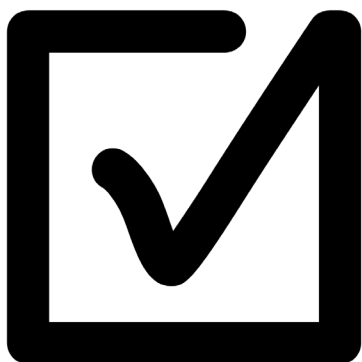# Distributed CANopen Logic Controller M258
System User Guide

04/2014

Schneider Electric

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.

No part of this document may be reproduced in any form or by any means, electronic or mechanical, including photocopying, without express written permission of Schneider Electric.

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, 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.

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.

⚠ CAUTION

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 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 M258 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 with the release of SoMachine V4.1.

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
Multi 9 System, Catalog	0860CT0201
Phaseo power supplies and transformers, Catalogue Pages	14082-EN
PM3200 series, Power Meters, User Manual	DOCA0006EN
TI current transformers, Catalogue Pages	92068EN
Control and protection components	MKTED210011EN
Safety automation solutions, XPSAC, XPSAV	38700-EN
Preventa, Machine Safety Products	MKTED208051EN
The essential guide: Preventa machine safety	DIA4ED2041204EN
ATV32 - Safety integrated functions manual	S1A45606
Magelis GTO, User Manual	EIO0000001133 (ENG)
Harmony XB5R, ZBRN1/ZBRN2, User Manual	EIO0000001177 (EN)
Harmony XB5R, Expert Instruction Sheet	EIO0000000812 (EN)
Control and signaling components	MKTED208031EN
Modicon M258, Logic Controller, Hardware Guide	EIO0000000432 (ENG)
Modicon M258, Logic Controller, Programming Guide	EIO0000000402 (ENG)
ConneXium Ethernet Switches, TCSESU0••F•N0, Quick Reference Guide	31007950
Modicon TM7, CANopen Interface I/O Blocks, Hardware Guide	EIO0000000685 (ENG)
Modicon TM5 / TM7, CANopen Interface, Programming Guide	EIO0000000697 (ENG)
Modicon TM5, Expansion Modules DTM Configuration, Programming Guide	EIO0000000679
Modicon TM5, Digital I/O Modules, Hardware Guide	EIO0000000444 (ENG)
Modicon TM5, Analog I/O Modules, Hardware Guide	EIO0000000450 (ENG)
Modicon TM5, CANopen Interface, Hardware Guide	EIO0000000691 (ENG)
CANopen, Hardware Setup Manual	35010857
Modicon TM5 / TM7 Flexible System, System Planning and Installation Guide	EIO0000000426 (ENG)
Modicon TM7, Expansion Blocks DTM Configuration, Programming Guide	EIO0000000715
Modicon TM7, Expansion Blocks Configuration, Programming Guide	EIO0000000880
Control and protection components	MKTED210011EN
TeSys U, Starter-controllers, Catalogue	DIA1ED2081003EN
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)

Title of Documentation	Reference Number
Altivar 61 / 71, CANopen, User's manual	1755865 (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 motors and asynchronous motors, Installation Manual (0.37 - 90 kW)	1755843 (ENG)
Altivar 71, Variable speed drives for synchronous and asynchronous motors, Programming manual	1755855 (ENG)
Altivar 71, Variable speed drives for synchronous and asynchronous motors, Programming manual, Specification 383	AAV49426
LXM32A, AC servo drive, Product manual	0198441113755 (ENG)
BMH, Servo motor, Motor manual	0198441113749 (ENG)
BSH, Servo motor, Motor manual	0198441113837 (ENG)
ILA1B, ILA1F, ILA1R, Lexium Integrated Drive, Product manual	0198441113562 (ENG)
LXM32iCAN BMi, Lexium 32 Integrated, Product manual	0198441113950 (ENG)
Electromechanical and solid-state relays, Zelio relay, Catalog	DIA5ED2120404EN
Lexium 32 motion control, Catalogue	DIA7ED2111002EN
Detection for automation solutions OsiSense	MKTED210041EN
OsiSense XCC, CANopen Multi-Turn Absolute Encoder, User's Manual	169002302
The essential guide of Detection	DIA4ED2041203EN
Transparent Ready, User Guide	31006929
Modbus Serial Line, Planning and Installation Guide	33003925
SoMachine Programming Guide	EIO0000000067 (ENG)

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

> ### ⚠ ⚠ 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.

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. Full functional tests are performed on real machines to verify that the control system meets the machine requirements it is recommended for. 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 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

Ready-to-use controller project covers the complete system configuration, with preconfigured application code to operate field devices to monitor the system status and to handle detected errors.

HMI Application

Ready-to-use HMI application as interface to
- control the system in its main functionalities,
- indicate the system status,
- visualize the detected system faults.

System User Guide (SUG)

- System documentation with 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
- Guide on how to adapt the system efficiently by making use of dedicated functions provided within SoMachine software

Wiring Diagram

Detailed guidance on the system wiring, reusable as a base to generate final technical wiring 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 P8 V2.1 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

The manufacturer or the operating company of the machine must take precautions to avoid unintentional equipment operation that may be caused by remote control.

⚠ 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 critical operator commands against unauthorized access (for example, by access control, password protection, or key switch).
- Ensure that unintended equipment operation (for example by remote control) is prohibited at machine site.
- 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 any 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 upper performance class and is distinguished by the following characteristics:

- Performance controller Modicon M258 Logic Controller
- Optimized Magelis touch-panel HMI GTO5310
- Energy metering
- CANopen fieldbus with 23 nodes
- Modbus serial line communication
- Modbus TCP communication
- Ethernet connectivity
- Application of machine safety
- Wireless and batteryless operator push-buttons
- 94 digital inputs (50 local and 44 distributed)
- 82 digital outputs (38 local and 44 distributed)
- 8 analog inputs (local)
- 2 analog outputs (local)

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

- 18 coordinated drives:
  - 6 Altivar 32
  - 4 Altivar 71
  - 1 TeSys U
  - 4 Lexium 32A
  - 1 Lexium 32i
  - 2 Lexium ILA

- 1 absolute multiturn encoder
- 4 distributed I/O modules

Layout

Main cabinet H1
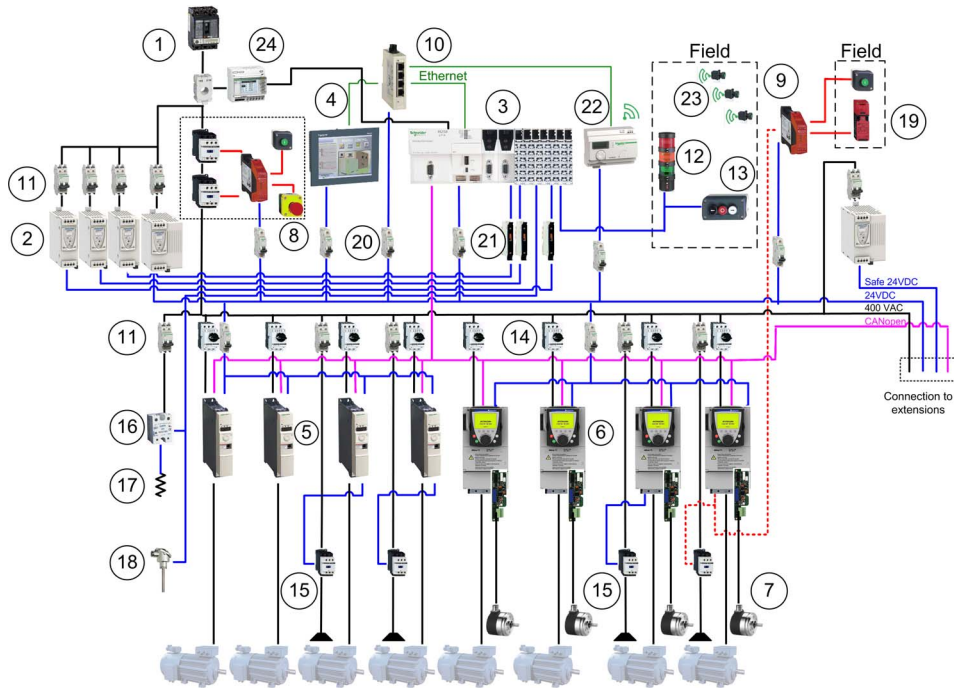
Main cabinet H1

1	PowerPact H-Frame circuit breaker	13	Harmony XALD housing
2	Phaseo ABL8 power supply	14	TeSys GV2P motor circuit breaker
3	Modicon M258 Logic Controller	15	TeSys D LC1D contactor
4	Magelis HMI GTO5310 panel	16	Zelio solid-state relay (4x)
5	Altivar 32 variable speed drive	17	Heating element (4x)
6	Altivar 71 variable speed drive + encoder card	18	Temperature sensor PT100 (4x)
7	OsiSense incremental encoder	19	Preventa XCS guard switch
8	Harmony XALK emergency stop	20	Multi-9 C60 (UL 1077) circuit breaker
9	Preventa XPS safety module	21	Fuse
10	ConneXium Ethernet switch	22	Harmony ZBRN1 wireless receiver

11	Multi-9 C60 (UL 489) circuit breaker	23	Harmony XB5R wireless push buttons
12	Harmony XVBC tower lights	24	PM3250 power meter + 3 current transformers

Remote cabinets H2, H3, H4

25	Modicon TM5 I/O island	30	OsiSense optional sensors
26	TeSys U LU motor starter with CANopen module	31	Lexium ILA integrated drive
27	Lexium 32A servo drive	32	OsiSense CANopen encoder
28	Lexium BSH servo motor	33	Lexium 32i integrated drive + Lexium BMI servo motor
29	Modicon TM7 I/O island (IP 65)	*	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 LXM32A, AC servo drive, Product manual, 0198441113755 (ENG).

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 44)*
6. Selecting the applicable standard *(see page 51)*
7. Where to get more information regarding safety *(see page 52)*
   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.

Fundamental rights from EU	Free circulation (CE mark)	Workers Protection	Environment Protection
European Union Directive	Machinery 2006/42/EC	Use of Work Equipment 89/391/EC	Seveso II 2008/99/EC96/82/EC
Sector of Activity	Machine Builder	End User System Integrator	End User System Integrator

Safety Standards

Generic Standard EN/IEC 61508	Harmonized Standards EN ISO 13849-1 EN/IEC 62061	EN ISO 13849-1 EN/IEC 62061 EN/IEC 61508	EN/IEC 61511

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

Risk related to the potential hazard	=	Severity of the potential harm	X	Probability of occurrence Frequency and duration of exposure Possibility of avoiding or limiting the probability of the occurrence of an event that could cause harm
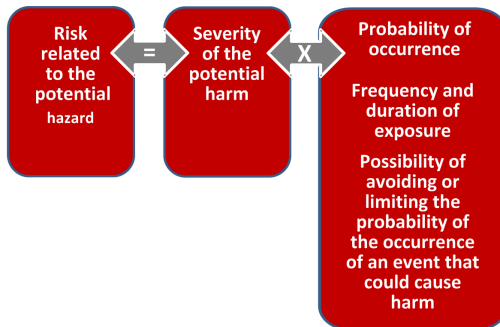
Determination of Machine Limits

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
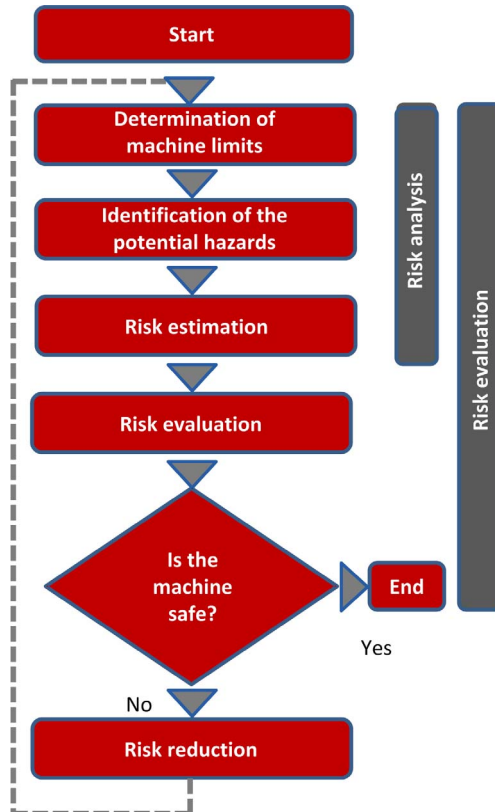
Identification of the Potential Hazard

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
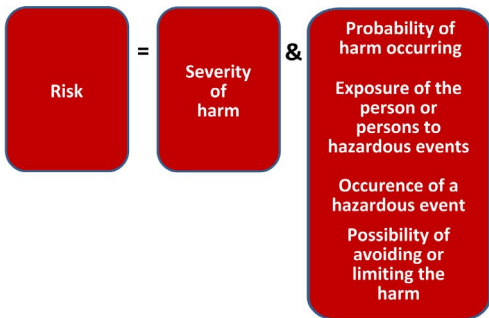
Risk Evaluation

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
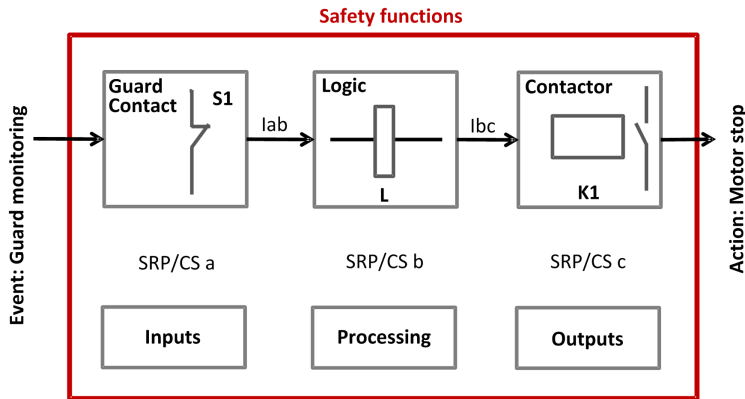
Stage 2 - Estimation of Required Performance Level (PLr)

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 $\leq MTTF_d <$ 10 years
Medium	10 years $\leq MTTF_d <$ 30 years
High	30 years $\leq MTTF_d <$ 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.
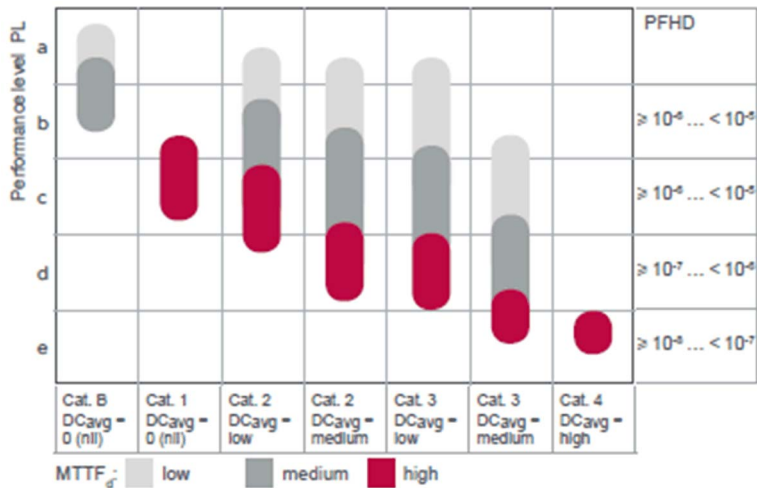
Using the above chart you can now select the most appropriate architecture, the required diagnostic coverage as well as ensure the products selected have the right $MTTF_d$ values.

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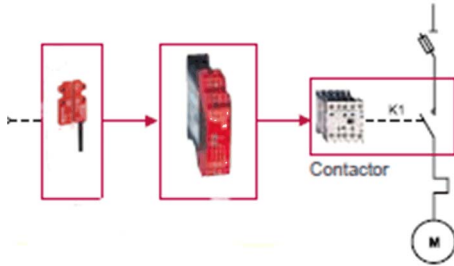
The selection of the right products may take several iterations as it is only possible to ensure that the right products are selected after calculations have been made.

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
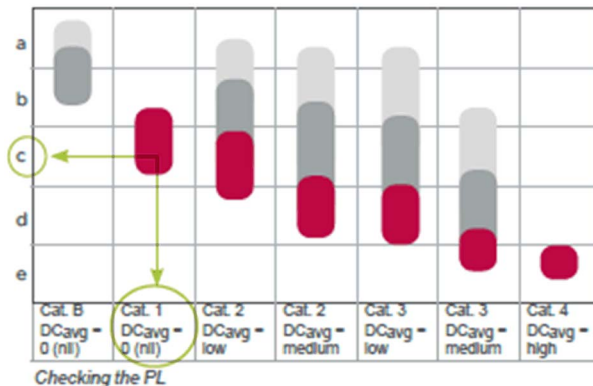
Stage 6 - Validation of the Required Performance Level

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

Risk related to the hazardous phenomenon identified = Severity of the potential harm **Se** & Probability of harm occurring: Frequency and duration of exposure **Fr**; Probability of an event occuring **Pr**; Probability of avoiding or limiting the harm **Av**
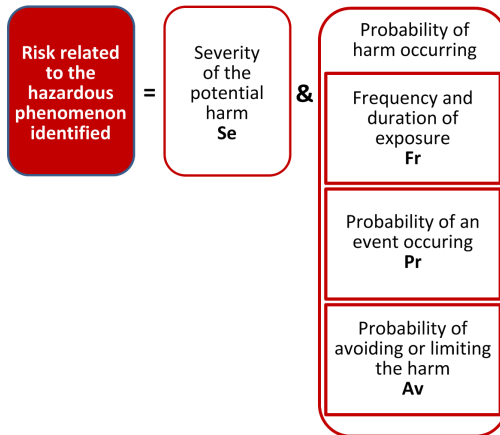
Stage 1 - Assign a Safety Integrity Level (SIL) and Identify the Structure of the SRECS

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.
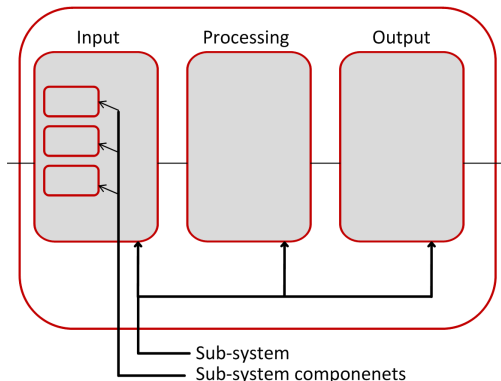
Severity Se

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
> 1 hour...≤1 day	4
>1 day=< 2 weeks	3

Frequency of Dangerous Exposure	Fr
2 weeks ⊴ 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 Cl				
	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.
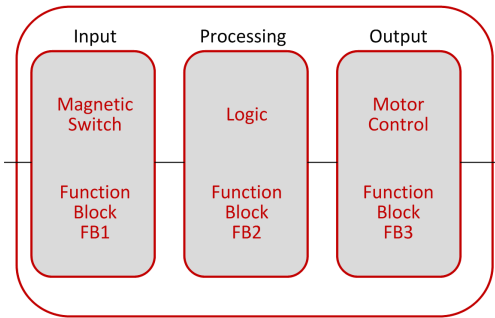
Stage 2 - Break down Each Function into a Function Block Structure (FB)

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

Sub-system element 1
λde1

Sub-system element n
λden

Sub-system type A

Sub-system element 1
λde1

Sub-system element 2
λde2

Common cause failure

Sub-system type B

Sub-system element 1
λde1

Sub-system element n
λden

Diagnostic function(s)

Sub-system type C

Sub-system element 1
λde1

Diagnostic function(s)

Sub-system element 2
λde2

Common cause failure

Sub-system type D
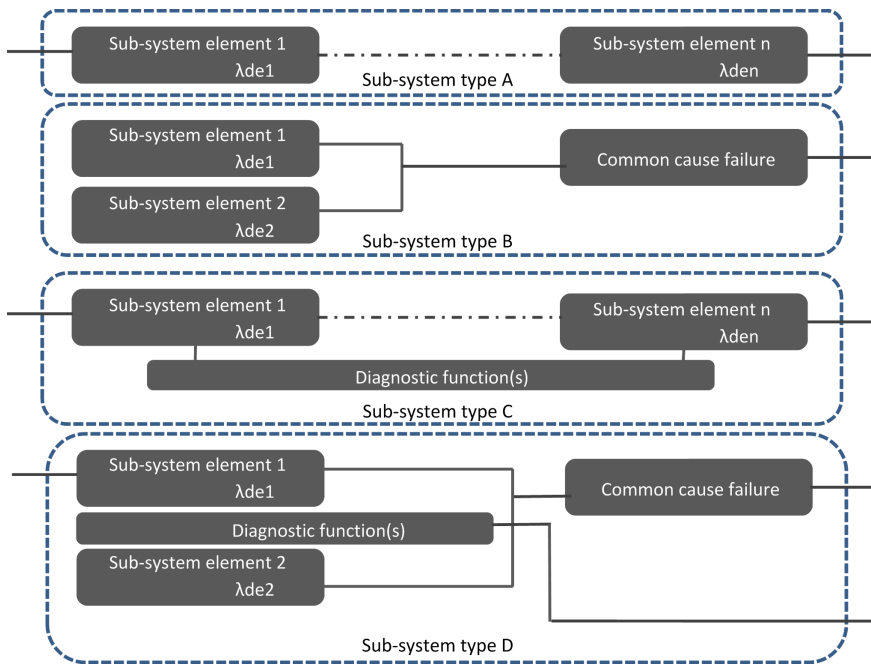
Stage 4 - Select the Components for Each Subsystem

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	$\geq 3 \times 10^{-6} < 10^{-5}$
c	1	$\geq 10^{-6} < 3 \times 10^{-6}$
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.

Select the right safety chain
solution

Schneider Electric's
safety chain solutions,
approved by the TÜV
to achieve the safety
level required

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.
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 5 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.

Using pre-certified architectures reduces time on implementation and calculations. Nevertheless, a full understanding of the appropriate risks and associated risk reduction must be considered before starting the implementation of the offer.

Emergency Stop - Main Cabinet H1

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

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**.

Used devices

Device	Description
Input	2 channel emergency stop button Harmony XAL K
Logic	Preventa safety module XPS AC
Output	2 redundant contactors with feedback loop LC1D

Interlocking Guard for Door Monitoring - Main Cabinet H1

In this TVDA, the safety function interlocking guard for door monitoring is applied to stop the motor controlled by an Altivar 71. Following the controlled stop of the motor by the Altivar, the power stage of the drive is disconnected by the safety-related input PWR (Power removal).

The safety function PWR (Power removal) 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 architecture is conforming to category 3 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 **c** and a safety integrity level (SIL) of **2**.

Used devices

1 Immediately opening safety contact linked to the stop input of the drive
2 Delayed opening safety contact linked to the PWR (power removal) input of the drive

Device	Description	Comment
Input	2 channel guard switch Preventa XCS	-
Logic	Safety module Preventa XPS AV	With immediately and delayed opening safety contacts and adjustable delay time*.

Device	Description	Comment
Output	Variable speed drive Altivar 71 with safety-related input	1: Stop input of Altivar 71 to initiate the controlled stop 2: PWR (Power removal) input of Altivar 71 to disconnect the power stage of the drive when the motor is stopped
* The time delay has to correspond with the deceleration of the motor during the controlled stop by the drive.		

NOTE: The Altivar 71 contains a single channel input with safety function. In order to reach a category 3 architecture, it is necessary to use a shielded cable for the wiring. The cable shield must be connected to the protective earth ground. Follow the wiring guidelines from the drive user manual.

Interlocking Guard for Door Monitoring - Remote Cabinet H2

In this TVDA, the safety function interlocking guard for door monitoring is applied to stop the motor driven by an Altivar 32. The uncontrolled stop of the motor is realized using the safety-related input STO (Safe Torque Off) of the Altivar 32.

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 **c** and a safety integrity level (SIL) of **2**.

Used devices

Device	Description	Comment
Input	2 channel guard switch Preventa XCS	-
Logic	Safety module Preventa XPS AC	-
Output	Variable speed drive Altivar 32 with safety-related input	STO (Safe Torque Off) input of Altivar 32 to disconnect the power stage of the drive

NOTE: In this architecture the single channel input with safety function on the Altivar 32 is used. In order to reach a category 3 architecture, it is necessary to use a shielded cable for the wiring. The cable shield must be connected to the protective earth ground. Follow the wiring guidelines from the drive user manual.

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.

Interlocking Guard for Door Monitoring - Remote Cabinets H3 and H4

In this TVDA, the safety function interlocking guard for door monitoring is applied to stop the motor driven by a Lexium 32. The uncontrolled stop of the motor is realized using the safety-related input STO (Safe Torque Off) of the Lexium 32.

