Altivar 61/71/LIFT, Variable speed drives for synchronous and asynchronous motors, Safety integrated function manual	S1A91443 (ENG)
XGST2020 Handheld Terminal - Software Guide	EIO0000002166 (ENG)

You can download these technical publications and other technical information from our website at http://download.schneider-electric.com

Product Related Information

⚠ ⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

- Disconnect all power from all equipment including connected devices prior to removing any covers or doors, or installing or removing any accessories, hardware, cables, or wires except under the specific conditions specified in the appropriate hardware guide for this equipment.
- Always use a properly rated voltage sensing device to confirm the power is off where and when indicated.
- Replace and secure all covers, accessories, hardware, cables, and wires and confirm that a proper ground connection exists before applying power to the unit.
- Use only the specified voltage when operating this equipment and any associated products.

Failure to follow these instructions will result in death or serious injury.

This equipment has been designed to operate outside of any hazardous location. Only install this equipment in zones known to be free of a hazardous atmosphere.

⚠ DANGER

POTENTIAL FOR EXPLOSION

Install and use this equipment in non-hazardous locations only.

Failure to follow these instructions will result in death or serious injury.

⚠ WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for certain critical control functions, provide a means to achieve a safe state during and after a path failure. Examples of critical control functions are emergency stop and overtravel stop, power outage and restart.
- Separate or redundant control paths must be provided for critical control functions.
- System control paths may include communication links. Consideration must be given to the implications of unanticipated transmission delays or failures of the link.
- Observe all accident prevention regulations and local safety guidelines.[1]
- Each implementation of this equipment must be individually and thoroughly tested for proper operation before being placed into service.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

[1] For additional information, refer to NEMA ICS 1.1 (latest edition), "Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control" and to NEMA ICS 7.1 (latest edition), "Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems" or their equivalent governing your particular location.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- Only use software approved by Schneider Electric for use with this equipment.
- Update your application program every time you change the physical hardware configuration.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Terminology Derived from Standards

The technical terms, terminology, symbols and the corresponding descriptions in this manual, or that appear in or on the products themselves, are generally derived from the terms or definitions of international standards.

In the area of functional safety systems, drives and general automation, this may include, but is not limited to, terms such as *safety*, *safety function*, *safe state*, *fault*, *fault reset*, *malfunction*, *failure*, *error*, *error message*, *dangerous*, etc.

Among others, these standards include:

Standard	Description
EN 61131-2:2007	Programmable controllers, part 2: Equipment requirements and tests.
ISO 13849-1:2008	Safety of machinery: Safety related parts of control systems. General principles for design.
EN 61496-1:2013	Safety of machinery: Electro-sensitive protective equipment. Part 1: General requirements and tests.
ISO 12100:2010	Safety of machinery - General principles for design - Risk assessment and risk reduction
EN 60204-1:2006	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
EN 1088:2008 ISO 14119:2013	Safety of machinery - Interlocking devices associated with guards - Principles for design and selection
ISO 13850:2006	Safety of machinery - Emergency stop - Principles for design
EN/IEC 62061:2005	Safety of machinery - Functional safety of safety-related electrical, electronic, and electronic programmable control systems
IEC 61508-1:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems: General requirements.
IEC 61508-2:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems: Requirements for electrical/electronic/programmable electronic safety-related systems.
IEC 61508-3:2010	Functional safety of electrical/electronic/programmable electronic safety-related systems: Software requirements.
IEC 61784-3:2008	Digital data communication for measurement and control: Functional safety field buses.
2006/42/EC	Machinery Directive
2014/30/EU	Electromagnetic Compatibility Directive
2014/35/EU	Low Voltage Directive

In addition, terms used in the present document may tangentially be used as they are derived from other standards such as:

Standard	Description
IEC 60034 series	Rotating electrical machines
IEC 61800 series	Adjustable speed electrical power drive systems
IEC 61158 series	Digital data communications for measurement and control – Fieldbus for use in industrial control systems

Finally, the term *zone of operation* may be used in conjunction with the description of specific hazards, and is defined as it is for a *hazard zone* or *danger zone* in the *Machinery Directive* (*2006/42/EC*) and *ISO 12100:2010*.

NOTE: The aforementioned standards may or may not apply to the specific products cited in the present documentation. For more information concerning the individual standards applicable to the products described herein, see the characteristics tables for those product references.

Chapter 1
General Information

What Is in This Chapter?

This chapter contains the following topics:

Introduction

Overview

With **Tested Validated Documented Architectures** (TVDAs), Schneider Electric provides complete controlling system proposals applicable for a wide range of applications.

TVDAs are meant to help you to

- quickly find cost efficient controlling solutions,
- optimize the system implementation time,
- gain a competitive advantage and optimize overall costs for your machine.

With detailed component lists, wiring diagrams, commissioning guides, controller, and HMI applications the effort to assemble and setup the system becomes significantly reduced.

For a high level of reliability and robustness each TVDA is subjected to extensive system validation. Specific performance requirements as well as installation constraints are considered in the system design.

TVDAs provide a high level of openness for adaptations. With a clear separated project template structure and dedicated functions embedded in SoMachine and SoMachine Basic, required modifications can be realized quickly.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Thoroughly read and understand any and all device manuals for the characteristics and properties of the devices employed before attempting to modify parameters that may alter those characteristics and properties.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Deliverables

SoMachine Project Template

The SoMachine Project Template is comprised of a ready-to-use controller project covering the complete system configuration. Within the project template, you can find preconfigured application code to operate field devices, to monitor the system status, and to handle errors that are detected.

HMI Application

The HMI application is a ready-to-use interface that can:

- Control the main functionalities of the system
- Indicate the system status
- Visualize the system errors that are detected

System User Guide (SUG)

The System User Guide provides:

- System documentation with a focus on installation, commissioning, and adaptation of the system
- Bill of Material (BOM), including power distribution components
- Detailed installation information for each component
- Guidance on how to commission the complete system
- Introduction of available ranges and key features of each component used within the architecture
- Guidance on how to adapt the system efficiently by making use of dedicated functions provided within SoMachine software

Wiring Diagram

The wiring diagrams provide detailed guidance on the system wiring, and are reusable as a base to generate final technical documentation of the controlling system.

The wiring diagrams are provided for download on the Schneider Electric web page *www.schneider-electric.com* and are available in the following file formats:

- EPLAN Electric P8 V2.4 project archive
- **.pdf* (generated with EPLAN)
- **.dwg* (generated with EPLAN)

Chapter 2
System Architecture

What Is in This Chapter?

This chapter contains the following topics:

Architecture Related Safety Information

Remote Devices

Remote control operating devices may lead to unintended equipment operation by:

- incorrect operation
- insufficient view on the machine during operation
- unintentional manipulation

Care must be taken and provisions made for use of this product as a control device to avoid inadvertent consequences of commanded machine operation, controller state changes, or alteration of data memory or machine operating parameters.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- Place operator devices of the control system near the machine or in a place where you have full view of the machine.
- Protect operator commands against unauthorized access.
- If remote control is a necessary design aspect of the application, ensure that there is a local, competent, and qualified observer present when operating from a remote location.
- Configure and install the Run/Stop input for the application so that local control over the starting or stopping of the controller can be maintained regardless of the remote commands sent to the controller.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Wireless Devices

Data transmission between wireless devices can be influenced by environmental conditions. Especially for portable devices, such as wireless and batteryless push-buttons, the quality of the wireless communication is changing depending on the position of the device to the receiver.

⚠ WARNING

LOSS OF CONTROL

- Do not use wireless equipment as the only means of control for critical control functions such as motor start/stop or power disconnect.
- Provide separate or redundant control paths for critical control functions.
- Provide a means to achieve a safe state during and after a path failure for critical control functions such as emergency stop and overtravel stop.
- Improve the reliability of the wireless network by the use of repeater(s).

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Communication

Fieldbusses or network communication may lead to loss of control by:

- Communication disturbance by external influences (for example wiring or EMC)
- Delay during communication
- Interruption of communication
- Inaccurate communication

⚠ WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for certain critical control functions, provide a means to achieve a safe state during and after a path failure. Examples of critical control functions are emergency stop and overtravel stop, power outage and restart.
- Separate or redundant control paths must be provided for critical control functions.
- System control paths may include communication links. Consideration must be given to the implications of unanticipated transmission delays or failures of the link.
- Observe all accident prevention regulations and local safety guidelines.[1]
- Each implementation of this equipment must be individually and thoroughly tested for proper operation before being placed into service.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

[1] For additional information, refer to NEMA ICS 1.1 (latest edition), "Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control" and to NEMA ICS 7.1 (latest edition), "Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems" or their equivalent governing your particular location.

System Architecture

Overview

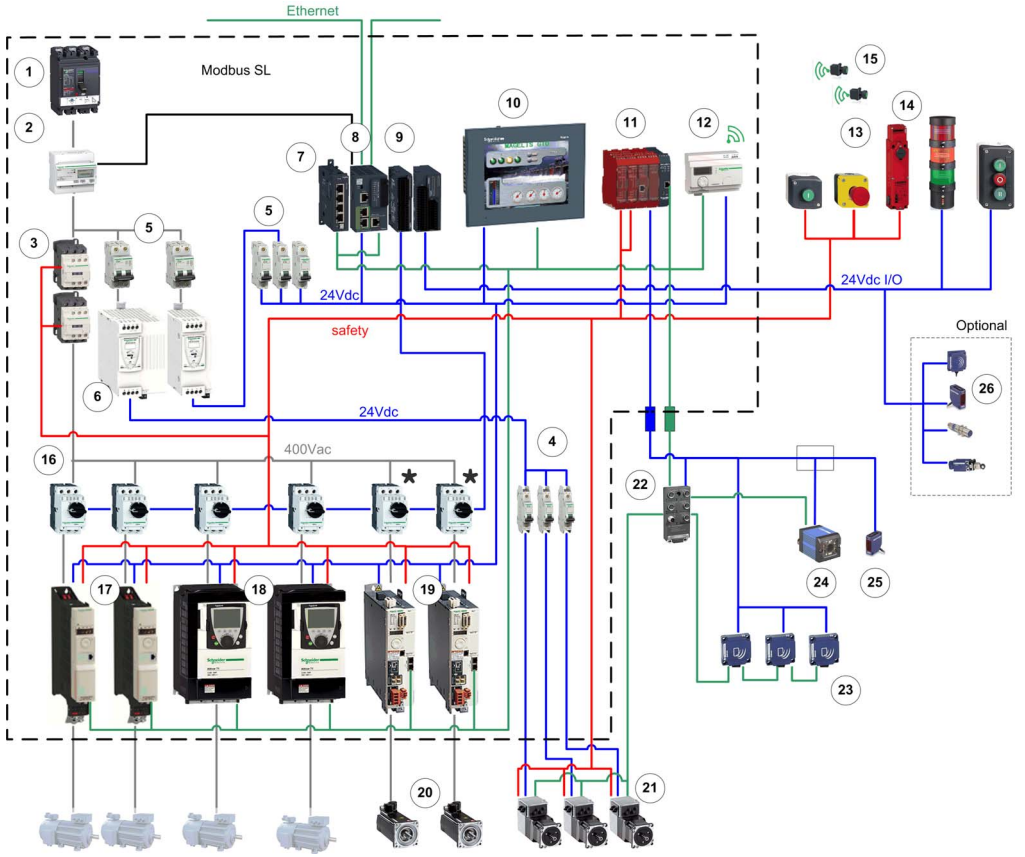
The architecture is arranged into the optimized performance class and is distinguished by the following characteristics:

- Modicon M251 Logic Controller
- 1 optimized Magelis touch panels HMIGTO4310
- Energy metering
- Industrial Ethernet for Modbus TCP and EtherNet/IP communication
- Modbus serial line communication
- Ethernet connectivity
- Application of machine safety
- Wireless and batteryless operator push-buttons
- 16 digital inputs
- 16 digital outputs

The following devices are linked to the Ethernet fieldbus and are controlled and monitored by the controller:

- 2 Altivar 32 variable speed drives (EtherNet/IP target)
- 2 Lexium 32M servo drives (EtherNet/IP target)
- 1 Harmony wireless push-button access point (Modbus TCP slave)
- 3 OsiSense XG RFID Smart Antennas (EtherNet/IP target)
- 1 integrated Lexium ILA servo drive (EtherNet/IP target)
- 1 integrated Lexium ILE servo drive (EtherNet/IP target)
- 1 integrated Lexium ILS servo drive (EtherNet/IP target)

Layout



* Conformance to UL standards requires that fuses are used for the branch circuit protection in place of the motor circuit breakers depicted above in front of the Lexium servo drives. For more information, refer to LXM32M AC servo drive, Product manual, 0198441113767.

1	PowerPact circuit breaker	14	Preventa XCSL safety interlock switch
2	iEM3150 energy meter	15	Harmony wireless push-buttons
3	TeSys D LC1D contactor	16	TeSys GV2P motor circuit-breaker
4	Multi-9 C60 (UL 489) circuit breaker	17	Altivar 32 variable speed drive + communication module (EtherNet/IP)
5	Multi-9 C60 (UL 1077) circuit breaker	18	Altivar 71 variable speed drive + communication module (EtherNet/IP)
6	Phaseo power supply	19	Lexium 32M servo drive + communication module (EtherNet/IP)

7	Modicon TM4 Ethernet switch 4 ports	20	Lexium BSH servo motor
8	Modicon M251 Logic Controller	21	EtherNet/IP Lexium integrated drives (ILA2K, ILE2K, ILS2K)
9	TM3 digital I/O expansion module	22	ConneXium Ethernet switch IP 67
10	Magelis HMIGTO touch panel	23	OsiSense XGCS RFID compact station
11	Preventa XPS MCM Modular Safety Controller	24	OsiSense XUW vision sensor
12	Harmony wireless receiver ZBRN1 (Modbus TCP)	25	OsiSense sensor to trigger the vision sensor
13	Harmony signaling/control devices	26	OsiSense optional sensors

Chapter 3
Safety & Safety Requirements

What Is in This Chapter?

This chapter contains the following topics:

Safety Evolution Structure for the System User Guides

Overview

1. Evolution of legal framework *(see page 29)*
2. Risk assessment *(see page 32)*
3. Functional safety standards overview *(see page 36)*
4. Standard EN ISO 13849-1 machinery safety *(see page 37)*
5. Standard EN/IEC 62061 machinery safety *(see page 45)*
6. Selecting the applicable standard *(see page 52)*
7. Where to get more information regarding safety *(see page 53)*
   a. Safety guide
   b. Sistema
   c. Sistema library
8. Concept used on specific TVDA

Evolution of Legal Framework

EC Directive

Legal instrument to harmonize the legislation of the European member states

- Defines the essential health and safety requirements (EHSRs).
- Transposed into national law (act, decree, order, regulations).

Standard

A standard is a technical specification approved by a recognized standardization body for repeated or continuous application, with which compliance is not compulsory.

Harmonized Standard

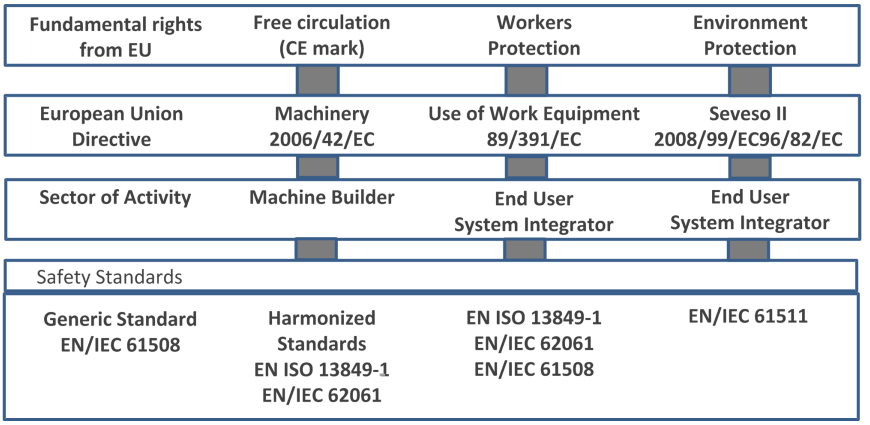
A standard becomes harmonized when published throughout the member states.

Presumption of Conformity

- When a product conforms to a harmonized European standard, the reference to which has been published in the official journal of the European Union for a specific directive, and which covers one or more of the essential safety requirements, the product is presumed to comply with those essential safety requirements of the directive.
- In many cases European standards (ENs) are technically similar to international (IEC or ISO) standards. However only European standards include a list of which EHSRs are covered, so only European standards can confer a presumption of conformity.

European Directives and Safety Standards

Link between some of the main safety standards and the European directives according with the sectors of activity.



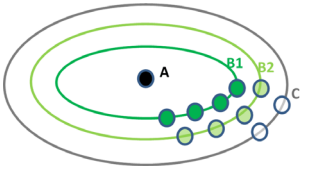
A list of such standards can be accessed at:

http://www.newapproach.org/Directives/DirectiveList.asp

A, B and C Standards

When a type C standard deviates from one or more provisions dealt with by a type A standard or by a type B standard, the type C standard takes precedence. EN ISO 12100 is type A standards.

European standards for the machinery safety form the following structure:

Type A standards Basic safety standards giving basic concepts, principles for design, and general aspects that can be applied to all machinery.	
Type B standards Generic safety standards dealing with one safety aspect or one type of safeguard that can be used across a wide range of machinery: ● Type B1 standards on particular safety aspects (for example, safety distances, surface temperature, noise) ● Type B2 standards on safeguards (for example, two-hand controls, interlocking devices, pressure sensitive devices, guards)	
Type C standards Machine safety standards dealing with detailed safety requirements for a particular machine or group of machines.	

Some examples of these types of standards are:

Name	Type	Description
EN ISO 12100	A	2010 Safety of machinery - General principles for design - Risk assessment and risk reduction
EN ISO 13850	B	Emergency stop - Principles for design
EN/IEC 62061	B	Functional safety of safety-related electrical, electronic, and electronic programmable control systems
EN ISO 13849-1	B	Safety of machinery - safety-related parts of control systems - Part 1 general principles for design
EN 349	B	Minimum gaps to avoid crushing of parts of the human body
EN ISO 13857	B	Safety of machinery - safety distances to prevent hazard zones being reached by upper and lower limbs
EN 60204-1	B	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
EN 1088/ISO 14119	B	Interlocking devices associated with guards - Principles for design and selection

Manufacturers' Responsibilities

Manufacturers placing machines on the market within the European Economic Area (EEA) must comply with the requirements of the machinery directive. Note that "placing on the market" includes an organization supplying a machine to itself, that is, building or modifying machines for its own use, or importing machines into the EEA.

Users' Responsibilities

Users of machines need to ensure that newly purchased machines are CE marked, and accompanied by a declaration of conformity to the machinery directive. Machines must be used in accordance with the manufacturer's instructions.

Existing machines taken into service before the machinery directive came into force do not need to comply, although they need to comply with the regulations resulting from the use of work equipment directive and be safe and fit for purpose.

Modification of machines can be considered as manufacture of a new machine, even if for use in-house, and the company modifying a machine needs to be aware that it might need to issue a declaration of conformity and CE marking.

Risk Assessment

European Legislation

Machines are sources of potential risk and the machinery directive requires a risk assessment to ensure that any potential risk is reduced to less than the acceptable risk.

Standard EN/ISO 12100 defines risk as follows: risk is the severity multiplied by the possibility of occurrence. It defines an iterative process for achieving machine safety, which states that the risks for each potential hazard can be determined in 4 stages.

1. Risk assessment
2. Determination of machine limits
3. Identification of the potential hazard
4. Risk evaluation

This method provides the basis for the requisite risk reduction.

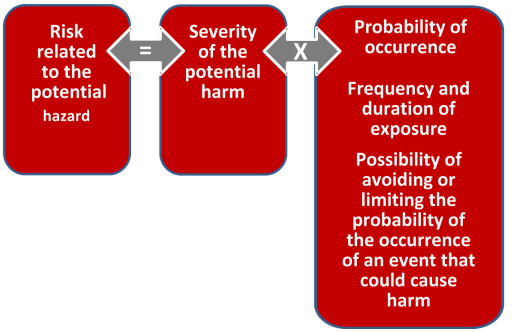
Risk Assessment

Risk assessment consists of a series of logic steps which make it possible to analyze and evaluate machinery-related risks systematically.

Risk assessment is followed, whenever necessary, by a reduction of the risk.

This definition taken from standard EN/ISO 12100 is based on an iterative process represented in the diagram opposite.

Definition of risk



Determination of Machine Limits

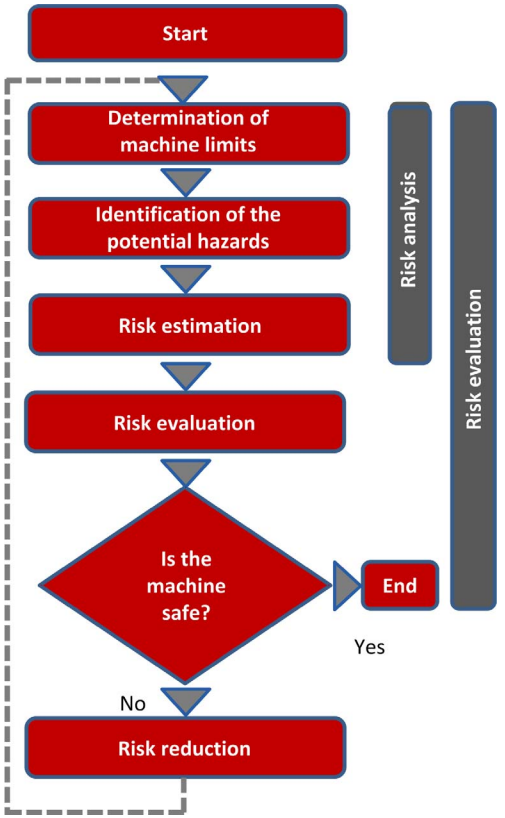
Risk assessment starts by determining the limits of the machine at all stages of its life cycle:

- Transport, assembly, installation
- Commissioning
- Use
- De-commissioning, dismantling

The use limitations must then be specified:

- Operating modes
- Level of training required
- Space limits (amplitude, movement...)
- Time limits (life cycle, frequency of maintenance...)

Logic steps for risk analysis



Identification of the Potential Hazard

If a potential hazard exists, a hazardous phenomenon will cause harm if measures are not taken. All the tasks associated with the life cycle of a machine must be identified, such as:

- Assembly, transport, and installation
- Adjustment, testing
- Learning, programming
- Tool changing
- Feeding, removal of product from the machine

- Starting, stopping
- Emergency stops, restarting after an unexpected stop
- Maintenance, cleaning, and so on.

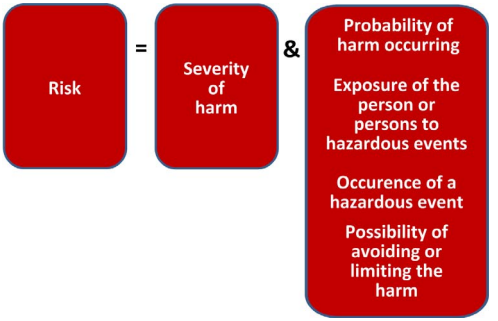
The risk is a function of the severity of the harm and the probability that this harm will occur. The severity of the harm takes into account:

- The severity of injuries (slight, serious, death)
- The extent of the harm (number of persons)

The probability of the harm occurring takes into account:

- Exposure to the hazard (nature of access, time spent in the hazardous zone, number of persons exposed, frequency of access)
- The occurrence of a hazardous event (accident history, comparison of risks, ...)
- The possibility of avoiding or limiting the harm (experience, awareness of the risk, ...)

Elements of the risk



Risk Evaluation

Based on the risk assessment, the designer has to define the safety-related control system. To achieve that, the designer will choose one of the 2 standards appropriate to the application:

- either standard EN ISO 13849-1, which defines performance levels (PL)
- or standard EN/IEC 62061, which defines safety integrity level (SIL)

Risk Reduction

The process of risk reduction for dangerous events starts by:

- intrinsic prevention (inherently safe design)
- definition of the appropriate protective means (guards, carters, fix fences, ...)
- personnel training

If the selected preventive measure depends on a safety-related control system, the designer has to perform an iterative process for the design of the safety relative control system. The first stage is to define the necessary safety-related control functions:

- either through the choice of components
- or by adapting the control system architecture. Redundancy (double circuit components), for example, significantly increases the reliability of the solution

Once the limits of available technologies have been reached; it will not be possible to further reduce the rate of dangerous failures. To achieve the required level of safety, it will be necessary to use a diagnostic system that allows dangerous failures to be detected.

Functional Safety Standards

Overview

The functional safety standards are intended to encourage designers to focus more on the functions that are necessary to reduce each individual risk, and on the performance required for each function, rather than simply relying on particular components. These standards make it possible to achieve greater levels of safety throughout the life of a machine.

- Under the previous standard, EN 954-1, categories (B, 1, 2, 3 and 4) dictated how a safety-related electrical control circuit must behave under fault conditions. Designers can follow either EN ISO 13849-1 or EN/IEC 62061 to demonstrate conformity with the machinery directive. These 2 standards consider not only whether a fault will occur, but also how likely it is to occur.
- This means that there is a quantifiable, probabilistic element in compliance: machine builders must be able to determine whether their safety circuit meets the required safety integrity level (SIL) or performance level (PL). Panel builders and designers should be aware that manufacturers of the components used in safety circuits (such as safety detection components, safety logic solvers, and output devices like contactors) must provide detailed data on their products.

Standard EN ISO 13849-1 Machinery Safety - Safety-Related Parts of Control System

Overview

Standard EN ISO 13849-1 is an evolution of standard EN 954-1.

Field of Application of the Standard

This standard gives safety requirements and advice relating to principles for the design and integration of safety-related parts of control systems (SRP/CS), including software design.

For these parts, it specifies the characteristics, including the performance level, needed to achieve these safety functions. It applies to the SRP/CS of all types of machine, regardless of the technology and type of energy used (electric, hydraulic, pneumatic, mechanical, and so on).

Process

The risk assessment leads to decisions on risk reduction measures.

It defines a 6-stage design process:

1. Selection of the essential safety functions that SRP/CS must perform. For each safety function, specify the required characteristics.
2. Determine the required performance level (PLr).
3. Design and technical creation of safety functions: identify the parts that perform the safety function.
4. Evaluate the performance level PL for each safety-related part.
5. Check that the performance level PL achieved is greater than or equal to the required level (PLr).
6. Check that all requirements are satisfied.

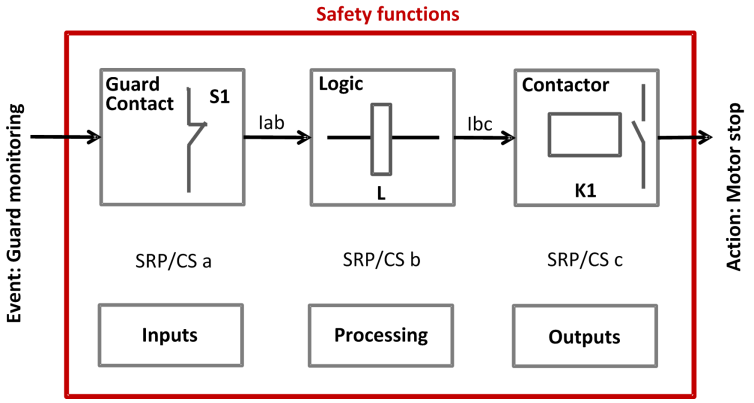
The above 6 stages will be illustrated taking as an example a safety function where a severe injury can be caused by a horizontal movement on a machine not stopping where an operator maybe exposed to this dangerous situation. The machine is sometimes accessed by production workers and monitored during operation.

Stage 1 - Selection of Safety Functions

The diagram below shows a safety function which consists of several parts:

- The input actuated by opening of the guard (SRP/CSa)
- The control logic, limited in this example to opening or closing of a contactor coil (SRP/CSb)
- The power output that controls the motor (SRP/CSc)
- The connections (Iab, Ibc)

Representation of the safety function



Stage 2 - Estimation of Required Performance Level (PLr)

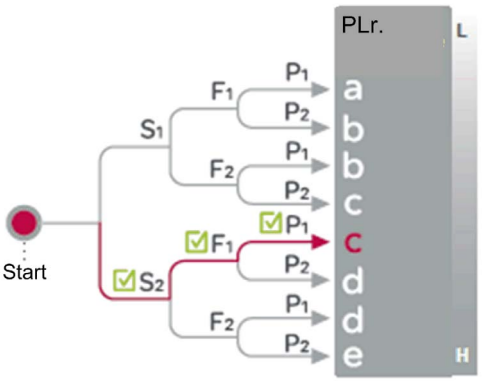
Considering the example of the person coming into area where the machine is operating, the risk is estimated using the risk graph.

The parameters to be considered are:

S: Severity of the injury
- **S1**: Slight injury, normally reversible
- **S2**: Serious, normally irreversible, including death

F: Frequency and/or duration of exposure to the hazardous phenomenon
- **F1**: Rare to fairly frequent and/or short duration of exposure
- **F2**: Frequent to permanent and/or long duration of exposure

P: Possibility of avoiding the hazardous phenomena or limiting the harm
- **P1**: Possible under certain circumstances
- **P2**: Virtually impossible



Start Starting point for the evaluation
PLr Required performance level
L Low contribution to risk reduction
H High contribution to risk reduction

For the example: a serious injury **S2** can be caused by being exposed near the machine as if there is no safe guarding to ensure that the movement will stop the horizontal movement with a load may continue until collision.

After considering the severity of the injury investigate the frequency and/or duration of the possible entry to the dangerous area. Here you define the frequency of exposure to the hazard is low **F1** (occasional presence).

The last step is based upon the possibility to avoid the hazard and limiting the harm. To evaluate this, take into consideration that it is possible to avoid the harm as the visibility around the dangerous machine is monitored by the operator and in this case there is a possibility to avoid the harm under certain conditions so define it as **P1**.

The result of the estimation gives a required performance level **PLr = c**.

Stage 3 - Design and Creation of the Safety Functions

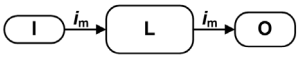
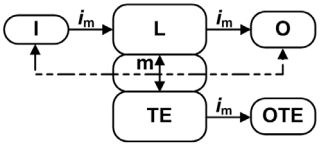
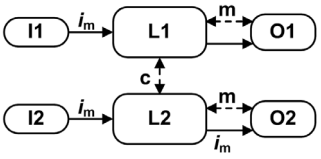
There is a need to describe the PL (performance level) calculation method.

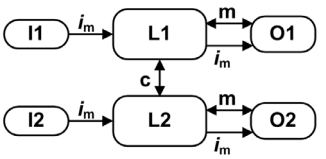
For a SRP/CS (or a combination of SRP/CS), PL could be estimated with the figure after estimation of several factors such as:

- Hardware and software system structure (categories)
- Mechanism of failures, diagnostic coverage (DC)
- Components reliability, mean time to dangerous failure ($MTTF_d$)
- Common cause failure (CCF)

Categories (Cat.) and designated architectures

Summarized system behavior in the event of a failure and the principles used to achieve the safety, for the 5 categories defined.

Category	System Behavior	Designated Architecture
B	A fault can lead to loss of the safety function.	
1	As for category B but the probability of this occurrence is lower than for the category B.	
2	A fault can lead to loss of the safety function between 2 periodic inspections and loss of the safety function is detected by the control system at the next test.	
3	For a single fault, the safety function is always ensured. Only some faults will be detected. The accumulation of undetected faults can lead to loss of the safety function.	

Category	System Behavior	Designated Architecture
4	When faults occur, the safety function is always ensured. Faults will be detected in time to prevent loss of the safety function.	

Im Interconnecting means
C Cross monitoring
I, I1, I2 Input device, for example sensor
L, L1, L2 Logic
m Monitoring
O, O1, O2 Output device, for example main contactor
TE Test equipment
OTE Output of TE

$MTTF_d$ (mean time to dangerous failure)

The value of the $MTTF_d$ of each channel is given in 3 levels (see table below) and shall be taken into account for each channel (for example, single channel, each channel of a redundant system) individually.

Reliability levels of components

Index	Range
Low	3 years ≤ $MTTF_d$ < 10 years
Medium	10 years ≤ $MTTF_d$ < 30 years
High	30 years ≤ $MTTF_d$ < 100 years

A $MTTF_d$ of less than 3 years should never be found, because this would mean that after 1 year in operation, 30% of all those components in use would have failed to a dangerous state. The maximum value is limited to 100 years because devices dealing with a significant risk should not depend on the reliability of a single component. Additional measures such as redundancy and tests are required.

Diagnostic coverage (DC)

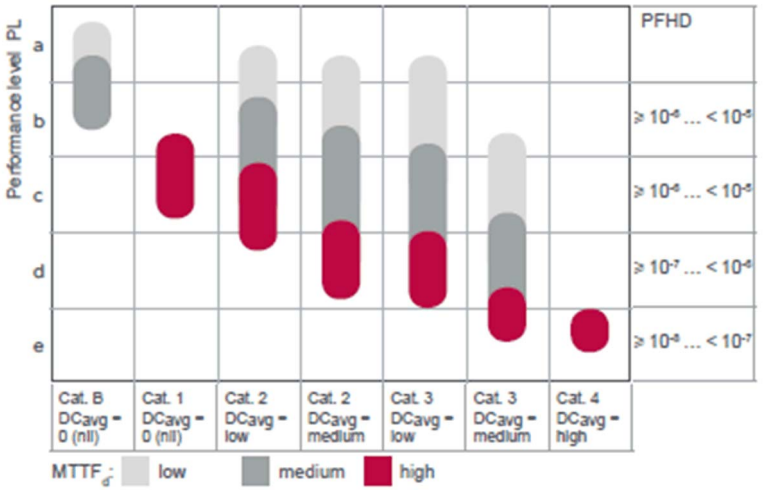
This term is expressed as a percentage and quantifies the ability to diagnose a dangerous failure.

