Thank you for using our **S100 EtherCAT option module**

Safety PRECAUTIONS

● Always follow safety instructions to prevent accidents and potential hazards from occurring.
● Safety precautions are classified into "WARNING" and "CAUTION" and their meanings are as follows:

⚠ **WARNING**   Improper operation may result in serious personal injury or death.

⚠ **CAUTION**   Improper operation may result in slight to medium personal injury or property damage

● The indicated illustrations on the product and in the manual have the following meanings.

⚠ Danger may be present. Read the message and follow the instructions carefully.

⚡ Particular attention should be paid because danger of an electric shock may be present.

● Keep operating instructions handy for quick reference.
● Read the operating instructions carefully to fully understand the functions of the S100 series and to use it properly.

⚠ **CAUTION**

● **Be cautious, when handling the CMOS components of the communication module.**
  Static may lead to malfunctioning of the product.

● **Turn off the inverter power, when changing the communication cable.**
  Otherwise, you may damage the module or a communication error may occur.

● **Make sure to insert the Communication module connector to the inverter precisely.**
  Otherwise, you may damage the module or a communication error may occur.

● **Check the parameter unit before setting up the parameter.**
  Otherwise, a communication error may occur.

Table of Contents

1   About the Product

The LSIS S100 EtherCAT communication module provides EtherCAT network communication for the S100 inverter. EtherCAT is a communication protocol compliant with IEC 61158 Type 12. The EtherCAT communication module provides full-duplex data transfer which enables real-time communication without transmission collisions. Using an EtherCAT connection, the S100 inverter can be controlled and monitored via a PLC sequence program or any master PLC module. In addition, EtherCAT is easy to connect, enabling faster installation and easier maintenance.

1.1   EtherCAT Technical Features

Item	Description
Communication protocol	EtherCAT
Communication speed	100 Mbps
Communication type	Full Duplex
Distance	100m (Twisted Pair)
Service	EtherCAT/Full slave/CoE/CiA402/EMCY
Topology	Line/Ring topology network (Tree/Star topology is available when an additional device, such as an EtherCAT hub, is installed.)
Cable	STP

1.2   Included Items

This product is consisting of these kinds of parts.
- EtherCAT Communication Module board (CECT- S100): 1 ea
- EtherCAT Module manual: 1 ea
- Brass Bar(M3xL23): 1 ea
- Brass Bar(M3xL17.3): 1 ea
- Fixed Screw(M3xL8): 2 ea

2 Part Names and Installation

2.1 Exterior

2.2 Installation

Warning) Connect a communication network after the power supply is off. If EtherCAT communication module is removed or installed, the power supply should be switched off. Otherwise, the S100 inverter will be damaged entirely.
Take off EtherCAT communication module from the product after the power supply is totally discharged.

■ Unfasten the front cover fixing bolt
    to remove the front cover and remove
    I/O cover((1), (2)) from
    a dedicated S100 inverter
    for communication.
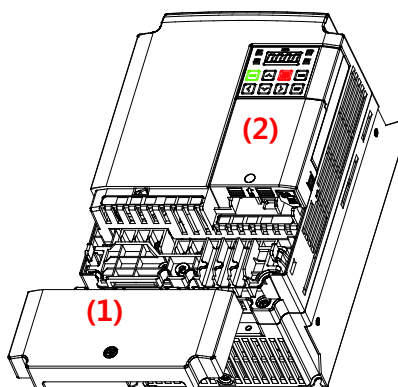
■   Remove the keypad (3).

(3)
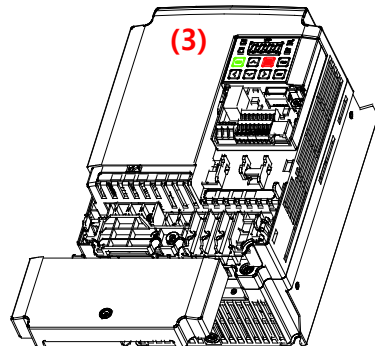
■   Unfasten a screw from
I/O board and
fasten the prepared
brass bar(4).