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

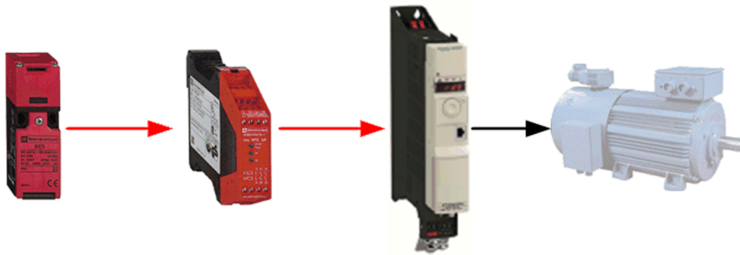**ELECTRIC SHOCK, EXPLOSION OR ARC FLASH**

- 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) up to **e** and a safety integrity level (SIL) of **3**.

Used devices
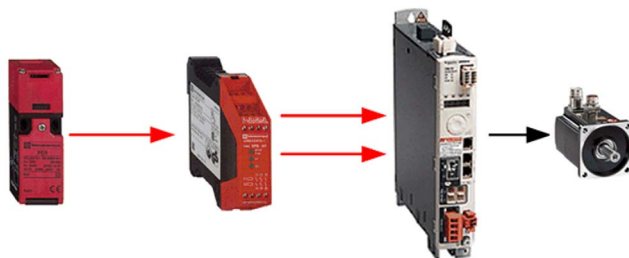
Device	Description	Comment
Input	2 channel guard switch Preventa XCS	-
Logic	Safety module Preventa XPS AC	-
Output	Variable speed drive Lexium 32 with safety-related input	STO (Safe Torque Off) inputs of Lexium 32 to disconnect the power stage of the drive

NOTE: Install safety-related signal cable in accordance with ISO 13849-2.

For more information about the safety functions of the Lexium 32A, refer to LXM32A, AC servo drive, Product manual, 0198441113755 (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 C60 (UL 1077) Circuit Breaker - Hardware

Front View

Multi-9 C60 (UL 1077) miniature supplementary protectors

Description

The Multi-9 supplementary protector line from Schneider Electric is a modular system of supplementary protectors, accessories, and installation equipment that makes up the most complete product offering in its class.

These UL 1077 recognized supplementary protectors provide overcurrent protection in applications where branch circuit protection is either already provided or is not required.

- 0.5...63 A at 480Y/277 Vac
- Up to 10 k AIR
- 1-, 2-, 3-, and 4-pole versions
- Common tripping of all poles
- B-curve 3...5 in. (76.2...127 mm), C-curve 7...10 in.(177.8...254 mm), D-curve 10...14 in. (254...355.6 mm)
- Current limiting capability is standard
- Full line of accessories
- Only 0.71 in. (18 mm) width per pole
- Flush, surface, or DIN rail mountable
- UL 1077, IEC 60947-2, and CE marked

New accessories with UL ratings include the following:

- Comb bus bars - UL recognized comb bus bars for UL 1077 supplementary protectors simplify wiring. They are available in 1-, 2-, and 3-phase versions. They are fixed length of 12 poles and cannot be cut. (A wide variety of IEC rated comb bus bars is also available).
- Tooth caps for the unused teeth of the comb bus Bar are also available. They come in bags of 4 strips of 5 (for a total of 20 poles), but can be snapped apart to be used individually.
- Ring tongue terminal Kit: A field-installable kit provides isolation barriers and ring terminals to convert a standard box lug Multi-9 C60 (UL 1077) miniature supplementary protector.

For more information, refer to Multi 9 System, Catalog, 0860CT0201.

Multi-9 C60 (UL 489) Circuit Breaker - Hardware

Front View

Multi-9 C60 (UL 489) miniature circuit breakers

Description

The Multi-9 C60 (UL 489) miniature circuit breaker is a UL 489 version of the Schneider Electric Multi-9 C60 family of DIN rail mountable circuit protection devices.

UL 489 devices provide branch circuit protection while UL 1077 supplementary protectors do not.

Designed to meet global applications and code requirements, the UL listed Multi-9 breakers are the first product to carry UL 489, IEC 947-2, and CSA C22.2 ratings as well as the CE mark.

The Multi-9 breaker family features an extensive array of accessories.

- 1-, 2-, and 3-pole configurations
- 17 UL 489 ratings 0.5 A...35 A
- 2 trip curves available: C curve (7...10 times handle rating); D curve (10...14 times handle rating)
- Small size: less than 19.05 mm (0.75 in.) wide per pole
- Interrupting ratings 10K AIR standard
- System voltages include 120/240 Vac and 240 Vac; also DC ratings of 60 Vdc (1P) and 125 Vdc (2P)
- Ring terminals available (with finger-safe option)
- Padlock attachments for locking in the "OFF" position only
- Common tripping of all poles
- Variety of accessories including shunt trip, auxiliary switch, and under-voltage release. Same accessories can be used on both UL 1077 and UL 489 devices.
- Mounting base for 12...60 poles.

For more information, refer to Multi 9 System, Catalog, 0860CT0201.

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
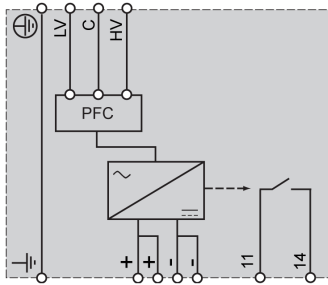
Wiring example: 200…500 V single phase
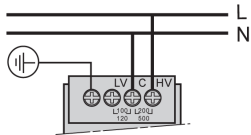
PM3200 Series Power Meter - Hardware

Front View

PM3250 power meter

Description

The PM3200 series power meters are a cost-attractive and competitive range of DIN rail-mounted power meters ideal for power metering and network monitoring applications in addition to sub billing and cost allocation applications.

The PM3200 series power meters are fully compatible with the Acti 9 communication system, which makes it easy to integrate electrical distribution into the facility management system of your customer.

The meters can be included in main switch boards or subcabinets for industrial applications.

- Backlight, graphical display for easy viewing
- Accuracy class 0.5 s
- Modbus SL RS-485 2-wire communication (only PM325•)
- Save installation time, costs, and space
- Commissioning with ease
- Compact size

Standards and certifications	IEC 61557-12, IEC 62053-21/22, IEC 62053-23, CE, UL
Power supply	110…415 V (L-N, L-L)
Functions	Depends on the model: ● Electrical parameters monitoring such as I, U, Hz, THD ● Power/current demand, peak demand ● Time stamped alarms ● Minimum/maximum ● Up to 4 tariff managements ● Up to 2 digital inputs and 2 digital outputs

Degree of protection	● Front panel: IP 40 ● Casing: IP 20
Dimensions	W x H x D: 90 x 95 x 70 mm (3.54 x 3.74 x 2.76 in.)

For more information, refer to PM3200 series, Power Meters, User Manual, DOCA0006EN.

Wiring

Wiring example with three-phase system with 3 CTs (current transformers)
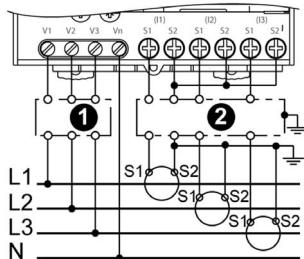
Power supply wiring: 100...277 Vac, 45...65 Hz
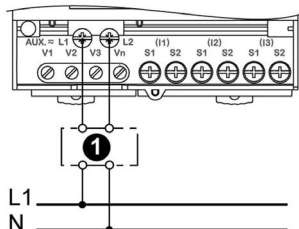
1 Protection containing a voltage disconnect switch with a fuse or disconnect circuit breaker
2 Shorting switch unit

Section 4.2
Safety Modules

What Is in This Section?

This section contains the following topics:

Preventa XPSAC Safety Module - Hardware

Front View

Preventa XPSAC safety module

Description

Safety module XPSAC is used for monitoring emergency stop circuits conforming to standards EN/ISO 13850 and EN 60204-1 and also meets the safety requirements for the electrical monitoring of switches in protection devices conforming to standard EN 1088/ISO 14119.

● 2 LEDs which provide information on the monitoring circuit status
● Manual or automatic start
● 3 enabling paths, 1 signaling path
● Feedback loop to monitor external contactors

Max. achievable safety level	PL e/Category 4 conforming to EN/ISO 13849-1 SILCL3 conforming to EN/IEC 62061
Standards and certifications	EN 60204-1, EN /ISO 14119, EN/ISO 13850, EN/IEC 60947-1 + A11, EN/IEC 60947-5-1, UL, CSA, BG
Power supply	24 Vdc 24…230 Vac
Outputs	Type of safety circuits: 3 Type of additional circuits: 1 solid state
Response time on input opening	< 100 ms
Degree of protection	Terminals: IP 20 Enclosure: IP 40
Dimensions	W x H x D: 22.4 x 99 x 114 mm (0.88 x 3.9 x 4.49 in.)
Options	Safety relay modules XPSECME and XPSECPE (for increasing the number of safety contacts)

For more information, refer to

- Preventa, Machine Safety Products, MKTED208051EN
- The essential guide: Preventa machine safety, DIA4ED2041204EN

Wiring

Module XPSAC associated with an emergency stop button with 2 NC contacts
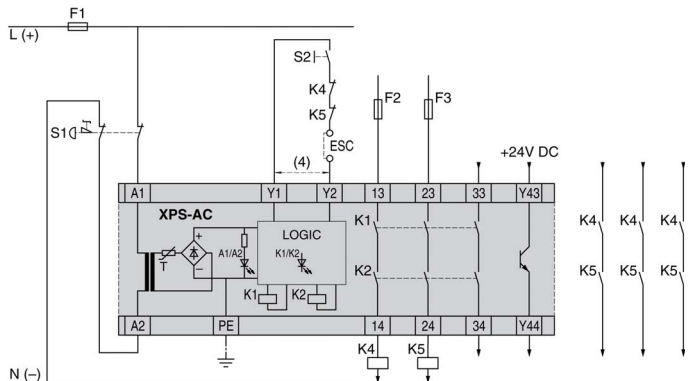
S1 Emergency stop
S2 Start button
Y1-Y2 Feedback loop
ESC External start conditions

Preventa XPSAV Safety Module - Hardware

Front View

Preventa XPSAV safety module

Description

Safety module Preventa XPSAV is used for monitoring emergency stop circuits conforming to standards EN/ISO 13850 and EN 60204-1 and also meets the safety requirements for the electrical monitoring of switches in protection devices conforming to standard EN 1088/ISO 14119.

● 11 LEDs which provide information on the monitoring circuit status
● Manual or automatic start
● Integrated stop category 1 time delay outputs
● Feedback loop to monitor external contactors

Max. achievable safety level	PL e/Category 4 conforming to EN/ISO 13849-1 SILCL3 conforming to EN/IEC 62061
Standards and certifications	EN 60204-1, EN 1088/ISO 14119, EN/ISO 13850, EN/IEC 60947-1, EN/IEC 60947-5-1, UL, CSA, BG
Power supply	24 Vdc
Outputs	Type of immediate opening safety circuits: 3 N.O. Type of time delay opening safety circuits: 3 N.O. Type of additional circuits: 3 solid state
Response time on input opening	< 30 ms
Degree of protection	Terminals: IP 20 Enclosure: IP 40
Dimensions	W x H x D: 45 x 99 x 114 mm (1.77 x 3.9 x 4.49 in.)
Options	Safety relay modules XPSECME and XPSECPE (for increasing the number of safety contacts)

For more information, refer to

- Preventa, Machine Safety Products, MKTED208051EN
- The essential guide: Preventa machine safety, DIA4ED2041204EN

Wiring

Module XPSAV associated with an emergency stop button with 2 NC contacts
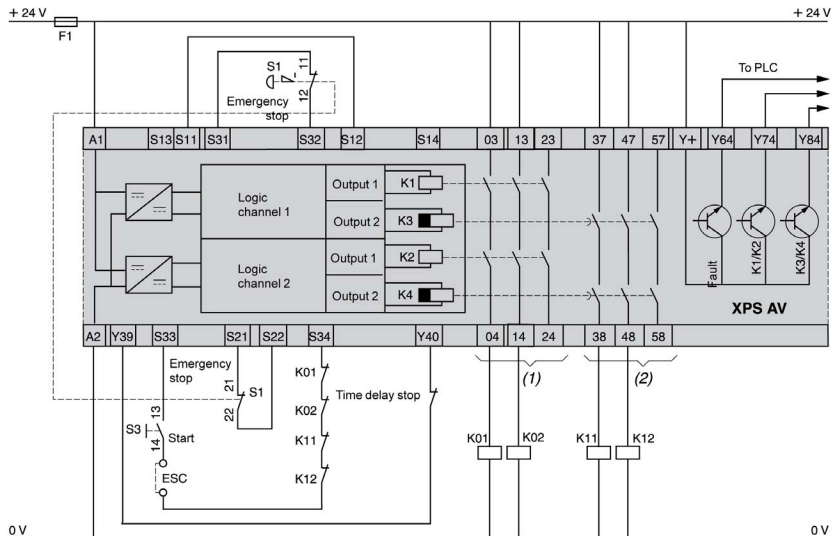
(1) Immediate opening safety outputs (stop category 0)
(2) Time delay opening safety outputs (stop category 1)
ESC External start conditions

Preventa Detection and Dialog - Hardware

Front View

Preventa product range

Description

The Preventa product range, offered under the Telemecanique Sensors brand, consists of safety detection products, safety dialog products, safety motor control products, safety automation products, and so on.

Preventa modules help to easily reach the required safety machinery and standards level in conformance with directives and standards.

The Preventa product range includes: Safety switches, limit switches, light curtains, emergency stop, foot switches, safety modules, and so on.

For more information, refer to
● Preventa, Machine Safety Products, MKTED208051EN
● The essential guide: Preventa machine safety, DIA4ED2041204EN

Section 4.3
HMI

What Is in This Section?

This section contains the following topics:

Topic	Page
Magelis HMI GTO - Hardware	77
Harmony ZBRN1/ZBRN2 Access Point - Hardware	79
Harmony Control and Signaling - Hardware	82

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
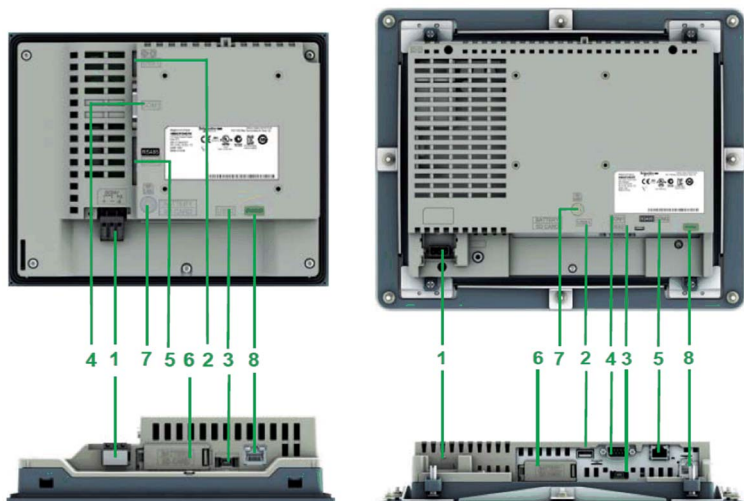
1	Removable screw terminal block for the 24 Vdc power supply	5	RJ45 connector for RS 485 serial link (COM2)
2	Type A USB host connector for connecting peripherals, transferring applications	6	Slot for SD memory card, with hinged cover
3	Mini-B USB connector for application transfer	7	LED indicating presence 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
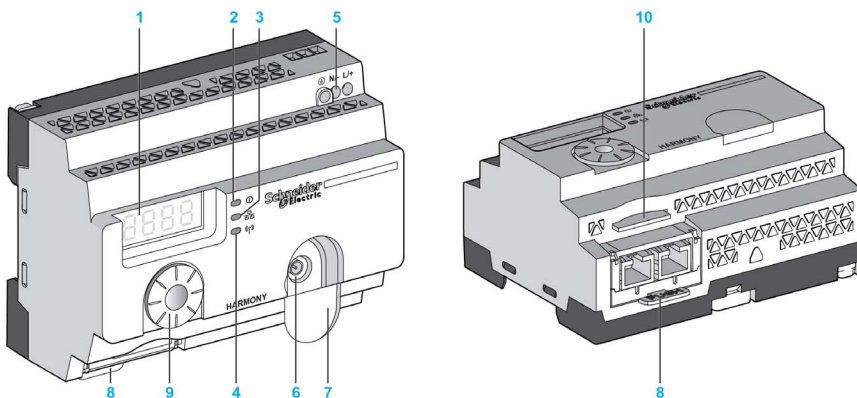
1	Four 7-segment displays with 5 LEDs	6	External antenna (optional) connector
2	Power LED	7	External antenna (optional) connector protective plug
3	Communication LED	8	• ZBRN1: Communication module inserted with 2 RJ45 Ethernet connectors • ZBRN2: 2 RJ45 Modbus RS 485 2 wire serial line connectors
4	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.
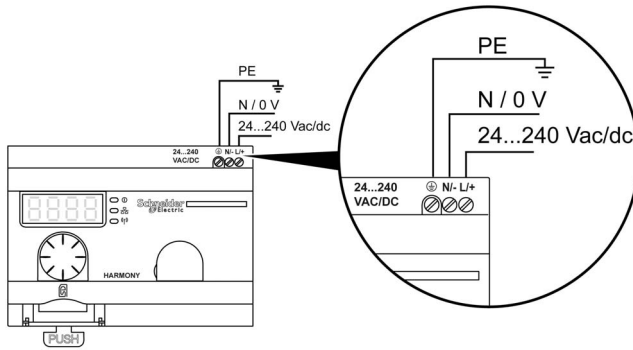
Harmony Control and Signaling - Hardware

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 M258 Logic Controller - Hardware

Front View

TM258LF42DT

Description

The Modicon M258 Logic Controller is a compact, high-performance, and fully expandable controller.

This controller is designed for machine manufacturers (OEMs) focusing on applications such as packaging, hoisting, conveying and storage, textiles and woodworking, and so on.

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

The SoMachine software, used to configure and program the Modicon M258 Logic Controller, supports the following IEC61131-3 programming languages for use with these controllers:
- IL: Instruction List
- LD: Ladder Diagram
- ST: Structured Text
- FBD: Function Block Diagram
- SFC: Sequential Function Chart
- CFC: Continuous Function Chart

The following communication functions, depending on the model, are supported by the controllers:
- CANopen Master
- Ethernet
- Serial line

All controllers support the following functions and I/O types:
- Expert functions (counting, reflex outputs...)
- Embedded I/Os

All controllers support up to 21 application program tasks with the following limits:
- 4 cyclic tasks: one is configured by default (MAST)
- 1 freewheeling task
- 8 software event driven tasks
- 8 hardware event driven tasks

Standard	IEC61131-2 ed. 3 2007
Agencies	UL 508, CSA 22.2 No. 142-M1987, CSA 22.2 No. 213-M1987
Rated voltage	24 Vdc
Voltage range	20.4…28.8 Vdc
Degree of protection	IP 20
Memory	RAM: 64 Mbytes (to execute the application) Flash: 128 Mbytes (to save in case of power outage)
Dimensions	Device-dependent (W x H x D): 175 - 262.5) x 99 x 85 mm [6.89 (10.33) x 3.9 x 3.35 in.]
Options	• TM5 communication modules via PCI (device dependent) • TM5 expansion modules

For more information, refer to :
- Modicon M258, Logic Controller, Hardware Guide, EIO0000000432 (ENG)
- Modicon M258, Logic Controller, Programming Guide, EIO0000000402 (ENG)

Interfaces

Device	PCI	CAN	USB A	USB Prg	Ethernet	Serial Line
TM258LD42DT	0	0	1	1	1	1
TM258LF42DT	0	1	1	1	1	1
TM258LD42DT4L	2	0	1	1	1	1
TM258LF42DT4L	2	1	1	1	1	1
TM258LF42DR	2	1	1	1	1	1
TM258LF66DT4L	2	1	1	1	1	1

Embedded I/Os

Device	Embedded Expert I/Os				Embedded Regular I/Os			
		Fast Inputs	Fast Outputs	Regular Inputs		Digital Inputs	Digital Outputs	Analog Inputs
TM258LD42DT	2x	5	2	2	1x	12	12	0
TM258LF42DT	2x	5	2	2	1x	12	12	0

Device	Embedded Expert I/Os			Embedded Regular I/Os			
		Fast Inputs	Fast Outputs	Regular Inputs		Digital Inputs	Digital Outputs	Analog Inputs
TM258LD42DT4L	2x	5	2	2	1x	12	12	4
TM258LF42DT4L	2x	5	2	2	1x	12	12	4
TM258LF42DR	2x	5	2	2	2x	6	6 relays	0
TM258LF66DT4L	2x	5	2	2	2x	12	12	4

You can expand the number of I/Os for your controller by adding Modicon TM5 expansion I/O slices.

Controller Components
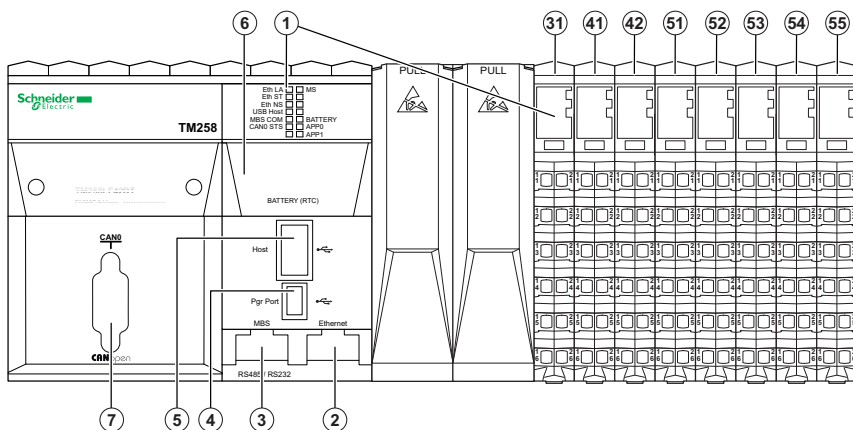
1	Display block with: ● 4 controller status LEDs ● 6 built-in communication port status LEDs	7	9-way male SUB-D connector for connection to the CANopen bus
2	RJ45 connector for connection to Ethernet network and/or connection to the Magelis HMI GTO graphic terminal	31	Controller power distribution module (CPDM)
3	RJ45 connector for RS-232 or RS-485 serial link	41, 42	Embedded expert I/O modules
4	USB-B mini-connector for connection to the programming PC	51 - 54	Embedded regular input/output modules

5	USB-A port for connection of a USB memory stick for transferring programs, data, or firmware updates	55	Embedded analog input module
6	Slot for the RTC (real time clock) battery	-	2 PCI slots in the middle (depends on the controller reference)

Wiring

Wiring example power distribution
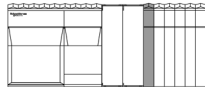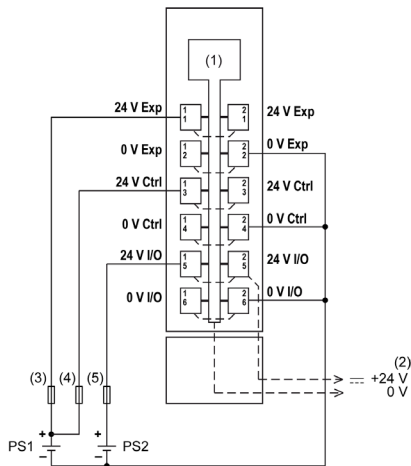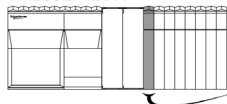
(1) Internal electronics
(2) 24 Vdc I/O power segment integrated into the bus bases
PS1/PS2 External isolated power supply 24 Vdc
(3) External fuse, type T slow-blow, 3 A 250 V
(4) External fuse, type T slow-blow, 2 A 250 V
(5) External fuse, type T slow-blow, 10 A max., 250 V

Wiring example embedded expert I/O (DM72F•)

TM258LD42DT
TM258LF42DT••
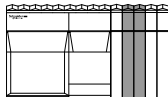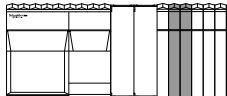
TM258LD42DT4L
TM258LF42DT4L••

TM258LF66DT4L••
TM258LF42DR••
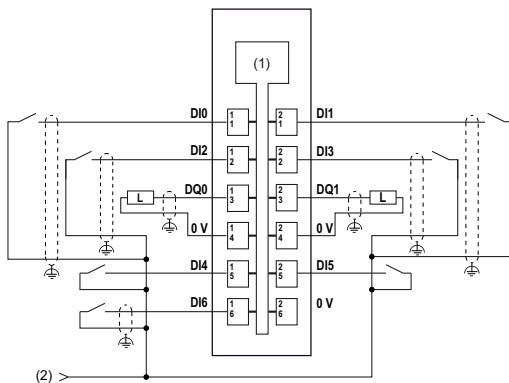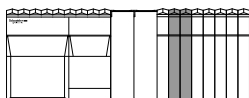
(1) Internal electronics
(2) 24 Vdc embedded expert modules power by external connection

Wiring example embedded expert I/O with encoder (DM72F•)