For example, in the event of welding of a N/C contact in a relay, the state of the N/O contact could incorrectly indicate the opening of the circuit, unless the relay has mechanically linked N/O and N/C contacts, when the fault can be detected.

The standard recognizes 4 levels:

Denotation	Range
Nil	DC < 60%
Low	60% ≤ DC <90%
Medium	90% ≤ DC < 99%
High	99% ≤ DC

The relationship between categories, DC and $MTTF_d$ of each channel and PL.

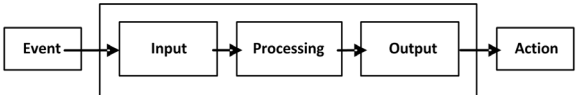


Using the above chart you can now select the most appropriate architecture, the required diagnostic coverage as well as ensure the products selected have the right $MTTF_d$ values.

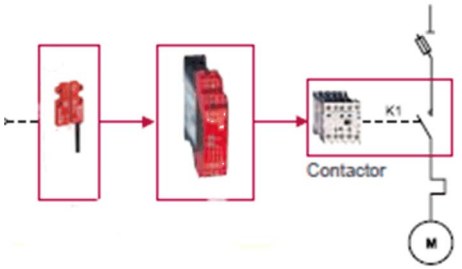
As the example requires PL=c the chart states as a minimum a category 1 architecture with a diagnostic coverage of 0 (Nil) and a $MTTF_d$ of high is required.

It is possible to use architectures with higher categories to solve the safety function needs.

You start with determining the architecture required to solve the function. Use the following category 1 architecture:

Category	System Behavior	Designated Architecture
1	As for category B but the probability of this occurrence is lower than for the category B.	

Knowing the architecture it is now possible to select the most appropriate products. Using the offer catalogs you define the products as illustrated below.



The selection of the right products may take several iterations as it is only possible to ensure that the right products are selected after calculations have been made.

Stage 4 - Evaluate the Performance Level (PL) for Each Safety-Related Part

Typically the data needed for the calculation of the performance level is being provided by the components supplier.

For safety processing devices the $MTTF_d$, DC and performance level values are provided.

For other non-safety components such as contactors, limit switches, and so on, which wear primary as a result of their mechanical actuation, B10d values are provided by the supplier in some cases. When the B10d values are not available, the annex C from the 13849-1 standard can be used.

Example	B_{10d} (Where 10% of the Population Fail to Dangerous Failure Mode)	$MTTF_d$	DC
SRP/CS_a: Magnetic switch	50000000	1578.28	-
SRP/CS_b: XPS AXE safety module	-	457	99.99%
SRP/CS_c: TeSys contactor	1369863	194	99%

To estimate the performance level of a safety function, the condition is that the $MTTF_d$, the DC, and the category from each component are known. The procedure to follow:

- Calculation of $MTTF_d$ and DC of the complete system
- Analysis of the category

For electromechanical products:

- The $MTTF_d$ is calculated based on the total number of operations that the product can perform, using B_{10d} values.

In this case, the machine operates for 220 days per year, 8 hours per day with a cycle of 90 s

- N = 220 x 8 x (3600 / 90) = 70,400 operations/year
- $MTTF_d = B_{10d} / (0.1 \times N)$

For the magnetic switch:

- The $MTTF_d$= 1578 years

For the contactors:

- The $MTTF_d$ = (1,369,863) / (0.1) x 70,400 = 194 yearsThe $MTTF_d$ for each channel will then be calculated using the formula:

$$\frac{1}{MTTFd} = \frac{1}{MTTFda} + \frac{1}{MTTFdb} + \frac{1}{MTTFdc}$$ that is, 284 years

A similar formular is used to calculate the diagnostic capability:

$$DCavg = \frac{\frac{DCa}{MTTFda} + \frac{DCb}{MTTFdb} + \frac{DCc}{MTTFdc}}{\frac{1}{MTTFda} + \frac{1}{MTTFdb} + \frac{1}{MTTFdc}}$$

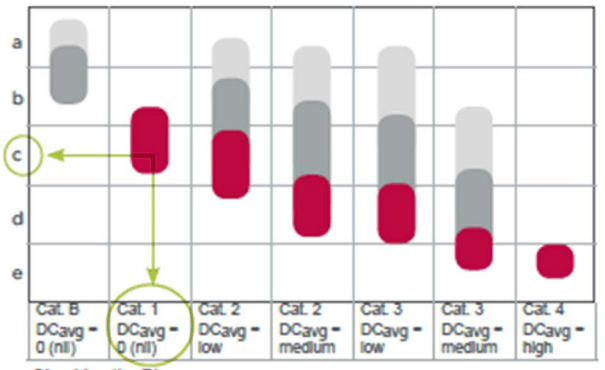
The DC in the example is < 60%, for example nil.

Stage 5 - Checking That Required Performance Level Is Achieved

The result of the above calculations is summarized below:

- An architecture: category 1
- A mean time to failure > 30 years:
  high $MTTF_d$ >> a diagnostic capability < 60% (nil)

Looking at this table, confirms that PL level c is achieved:



Checking the PL

Stage 6 - Validation of the Required Performance Level

The design of SRP/CS must be validated and must show that the combination of SRP/CS performing each safety function satisfies all the applicable requirements of EN/ISO 13849.

Standard EN/IEC 62061 Machinery Safety - Safety-Related Parts of Control System

Overview

This standard is specific to the machine sector according to EN/IEC 61508. It gives rules for the integration of subsystems designed in accordance with EN/ISO 13849. It does not specify the operating requirements of non-electrical control components in machines (for example: hydraulic, pneumatic).

Functional Approach to Safety

As with EN/ISO 13849-1, the process using the EN/IEC 62061 starts with analysis of the risks (EN/ISO 12100) in order to be able to determine the safety requirements.

A particular feature of this standard is that it prompts you to make a functional analysis of the architecture; then split it into subfunctions and analyze their interactions before deciding on a hardware solution for them (the SRECS).

A functional safety plan must be drawn up and documented for each design project. It must include a specification of the safety requirements for the safety functions (SRCF) that is in 2 parts:

- Description of the functions and interfaces, operating modes, function priorities, frequency of operation, and so on.
- Specification of the safety integrity requirements for each function, expressed in terms of SIL (safety integrity level).

The structured and documented design process for safety-related electrical control systems (SRECS):

- The procedures and resources for recording and maintaining appropriate information.
- The process for management and modification of the configuration, taking into account organization and authorized personnel.
- The verification and validation plan

The decisive advantage of this approach is that of being able to offer a failure calculation method that incorporates all the parameters that can affect the reliability of electrical systems, whatever the technology used.

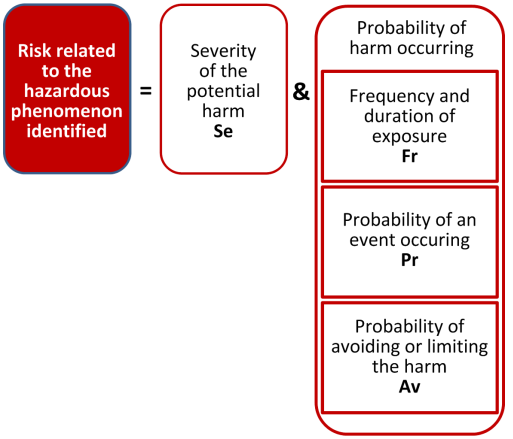
The method consists of assigning a SIL to each function, taking into account the following parameters:

1. The probability of a dangerous failure of the components (PFH_d)
2. The type of architecture; with or without redundancy, with or without diagnostic device making it possible to avoid some of the dangerous failures
3. Common cause failures (power cuts, overvoltage, loss of communication network, and so on) (CCF)
4. The probability of a dangerous transmission error where digital communication is used
5. Electromagnetic interference (EMC)

Process

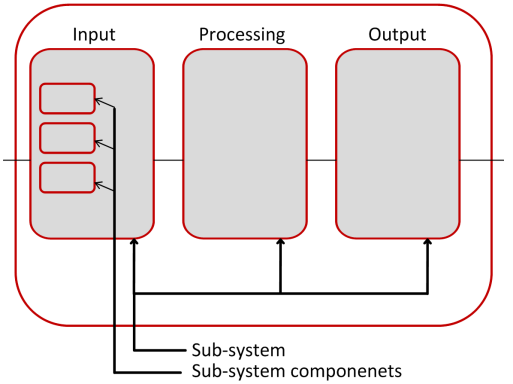
Designing a system is split into 5 stages after having drawn up the functional safety plan:

1. Based on the safety requirements specification (SRS), assign a safety integrity level (SIL) and identify the basic structure of the safety-related electrical control system (SRECS), describe each related function (SRCF)
2. Break down each function into a function block structure (FB)
3. List the safety requirements for each function block and assign the function blocks to the subsystems within the architecture
4. Select the components for each subsystem
5. Design the diagnostic function and check that the specified safety integrity level (SIL) is achieved



Stage 1 - Assign a Safety Integrity Level (SIL) and Identify the Structure of the SRECS

Based on the risk assessment performed in accordance with standard EN/ISO 12100, estimation of the required SIL is performed for each hazardous phenomenon and is broken down into parameters, see illustration below.



Severity Se

The severity of injuries or damage to health can be estimated by taking into account reversible injuries, irreversible injuries, and death.

Consequence	Severity Se
Irreversible: death, loss of an eye or an arm	4
Irreversible: shattered limb, loss of a finger	3
Reversible: requires the attention of a medical practitioner	2
Reversible: requires first aid	1

Probability of the harm occurring

Each of the 3 parameters Fr, Pr, Av must be estimated separately using the most unfavorable case. It is strongly recommended that a task analysis model is used in order to ensure that estimation of the probability of the harm occurring is correctly taken into account.

Frequency and duration of exposure Fr

The level of exposure is linked to the need to access the hazardous zone (normal operation, maintenance ...) and the type of access (manual feeding, adjustment...). It must then be possible to estimate the average frequency of exposure and its duration.

Frequency of Dangerous Exposure	Fr
≤ 1 hour	5

Frequency of Dangerous Exposure	Fr
> 1 hour...≤ 1 day	4
>1 day=< 2 weeks	3
2 weeks ≤1 year	2
> 1 year	1

Probability of occurrence of a hazardous event Pr

2 basic concepts must be taken into account:

- The predictability of the dangerous components in the various parts of the machine in its various operating modes (normal, maintenance, troubleshooting), paying particular attention to unexpected restarting
- The behavior of the persons interacting with the machine, such as stress, fatigue, inexperience, and so on.

Probability of Occurrence of a Dangerous Event	Pr
Very High	5
Probable	4
Possible	3
Almost impossible	2
Negligible	1

Probability of avoiding or limiting the harm Av

This parameter is linked to the design of the machine. It takes into account the suddenness of the occurrence of the hazardous event, the nature of the dangerous component (cutting, temperature, electrical) and the possibility for a person to identify a hazardous phenomenon.

Probability of Avoiding or Limiting the Harm	Av
Impossible	5
Almost impossible	3
Probable	1

Assignment of the SIL

Estimation is made with the help of the table below. In the example, the degree of severity is 4 because there is a risk of death; this value is shown in the first column of the table.

All the other parameters must be added together in order to select one of the classes (vertical columns in the table below), which gives:

- Fr = 5; access between 1 hour and a day
- Pr = 2; low probability of occurrence of the hazardous event (for example, operator monitoring)
- Av = 3; probability of avoiding almost impossible

Therefore a class CI = 5 + 2 + 3 = 10

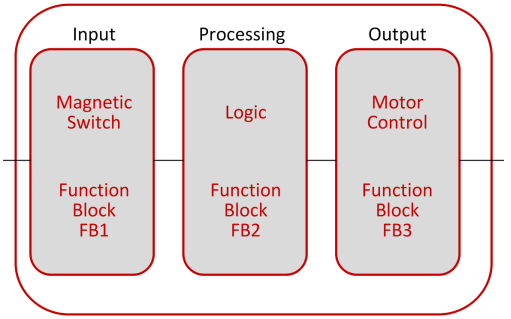
A level of SIL 2 must be achieved by the safety-related electrical control systems (SRECS) on the machine.

Se	Class CI				
	3-4	5-7	8-10	11-13	14-15
4	SIL 2	SIL 2	SIL 2	SIL 3	SIL 3
3	-	-	SIL 1	SIL 2	SIL 3
2	-	-	-	SIL 1	SIL 2
1	-	-	-	-	SIL 1

Basic structure of the SRECS

Without going into detail about the hardware components to be used, the system is broken down into subsystems. In the example, you find the 3 subsystems that will perform the input, processing, and output functions.

The figure below illustrates this stage, using the terminology given in the standard.



Stage 2 - Break down Each Function into a Function Block Structure (FB)

A function block (FB) is the result of a detailed breakdown of a safety-related function. The function block structure gives an initial concept of the SRECS architecture. The safety requirements of each block are deduced from the specification of the safety requirements of the system's function.

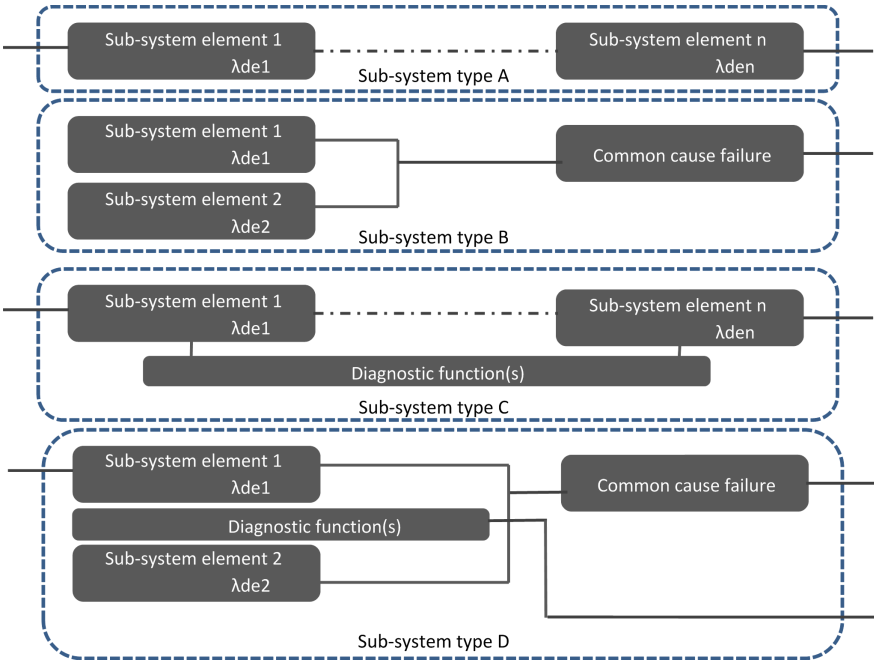
Stage 3 - List the Safety Requirements for Each Function Block and Assign the Function Blocks to the Subsystems

Each function block is assigned to a subsystem in the SRECS architecture. A failure of any subsystem will lead to the failure of the safety-related control function.

More than one function block may be assigned to each subsystem. Each subsystem may include subsystem elements and, if necessary, diagnostic functions in order to ensure that anomalies can be detected and the appropriate action taken.

These diagnostic functions (D) are considered as separate functions; they may be performed within the subsystem, by another internal or external subsystem.

Types of subsystem architectures



Stage 4 - Select the Components for Each Subsystem

As the safety integrity level required in the example mentioned above is SIL 2, each of the components must achieve this level.Once the targeted SIL is determined, the components constructing the system from safety-related subsystems (sensor/switch, logic, actuator) have to be selected. The components must have PFH_d (probability of dangerous failure per hour) equal to the required SIL rating needed.

Stage 5 - Design the Diagnostic Function

The SIL of the subsystem depends not only on the components, but also on the architecture selected. In EN 62061, a safety integrity requirement is expressed as a target failure value for the probability of dangerous failure per hour (PFH_d) of each safety-related control function (SRCF).

This can be calculated from reliability data for each component or subsystem, and is related to the SIL as shown in table 3 of the standard.

Relationship between SIL and PFH_d values

SIL	Probability of Dangerous Failures Per Hour (PFH_d)
3	$\geq 10^{-8} < 10^{-7}$
2	$\geq 10^{-7} < 10^{-6}$
1	$\geq 10^{-6} < 10^{-5}$

For each of the 4 logical architectures A to D presented above, there is a different formula to calculate the PFH_d. The calculation method is complex and will not be presented here (see EN/IEC 62061 for the formula and the parameters taken into account).

Selecting the Applicable Standard

Overview

In order to be able to select the applicable standard, a common table in both standards gives indications which are summarized below:

Technology Used	EN ISO 13849-1 Maximum PL	EN/IEC 62061 Maximum SIL
Non-electric only, for example, hydraulic	e	Not covered
Including some electromechanical, example: relays, and/or complex electronics	e (for designated architectures only)	3
Including complex electronics, for example programmable	D	3

Relationship between the performance level (PL) and the safety integrity level (SIL):

PL	SIL	Probability of Dangerous Failures Per Hour (1/h)
a	No correspondence	$\geq 10^{-5} < 10^{-4}$
b	1	$\geq 3x10^{-6} < 10^{-5}$
c	1	$\geq 10^{-6} < 3x10^{-6}$
d	2	$\geq 10^{-7} < 10^{-6}$
e	3	$\geq 10^{-8} < 10^{-7}$

More Information Regarding Safety

Overview

To know more about the relevant regulations, take a look to the safety guide:

http://www.schneider-electric.com/download/ww/en/details/10101698-Machine-safety-guide/?reference=DIA4ED1100102EN

Sistema

For support in creating the safety-related calculations in accordance to EN ISO 13849-1, refer to the free software as well as the related Schneider Electric Sistema offer library.

Sistema:

http://www.dguv.de/bgia/en/pra/softwa/sistema/index.jsp

Sistema library:

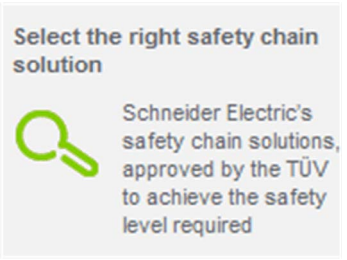
http://www2.schneider-electric.com/documents/original-equipment-manufacturers/SCHNEIDER-ELECTRIC-SAFETY-EN_2012_09.zip

Safety Chain Solutions

Schneider Electric offers a library of certified safety chain solutions.

Safety chain solutions provide you with a complete document explaining the concept, the used cases, the architecture, wiring diagram as well the complete calculation.

Each of the safety chain solutions is certified by TÜV enabling you to reuse the architectures for your machine and reusing the Sistema calculations as well as the documentation to help certify the machine to the European legislation.



To find more information regarding the safety chain solutions:

http://www2.schneider-electric.com/sites/corporate/en/solutions/oem/machine-safety/safety-selector.page

Using the safety chain solutions provided by Schneider Electric to solve the existing architecture:

Step	Action	Comment
1	Perform a risk assessment of your machine.	A required performance level (**PLr**) must be specified for each intended safety function following a risk assessment in accordance to the standard EN ISO 12100.
2	Use the **Safety Chain Selector*** to find the most appropriated pre-certified architecture.	By answering the questions the most appropriated architectures will be proposed by the tool.
3	Adapt the proposed architecture to meet the needs of your machine risk assessment.	Select other devices to substitute those in the proposed architecture by examining the safety catalog.
4	Create the **Systema** file based on the used architecture within the **Systema** tool.	Each architecture, which is provided with the **Safety Chain Selector** is available as a template in the **Systema** tool.
5	Adapt the template in the **Systema** tool based on the adaptations to the architecture and/or substitution of devices done in step 3.	The safety library within the **Systema** tool contains numerous devices with all required parameters for the calculation.
6	Adapt the number of machine operations within the **Systema** file for your machine.	Within the template, default values were set and these have to be adapted in order to match the machine requirements.
7	Re-evaluate the achieved performance level.	Verify that the attained performance level by the control system is greater than or equal to the required performance level resulting from the risk assessment in step 1.
* **Safety Chain Selector**: *http://www2.schneider-electric.com/sites/corporate/en/solutions/oem/machine-safety/safety-selector.page*		

Step	Action	Comment
8	Document the relevant changes in the **Systema** file.	Specific information about the machine, the author, and so on, must be documented.
9	Print the **Systema** file to be used as part of the machine documentation.	It is necessary to provide the documentation about the risk assessment and the calculation of the machine.
* **Safety Chain Selector**: *http://www2.schneider-electric.com/sites/corporate/en/solutions/oem/machine-safety/safety-selector.page*		

Functional Safety Measures Implemented in this Architecture

Overview

Within the described architecture, there are 2 safety functions covering different risks. These are described in the following sections.

NOTE: The safety functions proposed in this architecture do not provide a preferred safety chain solution for your machine. These are proposals as to how a safety function could be realized.

⚠ WARNING
UNINTENDED EQUIPMENT OPERATION Ensure that a risk assessment is conducted and respected according to EN/ISO 12100 during the design of your machine. **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

Emergency Stop

In this TVDA, the safety function emergency stop is applied to disconnect the main power supply of all drives.

The disconnection of the main power supply of the drives is delayed. During this delay time, a controlled stop of the drives is performed.

This safety architecture is conforming to category 4 EN ISO 13849-1:2008 and is using the stop category 1 in accordance with the standard IEC/EN 60204-1.

The architecture achieves a performance level (PL) of **e** and a safety integrity level (SIL) of **3**.

Used devices:

Device	Description	Comment
Input	2 channel emergency stop button Harmony XAL K	The 2 channels are linked to 2 safety-related inputs and the associated test outputs of the Modular Safety Controller system.

Device	Description	Comment
Logic	Preventa XPSMCM• Modular Safety Controller with the following configuration: ● XPSMCMCP0802x ● XPSMCMRO00004x ● XPSMCMRO00004DAx	Safety controller which has to be configured using the SoSafe Configurable software.
Output	2 redundant contactors with feedback loop LC1D	Both contactors are linked to a 2-channel relay output of the Modular Safety Controller system. The feedback signal from the contactors is linked to the associated safety-related input.

Safety Guard Monitoring with Unlocking Function

In this TVDA, the safety guard monitoring function with solenoid interlock is used.

The motor movementss are covered by a protective fence.

The protective fence contains a guard door which is equipped with a Preventa safety guard switch with a solenoid for the unlocking function.

To gain access into the hazardous machine area, a request command is initiated by a harmony push-button. The command is recognized and the machine ramps down to stop condition by SS1 functionality (controlled ramp down). After stop is reached, the solenoid can be unlocked by another harmony push-button and the operator can access the machine area.

The monitoring of the safety guard switch and the control of the unlock function is achieved with the Preventa XPSMCM• Modular Safety Controller.

The drives used in this TVDA implement the safety function STO (Safe Torque Off) as defined by the IEC61800-5-2, the safety function becomes activated (safe condition) or deactivated through associated safety-related inputs on the drive.

The safety-related inputs on the drives are linked to safety outputs of the Modular Safety Controller system which are controlled as a function of the safety guard monitoring and the unlock function.

The safety outputs of the Modular Safety Controller are only active when the guard is closed and locked. In other states, the outputs are deactivated and so the STO function in each properly connected drive is activated.

The safety function STO (Safe Torque Off) only removes power to the motor. However, the drive itself remains under power. Further, the DC bus voltage is still present. If the door monitoring has been triggered because of, for example, the intention to do maintenance, you will need to remove main power even though power has been removed from the motor.

⚠ ⚠ DANGER

ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

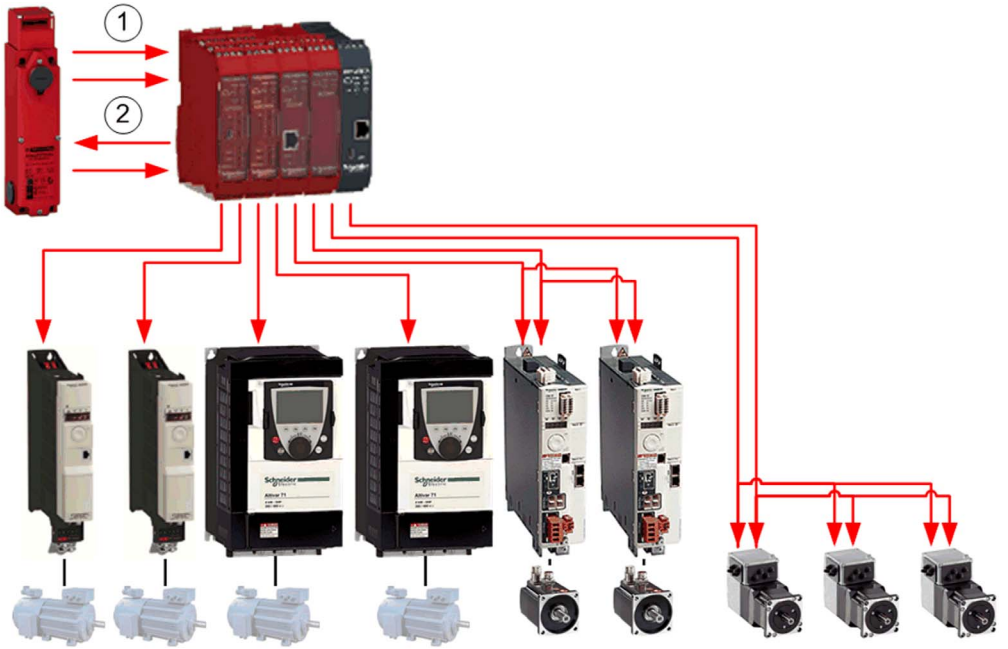
- Turn off the mains voltage using an appropriate switching device to remove power from the drive.
- After removing power, wait for 15 minutes to allow the DC bus capacitors to discharge in the drives.

Failure to follow these instructions will result in death or serious injury.

This safety architecture is conforming to category 3 EN ISO 13849-1:2008 and is using the stop category 0 in accordance with the standard IEC/EN 60204-1.

The architecture achieves a performance level (PL) of **d** and a safety integrity level (SIL) of **2**.

Devices used:



1 Safety guard monitoring
2 Unlock signal and feedback of the solenoid contacts

Device	Description	Comment
Input	Safety guard switch type XCSLE with separate operator key	The 2 channels are linked to 2 safety-related inputs and the associated test outputs of the Modular Safety Controller system.
Logic	{(notrans) Preventa} {(notrans) XPSMCM•} Modular Safety Controller with the following configuration: ● XPSMCMCP0802x ● XPSMCMRO00004x ● XPSMCMRO00004DAx	Safety controller which has to be configured using the SoSafe Configurable software.
Output	2x variable speed drive Altivar 32 with 1 safety related input	STO (Safe Torque Off) input of Altivar 32 to disconnect the power stage of the drive
	2x variable speed drive Altivar 71 with 1 safety related input	PWR (Power Removal) input of Altivar 71 to disconnect the power stage of the drive
	2x Servo drive Lexium 32M with 2 safety related inputs	STO (Safe Torque Off) inputs (2 channel) of Lexium 32S to disconnect the power stage of the drive
	3x Servo drive Lexium ILx2 with 2 safety related inputs	STO (Safe Torque Off) inputs (2 channel) of Lexium ILx2 to disconnect the power stage of the drive

NOTE: For wiring the safety-related inputs on the Lexium 32M and the Lexium ILx2 use a safety-related signal cable in accordance with ISO 13849-2.

For more information about the safety-related functions of the Lexium servo drives, refer to
- LXM32M AC servo drive, Product manual, 0198441113767.
- ILA2K EtherNet/IP Lexium Integrated Drive, Product manual, 0198441113670
- ILE2K EtherNet/IP Lexium Integrated Drive, Product manual, 0198441113676
- ILS2K EtherNet/IP Lexium Integrated Drive, Product manual, 0198441113682

NOTE: In this architecture, the single channel safety-related input STO on the Altivar 32, as well as the single channel safety-related input PWR on the Altivar 71 is used. It is necessary to use a shielded cable for wiring. The cable shield must be connected to the functional earth ground. Follow the wiring guidelines from the user manual of the respective drive.

The Altivar 32 drive incorporates additional safety-related functions which are not applied in this TVDA.

For more information, refer to ATV32 - Safety integrated functions manual, S1A45606.

For more information on the safety-related topics for the Altivar 71, refer to Altivar 61/71/LIFT, Variable speed drives for synchronous and asynchronous motors, Safety integrated function manual, S1A91443 (ENG).

Chapter 4
Hardware

Overview

This chapter provides general information about the hardware.

What Is in This Chapter?

This chapter contains the following sections:

Section 4.1
Electrical Distribution and Monitoring

What Is in This Section?

This section contains the following topics:

PowerPact H-Frame Circuit Breaker - Hardware

Front View

PowerPact H-Frame circuit breaker (15...150 A)

Description

The PowerPact multistandard circuit breakers are designed to help protect electrical systems from damage caused by overloads and short circuits.

Multistandard circuit breakers are available with either thermal-magnetic or Micrologic electronic trip units. Multistandard circuit breakers with thermal-magnetic trip units contain individual thermal (overload) and immediate (short circuit) sensing elements in each pole.

PowerPact multistandard circuit breakers offer high performance and a wide range of interchangeable trip units to protect most applications. Electronic trip units provide highly accurate protection with wide setting ranges and can integrate measurement, metering, and communication functions. They can be combined with the front display module (FDM121) to provide functions similar to a power meter.

Industry-leading multistandard-compliant circuit breakers provide unrivalled reliability for heavy-duty applications. Common catalog numbers, standardized ratings, and a full range of field-installable accessories make product selection, installation, and maintenance easier than ever.

Features	• Rated current 15...600 A • Breaking capacity from 18...65 kA at 480 Vac • 3-pole versions • 3 frame sizes: PowerPact H (15...150 A), PowerPact J (150...250 A), and PowerPact L (250...600 A) • Thermal-magnetic and electronic protection available for the entire range • Common accessories and auxiliaries with Compact NSX range • Suitable for isolation • Switch-disconnector versions available • Compliance with IEC 60947-2 and UL 489 • Certifications: UL, CSA, CCC
Benefits	• Multistandard compliant: IEC, UL, CSA, CCC • Worldwide available with unique global part numbers • Flexible and simple offer, with proven performance • With direct access to energy metering and energy efficiency thanks to the Micrologic control units
Applications	Feeder protection and circuit disconnect solutions when a multistandard approach for one global design machine is needed. • International & global multi-site OEMs applications • Regional OEMs exporting to USA, with production in different countries, and in need of local support/maintenance.

For more information, refer to PowerPact Multistandard, Catalogue, LVPED212023EN.

Multi 9 System C60 Multi-Standard Range - Hardware

Front View

Description

The Multi 9 system is designed for OEMs to provide an electric protection of their products or the specific circuits inside the equipment.

This range allows OEMs to offer equipment in compliance with the leading international standards:

- UL 489, UL 1077
- CSA C22.2 No. 5-02, CSA C22.2 No. 235-04
- IEC 60947-2
- GB 14048-2

It saves space in the switchboard thanks to its small size.

Easy installation on symmetrical DIN rail (35 mm).

It includes ratings that also make it possible to protect low-power circuits.

The setup of circuit protective devices depends on the electrical installation standard. Multi 9 devices (designed for machinery and equipment manufacturers, integrators, panelbuilders, and so on) are tested in accordance with the UL (Underwriter Laboratories) product standard in order to meet the requirements of the NEC (National Electric Code) installation standard, in force in the United States. Multi 9 "UL" products are also tested to ensure compliance with IEC and CSA standards.

For more information, refer to C60 Multi-Standard Range, Catalog, CM909003E.

Phaseo Power Supply Universal - Hardware

Front View

Phaseo ABL8RPS24100 power supply

Description

The Phaseo electronic switch mode power supply is designed to provide the DC voltage necessary for the controller and automation system equipment control circuits.

Conforming to IEC standards and UL, CSA, TÜV and C-Tick certified, they are suitable for industrial use.

The ABL8RPS/8WPS range of Phaseo power supplies covers power ratings 72...960 W in 24 Vdc and adapts to most power distribution systems used throughout the world. The same power supply can thus be connected phase to neutral or phase to phase for line supplies ranging 100...500 Vac nominal.

- Local or remote diagnostic functions
- Current limiting or stop in event of an overload
- Function modules to ensure continuity of service
- Power reserve for absorbing the transient current peaks

Standards and certifications	UL, CSA, TÜV, C-Tick
Power range	72…960 W
Voltage range	Input: 100…500 Vac Output: 24 Vdc
Degree of protection	IP 20 conforming to IEC 60529

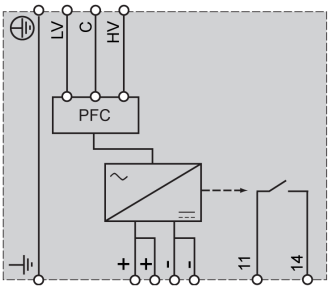
Dimensions	6 different types (W x H x D): 44…165 x 143 x 120…155 mm (1.73…6.5 x 5.63 x 4.72…6.1 in.)