(4)
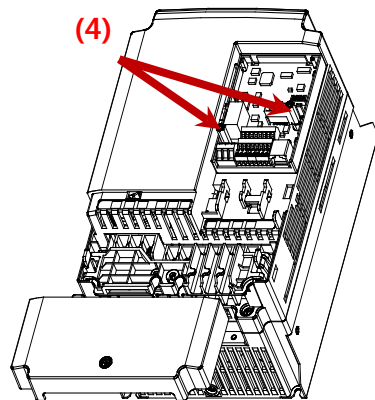
■   Mount EtherCAT communication Module
and fasten the removed screw(6)
and the included screw(7).

(6)   **(5)**

(7)

■ Install the keypad (8) at first and
the communication module
cover(9) in order.

(8)

(9)

■ Install the front cover(10) again
And installation is completed.

(10)
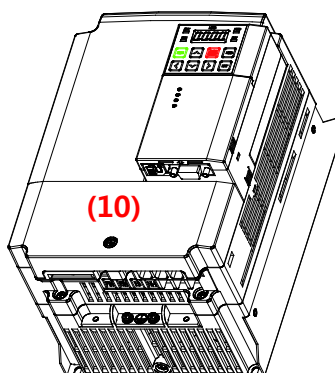
2.3 EtherCAT Communication Module Front Panel

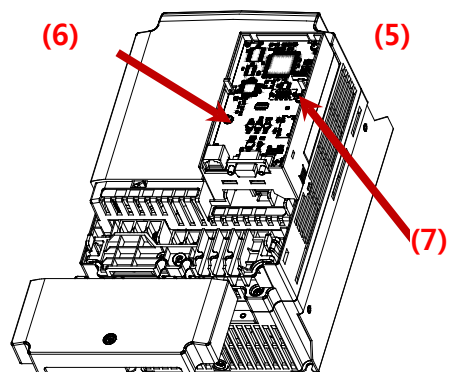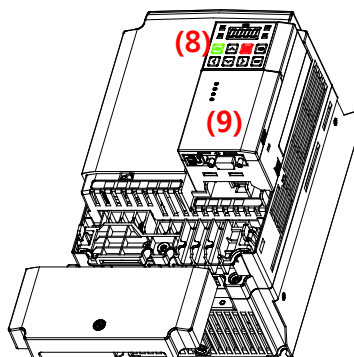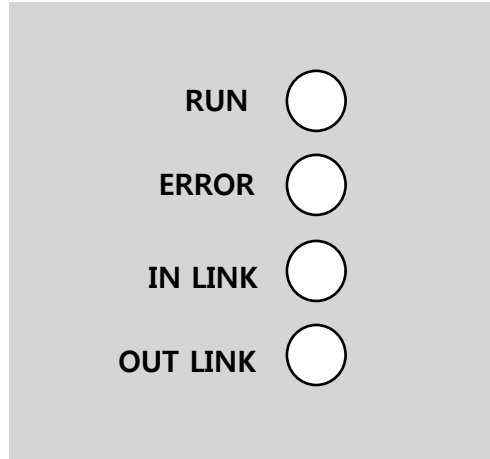| Indicator	Indicator Description	Color	Color Description	Status	Status Description
RUN	Operating status	Green	Normal operation	Flashing	Pre-operational
				OFF	Ready for operation
				ON	Operation is in progress.
				Single Flash	Safe operation is in progress.
ERROR	Error status	Red	Normal operation	OFF	ESC is operating normally.
			ESC Communication error	Flashing 0.2 s ON / 0.2 s OFF	ESC configuration error
				Single Flash 0.2 s ON / 1 s OFF	ESC local error is detected (enters a safe state).
				Double Flash 0.2s ON / 0.2 s OFF / 0.2 s ON / 1s OFF	ESC Watchdog timeout
				ON	Severe ESC Error is detected.
				Flashing	ESC failed to boot.