TM258LD42DT
TM258LF42DT••
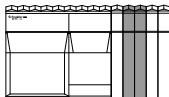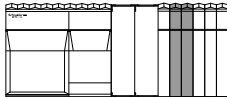
TM258LD42DT4L
TM258LF42DT4L••

TM258LF66DT4L••
TM258LF42DR••
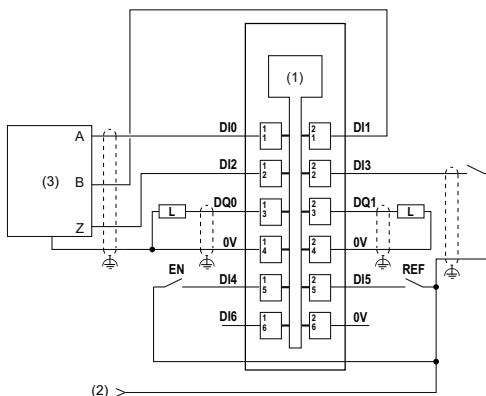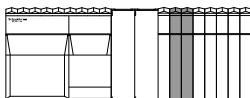
(1) Internal electronics
(2) 24 Vdc embedded expert modules power by external connection
(3) Encoder

Wiring example embedded regular I/O DI12DE

TM258LD42DT
TM258LF42DT●●

TM258LD42DT4L
TM258LF42DT4L●●

TM258LF66DT4L●●
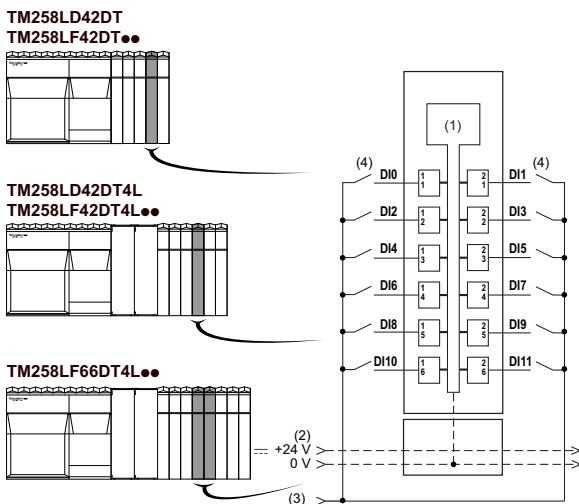
(1) Internal electronics
(2) 24 Vdc I/O power segment integrated into the bus bases
(3) 24 Vdc I/O power segment by external connection
(4) 2-wire sensor

Wiring example embedded regular I/O DO12TE
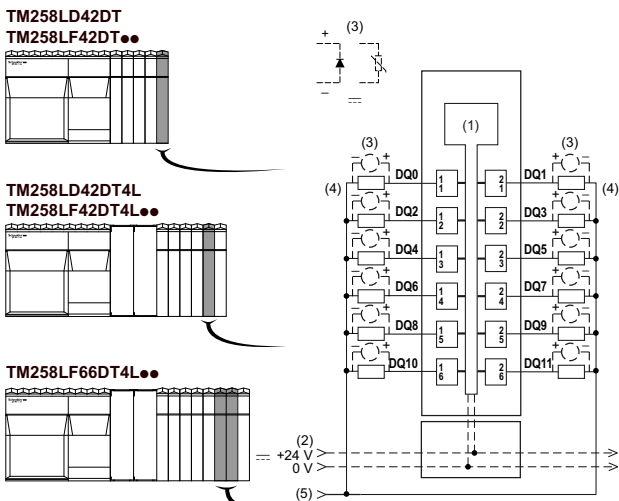
TM258LD42DT
TM258LF42DT●●

TM258LD42DT4L
TM258LF42DT4L●●

TM258LF66DT4L●●

(1) Internal electronics
(2) 24 Vdc I/O power segment integrated into the bus bases
(3) Inductive load protection
(4) 2-wire load

(5) 0 Vdc I/O power segment by external connection

Wiring example embedded regular I/O AI4LE
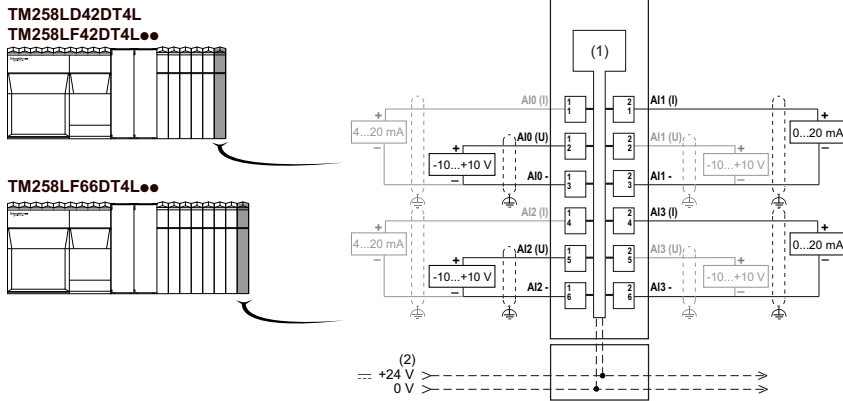
(1) Internal electronics
(2) 24 Vdc I/O power segment integrated into the bus bases
(I) Current
(U) Voltage

Modicon TM5 Modules - Hardware

Front View

Modicon TM5 Modules
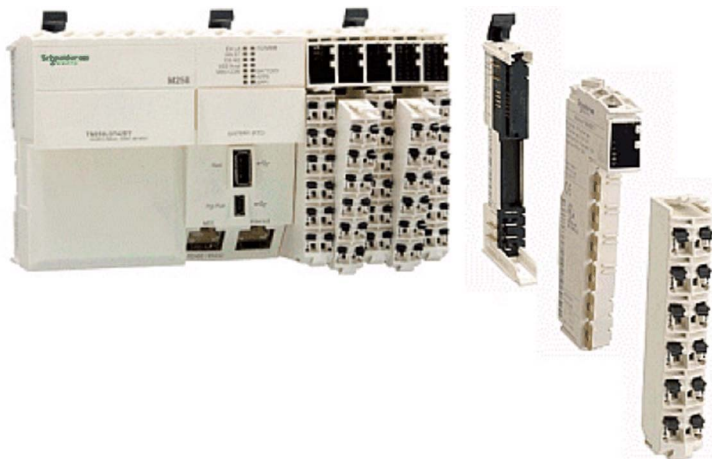
Description

The Modicon TM5 modular I/O system provides flexible and scalable configuration of expansions or distributed I/O islands by direct connection with Modicon M258 Logic Controller and Modicon LMC058 Motion Controller or via the CANopen bus. Characterized by easy wiring and maintenance, this modular I/O system offers a wide variety of modules that enables you to meet exactly their desired configuration for reducing costs and simplification.

Flexible and scalable I/O configuration:
- Distributed I/Os via the CANopen interface module, or local or remote expansion via the local TM5 expansion bus on Modicon M258 Logic Controller and Modicon LMC058 Motion Controller
- Wide range of I/O expansion modules: digital, analog, expert, non-functioning dummy, remote I/O module, and so on.

Simplified maintenance installation:
- Embedded diagnostics for local and distant supervision
- Hot swapping of I/O modules
- Wiring simplicity: spring terminals, removable terminal blocks

Save engineering time:
- Fully compatible with SoMachine software
- Certified FDT/DTM technology for all compatible automation software systems (on CANopen)

Standards and certifications	IEC 61131-2 ed. 3 2007, UL 508, CSA 22.2 No. 142-M1987, CSA 22.2 No. 213-M1987

Power supply	24 Vdc (white housings) 100…240 Vac (black housings)
Degree of protection	IP 20 conforming to IEC 61131-2
Dimensions	One assembled integral module (W x H x D): 12.5 x 99 x 75 mm (0.49 x 3.9 x 2.95 in.)

For more information, refer to :
- Modicon TM5 / TM7 Flexible System, System Planning and Installation Guide, EIO0000000426 (ENG).
- Modicon TM5, Digital I/O Modules, Hardware Guide, EIO0000000444 (ENG).
- Modicon TM5, Analog I/O Modules, Hardware Guide, EIO0000000450 (ENG).
- Modicon TM5, Expansion Modules DTM Configuration, Programming Guide, EIO0000000679.

Module Components
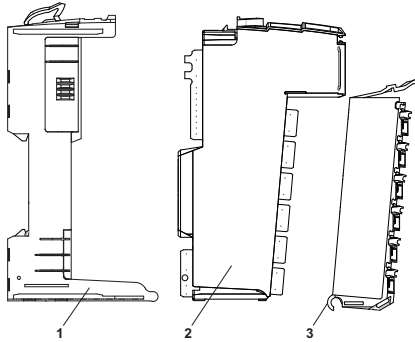
1 Bus base
2 Electronic module
3 Terminal block

Wiring

For a brief overview, refer to the 2 wiring examples below.

Wiring example TM5SDI6D
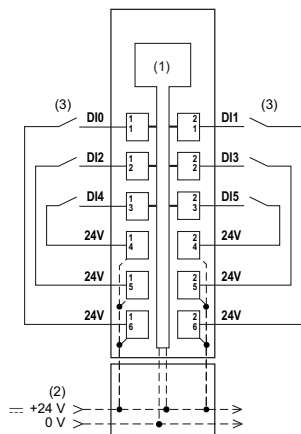
(1) Internal electronics
(2) 24 Vdc I/O power segment integrated into the bus bases
(3) 2-wire sensor

Wiring example TM5SDO6T
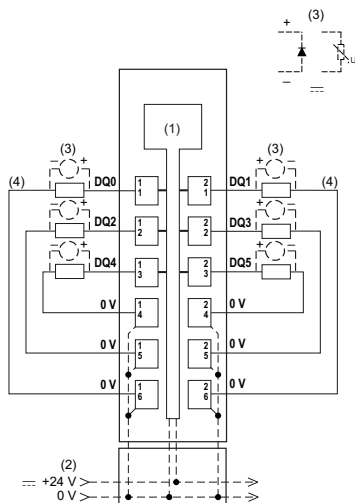
(1) Internal electronics
(2) 24 Vdc I/O power segment integrated into the bus bases
(3) Inductive load protection
(4) 2-wire load

Modicon TM5 CANopen Interface Module - Hardware

Front View

Modicon TM5 CANopen interface module

Description

The Modicon TM5 CANopen interface module provides CANopen access to distributed I/O.

The Modicon TM5 CANopen interface module allows the connection of distributed I/O islands like sensors and actuators that are distributed over machines via the CANopen fieldbus.

The TM5 CANopen interface module offer consists of 4 parts. These can be ordered separately or as kit.

- Bus base (TM5ACBN1)
- CANopen electronic interface module (TM5NCO1)
- Removable terminal block (TM5ACTB12PS)
- Power distribution electronic module (TM5SPS3)

The product reference for the kit is TM5NCO1K and includes all the 4 parts.

The modules can be mechanically assembled on the bus base before mounting on a symmetrical rail. These modules offer the following advantages:

- Removable terminal block
- Spring terminals for connecting the power supply of the interface module and the I/O expansion modules quickly, with no tools required. In addition, the quality of the spring terminals avoids the need for periodic retightening.

Standards and certifications	IEC 61131-2, CE, UL, CSA, GOST-R and C-Tick
Power supply	24 Vdc
Degree of protection	IP 20 conforming to IEC 61131-2
Dimensions	W x H x D: 37.5 x 99 x 75 mm (1.47 x 3.9 x 2.95 in.)

For more information, refer to :

- Modicon TM5 / TM7 Flexible System, System Planning and Installation Guide, EIO0000000426 (ENG).
- Modicon TM5 / TM7, CANopen Interface, Programming Guide, EIO0000000697 (ENG).
- Modicon TM5, CANopen Interface, Hardware Guide, EIO0000000691 (ENG).
- Modicon TM5, Expansion Modules DTM Configuration, Programming Guide, EIO0000000679.

Wiring
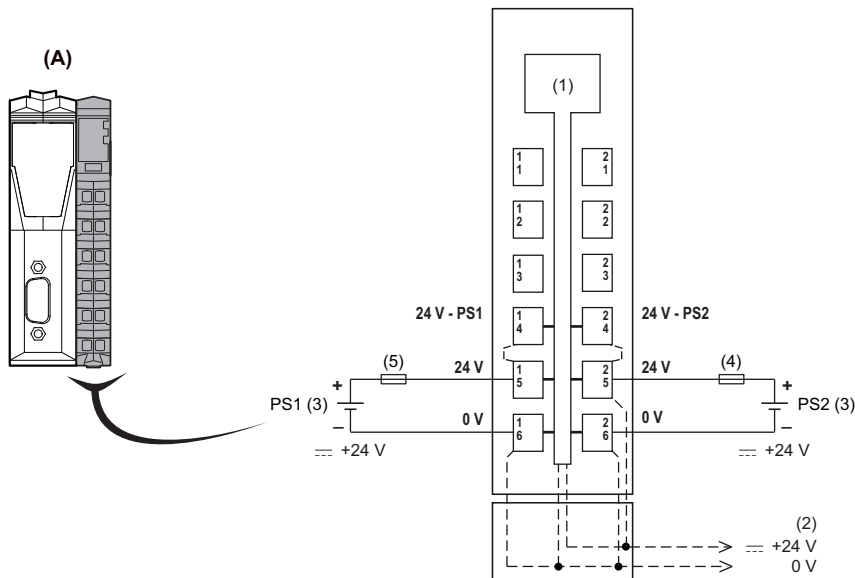
(A) Interface power distribution module (IPDM)
(1) Internal electronics
(2) 24 Vdc I/O power segment integrated in the bus bases
(3) PS1/PS2: External isolated power supply 24 Vdc
(4) External fuse, type T slow blow, 10 A max., 250 V
(5) External fuse, type T slow blow, 1 A, 250 V

The CANopen electronic interface module provides a SUB-D 9 port for the connection to the CANopen fieldbus.

Modicon TM7 CANopen Interface I/O Block - Hardware

Front View

Modicon TM7 CANopen interface I/O block
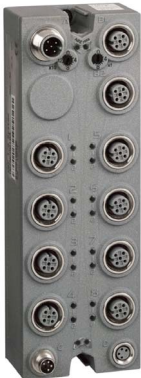
Description

With its robust design and maximum flexibility, the Modicon TM7 is a modular I/O system that is suitable for installation at the heart of a process or in harsh environments of machines controlled by the Modicon M258 Logic Controller or Modicon LMC058 Motion Controller.

The TM7 CANopen system is comprised of IP 67-rated components and provides CANopen access to distributed I/O.

The TM7 offer consists of fieldbus interface I/O blocks, expansion blocks, and accessories conforming to IP 67 (splashing water, oil, dust, and so on).

Additionally to the fieldbus interface function, the TM7 fieldbus interface I/O blocks provide:
- An integrated power supply
- Digital connections, which can be configured as inputs or outputs

Each model of fieldbus interface I/O blocks is distinguished by the fieldbus connectors, the number of I/O and its overall size (1 or 2).

The table describes the fieldbus interface I/O block references available for the TM7 system:

Device	Fieldbus Connection			Digital Channels		
	Type	In	Out	Number	Type	Connector
TM7NCOM08B	CANopen	Yes	No[1]	8	Input or output configurable	M8, 3-pin
TM7NCOM16A		Yes	Yes	16		M12, 5-pin
TM7NCOM16B		Yes	Yes	16		M8, 3-pin
[1] = To connect in a CANopen network use a Y-adapter (TM7ACYC or a TM7ACYCJ).						

Thanks to M8 and M12 connectors the Modicon TM7 CANopen interface provides easy installation and high flexibility.

Standards and certifications	IEC 61131-2 ed. 3 2007, UL 508, CSA 22.2 No. 142-M1987, CSA 22.2 No. 213-M1987, CE, cURus, GOST-R and C-Tick
Power supply	24 Vdc
Degree of protection	IP 67 conforming to EN/IEC 60529
Dimensions	2 sizes available (W x H x D): 53 x 85 mm or 155 x 42 mm (2.1 x 3.35 in. or 6.1 x 1.65 in.)

For more information, refer to :
- Modicon TM5 / TM7 Flexible System, System Planning and Installation Guide, EIO0000000426 (ENG).
- Modicon TM5 / TM7, CANopen Interface, Programming Guide, EIO0000000697 (ENG).
- Modicon TM7, CANopen Interface I/O Blocks, Hardware Guide, EIO0000000685 (ENG).
- Modicon TM7, Expansion Blocks DTM Configuration, Programming Guide, EIO0000000715.
- Modicon TM7, Expansion Blocks Configuration, Programming Guide, EIO0000000880.

Connectors

Front view of TM7NCOM16A
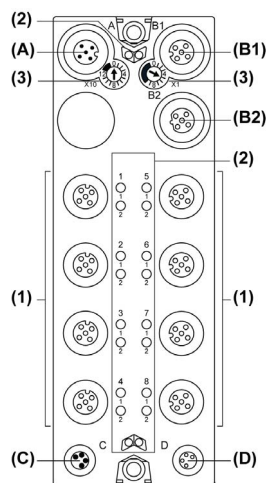
(A) CANopen bus IN connector
(B1) CANopen bus OUT connector
(B2) TM7 bus OUT connector
(C) 24 Vdc power IN connector
(D) 24 Vdc power OUT connector
(1) Input / output connectors
(2) Status LEDs
(3) Fieldbus settings rotary switches

Section 4.5
Communication

ConneXium Ethernet Switch (Unmanaged) - Hardware

Front View

5-port TCSESU053FN0 Ethernet switch (unmanaged)

Description

The ConneXium unmanaged Ethernet switch range offers you a smart and flexible way to integrate Ethernet solutions into your operation, from the device level to the control network and to your corporate network.

Unmanaged devices are those which there is no possibility to configure or control any of the parameters of the devices. They support Ethernet 10 Mbit/s and Fast Ethernet 100 Mbit/s.

Furthermore the switch modules support switched Ethernet networks in accordance with IEEE standard 802.3 or 802.3u using copper and fiber optic technology.

All switches are mounted on a standard DIN rail.

- 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
- Low-cost wiring solution

Standards and certifications	UL508, CSA 22.2 No.142, CE
Power supply	24 Vdc
Operating voltage	9.6...32 Vdc
Ports	3, 4, 5,8
Degree of protection	IP 30
Dimensions	W x H x D: 25 x 114 x 79 mm (0.98 x 4.49 x 3.1 in.) (TCSESU053FN0)

For more information, refer to ConneXium Ethernet Switches, TCSESU0••F•N0, Quick Reference Guide, 31007950.

Wiring

TCSESU053FN0 connector overview
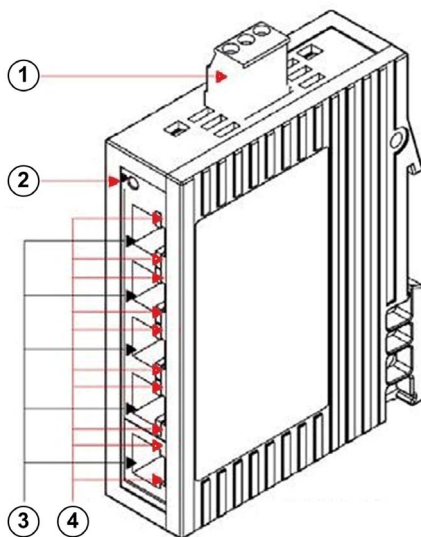
1 3-pin terminal block for power supply
2 Power indicator
3 10/100 base-TX (RJ45 connectors)
4 Port ACT/LNK LEDs

Section 4.6
Motor Control

What Is in This Section?

This section contains the following topics:

TeSys D Contactor - Hardware

Front View

TeSys D-LC1D contactor

Description

TeSys D-LC1D contactors are designed for all power switching, control applications, and integration into control systems.

They conform to standard IEC 60947-4-1, for utilization categories AC6b, as well as to UL/CSA standards.

This product constitutes a ready-to-use solution and offers you quick simple setup.

TeSys D contactors can be used to create motor starters for any type of application.

- AC, DC, and low-consumption DC control circuit
- All types of starter: reversing or non-reversing, star/delta, by auto-transformer, and so on.
- Various connectors: spring terminal, EverLink terminal block, screw clamp, ring-type connection, faston connector
- Easy and simple direct mounting between contactor and circuit breaker, according to EverLink terminal block (40...65 A)

Standards and certifications	IEC/EN 60947-4-1, IEC/EN 60947-5-1, UL 508, CSA C22.2 n° 14, UL, CSA, CCC, GOST, GL, DNV, RINA, VB, LROS
Rated operational current (Ie)I in AC-3 (Ue max. 440 V)	9…150 A
Rated control circuit voltage (Uc)	12(24*)…690(500*) Vac 12(24*)…440 Vdc *D115 and D150
Degree of protection (front face)	IP 20 (conforming to IEC 60529)
Protective treatment	"TH" (conforming to IEC 60068-2-30)

Dimensions	19 different types without add-on blocks or cover (WxHxD): 45…155 x 77…158 x 84…132 mm (1.77…6.1 x 3.0…6.22 x 3.3…5.2 in.)
Options	Various connector types, wide range of auxiliary contact blocks and modules, power connection accessories, suppressor modules

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

Wiring

TeSys D09…150 3-pole contactors wiring diagram
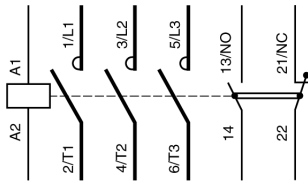
TeSys U LU2B Motor Starter- Hardware

Front View

TeSys U LU2B•• motor starter

Description

The TeSys U starter-controller is a D.O.L. starter which performs the following functions:

- Protection and control of single-phase or 3-phase motors:
  - isolation and breaking function
  - overload and short-circuit protection
  - thermal overload protection
  - power switching

- Control of the application:
  - protection function indication
  - application monitoring (running time, number of detected faults, motor current values, and so on)
  - logs (last 5 detected faults saved, together with motor parameter values)

These functions can be added by selecting control units and function modules which simply clip into the power base. This late customization is even possible after power and control circuit wiring has been completed.

TeSys U is a flexible range that meets the current and future needs of system builders, panel builders, and machine manufacturers, as well as those of additional systems.

From design through to operation, TeSys U offers many advantages and simplifies the selection of components in comparison with a traditional solution.

- The breaking, isolation, and contactor functions are incorporated in a single block. This means fewer references to be ordered and easy selection because a single reference covers all needs up to 15 kW.
- The control unit has a wide setting range. It can operate on a d.c. or a.c. supply.

The compact components in the TeSys U range are mounted on a single rail, so optimizing the amount of space required in enclosures. As power wiring between the circuit-breaker and contactor is not needed, TeSys U reduces installation times in enclosures.

Setting-up accessories simplify or completely save wiring between components, and allow easy selection and ordering.

With a capacity of up to 32 A/15 kW, TeSys U consists of:

- One 45 mm (1.77 in.) power base: 2 ratings, reversing or non-reversing, circuit-breaker function, and built-in interference suppression
- One clip-on control unit:
  - Standard CU: protection against overloads and short-circuits
  - Expandable CU: in addition alarm and fault differentiation
  - Multifunction CU: real-time control of motor load, local or remote diagnostics and parameter setting
- One clip-on automation control module: Modbus SL RS-485 2-wire, CANopen, AS-Interface, PROFIBUS DP, Ethernet, DeviceNet, Fipio, Interbus S via Advantys STB module or a simple parallel link
- 2 optional 45 mm (1.77 in.) power functions: limiter-isolator and changeover relay

Standards and certifications	IEC/EN 60947-6-2, CSA C22-2 N° 14, Type E, UL508 type E: with phase barrier LU9SP0, UL, CSA, CCC, Gost, ASEFA, ABS, BV, DNV, GL, LROS, ATEX
Power range	0…15 kW at 400 V
Rated insulation voltage	- Conforming to IEC/EN 60947-1, overvoltage category III: 690 V - Conforming to UL508, CSA C22-2 n° 14: 600 V
Degree of protection	- Front panel outside connection zone: IP 40 - Front panel, wired terminals, and other faces IP 20
Dimensions	W x H x D: LUB: 45 x 154 (224*) x 135 mm (1.77 x 6.1 (8.8*) x 5.3 in.) *LU2B (reversible)
Options	- 4 different control units - Detected fault signaling modules - Communication modules - Auxiliary contact modules - Load level modules - Reverser block - Plug-in terminal blocks - Control circuit pre-wiring system

For more information, refer to :

- Control and protection components, MKTED210011EN
- TeSys U, Starter-controllers, Catalogue, DIA1ED2081003EN

Components

TeSys U - non-reversing
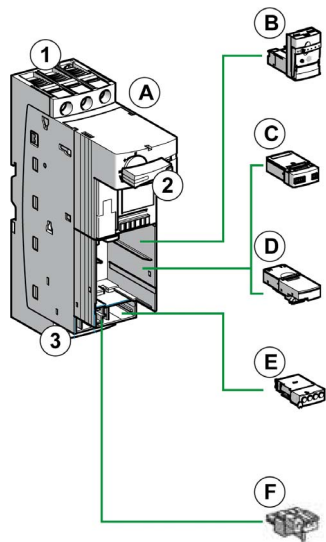
1   Power supply terminal block
2   On/Off/Reset control handle
3   "Motor" terminal block
A   Power base
B   Control units
C   Auxiliary contact modules (LUF), thermal overload signaling, detected fault signaling modules, or load level modules
D   Communication modules
E   Auxiliary contact module (LUA)
F   Terminal block

TeSys U - reversing
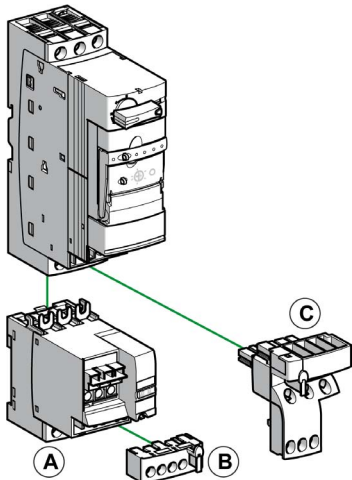
A Reverser block
B Plug-in terminal blocks
C Control circuit pre-wiring system

A preassembled reversing power base can be ordered by a specific part number.