For more information, refer to :

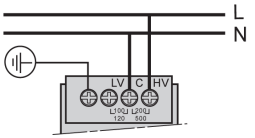
- The essential guide for power supplies and transformers, DIA3ED2070412EN
- Phaseo power supplies and transformers, Catalogue Pages, 14082-EN

Wiring

Connection overview ABL8RPS24100



Wiring example: 200…500 V single phase



iEM31xx Energy Meter Series - Hardware

Front View

The graphic shows the front view of the energy meter iEM3110:

Description

The Acti 9 iEM3100 Energy Meter series offers a cost-attractive, competitive range of DIN rail-mounted energy meters ideal for subbilling and cost allocation applications. Combined with communication systems such as Smart Link, the Acti 9 iEM3100 series makes it easy to integrate electrical distribution measurements into your facility management systems. The Acti 9 iEM3100 series contains 8 versions of energy meter (for example, iEM3110 and iEM3150) to satisfy basic to advanced applications for buildings and industry, data centers, and networks, infrastructure, and so on.

- Graphical display for easy viewing
- Self-powered meters
- Direct measurement up to 63 A
- Onboard Modbus, LON, M-Bus or BACnet communication
- Commissioning safely with ease
- Compact size

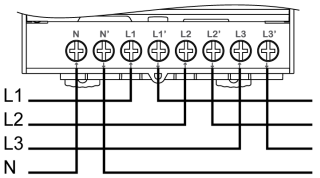
Standards and certifications	IEC 61557-12, IEC 61036, IEC 61010, IEC 62053-21/22 class 1 and 0.5S, IEC 62053-23, EN50470-3
Current (max)	63 A
Models	iEM3100, iEM3110, iEM3115, iEM3135, iEM3150, iEM3155, iEM3165, iEM3175

Functions (depending on the model	• Active energy measurement • Electrical measurements such as I, V, P, and so on. • Alarm • Digital output for pulse • MID (legal metrology certification)
Degree of protection	• front panel: IP40 • casing: IP20
Dimensions	W x H x D: 90 x 95 x 69 mm (3.54 x 3.74 x 2.72 in.)

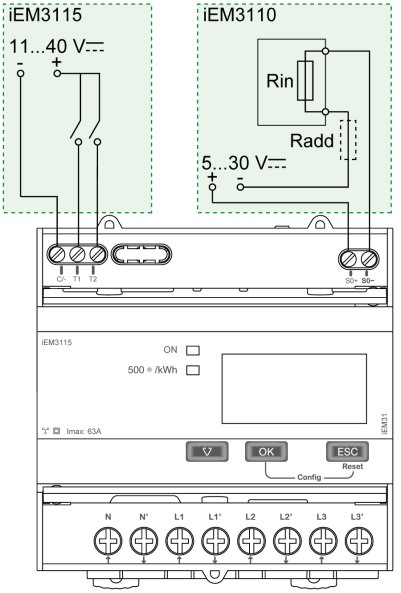
For more information, refer to iEM3100 series / iEM3200 series, Energy Meters, User Manual, DOCA0005EN.

Wiring

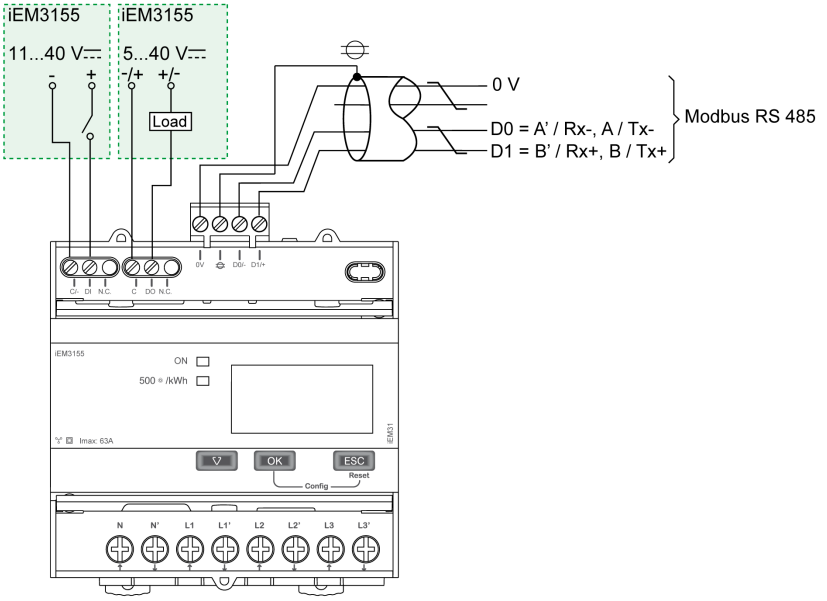
The graphic shows the wiring on three-phase systems for direct measurement of iEM31••



The graphic shows the connection diagram of iEM3100 / iEM3110 / iEM3115:



The figure shows the connection diagram of iEM3150 / iEM3155:



Section 4.2
Safety Modules

What Is in This Section?

This section contains the following topics:

Modular Safety Controller System - Hardware

Front View

Description

The XPSMCM• functional safety offer consists of a XPSMCMCP0802• Modular Safety Controller, which can be configured using the SoSafe Configurable software. The controller has 8 safety-related inputs and 2 independent dual-channel solid-state safety-related outputs. Expansion input and output modules can be connected to theXPSMCMCP0802• controller via the backplane bus. Together, these references form the structural basis of a functional safety system.

The system consists of a XPSMCMCP0802• controller, and may include a number of electronic expansions up to a maximum of 14, and not more than 4 I/O modules of the same reference. The external relay modules XPSMCMER0002• and XPSMCMER0004• are not included in the count of electronic expansions.

With 14 expansions, the system supports up to 128 inputs, 16 dual-channel safety-related outputs, and 16 status outputs. The controller and its expansion modules communicate via the 5-way backplane bus physically arranged on the back of the controller and expansion modules. However, if the network function block is used within the configuration, a maximum number of 9 expansion modules can be used with a controller.

In addition, 8 fieldbus inputs and 16 fieldbus probes can be used for non-safety-related commands through the addition of fieldbus expansion modules.

The SoSafe Configurable software enables you to create simple to complex configurations with the mixture of safety-related functions and logic; such as the combination of muting function with timers or counters.

Rated voltage	24 Vdc ± 20 % (PELV supply)
Dissipated power	3 W maximum
Over voltage category	II
Ambient operating temperature	-10...+55 °C (14...131 °F)
Storage temperature	-20...+85 °C (-4...185 °F)
Maximum operation altitude	2000 m (6562 ft)
Pollution degree	2
Vibration resistance (IEC/EN 61496-1)	+/- 3.5 mm (0.138 in) 5...8.4 Hz 1 g (8.4...150 Hz)
Shock resistance (IEC/EN 61496-1)	15 g (11 ms half-sine)
EMC category	zone B
Enclosure protection class	IP20
Terminal blocks protection class	IP2x
Mounting	35 mm DIN rail according to EN/IEC 60715
Mounting positioning	horizontal
Dimensions	• Screw terminals: 108 x 22.5 x 114.5 mm (4.25 x 0.89 x 4.5 in) • Spring terminals: 118.5 x 22.5 x 114.5 mm (4.67 x 0.89 x 4.5 in)

Expansion I/O Modules

Expansion Module	Description
XPSMCMMX0802•	• 8 safety-related inputs • 2 dual-channel solid-state safety-related output (Output Signal Switching Device, OSSD.)
XPSMCMDI0800•	• 8 safety-related inputs • With this module, the number of inputs in the system can be increased to allow more external devices to be connected.
XPSMCMDI1600•	• 16 safety-related inputs • With this module, the number of inputs in the system can be increased to allow more external devices to be connected.
XPSMCMDI1200MT•	• Specific module to connect safety mats. • Provides 8 test outputs for line control monitoring. • With this module, the number of inputs in the system can be increased to allow more external devices to be connected.

Expansion Module	Description
XPSMCMDO0002•	• 2 dual-channel solid-state safety-related output pairs for connection to contactors or drives.
XPSMCMDO0004•	• 4 dual-channel solid-state safety-related output pairs for connection to contactors or drives.
XPSMCMER0002•	• 2 forcibly guided contact safety-related relay output modules without backplane connection. • The XPSMCMER0002• module is not connected to the backplane bus.
XPSMCMER0004•	• 4 forcibly guided contact safety-related relay output modules without backplane connection. • The XPSMCMER0004• module is not connected to the backplane bus.
XPSMCMRO0004•	• 4 forcibly guided contact safety-related relay output modules with backplane connection. • Expansion module with 4 independent safety-related relay outputs and the corresponding 4 inputs for the external feedback contacts (EDM). • The relay can be configured according to Category 1, 2 and 4 architectures.
XPSMCMRO0004DA•	• 4 forcibly guided contact safety-related relay output modules with backplane connection. • Expansion module with 4 independent safety-related relay outputs and the corresponding 4 inputs for the external feedback contacts (EDM). • The relay can be configured according to Category 1, 2 and 4 architectures. • Contains 8 non-safety-related status outputs.
XPSMCMEN0200• XPSMCMEN0100SC• XPSMCMEN0200SC•	• Modules for monitoring speed by proximity sensors and safety encoders with SinCos interface. • The XPSMCMEN• expansion units can be used to control the following (up to PLe): ❍ Zero speed, maximum speed, speed range ❍ Direction of movement, rotation/translation • Up to 4 speed thresholds can be set for each logic output (axis). • Each unit incorporates two logic outputs that can be configured using the SoSafe Configurable software and is thus capable of controlling up to two independent axes.

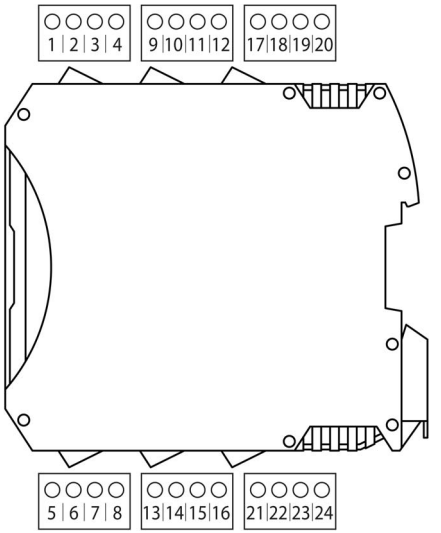
Communication Modules

Expansion Module	Description
XPSMCMCO0000S1• XPSMCMCO0000S2•	• The XPSMCMCO0000S1 and XPSMCMCO0000S2 units are used to build remote functional safety islands between controller and I/O expansion modules at distance (< 50 m / 164 ft) between islands and up to 6 islands. • Two XPSMCMCO0000S1 or XPSMCMCO0000S2 expansion modules can be connected using an RS-485 shielded cable
XPSMCMCO0000EI• XPSMCMCO0000EM• XPSMCMCO0000UB•	• The fieldbus expansion modules allow connection to common industrial fieldbus systems for diagnostics and data transmission. • Available interfaces: EtherNet/IP, Modbus TCP, and USB

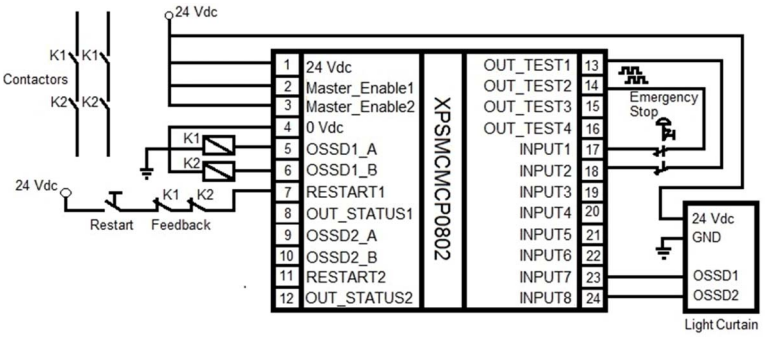
Terminal Blocks

The Modular Safety Controller references are provided with removable terminal blocks for the electrical connections. Each reference can have 8 (2 terminal blocks), 16 (4 terminal blocks) or 24 (6 terminal blocks) terminals.

The following graphic shows an example with the maximum number of terminals:



Modular Safety Controller Example Wiring Diagram



For more information, refer to Modular Safety Controller, User Guide, EIO0000001987.

Preventa Detection and Dialog - Hardware

Front View

Preventa product range

Description

Schneider Electric is the provider of the safety chain covering the safety functionality and scalability for your machine. Preventa offers an extensive range of safety-related products, compliant with international standards, designed to provide protection for personnel and equipment.

For more information, refer to Preventa solutions for efficient machine safety - catalogue, MKTED2140201EN.

Complementary safety-related products like light curtains, emergency stop rope pull switches or switches are offered by Telemecanique Sensors; brand of Schneider Electric.

Telemecanique Sensors proposes a number of ranges of safety-related products:

- Discover this offer on the website: *http://www.tesensors.com/global*
- Access to the catalog by product at this URL: *http://www.tesensors.com/global/en/product/catalog/*

Section 4.3
HMI

What Is in This Section?

This section contains the following topics:

Magelis HMI GTO - Hardware

Front View

Magelis HMI GTO product range

Description

Magelis HMI GTO displays are advanced HMIs with optimized features to improve communication quality. The displays are easy to install and adapt to your environment. Different screen sizes and a complete dimming functionality are available for specific applications. Industry machines for the integration of the Magelis HMI GTO for example are: Compact machines, material handling systems, food and beverage machines, pharmaceutical industry, and so on.

- TFT 65 K colors for all screen sizes with energy saving LED backlight
- Easy connectivity via Ethernet
- Up-to-date interfaces (USB 2.0, SD cards) to allow easy maintenance and good peripheral links
- Unique fast connection power plug for the whole range
- Addition of function keys on the 3.5" and 7" (wide) displays
- Worldwide certifications including hazardous locations and marine "Bridge and deck"
- Operating up to 55° C (151° F) for hot environment
- Stainless steel panel for food and beverage applications available

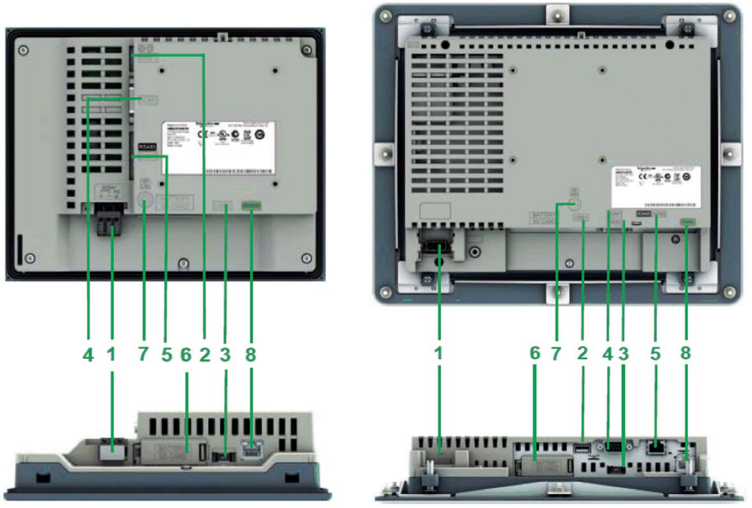
Standards and certifications	EN 61000-6-4, EN 61000-6-2, UL508, CSA C22.2 n°142
Power supply	24 ± 4.4 Vdc
Degree of protection	Depends on the type: ● IP 65 (IP 67 with addition of a cover) ● IP 66 K (front panel with stainless steel frame)

Dimensions	8 different types (W x H x D) ● Min.: 132 x 106 x 42 mm (5.2 x 4.2 x 1.65 in.) ● Max.: 359 x 285 x 56 mm (14.1 x 11.2 x 2.2 in.)
Screen sizes and resolutions	● 3.5" and 5.7": 320 x 240 pixels (QVGA) ● 7.0" (wide): 800 x 480 pixels (WVGA) ● 7.5" and 10.4": 640 x 480 pixels (VGA) ● 12.1": 800 x 600 pixels (SVGA)
Options	Screen protection sheet, environment cover

For more information, refer to Magelis GTO, User Manual, EIO0000001133 (ENG).

Wiring

Connector overview GTO3510/4310 and GTO5310/5315



1	Removable screw terminal block for the 24 Vdc power supply	5	RJ45 connector for RS 485 serial link (COM2)
2	Type A USB host connector for connecting peripherals, transferring applications	6	Slot for SD memory card, with hinged cover
3	Mini-B USB connector for application transfer	7	LED indicating presence of the SD memory card
4	9-way male SUB-D connector for RS 232C serial link (COM1)	8	RJ45 connector for Ethernet TCP/IP link, 10 BASE-T/100BASE-TX with an activity LED

Harmony ZBRN1/ZBRN2 Access Point - Hardware

Front View

Harmony ZBRN1 access point

Description

Harmony XB5R wireless and batteryless push buttons are used for remote control with an access point. This allows more flexibility and simplicity in the installation.

The control is realized via radio transmission. Each transmitter is equipped with a "dynamo" generator that converts the mechanical energy produced by pressing the push button into electrical energy.

A radio-coded message with a unique ID code will be sent in a single pulse to one or more receiver(s). These receivers can be located several tens of meters away.

The access points process the received radio frequency inputs and provide these via various communication protocols. They operate as intermediate equipment between a transmitter and a controller. Based on the model the receiver is linked to the controller via RS-485 2 wire serial line (Modbus RTU) or Ethernet (Modbus/TCP).

Wireless and batteryless push-button technology reduces the wiring and hence the cost of installation. They have a wide range of industrial and building applications such as:

- packing lines
- automatic doors in logistic centers
- automobile industries
- bag filling in cement industries
- office lighting for efficient usage of the power

Standards and certifications	R&TTE 1995/EC, LVD2006/95/EC, EMC 2004/108/EC EN/IEC 60947-1, EN/IEC 60947-5-1, EN/IEC 60950-1, IEC 61131-2, EN 300440-2, EN 300489-3, EN 300328, EN 62311 UL 508 (USA), CSA C22-2 n°14 (Canada), CCC (China), GOST (Russia)

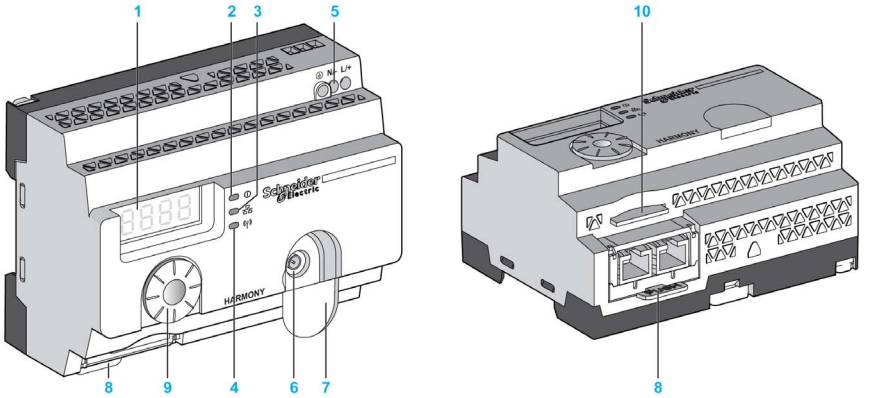
Radio certifications	FCC (USA), CSA, RSS (Canada), C-Tick (Australia), ANATEL (Brazil), SRRC (China), MIC (Japan)
Agencies	UL508, 17th edition, CSA C22.2 No. 142-M2000
Rated voltage	24...240 Vac/Vdc
Degree of protection	IP 20
Dimensions	W x H x D: 122 x 89 x 63 mm (4.8 x 3.5 x 2.48 in.)
Options	Wide range of wireless and batteryless push buttons, external antennas (active or passive)

For more information, refer to :

- Harmony XB5R, ZBRN1/ZBRN2, User Manual, EIO0000001177 (EN)
- Harmony XB5R, Expert Instruction Sheet, EIO0000000812 (EN)

Components

Harmony ZBRN1

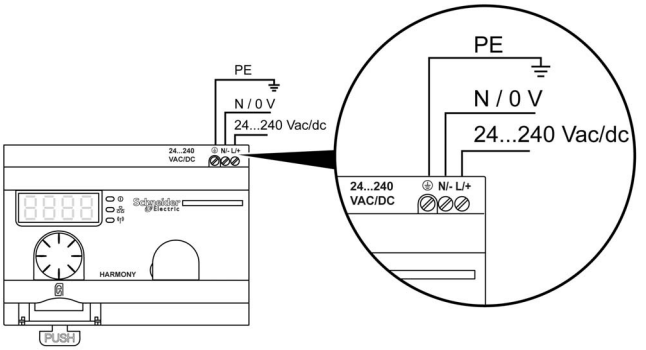


1	Four 7-segment displays with 5 LEDs	6	External antenna (optional) connector
2	Power LED	7	External antenna (optional) connector protective plug
3	Communication LED	8	• ZBRN1: Communication module inserted with 2 RJ45 Ethernet connectors • ZBRN2: 2 RJ45 Modbus RS 485 2 wire serial line connectors
4	Radio signal strength LED	9	Jog dial

5	Power input terminal block	10	SD memory card slot

Wiring

The power supply voltage allows any common supply connection from 24...240 Vac/Vdc.



Harmony Control and Signaling - Hardware

Front View

Harmony product range

Description

Schneider Electric offers a comprehensive range for control and signaling in industrial and commercial applications. All aspects of control and signaling needs are catered for including pilot devices such as push-buttons, indicator lamps, selector switches, and joysticks for standard hole cutouts.

For more information, refer to Control and signaling components, MKTED208031EN.

Section 4.4
Controller

What Is in This Section?

This section contains the following topics:

Modicon M251 Logic Controller - Hardware

Front View

Modicon M251 Logic Controller

Description

The Modicon M251 Logic Controller has various powerful features and can service a wide range of applications. Software configuration, programming, and commissioning are accomplished with the SoMachine software.

Thanks to the SoMachine software platform it offers optimized solutions for speed control, counting, axis control and communication functions.

The SoMachine software, used to configure and program the Modicon M251 Logic Controller, supports the following IEC61131-3 programming languages for use with these controllers:

- IL: Instruction List
- ST: Structured Text
- FBD: Function Block Diagram
- SFC: Sequential Function Chart
- LD: Ladder Diagram

SoMachine software can also be used to program this controller using CFC (Continuous Function Chart) language.

The Modicon M251 Logic Controller native communication ports include (depending on the controller reference):

- Ethernet
- USB programming
- Serial line
- CANopen Master

All controllers support up to 13 application program tasks with the following limits:
- 3 cyclic tasks: one is configured by default (MAST)
- 1 freewheeling task
- 8 event tasks
- 1 external event task

Standards and certifications	IEC/EN 61131-2, UL 508
Rated voltage	24 Vdc
Degree of protection	IP 20
Memory	RAM: 64 Mbytes, of which 8 Mbytes available for the application - to execute the application Flash: 128 Mbytes - to save the program and data in case of power interruption
Dimensions	Device-dependent (W x H x D): 54 x 90 x 90 mm (2.12 x 3.54 x 3.54 in.)]
Options	• SD card • TM2 I/O modules • TM3 I/O modules • TM4 communication modules

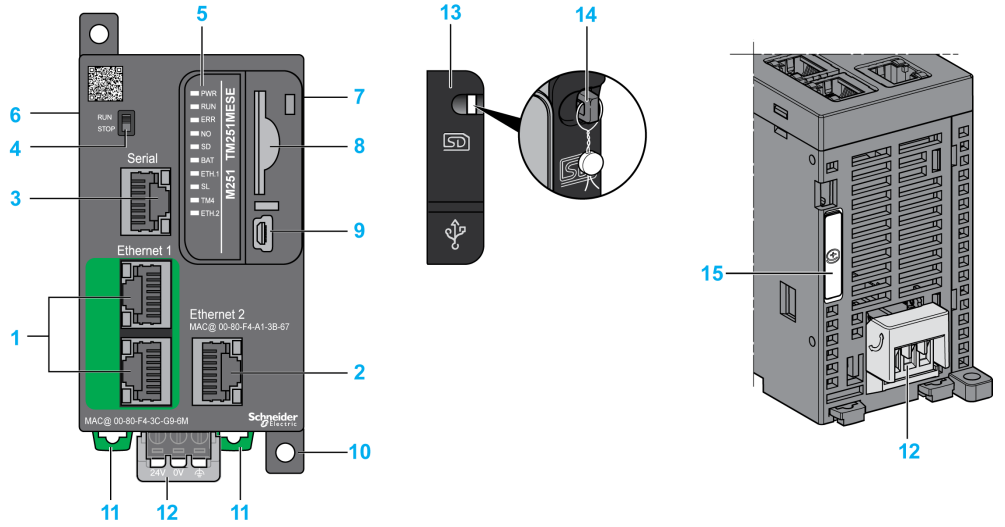
For more information, refer to :
- Modicon M251 Logic Controller, Hardware Guide, EIO0000001486
- Modicon M251 Logic Controller, Programming Guide, EIO0000001462

Modicon M251 Logic Controllers

Device	Digital inputs	Digital outputs	Communication ports
TM251MESC	0	0	1 serial line port 1 USB mini-B programming port 2 Ethernet switched ports 1 CANopen port
TM251MESE	0	0	1 serial line port 1 USB mini-B programming port 2 Ethernet switched ports 1 Ethernet port for fieldbus

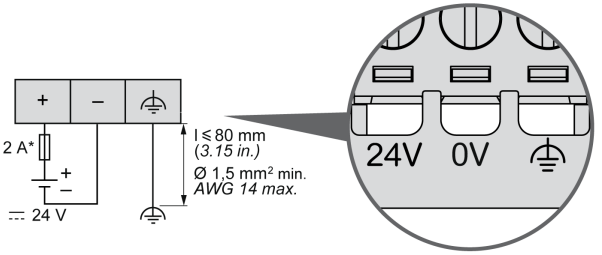
Physical Overview

Modicon TM251MESE logic controller



1	2 Ethernet switched ports	9	USB mini-B programming port
2	Ethernet port 2	10	Screwing plate
3	Serial line port	11	Clip-on lock for 35 mm (1.38 in) top hat section rail (DIN-rail)
4	Run/Stop switch	12	24 Vdc power supply
5	Status LEDs	13	Protective cover
6	TM4 bus connector	14	Locking hook
7	TM3/TM2 bus connector	15	Battery holder
8	SD card slot	-	-

Wiring Power Supply



* Type T fuse

Modicon TM3 Modules - Hardware

Front View

Modicon TM3 Modules

Description

The Modicon TM3 modular I/O system provides flexible and scalable configuration of expansions by direct connection with M221, M241, and M251 controllers. Characterized by easy wiring and maintenance, this modular I/O system offers a wide variety of modules that enables you to meet your desired configuration for reduced costs and simplification.

Flexible and scalable I/O configuration:

- Local or remote expansion via the local TM3 expansion bus on M221, M241, and M251 controllers.
- Wide range of I/O expansion modules:
  - Digital I/O modules
  - Analog I/O modules
  - Expert I/O modules
  - Safety I/O modules
  - Transmitter and receiver modules

Simplified maintenance installation:

- Embedded diagnostics for local and distant supervision
- Wiring simplicity: spring terminals, removable terminal blocks

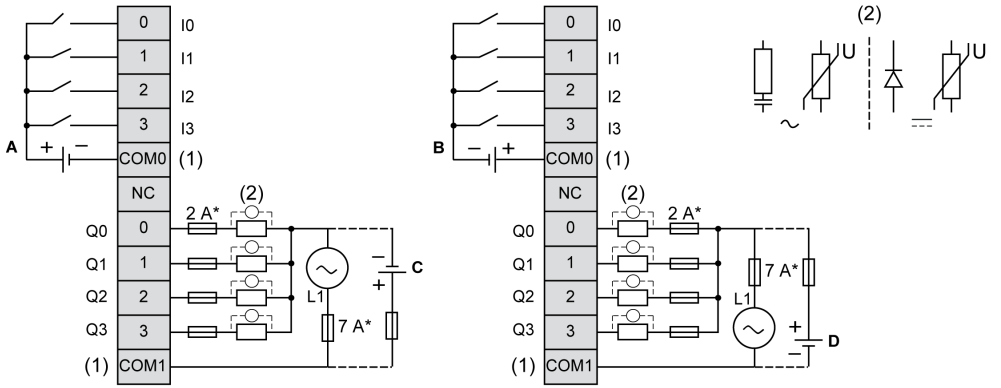
Standards and certifications	IEC/EN 61131-2 ed. 3 2007, UL 508, CSA 22.2 No. 142, CE
Power supply	24 Vdc or 120 Vac* * only TM3DI8A

Degree of protection	IP 20
Dimensions	One assembled integral module (W x H x D): 21.4…42.9 x 94.5…95 x 81.3…88.1 mm (0.84…1.69 x 3.72…3.74 x 3.2…3.47 in.)

For more information, refer to Modicon TM3, Expansion Modules Configuration, Programming Guide, EIO0000001402.

Wiring

Wiring example TM3DM8R



* Type T fuse

(1) The COM0 and COM1 terminals are **not** connected internally.

(2) To improve the life time of the contacts, and to protect from potential inductive load damage, you must connect a free wheeling diode in parallel to each inductive DC load or an RC snubber in parallel of each inductive AC load.

A Sink wiring (positive logic)

B Source wiring (negative logic)

C Source wiring (positive logic)

D Sink wiring (negative logic)

Section 4.5
Communication

What Is in This Section?

This section contains the following topics:

Modular TM4ES4 Ethernet Module - Hardware

Front View

Description

The Modicon TM4ES4 Ethernet module is a 4-port Ethernet switch to be connected to TM4 bus expansion of the controller. The TM4 bus interface of the M241 Logic Controller and M251 Logic Controller supports up to 3 TM4 expansion modules.

The TM4ES4 module has 2 applications:

- Expansion: addition of an Ethernet interface to extend the number of Ethernet ports for a controller
- Standalone: Ethernet switch (only getting its power supply from the controller)

Only 1 TM4ES4 module can be added to a controller as expansion. Further, if a controller already has an Ethernet port, the TM4ES4 module can only be used as standalone Ethernet switch. Up to 3 TM4ES4 modules can be added as standalone switches.

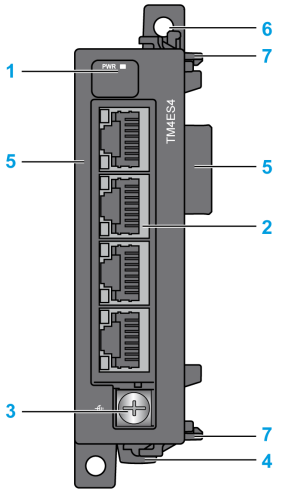
NOTE: The use as standalone Ethernet switch does not require configuration in SoMachine.

Standards and certifications	EN/IEC 61131-2, UL508, IEC/EN 61010-2-201
Consumption	360 mA

Dissipated power	2.5 W
Dimensions	W x H x D: 25.1 x 110 x 90 mm (0.99 x 4.32 x 3.54 in.)

For more information, refer to Modicon TM4 Expansion Modules, Hardware Guide, EIO0000001796.

Physical Overview



1 LED for power supply status
2 4 Ethernet RJ45 connectors
3 Screw for functional ground connection
4 Clip on lock for 35 mm (1.38 in.) top hat section rail (DIN-rail)
5 Connector for TM4 expansion modules (one on each side)
6 Locking device for attachment to the previous module
7 Clip for attachment to the previous module or the controller

ConneXium Ethernet Switch (Unmanaged) IP 67 - Hardware

Front View

ConneXium Ethernet 5TCSESU051F0 switch

Description

The ConneXium 5TCSESU051F0 switch has been especially designed for use in industrial environments.

According to EN 620529 the Ethernet switch has a degree of protection of IP 67.

It supports Ethernet 10 Mbit/s and Fast Ethernet 100 Mbit/s.

The switch module supports switched Ethernet networks in accordance with IEEE standard 802.3 (10BASE-T) or 802.3u (100BASE-TX) using copper technology.

The ConneXium 5TCSESU051F0 switch has five 10/100 Mbit/s twisted-pair ports (10BASET/100BASE-TX, shielded M12 connectors).

It is mounted at the installation site using screws.

- Multi-address capability
- Storage and rerouting of received data
- Data packets with VLAN tags are transmitted unchanged (IEEE 802.1 Q)
- Automatic negotiation of 10/100 Mbit/s and duplex mode
- Automatic change of polarity
- Protected against shock and foreign particles

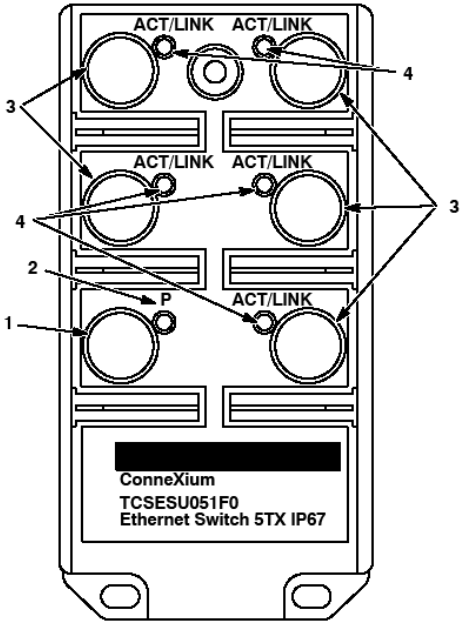
- Dust proof
- Water protected (temporary immersion)

Standards and certifications	UL508, CSA 22.2 No.14 (cUL mark), CE
Power supply	24 Vdc
Ports	5
Degree of protection	IP 67
Dimensions	W x H x D: 60 x 126 x 31 mm (2.36 x 4.96 x 1.22 in.)

For more information, refer to :
- ConneXium Industrial Ethernet Cabling System, 5TX IP67 Switch, TCSESU051F0, 31006691
- ConneXium Ethernet Switches, TCSESU0••F•N0, Quick Reference Guide, 31007950

Physical Overview

Connector overview of the TCSESU051F0



1 Power supply connector
2 Power LED
3 Ethernet connector
4 Port status LED

Section 4.6
Motor Control

What Is in This Section?

