



Programme: Directorate of Engineering (DOE)

Project/WP: ESO Engineering Standards

List of PLC Modules

Document Number: ESO-253356

Document Version: 4

Document Type: Standard (STD)

Released On: 2022-07-13

Document Classification: ESO Internal Use [Confidential for Non-ESO Staff]

Prepared by: Brast, Roland

Validated by: Brast, Roland

Approved by: Egner, Sebastian Elias



Authors

Name	Affiliation
R.Brast	ESO European Southern Observatory

Change Record from previous Version

Affected Section(s)	Changes / Reason / Remarks
All	January 2022, A complete update of the document / Version 4



Contents

- 1. Scope.....5
- 2. Related Documents.....5
 - 2.1 Applicable Documents.....5
 - 2.2 Reference Documents.....5
- 3. Introduction6
 - 3.1 Definitions, Acronyms and Abbreviations.....6
 - 3.2 Stylistic conventions6
- 4. PLC Standards and Applications7
 - 4.1 PLC standards.....7
 - 4.2 Beckhoff PLC modules8
 - 4.2.1 List of PLC Controllers and necessary accessories8
 - 4.2.2 List of Standard Software Licenses9
 - 4.2.3 List of EtherCAT distribution Modules.....10
 - 4.2.4 List of various EtherCAT to other Fieldbus converter Modules.11
 - 4.2.5 List of Digital Input Modules12
 - 4.2.6 List of Digital Output Modules.....13
 - 4.2.7 List of Analogue Input Modules14
 - 4.2.8 List of Analogue Output Modules.....15
 - 4.2.9 Time Synchronisation.....16
 - 4.2.10 Panel PCs and HMI Panels.....17
 - 4.2.11 Motion Control.....18
 - 4.2.11.1 List of Beckhoff Motion Control Modules.....18
 - 4.2.11.2 List of Beckhoff Encoder Interfaces / Position Feedback Modules20
 - 4.2.11.3 LIST of ELMO MOTION Control Solution.....21
 - 4.2.12 System Terminal Modules.....22
 - 4.2.13 Safety Modules24
 - 4.3 Siemens automation hardware & accessories25
 - 4.3.1 General25
 - 4.3.2 PLC CPU.....25
 - 4.3.3 Modules25
 - 4.3.4 HMI Touch Panels.....25
 - 4.3.5 Siemens IPC25
 - 4.3.6 Profinet switchgear.....25
 - 4.3.7 Engineering SW26



Tables

Table 1: List of PLC Controller	8
Table 2: List of TwinCAT software licenses.....	9
Table 3: License Management Tools	9
Table 4: List of EtherCAT distribution modules	10
Table 5: List of EtherCAT communication / Fieldbus converter Modules.....	11
Table 6: List of digital input modules	12
Table 7: List of digital output modules.....	13
Table 8: List of analogue input modules.....	14
Table 9: List of analogue output modules.....	15
Table 10: List of Time synchronisation modules.....	16
Table 11: List of Beckhoff Motion Control Modules	18
Table 12: List of Beckhoff Encoder Interfaces.....	20
Table 13: List of Motion Controllers from ELMO.....	21
Table 14: List of modules for system supply	22
Table 15: List of TwinSAFE Modules	24



1. Scope

This document is aimed at giving the list of the PLC modules to be used in actual and future ESO instruments and telescope applications. The modules listed in this document have been tested and shall cover most of the applications at Instrument and Telescope level.

2. Related Documents

2.1 Applicable Documents

The following documents, of the exact version shown, form part of this document to the extent specified herein. In the event of conflict between the documents referenced herein and the content of this document, the content of this document shall be considered as superseding.

AD references shall be specific about which part of the target document is the subject of the reference.

AD Nr.	Document Nr.	Version	Document Title
AD1	ESO-434461	1	Data Sheets associated with List of PLC Modules.zip

None

2.2 Reference Documents

The following documents, of the exact version shown herein, are listed as background references only. They are not to be construed as a binding complement to the present document.