Wiring

TeSys U - reversing
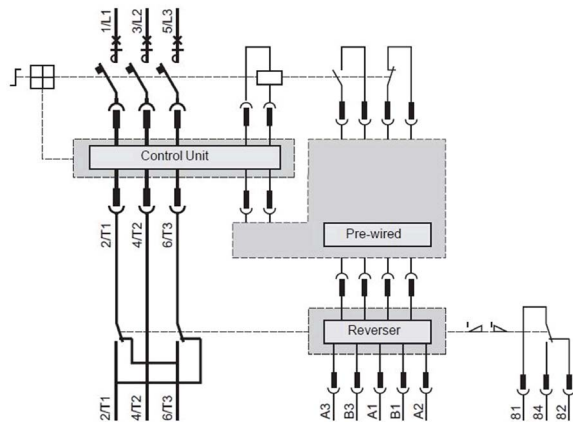
TeSys GV2 Motor Circuit Breakers - Hardware

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 diverse characteristics following is presented only the GV2 P, which is integrated into the TVDA.

The TeSys GV2 P motor circuit-breakers are 3-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: Fault 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
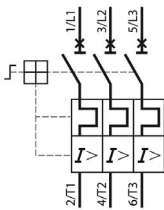
Altivar 32 Variable Speed Drive - Hardware

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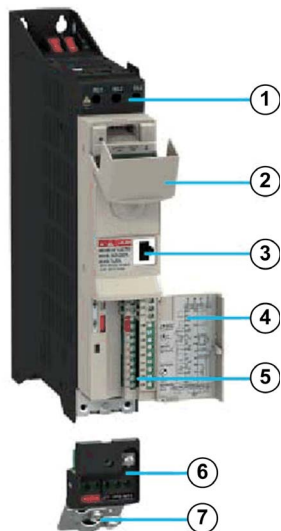
1 Power terminals
2 Protective cover
3 RJ45 Modbus SL RS-485 2-wire
4 Protective cover
5 Control terminals
6 Removable motor power terminal block
7 EMC mounting plate

Wiring example power supply and motor

(1) Line choke (if used)

(2) Fault detected relay contacts

Wiring example control terminals
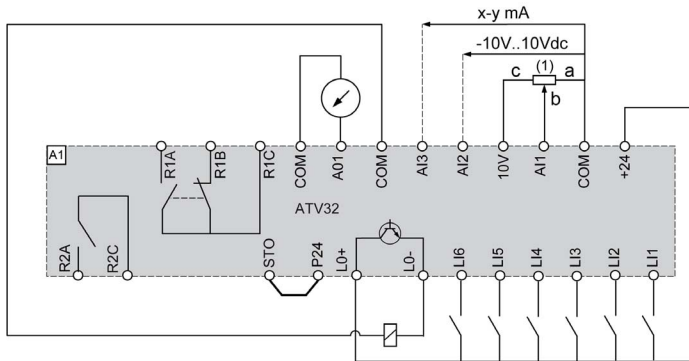
(1) Reference potentiometer SZ1RV1202 (2.2 kΩ) or similar (10 kΩ maximum)

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
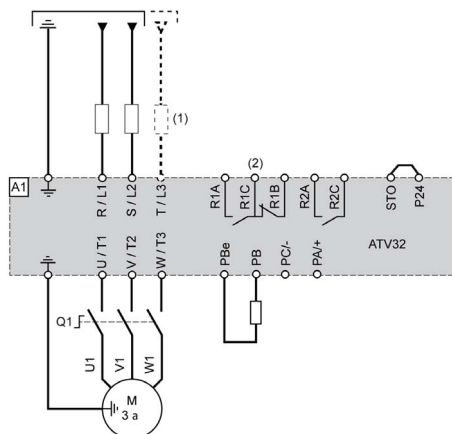
Wiring

Wiring example power supply and motor
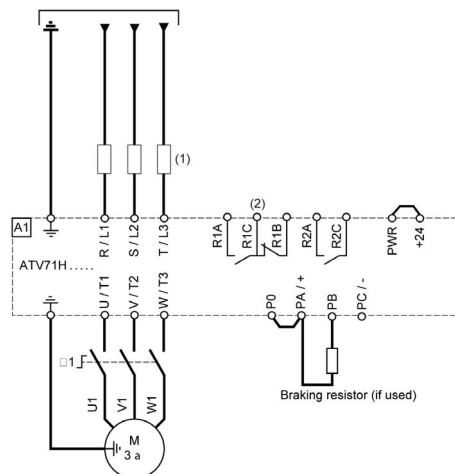
1 Line chock (if used)
2 Fault detected relay contacts for remote signaling of drive status

Wiring example control terminals
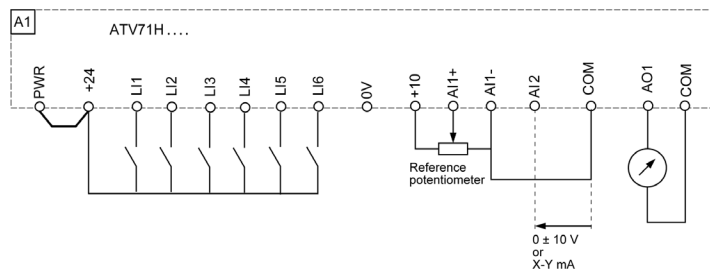
Lexium 32A Servo Drive - Hardware

Front View

Lexium 32A 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.

- Integrated "Safe Torque Off" function
- Extra slim book format
- Easy to configure and set up with SoMove software
- Homogeneous mounting and wiring systems
- High-performance communication system
- Built in Bluetooth as standard
- Can be configured with the power off in its original packaging.
- Configurations can be transferred remotely via mobile phone using SoMove Mobile software.

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	• Modbus SL RS-485 2-wire • CANopen, CANmotion machine bus • built in Bluetooth as standard
Operating modes	• homing • manual mode (JOG) • speed control • current control • position control
Functions	• auto-tuning, monitoring, stopping, conversion • stop window • rapid entry of position values
I/Os	• 3 logic inputs (24 Vdc) • 1 capture input (24 Vdc) • 2 logic outputs (24 Vdc)
Protections	"Safe Torque Off" STO
Sensor	SinCos Hiperface sensor
Degree of protection	IP 20
Dimensions	3 types (WxHxD) • 48 x 270 x 225 mm (1.89 x 10.63 x 8.86 in.) • 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 LXM32A, AC servo drive, Product manual, 0198441113755 (ENG).

Wiring

Lexium 32A connector overview
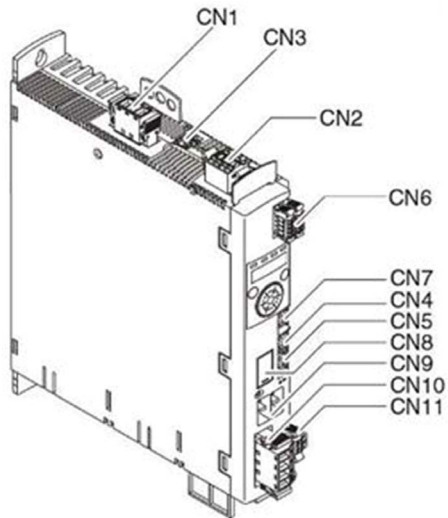
Connector	Description
CN1	power stage supply
CN2	24 controller power supply and STO function
CN3	motor encoder (encoder 1)
CN4	CAN
CN5	CAN
CN6	digital inputs/outputs
CN7	Modbus SL RS-485 2-wire (commissioning interface)
CN8	external braking resistor
CN9	DC bus connection for parallel operation
CN10	motor phases
CN11	holding brake

Wiring example Lexium 32A on CANopen
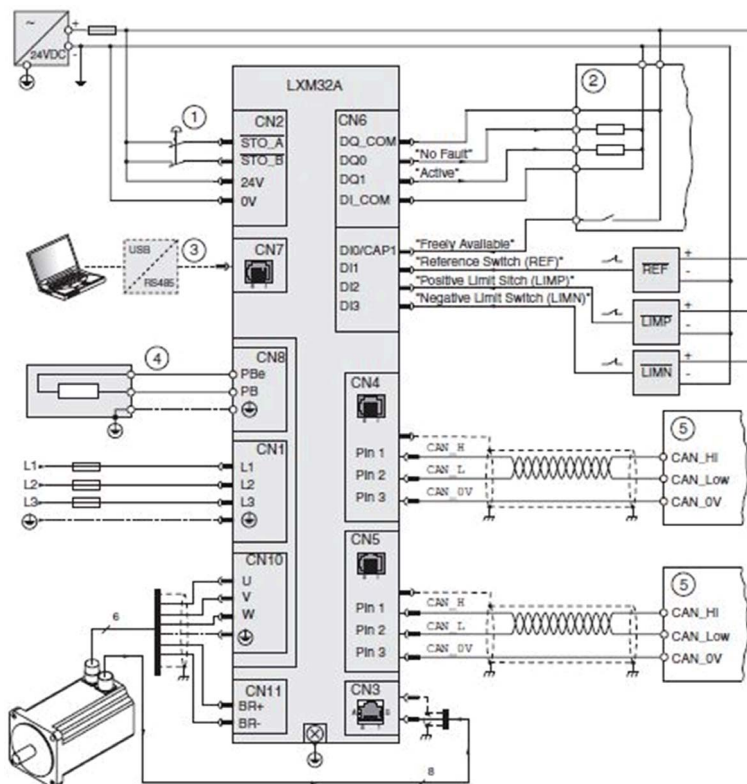
1 Emergency stop
2 PLC
3 Commissioning accessories
4 External braking resistor
5 CANopen fieldbus device

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 3K3 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 3K3, 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 ILA Integrated Drive - Hardware

Front View

Lexium ILA integrated drive

Description

The Lexium integrated drives integrate motor, positioning controller, power electronics, fieldbus, and protection function in a single compact device.

3 different motor technologies propose a great versatility. The Lexium ILA integrated drive AC servo motor offers a high dynamic performance and precise positioning.

Preferred applications for the integration of the Lexium ILA integrated drive are: Printing machines, packaging machines, labeling machines, electronic manufacture, or medicinal technology.

- Compact design
- Various fieldbus interfaces are available
- High dynamic performance
- Precise positioning
- Integrated "Safe Torque Off"
- Easy installation and commissioning: 25 % reduction in installation time, 40 % decrease in wiring

Standards and certifications	IEC 61800-5-2, TÜV Nord, UL
Fieldbus and networks	CANopen, PROFIBUS DP, proprietary RS 485 2-wire, DeviceNet, EtherCAT, EtherNet/IP, Modbus TCP, Ethernet Powerlink
Nominal power	150…370 W
Nominal speed	500…9000 rpm

Nominal torque	0.26…0.78 Nm
Torque	0.25…0.66 Nm
Peak torque	0.43…1.26 Nm
Positioning resolution	0.022°
Operating modes	homing, electronics gear, profile position, profile velocity
Type of sensor (resolution given for the drive-motor combination)	single-turn SinCos encoder (16,384 pulses/rev) multi-turn SinCos encoder (16,384 pulses/rev x 4096 revolutions)
Flange size	57 mm (2.24 in.)
Configuration	baud rate, network address, and terminating resistor via DIP switch; 4 configurable I/Os (for example, as limit switch or stop input)
Degree of protection	• shaft bushing: IP 41 • shaft bushing with GBX gear (accessory): IP 54 • housing, except shaft bushing: IP 54
Protections	"Safe Torque Off" as per IEC/EN 61800-5-2 and performance level "d" (PLd) according to ISO 13849-1
Power section line supply	24/36/48 Vdc
Dimensions	3 different types (W x H x D): 57.2 x 92.2 x 145.3…190.8 mm (2.25 x 3.63 x 57.2…75.12 in.)

For more information, refer to ILA1B, ILA1F, ILA1R, Lexium Integrated Drive, Product manual, 0198441113562 (ENG).

Wiring

Lexium ILA integrated drive
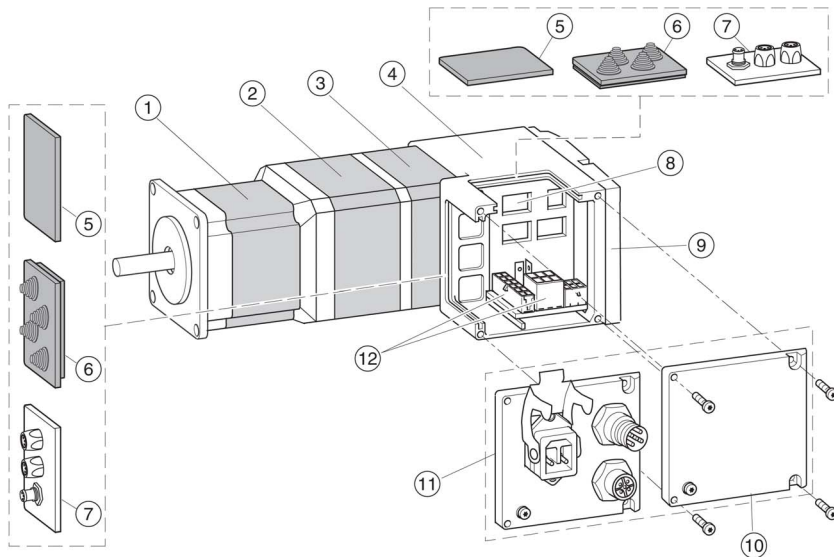
1	Synchronous AC servo motor	7	I/O insert with industrial connector (accessory)
2	Holding brake (optional)	8	Switches for settings
3	Encoder	9	Cover of electronics housing (not to be removed)
4	Electronics housing	10	Cover of connector housing (to be removed for installation)
5	Insert for sealing (accessory)	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 ILA connector overview

CN1	Supply voltage Vdc ● VDC: supply voltage ● 0VDC: reference potential to Vdc	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 preassembled for the connection to the electrical interface on the integrated drive.

Wiring example
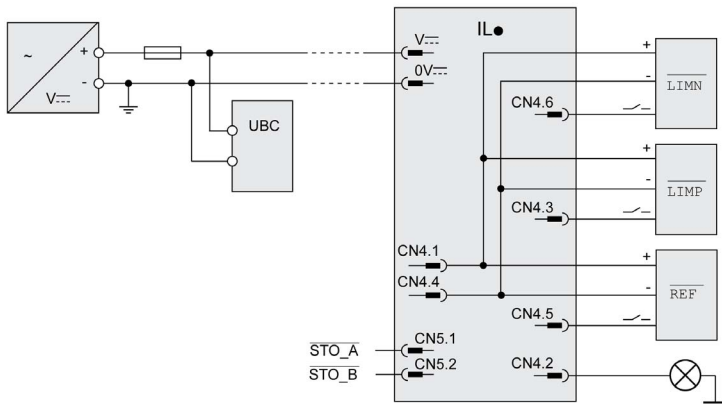
Lexium 32i Servo Drive - Hardware

Front View

Lexium 32i servo drive

Description

With servo motor, servo drive, power supply connector, and I/O and fieldbus module integrated in one housing, the compact Lexium 32i (integrated) is designed for application areas requiring high precision and advanced motor control.

The modular components of the product family Lexium 32i (integrated) can be composed to meet the requirements of a great variety of applications. Minimum wiring as well as a comprehensive range of options and accessories allowing to implement compact, high-performance drive solutions for a wide range of power requirements. Typical application areas for the integration of the Lexium 32i (integrated) are: Material handling, material working, packaging, printing, and so on.

- Easy selection of the cataloged components using the on-line configurator
- Easy to integrate thanks to standard fieldbusses and standard software
- No cabinet space needed for the drive
- Reduce costs by up to 30%
- Easy to assemble and to maintain
- Memory cards allow for copying of parameters and fast device replacement

Standards and certifications	TÜV Nord, UL, CSA, CiA (CAN in automation)
Power range	0.6 (0.8*)…1.3 (2.2*) kW *3-phase

Voltage range	1-phase, 115...240 Vac 3-phase, 400...480 Vac
Speed	up to 3600 rpm
Torque	up to 7.8 Nm
Communication	Modbus serial link, CANopen, CANmotion, EtherCAT
Operating modes	Homing, manual mode (JOG), speed control, current control, position control
Functions	- Auto-tuning, monitoring, stopping, conversion - Stop window - Rapid entry of position values
I/Os	4 logic inputs (24 Vdc) 2 logic outputs (24 Vdc)
Protections	"Safe Torque Off" (STO)
Degree of protection	- Casing: IP 65 - Shaft end: IP 54 or IP 65
Flange size	70/100 mm (2.76/3.94 in.)
Options	2 drive control units 18 motors with power stage - various connector modules - SoMove setup software - Memory card - Sealing ring - External braking resistors

For more information, refer to LXM32iCAN BMi, Lexium 32 Integrated, Product manual, 0198441113950 (ENG).

Assembly

Lexium 32i components
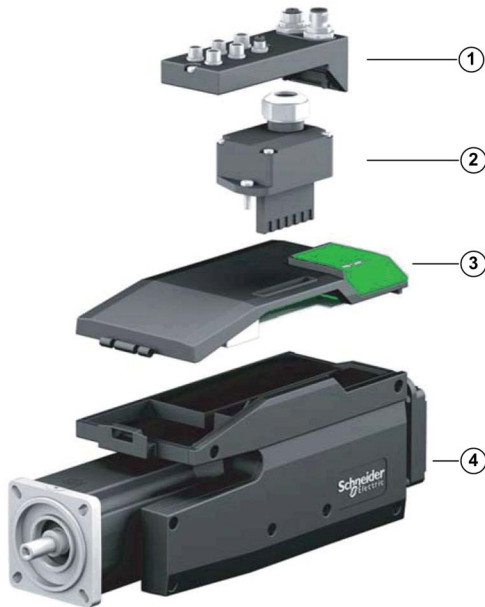
1 I/O and fieldbus connector module
2 Power supply connector module
3 Drive control unit
4 Motor with power stage

Wiring

Wiring example
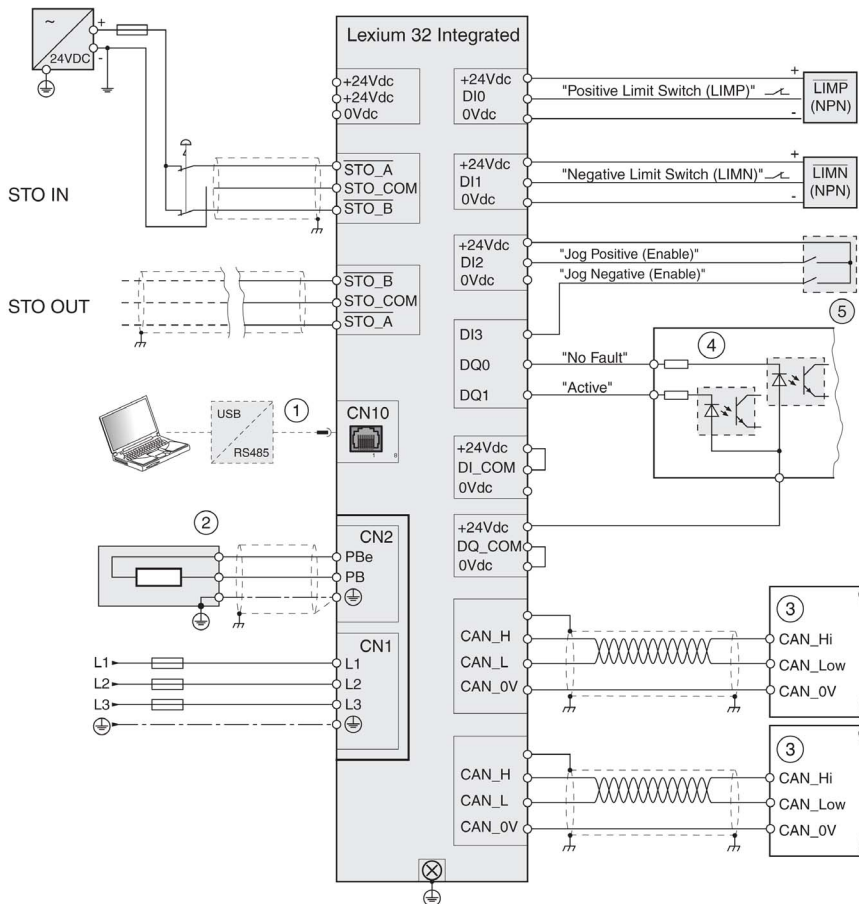
1 Commissioning accessories
2 Standard or external braking resistor
3 CANopen bus device
4 Signal lights or inputs of the PLC
5 Test box for commissioning

Zelio SSR - SSRP Solid-State Relay - Hardware

Front View

Zelio SSR - SSRP solid-state relay

Description

Zelio SSR - SSRP solid-state relays are designed for heating control, motion control, lighting control, and switching applications.

They conform to standard IEC 62314, IEC 60950-1, UR E258297, and CSA LR 40787 standards.

SSRP range of solid-state relays are panel mounted. They can be used either on their own or combined with a heat sink for applications requiring considerable heat exchange.

As solid-state switching, SSRP offers:
- Extended service life - offering more reliability
- Complete silence when switching - providing suitability for buildings and hospital applications
- High switching frequency - particularly on packaging and textile machines.

Rated operational current (AC)	10...125 A
Rated operational current (DC)	12…40 A
Control voltage range (AC)	90...280 V
Control voltage range (DC)	3...32 V
Load voltage range (AC)	• 24…280 V • 48…530 V • 48…600 V
Load voltage range (DC)	3…100 V
Degree of protection	IP 20
Operating temperature range	-40...+80 ° C (-40...+176° F)
Dimensions	W x H x D: 47.2 x 58.4 x 35.5 mm (1.86 x 2.23 x 1.4 in.)

- SSRP offers SCR (semiconductor controlled rectifier) outputs
- SSRP offers combination of DC control and AC, DC load voltage.
  AC control and AC load voltage.

For more information, refer to Electromechanical and solid-state relays, Zelio relay, Catalog, DIA5ED2120404EN.

Wiring

Wiring example

Section 4.7
Detection

What Is in This Section?

This section contains the following topics:

OsiSense XCC Encoder - Hardware

Front View

OsiSense XCC encoders

Description

The rotary encoder is an angular position sensor, which is mechanically coupled to a driving spindle of a machine. A wide range of opto-electronic rotary encoder types is offered under the Telemecanique Sensors brand. These are the incremental encoders and the absolute encoders in single-turn and multi-turn model.

Incremental encoders provide counting indication (A, B and index signal) and can be applied for counting, positioning by counting and speed evaluation.

Absolute encoders provide an absolute position within each revolution in terms of binary or Gray code. The multi-turn encoders indicate in addition to the position value the number of revolutions. They can be applied for absolute positioning.

Encoders are offered with M23 connectors or as pre-cabled versions with 2 m long shielded cables. Preferred machines for the integration of the encoders are: Packaging, cranes, automatic dispensers, and so on.

Certifications	CE
Output type	Incremental encoders: ● 5 Vdc output driver RS422 ● Push-pull output driver (based on supply voltage) Single-turn absolute encoders: ● Push-pull output driver, 11…30 Vdc, binary code, or gray code ● SSI output without parity, 13-bit clock, 11…30 Vdc, binary code, or gray code Multi-turn absolute encoders: ● SSI output without parity, 25-bit clock, 11…30 Vdc, binary code, or gray code

Supply voltage	Incremental encoders: ● Push-pull: 5 or 11…30 Vdc ● RS422: 4.5...5.5 Vdc or 4.75...30 Vdc Absolute encoders: ● 11…30 Vdc
Degree of protection	Based on the selected type:IP 52, IP 54, IP 66, IP 67 or IP 69 K
Maximum resolution	Incremental encoders: ● 100…10.000 points Absolute encoders: ● 8192 points/4096 turns ● 4096 points/8192 turns
Maximum rotational speed	Diameter of shaft <12 mm (0.47 in.): 9000 rpm Diameter of shaft ≥12 mm (0.47 in.): 6000 rpm
Type of shaft	Solid shaft or through shaft
Diameter of shaft	6…30 mm (0.24…1.18 in.)
Diameter of housing	40 mm*, 58 mm, or 90 mm (1.57 in.*, 2.28 in., or 3.54 in.) *only incremental encoders
Options	Cables, connectors, deserialization jumper cables, mounting and mounting accessories

For more information, refer to OsiSense XCC, Rotary Encoders, Catalog, 9006CT1101.