This section contains the following topics:

TeSys GV2 Motor Circuit Breakers - Hardware

Front View

TeSys GV2 P motor circuit breaker

Description

The large TeSys motor circuit-breakers range GV2, GV3 and GV7 is categorized according to their level of performance and functions. Due to its diverse characteristics, only the GV2 P is presented and integrated into the TVDA.

The TeSys GV2 P motor circuit-breakers are three-pole thermal-magnetic circuit-breakers designed for the control and protection of motors.

The motor protection is provided by the thermal-magnetic elements incorporated in the industrial motor circuit-breaker.

The magnetic elements (short-circuit protection) have a non-adjustable tripping threshold, which is equal to 13 times the maximum setting current of the thermal trips.

The thermal elements (overload protection) include automatic compensation for ambient temperature variations. The addition of an under voltage trip allows the circuit-breaker to be de-energized in the event of an under voltage condition.

- Motor and personnel protection
- Live parts are protected from direct finger contact
- Compact size
- Easy to install: screw mounting or clip-on mounting
- Control by rotary knob
- Connection by screw clamps

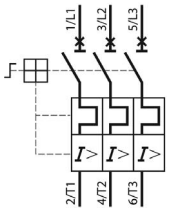
Standards and certifications	IEC 60947-1, 60947-2, 60947-4-1, EN 60204, UL508, CSA C 22.2 n° 14-05, NF C 63-650, 63-120, 79-130, VDE 0113, 0660, UL*, CSA, PTB, EZU, GOST, TSE, DNV, LROS, GL, BV, RINA, CCC, ATEX *UL508 type E for GV2 P••H7 (line spacer included)

Operational voltage	690 V
Degree of protection	IP 20
Dimensions	W x H x D: 44.5 x 89 x 97 mm (1.75 x 3.5 x 3.82 in.)
Options	• Combination block • Sets of 3-pole busbars • Protective end cover • Terminal blocks • Padlock able external operator • Contact blocks: Error signaling contact and immediate auxiliary contacts • Undervoltage/Shunt trips • Padlocking devices

For more information, refer to Control and protection components, MKTED210011EN.

Wiring

TeSys GV2 P contactors wiring diagram



Altivar 32 Variable Speed Drive - Hardware

Front View

Altivar 32 variable speed drive

Description

The Altivar 32 drive is a frequency inverter for 200…500 V three-phase asynchronous and synchronous motors rated from 0.18 kW to 15 kW which includes a various motor control profile.

In combination with synchronous motors, Altivar 32 variable speed drives offer optimized energy efficiency.

It features more than 150 functions. It is robust, compact, and easy to install.

The Altivar 32 drive incorporates functions which are suitable for the most common applications, including: hoisting, material handling, packaging, and special machines (like wood working machines, metal processing, and so on).

- Compact book format
- Integrated Modbus SL RS-485 2-wire
- Open: communication cards available as options
- integrated protection
- Simple setup
- Integrated programmable logic functions
- Energy saving: control of energy efficient permanent magnet synchronous motors

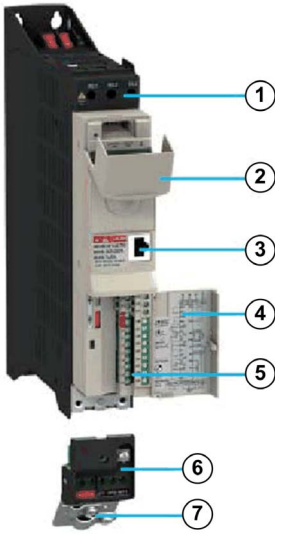
Standards and certifications	IEC 61800-5-1, IEC 61800-3 (environments 1 and 2, category C2), ISO/EN13849-1/-2 (category 3, PL d), IEC 61508 (parts 1 & 2), IEC 60721-3-3 (environments 3C3 and 3S3, classes 3C3 and 3S2), UL508c, CSA, NOM, GOST, C-Tick
Power range	0.18…15 kW
Voltage range	• single-phase 200…240 V (0.18 to 2.2 kW) • three-phase 380…500 V (0.37 to 15 kW)
Output frequency	0.1…599 Hz
Transient overtorque	170…200 % of the nominal motor torque
Communication	• integrated: Modbus SL RS-485 2-wire and CANopen, Bluetooth link • optional: DeviceNet, PROFIBUS DP V1, Modbus SL RS-485 2-wire, EtherNet/IP, Modbus TCP, EtherCAT
Functions	• standard or customizable configurations • factory or OEM settings • application-specific functions • adjustable switching frequency • HMI and dialog or configuration tools • uploads and downloads with drive on or off
Protections	• STO: Safe Torque Off • SLS: Safely Limited Speed • SS1: Safe Stop 1
I/Os	• 3 analog inputs - response time: 3 ms, resolution 10 bits • 6 logic inputs - response time: 8 ms, configurable in PTC and IN PWM • 1 analog input - updating time: 2 ms • 1 logic output - sampling time: 2 ms, configurable as voltage or current • 2 relay outputs
Degree of protection	IP 20
EMC filter	• integrated: C2 EMC • optional: C1 EMC
Dimensions	4 types (WxHxD) • 45 x 317 x 245 mm (1.77 x 12.48 x 9.65 in.) • 60 x 317 x 245 mm (2.36 x 12.48 x 9.65 in.) • 150 x 308 (232*) x 232 mm (5.9 x 12.13 (9.13*) x 9.13 in.) • 180 x 404 (330*) x 232 mm (7.1 x 15.9 (13*) x 9.13 in.) * = EMC plate not installed

Options	• SoMove and SoMove Mobile setup software • simple and multi-loader configuration tool • remote display terminals • communication cards in cassette format • optimized offer for connection to the CANopen bus • quick connect for a TeSys GV2 circuit breaker

For more information, refer to :
- Altivar 32, Variable speed drives for synchronous and asynchronous motors, Installation manual, S1A28686 (ENG).
- Altivar 32, Variable speed drives for synchronous and asynchronous motors, Programming manual, S1A28692 (ENG).

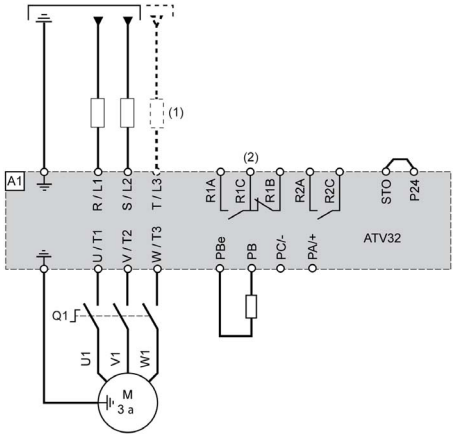
Wiring

Altivar 32 connector overview



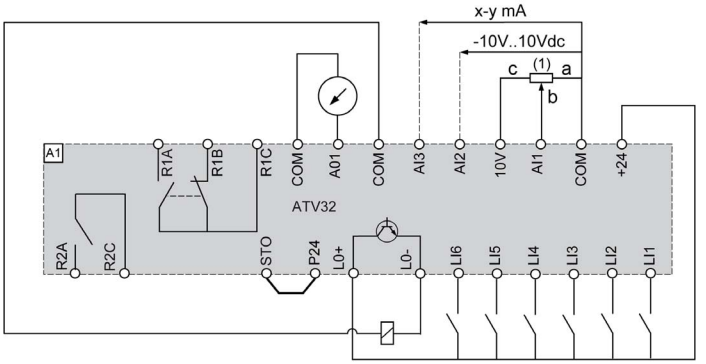
1 Power terminals
2 Protective cover
3 RJ45 Modbus SL RS-485 2-wire
4 Protective cover
5 Control terminals
6 Removable motor power terminal block
7 EMC mounting plate

Wiring example power supply and motor



(1) Line choke (if used)
(2) Relay contacts signifying detected errors

Wiring example control terminals



(1) Reference potentiometer SZ1RV1202 (2.2 kΩ) or similar (10 kΩ maximum)

Altivar 71 Variable Speed Drive - Hardware

Front View

Altivar 71 variable speed drive

The Altivar 71 drive is a frequency inverter for 200…690 V three-phase asynchronous and synchronous motors.

With its different types of motor control and numerous integrated functions, the Altivar 71 range of drives meets the most stringent requirements.

In combination with the wide voltage range for a 690 V line supply, the Altivar 71 drive's advanced functions boost performance levels and make machines more versatile. It features more than 150 functions.

The Altivar 71 drive incorporates functions which are suitable for the most common applications, including: hoisting, material handling, packaging, and special machines (like wood working machines, textile machines, and so on).

- Motor control: high-performance in open-loop and closed loop-mode
- Protection of motor and of drive
- Integrated safety
- Integrated Modbus SL RS-485 2-wire and CANopen
- I/O extension cards, interface cards for encoder
- Communication cards: Fipio, Ethernet, Modbus Plus, PROFIBUS DP, DeviceNet, Uni-Telway; Interbus
- Integrated machine controller (IMC) programmable card

Standards and certifications	IEC 61800-5-1, IEC 61800-2, IEC/EN 61800-3, EN 55011, EN 55022, UL, CSA, DNV, NOM 117, GOST, C-Tick, CE, RoHS, WEEE
Power range	● 0.37…630 kW ● 0.75…75 kW * * = IP 54 drives
Voltage range	● single-phase 200…240 V (0.37 to 5.5 kW) ● three-phase 220…240 V (0.37 to 75 kW) ● three-phase 380…480 V (0.75 to 500 kW) ● three-phase 500…600 V (1.5 to 7.5 kW) ● three-phase 500…690 V (1.5 to 630 kW)
Output frequency	0.1…599 Hz* * = 500 Hz for drives with 45...630 kW
Transient overtorque	220 % of the nominal motor torque for 2 s and 170 % for 60 s
Communication	● integrated: Modbus SL RS-485 2-wire and CANopen ● optional: DeviceNet, PROFIBUS DP, PROFIBUS DP V1, EtherNet/IP, Modbus TCP, Uni-Telway, Interbus S, CC-Link
Cards	Encoder interface cards, I/O extension cards, integrated machine controller (IMC)
Functions	● application-specific functions ● maintenance, monitoring, and diagnostic functions ● quick start-up ● PID controller ● brake control suited to traveling ● hoisting and slewing movements
Protections	● power removal function (ATEX certification) ● category 3 of the ISO 13849 machine safety standard ● SIL2 of IEC/EN 61508 ● IEC/EN 61800-5-2
I/Os	● 2…4 analog inputs ● 6…20 logic inputs ● 1…3 analog inputs ● 0…8 logic output ● 2…4 relay outputs ● 1 safety input
Degree of protection	IP 20 for unprotected drives and IP 41 on the upper part UL Type12(1) / IP 54
EMC filter	● integrated: C2 EMC up to 4 kW C3 EMC for 5.5...500 kW ● optional: C1 EMC for 0.75...500 kW

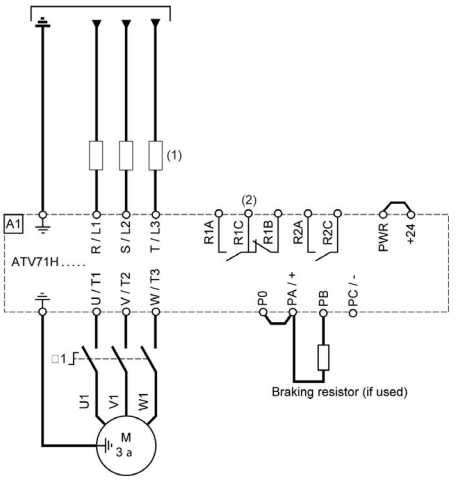
Dimensions	16 types (W x H x D) ● min: 130 x 230 x 175 mm (5.12 x 9.1 x 6.9 in.) ● max: 1120 x 1390 x 377 mm (44.1 x 54.72 x 14.85 in.)
Options	● option cards ● SoMove and SoMove Mobile setup software ● simple and multi-loader configuration tool ● remote display terminals ● network braking units ● active front end ● DC chokes, line chokes, and passive filters

For more information, refer to :

- Altivar 71, Variable speed drives for synchronous motors and asynchronous motors, Installation Manual (0.37 - 90 kW), 1755843 (ENG)
- Altivar 71, Variable speed drives for synchronous motors and asynchronous motors, Installation Manual (55 - 630 kW), 1755849 (ENG)
- Altivar 71, Variable speed drives for synchronous and asynchronous motors, Programming manual, Specification 383, AAV49426

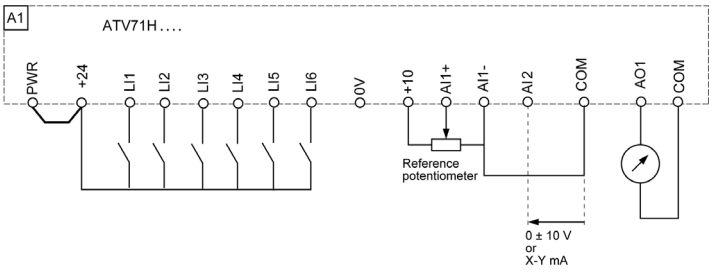
Wiring

Wiring example power supply and motor



1 Line chock (if used)
2 Fault detected relay contacts for remote signaling of drive status

Wiring example control terminals



Lexium 32M Servo Drive - Hardware

Front View

Lexium 32M servo drive

Description

The Lexium 32 is a drive system for applications involving high-precision and/or dynamic positioning.

The Lexium 32 servo range consists of 3 high-performance book-size servo drive models - Lexium 32 (C, A, M) and 2 motor families - the versatile medium inertia Lexium BMH and the dynamic low inertia Lexium BSH.

Preferred machines for the integration of the Lexium 32 are: packaging machines, material handling machines, material working machines, and assembling machines.

Simplicity throughout the entire lifecycle of your machine:

- Fast engineering with powerful integration and design software (motor sizing, CAD, and cabinet drawings, support for PLCopen libraries, commissioning software SoMove) reduces time-to-market
- Simplified installation with easy access to removable, color-coded connectors, memory cards, and multi-loader

- Memory card and standardized "Faulty Device Replacement" (FDR) function with EtherNet/IP for fast device replacement
- "Safe Torque Off" function on board

Openness and modularity:
- Intelligent, modular product concept responds to most requirements
- Large selection of fieldbus modules for fast integration into your architecture
- 3 encoder modules for machine encoder/second motor encoder
- eSM module for additional safety-related functions

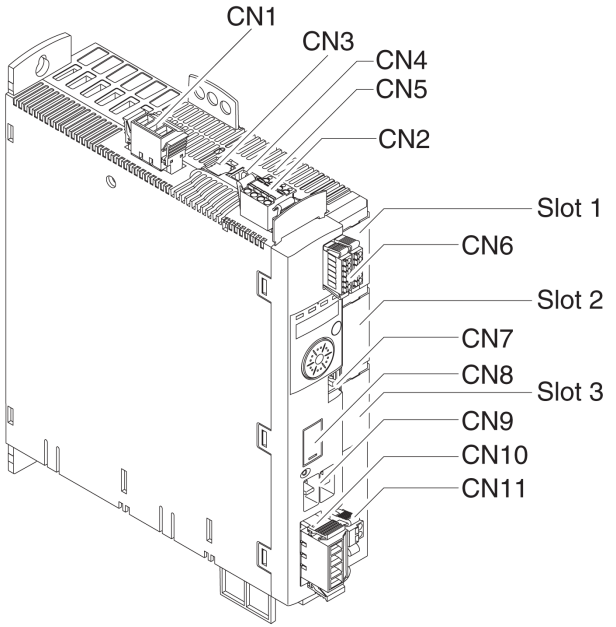
Power and performance:
- Easy auto-tuning for different levels of expertise
- Superior motor control
- Intelligent vibration and jerk suppression for long machine life
- 2 powerful motor ranges: the versatile medium-inertia Lexium BMH and the dynamic low-inertia Lexium BSH

Standards and certifications	IEC 61800-5-1, IEC 61800-3 (environments 1 and 2, categories C2 and C3) IEC 61000-4-2/4-3/4-4/4-5, ISO/EN13849-1 (PL e), IEC 61508 SIL 3 level, CE, UL, CSA
Power range	0.15…7 kW
Voltage range	115…240 Vac, 400…480 Vac
Speed	up to 8000 rpm
Torque	up to 84 Nm
Communication	• Integrated: Modbus serial link, Pulse train • As an option: CANopen, CANmotion machine bus, DeviceNet, EtherNet/IP, PROFIBUS DP, EtherCAT, I/O module
Operating modes	• homing • manual mode (JOG) • motion sequence • electronic gearbox • speed control • current control • position control
Functions	• auto-tuning, monitoring, stopping, conversion • stop window • rapid entry of position values • rotary axis • position register
I/Os	• 4 logic inputs (24 Vdc) • 2 capture input (24 Vdc) • 3 logic outputs (24 Vdc)

Pulse control input	1 configurable as: ● RS 422 link ● 5 V or 24 V push-pull ● 5 V or 24 V open collector
ESIM PTO output	RS 422 link
Safety-related functions	● Integrated: "Safe Torque Off" STO ● As an option: Safe Stop 1 (SS1) and Safe Stop 2 (SS2), Safe Operating Stop (SOS), Safe Limited Speed (SLS)
Sensor	● Integrated: SinCos Hiperface sensor ● As an option: Resolver encoder, analog encoder, digital encoder
Degree of protection	IP 20
Dimensions	2 types (W x H x D) ● 68 x 270 x 225 mm (2.68 x 10.63 x 8.86 in.) ● 108 x 274 x 225 mm (4.25 x 10.79 x 8.86 in.)
Options	● SoMove setup software ● Multi-Loader configuration tool ● IP 54 remote graphic display terminal ● filters, braking resistors, line chokes

For more information, refer to LXM32M AC servo drive, Product manual, 0198441113767.

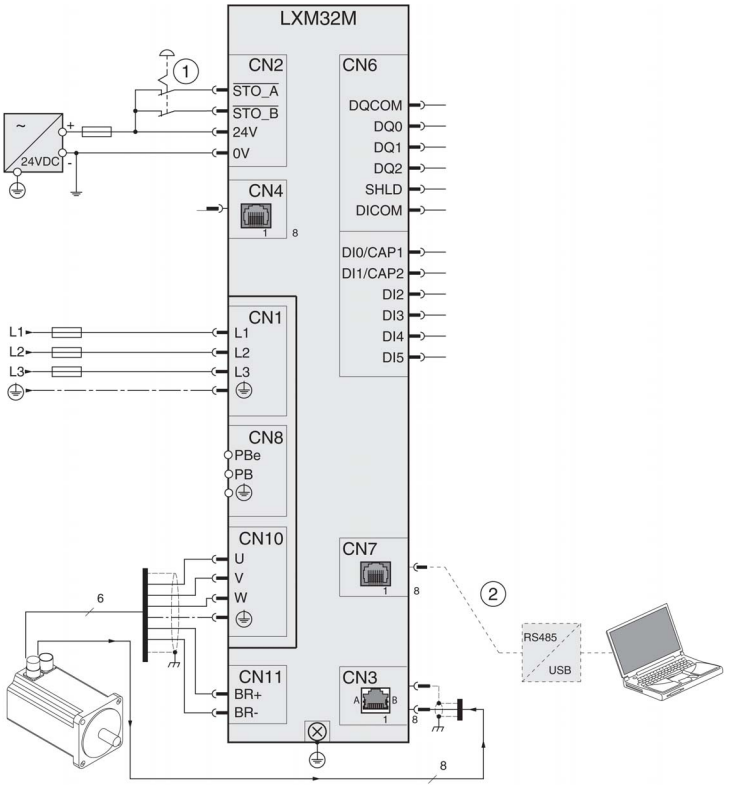
Physical Overview



Connector	Description
CN1	Power stage supply
CN2	24 controller power supply and safety-related function STO
CN3	Motor encoder (encoder 1)
CN4	PTO (encoder simulation ESIM)
CN5	PTI (A/B signals, P/D-signale, CW/CCW signals)
CN6	Digital inputs/outputs
CN7	Modbus SL RS-485 2-wire (commissioning interface)
CN8	External braking resistor
CN9	DC bus connection for parallel operation
CN10	Motor phases
CN11	Holding brake
Slot 1	Safety module or I/O module
Slot 2	Encoder module (encoder 2)
Slot 3	Fieldbus module

Wiring

The wiring example shows the basic wiring of the Lexium 32M servo drive. Thanks to the flexibility of the Lexium 32M servo drive the device can be adapted to a wide variety of tasks with numerous modules. See the product manuals of the modules for details on wiring.



1 Emergency stop
2 Commissioning accessories

Lexium BSH/BMH Servo Motors - Hardware

Front View

Lexium BSH/BMH servo motors

BSH BMH

Description

The Lexium BSH/BMH servo motor movements are controlled by Lexium 32 servo drives.

BSH servo motors are the ideal choice to meet requirements for dynamics and precision. With 4 flange sizes and various lengths, there is a suitable solution for most applications, covering a continuous stall torque range from 0.5 Nm to 33.4 Nm for speeds up to 9000 rpm.

BMH servo motors provide unequaled power density values to meet the requirements of most compact machines. With 5 flange sizes and 3 different lengths for each flange size, they are suitable for most applications, covering a continuous stall range from 1.2 Nm to 84 Nm for speeds up to 8000 rpm. With their medium inertia motor, the BMH servo motors are ideal for high-load applications and enable more robust adjustment of the movement, making for easier installation and adjustment.

BSH and BMH servo motors are certified as "Recognized" by the UL (underwriters laboratories) and conform to UL 1004 standards as well as to European directives (CE marking).

They are available with the following variants:

- 4 (BSH) and 5 (BMH) flange sizes (mm): 55, 70, 100, 140 and 205 (BMH)
- 2 degrees of protection for the shaft end: IP 50 or IP 65 in accordance with standard IEC/EN 60529
  The degree of protection of the casing is IP 65 (IP 67 with the conformity kit, which is available as an option).
- With or without holding brake
- Straight or angled connectors for power and encoder connection
- Integrated SinCos Hiperface single turn or multiturn encoder (medium or high resolution)
- Untapped or keyed shaft end

BSH and BMH servo motors have been developed to comply with the following main specifications:

- The ambient operating temperature is –20...+ 40 °C (–4...+ 104 °F) without derating, in accordance with standard IEC 60721-3-3, category 3 K3 and up to 55 °C (131 °F) with derating of 1% of the nominal output power per additional 1 °C (1.8 °F) above 40 °C (104 °F).
- The maximum operating altitude is 1000 m (3281 ft) without derating, 2000 m (6562 ft) with k = 0.86 and 3000 m (9843 m) with k = 0.8.
- The relative humidity that the servo motor can withstand is in line with standard IEC 60721-3-3, categories 3 K3, 3Z12 and 3Z2.
- The windings are insulation class F (maximum temperature for windings 155 °C/311 °F) in accordance with standard IEC 60034-1.
- All mounting positions are permitted (horizontal mounting (IMB5) or vertical mounting (IMV1 with shaft end at the top and IMV3 with shaft end at the bottom) in accordance with standard IEC 60034-7.

For more information, refer to :

- BMH, Servo motor, Motor manual, 0198441113749 (ENG)
- BSH, Servo motor, Motor manual, 0198441113837 (ENG)

Wiring

Schneider Electric provides a wide range of preformed cables for motor and encoder connections between the servo motor and the Lexium 32 drive. An overview about the offer is provided in the appropriate catalog and in the product manual of the Lexium BSH respectively BMH servo motors.

Lexium ILx Integrated Drives - Hardware

Front View

Lexium ILA, Lexium ILE, Lexium ILS integrated drives

Description

The Lexium integrated drives ILx comprises motor, positioning controller, power electronics, fieldbus, and safety-related functions in a single compact device.

Three different motor technologies allow the combination of the individual benefits of each technology.

- Lexium ILA with servo motor for high dynamic
- Lexium ILE with DC brushless motor with high holding torque without power
- Lexium ILS with 3-phase stepper motor with high torque at low speed

Simple in use:

- Easy and reduced wiring
- Integrated EMC filter
- Fast and simple commissioning with ergonomic commissioning software
- PLCopen application function blocks included
- "Safe Torque Off" safety-related function on board

For more information, refer to :

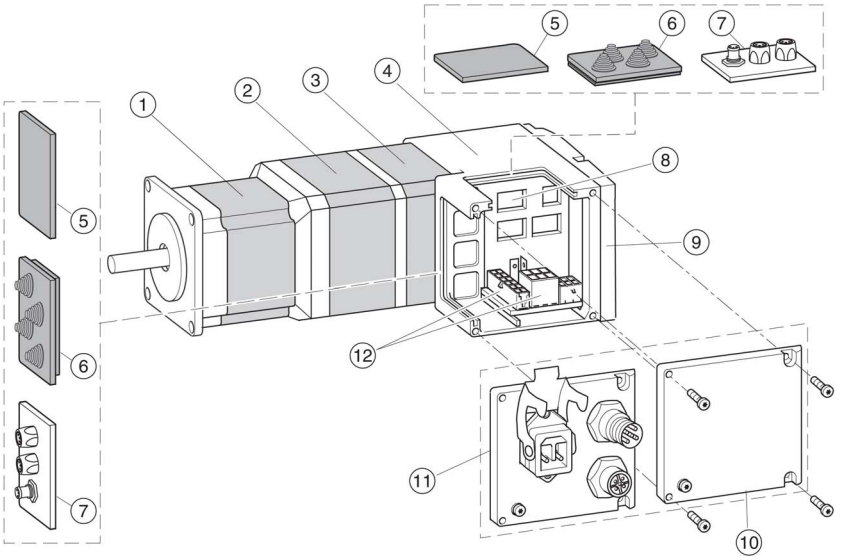
- ILA2K EtherNet/IP Lexium Integrated Drive, Product manual, 0198441113670.
- ILE2K EtherNet/IP Lexium Integrated Drive, Product manual, 0198441113676.
- ILS2K EtherNet/IP Lexium Integrated Drive, Product manual, 0198441113682.

-	Lexium ILA	Lexium ILE	Lexium ILS
Type of process	Dynamic process and accurate positioning	Automatic format adjustment	Short distance movements with accurate positioning
Type of technology	Servo motor	DC brushless motor	3-phase stepper motor

-	Lexium ILA	Lexium ILE	Lexium ILS
Main characteristics	High dynamic, compact, integrated holding brake as an option	High holding torque without power, integrated gearbox as an option	High torque at low speed
Control interface			
Control signals	Inputs/outputs		Pulse/direction Inputs/outputs
Fieldbus and networks	CANopen, PROFIBUS DP, RS 485 serial link, DeviceNet, EtherCAT, Modbus TCP, Ethernet Powerlink, EtherNet/IP		
Nominal power	150...350 W	100...350 W	100...350 W
Nominal speed	500...9000 rpm	1500...7000 rpm	0...1000 rpm
Nominal torque	0.26...0.78 Nm	0.18...0.5 Nm	0.45...6 Nm
Power supply	24/36/48 Vdc, maximum 10 A		
Type of sensor	Single-turn SinCos encoder (16,384 increments/turn) Multiturn SinCos encoder (16,384 increments/turn × 4,096 turns)	Absolute value encoder (12...1380 increments/turn)	Index pulse monitoring
Motor flange size	57 mm	66 mm	57 mm or 85 mm
Accessories	Cable, connector kits, installation sets, commissioning tools, planetary gearboxes		

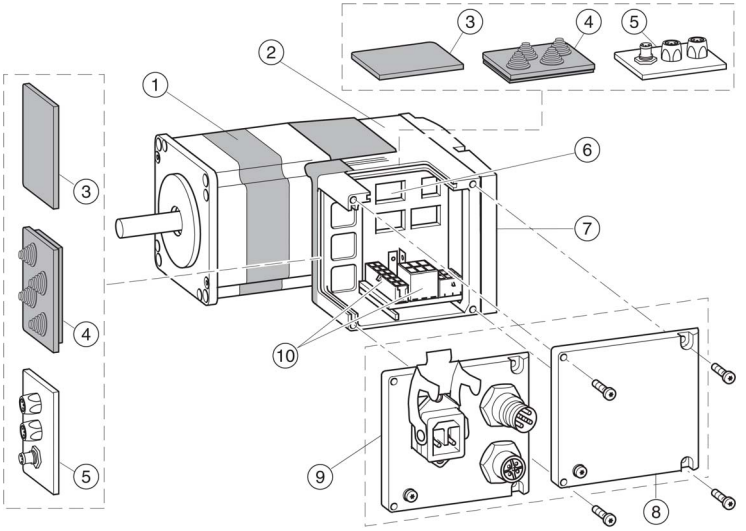
Wiring

Lexium ILA integrated drive



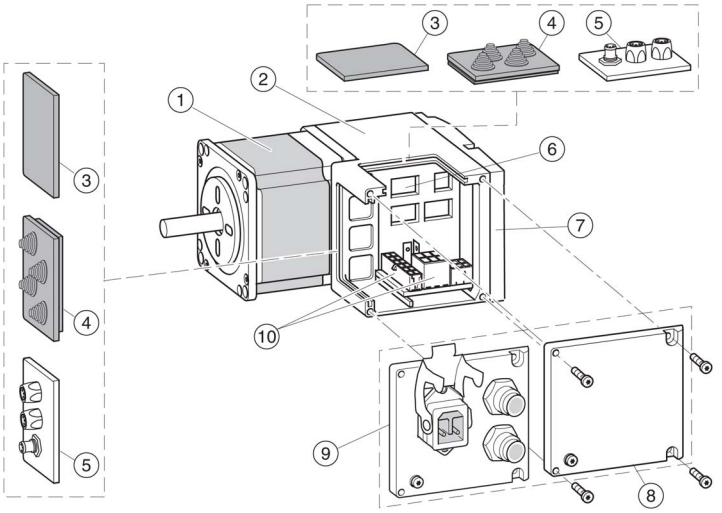
1	Synchronous AC servo motor	7	I/O insert with industrial connector (accessory)
2	Holding brake (optional)	8	Switches for settings
3	Encoder	9	Cover of electronics housing (not to be removed)
4	Electronics housing	10	Cover of connector housing (to be removed for installation)
5	Insert for sealing (accessory)	11	Cover with industrial connector for Vdc supply voltage and IN/OUT fieldbus connection (optional)
6	Insert for cable entry (accessory)	12	Electrical interfaces

Lexium ILE integrated drive



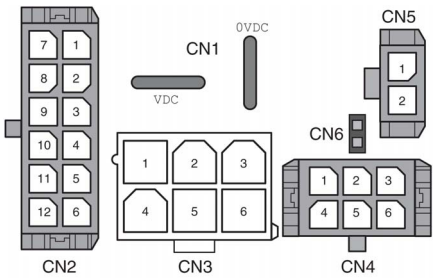
1	Brushless DC motor	6	Switches for settings
2	Electronics housing	7	Cover of electronics housing (not to be removed)
3	Insert for sealing	8	Cover of connector housing (to be removed for installation)
4	Insert with cable entry	9	Cover with industrial connector for Vdc supply voltage and IN/OUT fieldbus connection (optional)
5	I/O insert with industrial connector	10	Electrical interfaces

Lexium ILS integrated drive



1	3-phase stepper motor	6	Switches for settings
2	Electronics housing	7	Cover of electronics housing (not to be removed)
3	Insert for sealing (accessory)	8	Cover of connector housing (to be removed for installation)
4	Insert with cable entry (accessory)	9	Cover with industrial connector for Vdc supply voltage and IN/OUT fieldbus connection (optional)
5	I/O insert with industrial connector (accessory)	10	Electrical interfaces

Lexium ILx connector overview

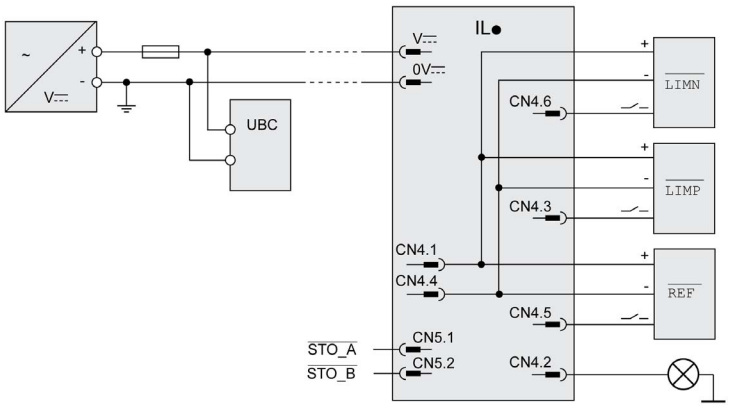


CN1	Supply voltage Vdc ● VDC: supply voltage ● 0VDC: reference potential	CN4	24 V signal interface ● Pin 1: +24VDC_OUT ● Pin 2: IO2 ● Pin 3: IO0 ● Pin 4: 0VDC ● Pin 5: IO3 ● Pin 6: IO1
CN2	Interface for PROFIBUS DP ● Pin 12: RxD/TxD-N - green IN ● Pin 11: RxD/TxD-P - red IN ● Pin 6: RxD/TxD-N - green OUT ● Pin 5: RxD/TxD-P - red OUT	CN5	Interface for STO function ● Pin 1: STO_A (PWRR_A) ● Pin 2: STO_B (PWRR_B)
CN3	Interface for CAN or RS-485 ● Pin 3: CAN_H ● Pin 6: CAN_L ● Pin 4: CAN_0V or RS485 GND ● Pin 2: RS485 (+) / (B) / (D1) ● Pin 5: RS485 (-) / (A) / (D0)	CN6	Jumper for STO function ● Jumper plugged in: STO disabled ● Jumper removed: STO enabled

The drive can be connected via cable entries or industrial connectors.