RD Nr.	Document Nr.	Version	Document Title
RD1	ESO-044295	4	Electrical and Electronic Design Standards
RD2	ESO-253475	1	PLC Standards



3. Introduction

3.1 Definitions, Acronyms and Abbreviations

This document employs several abbreviations and acronyms to refer concisely to an item, after it has been introduced. The following list is aimed to help the reader in recalling the extended meaning of each short expression:

I/O	Input / Output
ICS	Instrument Control SW
PAC	Preliminary Acceptance Chile
PLC	Programmable Logic Controller
PM	Project Manager
ESCB	Engineering Standards Control Board
SETB	Standing Electronics Technical Board (Experts from the fields of Control, Software and Electronic)
TBC	To Be Clarified
TBD	To Be Defined
TC3	TwinCat 3

3.2 Stylistic conventions



Contains useful information for the user



Highlight very important information for the user.



Red text contains critical information, the user shall not ignore!



4. PLC Standards and Applications

4.1 PLC standards



What is behind the word “standard”?

Here an extract from the PLC standards document [RD2] chapter 5 that explains the concept.

“The standardization of PLC technology aims at identifying a combination of hardware and software based on industrial off the shelf PLCs for the development of control system functions.

The following aspects of PLC technology and usage are standardized:

- A set of PLCs able to satisfy different sets of requirements with a palette of commercial off-the-shelf (COTS) solutions with appropriate cost/performance ranges, in particular:
 - Siemens S7 PLC family
 - Beckhoff soft-PLC family

For cryogenic and safety related application, both SIEMENS and BECKHOFF modules shall be used. For ICS application, only BECKHOFF PLC shall be used.

In this document, we will present a list of modules from both SIEMENS and BECKHOFF manufacturer. Only the module, stated with their specific module name, are tested at least communication / interface wise.

What does that mean?

It means that you can use any of the module listed below to build-up your instrument/telescope application without asking. ESO will keep a stock of the standard modules at LPAO premises such projects do not need to provide spare parts for these components, as long these spares are not requested contract wise.



It means also that you are not allowed to use any module that is not listed here on your own initiative. That might sound restrictive, but the main purpose is to keep the number of supported modules to a reasonable number and facilitate the maintenance of ESO premises.



If you need a module, that is not listed here, you can follow the request for deviation (RfD) process, offered by ESO. The ESO-PM of the corresponding project shall file the RfD to the SETB for technical assessment. Minor RfD will be approved directly by the SETB, otherwise the ESCB needs to be involved.

The document “List of PLC Modules” will be regularly reviewed by the SETB to incorporate obsolescence information, updates, new modules and to reflect our experience made over time.



4.2 Beckhoff PLC modules

All modules listed under the “Beckhoff Reference” column have a short datasheet description listed in the document given under AD1:

Data Sheets associated with List of PLC Modules.zip

The datasheets in the Zip-File give a concise overview of the function and features of the specific modules. The ZIP-File is organised like the chapters given under 4.2. The short datasheets should provide additional information to ease the module selection process.

The listed short datasheets do not replace the full featured datasheet, nor the installation manual available at the Beckhoff information system.

<https://www.beckhoff.com>

4.2.1 List of PLC Controllers and necessary accessories

The PLC Options to choose from depending on the application, are given in Table 1

Beckhoff Reference	Description
CX2033-0175	Medium performance application (PL50) No Fan
CX2043-0175	CPU Hardware: Demanding performance application (PL60) With Fan
CX2042-0175	CX2042 Intel® Xeon® CPU with a clock rate of 2.2 GHz (4 cores)
CX2042-N167	2 x 10G Ethernet interface (optical, 2 x SFP + cage)
CX2100-0004 CX2100-0014	Collocated Power Supply, attached to CPU for CX-2030for CX-2040
CX2500-0060	Interface module for 10/100/1000 Mbit Ethernet
CX8110	Embedded PC with EtherCAT Interface & Address switch Programming via separate Ethernet Port (For simple, remote applications like cabinet cooling etc.)

Table 1: List of PLC Controller

Short datasheets for PLC Controllers are given under AD1

The system designer is responsible to ensure the selected PLC Performance Level (PL) is appropriate for the application. The corresponding licenses (next chapter) are bound to the selected PL. An upgrade of PLC PL comes along with an update of licenses for the new PLC! Licenses for higher PL are always downwards compatible.