OsiSense XCC CANopen Multi-Turn Absolute Encoder - Hardware

Front View

OsiSense XCC CANopen multi-turn absolute encoder

Description

The rotary encoder is an angular position sensor, which is mechanically coupled to a driving spindle of a machine. A wide range of optoelectronic rotary encoder types is offered under the Telemecanique Sensors brand. To these belong the absolute multi-turn encoders with CANopen connectivity.

The CANopen encoder provides 2 M12 connectors for the fieldbus IN/OUT connection. The power to the encoder is supplied directly through a separate cable entry on each base.

Preferred machines for the integration of the OsiSense XCC CANopen multi-turn absolute encoder are: Packaging, cranes, automatic dispensers, and so on.

Certifications	CE
Supply voltage	11…30 Vdc, maximum ripple: 500 mV
Degree of protection	IP 64
Maximum resolution	8192 points/4096 turns (No. of bits 25)
Maximum rotational speed	6000 rpm
Type of shaft	Solid shaft
Diameter of shaft	10 mm (0.39 in.) solid shaft
Dimensions	W x H x D: 58 x 66 x 110 mm (2.28 x 2.6 x 4.33 in.)

For more information, refer to :
- OsiSense XCC, Rotary Encoders, Catalog, 9006CT1101
- OsiSense XCC, CANopen Multi-Turn Absolute Encoder, User's Manual, 169002302

Wiring

Connection base
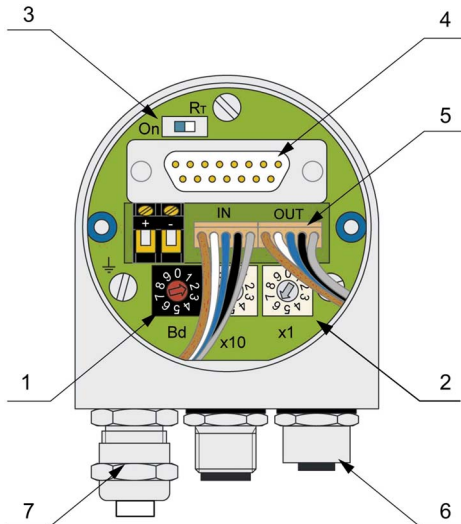
1 Rotary switches (CANopen baud rate setting)
2 Rotary switches (CANopen address setting)
3 Switch (termination resistor)
4 15-pin female SUB-D (to encoder)
5 Terminals (power supply and CANopen)
6 2 x M12 A-coded connectors (CANopen IN/OUT)
7 Cable gland (24 Vdc power supply)

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 3 different communication networks.

- CANopen
  The CANopen fieldbus is defined with the Modicon M258 Logic Controller as CANopen master. The Altivar drives, Modicon TM5 I/O island, Lexium drives (Lexium 32A, Lexium ILA and Lexium 32i), TeSys U, and CANopen encoder are CANopen slave nodes.
  The CANopen transmission rate is 500 kbps.
- Ethernet
  The Modicon M258 Logic Controller, the Magelis HMI GTO and the Harmony ZBRN1 access point are linked to the Ethernet network. The Ethernet network is the physical layer for the protocols used in the architecture.
  The communication between the controller and the HMI is realized via SoMachine network protocol and the communication between the controller and the Harmony access point uses the Modbus TCP protocol.
- Modbus SL
  The Modbus SL RS-485 2-wire network is used for the communication between the Modicon M258 Logic Controller (Master) and the power meter PM3250 (Slave).

Section 5.2
CANopen/CANmotion Network

What Is in This Section?

This section contains the following topics:

CANopen Network Topology

CANopen Topology

The baud rate used is 500 kbps.

#... node address
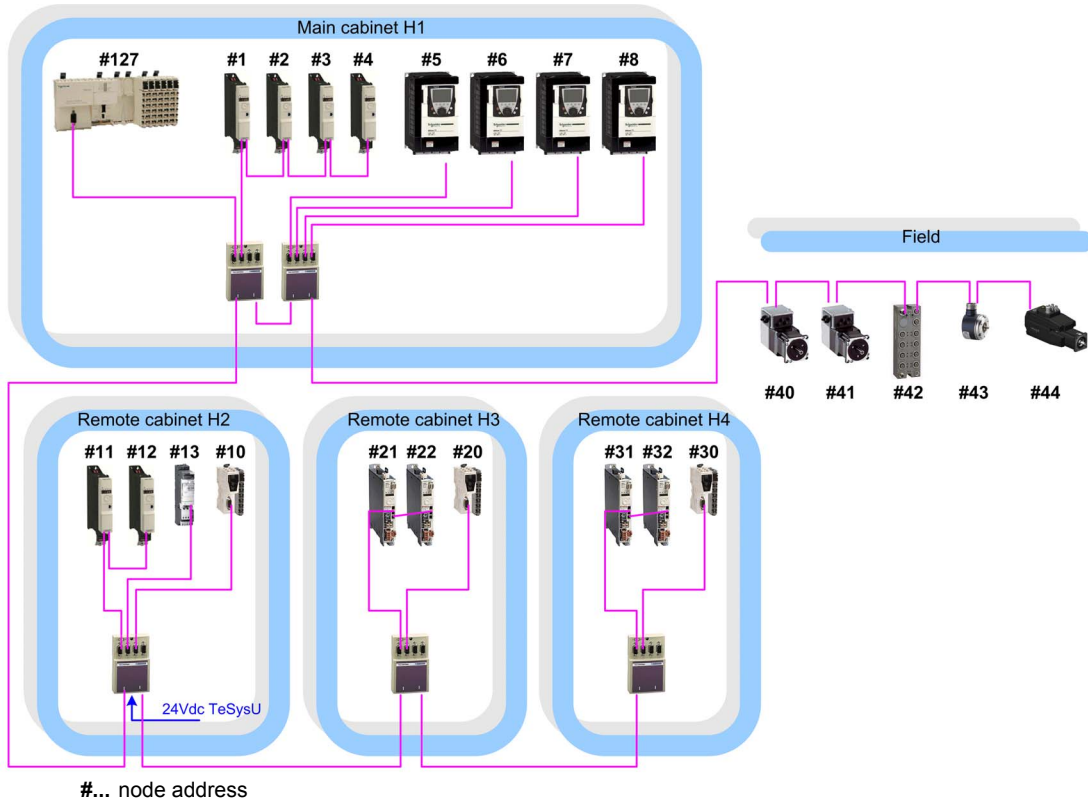
CANopen Network Wiring

CANopen Overview
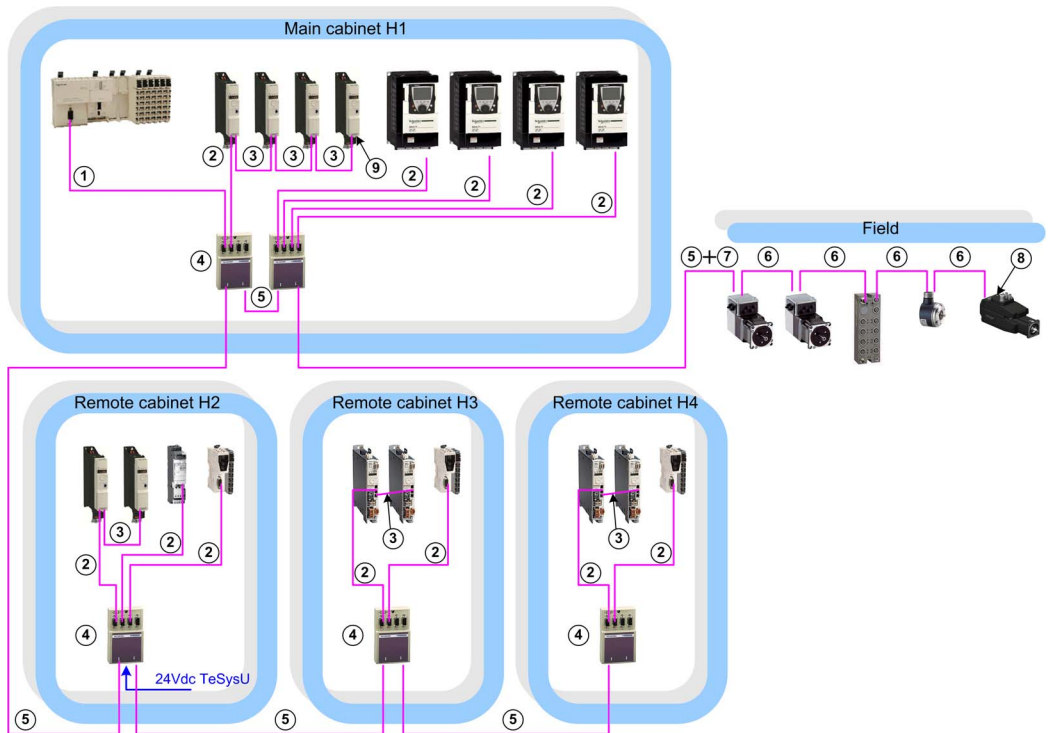
For the position numbers, refer to table below.

For more information, refer to CANopen, Hardware Setup Manual, 35010857.

CANopen Wiring

Reference	Designation	Description	Position	Cable Length
TSX CAN CADD03	preformed cordset standard, CE marking: low smoke emission, zero halogen. flame-retardant (IEC 60332-1)	one 9-way female SUB-D connector at each end	1	0.3 m (0.98 ft)
TSX CAN CADD1				1.0 m (3.28 ft)
TSX CAN CADD3				3.0 m (9.84 ft)
TSX CAN CADD5				5.0 m (16.40 ft)

Reference	Designation	Description	Position	Cable Length
TCS CCN 4F3M05T	preformed cordset	one 9-way SUB-D connector, one RJ 45 connector	2	0.5 m (1.64 ft)
TCS CCN 4F3M1T				1.0 m (3.28 ft)
TCS CCN 4F3M3T				3.0 m (9.84 ft)
VW3 CAN CARR03	preformed cordset	one RJ 45 connector at each end	3	0.3 m (0.98 ft)
VW3 CAN CARR01				1.0 m (3.28 ft)
TSX CAN TDM4	IP20 CANopen tap junction	4 SUB-D ports, screw terminal block for connecting the trunk cables, line termination	4	-
TSX CAN CA•••	dedicated to the European market low smoke emission, zero halogen, fire retarding	CANopen cable	5	50 m (164 ft)
TSX CAN CB•••	dedicated to the American market, UL and CSA certified, fire retarding			100 m (328 ft)
TSX CAN CD•••	flexible cable for severe environments, good chemical resistance to oil and grease, low smoke emission, zero halogen, fire retarding and ready for mobile applications			300 m (984 ft)
FTX CN 3203	preformed cordset	two 5-way M12 A-coded angled connectors (one male connector and one female connector)	6	0.3 m (0.98 ft)
FTX CN 3206				0.6 m (1.96 ft)
FTX CN 3210				1.0 m (3.28 ft)
FTX CN 3220				2.0 m (6.56 ft)
FTX CN 3230				3.0 m (9.84 ft)
FTX CN 3250				5.0 m (16.40 ft)
FTX CN 12F5	IP67 M12 connectors	5-way M12 A-coded connectors female	7	–
FTX CNTL12	IP67 line terminator	equipped with one M12 connector (for end of bus)	8	–
TCS CAR 013M120	IP20 line terminator	RJ 45 termination resistor (for end of bus)	9	–
TSX CAN KCDF90T	IP20 connectors CANopen female 9-way SUB-D, switch for line termination	90° angled	–	–
TSX CAN KCDF180T		straight		
TSX CAN KCDF90TP		right angle with 9-way SUB-D for connecting a PC or diagnostic tool		

IP67 M12 Cable Connector

Schneider Electric provides 2 types of IP67 M12 connectors:

male	FTX CN 12M5
female	FTX CN 12F5

IP67 M12 cable connector (5-pin M12 male BUS IN, female BUS OUT):

Pin assignment of the BUS IN and BUS OUT connector pins:

Pin	Signal	Meaning
1	(CAN_SHLD)	optional CAN shield
2	(CAN_V+)	optional CAN external positive supply
3	CAN_GND	CAN ground
4	CAN_H	CAN_H bus line
5	CAN_L	CAN_L bus line

The wiring connections has to comply with the combinations described in the table above.

SUB-D 9 Cable Connectors

Schneider Electric provides the following types of SUB-D 9 cable connectors:

Schneider Electric Cable Connector	Characteristics
TSX CAN KCDF90T	90° cable
TSX CAN KCDF180T	180° cable
TSX CAN KCDF90TP	● 90° lead ● male connector available for temporary connection of a diagnostic tool

The figure below shows the wiring of TSX CAN KCDF90T, TSX CAN KCDF180T and TSX CAN KCDF90TP:
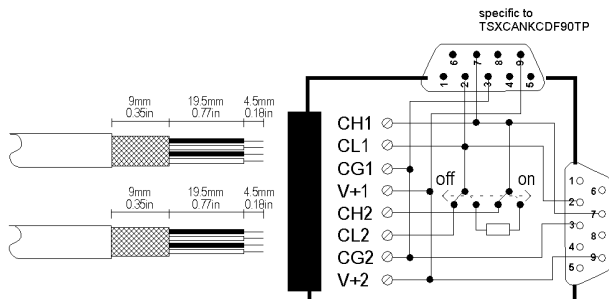
When using the Schneider Electric standard CANopen cable (TSX CAN CA•••, TSX CAN CB••• or TSX CAN CD•••),comply with the wiring combinations (signal, wire color) described in the table below.

The table shows terminal block wiring depending on the signal:

Pin	Signal	Terminal Block 1, Incoming Cable	Terminal Block 2, Outgoing Cable	Wire Color	Meaning
1	N.C.	–	–	–	not connected
2	CAN_L	CL1	CL2	blue	CAN_L bus line
3	CAN_GND	CG1	CG2	black	CAN ground
4	N.C.	–	–	–	not connected
5	(CAN_SHLD)	–	–	–	optional CAN shield
6	GND	–	–	–	ground, connection to pin 3
7	CAN_H	CH1	CH2	white	CAN_H bus line
8	N.C.	–	–	–	not connected
9	(CAN_V+)	V+1	V+2	red	optional CAN external positive supply

The wiring connections has to comply with the combinations described in the table above.

TSX CAN TDM4

The TSX CAN TDM4 tap allows connection of 4 devices by branching the drop cable to the 4 male SUB-D 9 plugs.

A line termination switch is provided to switch a built-in termination resistor. If the line termination switch is switched ON, the signals CAN_H and CAN_L of the outgoing cable are disconnected.

TSX CAN TDM4 with line termination switch
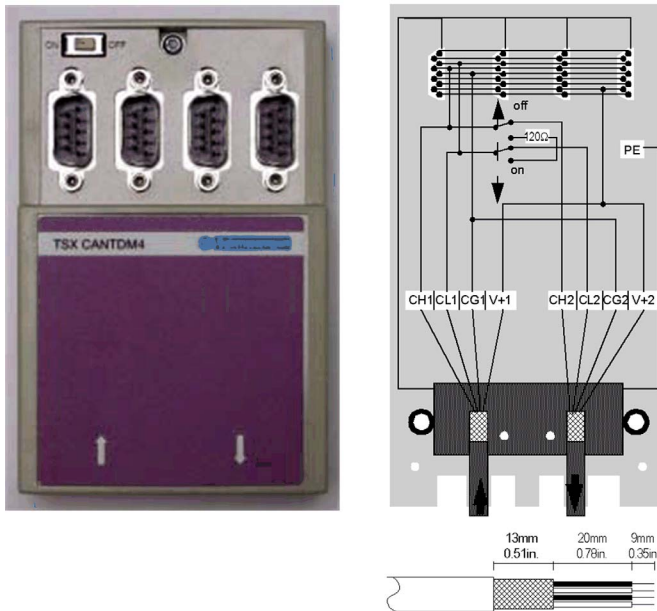
The wiring connections has to comply with the combinations described in the following table.

The table shows terminal block wiring depending on the signal:

Signal	Terminal Block 1	Terminal Block 2	Wire Color	Description
CAN_H	CH1	CH2	white	CAN_H bus line
CAN_L	CL1	CL2	blue	CAN_L bus line
CAN_GND	CG1	CG2	black	CAN ground
CAN_V+	V+1	V+2	red	optional CAN external positive supply

NOTE: When using devices which require a 24 Vdc power supply on CANopen line (such as TeSys U) the 24 Vdc power has to be wired (V+1: 24 Vdc, CG1: 0 Vdc).

Modicon M258 Logic Controller - CANopen Wiring

CANopen Ports
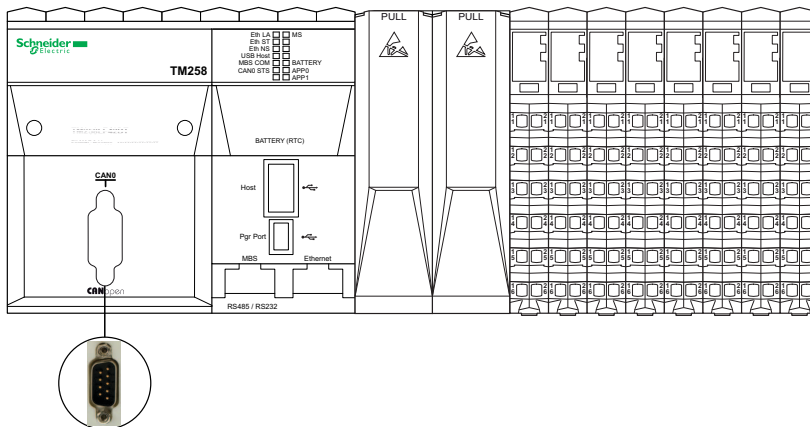
Pin Assignment
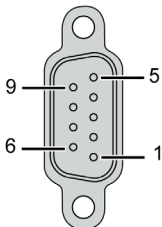
Pin	Designation	Description
1	N.C.	not connected
2	CAN_L	CAN_L bus line (low)
3	CAN_GND	CAN ground
4	N.C.	not connected
5	N.C.	not connected
6	GND	0 Vdc
7	CAN_H	CAN_H bus line (high)
8	N.C.	not connected
9	N.C.	not connected

CANopen Interface Module TM5NCO1 - CANopen Wiring

Overview
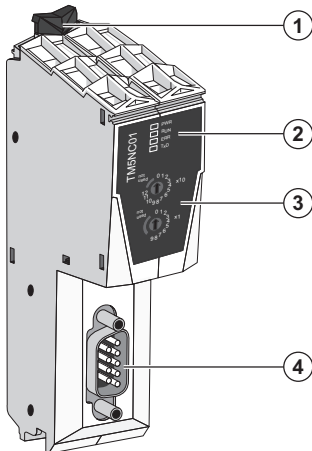
1 Locking clip
2 Status LEDs
3 CANopen address setting rotary switches
4 CANopen bus connector (SUB-D 9)

Refer to SUB-D 9 cable connectors .

Address Setting

The CANopen interface module address (from 1 to 126, decimal) is configured using the 2 CANopen address settings rotary switches. The factory setting of the rotary switches is 0.

NOTICE

UNINTENDED EQUIPMENT OPERATION

Do not use an address outside of the specified range (from 1 to 126).

Failure to follow these instructions can result in equipment damage.

To reset the CANopen interface module, remove power and provide a correct address before reapplying power to the module.

TM5NCO1 CANopen rotary switches:
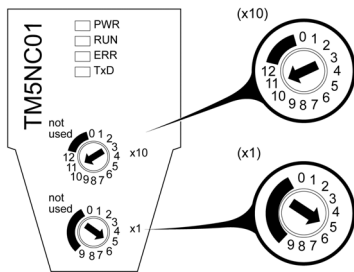
(x10) High-order rotary switch: represents the 'tens' of the CANopen address
(x1) Low-order rotary switch: represents the 'ones' of the CANopen address

The positions of the rotary switches in the figure above define the node address 115 for the device.

Baud Rate

The baud rate is detected automatically by the device.

CANopen Interface I/O Block TM7NCOMx - CANopen Wiring

Overview

Connector assignment
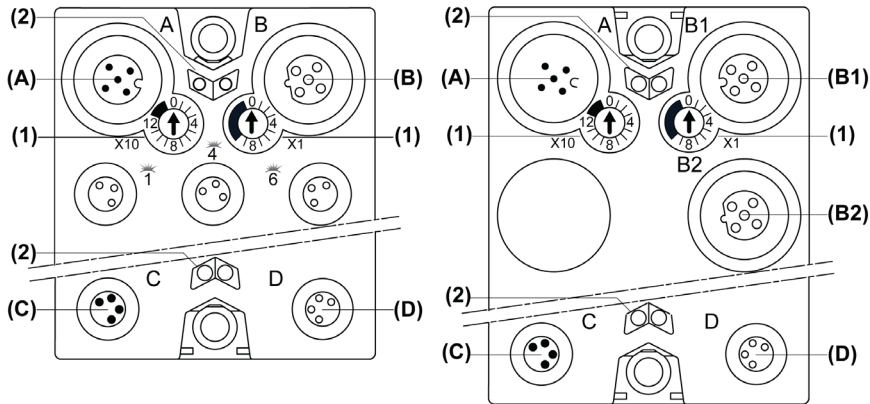
(A) CANopen bus IN connector M12
(B) and (B2) TM7 bus OUT connector M12
(B1) CANopen bus OUT connector M12
(C) 24 Vdc power IN connector
(D) 24 Vdc power OUT connector
(1) Address settings rotary switches
(2) Status LEDs

Refer to IP67 M12 cable connector *(see page 145)*.

Address Setting

The CANopen interface block address (from 1...126, decimal) is configured using the 2 CANopen address settings rotary switches. The factory setting of the rotary switches is 0.

NOTICE

UNINTENDED EQUIPMENT OPERATION

Do not use an address outside of the specified range (from 1 to 126).

Failure to follow these instructions can result in equipment damage.

To reset the CANopen interface block, remove power and provide a correct address before reapplying power to the block.

TM7NCOMx CANopen rotary switches:

(x10) High-order rotary switch: represents the 'tens' of the CANopen address
(x1) Low-order rotary switch: represents the 'ones' of the CANopen address

The positions of the rotary switches in the figure above define the node address 115 for the device.

Baud Rate

The baud rate is detected automatically by the device.

TeSys U Communication Module LULC08 - CANopen Wiring

Bottom View

Bottom view of a TeSys U communication module LULC08
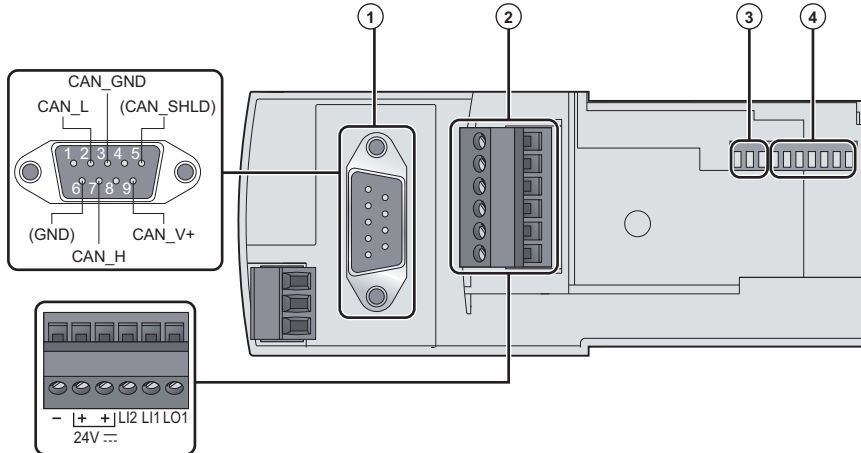
1 CANopen SUB-D 9 connector
2 Input/output terminal block and 24 Vdc
3 Baud rate
4 Address

NOTE: The 24 V power supply of the LULC08 is internally connected to the CAN_V+ pin of the CANopen connector. If you do not use the CANopen sensor power supply for your application, do not connect the CAN_V+ wire to pin 9.

Address Setting

The address of the communication module on the CANopen bus is the node ID. The system allows you to assign an address from 1 to 127, using the 7 right-most switches (SW1 to SW7). Address 0 (zero) is not allowed and is considered as an invalid configuration.

Example: Node address = 21 ($2^4+2^2+2^0$)

SW7 (2^6)	SW6 (2^5)	SW5 (2^4)	SW4 (2^3)	SW3 (2^2)	SW2 (2^1)	SW1 (2^0)
OFF	OFF	ON	OFF	ON	OFF	ON

Baud Rate

The system allows you to assign a baud rate using the 3 left-most switches (SW8 to SW10). The baud rate is according to the decimal value of the switches and will be interpreted as follows: 0 = 10, 1 = 20, 2 = 50, 3 = 125, 4 = 250, 5 = 500, 6 = 800 and 7 = 1000 kbps.