- For cable entries, the connector housings and crimp contacts are available as accessory kits for the connection to the electrical interface on the integrated drive.
- The device variant with industrial connectors includes the cover with industrial connectors for the power supply and fieldbus connection. Furthermore Schneider Electric offers inserts with industrial connectors for I/O and STO connections. These are pre-assembled for the connection to the electrical interface on the integrated drive.

Wiring example



Section 4.7
Detection

What Is in This Section?

This section contains the following topics:

OsiSense XGCS850 RFID - Hardware

Front View

OsiSense XGC850

Description

The OsiSense XG Ethernet Smart Antenna combines a compact design and remarkable features to provide elevated performances in read/write operations on 13.56 MHz RFID tags, and flexibility in network connectivity supporting both Ethernet IP and Modbus TCP/IP networks.

The Smart Antenna is a compact RFID station offering the following advantages:

- 2 Ethernet ports
- Daisy chaining up to 32 Smart Antennas
- Compatible with most 13.56 MHz tags on the market

Embedded functions are activated by standard requests to read/write words, sent by the logic controller:

- Reset: The RFID part of the Smart Antenna is reinitialized and assumes its factory default configuration.
- Init: The Smart Antenna is reinitialized and operates as it would after being switched back on (address unchanged, RFID parameters deleted).
- Sleep mode: Transmission of the electromagnetic field of the Smart Antenna is only activated upon receipt of a read or write instruction. This mode reduces the power consumption of the Smart Antenna and prevents interference when the Smart Antennas are in close proximity to each other.
- Auto read/write: This mode enables the Smart Antenna to execute up to 10 read or write instructions on a tag automatically (without logic controller command) as soon as the RFID tag enters the dialogue zone.

For more information, refer to RFID OsiSense XG, Ethernet Smart Antenna, User Manual, EIO0000001601.

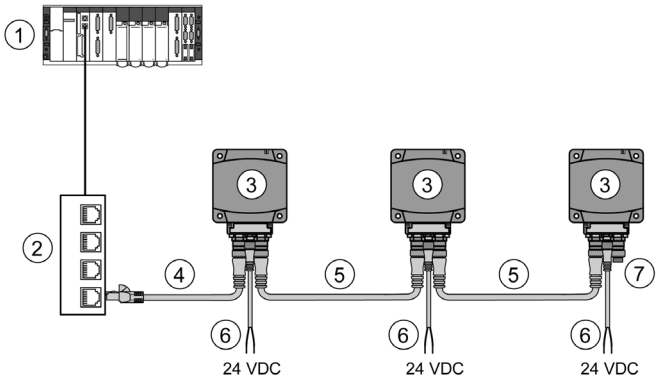
Standards and certifications	UL508, CE, EN 300330, EN 301489-01/03
Power supply	24 Vdc PELV, connection on M8 4 pins male socket
Power consumption	< 150 mA
Nominal range	20...100 mm (0.78...3.94 in) depending on associated tag
Type of associated tag	Standardized ISO 15693 and ISO 14443 tags, automatic detection of the tag type
RFID frequency	13.56 MHz
Communication	Interface: Ethernet dual port 10 BASE-T/100 BASE-TX Connection: 2x M12 D coded female sockets for chaining
Temperature	Operation: -25...+70 °C (-13...+158 °F) Storage: -40...+85 °C (-13...+158 °F)
Degree of protection	IP 65 according to IEC 60529
Dimensions	W x H x D: 80 x 93 x 40 mm (3.15 x 3.66 x 1.57 in.)

Physical Overview

1	TAG: Tag LED	6	M8 socket, 24 Vdc power supply
2	COM: Communication LED	7	M12 socket, Ethernet port 2
3	NS: Network status LED	8	LK/SP: Ethernet communication port 2 LED
4	LK/SP: Ethernet communication port 1 LED	9	MS: Ethernet module status LED
5	M12 socket, Ethernet port 1	-	-

Installation Example

Example of an Ethernet TCP/IP network setup with OsiSense XG Smart Antennas in daisy chain topology



1	Logic controller	5	Ethernet cable XGSZ12E12••
2	Ethernet switch	6	Power supply cable XZCP0941L•
3	Smart Antenna	7	M12 connector cap ASI67FACC1 (2 caps are supplied with the Smart Antenna)
4	Ethernet cable XGSZ12E45••	-	-

OsiSense XUW Vision Sensor - Hardware

Front View

Description

The XUW vision sensor precisely detects defective parts, parts in an incorrect place, at an incorrect angle or in an incorrect order or a combination of these. A total of five detectors are available for inspection tasks and interpretation:

- Pattern matching
- Contour detection
- Brightness
- Gray level
- Contrast detection

In contrast to the standard version (XUWSA•••) of the XUW vision sensor, the advanced version (XUWAA•••) also offers position tracking. Thus it is also possible to detect those features which do not appear with repeated accuracy in the taught position.

The interpretation is carried out relative to the position and angle of the part without having to define an independent characteristic for each possible position. This high capacity tool also enables you to solve demanding pick and place applications.

Operating voltage	20,4...26,4 Vdc
Input current (without I/O)	≤ 200 mA
Input current (without light and I/O)	≤ 120 mA
Input impedance	> 20 kΩ
Maximum current per output	50 mA 100 mA (pin 12)
Short circuit protection	Yes, all outputs
Polarity inversion protection	Yes, all outputs
Lag time	Approximately 13 s after powering up
Dimensions (L x W x H)	65 x 45 x 45 mm (2.56 x 1.77 x 1.77 in.)

Operating temperature	0...+50 °C (32...122 °F)
Storage temperature	-20...+60 °C (-4...140 °F)
Degree of protection	IP65 / IP67 depending on the used connector

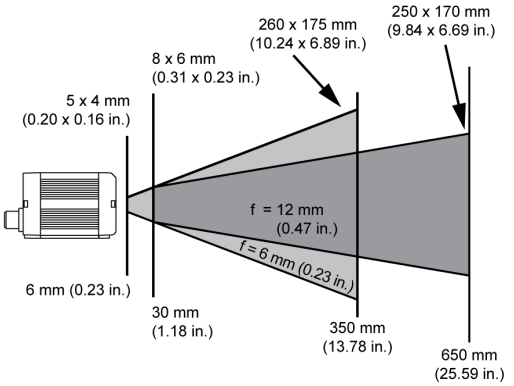
Functional Characteristics

Functional characteristics	XUWSA (standard)	XUWAA (advanced)
Frames per second	50	50
Number of jobs	2	64
Alignment	No	Yes
Number of detectors	32	64
Type of detectors	Pattern matching (X, Y translation)	Pattern matching (X, Y translation)
	Contour (X, Y translation, and rotation)	Contour (X, Y translation, and rotation)
	Gray level	Gray level (X, Y translation, and rotation with alignment tool)
	Contrast	Contrast (X, Y translation, and rotation with alignment tool)
	Brightness	Brightness (X, Y translation, and rotation with alignment tool)
Inputs/Outputs	4 digital outputs, 2 digital inputs, all PNP, or NPN	6 digital outputs, 2 digital inputs, all PNP, or NPN
	2 freely definable in- / outputs	4 freely definable in- / outputs
Shape modification	Contour detector	All detectors
Timeout, specified time response	Yes	Yes
Variable resolutions	Yes	Yes
Illumination quadrant controlled	Yes	Yes
Image recorder	Yes	Yes
Encoder input	No	Yes
Ethernet TCP/IP	No	Yes
RS422 interface for data transmission	No	Yes
EtherNet/IP interface	Yes	Yes
Sensor monitoring with viewer, job upload and so on.	Yes	Yes

Sensor Types

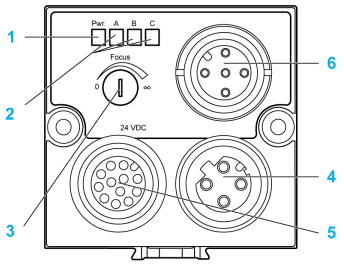
References	Focal lens mm (in.)	Internal illumination	Min. operating distance mm (in.) (1)	Min. field of view / mm x mm (in. x in.)
XUWSA06W	6 (0.23)	White	6 (0.23)	5 x 4 (0.2 x 0.16)
XUWAA06W				
XUWSA06R		Red		
XUWAA06R				
XUWSA12W	12 (0.47)	White	30 (1.18)	8 x 6 (0.31 x 0.23)
XUWAA12W				
XUWSA12R		Red		
XUWAA12R				
(1) For greater operating distances (from approx. 200 mm (7.87 in.)) external illumination may be necessary.				

The following graphic presents the size of the field of view for the 2 focal lens types depending on the operating distance.



Physical Overview

The following graphic shows the electrical connection on the rear of the XUWAA••• sensor.



1 Operating LED
2 Output LEDs
3 Focus adjustable
4 M12 socket, Ethernet port
5 Power supply and digital I/O M12 connector
6 M12 plug, data (RS422) - not available on standard version XUWSA•••

The following graphic and table present the pin assignment of the power cable XZCPB4•P14L••.

Pin	Color	Description	
		XUWSA (standard)	XUWAA (advanced)
1	Brown	+Ub (24 Vdc)	
2	Blue	GND	
3	White	Input (1)	
4	Green	Output: Ready for a new trigger	
5	Pink	-	Input / output (1) (Encoder -)
6	Yellow	-	Input / output (1)
7	Black	Input / output (1)	
8	Gray	Input / output (1)	
9	Red	Output (1)	
10	Purple	Input (1) (Encoder +)	
11	Gray/pink	Output: Valid new results are available	
12	Red/blue	Output (1) 100 mA	

Pin	Color	Description	
		XUWSA (standard)	XUWAA (advanced)
(1) Configurable digital inputs / outputs **NOTE:** All inputs and outputs can be selected as PNP or NPN type.			

For more information, refer to :

- XUWSA••• Vision Sensors - Standard, User Manual, EIO0000001325
- XUWAA••• Vision Sensors - Advanced, User Manual, EIO0000001328

OsiSense Industrial Sensors - Hardware

Front View

OsiSense industrial sensors product range

Description

Under the Telemecanique Sensors brand, the latest innovations in the field of sensors for industrial detection operations are offered.

The OsiSense product range consists of safety and limit switches, pressure control sensors, ultrasonic sensors, inductive and capacitive proximity sensors, and so on.

For more information, refer to Detection for automation solutions OsiSense, MKTED210041EN.

Chapter 5
Communication Topology and Wiring Guide

What Is in This Chapter?

This chapter contains the following sections:

Section 5.1
Introduction to System Communication

Introduction

Overview

The TVDA (Tested Validated Documented Architecture) includes three different communication networks.

- Ethernet 1
  The Ethernet 1 interface of the M251 controller is equipped with an embedded 2-port Ethernet switch and is used to connect the controller to a LAN (Local Area Network). This way the remote access to the controller via the LAN is provided.
- Ethernet 2
  The Ethernet 2 interface of the M251 controller is used to connect the controller to the device network of the architecture. The device network links all devices with Ethernet connectivity in the architecture. The network structure combines star topology and daisy-chain topology.
  The Ethernet network is the physical layer for the communication protocols used in this architecture.
  The SoMachine network protocol is used for the communication between the controller and the Magelis touch-panel HMI GTO.
  The Modbus TCP and the EtherNet/IP protocol are used as fieldbus in the architecture and the Modicon M251 Logic Controller is defined as Modbus TCP master and as EtherNet/IP originator. The Altivar 32 and Altivar 71 variable speed drives, the Lexium 32M and ILx drives, the OsiSense XGCS and XUW sensors, and the Preventa XPSMCM Modular Safety Controller are EtherNet/IP targets. The Harmony wireless access point is Modbus TCP slave.
- Modbus SL
  The Modbus SL RS-485 2-wire network is used for the communication between the Modicon M251 Logic Controller (master) and the energy meter iEM3150 (slave).

Section 5.2
Ethernet Network

What Is in This Section?

This section contains the following topics:

Network Planning and Installation

Overview

The controller TM251MESE is equipped with two independent Ethernet interfaces. This allows you to link the controller to two different networks. Usually, the Ethernet 1 interface is used to link the controller to the control network, such as a manufacturing execution system. The Ethernet 2 interface of the controller is dedicated for the device network of the architecture.

In contrast to Ethernet 1 interface, the Ethernet 2 interface supports additional features like **Modbus TCP IOScanner**, **EtherNet/IP IOScanner**, and **DHCP Server**, which are tools for the realization of an industrial Ethernet network at the machine level; that is, as a fieldbus network. These features are contained within the **Industrial Ethernet Manager** in the **Devices tree** in SoMachine.

For more information, refer to :

- Modicon M251 Logic Controller, Programming Guide, EIO0000001462.
- SoMachine Industrial EtherNet, User Guide, EIO0000002215

Transparency

The controller TM251MESE supports IP Forwarding between the Ethernet 1 network and the Ethernet 2 network. Therefore a PC connected to the Ethernet 1 network is able to access to the devices linked to the Ethernet 2 network.

A precondition for IP Forwarding is that the PC has the correct IP routes defined. For example, you can set the gateway in the Ethernet settings of the PC to those defined for the Ethernet 1 interface. In addition, the devices on the Ethernet 2 network must use the IP address of the Ethernet 2 interface of the target controller as gateway address.

Security Parameters

The controller TM251MESE supports numerous features related to the cyber security. The different protocols supported by the controller can be enabled or disabled in the Ethernet configuration.

In addition, a configurable firewall can be activated for the controller. The firewall helps to protect the controller on the network by blocking unauthorized access while permitting authorized access. The firewall is configured via a script file. The script file can be stored on the controller or on the SD card of the controller.

Network Planning

Define Ethernet 1 network

In this architecture, the Ethernet 1 interface is used to link the controller to the control network. The Ethernet setting for the Ethernet 1 interface of the controller are defined by the administrator of the control network.

Define Ethernet 2 network

The Ethernet 2 network is an independent, local network and has only few nodes.

Essential steps for the planning of the device network:
- Define the IP address of the controller.
- Decide whether to use static or served IP addresses for the devices.
- Define the IP addresses of the devices.
- Define the number and type of switches to be used, taking into account the capability of daisy chaining on some devices.
- Define for each device the repetition rate (Modbus TCP) and the RPI (CIP connection) according to your needs and in order to optimize the band width of the network.

NOTE: Each daisy chain link introduces 20 µs delay of the frames.

Test Installation and IP Address Assignment

After installation and configuration, verify your installation:
- Verify the correct installation of the network.
- Verify the Ethernet state LEDs on all network devices.
- Connect a PC with a compatible IP address to the network and verify the IP addresses for each device using a ping service. (Remote ping service is available on the Web server of the M251 controller).

Carefully manage the IP addresses because each device on the network requires a unique address. Having multiple devices with the same IP address can cause unintended operation of your network and associated equipment.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

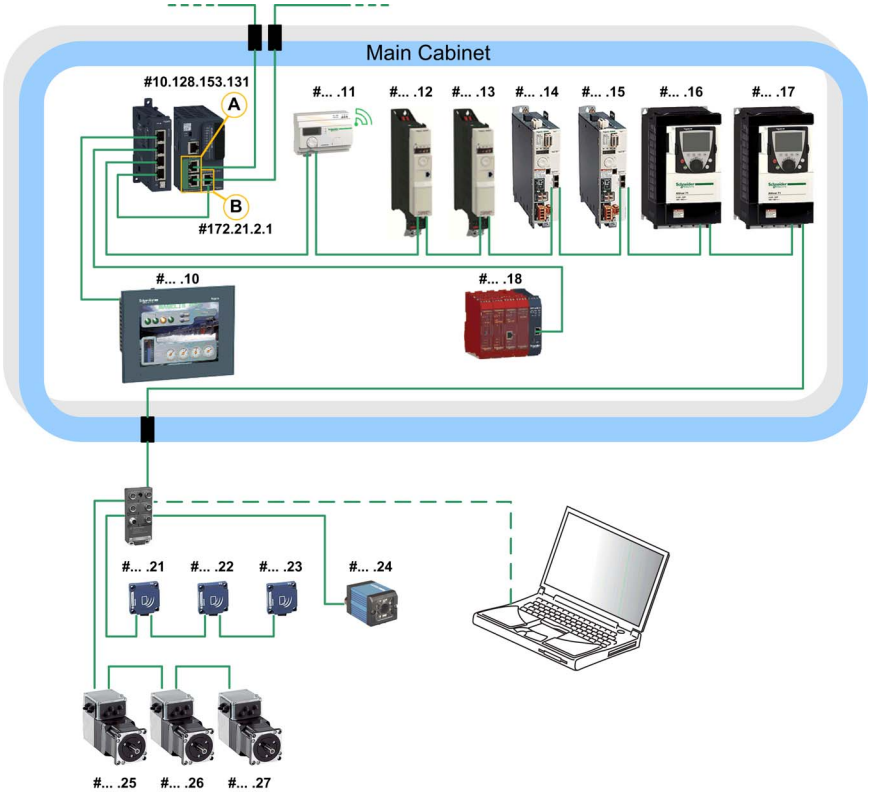
- Verify that there is only one master controller configured on the network or remote link.
- Verify that all devices have unique addresses.
- Obtain your IP address from your system administrator.
- Confirm that the IP address of the device is unique before placing the system into service.
- Do not assign the same IP address to any other equipment on the network.
- Update the IP address after cloning any application that includes Ethernet communications to a unique address.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

NOTE: Verify that your system administrator maintains a record of all assigned IP addresses on the network and subnetwork, and inform the system administrator of all configuration changes performed.

Ethernet Network Topology

Ethernet Topology



#... IP address - the first 3 digits are always 172.21.2
A Ethernet 1 interface - linked to the factory network
B Ethernet 2 interface - fieldbus architecture and HMI communication

The subnet mask for Ethernet 1 is 255.255.255.0.

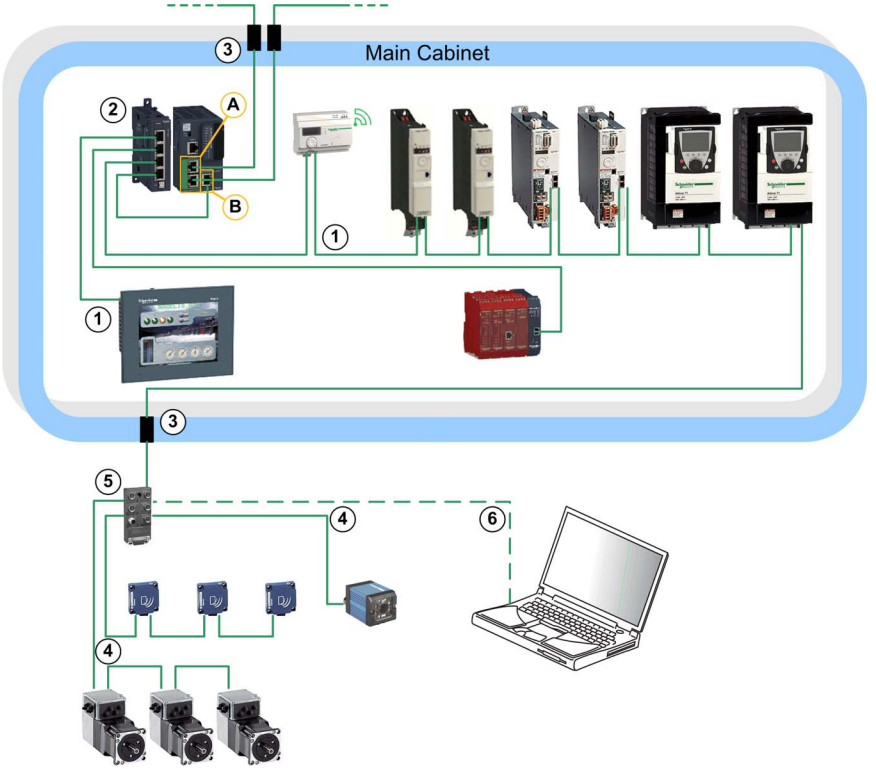
The subnet mask for Ethernet 2 is 255.255.255.0.

Optionally a PC with compatible Ethernet settings can be linked to the Ethernet 2 network for commissioning and monitoring.

Thanks to the capability of the IP forwarding on the M251 controller, you also have access to Ethernet 2 network from a PC which is linked to Ethernet 1 network (refer to Transparency *(see page 136)*).

Ethernet Wiring

Overview Ethernet



A Ethernet 1 interface - linked to the factory network
B Ethernet 2 interface - fieldbus architecture and HMI communication

For more information, refer to Transparent Ready, User Guide, 31006929.

Wiring Accessories

Reference	Designation	Description	Position	Cable length
VW3E3001R005	Ethernet patch cable - shielded twisted-pair straight cord	One RJ45 connector at each end	1	0.5 m (1.64 ft)
VW3E3001R010				1.0 m (3.28 ft)
VW3E3001R020				2.0 m (6.56 ft)
VW3E3001R030				3.0 m (9.84 ft)

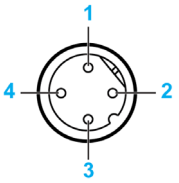
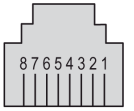
Reference	Designation	Description	Position	Cable length
TCSEAAF11F13F00	ConneXium M12 to RJ45 Ethernet adapter	Adapter for panel mounting	3	-
TCSECL1M1M1S2	Ethernet patch cable - shielded twisted-pair straight cord	One IP 67, M12, 4-pin (D-coded) connector at each end	4	1.0 m (3.28 ft)
TCSECL1M1M3S2				3.0 m (9.84 ft)
TCSECL1M1M10S2				10.0 m (32.8 ft)
TCSECL1M1M25S2				25.0 m (82 ft)
TCSECL1M1M40S2				40.0 m (131.2 ft)
TCSECL1M3M3S2	Ethernet patch cable - shielded twisted-pair straight cord	One IP 67, M12, 4-pin (D-coded) connector and one RJ45 connector	6	3.0 m (9.84 ft)

Switches

Reference	Designation	Description	Position
TM4ES4	Modicon Ethernet TCP/IP unmanaged switch	4 x 10/100BASE-TX ports (copper cable), RJ45 shielded connectors	2
TCSESU053FN0	ConneXium Ethernet TCP/IP unmanaged switch	5x 10BASE-T/100BASE-TX ports (copper cable), RJ45 shielded connectors	5

ConneXium Ethernet Adapter

TCSEAAF11F13F00

M12 connector (D-Coded)	M12 pin	Signal	Description	RJ45 pin	RJ45 connector
	1	TD+	Transmit data +	1	
	2	RD+	Received data +	3	
	3	TD-	Transmit data -	2	
	4	RD-	Received data -	6	
	-	-	Not connected	4	
	-	-	Not connected	5	
	-	-	Not connected	7	
	-	-	Not connected	8	

ConneXium Ethernet Cable

TCSECL1M1MxxS2

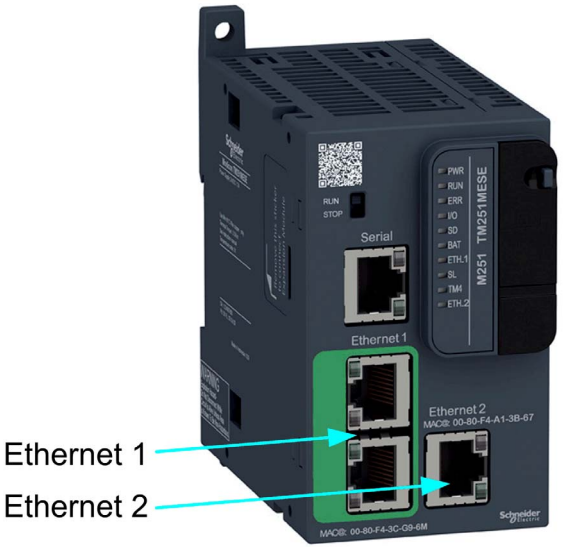
M12	Signal	Signal	M12
1	TD +	TD +	1
3	TD –	TD –	3
2	RD +	RD +	2
4	RD –	RD –	4

TCSECL1M3MxxS2

M12	Signal	Signal	RJ45
1	TD +	TD +	1
3	TD –	TD –	2
2	RD +	RD +	3
4	RD –	RD –	6

Modicon M251 Logic Controller - Ethernet Wiring

Ethernet Interfaces TM251MESE



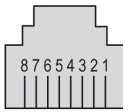
Characteristic	Description
Standard	Ethernet
Connector type	• Ethernet 1: Embedded dual port RJ45 Ethernet switch • Ethernet 2: RJ45
Bit rate	Supports Ethernet "10BaseT" and "100BaseTX" with auto-negotiation
Automatic cross-over	MDI / MDIX
Services supported	Ethernet 1 and Ethernet 2: • Modbus TCP client/server • EtherNet/IP device • FTP server • Web server • SNMP • Modbus TCP slave device • IEC VAR ACCESS For Ethernet 2 only: • Modbus TCP IOScanner • EtherNet/IP originator • DHCP server • Fast Device Replacement (FDR) server

Characteristic	Description
IP address negotiation type supported	• DHCP • BOOTP • Fixed IP
Power over Ethernet	No

For more information, refer to Modicon M251 Logic Controller, Hardware Guide, EIO0000001486.

Pin Assignment

RJ45 Ethernet connector



RJ45 pin	Signal	Description
1	TD+	Transmit data +
2	TD-	transmit data -
3	RD+	Received data +
4	-	No connection
5	-	No connection
6	RD-	Received data -
7	-	No connection
8	-	No connection

NOTE: The controller supports the MDI/MDIX auto-crossover cable function. It is not necessary to use special Ethernet crossover cables to connect devices directly to this port (connections without an Ethernet hub or switch).

Altivar 32 Variable Speed Drive - Ethernet Wiring

Overview

For the operation via Modbus TCP or EtherNet/IP, the Altivar 32 has been equipped with the dual port Ethernet communication module VW3 A3616.

In addition to the communication services provided by each protocol, the VW3 A3616 provides a set of common services at the Ethernet and TCP/IP level.

The VW3 A3616 also provides an embedded web server which offers monitoring and commissioning functions directly from a web browser.

Altivar 32 with dual port Ethernet communication module (VW3 A3616)

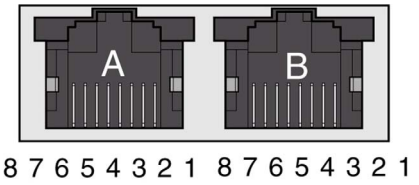
VW3 A3616 option cards, with 1.2IE01 or greater version of firmware, are compliant with Altivar 32.

NOTE: Verify the firmware version on the packaging label (on the right part of the label).

For more information, refer to Altivar 32 Variable speed drives for synchronous and asynchronous motors, Modbus TCP - EtherNet/IP, Communication Manual, S1A28701.

Pin Assignment

The VW3 A3616 option card is equipped with 2 RJ45 female sockets for the Ethernet connection.



The table describes the pin out of each RJ45 female socket.

Pin	Signal	Description
1	TX+	Ethernet transmit line +
2	TX-	Ethernet transmit line -
3	RX+	Ethernet receive line +
4	No connection	Not connected
5	No connection	Not connected
6	RX-	Ethernet receive line -
7	No connection	Not connected
8	No connection	Not connected

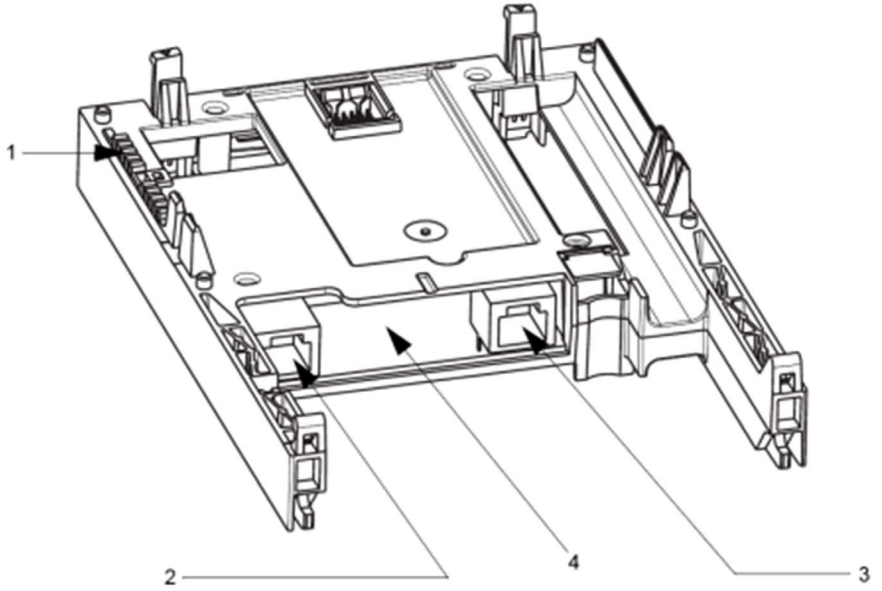
Communication Settings

The configuration of the devices used in this architecture is described in the *System Setup* chapter.

Altivar 71 Variable Speed Drive - Ethernet Wiring

Overview

For the operation via EtherNet/IP, the Altivar 71 is equipped with the dual port Ethernet communication card VW3 A3316.



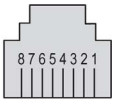
1 LEDs
2 Shielded female RJ45 connector, port 2
3 Shielded female RJ45 connector, port 1
4 Label with the MAC address

NOTE: This communication option card is supported by version V1.6IE19 (or later) of the Altivar 71.

For more information, refer to Altivar 61/71 EtherNet/IP card – User manual, AAV68822 (ENG).

Pin Assignment

The VW3 A3616 option card is equipped with 2 RJ45 female sockets for the Ethernet connection.



The following table describes the pin out of each RJ45 female socket.

Pin	Signal	Description
1	TX+	Ethernet transmit line +
2	TX-	Ethernet transmit line -
3	RX+	Ethernet receive line +
4	No connection	Not connected
5	No connection	Not connected
6	RX-	Ethernet receive line -
7	No connection	Not connected
8	No connection	Not connected

Communication Settings

The configuration of the devices used in this architecture is described in the *System Setup* chapter *(see page 198)*.

Lexium 32M Servo Drive - Ethernet Wiring

Overview

For the operation via Modbus TCP or EtherNet/IP, the Lexium 32M has been equipped with the dual port Ethernet communication module VW3 A3616.

In addition to the communication services provided by each protocol, the VW3 A3616 provides a set of common services at the Ethernet and TCP/IP level.

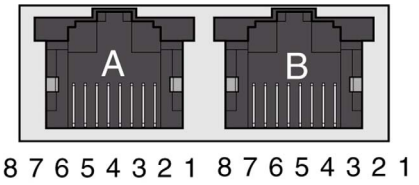
The VW3 A3616 also provides an embedded web server which offers monitoring and commissioning functions directly from a web browser.

Lexium 32M with dual port Ethernet communication module (VW3 A3616)

For more information, refer to LXM32M, Modbus-TCP module, Fieldbus manual, 0198441113843.

Pin Assignment

The VW3 A3616 option card is equipped with 2 RJ45 female sockets for the Ethernet connection.



The table describes the pin out of each RJ45 female socket.

Pin	Signal	Description
1	TX+	Ethernet transmit line +
2	TX-	Ethernet transmit line -
3	RX+	Ethernet receive line +
4	No connection	Not connected
5	No connection	Not connected
6	RX-	Ethernet receive line -
7	No connection	Not connected
8	No connection	Not connected

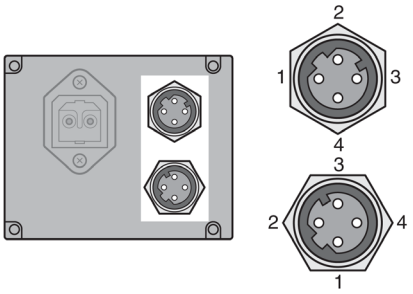
Communication Settings

The configuration of the devices used in this architecture is described in the *System Setup* chapter.

Lexium ILx2K - Ethernet Wiring

Pin Assignment

In this architecture, the device version with a cover with industrial connectors is used. This version provides 2 female M12 connectors on the cover for the connection to the Ethernet fieldbus.



The following table describes the pin out of each RJ45 female socket.

Pin	Signal	Description
1	TX+	Ethernet transmit line +
2	RX+	Ethernet receive line +
3	TX-	Ethernet transmit line -
4	RX-	Ethernet receive line -

Communication Settings

There are four different ways of setting the IP address of the drive during booting:

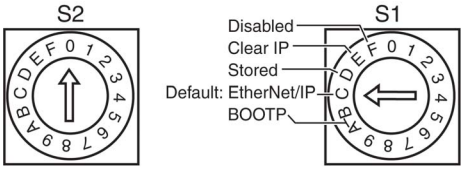
- DHCP address assignment by using a device name
- DHCP address assignment via the MAC address
- Using the IP address from the EEPROM
- Deriving the IP address from the MAC address

There are two interfaces for setting the IP address:

- For basic configuration without software, the device provides 2 rotary switches.
- The commissioning software or the Web server must be used for an extended configuration.

Rotary Switches for Setting the IP Address

There are 2 rotary switches for setting the IP address on the connector board of the drive.



A, B BOOTP
C Default: EtherNet/IP
D Stored
E Clear IP
F Disabled

In the following table, the 2 most commonly used methods for the IP address settings are described.