4.2.2 List of Standard Software Licenses

ESO recommends using terminal EL6070 to manage TwinCAT software licenses listed in table Table 2: List of TwinCAT software licenses. Additional licenses might be needed by projects. ESO suggest using the C9900-L100 USB stick to manage additional licenses. The current version of TwinCAT is: TwinCat 3.1

The Software License options to choose from depending on the application, are given in Table 2

License/Order Number	License Description
Windows 10 IoT	Operating System
TC1000	TC3 ADS - Runtime License
TC1100	TC3 IO - Runtime License
TC1200	TC3 PLC - Runtime Licenses
TF6100	TC3 OPC-UA - Runtime License
TC1250	License for Motion Control: TwinCAT NC PTP TC3 PLC/NC PTP 10 axes
TF5000	TC3 NC PTP 10 axes
TF5020	TC3 PTP Axes pack unlimited
TF6311	TC3 TCP/UDP RT
TF6340	TC3 Serial Communication
TC1300	TC3 C++
TF1800	TwinCAT 3 PLC HMI
TF6255	TwinCAT 3 Modbus RTU

Table 2: List of TwinCAT software licenses.

Beckhoff Reference	Hardware for License Management
EL6070	License Module, embodies the hardware license key in the EtherCAT I/O system.
C9900-L100	License key USB stick, an alternative to the EL6070 license key module

Table 3: License Management Tools

Short datasheets for Software Licenses are given under AD1



4.2.3 List of EtherCAT distribution Modules

The EtherCAT distribution modules to choose from, are given in Table 4

Beckhoff Reference	Module Description
EK1100	EtherCAT Coupler/ RJ45 / 100m Communication to EtherCAT Field-Nodes
EK1101	EtherCAT Coupler/ RJ45 / ID Switch / 100m Communication to EtherCAT Field Nodes
EK1110	EtherCAT Extension / RJ45 / 100m One channel - Line Topology
EK1122	EtherCAT Extension / RJ45 / 100m Two channel - Star Topology
EK1501	EtherCAT Coupler/ Multimode LWL SC / ID Switch / 2km Communication to EtherCAT Field Nodes
EK1501-0010	EtherCAT Coupler / Single Mode
EK1521	EtherCAT Extension / Multimode LWL SC / 2km One channel - Star Topology
EK1521-0010	EtherCAT Extension / Single Mode
EK1914	EtherCAT Bus Coupler with TwinSAFE IOs 4-channel non fail-safe dig. Output / 24 VDC / 0.5 A 2-channel fail-safe dig. Output / 24 VDC / 0.5 A 4-channel non fail-safe dig. Input 2-channel fail-safe dig. input

Table 4: List of EtherCAT distribution modules

Short datasheets for EtherCAT distribution modules are given under AD1



4.2.4 List of various EtherCAT to other Fieldbus converter Modules.

The primary bus system is always EtherCAT. Just in case a specific sensor or actuator cannot be connected straight to an EtherCAT Module the bridging to another bus system is allowed.

If there are Modules offered in various bus systems and one of it is EtherCAT, the EtherCAT Modul shall be selected.

The EtherCAT communication and converter modules to choose from, are given in Table 5

Beckhoff Reference	Module Description
EL6001	RS232 / clamp contacts / one channel / 15m Serial Interface Communication (2400...115.2 kBaud)
EL6002	RS232 / D-Sub9 / two channel / 15m Serial Interface Communication (300...115.2 kBaud)
EL6021	RS422-485 / clamp contact / one channel / 1000m twisted pair Serial Interface Communication (2400 ... 115.2 kBaud)
EL6022	RS422-485 / D-Sub9 / two channel / 1000m twisted pair Serial Interface Communication (300 ... 115.2 kBaud)
EL6224	IO – Link / four channel, 20m, three wire technics Communication (4.8, 38.4 & 230.4 kBaud)
EL6601	Ethernet / RJ45 / one channel / 100m twisted pair Communication 10BASE-T/100BASE-TX
EL6614	EtherCAT Terminal, 4-port Ethernet switch port
EL6631	PROFINET RT Controller / RJ45 / Two Ports / 100m Max. 15 PROFINET RT Slaves / Line Topology
EL6731	PROFIBUS Master / D-Sub-9 / one channel Communication (6 kBaud...12 MBaud)
EL6751	CANopen Master-Slave Terminal D-Sub9 / one channel Communication (20 ... 1000 kBaud)