Indicator	Indicator Description	Color	Color Description	Status	Status Description
		Green	Normal operation	OFF	Communication between the communication module and the inverter is normal.
			Communication error	Flashing 0.2 s ON / 0.2 s OFF	Communication between the communication module and the inverter is abnormal.
				ON	Inverter error, or a communication error between the communication module and an upper-level device.
		The green and red indications are mutually exclusive–they do not light up at the same time. The red indication holds priority over the green indication. Eg.) If an ESC error and an inverter communication error occur simultaneously, a red indication is turned on. A green indication is turned on after the ESC error condition is resolved.			
IN LINK	IN Link status	Green	Normal operation	ON	Link is established, but no operation is in progress.
				OFF	Network Link 1 is not connected.
				Flashing 0.05 s ON / 0.05 OFF	Link is established, and an operation is in progress.
OUT LINK	OUT Link status	Green	Normal operation	ON	Link is established, but no operation is in progress.
				OFF	Network Link 2 is not connected.
				Flashing 0.05 s ON / 0.05 OFF	Link is established, and an operation is in progress.

3   Network Connections

3.1   Network Cable Contacts

Pin No.	Signal	Description	Cable Color
1	TX+	Data Transmission (+)	White/Yellow
2	TX-	Data Transmission (-)	Yellow
3	RX+	Data Reception (+)	White/Green
4	NONE	Not Used	Blue
5	NONE	Not Used	White/Blue
6	RX-	Data Reception (-)	Green
7	NONE	Not Used	White/Brown
8	NONE	Not Used	Brown

3.2   Communication Cable Connector
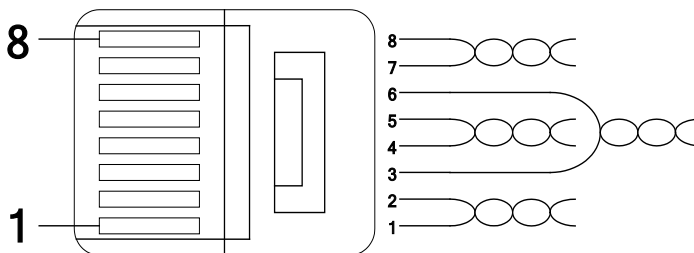
** Wires connected to pin #1 and pin #2 must be twisted.
** Wires connected to pin #3 and pin #6 must be twisted.

3.3   Network Cable Specification

3.3.1   Frequency Range

There are five different STP cable categories depending on the frequency range, from category 1 to category 5. EtherCAT network communication requires category 5 STP

cables. Transmission speed of category 5 is 100MHz and available up to 100Mbps.

3.3.2   STP Cable
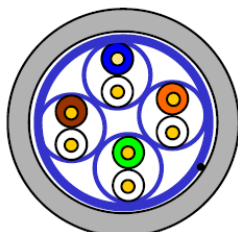
STP

Item	Description	Used
STP (S.STP)	Shielded twisted pair cable *Pair insulation: AL/Plastic complex foil *Core insulation: AL/Plastic complex foil, or copper braid	Maximum 500MHz, Voice +Information(Data)+Video signal, Replacement for 75Ω coaxial cable

* EtherCAT network communication requires CAT5 STP cables.

4   EtherCAT

4.1   About EtherCAT Technology

EtherCAT is a fieldbus protocol for I/O transmission and servo actuation, which had been initially created by a German corporation called Beckhoff. The EtherCAT Technology Group, a non-profit association, then promoted the standardization of the protocol, and the EtherCat protocol is now a part of the IEC 61131 and IEC 61158 international standards. As a high-performance industrial protocol based on real-time Ethernet communication, it provides high-speed Ethernet frame transmission between nodes (master and slave devices) in short cycles. An EtherCAT network features linear data transmission, which enables high-speed data transmission. The master device does not transmit multiple data frames to multiple slave devices. Instead, the master device transmits a single data frame to one slave device, and then the data frame received by the slave device is transmitted to the next slave device. Each slave device performs reading and writing while the data frame is being transmitted, and then the data frame is returned to the master device after the last slave device on the network has received it.