IP address setting	Function	Valid position S2	Valid position S1
IP address by using the device name	The DHCP server provides an IP address via the device name. The device name of the drive is given by the fixed string `Lexium-ILx-` and an adjustable 3-digit number. This number results from the setting of the 2 rotary switches S1 and S2 (number = 10*S2 + S1). For example, with the setting S2 = 2 and S1 = 5 the resulting device name is `Lexium-ILx-025`.	0...F	0...9
Using the IP address from the EEPROM	The IP parameters stored in the EEPROM are used. The default IP address is 192.168.100.10. By this address, the commissioning PC can be connected to the Web server to adjust the IP parameters with respect to the application needs.	Any	D

For more information, refer to :

- ILA2K EtherNet/IP Lexium Integrated Drive, Product manual, 0198441113670.
- ILE2K EtherNet/IP Lexium Integrated Drive, Product manual, 0198441113676.
- ILS2K EtherNet/IP Lexium Integrated Drive, Product manual, 0198441113682.

The configuration of the devices used in this architecture is described in the chapter System Setup *(see page 204)*.

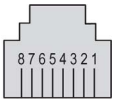
Preventa XPSMCMCO0000EI• Module - Ethernet Wiring

Overview

In order to realize the data exchange with the Preventa XPSMCM• Modular Safety Controller via EtherNet/IP fieldbus the safety controller system needs to be equipped with the fieldbus expansion module for EtherNet/IP (XPSMCMCO0000EI•).

The module is equipped with a single RJ45 female socket for the Ethernet connection on the front plate.

Pin Assignment



The following table describes the pin out of each RJ45 female socket.

Pin	Signal	Description
1	TX+	Ethernet transmit line +
2	TX-	Ethernet transmit line -
3	RX+	Ethernet receive line +
4	No connection	Not connected
5	No connection	Not connected
6	RX-	Ethernet receive line -
7	No connection	Not connected

Pin	Signal	Description
8	No connection	Not connected

Communication Settings

The fieldbus expansion module must be configured using the BUS Configurator software, part of the install package for SoSafe Configurable software.

The configuration of the devices used in this architecture is described in the *System Setup* chapter *(see page 207)*.

Magelis HMI GTO5310 - Ethernet Wiring

Ethernet Port

The Ethernet connection is used for the communication between the controller and the HMI. The Magelis panel HMI GTO provides an RJ45 port for Ethernet TCP/IP link, 10BASE-T/100BASE-TX with an activity LED to communicate with the controller and the PC.

1 RJ45 connector

OsiSense XGCS850 RFID - Ethernet Wiring

Overview

The OsiSense XG Smart Antenna is equipped with a built-in unmanaged 2-port Ethernet switch comprising two female 4-pin D-coded M12 connectors. This allows you to use the network topology that meets your application needs.

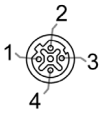
These topologies include the following:

- Star
- Daisy-chain
- Ring (daisy-chain with loopback)
- Combination of star and daisy-chain

For more information, refer to RFID OsiSense XG, Ethernet Smart Antenna, User Manual, EIO0000001601.

Pin Assignment

The figure shows the pin assignments of the two Ethernet network connectors on the module.



Pin	Signal	Description
1	TX+	Ethernet transmit line +
2	RX+	Ethernet receive line +
3	TX-	Ethernet transmit line -
4	RX-	Ethernet receive line -

Communication Settings

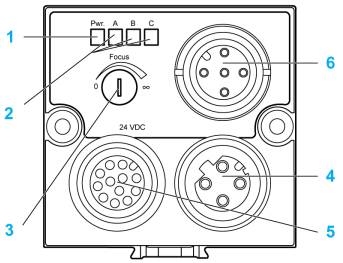
The configuration of the devices used in this architecture is described in the *System Setup* chapter.

OsiSense XUW - Ethernet Wiring

Overview

The OsiSense XUW vision sensor is equipped with a single M12 female Ethernet connector. The Ethernet connection is used for configuration and monitoring of the sensor through the XUW software on a PC. Furthermore the Ethernet connection is used for monitoring and control functions from the controller application via EtherNet/IP.

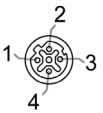
The following graphic shows the electrical connection on the rear of the XUWAA••• sensor.



1 Operating LED
2 Output LEDs
3 Focus adjustable
4 M12 socket, Ethernet port
5 Power supply and digital I/O M12 connector
6 M12 plug, data (RS422) - not available on standard version XUWSA•••

Pin Assignment

The figure shows the pin assignments of the M12 female Ethernet connector on the module.



Pin	Signal	Description
1	TX+	Ethernet transmit line +
2	RX+	Ethernet receive line +
3	TX-	Ethernet transmit line -
4	RX-	Ethernet receive line -

Communication Settings

The IP parameter of the sensor must be configured using the XUW software.

The configuration of the device used in this architecture is described in the *System Setup* chapter *(see page 218)*.

Harmony ZBRN1 Access Point - Ethernet Wiring

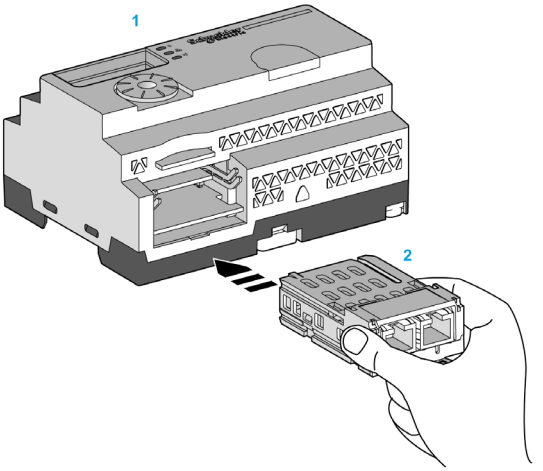
Ethernet Port

The Ethernet connection is used to exchange data between several devices connected together on a network.

The ZBRN1 access point is equipped with a plugged-in ZBRCETH communication module which provides 2 RJ45 plugs.

The communication module supports the Ethernet Modbus/TCP protocol.

It enables daisy chain wiring between devices without using a switch.



1 ZBRN1 access point
2 ZBRCETH communication module with 2 RJ45 plugs

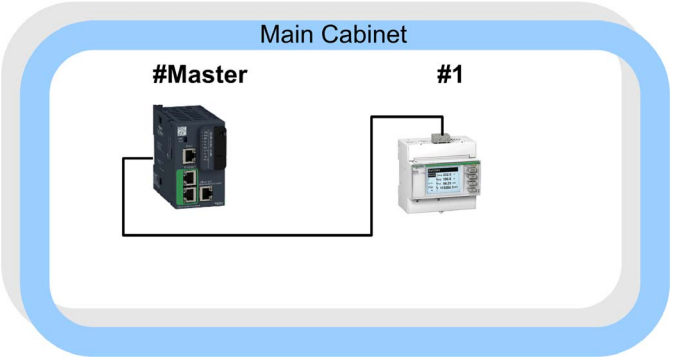
Section 5.3
Modbus Serial Line Network

What Is in This Section?

This section contains the following topics:

Modbus SL Network Topology

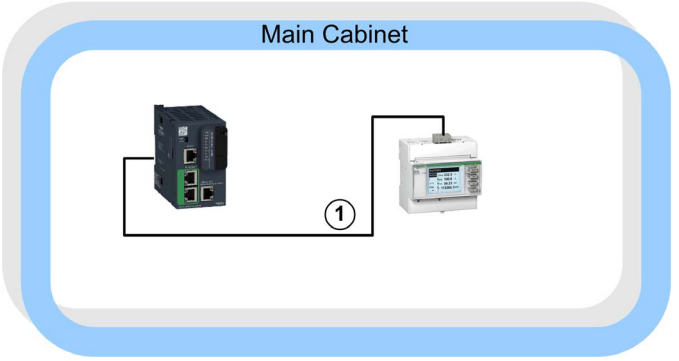
Modbus SL Topology



#... Slave address

Modbus SL Wiring

Modbus SL Overview



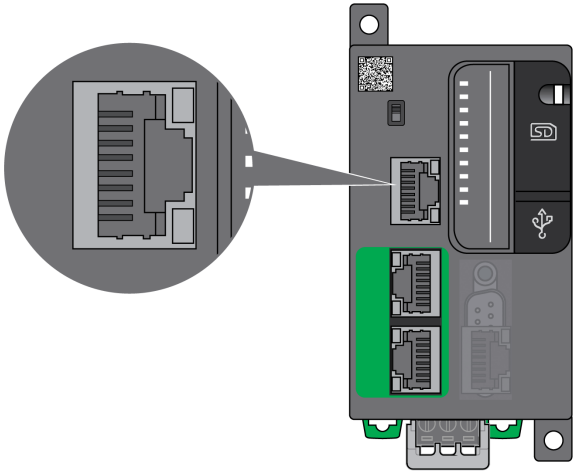
For more information, refer to Modbus Serial Line, Planning and Installation Guide, 33003925.

Cable

Reference	Designation	Description	Position	Cable length
VW3A8306D30	Modbus SL drop cable	1 RJ45 connector and one end stripped	1	3.0 m (9.8 ft)

Modicon M251 Logic Controller - Modbus SL Wiring

Modbus SL Port (Serial Line)



The serial line

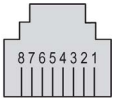
- is used to communicate with devices supporting the Modbus protocol as either master or slave, ASCII protocol (printer, modem...), and SoMachine protocol (HMI,...)
- provides a 5 Vdc power distribution

For more information, refer to Modicon M251 Logic Controller, Hardware Guide, EIO0000001486.

Pin Assignment

For this architecture, the port is configured as an RS-485.

Pins for RS-485 and RS-232



Pin	Signal RS-485	Signal RS-232	Description
1	-	RxD	RS-232: Receive data line
2	-	TxD	RS-232: Transmit data line
3	-	-	-
4	D1	-	Modbus SL: D1 (+/B) RS-485 2-wire
5	D0	-	Modbus SL: D0 (-/A) RS-485 2-wire

Pin	Signal RS-485	Signal RS-232	Description
6	-	-	-
7	VP5S	-	Power over Modbus SL: 5 V / max. 200 mA supply
8	SNG	Common	Modbus SL signal ground / reference to VP5S

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Do not connect wires to unused terminals and/or terminals indicated as “No Connection (N.C.)”.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Communication Settings

The Modbus SL port of the controller has to be configured within SoMachine.

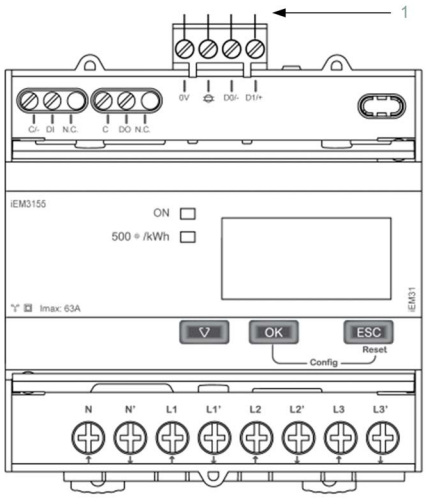
- Baud rate: 19.2 kbps
- Parity: even
- Stop bit: 1
- Physical medium: Modbus SL RS-485 2-wire

Line Polarization

Line polarization is provided by the controller.

iEM31xx Energy Meter - Modbus SL Wiring

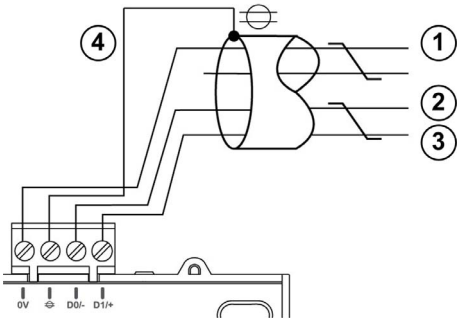
Modbus SL Port



1 Modbus SL RS-485 2-wire port

For more information, refer to iEM3100 series / iEM3200 series, Energy Meters, User Manual, DOCA0005EN.

Pin Assignment



Item	Signal	Description
1	SNG	Modbus SL signal ground
2	D0	Modbus SL: D0 (-/A) RS-485 2-wire

Item	Signal	Description
3	D1	Modbus SL: D1 (+/B) RS-485 2-wire
4	SHLD	Modbus SL shield

Communication Settings

The Modbus SL port of the energy meter has to be configured via the local HMI on the front.

Chapter 6
Implementation

What Is in This Chapter?

This chapter contains the following sections:

Section 6.1
Software Requirements

Software Requirements

Overview

The software required to open and to edit the project template is SoMachine V4.1 SP2 or later.

NOTE: The SoMachine V4.1 SP2 software is only an update package and requires a previously installed SoMachine V4.1 SP1 on your PC.

The following components must be installed together with SoMachine:

- SoMachine components
  - SoMachine Logic Builder
  - Vijeo-Designer
  - Gateway
- Auxiliary tools
  - Controller assistant
- Controllers
  - TM251MESE
- Devices
  - Altivar (DTM)
  - Harmony (DTM)
  - Lexium (DTM)
- Repository
  - Optimized repository
- Documentation
  - Tested, Validated and Documented Architecture, including TVDA for EtherNet/IP

The SoMachine Configuration Manager, which is part of the SoMachine installation, allows you to verify the current installation. In addition you can add, remove, or update components of your SoMachine installation.

Additional software required:

- SoSafe Configurable V1.5.0 or later has to be used to program and commissioning the Preventa XPSMCM Modular Safety Controller system.
- XUW PC software V1.7.10.1 or later has to be used to configure and monitor the OsiSense XUW vision sensor.

Optional software:

- SoMove Build 2.2 for extended configuration and monitoring of the Altivar, Altistart and Lexium (except Lexium ILx) devices
- Lexium CT V1.4 or later for extended configuration and monitoring of the integrated drives Lexium ILA, ILE and ILS
- IP Recovery tool V2.3 or later for recovering the IP parameters of an OsiSense XGCS RFID smart

Section 6.2
Access the SoMachine Project Template

Access the SoMachine Project Template

Overview

The SoMachine project related to the described architecture is available in terms of a project template.

It is tested and validated and includes the complete and executable application with program code and device configurations.

Also part of the SoMachine project is the Vijeo-Designer application which is ready to run on the defined Magelis panel for this architecture.

You can use the project template as basis for your own application.

Procedure

You can access the project template as described below.

Step	Action
1	Launch SoMachine. The **Get started** dialog box of SoMachine Central is displayed.
2	Click **New**. The **New Project** dialog box is displayed.
3	Click **Templates**. The **New Project Assistant - Templates** dialog box is displayed.
4	Enter a **Project Name** of your choosing.
5	Select a template from the list. The template that you choose will have the same name as the title of the present document.
6	Click the **Create Project** button. A new project based on the selected template is opened in SoMachine Logic Builder.
7	Now you can adapt *(see page 222)* your new project according to your requirements.

Section 6.3
Project

What Is in This Section?

This section contains the following topics:

Controller

Overview

The controller in this architecture is the TM251MESE. The mandatory settings for the controller are described below. The parameter values depicted in this document relate to the template project and the test equipment used during development.

For more information about the Ethernet settings, refer to the document Modicon M251 Logic Controller, Programming Guide, EIO0000001462.

Ethernet 1

The Ethernet 1 network in this architecture is used to connect the controller to a LAN (Local Area Network), for example the control network.

The Ethernet settings for the Ethernet 1 interface in this architecture are:

- Fixed IP address
  - IP address: 10.128.153.131
  - Subnet mask: 255.255.255.0

The default settings for the network security parameters have been retained (all services and protocols enabled). You need to decide, according to your network security needs, which services and protocols must be disabled.

Ethernet 2

The Ethernet 2 network on the M251 controller is defined for the device network. All Ethernet devices of this architecture like HMI, drives, sensors, and I/O devices are linked to the Ethernet 2 network.

The Ethernet settings for the Ethernet 2 interface in this architecture are:

- Fixed IP address
  - IP address: 172.21.2.1
  - Subnet mask: 255.255.255.0

The default settings for the network security parameters have been retained (all services and protocols enabled). You need to decide, according to your network security needs, which services and protocols must be disabled.

The Ethernet 2 interface supports a DHCP server. Via the corresponding check box in the device editor of the Ethernet 2 interface, the DHCP server can be disabled. In this application, the DHCP server is enabled because some of the network devices are configured in this mode. If the DHCP server is enabled, the use of fixed IP addresses is not suppressed, but if so, each device that is added under the Ethernet **Network Manager** in the **Devices tree** has the DHCP mode enabled by default.

Industrial Ethernet Manager

The DHCP server and the fieldbus communication with the network devices in the device network is managed through the **Industrial Ethernet manager**. Therefore it is added under the Ethernet 2 interface of the controller in the **Devices tree**.

Scanner Settings

On the tab **Scanner Settings**, various parameters can be adjusted.

The preferred protocol in this architecture is **Ethernet/IP**. The preferred protocol determines the type of protocol used for a device when added to the fieldbus using the drag-and-drop function from the catalog.

The timeout for the explicit messaging is set to 3 s for connected messages and 10 s for unconnected messages.

Network Manager

On the tab **Network Manager**, the network devices configured in the device network are listed. This is a central place to manage the IP configuration of the network devices. Although this is the central place to manage IP configuration, you can also modify IP configuration information in the **Device Editor** of the device. The settings on the devices are updated with the settings which were modified in the **Network Manager** and conversely with the **Device Editor**.

Scanner Resources

On the tab **Scanner Resources**, the resources used by the configuration are summarized. Based on the resources used, the total load for the **Industrial Ethernet manager** can be calculated.

The values for this application are listed below:

- EtherNet/IP scanner resources
  - Number of connections configured: 14/16
  - Input words: 390/1024
  - Output words: 299/1024
- Modbus TCP scanner resources
  - Number of channels configured: 1/64
  - Input words: 4/2048
  - Output words: 0/2048
- Industrial Ethernet scanner load: 61%

Serial Line

The serial line in this architecture is used for the communication between the controller and the energy meter. Therefore, a Modbus manager has been added, via the template you used to create the application, under the serial line interface of the controller.

The serial line settings for this architecture are:

- Baud rate: 19200
- Parity: even
- Data bits: 8

- Stop bits: 1
- Physical medium:
  - Modbus SL RS-485 2-wire
  - Polarization resistor: No

The configuration of the Modbus manager is:

- Transmission mode: RTU
- Addressing: Master
- Time between frames: 10 ms

HMI

Overview

The HMI used in this architecture is the Magelis HMI GTO 4310. The mandatory settings for the HMI devices are described below. The parameter values depicted in this document relate to the template project and the test equipment used during development.

Ethernet

The communication between the HMI and the controller is realized via an Ethernet connection using the SoMachine network protocol. Therefore, the HMI is also linked to the device network of the system but, in contrast to the other network devices the HMI is not configured on the controller.

The Ethernet settings for the panel HMI GTO 4310 are:

- Fixed IP address
  - IP address: 172.21.2.10
  - Subnet mask: 255.255.255.0
  - Gateway address: 172.21.2.1

For the other parameters, the default settings have been kept.

I/O Manager

The communication between HMI and controller is realized via SoMachine network protocol based on Ethernet.

The SoMachine network driver on the panel accesses variables in the controller by a defined reference. Therefore, the node name (equipment address) of the connected controller must be set in the SoMachine network configuration dialog in Vijeo-Designer.

The node name of the controller is per default a combination of controller type and MAC address, you can change it to a user-defined name (for example: *machine 1*).

In this application, the default node name of the controller has been set within the Vijeo-Designer configuration.

Usually the node name of the controller is added automatically to configuration in **Vijeo Designer** once the controller has been selected in the **Controller Selection** tab in SoMachine. If not, or if the node name has been modified, the node name can be obtained in the **Controller Selection** tab in SoMachine and must be added manually in **Vijeo Designer**.

For more information about the SoMachine network driver, refer to the document Magelis XBT GC/XBT GK/XBTGT, SoMachine - Combo and Network Drivers, EIO00000000219 (ENG).

Devices

Overview

In this chapter, the devices configured within the SoMachine project are described.

TM3 I/O Expansion Modules

The controller provides the possibility to expand the embedded I/Os by adding TM3 expansion modules to the controller.

The expansion modules must be configured within the SoMachine project.

In this architecture, the following modules were added to the TM3 bus (IO_Bus).

Module name	Module type	Comment	Configuration
Module_1	TM3DI16	16-channel, 24 Vdc digital input expansion module, with 1 common line	Default
Module_2	TM3DQ16T	16-channel, 0.5 A/24 Vdc source transistor outputs expansion module, with 1 common line	Default

For more information, refer to Modicon TM3, Expansion Modules Configuration, Programming Guide, EIO0000001402.

Energy Meter iEM3150

The architecture implements one energy meter of type iEM3150 for energy measurement. The energy data are read from the device via Modbus serial line.

The device itself is not configured in the application. The Modbus communication is realized by system functions as part of the function block `FB_PowerMeter` out of the **ModbusEnergyEfficiencyToolbox** library.

The program code to read and to process the data of the energy meter was created in the application by adding the Device Module MED_iEM3150_ModbusSL which is represented as a function template within the **TVDA Device Module Library**.

The Modbus slave address and the network ID must be assigned by an initial value to the associated variables (`CONSTANT`). The assignment of the values can be done directly within the **Add Function From Template** dialog box. It can also be done later in the declaration part of the associated program (**POU**) after the template was added to the application.

Harmony ZBRN1

The architecture implements one Harmony wireless access point of type ZBRN1. The ZBRN1 receives the signals from the wireless and batteryless push-buttons and provides these in four 16-bit registers. The registers are read from the device via Modbus TCP.

The Harmony ZBRN1 must be configured within the SoMachine project. Therefore, the device ZBRN1 was added under the **Industrial Ethernet manager**.

The device was added using the Device Module Harmony_Wireless_ModbusTCP_2, which is represented as a function template within the **TVDA Device Module Library**.

The name of the device corresponds with the name which was assigned within the **Add Function From Template** dialog box.

The device is preconfigured, so the only configuration is the selection of the IP address what can be done directly within the **Add Function From Template** dialog box. Further settings for the IP parameter dependent to the selected IP mode must be done within the **Network Manager** tab of the **Industrial Ethernet manager**.

The following device was added under the **Industrial Ethernet manager** of the Ethernet 2 interface:

Device name	Configuration
HarmonyWireless_ZBRN1	Fixed IP address: 172.21.2.11

Altivar

The architecture implements four variable speed drives, two of type Altivar 32 and two of type Altivar 71, which are controlled via EtherNet/IP.

These devices must be configured within the SoMachine project. Therefore, the devices were added under the **Industrial Ethernet manager**.

Each device was added using the Device Modules ATV32_EtherNetIP respectively ATV71_EtherNetIP, which are represented as function templates within the **TVDA Device Module Library**.

The name of each device corresponds with the name which was assigned within the **Add Function From Template** dialog box.

The devices are preconfigured, so the only configuration is the selection of the IP address what can be done directly within the **Add Function From Template** dialog box. Further settings for the IP parameter dependent to the selected IP mode must be done within the **Network Manager** tab of the **Industrial Ethernet manager**.

The following devices were added under the **Industrial Ethernet manager** of the Ethernet 2 interface:

Device name	Configuration
ATV32_1	Fixed IP address: 172.21.2.12
ATV32_2	Fixed IP address: 172.21.2.13
ATV71_1	Fixed IP address: 172.21.2.16
ATV71_2	Fixed IP address: 172.21.2.17

Lexium 32M

The architecture implements two servo drives of type Lexium 32M which are controlled via EtherNet/IP.

These devices must be configured within the SoMachine project. Therefore the devices were added under the **Industrial Ethernet manager**.

Each device was added using the Device Module Lexium_32M_EtherNetIP, which is represented as a function template within the **TVDA Device Module Library - EtherNetIP**.

The name of each device corresponds with the name which was assigned within the **Add Function From Template** dialog box.

The devices are preconfigured, so the only configuration is the selection of the IP address what can be done directly within the **Add Function From Template** dialog box. Further settings for the IP parameter dependent to the selected IP mode must be done within the **Network Manager** tab of the **Industrial Ethernet manager**.

The following devices were added under the **Industrial Ethernet manager** of the Ethernet 2 interface:

Device name	Configuration
LXM32_1	IP address: 172.21.2.14
LXM32_2	IP address: 172.21.2.15

In this application, the servo motors controlled by the Lexium 32M servo drives are operated in modulo/endless move. Therefore the limit switches in positive and negative direction are set to inactive. This setting has been done by the user parameters. These parameters are sent to the device each time when the configured CIP connection is started.

The following parameters have been added to the **User Parameter** tab of the Lexium drives:

Line	Name	Class	Instance	Attribute	Datatype	Value	Comment
1	IOsigLIMN	106	1	15	UINT	0	Sets the limit switch for negative direction inactive
2	IOsigLIMP	106	1	16	UINT	0	Sets the limit switch for positive direction inactive

Lexium ILx2K Integrated Drive

The architecture implements three Lexium integrated drives (1x ILA2K, 1x ILE2K and 1x ILS2K) which are controlled via EtherNet/IP.

These devices must be configured within the SoMachine project. Therefore the devices were added under the **Industrial Ethernet manager**.

Each device was added using the associated Device Modules Lexium_ILA2K_EtherNetIP, Lexium_ILE2K_EtherNetIP, or Lexium_ILS2K_EtherNetIP. The Device Modules are represented as function templates within the **TVDA Device Module Library - EtherNetIP**.

The name of each device corresponds with the name which was assigned within the **Add Function From Template** dialog box.

The device is preconfigured, so the only configuration is the selection of the IP address what can be done within the **Add Function From Template** dialog box. Further settings for the IP parameter dependent to the selected IP mode must be done within the **Network Manager** tab of the **Industrial Ethernet manager**.

The following devices were added under the **Industrial Ethernet manager** of the Ethernet 2 interface:

Device name	Configuration
ILA_1	DHCP mode, DHCP Device Name: Lexium-ILx-025, IP Address: 172.21.2.25
ILE_1	DHCP mode, DHCP Device Name: Lexium-ILx-026, IP Address: 172.21.2.26
ILS_1	DHCP mode, DHCP Device Name: Lexium-ILx-027, IP Address: 172.21.2.27

In this application, the Lexium integrated drives are operated in modulo/endless move. Therefore the limit switches in positive and negative direction are set to inactive. This setting has been done by the user parameters. These parameters are sent to the device each time when the configured CIP connection is started.

The following parameters have been added to the **User Parameter** tab of the Lexium integrated drives:

Line	Name	Class	Instance	Attribute	Datatype	Value	Comment
1	IOsigLIMN	106	1	15	UINT	0	Sets the limit switch for negative direction inactive
2	IOsigLIMP	106	1	16	UINT	0	Sets the limit switch for positive direction inactive

OsiSense XGCS

The architecture implements three OsiSense XGCS Smart Antennas which are controlled via EtherNet/IP.

These devices must be configured within the SoMachine project. Therefore the devices were added under the **Industrial Ethernet manager**.

Each device was added using the Device Module OsiSense_RFID_EtherNetIP, which is represented as a function template within the **TVDA Device Module Library - EtherNetIP**.

The name of each device corresponds with the name which was assigned within the **Add Function From Template** dialog box.

The devices are preconfigured, so the only configuration is the selection of the IP address what can be done directly within the **Add Function From Template** dialog box. Further settings for the IP parameter dependent to the selected IP mode must be done within the **Network Manager** tab of the **Industrial Ethernet manager**.

The following devices were added under the **Industrial Ethernet manager** of the Ethernet 2 interface:

Device name	Configuration
OsiSense_XGCS_1	Fixed IP address: 172.21.2.21
OsiSense_XGCS_2	Fixed IP address: 172.21.2.22
OsiSense_XGCS_3	Fixed IP address: 172.21.2.23

OsiSense XUW

The architecture implements an OsiSense XUW vision sensor which is controlled via EtherNet/IP.

The vision sensor must be configured within the SoMachine project. Therefore it is added as a device under the **Industrial Ethernet manager**.

The device was added with the use of the Device Module OsiSense_XUW_EtherNetIP, which is represented as function template within the **TVDA Device Module Library - EtherNetIP**.

The name of the device corresponds with the name which was assigned within the **Add Function From Template** dialog box.

The device is preconfigured, so the only configuration is the selection of the IP address what can be done within the **Add Function From Template** dialog box. Further settings for the IP parameter, dependent to the selected IP mode, must be done within the **Network Manager** tab of the **Industrial Ethernet manager**.

The following device was added under the **Industrial Ethernet manager** of the Ethernet 2 interface:

Device name	Configuration
OsiSense_XUW	Fixed IP address: 172.21.2.24

Preventa XPSMCM Modular Safety Controller

The safety functions in this architecture are realized with the Preventa XPSMCM Modular Safety Controller system. For extended monitor and control functions, the safety controller is linked to the M251 controller via EtherNet/IP.

For the EtherNet/IP communication, the device must be configured in the SoMachine project. Therefore the device was added under the **Industrial Ethernet manager**.

The device was added using the Device Module Preventa_XPSMCM_EtherNetIP, which is represented as a function template within the **TVDA Device Module Library - EtherNetIP**.

The name of the device corresponds with the name which was assigned within the **Add Function From Template** dialog box.

The device is preconfigured, so the only configuration is the selection of the IP address what can be done within the **Add Function From Template** dialog box. Further settings for the IP parameter dependent to the selected IP mode must be done within the **Network Manager** tab of the **Industrial Ethernet manager**.

The following device was added under the **Industrial Ethernet manager** of the Ethernet 2 interface:

Device name	Configuration
SafetyCtrl_XPSMCM	Fixed IP address: 172.21.2.18

NOTE: The described configuration of the XPSMCM Modular Safety Controller as EtherNet/IP device is compatible for the use of the fieldbus expansion module XPSMCMCO0000EI• with firmware version 1.8 or later. In case you use a module with an earlier firmware version contact your local Schneider Electric representative.

Application

Library Manager

The library manager is a standard object of the application. Most of the libraries referenced by the library manager are loaded automatically when adding devices or objects to the application.

Furthermore, SoMachine provides libraries with utility functions for the access to extended features of the controller and/or to assist the user during the realization of the application.

In this example project, the libraries listed in the following table have been added manually to the library manager:

Library name	Comment
SysTimeRtc	Library provides access to the target real-time clock.
Toolbox	Set of utility functions and function blocks complementary to the Standard library and Util library.

Symbol Configuration

The symbol configuration functionality allows you to create symbol names for objects, so that those objects can be accessed from external devices, for example when exchanging variables with an HMI application created with Vijeo-Designer or via the OPC server.

The variables for control and monitor functions on the Magelis HMI were published within the symbol configuration editor. By publishing the variables in SoMachine, they are automatically available for use in the Vijeo-Designer HMI application as SoMachine variables.

For the manual export of the variables, use the command **Export Variables to Vijeo-Designer** from the context menu of the **Symbol Configuration** in the **Tools tree**.

For more information, refer to the following chapters of the SoMachine Programming Guide:
- Symbol Configuration Editor *(see SoMachine, Programming Guide)*
- SoMachine Controller - HMI Data Exchange *(see SoMachine, Programming Guide)*

Task Configuration

The **Task Configuration** defines one or several tasks for controlling the processing of an application program. It is a core resource object for an application that is automatically added to the application node.

In this example application one task is configured:

Task	Type	Comment
MAST	Cyclic: 10 ms	This task includes the program calls related to the Ethernet devices, Modbus SL communication, and general application code.

For more information, refer to Task Configuration Editor *(see SoMachine, Programming Guide)*.

Program Code

The program code, part of the project template you had selected, is divided into several POUs (Program Organization Units) of type program and GVLs (Global Variable Lists).

Each POU is called separately within the associated task.The POUs and GVLs which are related to the devices or functional units were created when adding the Device Modules. They are placed in folders (with the corresponding names) under the **Application** node.

The following folders including the respective POUs and GVLs are available:

- ATV32_1
- ATV32_2
- ATV71_1
- ATV71_2
- iEM3150_MDBSL
- ILA_1
- ILE_1
- ILS_1
- LXM32_1
- LXM32_2
- OsiSense_XGCS_1
- OsiSense_XGCS_2
- OsiSense_XGCS_3
- OsiSense_XUW
- SafetyCtrl_XPSMCM
- ZBRN1

For the general programming part, additional POUs are available. In these POUs, the processing of HMI commands, a summary of information about devices, the communication state, and state of the safety-related functions is realized in relation to the different functional units of the application.

The following POUs are available:

- **Prg_PreProcessing**: This POU is called at the beginning of the task and mainly contains the input mapping.
- **Prg_Alarms**: Processing of alarm management of the system.
- **Prg_Main**: Processing of command signals for the devices (for example, operator push buttons, HMI commands, and so on) and processing of summary information about device and communication state.
- **Prg_PostProcessing**: This POU is called at the end of the task and mainly contains the processing of output signals for tower light, operator push-button lighting, and analog outputs.

Vijeo-Designer

Overview

The HMI application is created with the configuration software Vijeo-Designer, which is integrated in SoMachine.

This architecture implements a Magelis HMI panel.

The application is executed on this panel and provides extensive monitoring and control functions of the architecture.

Start Page

The start page provides general information about the state of the architecture:
- Device state
- Communication state
- State of the safety-related functions

Alarm Page

The alarm page provides detailed alarm messages sorted by time of occurrence.

Ethernet Network Page

The Ethernet network page provides the network topology and the communication state of the Ethernet network devices.

Date and Time Page

The date and time page provides the value of the real time clock on the controller. In addition, it allows you to set the real time clock of the controller and the HMI.

Energy Pages

The energy pages provide information about the energy data of the architecture.

Safety Controller Page

The safety controller page provides:
- Information about the safety-related functions
- Restart of the safety-related function emergency stop
- Request to unlock and succeeding unlock command for the door guard

Device Pages

The device pages provide monitor and control functions for each device grouped by products:
- 4 Altivar pages
- 5 Lexium pages

- 1 OsiSense RFID page
- 1 OsiSense XUW page
- 1 ZBRN1 Wireless page

Chapter 7
System Setup

Overview

This chapter describes the steps necessary to set the architecture in operational mode. It is not intended to replace any specific product documentations or manuals.