Table 5: List of EtherCAT communication / Fieldbus converter Modules

Short datasheets for EtherCAT fieldbus converters are given under AD1



4.2.5 List of Digital Input Modules

The Digital Input Modules to choose from, are given in Table 6

Beckhoff Reference	Module Description
EL1004	4-channel Input / 24 V DC / filter 3.0 ms / 2-wire technics
EL1008	8-channel Input / 24 V DC / filter 3.0 ms / 1-wire technics
EL1034	4-channel Input / 24V DC / filter 10µs potential free input
EL1084	4-channel Input / 24 V DC / filter 3 ms / 2-wire technics Low side switch
EL1088	8-channel Input / 24 V DC / filter 3 ms / 1 wire technics Low side switch
EL1124	4-channel Input / 5 V DC / 0.05 µs / 3 wire technics
EL1259	8-channel Input / 24 V DC / filter 1 µs 8-channel Output / 24 V DC / 0.5 A timestamp
EL1502	2-channel Up/down counter / 24 V DC / 100 kHz / 32 bit counter depth 2-channel Output following the input channels
EL1808	8-channel Input / 24 V DC power pins / filter 3ms / 2-wire technics Reference to Modul internal 0V Contact
EL1809	16-channel Input / 24 V DC, filter 3.0 ms, 1-wire technics Reference to Modul internal 0V Contact
EL1852	8-channel Input / 24 V DC / filter 3 ms + 8-channel output / 24 V DC / 0.5A Flat-ribbon cable
EL1859	8-channel Input / 24V / filter 3ms + 8-channel output / 24V / 0.5A 1-wire technics / Reference to Modul internal 0V Contact
EL1862-0010	16-channel Input / 24 V DC, filter 3.0 ms, 2-wire system Flat-ribbon cable,

Table 6: List of digital input modules

Short datasheets for Digital Input Modules are given under AD1



4.2.6 List of Digital Output Modules

The Digital Output Modules to choose from, are given in Table 7

Beckhoff Reference	Module Description
EL2004	4-channel Output / 24 V DC / 0,5 A / 2-wire technics High side switching
EL2008	8-channel Output / 24 V DC / 0,5 A / 1-wire technics High side switching
EL2044	4-channel Output / 24 V DC / 2 A, 2-wire technics High side switching / with extended diagnostics
EL2124	4-channel Output / 5 V DC / 20 mA / 2-wire technics low side switching
EL2262	2-channel Output / 24 V DC / 0.5 A, 4-wire technics Push-Pull output / oversampling
EL2502	2-channel pulse width modulated Output 24 V DC /0.5 A / 4-wire system Push-Pull output
EL2535	2-channel current control for inductive loads (pulse width modulation) 24 V DC, 1 A, 30kHz, 10-bit current resolution
EL2612	2-channel relay Output / change-over contacts / potential-free [AC:125 V, 0.5A] / [DC: 30 V, 2A]
EL2634	4-channel relay Output / make contacts / potential-free 250 V AC / 30 V DC / 4 A resistive / 2 A Inductive - load
EL2652	2-channel relay Output / change-over / potential-free 230 V AC/300 V DC, 1 A, isolated For maximum current and minimum load check datasheet!
EL2819	16-ch Output / 24 V DC / 0.5 A / 1-wire technics High side switching / with diagnostics
EL2872	16-channel Output / 24 V DC / 0.5 A, 1-wire technics High side switching / Flat-ribbon cable
EL2872-0010	16-channel Output / 24 V DC, 0.5A / 1-wire technics Low side switching to Modul int. 0V/ Flat-ribbon cable
EL1259	8-channel Input / 24 V DC / filter 1 μ s / 8-channel Output / 24 V DC / 0.5 A / Timestamp