Example: Baud rate = 500 kbps (2^2+2^0)

SW10 (2^2)	SW9 (2^1)	SW8 (2^0)
ON	OFF	ON

Altivar 32 Variable Speed Drive - CANopen Wiring

Altivar 32 with Dual RJ45 Connector (VW3 A36 08)

For this architecture, the Altivar 32 variable speed drive has been equipped with the CANopen communication adapter VW3 A36 08 (dual RJ45 connector).

Using this adapter allows to daisy chain the CAN bus between the Altivar 32 drives.

NOTE: Maximum bus length are divided by 2 with the communication adapter (VW3 A36 08)

Both RJ45 are interconnected internally as on the diagram below:
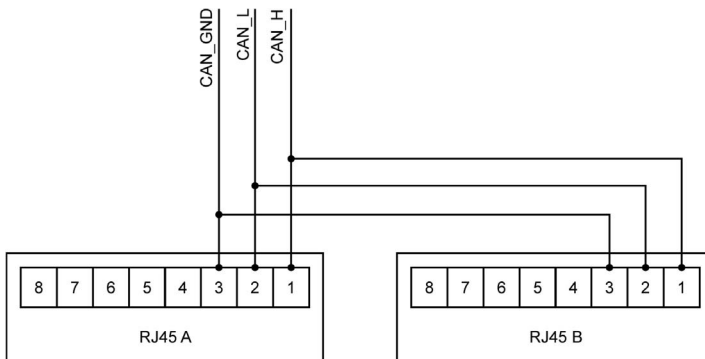
Pin Assignment

Pin	Signal	Description
1	CAN_H	CAN_H bus line
2	CAN_L	CAN_L bus line
3	CAN_GND	CAN ground
4	N.C.	not connected
5	N.C.	not connected
6	N.C.	not connected
7	N.C.	not connected
8	N.C.	not connected

Communication Settings

The Altivar 32 has to be configured for the operation on the CANopen fieldbus (node address, baud rate, and control channel). This can be done either via the local HMI on the front or via a commissioning software, for example, SoMove Lite.

Altivar 71 Variable Speed Drive - CANopen Wiring

Altivar 71 with CANopen and Modbus Port
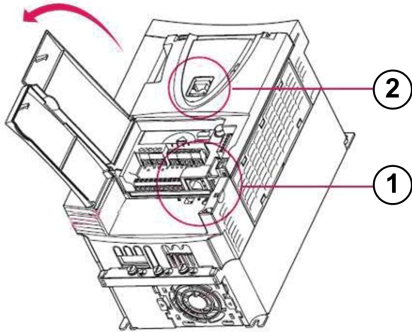
1 CANopen/Modbus port
2 Modbus terminal port (HMI)

NOTE: In case of CANopen, the CANopen tap TSX CAN TDM4 is used to connect the VSD drive to the CANopen bus via RJ45 socket.

Pin Assignment

RJ45 socket
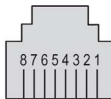
Pin	Signal	Description
1	CAN_H	CAN_H bus line
2	CAN_L	CAN_L bus line
3	CAN_GND	CAN ground
4	D1	Modbus SL: D1 (+/B) RS-485 2-wire
5	D0	Modbus SL: D0 (-/A) RS-485 2-wire
6	N.C.	Not connected
7	VP10S	power over Modbus SL: 10 V / max. 150 mA supplier
8	SNG	Modbus SL signal ground / reference to VP 10S

Communication Settings

The Altivar 71 has to be configured for the operation on the CANopen fieldbus (node address, baud rate, and control channel). This can be done either via the local HMI on the front or via a commissioning software, for example, SoMove Lite.

Lexium ILx1Fxxx Integrated Drive - CANopen Wiring

Overview

Lexium IL•1F•••

Pin Assignment
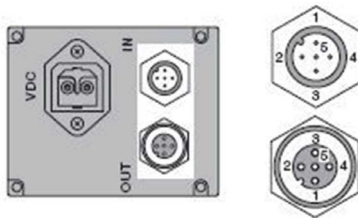
Pin	Signal	Description
1	`CAN_SHLD`	CAN shield
2	N.C.	not connected
3	`CAN_GND`	CAN ground
4	`CAN_H`	CAN_H bus line
5	`CAN_L`	CAN_L bus line

Parameter Switches
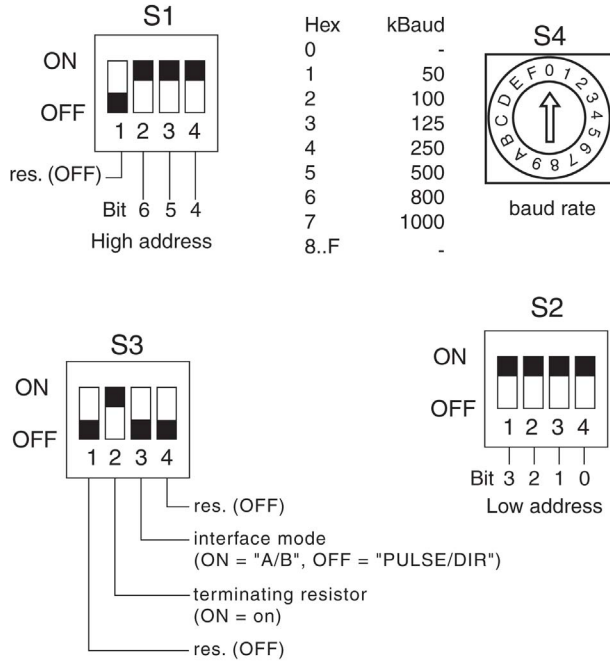
Address Setting

The node address has to be assigned by the switches on S1 and S2 (see figure above).

Example: Node address = 21 ($2^4+2^2+2^0$)

Switch	S1.2	S1.3	S1.4	S2.1	S2.2	S2.3	S2.4
Address bit	6 (2^6)	5 (2^5)	4 (2^4)	3 (2^3)	2 (2^2)	1 (2^1)	0 (2^0)
State	OFF	OFF	ON	OFF	ON	OFF	ON

Baud Rate

The baud rate for the CANopen communication has to be assigned using the rotary switch S4 (see figure above).

Terminating Resistor

The terminating resistor is already integrated and can be activated at the end of the network with the switch S3.2 (see figure above).

Lexium 32A Servo Drive - CANopen Wiring
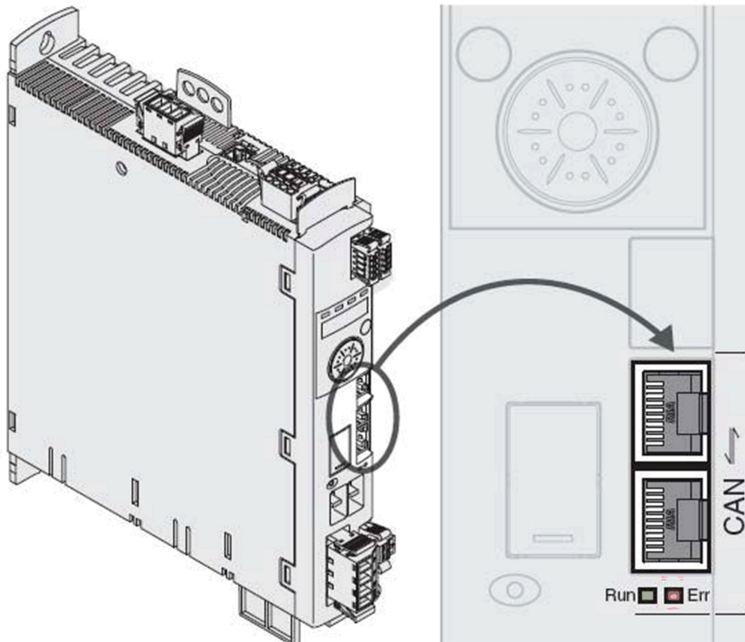
Overview

Pin Assignment

Pin	Signal	Description
1	CAN_H	CAN_H bus line
2	CAN_L	CAN_L bus line
3	CAN_GND	CAN ground
4	N.C.	not connected
5	N.C.	not connected
6	N.C.	not connected
7	N.C.	not connected
8	N.C.	not connected

Communication Settings

The Lexium 32A has to be configured for the operation on the CANmotion bus (node address, baudrate, and control channel). This can be done either via the local HMI on the front or via a commissioning software, for example, SoMove Lite.

Lexium 32i Servo Drive - CANopen Wiring

Overview
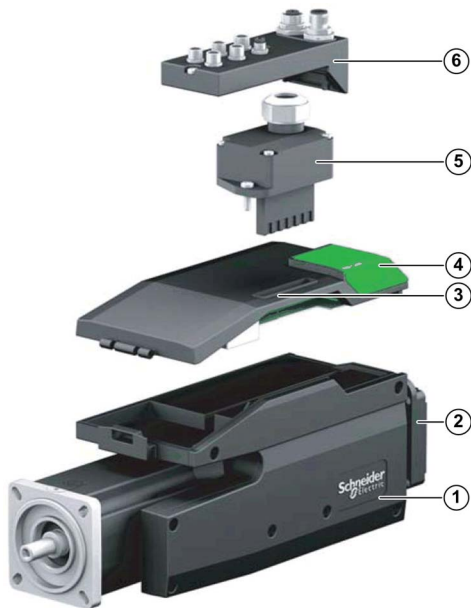
1 BMi servomotor with integrated power stage
2 Standard braking resistor or connection module for external braking resistor
3 Lexium 32i control unit for CAN fieldbus
4 Cover of commissioning interface
5 Connection module for supply voltage
6 I/O module / connection module for fieldbus, inputs/outputs and STO, versions with terminal box or industrial connector

I/O Module with Industrial Connectors

1 SHLD
2 NC
3 CAN_0V
4 CAN_H
5 CAN_L

1 SHLD
2 NC
3 CAN_0V
4 CAN_H
5 CAN_L
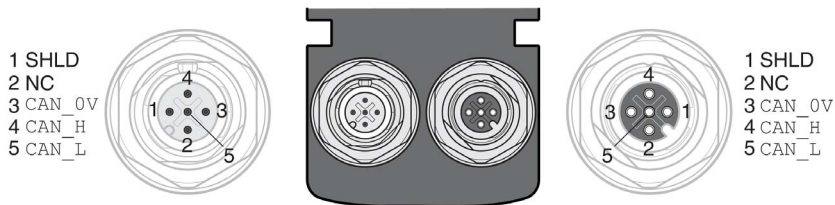
Commissioning Interface

The following components can be found below the cover of the commissioning interface:
- DIP switch for address and baud rate
- card holder for the memory card
- commissioning interface CN10

The cover of the commissioning interface can be opened with a flat blade screwdriver.
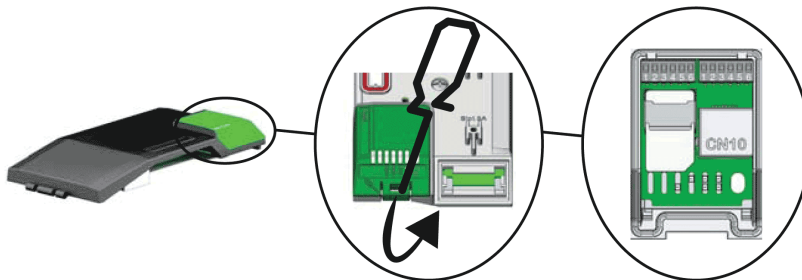
With the factory settings active, the address and the baud rate can be set via the parameters `CANbaud` and `CANaddress`. It is also possible to set the address and the baud rate via the DIP switches located below the cover of the commissioning interface. If the DIP switches are used, the values set via the parameters are ignored.

Address Setting

DIP switch device address (example to the right: device address 13 with DIP switches)
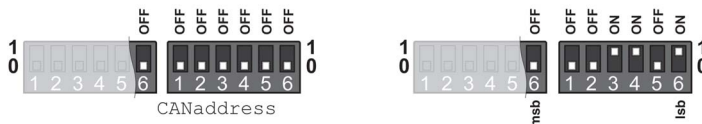
Example: Node address = 13 ($2^3+2^2+2^0$)

Switch	6	1	2	3	4	5	6
Address bit	6 (2^6)	5 (2^5)	4 (2^4)	3 (2^3)	2 (2^2)	1 (2^1)	0 (2^0)
State	OFF	OFF	OFF	ON	ON	OFF	ON

Baud Rate

The following DIP switch settings to assign the baud rate are possible. The settings for `CANbaud` means the baud rate has to be set by the commissioning software via the parameter `CANbaud`.
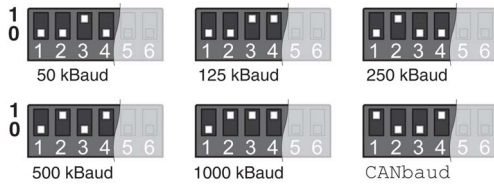
OsiSense XCC CANopen Multi-Turn Absolute Encoder - CANopen Wiring

Overview
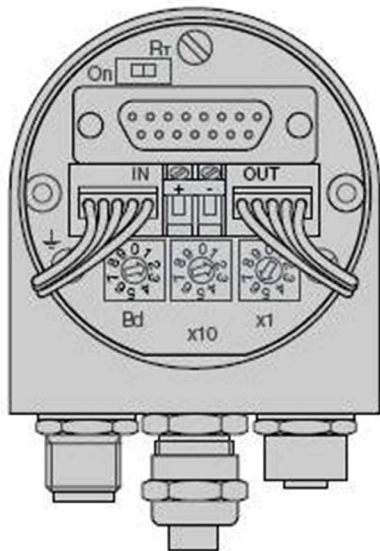
Pin Assignment

Bus IN

Bus OUT

Bus IN M12 male connector
Bus OUT M12 female connector

Pin assignment of the BUS IN and BUS OUT connector pins:

Pin	Signal	Meaning
1	(CAN_SHLD)	optional CAN shield
2	(CAN_V+)	optional CAN external positive supply
3	CAN_GND	CAN ground
4	CAN_H	CAN_H bus line
5	CAN_L	CAN_L bus line

Address Setting

The node address for the encoder has to be set by the 2 rotary switches.

Example: 59
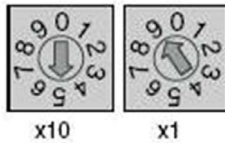
x10 High-order rotary switch: represents the 'tens' of the CANopen address
x1 Low-order rotary switch: represents the 'ones' of the CANopen address

The permissible address range is 1...89.

Baud Rate

The baud rate for the CANopen communication has to be set by the rotary switch (**Bd**).

Position	Baud Rate (kbps)
0	10
1	20
2	50 (shown in figure above)
3	125
4	250
5	500
6	800
7	1000
8	reserved
9	default (250)

Termination Resistor

The termination resistor is already integrated and can be activated at the end of the network with the switch **RT**.

Section 5.3
Ethernet Network

What Is in This Section?

This section contains the following topics:

Ethernet Network Topology

Ethernet Topology

Main cabinet H1

#192.168.100.30   #192.168.100.21   #192.168.100.20
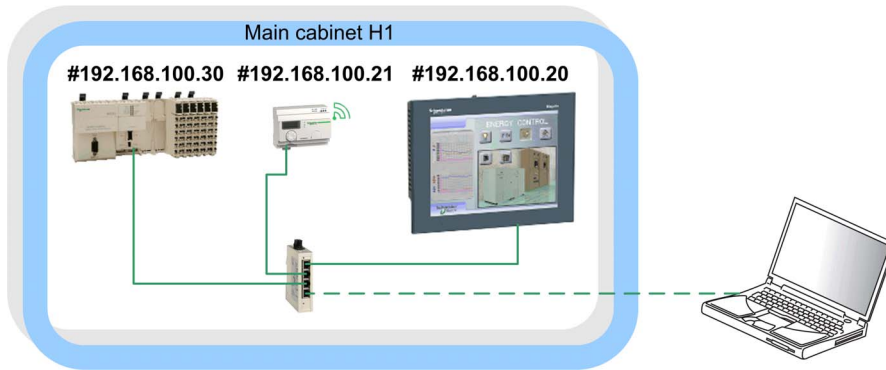
#... node address

The subnet mask is: 255.255.255.0.

Optionally a PC can be linked to the Ethernet network.

Ethernet Wiring

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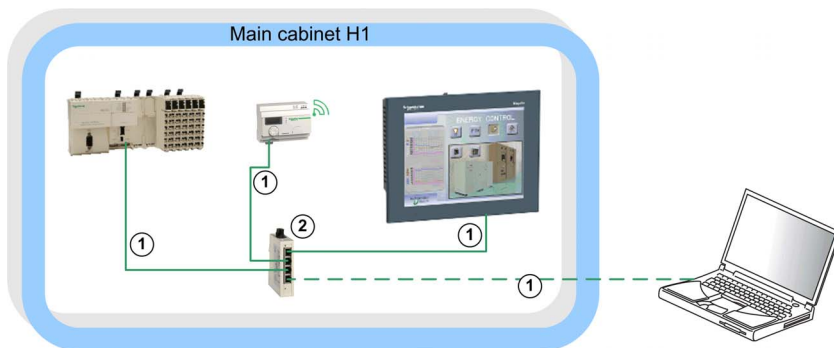
For more information, refer to Transparent Ready, User Guide, 31006929.

Cables

Reference	Designation	Description	Position	Cable Length
490NTW00002	Ethernet ConneXium cable - shielded twisted-pair straight cord	one RJ45 connector at each end	1	2.0 m (6.56 ft)
490NTW00005				5.0 m (16.40 ft)

Switch

Reference	Designation	Description	Position
TCSESU053FN0	Ethernet TCP/IP unmanaged switch	10BASE-T/100BASE-TX - 5x RJ45 ports copper cable	2

Modicon M258 Logic Controller - Ethernet Wiring

Ethernet Port
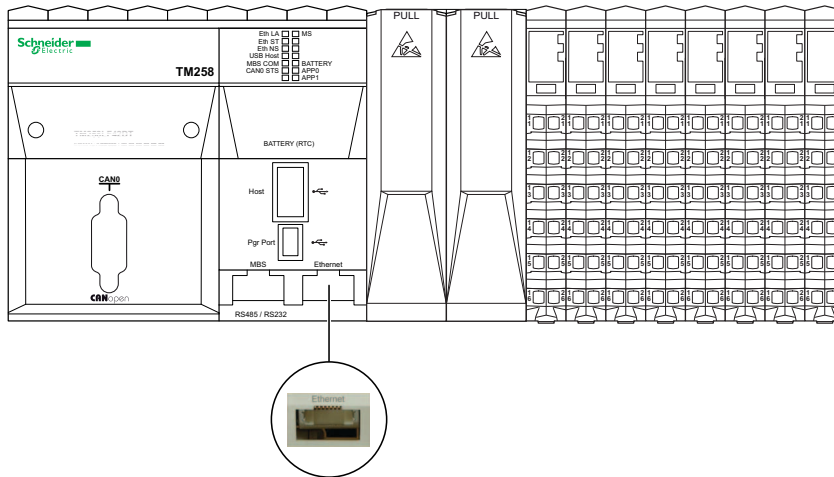
Characteristic	Description
Standard	Ethernet
Connector type	RJ45
Baud rate	Supports Ethernet "10BaseT" and "100BaseTX" with auto-negotiation
Auto-crossover	MDI / MDIX
Protocol supported	• SoMachine protocol • Modbus TCP client/server • Ethernet/IP adapter • FTP server • HTTP server • SNMP
IP address negotiation type supported	• DHCP • BOOTP • Fixed IP
Power over Ethernet	No

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

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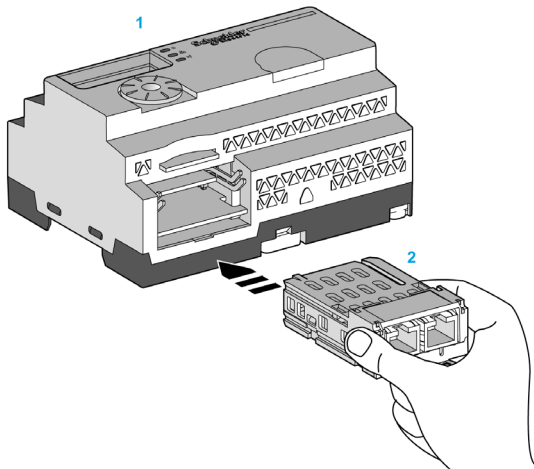
1   ZBRN1 access point
2   ZBRCETH communication module with 2 RJ45 plugs

Section 5.4
Modbus Serial Line Network

What Is in This Section?

This section contains the following topics:

Modbus SL Network Topology

Modbus SL Topology
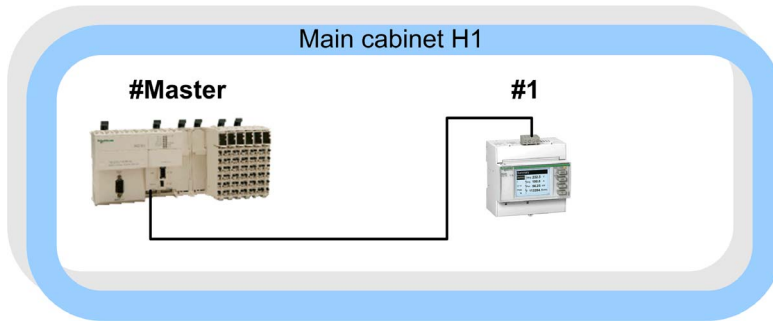
#... node address

Modbus SL Wiring

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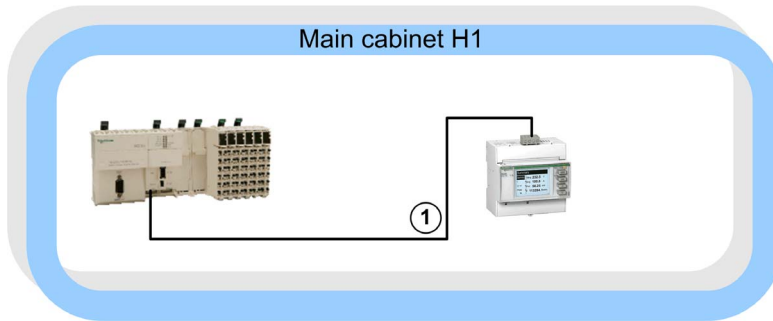
For more information, refer to Modbus Serial Line, Planning and Installation Guide, 33003925.

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 M258 Logic Controller - Modbus SL Wiring
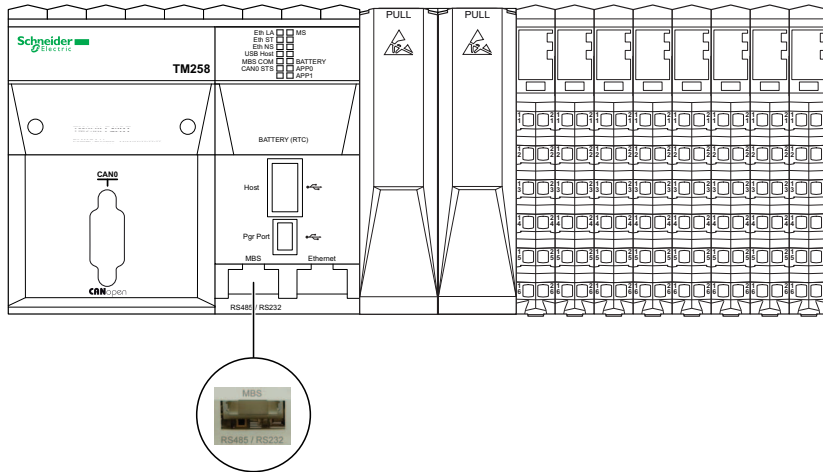
Modbus SL Port

The serial line
● is used to communicate to Modbus SL devices via RS-485/RS-232
● supports master and slave mode
● provides power over Modbus integrated: supplier (5 Vdc / 200 mA)

Pin Assignment

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

Pins for RS-485 and RS-232
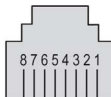
Pin	Signal RS-485	Signal RS-232	Description
1	-	RxD	RS-232: Receive data line
2	-	TxD	RS-232: Transmit data line
3	-	RTS	RS-232: Request to send
4	D1	-	Modbus SL: D1 (+/B) RS-485 2-wire
5	D0	-	Modbus SL: D0 (-/A) RS-485 2-wire
6	-	CTS	RS-232: Clear to send

Pin	Signal RS-485	Signal RS-232	Description
7	VP5S		power over Modbus SL: 5 Vdc / max. 200 mA supplier
8	SNG		Modbus SL signal ground / reference to VP5S

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: RS-485 2-wire

Line Polarization

Line polarization is provided by the controller.