The setup procedure depicted in this document is relevant only for the proposed architecture.

Before using any device in this application, perform the following steps:

- Thoroughly read this manual and the respective related documents before running this application.
- Install the drives according to their usage and configure the connected motors.
- Thoroughly verify your installation.
- Set up the communication parameters of the devices.

⚠ WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of control paths and, for certain critical control functions, provide a means to achieve a safe state during and after a path failure. Examples of critical control functions are emergency stop and overtravel stop, power outage and restart.
- Separate or redundant control paths must be provided for critical control functions.
- System control paths may include communication links. Consideration must be given to the implications of unanticipated transmission delays or failures of the link.
- Observe all accident prevention regulations and local safety guidelines.[1]
- Each implementation of this equipment must be individually and thoroughly tested for proper operation before being placed into service.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

[1] For additional information, refer to NEMA ICS 1.1 (latest edition), "Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control" and to NEMA ICS 7.1 (latest edition), "Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems" or their equivalent governing your particular location.

What Is in This Chapter?

This chapter contains the following sections:

Section 7.1
Setup Controller and HMI

Setup Controller and HMI

Overview

Download the applications from the PC to the controller and to the HMI to run the applications.

There are several possibilities to perform the application download:
- Via an USB cable (linked to the integrated mini USB port on the devices).
- With an USB key (linked to the integrated USB port on the HMI).
- Via an SD card (plugged into the SD card slot on the front of the controller).
- Via an Ethernet connection (linked to the Ethernet network).

By using a USB connection or an Ethernet connection between controller and PC, additional features like monitoring of the application in online mode are available.

NOTE: SoMachine V4.1 SP2 and the associated Vijeo-Designer configuration software are required on the PC.

Communication Settings

To set up the communication between controller and HMI, it is mandatory to configure the communication settings in both applications (controller and HMI) using SoMachine and Vijeo-Designer.

To set up an Ethernet communication between controller and HMI, following configurations are mandatory:
- Ethernet configuration of the controller
- Ethernet configuration of the HMI
- Controller equipment address (node name) in the HMI application

To configure these settings, proceed as follows:

Step	Action	Comment
1	In the **Devices tree** of the , double-click the **Ethernet** node of the controller.	The **Ethernet** device editor opens.
2	Configure the Ethernet settings of the controller.	The Ethernet configuration is required to set up a connection between controller and HMI. The two devices have to be in the same sub network.
3	Select **Vijeo-Designer** from the **Quick Toolswitch** list of the overlay bar (refer to , User Guide *(see SoMachine Central, User Guide)*).	The Vijeo-Designer opens in a new window.

Step	Action	Comment
4	In Vijeo-Designer, select the target node in the **Navigators Project** tab.	The target property editor opens.
5	Select **Network** in the target property editor.	The network property editor opens.
6	Click the **...** button for network configuration.	The **Network Configuration** dialog box opens.
7	Perform the Ethernet configuration in the **Network Configuration** dialog box.	The **Network Configuration** dialog box allows the Ethernet configuration for the HMI. The Ethernet configuration is required to set up a connection between controller and HMI. The two devices have to be in the same sub network.
8	Click **OK** to apply the settings.	The Ethernet configuration becomes effective after a download of the application to the HMI.
9	In Vijeo-Designer, double-click **SoM_MyController** under the **I/O Manager → SoMachineNetwork01** node in the **Navigators Project** tab.	The **SoMachine - Network Equipment Configuration** dialog box opens.
10	Set the address of the associated controller in the field **Equipment Address or Node Name**.	The required information is provided in the **Controller selection** tab of the device editor of the controller in if the PC is connected to the controller.

Download Procedure

For the download procedure described in this section, an USB connection between PC and controller is used.

To set up a communication between a controller and a PC via USB, use one of the following cables:
- TCSXCNAMUM3P
- BMXXCAUSBH045

If HMI and controller are successfully connected via the Ethernet network, the HMI application can be transferred to the HMI using the USB connection between PC and controller.

The controller is routing between the mini USB and the Ethernet interface.

Using the established USB connection between PC and controller and the Ethernet connection between controller and HMI, proceed as follows to download the and HMI application.

Precondition for this workflow is a working Ethernet connection between controller and HMI.

Step	Action	Comment
1	Double-click the controller node in the **Devices tree**.	The controller device editor opens.
2	Select the **Controller selection** tab.	The compatible controllers detected by the gateway on the PC are listed.

Step	Action	Comment
3	Double-click a list entry to select a controller.	The selected controller is displayed in bold and the address is displayed at the bottom of the device editor.
4	Double-click the HMI device node in the **Devices tree**.	The HMI device editor opens.
5	Select the **Controller selection** tab.	The compatible HMIs detected by the gateway on the PC are listed.
6	Double-click a list entry to select an HMI.	The selected HMI is displayed in bold and the address is displayed at the bottom of the device editor.
7	Click **Online → Multiple Download...** to download the applications.	The **Multiple Download** dialog box opens. You can choose which application should be downloaded. Using the **Additional operations** a start of all applications after download can be performed.

NOTE: The firmware version of the controller must correspond with the firmware version of the controller in the SoMachine project. If the versions of the devices mismatch, upgrade the version of the controller. The procedure to update the firmware of the controller is described in the SoMachine online help and in the appropriate product guide of your controller.
For the initial download, the HMI requires the latest version of the runtime kernel. This is accomplished by using Vijeo-Designer for the initial download. Alternatively, use the **Runtime Installer** to download the runtime on the HMI.
The **Runtime Installer** is accessible via the tool access bar *(see SoMachine Central, User Guide)* in (**Tool Access Bar → Maintenance → Download Firmware HMI**).

Section 7.2
Setup Other Devices

What Is in This Section?

This section contains the following topics:

Network and Device Parameter Settings

Overview

This section describes the steps required to initialize and configure the different devices required to attain the described system function.

NOTE: If a device has already been configured for some other use, re-establish the factory settings. Instructions on how to do this can be found in the respective documentation.

NOTE: Be sure that the controller is in a STOPPED state before parameterizing the drives.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- Never assume that your controller is in a certain controller state before commanding a change of state, configuring your controller options, uploading a program, or modifying the physical configuration of the controller and its connected equipment.
- Before performing any of these operations, consider the effect on all connected equipment.
- Before acting on a controller, always positively confirm the controller state by viewing its LEDs, confirming the condition of the Run/Stop input (if so configured) and/or the Run/Stop switch (if so equipped), verifying the presence of output forcing, and reviewing the controller status information via SoMachine (1).

Failure to follow these instructions can result in death, serious injury, or equipment damage.

(1) The controller states can be read in the `SEC.PLC_GVL.PLC_R.i_wStatus` system variable of the M251 PLCSystem Library *(see Modicon M251 Logic Controller, System Functions and Variables, PLCSystem Library Guide)*.

Altivar 32 Variable Speed Drive - EtherNet/IP Setup

Overview

To operate the Altivar 32 via EtherNet/IP, the communication parameters have to be set for the device. In addition to this, it is mandatory to set the parameter of the connected motor in the drive. Further configuration settings are dependent on your application and on the installation.

There are several options to configure the drive:

- By the local HMI on the front of the drive
- By a graphic display terminal*
- By a remote display terminal*
- By the configuration software SoMove installed on a PC**
- By the FDT/DTM integrated in SoMachine installed on a PC**
- By the embedded web server of the Ethernet communication module VW3A3616

(* linked to the integrated communication port on the front of the drive)

(** various connection options)

NOTE: If a device has already been configured for some other use, re-establish the factory settings. Instructions on how to do this can be found in the respective documentation.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- Verify that both wiring and mounting are correct before you start to configure the drive.
- Verify that an unintentional start of the connected motor will not endanger personnel or equipment in any way.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

If necessary, disconnect the motor from the drive to prevent an unintentional motor start.

The configurations described in this section are done using the local HMI on the front of the drive.

Basic Configuration

The submenus and parameters listed in the table are accessible via **[CONFIGURATION]** `(COnF)` -> **[FULL]** `(FULL)` menu.

Step	Action	Comment
1	Switch on the power supply.	Do not give a run command to the drive.

Step	Action	Comment
2	Configure the motor parameters under the menu **[Motor Control]** (drc-): • **[Standard mot. freq]** (bFr) • **[Max frequency]** (tFr) • **[Motor control type]** (Ctt)	Refer to the motor rating plate. Values have to be adjusted if the factory settings differ with your application. If the drive shall apply the brake control logic, the parameter **[Motor control type]** (Ctt) has to be set either to [SVC V] (UUC) or [Energy sav.] (nLd).
3	Configure the motor parameters under the menu **[ASYNC. Motor]** (ASY-): • **[Rated motor power]** (nPr) • **[Motor 1 Cosinus Phi]** (COS) • **[Rated motor volt.]** (UnS) • **[Rated motor current]** (nCr) • **[Rated motor freq.]** (FrS) • **[Rated motor speed]** (nSP)	Refer to the motor rating plate. Values have to be adjusted if the factory settings differ with your application.
4	Configure the parameters under the menu **[SETTINGS]** (Set-): • **[Acceleration]** (ACC) • **[Deceleration]** (dEC) • **[Low Speed]** (LSP) • **[High Speed]** (HSP) • **[Mot. Therm. current]** (ItH)	In most cases, the factory settings can be maintained for a quick start. Nevertheless, you have to verify the values.
5	Configure the I/O assignment under the menu **[INPUTS/OUTPUTS CFG]** (I_O-).	The I/O configuration depends on your architecture and the activated application functions of the drive. In most cases, the factory settings can be maintained for a quick start. Nevertheless, you have to verify the values.
6	Configure the command channel under the menu **[COMMAND]** (Ctl-): • **[Ref. 1 channel]]** (Fr1)	If the drive is operated via Modbus TCP, the parameter **[Ref. 1 channel]** (Fr1) has to be set to **[Com. card]** (nEt).
7	Set the access level to enable further application functions under the menu **[ACCESS LEVEL]** (LAC)	To enable the settings for the brake control logic, the parameter **[ACCESS LEVEL]** (LAC) has to be set to **[Expert]** (EPr).
8	Configure the parameter for the brake control under the menu **[BRAKE LOGIC CONTROL]** (bLC-): • **[Brake assignment]** (bLC)	By the parameter **[Brake assignment]** (bLC) you select the logic output or control relay to control the contactor to release the electro magnetic brake on the motor. Further parameter can be set dependent to your application.
9	Power cycle the drive.	If the configuration is finished, do a power cycle of the drive because some parameter modifications only become effective after a power cycle.

⚠ WARNING
UNINTENDED EQUIPMENT OPERATION After any configuration changes or adjustments, power cycle the drive (power removal followed by power reapplied). **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

For more information, refer to Altivar 32, Variable speed drives for synchronous and asynchronous motors, Programming manual, S1A28692 (ENG).

EtherNet/IP Configuration

The parameters are accessible via **[CONFIGURATION]** `(COnF)` -> **[FULL]** `(FULL)` -> **[COMMUNICATION]** `(COM-)` menu and **[COMMUNICATION CARD]** `(Cbd-)` submenu.

Step	Action	Comment
1	Set the parameter for the **[Ethernet protocol]** `(EtHM)`.	The Ethernet protocol is EtherNet/IP. `EThM = EtIp`
2	Set the parameter for the **[IP Mode]** `(IPM)`.	Use this parameter to select the address assignment method. In this architecture, a fixed IP address is selected. `IPM = ManU`
3	Set the IP address for the communication card. **[IP card]** `(IPC-)`: • `(IPC1)` • `(IPC2)` • `(IPC3)` • `(IPC4)`	These parameters are editable when parameter **[IP Mode]** is set to fixed IP `(ManU)`. Value: 0...255 for each of the four parameters
4	Set the subnet mask for the communication card. **[IP Mask]** `(IPM-)`: • `(IPM1)` • `(IPM2)` • `(IPM3)` • `(IPM4)`	These parameters are editable when parameter **[IP Mode]** is set to fixed IP `(ManU)`. Value: 0...255 for each of the four parameters
5	Set the gateway address for the communication card. **[IP Gate]** `(IPG-)`: • `(IPG1)` • `(IPG2)` • `(IPG3)` • `(IPG4)`	These parameters are editable when parameter **[IP Mode]** is set to fixed IP `(ManU)`. Value: 0...255 for each of the four parameters In this example, the gateway address is equal to the IP address (Ethernet 2) of the controller.

Step	Action	Comment
6	Set the parameter for the **[Services]** (E E-).	This parameter enables the Web server of the communication card. E E- = Eb''

For more information about the Ethernet communication, refer to Altivar 32 Variable speed drives for synchronous and asynchronous motors, Modbus TCP - EtherNet/IP, Communication Manual, S1A28701.

Altivar 71 Variable Speed Drive - EtherNet/IP Setup

Overview

To operate the Altivar 71 via EtherNet/IP, the communication parameters have to be set for the device. In addition to this, it is mandatory to set the parameter of the connected motor in the drive. Further configuration settings are dependent on your application and on the installation.

There are several options to configure the drive:

- By the integrated display terminal on the front of the drive (dependent on type)
- By a graphic display terminal*
- By the configuration software SoMove installed on a PC**
- By the FDT/DTM integrated in SoMachine installed on a PC**
- By the embedded web server of the Ethernet communication module VW3A3616

(* linked to the integrated communication port on the front of the drive)

(** various connection options)

NOTE: If a device has already been configured for some other use, re-establish the factory settings. Instructions on how to do this can be found in the respective documentation.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- Verify that both wiring and mounting are correct before you start to configure the drive.
- Verify that an unintentional start of the connected motor will not endanger personnel or equipment in any way.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

If necessary, disconnect the motor from the drive to prevent an unintentional motor start.

The configurations described in this section are done using the graphic display terminal.

Basic Configuration

Step	Action	Comment
1	Switch on the power supply.	Do not give a run command to the drive.

Step	Action	Comment
2	Configure the motor parameters under the menu **[Motor Control]** (drc-): • **[Standard mot. freq]** (bFr) • **[Max frequency]** (tFr) • **[Motor control type]** (Ctt) • **[Rated motor power]** (nPr) • **[Motor 1 Cosinus Phi]** (COS) • **[Rated motor volt.]** (UnS) • **[Rated motor current]** (nCr) • **[Rated motor freq.]** (FrS) • **[Rated motor speed]** (nSP)	Refer to the motor rating plate. Values have to be adjusted if the factory settings differ with your application. If the drive shall apply the brake control logic, the parameter **[Motor control type]** (Ctt) has to be set either to [SVC V] (UUC) or [[SVC I] (CUC) or [FVC] (FUC).
3	Configure the parameters under the menu **[SETTINGS]** (Set-): • **[Acceleration]** (ACC) • **[Deceleration]** (dEC) • **[Low Speed]** (LSP) • **[High Speed]** (HSP) • **[Mot. Therm. current]** (ItH)	In most cases, the factory settings can be maintained for a quick start. Nevertheless, you have to verify the values.
4	Configure the I/O assignment under the menu **[INPUTS/OUTPUTS CFG]** (I_O-).	The I/O configuration depends on your architecture and the activated application functions of the drive. In most cases, the factory settings can be maintained for a quick start. Nevertheless, you have to verify the values.
5	Configure the command channel under the menu **[COMMAND]** (Ctl-): • **[Ref. 1 channel]**] (Fr1)	If the drive is operated via Modbus TCP, the parameter **[Ref. 1 channel]** (Fr1) has to be set to **[Com. card]** (nEt).
6	Set the access level to enable further application functions under the menu **[ACCESS LEVEL]** (LAC)	To enable the settings for the brake control logic, the parameter **[ACCESS LEVEL]** (LAC) has to be set to **[Expert]** (EPr).
7	Configure the parameter for the brake control under the menu **[BRAKE LOGIC CONTROL]** (bLC-): • **[Brake assignment]** (bLC)	By the parameter **[Brake assignment]** (bLC) you select the logic output or control relay to control the contactor to release the electro magnetic brake on the motor. Further parameter can be set dependent to your application.
8	Power cycle the drive.	If the configuration is finished, do a power cycle of the drive because some parameter modifications only become effective after a power cycle.

⚠ WARNING
UNINTENDED EQUIPMENT OPERATION After any configuration changes or adjustments, power cycle the drive (power removal followed by power reapplied). **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

For more information, refer to Altivar 71, Variable speed drives for synchronous and asynchronous motors, Programming manual, 1755855 (ENG).

EtherNet/IP Configuration

The parameters are accessible via **[COMMUNICATION]** (COM-) menu and **[EtherNet/IP]** (EtH-) submenu.

Step	Action	Comment
1	Set the parameter for the **[IP Mode]** (IPM).	Use this parameter to select the address assignment method. In this architecture, a fixed IP address is selected. IPM = **[fixed]** ManU
2	Set the IP address for the communication card. **[IP card]** (IPC-): • (IPC1) • (IPC2) • (IPC3) • (IPC4)	These parameters are editable when parameter **[IP Mode]** is set to fixed IP (ManU). Value: 0...255 for each of the four parameters
3	Set the subnet mask for the communication card. **[IP Mask]** (IPM-): • (IPM1) • (IPM2) • (IPM3) • (IPM4)	These parameters are editable when parameter **[IP Mode]** is set to fixed IP (ManU). Value: 0...255 for each of the four parameters
4	Set the gateway address for the communication card. **[IP Gate]** (IPG-): • (IPG1) • (IPG2) • (IPG3) • (IPG4)	These parameters are editable when parameter **[IP Mode]** is set to fixed IP (ManU). Value: 0...255 for each of the four parameters In this example, the gateway address is equal to the IP address (Ethernet 2) of the controller.
5	Set the parameter for the **[Services]** (E E).	This parameter enables the web server and Email function of the communication card. (E E) = **[Web Server]** (1)

For more information, refer to Altivar 61/71 EtherNet/IP card – User manual, AAV68822 (ENG).

Lexium 32M Servo Drive - EtherNet/IP Setup

Overview

To operate the Lexium 32M via EtherNet/IP, the communication parameters have to be set for the drive.

There are several options to configure the drive:

- By the local HMI on the front of the drive
- By a graphic display terminal
- By the configuration software SoMove installed on a PC*
- By the FDT/DTM integrated in SoMachine installed on a PC*
- By the embedded web server of the Ethernet communication module VW3A3616*

* various connection options

NOTE: If a device has already been configured for some other use, re-establish the factory settings. Instructions on how to do this can be found in the respective documentation.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- Verify that both wiring and mounting are correct before you start to configure the drive.
- Verify that an unintentional start of the connected motor will not endanger personnel or equipment in any way.

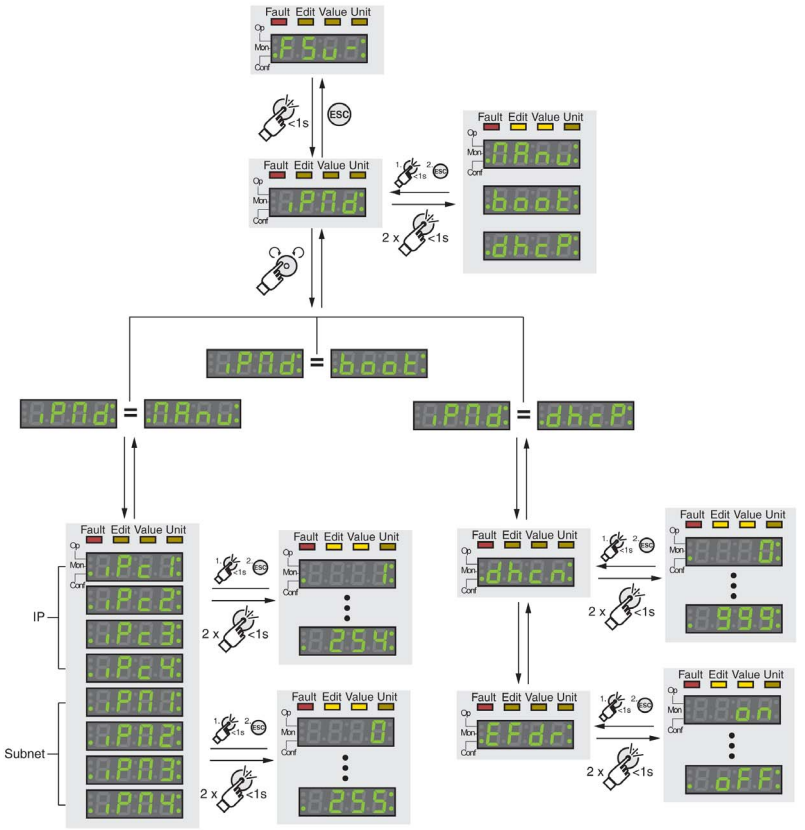
Failure to follow these instructions can result in death, serious injury, or equipment damage.

If necessary, disconnect the motor from the drive to prevent an unintentional motor start.

The configurations described in this section are done using the local HMI on the front of the drive.

Basic Configuration

A first setup is required when the power supply of the drive is switched on for the first time or after the factory settings have been restored. In this case follow the depicted menu structure below. After the initialization, the fieldbus interface must be configured. The product is configured via the integrated HMI.



Step	Action	Comment
1	Switch on the drive.	● The power stage supply is switched off. ● Disconnect the drive from the fieldbus during commissioning in order to avoid conflicts by simultaneous access. ● Switch on the power supply of the controller.
2	Set the parameter **[EthIpMode]**: `ConF -> CoM -> iPMd`	Use this parameter to select the address assignment method. In this architecture, a fixed IP address is selected. `iPMd = MAnu`
3	Set the parameters **[EthIPmodule1]**... **[EthIPmodule4]**: `ConF -> CoM -> iPc1 ... iPc4`	Set the IP address of the interface module. Value: 0...255 for each of the four parameters

Step	Action	Comment
4	Set the parameters **[EthIPmask1]**… **[EthIPmask4]**: `ConF -> CoM -> iPM ... iPM4`	Set the subnet mask of the interface module. Value: 0...255 for each of the four parameters
5	Set the parameters **[EthIPgate1]**… **[EthIPgate4]**: `ConF -> CoM -> iPG1... iPG4`	Set the IP address of the gateway of the interface module. Value: 0...255 for each of the four parameters In this example, the gateway address is equal to the IP address (Ethernet 2) of the controller.
6	Set the parameter **[EthMode]**: `ConF -> CoM -> EtMd`	Set the protocol for the Ethernet communication. In this architecture, the EtherNet/IP protocol is used. `EtMd = EtIP`

For more information, refer to LXM32M, EtherNet/IP module, Fieldbus manual, 0198441113802.

When the drive is switched on and if the motor encoder is connected to the drive, the device automatically reads technical information on the motor such as nominal torque and peak torque, nominal current, nominal velocity and number of pole pairs. Without this information, the device is not ready for operation.

Further configurations like tuning, limit values and I/O configuration can be done on basis of the application. In this architecture, an auto tuning has been performed and for the other values the default settings were retained.

For more information, refer to LXM32M AC servo drive, Product manual, 0198441113767.

Lexium ILx2K Integrated Drives - EtherNet/IP Setup

Overview

To operate the Lexium integrated drives ILA, ILE or ILS via EtherNet/IP, the communication parameters have to be set for the drive and the drive must be configured in the controller application of the automation system.

In addition to this, it is mandatory to configure the drive in accordance with the application where it is used.

There are several options to configure the drive:

- By the commissioning software Lexium CT installed on a PC
- By the embedded web server of the drive

NOTE: If a device has already been configured for some other use, re-establish the factory settings. Instructions on how to do this can be found in the respective documentation.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- Verify that both wiring and mounting are correct before you start to configure the drive.
- Verify that an unintentional start of the connected motor will not endanger personnel or equipment in any way.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

If necessary, disconnect the motor from the drive to prevent an unintentional motor start.

The configurations described in this section are done using the local HMI on the front of the drive.

Initial Setting the IP Parameter Via PC

Using the stored IP address by the settings of the rotary switches *(see page 151)* you must initially configure the IP address with a PC.

The default IP address of the drive is 192.168.100.10.

Step	Action	Comment
1	Set the IP address of the network adapter of your PC to 192.168.100.xxx.	"xxx" can be any value between 1...254 except for 10.
2	Connect the drive to your PC with an Ethernet cable.	–
3	Start a web browser and enter the IP address of the drive in the address bar.	The integrated web server is connected and the home page is displayed.

Step	Action	Comment
4	Navigate to the **Maintenance** page and select the submenu **Communication**.	An authentication dialog is open. Enter the **Username:** USER and the **Password:** USER to get access. **NOTE:** You can change the credentials to access the web server on the page **Setup → Security**.
5	Enter the IP parameter.	-
6	Click the **Write** button to send the parameters to the drive.	-
7	Click the **Save** button to store the parameters to the EEPROM.	-
8	Power cycle the drive.	After that the new IP parameters are used.

Change the default password upon first use. In addition, consider carefully the implications for giving any access to other people.

⚠ WARNING

UNAUTHORIZED DATA ACCESS

- Immediately change any and all default passwords to new, secure passwords.
- Do not distribute passwords to unauthorized or otherwise unqualified personnel.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

NOTE: A secure password is one that has not been shared or distributed to any unauthorized personnel and does not contain any personal or otherwise obvious information. Further, a mix of upper and lower case letters and numbers offer greater security. You should choose a password length of at least seven characters.

Commissioning of the Drive

Carry out the following steps using the commissioning software Lexium CT respectively the integrated web server.

Step	Action	Comment
1	Set the basic parameters and limit values.	Suitable limit values must be determined and calculated based on the system and motor data. As long as the motor is operated without loads, the default settings do not need to be changed.
2	Configure the Inputs and Outputs.	The device has 4 configurable 24 V signals. These 24 V signals can each be configured as either an input or an output.

Step	Action	Comment
3	Test the signals of the limit switches.	The use of limit switches can help provide some protection against collision with mechanical stops caused by incorrect reference values.
4	Test the safety-related function STO.	Verify the correct wiring of the signals and functioning of the safety-related function STO.
5	Release the holding brake manually.	The drive automatically controls the integrated holding brake. However, during commissioning it may be necessary to release the holding brake manually.
6	Verify the direction of movement.	Movements are made in positive or in negative directions. In the case of a rotary motor, direction of movement is defined in accordance with IEC 61800-7-204: Positive direction is when the motor shaft rotates clockwise as you look at the end of the protruding motor shaft.
7	Set parameters for encoder	For ILA only, and if an absolute encoder is used.
8	Optimize the motion behavior.	For stepper drive ILS only.
9	Controller optimization with step response.	For ILA only, and with the use of the Lexium CT using the sequence of menu and commands "Functions - Recording/Tuning…".

For more information, refer to :

- ILA2K EtherNet/IP Lexium Integrated Drive, Product manual, 0198441113670.
- ILE2K EtherNet/IP Lexium Integrated Drive, Product manual, 0198441113676.
- ILS2K EtherNet/IP Lexium Integrated Drive, Product manual, 0198441113682.

Preventa XPSMCM Modular Safety Controller - EtherNet/IP Setup

Overview

The functional safety measures *(see page 56)* defined for this architecture are realized with the Preventa XPSMCM• Modular Safety Controller system. On the safety controller, an application program is executed which has been developed with the SoSafe Configurable application software. The SoSafe Configurable application program for the described architecture is available as an external file inside the SoMachine project.

This chapter describes how to download an existing SoSafe application to the safety controller. Furthermore you obtain information about the configuration of the fieldbus module XPSMCMCO0000EI• for the EtherNet/IP communication with the M251 controller.

For more information, refer to Modular Safety Controller, User Guide, EIO0000001987.

Download the Project

SoSafe Configurable software requires a password to transfer the configuration. This password is stored on the controller. By default, the password is SAFEPASS.

Change the default password upon first use. In addition, consider carefully the implications for giving any access to other people.

⚠ WARNING

UNAUTHORIZED DATA ACCESS

- Immediately change any and all default passwords to new, secure passwords.
- Do not distribute passwords to unauthorized or otherwise unqualified personnel.
- Disable the FTP/Web server to prevent any unwanted or unauthorized access to data in your application.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

NOTE: A secure password is one that has not been shared or distributed to any unauthorized personnel and does not contain any personal or otherwise obvious information. Further, a mix of upper and lower case letters and numbers offer greater security. You should choose a password length of at least seven characters.

Step	Action	Comment
1	Start the SoSafe Configurable software and open your project for your safety application.	-
2	Connect the XPSMCMCP0802• to the PC.	Use USB/Mini-USB configuration cable TCSXCNAMUM3P.

Step	Action	Comment
3	Log on to the controller. Select the command **Connection** from the menu **Communication**.	A popup window appears requesting the password of the controller.
4	Download the configuration. Select **Send Configuration** from the menu **Communication**.	The password level 2 is required. **NOTE:** Before download, the project must be successfully verified with SoSafe Configurable.
5	Disconnect and reboot the controller. Select the command **Disconnect/Restart** from the menu **Communication**.	When the controller is disconnected, it automatically reboots and restarts the last transferred configuration.

Validation

After verifying and downloading the project to the XPSMCMCP0802• controller and connecting all physical input and output automation equipment, a functional validation must be carried out to validate the operation.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

- Empirically validate each safety function of your functional safety system before placing your application into service.
- Practice the guidelines outlined by EN ISO 13849-2 to thoroughly validate the functionality of your safety system in the context of your application.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

EtherNet/IP Configuration

The fieldbus module XPSMCMCO0000EI• is configured using the USB/Mini-USB interface on the front panel and the BUS Configurator software. The BUS Configurator software is installed along with the SoSafe Configurable software.

The BUS Configurator software is used to set the IP parameter for the module and to select the data to be exchanged via the fieldbus.

Step	Action	Comment
1	Start the BUS Configurator software on your PC.	-
2	Connect the XPSMCMCO0000EI• to the PC.	Use USB/Mini-USB configuration cable TCSXCNAMUM3P.
3	Press the **Connect** button in the software.	The fieldbus reference, firmware version, and XPSMCMCP0802• status are displayed.
4	On the **I/O Select** tab, activate the check boxes for **Map Output** and **Map Input**.	Available data is provided on the fieldbus (**Map Output**). Remote signals are enabled (**Map Input**).

Step	Action	Comment
5	On the **Address** tab, activate **Select IP address** and enter the IP parameter.	-
6	Press the **Write** button in the software.	The configuration data is sent to the module.

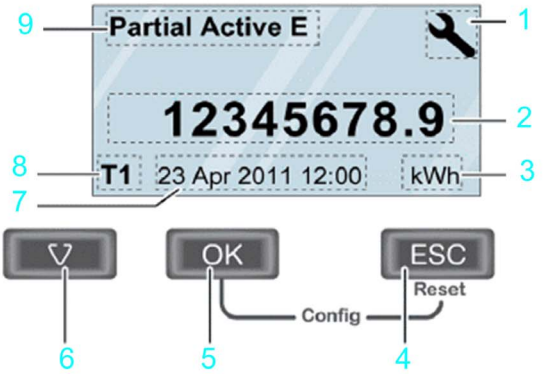
NOTE: The described EtherNet/IP configuration is compatible for the use of the fieldbus expansion module XPSMCMCO0000EI• with firmware version 1.8 or later. In case you use a module with an earlier firmware version, contact your local Schneider Electric representative.

iEM3150 Energy Meter - Modbus SL Setup

Overview

The energy meter features a sophisticated and intuitive human machine interface (HMI) with signaling LEDs, a graphic display, and contextual menu buttons for accessing the information required to operate the energy meter and modify parameter settings. The navigation menu allows displaying, configuring, and resetting parameters.

The graphic shows the general display:



1 configuration mode
2 values / parameters
3 unit
4 cancellation
5 confirmation
6 selection
7 date and time (except for iEM3100 / iEM3200)
8 Active tariff (iEM3115 / iEM3155 / iEM3215 / iEM3255)
9 functions / measurements

In addition to this system user guide the product manual for the iEM3150 energy meter has to be read carefully.

For more information, refer to iEM3100 series / iEM3200 series, Energy Meters, User Manual, DOCA0005EN.

Configuration

Before starting the configuration of the energy meter, verify and ensure that your equipment is properly installed and the application functions correctly:

Step	Action	Comment
1	Set date and time.	When the power is interrupted, the iEM3150 automatically resets the date and time. The start screen after power-on prompts you to set the date and time.
2	Enter the configuration mode. Press and hold **ESC** + **OK** for at least 2 seconds.	The display switches to configuration mode.
3	Select the submenu **Wiring** and set the parameter for it.	The default wiring parameter is set to 3PH4W.
4	Select the submenu **Frequency** and set the parameter for it.	The default frequency parameter is set to 50 Hz.
5	Select the submenu **Communication** and set the slave address, baud rate, and parity for it.	The default values of the parameters are set to: ● slave address = 1 ● baud rate = 19200 ● parity = even
6	Leave the setup menu by pressing **ESC** .	–

NOTE: Further configuration can be done depending on your application needs. For more information, refer to iEM3100 series / iEM3200 series, Energy Meters, User Manual, DOCA0005EN.

Harmony ZBRN1 Access Point - Modbus TCP Setup

Overview

To operate the Harmony wireless receiver via Ethernet, the communication parameters have to be set for the device.

There are several options to configure the drive:

- by the local HMI on the front of the drive
- by web pages via PC*
- by the FDT/DTM integrated in SoMachine installed on a PC*

(* linked to the communication port on the bottom of the device)

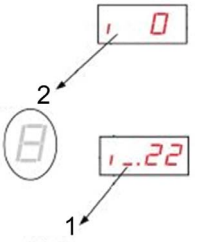
Basic Configuration

After configuring the communication parameters, you have the opportunity to teach up to 60 wireless push-buttons. To configure the wireless receiver, use the jog dial on front of the device.