Table 7: List of digital output modules

Short datasheets for Digital Output Modules are given under AD1

4.2.7 List of Analogue Input Modules

The Analogue Input Modules to choose from, ed are given in Table 8

Beckhoff Reference	Description
EL3102	2-channel Input / -10 V...+10 V / filter 5kHz / differential input / 16 bit
EL3104	4-channel Input / -10 V...+10 V / filter 5kHz / differential input / 16 bit
EL3114	4-channel Input / 0...20 mA / filter 5kHz /differential input / 16 bit
EL3124	4-channel Input / 4...20 mA / filter 5kHz /differential input / 16 bit
EL3154	4-channel input / 4...20 mA / filter 5kHz /single-ended /16-bit Sensor Supply via 2-wire technics
EL3162	2-channel Input / 0...10 V / filter 5kHz / single-ended / 16 bit
EL3164	4-channel Input / 0...10 V / filter 5kHz /single-ended / 16 bit
EL3174	4-channel input / Multi-Function / filter 5kHz Nominal Range: -10/0...+10 V -20/0/+4...+20 mA Technical Range: -10.73...+10.73 V -21.47...+21.47 mA Voltage: Differential / Current: Single Ended, common reference Enables extended sensor fault condition recognition (NAMUR NE43)
EL3174-0002	4-channel input / Multi-Function / filter 5kHz Nominal Range: -10/0...+10 V -20/0/+4...+20 mA Technical Range: -10.73...+10.73 V -21.47...+21.47 mA Voltage & Current: Differential and isolated channels Enables extended sensor fault condition recognition (NAMUR NE43)
EL3202-0010	2-channel Input / PT100 / filter 1kHz / single-ended / 16 bit 4-wire system / Resistor or Temperature measurement All channels share a common reference
EL3204	4-channel Input / PT100 / filter 1kHz / single-ended / 16 bit 2-wire system / Resistor or Temperature measurement All channels share a common reference
EL3208	8-channel Input / PT100 / filter 1kHz / single-ended / 16 bit 2-wire system / Resistor or Temperature measurement All channels share a common reference
EL3214	4-channel Input / PT100 / filter 1kHz / single-ended / 16 bit, 2- and 3-wire system / Resistor or Temperature measurement All channels share a common reference
EL3356-0010	1-channel Input /Measuring Full Bridge / filter 10kHz / 24 bit, High precision
EL3443	Mains - 3 Phase Power Measurement 3-channel input / 480V AC/DC / 1A / 24Bit
EL3681	1-channel Digital Multimeter / 300mV -300V or 100mA – 10A / 18bit 1s sampling time / auto or manual range selection
EL3702	2-channel Input terminal / -10 V...+10 V / filter 30kHz / differential input / 16 bit Oversampling

Table 8: List of analogue input modules

Short datasheets for Analogue Input Modules are given under AD1



4.2.8 List of Analogue Output Modules

The Analogue Output Modules to choose from, are given in Table 9

Beckhoff Reference	Description
EL4104	4-channel Output / 0...10 V / 4 kSps / 16 bit / 2-wire technics All channels share a common Gnd
EL4124	4-channel Output / 4...20 mA / 4 kSps / 16 bit / 2-wire technics All channels share a common Gnd
EL4134	4-channel Output / -10 V...+10 V / 4 kSps / 16 bit / 2-wire technics All channels share a common Gnd
EL4732	2-channel Output / -10 V...+10 V / 100 kSps / 16 bit / 2-wire technics All channels share a common Gnd Oversampling

Table 9: List of analogue output modules

Short datasheets for Analogue Output Modules are given under AD1



4.2.9 Time Synchronisation

For controlling tracking devices or when time accuracy is critical, an external time synchronization is needed. For this case, ESO requires using the terminal EL6688 which can be connected to a PTP network. For synchronizing timestamps in logs, there is normally no need to have the accuracy provided by PTP. In this case, ESO suggest using NTP and the TwinCAT corrected timestamps functionality.

The Time Synchronisation Modules to choose from, are given in Table 10

Beckhoff Reference	Description
EL6688	IEEE1588 PTP External Synchronization and time Interface

Table 10: List of Time synchronisation modules

Short datasheets for Time Synchronisation Modules are given under AD1



4.2.10 Panel PCs and HMI Panels

Panel PCs are designed for installation into 19-inch racks, cabinet front doors or standalone Units. The Panel PCs are suited for engineering control applications, for example with TwinCAT software and EtherCat as fieldbus. Nevertheless **ESO recommends to select the Control Unit from the “List of PLC Controllers” given in this document under chapter 4.2.1** and do not use a Panel PC. Please contact ESO in case your design incorporates a Panel PC, due to specific application constraints.

HMI (Human Machine Interface) Panels are used for visualisation of the process images. HMIs give access to the control plant, its status, parameters and alarms. Beckhoff offers a large variety of HMI panels in different formfactors and display capabilities. Please contact ESO if your application requires a HMI Panel to get further information about solutions already implemented for Instrument and subsystems.