PM3250 Power Meter - Modbus SL Wiring

Modbus SL Port

1 Modbus SL RS-485 2-wire port

Pin Assignment
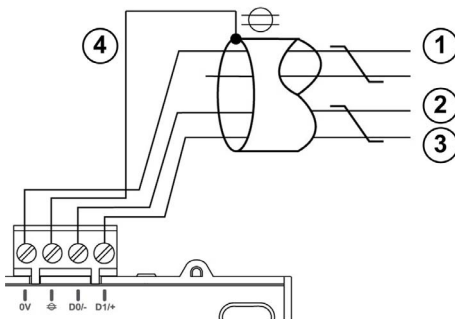
Item	Signal	Description
1	SNG	Modbus SL signal ground
2	D0	Modbus SL: D0 (-/A) RS-485 2-wire
3	D1	Modbus SL: D1 (+/B) RS-485 2-wire
4	SHLD	Modbus SL shield

Communication Settings

The Modbus SL port of the controller 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	Topic	Page
6.1	Access the SoMachine Project Template	182
6.2	Software Requirements	183
6.3	Project	184

Section 6.1
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**.
5	Select a template from the list.
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 224)* your new project according to your requirements.

Section 6.2
Software Requirements

Software Requirements

Overview

The software required to open and to edit the project template is SoMachine V4.0 or later.

The following components must be installed together with SoMachine:
- SoMachine components
  - SoMachine Logic Builder
  - Vijeo-Designer
  - Gateway
- Auxiliary tools
  - Controller assistant
- Controllers
  - M258
  - LMC058
- Devices
  - Advantys (DTM)
  - TM5 - TM7 (DTM)
- Repository
  - Performance repository
- Documentation
  - Tested, Validated and Documented Architecture

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.

Section 6.3
Project

What Is in This Section?

This section contains the following topics:

Topic	Page
Controller	185
HMI	187
Devices	188
Application	196
Vijeo-Designer	198

Controller

Overview

The controller in this architecture is the TM258LF42DT4L, which is assigned to the category of performance logic controller of Schneider Electric.

The mandatory settings for the controller are described below.

All parameter values depicted in this document relate to the template project and the test equipment used during development.

Ethernet

The Ethernet network in this architecture is used for the communication between the HMI and the controller and between the controller and the wireless access point Harmony ZBRN1

In addition, the network provides the possibility for a remote connection with the controller and the HMI, and the wireless access point.

The Ethernet settings for this architecture are:
- Fixed IP address
  - IP address: 192.168.100.30
  - Subnet mask: 255.255.255.0

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

For more information about the Ethernet settings, refer to the document Modicon M258, Logic Controller, Programming Guide/Ethernet configuration, EIO0000000402 (ENG).

Serial Line

The serial line in this architecture is used for the communication between the controller and the power meter.

Therefore a Modbus manager has been added under the serial line of the controller.

NOTE: Per default the SoMachine network manager is placed here, but this can be removed.

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

For more information about the serial line configuration, refer to the document Modicon M258, Logic Controller, Programming Guide/Serial line configuration, EIO0000000402 (ENG).

CANopen

This architecture includes a CANopen fieldbus which has to be configured in the project.

Therefore the CANopen manager **CANopen_Performance** has been added under the CAN0 interface.

The settings for the CAN0 interface are:
● Baud rate: 500,000
● Activate the checkbox labeled **Block SDO, DTM and NMT access while application is running**.

The settings for the CANopen manager **CANopen_Performance** are:
● Node ID: 127
● Heartbeat: Activate the checkbox **Enable Heartbeat Producing**.
  ● Node ID: 127
  ● Producer time: 200 ms
● Bus cycle options
  ● Bus cycle task: MAST

For more information about the CANopen configuration, refer to the document Modicon M258, Logic Controller, Programming Guide/CANopen configuration, EIO0000000402 (ENG).

HMI

Overview

The HMI in this architecture is a Magelis panel of type HMI GTO 5310.

The mandatory settings for the HMI device are described below.

All parameter values depicted in this document relate to the template project and the test equipment used during development.

Ethernet

The Ethernet network in this architecture is used for the communication between the HMI and the controller.

In addition, the network provides the possibility for a remote connection with the controller and the HMI.

The Ethernet settings for the panel are:
- Fixed IP address
  - IP address: 192.168.100.20
  - Subnet mask: 255.255.255.0

For all 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 named 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, but you can change it to a user-defined name like *machine 1*.

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

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, all devices configured within the SoMachine project are described.

TM5 I/O Expansion Modules

The controller provides the possibility to expand the embedded I/Os by adding TM5 expansion modules to the left of the controller.

The expansion modules must be configured within the SoMachine project.

In this architecture, the following modules were added to the TM5 manager.

Module name	Module type	Comment	Configuration
TM5SPS2F	TM5SPS2F	24 Vdc power supply module for internal I/O supply and bus, integrated fuse	Default
TM5SDI12D	TM5SDI12D	Module with 12 digital inputs 24 Vdc, sink	Default
TM5SDI12D_1	TM5SDI12D	Module with 12 digital inputs 24 Vdc, sink	Default
TM5SDO12T	TM5SDO12T	Module with 12 digital outputs 24 Vdc, 0.5 A	Default
TM5SDO12T_1	TM5SDO12T	Module with 12 digital outputs 24 Vdc, 0.5 A	Default
TM5SAI4PH	TM5SAI4PH	Module with 4 analog inputs, temperature resistor	Default
TM5SAO2L	TM5SAO2L	Module with 2 analog outputs ±10 V / 0...20 mA	Default

For more information about the TM5 configuration, refer to the documents:
- Modicon M258, Logic Controller, Programming Guide, EIO0000000402 (ENG)
- Modicon TM5, Expansion Modules Configuration, Programming Guide, EIO0000000420 (ENG)

Power Meter PM3250

The architecture implements 1 power meter of type PM3250 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 power meter was created in the application by adding the Device Module MED_PM3250_ModbusSL.

The only configuration is the assignment of the slave address and the network ID to the associated variables (CONSTANTS) within the **Add Function From Template** dialog box.

Harmony ZBRN1

The architecture implements 1 Harmony wireless access point of type ZBRN1 for receiving the signals from the wireless and batteryless push-buttons. The data are read from the device via Modbus TCP on Ethernet.

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

The program code to read and to process the data of the wireless access point was created in the application by adding the Device Module Harmony_Wireless_ModbusTCP_1.

The only configuration is the assignment of the slave address and the number of registers to read to the associated variables (CONSTANTS) within the dialog **Add Function From Template**.

Altivar 32

The architecture implements 6 variable speed drives of type Altivar 32 which are controlled via CANopen.

These devices must be configured within the SoMachine project.

Therefore the devices were added under the CANopen manager **CANopen Performance**.

Each device was added with the use of the Device Module ATV32_CANopen, which is represented as a function template 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 node ID within the **Add Function From Template** dialog box.

The following devices were added under the CANopen manager of the CAN0 interface:

Device name	Node ID configuration
ATV32_Node01	1
ATV32_Node02	2
ATV32_Node03	3
ATV32_Node04	4
ATV32_Node11	11
ATV32_Node12	12

Altivar 71

The architecture implements 4 variable speed drives of type Altivar 71 which are controlled via CANopen. Each Altivar 71 drive is equipped with an optional encoder card. These devices must be configured within the SoMachine project.

Therefore the devices were added under the CANopen manager **CANopen Performance**.

Each device was added with the use of the Device Module ATV71_CANopen_Enc, which is represented as a function template 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 node ID within the **Add Function From Template** dialog box.

The following devices were added under the CANopen manager of the CAN0 interface:

Device name	Node ID configuration
ATV71_Node05	5
ATV71_Node06	6
ATV71_Node07	7
ATV71_Node08	8

The device in this example uses the object IPath MenuItemPUC/MenuItem/IPath of the first transmit PDO.

NOTE: The device provided with the Device Module ATV71_CANopen_Enc differs to the standard device **Altivar 71** provided with the device repository of SoMachine. The device in this example uses the object **PUC** of the first transmit PDO. This object indicates the counted pulses of the connected encoder.

For more information about the SDO configuration, refer to the documents:
- SoMachine online help: **Programming with SoMachine →Device Editors →CAN bus Configuration Editor →CANopen Device →PDO Mapping**
- Altivar 61 / 71, CANopen, User's manual, 1755865 (ENG)
- Altivar 71, Communication parameters, User manual, 1755861 (ENG)

Lexium 32A

The architecture implements 4 servo drives of type Lexium 32A which are controlled via CANopen.

This device must be configured within the SoMachine project.

Therefore the devices were added under the CANopen manager **CANopen Performance**.

Each device was added with the use of the Device Module Lexium_32A_CANopen, which is represented as a function template 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 node ID within the **Add Function From Template** dialog box.

The following devices were added under the CANopen manager of the CAN0 interface:

Device name	Node ID configuration
LXM32A_Node21	21
LXM32A_Node22	22
LXM32A_Node31	31
LXM32A_Node32	32

NOTE: The device provided with the Device Module Lexium_32A_CANopen differs to the standard device **Lexium 32A** provided with SoMachine device repository. The device in this example uses the second and third transmit PDO (TPDO). The actual position value (second TPDO) and the actual velocity value (third TPDO) of the drive are transmitted in an event driven way. The event time for these TPDOs is set per default to 100 ms. In addition, the inhibit time for both TPDOs is set to 10 ms. These additional PDOs increase the bus load. Consider this fact for your own application.

For more information about the PDO configuration, refer to the documents:
- SoMachine online help: **Programming with SoMachine** →**Device Editors** →**CAN bus Configuration Editor** →**CANopen Device** →**PDO Mapping**
- LXM32A CANopen, Fieldbus interface, Fieldbus manual, 0198441113779 (ENG)

TeSys U

The architecture implements 1 motor starter controller of type TeSys U which is controlled via CANopen.

The TeSys U is equipped with a standard control unit. This device must be configured within the SoMachine project.

Therefore the device was added under the CANopen manager **CANopen Performance**.

The device was added with the use of the Device Module TeSysU_CANopen_Standard, 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 node ID within the **Add Function From Template** dialog box.

The following device was added under the CANopen manager of the CAN0 interface:

Device name	Node ID configuration
TeSysU_CANopen13	13

TM5NCO1 Distributed I/O

The architecture implements 3 TM5 distributed I/O island which is linked to the CANopen fieldbus.

This I/O island must be configured within the SoMachine project.

There are 2 steps to create the island under the CANopen manager:
1. Add the CANopen interface module TM5NCO1 under the CANopen manager.
2. Add the desired TM5 expansion modules under the CANopen interface module TM5NCO1.

Each device provides the possibility for an individual configuration if the default settings do not meet the requirements of your application.

In this architecture, the default settings are sufficient and the following devices were added under the CANopen manager of the CAN0 interface:

Module name	Module type	Comment	Configuration
TM5_Node10	TM5NCO1	TM5 CANopen interface including the power distribution module TM5SPS3	Node ID: 10
TM5SPS3	TM5SPS3		Default
TM5SDI12D_3	TM5SDI12D	Module with 12 digital inputs 24 Vdc, sink	Default
TM5SDO12T_1	TM5SDO12T	Module with 12 digital outputs 24 Vdc, 0.5 A	Default

Module name	Module type	Comment	Configuration
TM5_Node20	TM5NCO1	TM5 CANopen interface including the power distribution module TM5SPS3	Node ID: 20
TM5SPS3	TM5SPS3		Default
TM5SDI12D_3	TM5SDI12D	Module with 12 digital inputs 24 Vdc, sink	Default
TM5SDO12T_1	TM5SDO12T	Module with 12 digital outputs 24 Vdc, 0.5 A	Default

Module name	Module type	Comment	Configuration
TM5_Node30	TM5NCO1	TM5 CANopen interface including the power distribution module TM5SPS3	Node ID: 30
TM5SPS3	TM5SPS3		Default
TM5SDI12D_3	TM5SDI12D	Module with 12 digital inputs 24 Vdc, sink	Default
TM5SDO12T_1	TM5SDO12T	Module with 12 digital outputs 24 Vdc, 0.5 A	Default

The CANopen I/O mapping for all expansion modules is provided on the associated CANopen interface module TM5NCO1.

TM7NCOM16A Distributed I/O

The architecture implements 1 TM7 distributed I/O island which is linked to the CANopen fieldbus.

This I/O island must be configured within the SoMachine project.

The device is divided into 2 parts in the **Device Tree**:
1. TM7NCOM16A: the CANopen interface module
2. TM7BDM16AE: the embedded I/O block with 16 configurable I/Os

Module name	Module type	Comment	Configuration
TM7_Node42	TM7NCOM16A	TM7 CANopen interface including the embedded I/O block	Node ID: 42
TM7BDM16AE	TM7BDM16AE		Default: 16 digital inputs

The CANopen configuration and the I/O mapping has to be done within the device editor of the interface module TM7NCOM16A. Within the device editor of the embedded I/O block (TM7BDM16AE), you can configure each channel separately either as input or output.

Lexium ILA

The architecture implements 2 integrated servo drive of type Lexium ILA which is controlled via CANopen.

This device must be configured within the SoMachine project.

Therefore the devices were added under the CANopen manager **CANopen Performance**.

Each device was added with the use of the Device Module Lexium_ILA_CANopen, 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 node ID within the **Add Function From Template** dialog box.

The following devices were added under the CANopen manager of the CAN0 interface:

Device name	Node ID configuration
LXM_ILA_Node40	40
LXM_ILA_Node41	41

After the device was added, an additional configuration via SDO (service data object) was done within the device editor tab.

In this example application, a SDO was added to deactivate the input monitoring of the drive.

Index:Subindex	Name	Value	Comment
16#301C:16#0D	`Settings.SignEnabl`	0	Deactivates all monitoring inputs: `LIMP`, `LIMN`, `STOP` and `REF`.

NOTE: The monitoring inputs were disabled because the drive is applied in modulo motion mode (endless movements). If your application requires the end of travel limits, set the value for `Settings.SignEnabl` to your needs or respectively delete this SDO from the list and make the configuration via another channel.

For more information about the SDO configuration, refer to the documents:
- SoMachine online help: **Programming with SoMachine →Device Editors →CAN bus Configuration Editor →CANopen Device →Service Data Object**
- ILA1B, ILA1F, ILA1R, Lexium Integrated Drive, Product manual, 0198441113562 (ENG)

OsiCoder

The architecture implements 1 absolute multi-turn encoder (OsiCoder) which is linked to the CANopen fieldbus.

This device must be configured within the SoMachine project.

Therefore the device was added under the CANopen manager **CANopen Performance**.

The device was added with the use of the Device Module Encoder_AbsMlt_CANopen, 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 node ID within the **Add Function From Template** dialog box.

The following device was added under the CANopen manager of the CAN0 interface:

Device name	Node ID configuration
AbsMltEncoder_Node43	43

NOTE: The device provided with the Device Module Encoder_AbsMlt_CANopen differs to the standard device OsiCoder provided with SoMachine device repository. At the used device the second transmit PDO (TPDO) was unselected. By this object the actual position value of the encoder is transmitted in a cyclic/synchronous way. For this application, the first TPDO, whereby the position value is transmitted in an event driven way, is sufficient. Further the transmission parameters for the first TPDO were adapted as follows: the inhibit time was set to 10 ms and the event time was set to 100 ms.

For more information, refer to the documents:

- SoMachine online help: **Programming with SoMachine** →**Device Editors** →**CAN bus Configuration Editor** →**CANopen Device** →**PDO Mapping**
- OsiSense XCC, CANopen Multi-Turn Absolute Encoder, User's Manual, 169002302

Lexium 32i

The architecture implements 1 integrated servo drive of type Lexium 32i which is controlled via CANopen.

This device must be configured within the SoMachine project.

Therefore the device was added under the CANopen manager **CANopen Performance**.

The device was added with the use of the Device Module Lexium_32i_CANopen, 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 node ID within the **Add Function From Template** dialog box.

The following device was added under the CANopen manager of the CAN0 interface:

Device name	Node ID configuration
LXM32i_CANopen44	44

NOTE: The device provided with the Device Module Lexium_32i_CANopen differs to the standard device **Lexium 32i** provided with SoMachine device repository. The device in this example uses the second and third transmit PDO (TPDO). The actual position value (second TPDO) and the actual velocity value (third TPDO) of the drive are transmitted in an event driven way. The event time for these TPDOs is set per default to 100 ms. In addition, the inhibit time for both TPDOs is set to 10 ms. These additional PDOs increase the bus load.

For more information, refer to the documents:

- SoMachine online help: **Programming with SoMachine** →**Device Editors** →**CAN bus Configuration Editor** →**CANopen Device** →**PDO Mapping**
- LXM32iCAN BMi, Lexium 32 Integrated, Product manual, 0198441113950 (ENG)

Application

Library Manager

The library manager is a standard object of the application.

Within the library manager, you can add or remove libraries.

All libraries in this example application were loaded automatically on adding devices or Device Modules.

Symbol Configuration

The symbol configuration functionality allows to create symbol descriptions, via which project variables can be accessed from external, for example by the Magelis HMI.

All variables for control and monitor functions on the Magelis HMI were mapped within the symbol configuration editor.

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

Task Configuration

The **Task Configuration** defines one or several tasks for controlling the processing of an application program.

Thus it is a basic resource object for an application and is automatically added to the application node.

In this example application 1 task is configured:

Task	Type	Comment
MAST	Cyclic: 20 ms	This task includes all program calls related to the CANopen devices, Modbus communication and general application code.

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

Program Code

The program code 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 on adding the Device Modules. Hence, they are placed in folders (with the corresponding names) under the **Application** node.

For the general programming part additional POUs are available:
- **Input_Mapping**
  - Processing of input signals of the architecture (for example operator push buttons, sensors, and so on).

- **MAIN**
  - Processing of summary information about device, communication, and safety state.

- **Output_Mapping**
  - Processing of output signals of the architecture (for example signaling elements, actuators, and so on).

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 of type HMI GTO5310.

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
- Safety state

Alarm Page

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

CANopen Overview

The CANopen overview provides information about the fieldbus topology and the state of CANopen devices.

Energy Pages

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

Device Pages

The device pages provide monitor and control functions for each device grouped by products:
- Altivar
- TeSys U
- Lexium
- Encoder
- I/Os

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.

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[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

You must 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 devices)
- 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 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 SoMachine Logic Builder, 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 2 devices have to be in the same sub network.
3	In the **Devices tree** of the SoMachine Logic Builder, double-click the **HMI Application** node.	The Vijeo-Designer opens and the HMI application is displayed.

Step	Action	Comment
4	In the Vijeo-Designer, click **HMI device** → **Network**.	-
5	Configure the Ethernet settings of the HMI.	The Ethernet configuration is required to set up a connection between controller and HMI. The 2 devices have to be in the same sub network.
6	In the Vijeo-Designer, double-click **I/O Manager** →**SoMachineNetwork01** → **SoM_MyController**.	The **Network Equipment Configuration** dialog box opens.
7	Set the address of the associated controller.	When the PC is connected to the controller, the required information can be found in the device editor of the controller in the SoMachine Logic Builder.

Download Procedure

It is recommended to use an USB connection between controller and PC. This helps to ensure that the controller is found in SoMachine, regardless of the Ethernet configurations of the controller and the PC.

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 an existing 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 SoMachine Logic Builder and HMI application.

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

Step	Action	Comment
1	Double-click the controller.	The controller device editor opens.
2	Select the **Controller selection** tab.	The compatible controllers connected to the PC are listed.
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.	The HMI device editor opens.
5	Select the **Controller selection** tab.	The compatible HMIs connected to the PC are listed.

Step	Action	Comment
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. If the application can be stopped during the download, a full download is recommended. Using the **Additional operations** a start of all applications after download can be performed.

NOTE: The firmware version of the controller has to correspond with the firmware version of the controller in the SoMachine project. If the versions of the devices mismatch, you have to 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 product manual of the controller.

NOTE: 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 you can use the **Runtime Installer** to download the runtime on the HMI.

NOTE: The **Runtime Installer** is accessible via the tool access bar *(see SoMachine Central, User Guide)* in SoMachine Central (**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.

The following devices are configured by using the local control panel on the device itself:
- Lexium 32A
- Altivar 32
- Altivar 71
- Harmony ZBRN1
- PM3250 power meter

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 STOP 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), checking for 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 M258 PLCSystem Library Guide *(see Modicon M258 Logic Controller, System Functions and Variables, M258 PLCSystem Library Guide)*.

For setting the communication parameters of the following devices, refer to the respective sections in the *Communication* chapter:
- CANopen Interface Module TM5NCO1 - Cabling *(see page 149)*
- CANopen Interface I/O Block TM7NCOMx - Cabling *(see page 151)*
- OsiSense XCC CANopen Multi-Turn Absolute Encoder - Cabling *(see page 166)*

TeSys U Motor Starter - CANopen Setup

Overview

The setup of the TeSys U motor starter includes 2 steps.

● The communication settings will be done by the dip switches located on the communication module LULC08 and is described in the communication chapter *(see page 153)*.
● The thermal protection of the motor is set by the rotary switch on the front of the control unit LUCA05BL. The set value has to be appropriate for the connected motor.
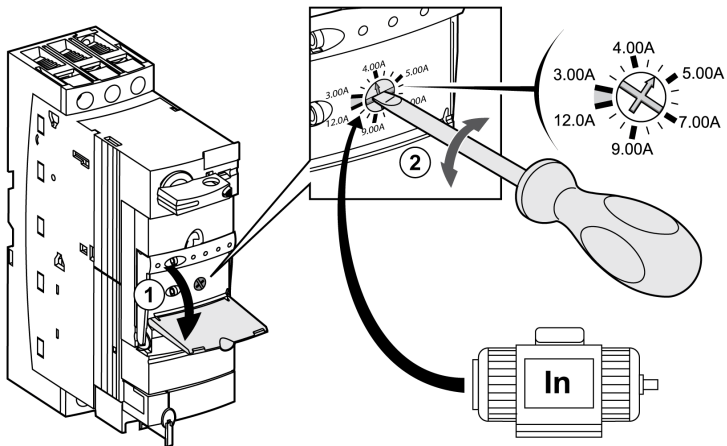
Altivar 32 Variable Speed Drive - CANopen Setup

Overview

To operate the Altivar 32 via CANopen fieldbus, 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 software SoMove Mobile installed on a mobile phone linked via Bluetooth

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

⚠ DANGER

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 will result in death or serious injury.

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

Basic Configuration

NOTE: The parameter or menu items which are mentioned within the table could be located under unmentioned menu items. This is dependent to the method of configuration.

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

Step	Action	Comment
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. But 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. But 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 CANopen fieldbus, the parameter **[Ref. 1 channel]** (Fr1) has to be set either to **[CANopen]** (CAn) or **[Com.card]** (net). This depends on the used communication port.

7	Configure the communication parameter under the menu **[COMMUNICATION]** (COM-):
	● **[CANopen]** (CnO-)
	  ● **[CANopen address]** (AdCO)
	  ● **[CANopen bit rate]** (bdCO)
		The communication parameter for the CANopen network is dependent on your architecture and the settings of the CANopen master which is usually the controller.

8	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).
9	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.
10	Power cycle the drive.	If the configuration is finished, do a power cycle of the drive, because some parameters only become effective after a power cycle.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Power cycle the drive after any configuration changes or adjustments (power removal followed by power reapplied).

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

Altivar 71 Variable Speed Drive - CANopen Setup

Overview

To operate the Altivar 71 via CANopen fieldbus, 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*

(* linked to the integrated communication port on the front 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.

⚠ DANGER

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 will result in death or serious injury.

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

CANopen Settings

The following steps to set up the drive are based on the configuration by the graphic display terminal.
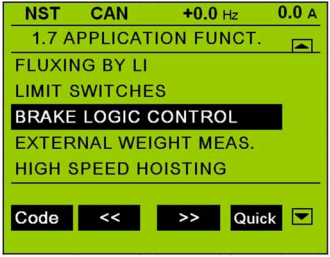
Step	Action	Graphic/Comment
1	Select **1 DRIVE MENU** and press ENT key of the jog dial.	
2	Select **1.9 COMMUNICATION** and press ENT key of the jog dial.	-

Step	Action	Graphic/Comment
3	Select **CANopen** and press ENT key of the jog dial.	-
4	The parameters are set to: ● **CANopen address: 5** ● **CANopen bit rate: 500 kbps** **Error code** is a read-only parameter.	NST CAN +0.0 Hz 0.0 A **CANopen** CANopen address : 5 CANopen bit rate : 500 kbps Error code : 0 Code Quick
5	Select ESC to go back to **1 DRIVE MENU** and switch to the **1.6 COMMAND** menu. To operate the drive via CANopen, set **Ref. 1 Channel** to **CANopen**.	NST CAN +0.0 Hz 0.0 A **1.6 COMMAND** Ref. 1 Channel: CANopen RV Inhibition: Stop Key Priority: Profile: Sinus Filter: Code << >> Quick

NOTE: For high-power drives, (more than 90 kW) it is recommended to do an automatic reboot with the local control panel (refer to drive user manual for details).