Before configuring the devices, connect the receiver module to the power supply and place the wireless push button within reach of the receiver module.

Steps to configure the ZBRN1

Step	Action	Comments
1	Configure the communication parameters under menu: **Configuration [Conf]** ● **Ethernet [Et.••]** ❍ **DHCP [d•••]** ❍ **BootP [bP]** ❍ **Static IP [St]** - **IP address [IP]** - **Subnet mask [SnN]** - **Gateway [gate]** - **Save [Save]** Save your settings.	Depending on your network select **DHCP**, **BootP** or **Static IP**. By selecting **Static IP** you have to set the 4 bytes of the **IP address**, **Subnet mask** and **Gateway**.

Step	Action	Comments
2	Set the input to teaching mode: **Configuration [Conf]** ● **Inputs [in.••]** ❍ **Unteached input •• [i ••]** - **Teach[t]** --- **Teach [t]** (blinking)	How to recognize whether an input is already taught:  **1** taught **2** not taught
3	Teach the wireless push button by pushing it 3 times while it is blinking.	
4	Unteach a battery less push button: **Configuration [Conf]** ● in.•• ❍ **i._••** - **Clr**	
5	Configure the holding time: **Configuration [Conf]** ● **Hd.••**	The input holding time can be set to: ● **Hd. 1** = 100 ms ● **Hd. 2** = 200 ms ● **Hd. 3** = 300 ms ● **Hd. 4** = 400 ms ● **Hd.5** = 500 ms ● **Hd.10** = 1 s

For more information, refer to Harmony XB5R, ZBRN1/ZBRN2, User Manual, EIO0000001177 (EN).

OsiSense XGCS850 RFID - Ethernet Setup

Overview

To operate the RFID Smart Antenna via Modbus TCP or EtherNet/IP, the IP parameters have to be set for the device.

Address Configuration

The factory default address is 192.168.0.10.

The configuration of the IP address is made by setting parameters with:

- XGST2020 Handheld Terminal,
- IP Recovery Tool.

NOTICE
UNINTENDED EQUIPMENT DAMAGE ● Do not use factory configured IP address for operation. ● Assign a new IP address for operation. **Failure to follow these instructions can result in equipment damage.**

NOTE: Two or more Smart Antennas with identical IP address on the same network generate a duplicate IP condition (Smart Antenna Diagnostic LEDs).

For more information, refer to RFID OsiSense XG, Ethernet Smart Antenna, User Manual, EIO0000001601.

Configuring IP Address with XGST2020 Handheld Terminal

You can configure the IP parameters of the Smart Antenna with the XGST2020 Handheld Terminal. For more information, refer to XGST2020 Handheld Terminal - Software Guide, EIO0000002166 (ENG).

NOTE: The IP address of the Smart Antenna must be known. If not, use the IP Recovery Tool (see below).

Configuring IP Address With IP Recovery Tool

Proceed as follows to retrieve and configure the IP address of a Smart Antenna:

Step	Action
1	Download and install on your PC the IP Recovery Tool software.
2	Connect a Smart Antenna to your PC with an Ethernet M12 / RJ45 cable (XGSZ12E4501).
3	Launch the IP Recovery Tool software.
4	Select in the list the network interface on which the Smart Antenna is connected to.

Step	Action
5	Click **SCAN**. **Result:** An information window is displayed.
6	Reboot or power-up the Smart Antenna connected to the PC
7	Click **OK** to close the information window.
8	Wait until the MAC address and the IP address of the Smart Antenna is displayed in the scan result area. The scan can take 30 seconds to 2 minutes. **NOTE:** If more than one Smart Antennas are connected to the PC, they are displayed in the scan result area.
9	Click **STOP SCAN** when the Smart Antennas are detected.
10	Select in the scan result area the Smart Antenna to configure.
11	Click **CONFIGURE DEVICE**. **Result:** A configuration window is displayed.
12	Set the new IP parameters of the Smart Antenna: ● IP address ● Subnet mask ● Gateway
13	You can select the **Factory settings** check box to set the factory settings. **NOTE:** If you modify the values, the **Factory settings** check box is cleared.
14	If you clear the **Configure local address automatically (recommended)** check box, you must modify the network configuration of your PC to be compatible with the actual IP address range of the Smart Antenna.
15	Click **Apply** to validate the settings.
16	Click **Done** to close the configuration window.
17	Click **EXIT** to close the IP Recovery Tool software.
18	Reboot the Smart Antenna to apply the new IP parameters.

Diagnostics

The 6 bicolor LEDs display the operating states of the OsiSense XG Smart Antenna.

LED	Name	LED state	Description	Smart Antenna state
1	TAG	Solid green	Tag presence	A tag is detected, communication ok
		1 flash	No tag detected	Waiting for a tag
		Red flashes	RFID detected error	Errors detected in the communication with the tag
2	COM	Green flashes	Requests received from a client	Ok
		Red flashes	Detected error in requests received from a client	Detected error code returned to the client (no tag / incorrect parameters, etc.)

LED	Name	LED state	Description	Smart Antenna state
3	NS (Network status)	Steady off	Not powered or no IP address	Waiting for IP address setting (fixed or DHCP).
		Flashing green	No connections	No CIP connection established, and an exclusive owner connection with a client has not timed out.
		Solid green	Connected	At least one CIP connection is established, and an exclusive owner connection with client has not timed out.
		Flashing red	Connection timeout	An exclusive owner connection with client has timed out.
		Solid red	Duplicate IP	The Smart Antenna has detected that its IP address is already in use.
		Flashing green/red	Self-test	The Smart Antenna is performing its power-on self-test.
4	Link activity (port 1 and 2)	Solid green	Ethernet link present at 100 Mbit/s	Ok
5		Flashing green	Traffic at 100 Mbit/s	Ok
		Solid yellow	Ethernet link present at 10 Mbit/s	Ok
		Flashing yellow	Traffic at 100 Mbit/s	Ok
6	MS (Ethernet module status)	Solid green	The Ethernet module of the Smart Antenna is operational	Ok
		Flashing green	Standby	The Smart Antenna is waiting for network configuration.
		Flashing red	Recoverable error	The Smart Antenna has detected a recoverable error. **NOTE:** An incorrect or inconsistent configuration is considered as a recoverable error.
		Steady red	Non-recoverable error	The Smart Antenna has detected a non-recoverable error on its Ethernet module.
		Flashing green/red	Self-test	The Smart Antenna is performing its power-on self-test.

OsiSense XUW - EtherNet/IP Setup

Overview

The OsiSense XUW vision sensor is used to process images in order to detect defective parts, parts in an incorrect place, at an incorrect angle or in an incorrect order or a combination of these. Therefore the sensor must be configured with the **XUW PC Software**.

This software includes the following components:

- **XUW Find**: To search for a sensor in the network, and to select it for configuration or monitoring and carry out different basic settings.
- **XUW Config**: To configure the sensor and to load and/or save the configuration.
- **XUW View**: To monitor the selected sensor.

The configuration of the vision sensor used in the described architecture is available as an external file inside the SoMachine project template.

In this chapter, it is described how to connect to a sensor for the initial setting of IP parameter and how to configure the sensor for EtherNet/IP communication.

Basic Configuration

The default IP address of the sensor is 192.168.100.100.

Step	Action	Comment
1	Set the IP address of the network adapter of your PC to 192.168.100.xxx.	"xxx" can be any value between 1...254 except for 100.
2	Connect the sensor to your PC with an Ethernet cable.	-
3	Start the **XUW PC Software**.	The **XUW Find** software starts and the sensor should be listed in the field active sensors.
4	Select the Sensor in the list and click the **Set** button in the **XUW Find** software.	The **Local Area Connection Properties** dialog box opens.
5	Enter the IP parameter.	-
6	Click the **Set** button to send the parameters to the drive.	-
7	Modify the IP parameter of your PC to match with the new IP settings of the sensor.	-
8	Click the **Find** button in the **XUW Find** software.	The sensor should be listed in the field active sensors.
9	Mark the sensor and click the **Config** button.	The **XUW Config** software is open.
10	Make the reference image and you need to configure the job(s) and the associated detectors dependent on your application.	An example configuration used for this architecture is provided as an external file inside the SoMachine project template.
11	Select **Output** under the menu **Setup**.	The **Configure Output** editor is displayed.

Step	Action	Comment
12	Select the desired settings on the **I/O mapping** tab.	In this example architecture, the sensor is triggered by the digital input **03/white**.
13	Enable the EtherNet/IP interface on the **Interfaces** tab.	Per default, the EtherNet/IP interface is disabled.
14	Select the data to be transmitted over EtherNet/IP on the **Telegram** tab.	Depending on the selection, the data are available in the input assembly cyclically sent to the controller.
15	Click the **Start Sensor** button under the menu **Setup**.	The active job is transmitted to the sensor, stored in the non-volatile memory (RAM) of the sensor and the sensor is started (run mode).
16	If the sensor is in run mode the **Result/Statistics** window is shown.	The result of the last processed image is displayed.
17	If the commissioning is finished, the job configuration can be stored offline for backup.	–

For more information, refer to :

- XUWSA••• Vision Sensors - Standard, User Manual, EIO0000001325
- XUWAA••• Vision Sensors - Advanced, User Manual, EIO0000001328

Chapter 8
Adapt TVDA Template

What Is in This Chapter?

This chapter contains the following sections:

Section 8.1
Adapt SoMachine Project Template

What Is in This Section?

This section contains the following topics:

Introduction

Overview

The structure of a TVDA project template has a modular design thanks to the use of Device Modules.

This allows you to create your customized project in an easy and flexible way by adapting the TVDA project template.

Device Modules in General

Overview

The Device Modules out of the **TVDA Device Module Library** are represented by Function Templates *(see SoMachine, Programming Guide)* within SoMachine. They are especially created for the TVDA project template.

Device Modules are available for the functional units implemented in the different TVD architectures.

By definition functional units in the extent of Device Modules are different sorts of field devices controlled (connected) in various ways by the controller.

The required SoMachine application content, beginning with integrating the device to the hardware configuration up to integration of the needed program code, is provided.

Each Device Module comes with its own global variable definition and helps to ensure consistency within the application.

During the device module insertion process, the software prompts you to assign the required configuration such as addresses, names, variable assignment to I/Os, and parameter assignment. (Refer to Add Device Module *(see page 226)*.)

Each Device Module provides a ready to use interface within the application program to control the device and to monitor its status.

Device Modules Used in This Project Template

Device Modules Used

The following Device Modules of the **TVDA Device Module Library** are used in this project template.

Device Module
MED_iEM3150_ModbusSL
Harmony_Wireless_ModbusTCP_2
ATV32_EtherNetIP
ATV71_EtherNetIP
Lexium_32M_EtherNetIP
Lexium_ILA2K_EtherNetIP
Lexium_ILE2K_EtherNetIP
Lexium_ILS2K_EtherNetIP
Preventa_XPSMCM_EtherNetIP
OsiSense_XUW_EtherNetIP
OsiSense_RFID_EtherNetIP

Refer to TVDA Device Module Library *(see TVDA Device Module Library, Function Template Library Guide)*.

Add Device Modules

Procedure

To add a Device Module, proceed as follows:

Step	Action
1	Right-click the **Application** node in the **Application tree** and select **Add Function From Template** from the context menu. The **Add Function From Template** dialog box is displayed.
2	Enter a **Function Name** that is used for the new folder of the Device Module and for the naming of the elements it contains (GVL, POU, POU call, device, and so on).
3	Click the **...** button and select a Device Module (Function Template) from the **TVDA Device Module Library**. Confirm with **OK**.
4	Now you can edit the different properties. Which properties can be edited depends on the selected Device Module.
5	For Device Modules which include a field device, the appropriated fieldbus master is preselected in the **Master** column of the **I/O Devices** field. If your configuration includes more than one fieldbus masters for the selected **I/O Device**, you can select the desired fieldbus master from the **Select Fieldbus Master** dialog box. This dialog box is open when you click the **...** button.
6	For Device Modules which include a field device, the device address must be selected. In **Address** column of the **I/O Devices** field the address must be entered respectively it can be selected from the **Select Device Address** dialog box. This dialog box is open when you click the **...** button.
7	The **I/O Mapping** field is an optional feature. For some Device Modules, it is possible to map variables directly to I/Os of current I/O configuration. In **Mapping** column of the **I/O Mapping** field, click the **...** button to open the **Select I/O Mapping** dialog box and map the variable to a **Channel** of your I/O configuration. Confirm with **OK**.
8	In **New Value** column of the **Parameters** field, you can enter an initial value for the displayed variables (for example constants). If you do not enter a value, the **Default** value is used in your project.
9	Click the **OK** button to add the Device Module to your project.

NOTE: For Device Modules associated with a fieldbus, the appropriate fieldbus master has to be available in your project. For example, the Device Module ATV32_ModbusTCP requires a **Industrial Ethernet manager** in the project configuration.

Objects Added

If you add a Device Module, the associated objects are added to the project at the appropriate position. Information on what was done when adding the Device Module, is displayed in the **Messages** window.

Potential objects and actions are listed in the table.

Object	Description
Root folder	A new folder is added under the **Application** node in the **Tools tree** that is named as defined in the **Function Name** text box in the **Add Function From Template** dialog box.
GVL (global variable list)	The global variable list that is included in the Device Module is added below the root folder using the **Function Name**. For example `GVL_ATV32_ModbusTCP`.
POU (program organization unit)	The POU that is included in the Device Module is added below the root folder using the **Function Name**. For example `Prg_ ATV32_ModbusTCP (PRG).`
POU call	The call of the POU that is included in the Device Module is added below **Task Configuration → MAST**.
Device	A device (if part of the Device Module) is added below the respective fieldbus master (for example **Ethernet_2 → Industrial Ethernet manager**) as selected in the **Select Fieldbus Master** dialog box. For example `ATV32_ModbusTCP`.
I/O mapping	Variables mapped in the **Add Function From Template** dialog box (**I/O Mapping** field), appear in the device editor of the respective device.
Libraries	Libraries referenced by the Device Module are automatically added to the **Library Manager** of your project.

Remove Device Module

Procedure

By adding *(see page 226)* a Device Module, various objects are added to your project.

To remove a functional unit (based on a Device Module) from your project, you have to remove the following objects manually from your project.

Objects to be Removed

Object	Description
Root folder	Remove the folder of the Device Module under the **Application** node in the **Tools tree**.
GVL (global variable list)	As the GVL is part of the root folder, it is removed with the root folder.
POU (program organization unit)	As the POU is part of the root folder, it is removed with the root folder.
POU call	Remove the POU call of the Device Module from **Task Configuration**.
Device	Remove the device (if part of the Device Module) from the respective fieldbus (for example **Ethernet_2** → **Industrial Ethernet manager**).
Variables	Remove the variables coming from your Device Module and being used in the project. For example in the **Symbol configuration** or in the I/O mapping.
Libraries	Remove the libraries referenced by the Device Module from the **Library Manager** of your project (if they are not referenced by other objects in your project).

Section 8.2
Adapt HMI Application

Introduction

Overview

The provided HMI application is a general solution.

Since every machine needs its own specific interface, the provided HMI application will in all likelihood not match exactly your requirements. Therefore, you will need to modify the provided HMI application using the Vijeo-Designer configuration software.

Vijeo-Designer is an efficient and flexible tool. It provides numerous functions to facilitate the creation or adaptation of the HMI application.

Especially for an easy adaptation, the following features are highlighted:
- Objects can be saved as templates in tool chest.
- Placeholder in variable expressions can be used.
- Resources for object design can be used.
- Export/import function is available.
- Master panels can be used.

If desired, the provided HMI application can be used as pattern for your solution.

Chapter 9
Bill of Material (BOM)

Bill of Material (BOM)

Overview

In this chapter, a Bill of Materials (BOM) for the main components of the architecture is provided.

Components and component combinations of the protection system of this architecture are marked with additional information about the conformity to standards IEC and UL. Those which are marked as UL can be considered as a multistandard solution. Nonetheless, you must consider and respect the local standards and codes, as well as the electrical and environmental conditions, where the system is installed and operated. For more information on this topic, refer to the associated product manuals and on the Schneider Electric webpage.

Regardless of the industrial application of a control panel, its protection systems and devices must comply with applicable international standards:

- IEC 60-204 safety of machinery
- UL 508A industrial control panel

Components and component combinations that meet multiple standards are equally important to design and size for ensuring that control panels meet legal requirements across international markets.

For more information about the multi-standard offer of Schneider Electric refer, to the website *http://www2.schneider-electric.com/sites/corporate/en/products-services/product-launch/multistandard-offer/multistandard-offer.page*

⚠ WARNING

REGULATORY INCOMPATIBILITY

Ensure that all equipment applied and systems designed comply with all applicable local, regional, and national regulations and standards.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Schneider Electric offers UL 508A support on the website at *www.Schneider-Electric.us*. A number of educational and product search tools are available on the website, including overview information, a UL 508A SCCR (Short Circuit Current Rating) determination flow chart, and information on Schneider Electric individual or product combination SCCRs. Underwriters Laboratories also publish SCCR tested combination ratings on its website. Updated tested combination ratings of Schneider Electric can be found on both websites and are free to download.

The UL 508A support website of Schneider Electric is located at:

http://www.schneider-electric.us/sites/us/en/support/product-support-resources/ul-508a-support/ul-508a-support.page

The UL 508A combination motor controller website of UL is located at:

http://www.ul.com/global/eng/pages/offerings/industries/powerandcontrols/industrialcontrolequipment

Main Switch

Quantity	Description	Reference	IEC	UL
1	PowerPact H-Frame multistandard circuit breaker, main switch, 3pin, 35 kA, with factory sealed trip unit current rating 15 A	NHGF36015TW	x	x
2	Lug kit 15...150 A	AL150HDS	x	x
1	Short lug shield	S37446	x	x
1	Red rotary handle on yellow bezel	LV429340	x	x

Energy meter

Quantity	Description	Reference	IEC	UL
1	Energy meter iEM3150, direct measurement up to 63 A, Modbus communication	A9MEM3150	x	x

Safety Functions

Quantity	Description	Reference
1	Preventa XPSMCM safety controller	XPSMCMCP0802•
1	Preventa XPSMCM output expansion module with 4 safety relay outputs	XPSMCMRO0004•
1	Preventa XPSMCM output expansion module with 4 safety relay outputs and 8 status outputs	XPSMCMRO0004DA•
1	Preventa XPSMCM fieldbus expansion module for EtherNet/IP, firmware≥V1.8	XPSMCMCO0000EI•
1	Preventa XPSMCM Single backplane expansion connector	XPSMCMCN0000SG
1	Emergency stop push-button, 2 NC, 22 mm, complete unit	XB5AS8444
1	Circular yellow legend for emergency stop push-button "emergency stop"	ZBY8330
1	Emergency stop push-button, complete plastic control station, yellow/ red, 2 NC	XALK178F
1	Illuminated push-button, blue, 1 NO + 1 NC, integral LED, complete unit	XB5AW36B5

Quantity	Description	Reference
1	Safety interlock switch with solenoid for unlocking on energization, 2x 2NC+1NO	XCSLF3737312
1	Actuator for interlock switch, latch for sliding doors	XCSZ05
2	TeSys D contactor, AC-3 400 V / 7.5 kW	LC1D18BD

Control and Signaling

Quantity	Description	Reference
1	Pilot light with integral LED 24 Vac/dc, white, complete unit	XB5AVB1
1	Harmony Wireless access point	ZBRN1
1	Plastic control station, empty, 2 cut-outs, IP 66	XALD02
1	Wireless push-button green	ZB5RTA3
1	Wireless push-button red	ZB5RTA4
1	Empty plastic box for mobile transmitter, 1 cut-out	ZBRM01
1	Wireless push-button blue	ZB5RTA6
1	Plastic control station, empty, 3 cut-outs, IP 66	XALD03
2	Push-button, green, 1 NO, complete unit	XB5AA31
1	Push-button, red, 1 NC, complete unit	XB5AA42
6	Legend holder and blank label (white or yellow) 18x27 mm	ZBY6102
1	Fixing plate for use on vertical support of tower light	XVBC12
1	Fixing base with support tube 80 mm, black	XVBZ02
1	Base unit for tower light	XVBC21
1	Set of 6 colored markers for the position	XVBC22
1	Signal element for tower light, green	XVBC2B3
1	Signal element for tower light, red	XVBC2B4
1	Signal element for tower light, blue	XVBC2B6
1	Signal element for tower light, clear	XVBC2B7

Controller and I/O Modules

Quantity	Description	Reference
1	Modicon M251 Logic Controller 24 Vdc, 2x Ethernet	TM251MESE
1	TM3 expansion module 16 DI	TM3DI16
1	TM3 expansion module 16 DO	TM3DQ16T

Magelis HMI

Quantity	Description	Reference
1	Magelis HMI optimum advanced panel, touch screen 7.5".	HMI GTO4310

Control Voltage Power Supply and Distribution

Quantity	Description	Reference	IEC	UL
1	Circuit breaker Multi9 UL1077 2P, C, 3 A (~230 V)	24444	x	x
1	Power supply 230 Vac / 24 Vdc, 10 A	ABL8RPS24100	x	x
8	Circuit breaker Multi9 UL1077 1P, C, 1 A (24 Vdc)	24425	x	x
12	Circuit breaker Multi9 UL1077 1P, C, 2 A (24 Vdc)	24426	x	x
1	Ground disconnect terminal 9760 U/8 TKE 48	57.110.1655.0 (Wieland)	x	x

Variable Speed Drives and General Motion Control

Quantity	Description	Reference	IEC	UL
Altivar 32				
2	Altivar 32 variable speed drive, 0.37 kW	ATV32H037N4	x	x
2	Magnetic circuit breaker, 2.5 A (3~400 V)	GV2L07	x	-
2	Auxiliary contacts for circuit breaker, 1 NO, 1 NC	GVAE11	x	-
2	Thermal-magnetic circuit breaker, 1.6...2.5 A (3~480 V)	GV2P07	-	x
2	Insulating barrier for motor circuit breaker	GV2GH7	-	x
2	Auxiliary contacts for circuit breaker, 1 NO, 1 NC	GVAN11	-	x
2	Ethernet communication module, daisy chain	VW3A3616	x	x
Altivar 71				
2	Altivar 71 variable speed drive, 0.75 kW	ATV71H075N4	x	x
2	Magnetic circuit breaker, 4 A (3~400 V)	GV2L08	x	-
2	Auxiliary contacts for circuit breaker, 1 NO, 1 NC	GVAE11	x	-
2	Thermal-magnetic circuit breaker, 2.5...4 A (3~480 V)	GV2P08	-	x
2	Insulating barrier for motor circuit breaker	GV2GH7	-	x
2	Auxiliary contacts for circuit breaker, 1 NO, 1 NC	GVAN11	-	x
2	EtherNet/IP communication module, daisy chain	VW3A3316	x	x
Lexium 32				
2	Lexium 32M servo drive 1~230 V/1 kW	LXM32MD18M2	x	x

Quantity	Description	Reference	IEC	UL
2	Magnetic circuit breaker, 10 A (1~230 V)	GV2L14	x	-
2	Auxiliary contact for circuit breaker, 1 NO, 1 NC	GVAE11	x	-
2	TeSys DFCC fuse holders + class CC fuses 10 A (fuses to be ordered separately - no Schneider Electric product)	DFCC2	-	x
2	Servo motor 0.6 kW 2500 U/min, multi, brake	BMH0702T02F2A	x	x
2	Motor cable, 5 m (16.4 ft)	VW3M5101R50	x	x
2	Encoder cable, 5 m (16.4 ft)	VW3M8102R50	x	x
2	Ethernet communication module, daisy chain	VW3A3616	x	x
Lexium integrated drives				
1	Circuit breaker Multi9 UL1077 2P, C, 3 A (~230 V)	24444	x	x
1	Power supply 230 Vac / 24 Vdc, 10 A	ABL8RPS24100	x	x
3	Circuit breaker Multi9 UL489 1P, C, 6 A (24 Vdc)	60107	x	x
1	Lexium ILA integrated drive with EtherNet/IP fieldbus interface and industrial connectors	ILA2K571PC1A0	x	x
1	Lexium ILE integrated drive with EtherNet/IP fieldbus interface and industrial connectors	ILE2K661PC1A0	x	x
1	Lexium ILS integrated stepper drive with EtherNet/IP fieldbus interface and industrial connectors	ILS2K571PC1A0	x	x
3	I/O adapter plate (4x I/O + 2xSTO)	VW3L40420	x	x
3	Power cable for Lexium IL•, 5 m	VW3L30001R50	x	x
1	STO cable with M8 female 4-pin connector and flying leads, 10 m	VW3L30010R100	x	x
2	STO cable with M8 female 4-pin connector and flying leads, 3 m	VW3L30010R30	x	x
2	Connector M8 male 4-pin, for STO daisy chain	VW3L50010	x	x

Sensors

Quantity	Description	Reference
OsiSense XG		
3	OsiSense XG RFID Smart Antenna, Modbus TCP, and EtherNet/IP, IP 67	XGCS850C201
1	RFID electronic tag - 13.56 MHz - ISO badge 54 x 85.5 x 1 mm - 256 Kb (10 pc.)	XGHB90E340
3	Power cable Smart Antenna with M8 connector at one end and flying leads at the other end, 2.0 m (6.56 ft)	XZCP0941L2

Quantity	Description	Reference
OsiSense XUW		
1	OsiSense XUW vision sesnor standard, focal lens 6 mm, internal illumination white	XUWSA06W
1	Cordset for power supply and I/O, with angled M12 female 12-pin connector and flying leads, 5 m (16.4 ft)	XZCPB45P14L5

Ethernet Wiring

Quantity	Description	Reference
Main cabinet		
1	Modicon TM4 bus expansion module, unmanaged Ethernet switch	TM4ES4
6	Ethernet patch cable, 2x RJ45, cat. 7, green, 0.5 m (1.64 ft)	VW3E3001R005
2	Ethernet patch cable, 2x RJ45, cat. 7, green, 1 m (3.28 ft)	VW3E3001R010
2	Ethernet patch cable, 2x RJ45, cat. 7, green, 2 m (6.56 ft)	VW3E3001R020
3	Ethernet patch cable, 2x RJ45, cat. 7, green, 3 m (9.8 ft)	VW3E3001R030
3	ConneXium M12 to RJ45 Ethernet adapter	TCSEAAF11F13F00
Field		
1	ConneXium Ethernet switch, unmanaged, IP 65, 5 ports M12	TCSESU051F0
1	Power cable Ethernet switch IP 67 with 5-pin M12 connector at one end and flying leads at the other end, 2 m (6.56 ft)	XZCP1164L2
3	Ethernet cable, 2 x M12 straight, 1 m (3.28 ft)	TCSECL1M1M1S2
3	Ethernet cable, 2 x M12 straight, 3.0 m (9.8 ft)	TCSECL1M1M3S2
2	Ethernet cable, 2 x M12 straight, 5.0 m (16.4 ft)	TCSECL1M1M5S2

Modbus SL Wiring

Quantity	Description	Reference
1	Modbus SL drop cable, 1 RJ45 connector, and 1 end stripped, 3 m (9.8 ft)	VW3A8306D30

Software Tools

Quantity	Description	Reference
1	SoMachine (includes Vijeo-Designer) on DVD, trial version - SoM V4.1 SP2 update	SOMNACS41
1	Single user license for SoMachine	SOMNACCZZSPA41
1	Programming cable (USB)	TCSXCNAMUM3P

Quantity	Description	Reference
1	Ethernet cable M12 - RJ45, 3 m (9.8 ft)	TCSECL1M3M3S2
1	SD card, 2 GB	TMASD1

Glossary

A

application

A program including configuration data, symbols, and documentation.

B

BSH

A Lexium servo motor from Schneider Electric.

C

CANopen

An open industry-standard communication protocol and device profile specification (EN 50325-4).

CFC

(*continuous function chart*) A graphical programming language (an extension of the IEC 61131-3 standard) based on the function block diagram language that works like a flowchart. However, no networks are used and free positioning of graphic elements is possible, which allows feedback loops. For each block, the inputs are on the left and the outputs on the right. You can link the block outputs to the inputs of other blocks to create complex expressions.

CIP

(*common industrial protocol*) When a CIP is implemented in a network application layer, it can communicate seamlessly with other CIP-based networks without regard to the protocol. For example, the implementation of CIP in the application layer of an Ethernet TCP/IP network creates an EtherNet/IP environment. Similarly, CIP in the application layer of a CAN network creates a DeviceNet environment. In that case, devices on the EtherNet/IP network can communicate with devices on the DeviceNet network through CIP bridges or routers.

configuration

The arrangement and interconnection of hardware components within a system and the hardware and software parameters that determine the operating characteristics of the system.

controller

Automates industrial processes (also known as programmable logic controller or programmable controller).

CSA

(*Canadian standards association*) The Canadian standard for industrial electronic equipment in hazardous environments.

D

DTM

(*device type manager*) Classified into 2 categories:

- Device DTMs connect to the field device configuration components.
- CommDTMs connect to the software communication components.

The DTM provides a unified structure for accessing device parameters and configuring, operating, and diagnosing the devices. DTMs can range from a simple graphical user interface for setting device parameters to a highly sophisticated application capable of performing complex real-time calculations for diagnosis and maintenance purposes.

E

encoder

A device for length or angular measurement (linear or rotary encoders).

Ethernet

A physical and data link layer technology for LANs, also known as IEEE 802.3.

EtherNet/IP

(*Ethernet industrial protocol*) An open communications protocol for manufacturing automation solutions in industrial systems. EtherNet/IP is in a family of networks that implement the common industrial protocol at its upper layers. The supporting organization (ODVA) specifies EtherNet/IP to accomplish global adaptability and media independence.

expansion bus

An electronic communication bus between expansion I/O modules and a controller.

F

FBD

(*function block diagram*) One of 5 languages for logic or control supported by the standard IEC 61131-3 for control systems. Function block diagram is a graphically oriented programming language. It works with a list of networks, where each network contains a graphical structure of boxes and connection lines, which represents either a logical or arithmetic expression, the call of a function block, a jump, or a return instruction.

FDT

(*field device tool*) The specification describing the standardized data exchange between the devices and control system or engineering or asset management tools.

H

HMI

(*human machine interface*) An operator interface (usually graphical) for human control over industrial equipment.

I

I/O

(*input/output*)

IEEE 802.3

A collection of IEEE standards defining the physical layer, and the media access control sublayer of the data link layer, of wired Ethernet.

IL

(*instruction list*) A program written in the language that is composed of a series of text-based instructions executed sequentially by the controller. Each instruction includes a line number, an instruction code, and an operand (refer to IEC 61131-3).

IP 20

(*ingress protection*) The protection classification according to IEC 60529 offered by an enclosure, shown by the letter IP and 2 digits. The first digit indicates 2 factors: helping protect persons and for equipment. The second digit indicates helping protect against water. IP 20 devices help protect against electric contact of objects larger than 12.5 mm, but not against water.

IP 67

(*ingress protection*) The protection classification according to IEC 60529. IP 67 modules are protected against ingress of dust, contact, and water up to an immersion depth of 1 m.

L

LD

(*ladder diagram*) A graphical representation of the instructions of a controller program with symbols for contacts, coils, and blocks in a series of rungs executed sequentially by a controller (refer to IEC 61131-3).

M

Magelis

The commercial name for Schneider Electric's range of HMI terminals.

Modbus

The protocol that allows communications between many devices connected to the same network.

Modbus SL

(*Modbus serial line* The implementation of the protocol over a RS-232 or RS-485 serial connection.

P

Profibus DP

(*Profibus decentralized peripheral*) An open bus system uses an electrical network based on a shielded 2-wire line or an optical network based on a fiber-optic cable. DP transmission allows for high-speed, cyclic exchange of data between the controller CPU and the distributed I/O devices.

program

The component of an application that consists of compiled source code capable of being installed in the memory of a logic controller.

R

RJ45

A standard type of 8-pin connector for network cables defined for Ethernet.

RPI

(*requested packet interval)* The time period between cyclic data exchanges requested by the scanner. EtherNet/IP devices publish data at the rate specified by the RPI assigned to them by the scanner, and they receive message requests from the scanner with a period equal to RPI.

RS-232

A standard type of serial communication bus, based on 3 wires (also known as EIA RS-232C or V.24).

RS-485

A standard type of serial communication bus, based on 2 wires (also known as EIA RS-485).

S

SFC

(*sequential function chart*) A language that is composed of steps with associated actions, transitions with associated logic condition, and directed links between steps and transitions. (The SFC standard is defined in IEC 848. It is IEC 61131-3 compliant.)

SL

(*serial line*)

SoMachine

A comprehensive controller development system software tool for configuring and programming the Modicon logic controller and devices compliant with IEC 61131-3.

ST

(*structured text*) A language that includes complex statements and nested instructions (such as iteration loops, conditional executions, or functions). ST is compliant with IEC 61131-3.

T

TCP

(*transmission control protocol*) A connection-based transport layer protocol that provides a simultaneous bi-directional transmission of data. TCP is part of the TCP/IP protocol suite.

terminal block

(*terminal block*) The component that mounts in an electronic module and provides electrical connections between the controller and the field devices.

TVDA

(*tested validated documented architectures*) Control system proposals based on Schneider Electric components.TVDAs cover a wide range of machine types and consider machine performance requirements, installation constraints, and target costs. To optimize the implementation effort, each TVDA comes with a detailed component list, wiring diagrams, and commissioning guide, as well as controller and HMI applications to control components of the system.

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