4.2.11 Motion Control

For operating motion control Modules, a specific Runtime Licenses is necessary:

- PLC/NC PTP X (X depends of the number of motorized functions)

For tracking devices, you shall implement all the following modules and SW:

- All components for Time Synchronization
- All components for Motion Control
- Additional Runtime Licenses: PLC/C++

4.2.11.1 List of Beckhoff Motion Control Modules

The Beckhoff Motion Control Modules to choose from, are given in Table 11

Beckhoff Reference	Description Motor
EL7332	2-channel DC Motor / 24 V DC, / 1 A No Encoder / Only Speed preset 1 digital Inputs (Reference / Limit)
EL7342	2-channel DC Motor / 48 V DC/ 3.5 A Single ended Inc. Encoder 1 digital Inputs (Reference)
EL7411	1-channel BLDC Motor / 48 V DC / 4.5 A Differential Inc. Encoder (A, B, C) Brake Control / Fan Control / 2 digital Inputs (Limits) Rotator feedback via 3 Hall Sensors
EL7037	1-channel Stepper Motor, 24 V DC, 1.5 A Single ended Inc. Encoder (A,B,C & Latch) 2 digital Inputs (Limits)
EL7047	1-channel Stepper Motor / 48 V DC / 5 A Single ended Inc. Encoder (A,B,C & Latch) 2 digital Inputs (Limits)
EL7201	1-channel Servo Motor / 8-48 V DC / 2.8 A Resolver (Ex, Sin, Cos) 2 digital Inputs (Limits) / Brake Control
EL7201-0010	1-channle Servo Motor / 8-48 V DC / 2.8A OCT (One Cable Technology) / absolute encoder interface 2 digital Inputs (Limits) / Brake Control Motor and Controller must support OCT!
EL7211-0010	1-channle Servo Motor / 8-48 V DC / 4.5 OCT (One Cable Technology) / absolute encoder interface 2 digital Inputs (Limits) / Brake Control Motor and Controller must support OCT!

Table 11: List of Beckhoff Motion Control Modules



Continuation of "List of Beckhoff Motion Control Modules"

Beckhoff Reference	Description Motor
AX5203	2 channel Compact Servo Drive Supply Voltage: 3 phase 100...480 V AC Output: Max 800V / Max 3 A Encoder Types: SinCos 1 Vpp, Resolver, EnDat 2.1, Hiperface, BiSS B OCT
EL9576	Brake Chopper Terminal High-performance capacitors for stabilising supply voltages To absorb Motor Supply variations due to Back EMF

Short datasheets for Beckhoff Motion Control Modules are given under AD1



4.2.11.2 List of Beckhoff Encoder Interfaces / Position Feedback Modules

The Beckhoff Encoder Modules to choose from, are given in **Error! Reference source not found.**

Beckhoff Reference	Description Encoder Interface
EL5001	1-channel SSI Encoder (Absolute Position) Differential Input / Adjustable baud rate / 32 bit position counter Encoder Supply 24V
EL5002	2-channel SSI Encoder (Absolute Position) Differential Input / Adjustable baud rate / 32 bit position counter No Encoder Supply
EL5021	1-channel Sin-Cos Encoder to Incremental position Sin-Cos 1 VPP and Reference differential, 32 bit position counter Sin-frequency 250kHz / Encoder Supply 5V
EL5032	2-channel EnDAT 2.2 Encoder Differential Input / 48 bit position counter 5V Encoder Supply
EL5042	2-channel BiSS C or SSI Encoder (Absolute Position) Differential Input / Adjustable baud rate / 64 bit position counter / Encoder Supply 5V & 9V
EL5072	2-channel LVDT or RVDT Sensor to Absolute Position Input Signal max 20 V _{PP} / 32bit position counter Adjust. Excitation in amplitude (1.5 ... 20 V _{PP}) and frequency (1..20kHz)
EL5101	1-channel Incremental Encoder (High-resolution) Differential inputs (A, B, C) / Latch and Gate / 32 bit position counter Encoder Supply 5V / 5 M Increments/s
EL5102	2-channel Incremental Encoder (High-resolution) Differential inputs (A, B, C) / Latch and Gate / 32 bit position counter Encoder Supply 5V / 5 M Increments/s
EL5101-0010	1-channel Incremental Encoder (High-resolution) Differential inputs (A, B, C) / Latch and Gate / 32 bit position counter Encoder Supply 5V / 20 M Increments/s
EL5112	2-channel Incremental encoder Differential, TTL or Open Collector (A, B, C) / Gate and Latch 32 bit position counter / Encoder Supply 5V
EL5152	2-channel Incremental Encoder or Up-Down Counter HTL (24 V) single ended Inputs (A, B) / 32 bit position counter Encoder Supply 24V / 400 k Increments/s

Table 12: List of Beckhoff Encoder Interfaces

Short datasheets for Beckhoff Encoder Interface Modules are given under AD1



4.2.11.3 LIST of ELMO MOTION Control Solution

The ELMO Gold Family motion controllers have an advanced control law. F. e. the position feedback loop via multiple encoders is closed inside the ELMO controllers, therefore independent from the PLC loop frequency.