Brake Settings

Step	Action	Graphic/Comment
1	Select **1 DRIVE MENU** and press ENT key of the jog dial.	NST CAN +0.0 Hz 0.0 A **MAIN MENU** 1 DRIVE MENU 2 ACCESS LEVEL 3 OPEN / SAVE AS 4 PASSWORD 5 LANGUAGE Code Quick
2	Select **1.7 APPLICATION FUNCT.** and press ENT key of the jog dial.	-

Step	Action	Graphic/Comment
3	Select **BRAKE LOGIC CONTROL** and press ENT key of the jog dial.	NST CAN +0.0 Hz 0.0 A 1.7 APPLICATION FUNCT. FLUXING BY LI LIMIT SWITCHES **BRAKE LOGIC CONTROL** EXTERNAL WEIGHT MEAS. HIGH SPEED HOISTING Code << >> Quick
4	In the sub menu of **BRAKE LOGIC CONTROL** the following parameter are set in the example: ● `Brake assignment:` R2 ● `Movement type:` Hoisting ● `Brake contact:` No ● `Brake impulse:` No ● `Brake release I FW:` 0 A ● `Brake release time:` 0 s ● `Brake release freq.:` 0 Hz ● `Brake engage freq.:` 0 Hz	-
5	Restart the drive. The changes become effective only after a restart of the drive.	-

NOTE: These parameters are for the machine described in this example only. In all likelihood, you will need to adapt these parameters for your specific machine.

Encoder Configurations

If an optional encoder interface card is installed on the drive and an encoder is connected to it, the parameters for the encoder configuration have to be set.

Step	Action	Graphic/Comment
1	Select **1 DRIVE MENU** and press ENT key of the jog dial.	-
2	Select **1.5 INPUTS/OUTPUTS CFG** and press ENT key of the jog dial.	-
3	Select **ENCODER CONFIGURATION** and press ENT key of the jog dial.	-
4	In the sub menu of **ENCODER CONFIGURATION** the following parameters are set in the example: ● `Encoder usage::no` ● `Encoder type:AABB` ● `Number of Pulses:1024` ● `Reference type:n.a.` ● `Freq. min. value:n.a.` ● `Freq. max. value:n.a.` ● `Freq. signal filter:n.a.`	The configuration of the encoder depends on your application. The appearance of the parameter in this sub menu varies based on other settings.
5	Restart the drive. The changes become effective only after a restart of the drive.	-

---

⚠ **WARNING**

UNINTENDED EQUIPMENT OPERATION

Power cycle the drive after any configuration changes or adjustments (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 61 / 71, CANopen, User's manual, 1755865 (ENG).

Lexium 32A Servo Drive - CANopen/CANmotion Setup

Overview

To operate the Lexium 32A via CANopen fieldbus, 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 a graphic display terminal
- by the configuration software SoMove Light installed on a PC

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.

⚠ **DANGER**

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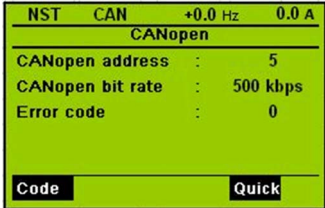
Failure to follow these instructions will result in death or serious injury.

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

Communication Settings

If the drive is being started for the first time, the `FSu` (first setup) is invoked.

Only the CANopen address (`CoAd`) and the baud rate (`Cobd`) are initially needed.

If the `FSu` is not displayed after switching on, the drive has been started once before. In this case follow the depicted menu structure below to change the address and the baud rate.

To adjust the parameters, use the following path and values

Step	Action	Graphic/Comment
1	Set the `CANaddress` (node number): - `FSu` -> `CoAd` or - `ConF` -> `CoM` -> `CoAd`	Every device in the CAN network has a unique address/node ID (1...127).

Step	Action	Graphic/Comment
2	Set the `CANbaud`: ● `500` for CANopen or ● `1000` for CANmotion (`1000` = 1000 kbps = 1 MBaud) ● `FSu` -> `Cobd` or ● `ConF` -> `CoM` -> `Cobd`	The baud rate for the CAN network is dependent on your architecture and the settings of the CAN master, usually the controller.
3		

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Power cycle the drive after any configuration changes or adjustments (power removal followed by power reapplied).

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

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

You can configure further limit values and basic parameters like digital inputs/outputs on basis of the system and motor data. As long as the motor is operated without loads, the default settings do not need to be changed.

For more information, refer to LXM32A, AC servo drive, Product manual, 0198441113755 (ENG).

Lexium ILx CANopen/CANmotion Setup

Overview

To operate the Lexium IL• via CAN fieldbus, the communication parameters have to be set for the device. Further configuration settings depend on your application.

There are several options to configure the communication parameter of the drive:
● by the switches on the drive
● by the configuration software Lexium CT installed on a PC

The commissioning software offers a graphical interface and extended capabilities to configure the drive for example, direction of rotation, acceleration/deceleration, setting current limitations, tuning.

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.

⚠ DANGER

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 will result in death or serious injury.

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

Communication Settings

Address

The device address factory setting is 0. This setting has to be changed. As long as the device address is set to 0 the fieldbus is not initialized.

The device address can be set with the DIP switches *(see page 160)*.

Baud rate

The baud rate factory setting is 250 kbps.

The transmission rate (baud rate) has to be the same for all devices in the network (500 kbps for CANopen, 1000 kbps for CANmotion).

The baud rate can be set with the rotary switches *(see page 160)*.

For more information, refer to :
● ILE1B, ILE1F, ILE1R, Lexium Integrated Drive, Product manual, 0198441113568 (ENG)
● ILA1B, ILA1F, ILA1R, Lexium Integrated Drive, Product manual, 0198441113562 (ENG)

Lexium 32i Servo Drive - CANopen Setup

Overview

To operate the Lexium 32i via CANopen fieldbus, the communication parameters have to be set for the device. Further configuration settings depend on your application.

There are several options to configure the communication parameter of the drive:
- by the switches on the drive
- by the configuration software SoMove installed on a PC*

(* linked to the integrated communication port CN10) below the cover of the commissioning interface of the drive *(see page 163)*.

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.

⚠ DANGER

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 will result in death or serious injury.

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

Communication Settings

Address

The device address can be set directly with the DIP switches *(see page 164)*. If all DIP switches are set to 0 (default), the address has to be set via the parameter `CANaddress` using the commissioning software.

Refer to Commissioning Interface and Address Setting *(see page 164)*.

Baud rate

The baud rate can be set directly with the DIP switches *(see page 164)*. If the DIP switches are set in a specific combination (default), the baud rate has to be set via the parameter `CANbaud` using the commissioning software.

Refer to Commissioning Interface and Baud Rate *(see page 165)*.

Also refer to LXM32iCAN BMi, Lexium 32 Integrated, Product manual, 0198441113950 (ENG).

PM3250 Power Meter - Modbus SL Setup

Overview

In addition to this system user guide the product manual for the PM3250 power meter has to be read carefully.

For more information, refer to PM3200 series, Power Meters, User Manual, DOCA0006EN.

The power 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 power meter and modify parameter settings.

The navigation menu allows displaying, configuring, and resetting parameters.

General Display
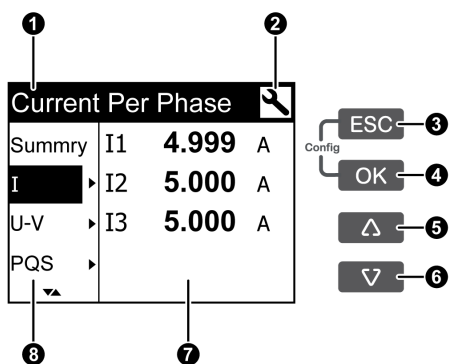
1   Main title
2   Configuration mode
3   Cancel
4   Confirm
5   Up
6   Down
7   Values/parameters
8   Sub menu

Basic Configuration

Before starting the configuration of the power meter, you have to check the correct installation.

Step	Action	Comment
1	Switch on the power supply.	The control voltage is sufficient to configure the device.
2	Keep **ESC** + **OK** pressed for at least 2 seconds.	The display switches to configuration mode.
3	Select the **Setup** menu.	The password (high) has to be entered. By default the password is `0010`.
4	Select the submenu **Wire** and set the parameters for: ● **Power System**: `3PH4W` ● **VTs**: `direct connection` ● **CTs**: `3 CTs`	This parameter describes the power system and the wiring of the power meter.
5	Select the submenu **CT Ratio** and set the parameter for: ● **Primary**: `5 A` ● **Secondary**: `100 A`	This parameter describes ratio of the connected current transformers.
6	Select the submenu **Nominal Frequency** and set the parameter to `50 Hz`.	-
7	Select the submenu **Communication** and set the parameter for: ● **Baud Rate**: `19200` ● **Parity**: `EVEN` ● **Address**: `1`	To operate the power meter via Modbus SL the communication parameters have to be set based on the settings on the master, usually the controller.
8	Press ESC to leave the **Setup** menu.	Basic configuration is finished. The power meter should display now the expected values and is ready for communication via Modbus SL.

Further configurations can be done depending on your application needs.

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)
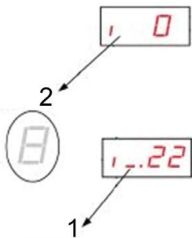
Basic Configuration

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: _display shows_ `i 0` 2 `i_.22` 1 **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).

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 which is based on Device Module *(see page 226)*.

This allows you to create your customized project in an easy and flexible way by adapting the TVDA project template.

- Add Device Modules *(see page 228)*
- Remove Device Modules *(see page 230)*

Device Modules in General

Overview

The Device Modules out of the **TVDA Device Module Library** are represented by Function Templates within SoMachine. They are especially created for the TVDA project template.

Device Modules are available for all functional units implemented in the different TVD architectures.

By definition functional units in the extent of Device Modules are all sorts of field devices controlled (connected) in various ways by the controller.

All required SoMachine application content, beginning with integrating the device to the hardware configuration up to integration of all 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 228)*.)

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

Used Device Modules

The following Device Modules of the **TVDA Device Module Library** are used in this project template.

Device Module
ATV32_CANopen
ATV71_CANopen_Enc
Encoder_AbsMlt_CANopen
Lexium_ILA_CANopen
Lexium_32A_CANopen
Lexium_32i_CANopen
MED_PM3250_ModbusSL
Harmony_Wireless_ModbusTCP_1
TeSysU_CANopen_Standard

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 **Tools 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 some Device Modules, it is possible to configure the device addresses. In **Address** column of the **I/O Devices** field, click the **...** button to open the **Select Device Address** dialog box and select a free address. (Free addresses are displayed in black and can be selected. Already applied addresses are grayed/disabled).
6	In **Master** column of the **I/O Devices** field, click the **...** button to open the **Select Fieldbus Master** dialog box and select the fieldbus master for your Device Module. Confirm with **OK**. If an appropriate fieldbus master is available, it is preselected in the dialog box.
7	The **I/O Mapping** field is an optional feature and not mandatory. 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.

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_CANopen requires a CANopen manager in the project configuration.

Objects Added

If you add a Device Module, all associated objects are added to the project at the appropriate position. Information on what was done during 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_CANopen`.
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_CANopen (PRG)`.
POU call	The call of the POU that is included in the Device Module is added below **Task Configuration** →**MAST** using the **Function Name**. For example `Prg_ATV32_CANopen`.
device	A device (if included in the Device Module) is added below the respective fieldbus (for example **CAN0** →**CANopen_Performance (CANopen Performance)**) as selected in the **Select Fieldbus Master** dialog box. For example `ATV32_CANopen (Altivar 32)`.
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 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.
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.
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 included in the Device Module) from the respective fieldbus (for example **CAN0 →CANopen_Performance (CANopen Performance)**).
libraries	Remove the libraries referenced by the Device Module from the **Library Manager** of your project (if 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 60204-1 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.

⚠ 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	NHGF36015TW	x	x
1	Lug kit 15...150 A	AL150HDS	x	x
1	Short lug shield	S37446	x	x
1	Extended rotary handle	LV429502	x	x
1	Red rotary handle on yellow bezel	LV429340	x	x

Powermeter

Quantity	Description	Reference	IEC	UL
4	Circuit breaker Multi9 UL1077 1P, C, 1A (~230 V)	24425	x	x
1	Power meter PM3250	METSEPM3250	x	x
3	Current transformer 100/5 A	16453 (only IEC)	x	*
* For applications on the North American market, use approbated current transformers.				

Emergency Stop

Quantity	Description	Reference
4	E-Stop safety module XPS AC	XPSAC5121
1	E-Stop safety extension module	XPSAV11113Z002
1	E-Stop push-button for cabinet door	XB5AS844
1	Auxiliary contacts for E-Stop push-button, mounted on the cabinet doors	ZB5AZ141
1	E-Stop push-button for field	XALK178G
10	Illuminated push-button, 1NC, blue	XB5AW36B5
5	Assembly housing 1 cut-out	XALD01
11	Load contactors 2.4 kW	LC1D09BL
2	Load contactors AC-3 440 V/18 A	LC1D18BD

Door Guard

Quantity	Description	Reference
1	E-Stop safety module XPS ECP (additional contacts)	XPSECP5131
4	Door guard switch	XCSPA792
4	Actuator for door guard switch	XCSZ12

Display and Indicators

Quantity	Description	Reference
1	3-position switch	XB5AD33
1	Assembly housing 3 cut-outs	XALD03
2	Push-button, red	XB5AA42
5	Illuminated push-button, 1 NC, green	XB5AW33B5
3	Illuminated push-button, 1 NC, red	XB5AW34B5
5	Illuminated push-button, 1 NC, yellow	XB5AW35B5
1	Base unit for tower light	XVBC21
1	Signal element green	XVBC2B3
1	Signal element red	XVBC2B4
1	Signal element blue	XVBC2B6
1	Signal element yellow	XVBC2B8
1	Tube with connection	XVBZ02
1	Wireless receiver (includes ZBRCETH)	ZBRN1
1	Communication module TCP	ZBRCETH
1	Assembly housing for 2 cut-outs	XALD02
1	Assembly housing for 1 cut-outs	ZBRM01
1	Wireless push-button green	ZB5RTA3
1	Wireless push-button red	ZB5RTA4
1	Wireless push-buttoning blue	ZB5RTA6
3	Legend holder marked with ON/OFF	ZBY2367

Automation Components

Quantity	Description	Reference
1	Modicon M258 Logic Controller	TM258LF42DT4L
2	Digital input module, 12 DI	TM5SDI12D
2	Digital output module, 12 DO	TM5SDO12T

Quantity	Description	Reference
1	Pt100/Pt1000 input module, 4 AI	TM5SAI4PH
1	Analog output module, 2 AO	TM5SAO2L
7	Terminal block, 12 pin coded	TM5ACTB12
1	Locking plate right	TM5ACLPR1
6	Base module for extension slices	TM5ACBM11
1	Power supply module 24 Vdc	TM5SPS2F
1	Base module for power supply	TM5ACBM01R
3	Bus base for fieldbus interface module and interface power distribution module (IPDM)	TM5ACBN1
3	TM5 CANopen interface module	TM5NCO1
3	TM5 fieldbus interface 24 Vdc power supply	TM5SPS3
1	TM7 CANopen I/O block	TM7NCOM16A
1	Power cable for TM7, 10 m	TCSXCNEFNX10V

Magelis HMI

Quantity	Description	Reference
1	Magelis HMIGTO 10.4 color touch-panel VGA-TFT	HMIGTO5310

Control Voltage Power Supply and Distribution

Quantity	Description	Reference	IEC	UL
1	Circuit breaker Multi9 UL1077 2P, C, 3A (~230V)	24444	x	x
1	Power supply 230 Vac / 24 Vdc, 10 A	ABL8RPS24100	x	x
4	Circuit breaker Multi9 UL1077 2P, C, 2A (~230V)	24443	x	x
4	Power supply 230 Vac / 24 Vdc, 5 A	ABL8RPS24050	x	x
13	Terminal with LED for micro fuse	AB1FUSE435U5XB	x	x
6	Fuse 1 A, slow-blow (third party)	0218001.HXP (Littelfuse)	x	x
4	Fuse 3.15 A, slow-blow (third party)	02183.15HXP (Littelfuse)	x	x
3	Fuse 6.3 A, slow-blow (third party)	021806.3HXP (Littelfuse)	x	x
10	Circuit breaker Multi9 UL1077 1P, C, 1A (24Vdc)	24425	x	x
5	Circuit breaker Multi9 UL1077 1P, C, 2A (24Vdc)	24426	x	x
5	Circuit breaker Multi9 UL1077 1P, C, 4A (24Vdc)	24428	x	x

Quantity	Description	Reference	IEC	UL
2	Disconnect terminal (9760U/8TKE48)	5711016550 (Wieland)	x	x
2	Pilot light white	XB5AVB1	x	x

Heating

Quantity	Description	Reference	IEC	UL
4	Solid-state relays for heating	SSRPCDS10A1	x	x
4	Circuit breaker Multi9 UL489 1P, C, 10A (~230V)	60110	x	x

Drives and Power

Quantity	Description	Reference	IEC	UL
Lexium 32				
4	Lexium 32A servo drive 1~230 V/1 kW	LXM32AD18M2	x	x
4	Magnetic circuit breaker, 10 A	GV2L14	x	-
4	Auxiliary contacts for circuit breaker, 1 NO, 1 NC	GVAE11	x	-
4	TeSys DFCC fuse holders + class CC fuses 10 A (fuses to be ordered separately - no SE product)	DFCC2	-	x
4	Servo motor	BSH0702T02F2A	x	x
4	Power cable for Lexium 32, 5 m	VW3M5101R50	x	x
4	Encoder cable for Lexium 32, 5 m	VW3M8102R50	x	x
Altivar 71				
4	Altivar 71 variable speed drive, 0.75 kW	ATV71H075N4	x	x
4	Magnetic circuit breaker, 4 A (3~400 V)	GV2L08	x	-
4	Auxiliary contacts for circuit breaker, 1 NO, 1 NC	GVAE11	x	-
4	Thermal-magnetic circuit breaker, 2.5...4 A (3~480 V)	GV2P08	-	x
4	Insulating barrier for motor circuit breaker	GV2GH7	-	x
4	Auxiliary contacts for circuit breaker, 1 NO, 1 NC	GVAN11	-	x
Altivar 32				
4	Altivar 32 variable speed drive, 0.37 kW	ATV32H037N4	x	x
4	Magnetic circuit breaker, 2.5 A (3~400 V)	GV2L07	x	-
4	Auxiliary contacts for circuit breaker, 1 NO, 1 NC	GVAE11	x	-
4	Thermal-magnetic circuit breaker, 1.6...2.5 A (3~480 V)	GV2P07	-	x
4	Insulating barrier for motor circuit breaker	GV2GH7	-	x

Quantity	Description	Reference	IEC	UL
4	Auxiliary contacts for circuit breaker, 1 NO, 1 NC	GVAN11	-	x
4	CANopen communication card for daisy chain	VW3A3608	x	x
Altivar 32				
2	Altivar 32 variable speed drive, 0.75 kW	ATV32H075N4	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	CANopen communication card for daisy chain	VW3A3608	x	x
Lexium ILA1				
2	Lexium ILA integrated drive	ILA1F57PC2A	x	x
2	Power cable for Lexium IL•, 5 m	VW3L30001R50	x	x
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
2	Circuit breaker Multi9 UL1077 1P, B, 10 A (24 Vdc)	24116	x	x
Lexium 32i				
1	BMi servomotor with integrated power stage	BMI702P06A	x	x
1	Magnetic circuit breaker, 4 A (3~400 V)	GV2L08	x	-
1	TeSys DFCC fuse holders + class CC fuses 4 A (fuses to be ordered separately - no SE product)	DFCC3	-	x
1	LXM32i control unit for CAN fieldbus	LXM32ICAN	x	x
1	Connection module supply voltage	VW3M9002	x	x
1	Connection module bus-I/O-STO	VW3M9101	x	x
1	Cable STO	VW3M9405	x	x
TeSys U				
1	TeSys U base module reversing; 12 A (without terminals)	LU2BA0BL	x	x
1	TeSys U control unit, standard 1.25...5 A	LUCA05BL	x	x
1	TeSys U wiring kit coil (reversible)	LU9MRC	x	x
1	TeSys U communication module CANopen	LULC08	x	x
1	Insulating barrier for TeSys U	LU9SPO	-	x

Encoder

The encoders are designed for compatibility with the UL standard, but they are not certified.

Quantity	Description	Reference
1	CANopen multi-turn absolute encoder	XCC3510PS84CB
4	Incremental encoder, 5 Vdc, RS422	XCC1510PS11X
4	Encoder interface card for ATV71, 5 Vdc, RS422	VW3A3401
4	Cable for incremental encoder, 5 m	XCCPM23121L5
4	Encoder mounting bracket	XCCRE5SN

CANopen/CANmotion Wiring

Quantity	Description		Reference
1	preformed cordset, standard, CE marking: low smoke emission, zero halogen. flame-retardant (IEC 60332-1), one 9-way female SUB-D connector at each end	1.0 m (3.28 ft)	TSX CAN CADD1
12	preformed cordset. one 9-way SUB-D connector, one RJ 45 connector	1.0 m (3.28 ft)	TCS CCN 4F3M1T
6	preformed cordset, one RJ 45 connector at each end	0.3 m (0.98 ft)	VW3 CAN CARR03
5	IP20 CANopen tap junction, 4 SUB-D ports, screw terminal block for connecting the trunk cables, line termination		TSX CAN TDM4
1	CANopen cable, dedicated to the American market, UL and CSA certified, fire retarding	100 m (328 ft)	TSX CAN CB•••
2	preformed cordset, two 5-way M12 A-coded angled connectors (one male connector and one female connector)	3.0 m (9.84 ft)	FTX CN 3230
2		5.0 m (16.40 ft)	FTX CN 3250
1	IP67 M12 connector, 5-way M12 A-coded connectors female		FTX CN 12F5
1	IP20 line terminator, RJ 45 termination resistor (for end of bus)		TCS CAR 013M120
1	IP67 line terminator, equipped with one M12 connector (for end of bus)	–	FTX CNTL12

Ethernet Wiring

Quantity	Description		Reference
2	Ethernet ConneXium cable, shielded twisted-pair straight cord, one RJ45 connector at each end	2.0 m (6.56 ft)	490NTW00002
1		5.0 m (16.40 ft)	490NTW00005
1	Ethernet TCP/IP unmanaged switch, 10BASE-T/100BASE-TX - 5x RJ45 ports copper cable		TCSESU053FN0

Modbus SL Wiring

Quantity	Description		Reference
1	Modbus SL drop cable, 1 RJ45 connector and 1 end stripped	3.0 m (9.8 ft)	VW3A8306D30

Software Tools

Quantity	Description	Reference
1	SoMachine (includes Vijeo-Designer) on DVD	SOMNACS41
1	Single user license for SoMachine	SOMNACCZXSPA41
1	Programming cable	TCSXCNAMUM3P

Glossary

A

A coded

Connectors that have 1 raised key on the male connector and 1 mating slot on the female connector. This is the standard coding used for sensors and distribution box applications.

B

BOOTP

(*bootstrap protocol*) A UDP network protocol that can be used by a network client to automatically obtain an IP address (and possibly other data) from a server. The client identifies itself to the server using the client MAC address. The server, which maintains a pre-configured table of client device MAC addresses and associated IP addresses, sends the client its pre-configured IP address. BOOTP was originally used as a method that enabled diskless hosts to be remotely booted over a network. The BOOTP process assigns an infinite lease of an IP address. The BOOTP service utilizes UDP ports 67 and 68.

bps

(*bit per second*) A definition of transmission rate, also given in conjunction with multiplicator kilo (kbps) and mega (mbps).

BSH

A Lexium servo motor from Schneider Electric.

bus base

A mounting device that is designed to seat an electronic module on a DIN rail and connect it to the TM5 bus for M258 and LMC058 logic controllers. Each base bus extends the integrated TM5 data and electronic power buses as well as the 24 Vdc I/O power segment. The electronic modules are added to the TM5 system through their insertion on the base bus.

C

CANmotion

A CANopen-based motion bus with an additional mechanism that provides synchronization between the motion controller and the drives.

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.

CiA

(*CAN in automation*) A non-profit group of manufacturers and users dedicated to developing and supporting CAN-based higher layer protocols.

controller

Automates industrial processes (also known as programmable logic controller or programmable controller).

CPDM

(*controller power distribution module*) The connection of the controller to the external 24 Vdc power supplies and the beginning of the power distribution for the local configuration.

CSA

(*Canadian standards association*) The Canadian standard for industrial electronic equipment in hazardous environments.

D

DHCP

(*dynamic host configuration protocol*) An advanced extension of BOOTP. DHCP is more advanced, but both DHCP and BOOTP are common. (DHCP can handle BOOTP client requests.)

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 IEE 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.

FTP

(*file transfer protocol*) A standard network protocol built on a client-server architecture to exchange and manipulate files over TCP/IP based networks regardless of their size.

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

PCI

(*peripheral component interconnect*) An industry-standard bus for attaching peripherals.

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.

R

RJ-45

A standard type of 8-pin connector for network cables defined for Ethernet.

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).

RTC

(*real-time clock*) A battery-backed time-of-day and calender clock that operates continuously, even when the controller is not powered for the life of the battery.

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*)

SNMP

(*simple network management protocol*) A protocol that can control a network remotely by polling the devices for their status and viewing information related to data transmission. You can also use it to manage software and databases remotely. The protocol also permits active management tasks, such as modifying and applying a new configuration.

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.

V

VSD

> (*variable speed drive*) An equipment that makes a variable and regulates the speed and rotational force, or torque output, of an electric motor.

Index