The ELMO Motion Control Modules to choose from, are given in Table 13

ELMO Reference	Description
G-DCWHI15/100EE Family: Gold Type: DC Whistle	Brushed DC / Brushless DC / Stand Alone Input: 12-95V DC / Output: 1.2kW / 15A Enc1: SSI, INC, Dig. Hall / Enc2: INC, Analog, Anal. Hall STO / Digi IOs / EtherCat
G-SOLWHI 15/100 EES Family: Gold Type: DC Solo Whistle	Brushed DC / Brushless DC / Integrated Input: 12-95V DC / Output: 1.2kW / 15A Enc1: SSI, INC, Dig. Hall / Enc2: INC, Analog, Anal. Hall STO / 24V-Digi IOs / EtherCat
G-OBO13/230FESO1 Family: Gold Type: Oboe	Brushed DC / Brushless DC / Stand Alone Input: 3-Phase 230V (1-Phase 230V) / Output: 3.6kW / 13A Enc1: SSI, INC, Dig. Hall / Enc2: INC, Analog, Anal. Hall STO / 24V-Digi IOs / EtherCat
G-TWIR 06/100EE Family: Gold Type: Twitter	Brushed DC / Brushless DC / Integrated - PCB Mounted Input: 10-95V DC / Output: 0.47kW / 6A Enc1: SSI, INC, Dig. Hall / Enc2: INC, Analog, Anal. Hall 24V-Digi IOs / EtherCat
D-DCBEL 5/100 EES Family: Gold Type: Bell	Stepper Controller / Stand Alone Input: 12-95V DC / Output: 0.4kW / 5A Enc1: SSI, INC, Dig. Hall / Enc2: INC, Analog, Anal. Hall STO / 24V-Digi IOs / EtherCat
D-DCBEL 5/100 ERS Family: Gold Type: Bell	Stepper Controller / Stand Alone Input: 12-95V DC / Output: 0.4kW / 5A Enc1: SSI, INC, Dig. Hall / Enc2: Resolver STO / 24V-Digi IOs / EtherCat

Table 13: List of Motion Controllers from ELMO

In the end, it is up to the designer to evaluate the complexity of the motion control application and to select the appropriate Controller. ESO is aware that the selection process for the motion control application is not trivial. Therefore, ESO is prepared to support this selection process. Please contact the ESO follow-up person for your instrument / project to start the collaboration.

Short datasheets for ELMO Motion Control Modules are given under AD1



4.2.12 System Terminal Modules

The System terminal Modules to choose from, are given in Table 14

Beckhoff Reference	Description Encoder Interface
EL9011	“Bus End Cover” for E-Bus Connections
EL9070	8 x Shield contacts to the Potential of the Modul Mounting Rail
EL9110	Power supply terminal with diagnostics Input: 24V DC connected to front terminals. Output: 24V DC to the Power Contacts to the right. It can be used to establish a separate 24V branch
EL9184	8 x 24V DC / 8 x 0V Potential distribution terminal Input: Via Power Contacts to the left Output: from the front terminal
EL9185	4 x 24 V DC Potential distribution terminal Input: Via Power Contacts to the left Output: from the front terminal
EL9188	16 x 24V Potential distribution terminal Input: Via 24V Power Contacts to the left Output: from the front terminal
EL9189	16 x 0V Potential distribution terminal Input: Via 0V Power Contacts to the left Output: from the front terminal
EL9221-6000	1-channel Overcurrent protection Output 24V / Max 4A adjustable (Protection-Level)
EL9410	E-bus Supply Extension Input: 24V DC & PE connected to front terminals. Output: 5V / 2A for E-Bus (Internally) Output: 24V / (Max. 10A) & PE for power Contacts to the right
EL9505	Power Supply Terminal Input: 24V DC connected to front terminals. Output: 5V DC & PE to the front terminals Output: 5V DC & PE to the Power Contacts to the right. It can be used to establish a separate 5V field branch Galvanically Coupled
EL9512	Power Supply Terminal Input: 24V DC connected to front terminals. Output: 12V DC & PE to the front terminals Output: 12V DC & PE to the Power Contacts to the right. It can be used to establish a separate 12V field branch Galvanically Coupled
EL9515	Power Supply Terminal Input: 24V DC connected to front terminals. Output: 15V DC & PE to the front terminals Output: 15V DC & PE to the Power Contacts to the right. It can be used to establish a separate 15V field branch Galvanically Coupled

Table 14: List of modules for system supply



List of PLC Modules

Doc. Number: ESO-253356

Doc. Version: 4

Released on: 2022-07-13

Page: 23 of 26

Short datasheets for Beckhoff System Terminals Modules are given under AD1



4.2.13 Safety Modules

The Safety Modules to choose from, are given in Table 15

Beckhoff Reference	Description Encoder Interface
EL1904	4-channel TwinSAFE digital Inputs / 24 VDC 2-wire technics / potential free contactors
EL1918	8-channel TwinSAFE digital Inputs / 24 VDC (Default Config) 2-wire technics / potential free contactors Embedded Safety Controller (Configurable Option) Controller functionality is similar to EL6910
EL2904	4-channel TwinSAFE digital Output / 24 VDC / 0.5 A 2-wire technics
EL2912	2-channel TwinSAFE digital Outputs / 24 VDC / 2 A 2-wire technics Embedded Safety Controller (Configurable Option) Controller functionality is similar to EL6910
EK1914	EtherCAT Bus Coupler with TwinSAFE IOs 4-channel standard Output / 24 VDC / 0.5 A 2-channel <i>safety</i> dig. Output / 24 VDC / 0.5 A 4-channel standard dig. Input 2-channel <i>safety</i> dig. input
EL3174-0090	4-channel TwinSAFE analog Input (configurable) Max. 4-channel +-10V / differential or Max. 4-channel +-20mA / Single-ended 16Bit resolution
EL3214-0090	4-channel safety temperature input (f.e. PT100/1000) 3 wire / 16 Bit resolution
EL6910	TwinSAFE Controller Module for digital and analog IO safety configuration. At least one EL6910 module is mandatory for safety applications or one Modules having the EL6910 functionality embedded (see above).

Table 15: List of TwinSAFE Modules

When selecting actuators connected to the TwinSAFE digital Output, please ensure that the test pulses (safety feature) from the safe outputs do not lead to actuator switching.

Short datasheets for Beckhoff Safety Modules are given under AD1



4.3 Siemens automation hardware & accessories

4.3.1 General

The following list of components is mainly based on the automation hardware used in the ELT dome and main structure (DMS). The DMS has several thousand I/O points and uses i.e. over one hundred Sinamics S120 drive modules. The PLC control network infrastructure is entirely based on Siemens multi-mode fibre Profinet switchgear. This hardware must be maintained over the next 50 years. Therefore, it is natural to use the same hardware wherever possible in other ELT systems.

Datasheets from Siemens are not included in this document, because no specific Siemens modules are specified herein, just Siemens module series / families.

4.3.2 PLC CPU

All S7-1500 CPUs including failsafe CPUs
All ET200SP CPUs including failsafe CPUs

CPUs must be approved for altitude of 3000m or higher (with de-rating).

4.3.3 Modules

All modules of the ET200SP series including failsafe.
All modules of the ET200MP series including failsafe.
All modules of SIMATIC MICRO-DRIVE including failsafe.
All modules of SINAMICS S120 book size including failsafe.
All Hilscher CIFX modules with Profinet.

All modules shall be approved for altitudes of 3000m or higher (with de-rating).
Safety components shall be certified for an altitude of 3000m or higher.

4.3.4 HMI Touch Panels

Any SIMATIC HMI TPxx00, KTPxx00 or KPxx00 Comfort panel with Profinet interface configurable with WinCC comfort.

4.3.5 Siemens IPC

All siemens IPCs of the xx47 series.

4.3.6 Profinet switchgear

Siemens Scalance series and associated accessories.



4.3.7 Engineering SW

Any TIA portal version of SIMATIC STEP7 Professional actively marketed by Siemens at time of PAC.

Any TIA portal version of SIMATIC WINCC COMFORT actively marketed by Siemens at time of PAC.

Any version of STARTER or STARTDRIVE actively marketed by Siemens at time of PAC.

--- End of document ---