Since the EtherCAT network is based on the same standard frame structure and physical hierarchy defined in the IEEE 802.3 standard, it is compatible with existing Ethernet devices.
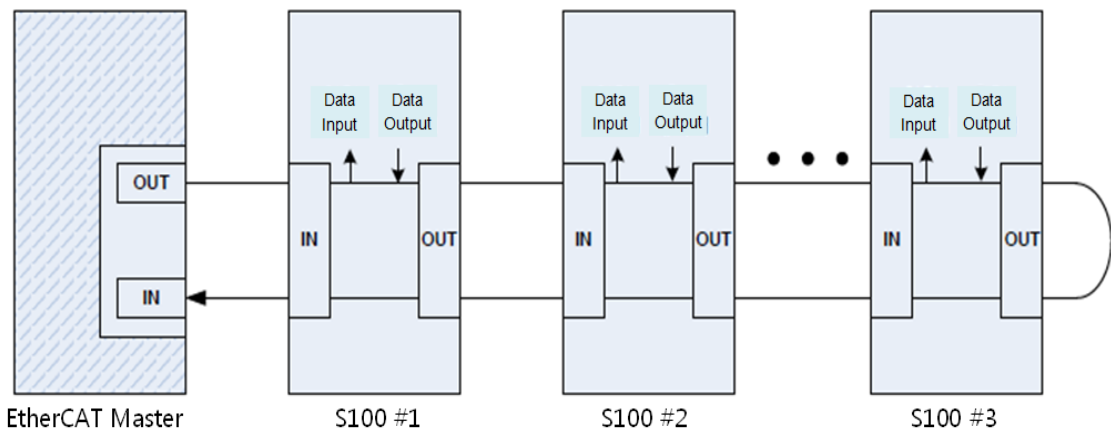
4.2   CANopen over EtherCAT (CoE)

The S100 EtherCAT communication module enables network communication between EtherCAT master and EtherCAT slave devices, using the CANopen over EtherCAT (COE) protocol for data transmission. In the CoE protocol, the parameter settings and data information is stored in an object dictionary. The object dictionary is a group of objects (parameters) accessible on a network, which includes device configurations and information for network communication.

Data transmission between the master and slave units utilizing the CoE protocol includes synchronous transmissions utilizing the process data object (PDO) and asynchronous transmissions utilizing the service data object (SDO). The S100 EtherCAT communication module performs periodic data transmissions to communicate the frequency reference and status data, and other data transmissions for error state reports and parameter reading and writing are performed when the requests are received.

Communication Type	Intervals	Description
Process data communication (PDO communication)	Synchronous (main task cycle)	Frequency reference, operating frequency, control commands, status commands, etc.
Service data communication (SDO communication)	Asynchronous (upon request)	Read/write inverter parameter, read inverter error information, etc.

4.3 EtherCAT Status Machine

The following diagram explains the EtherCAT communication statuses and transitions between different statuses.
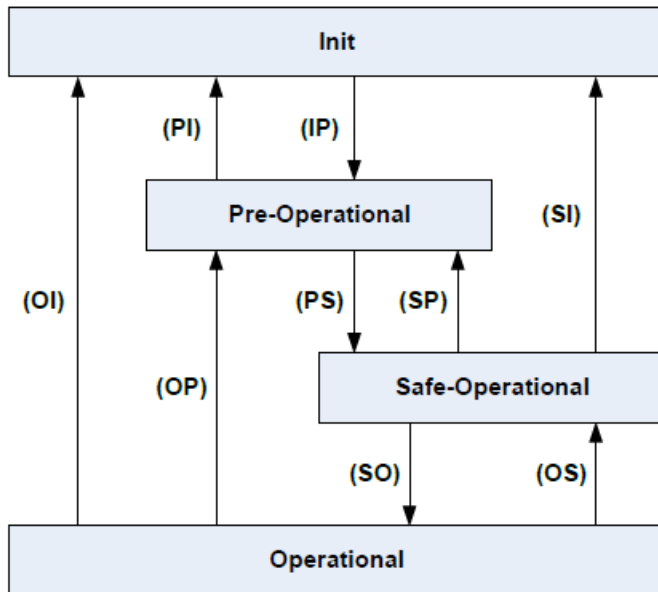
EtherCAT network communication between the master and slave units begins with a transition from an initial state (Init) to an operational state (Operational). Normal data transmission processes for controlling the motors connected to the inverters are available in the operational state.

If a communication error occurs during EtherCAT data communication while in an operational state, a transition to an initial state takes place, and communication stops. If this happens, the cause of the communication error must be eliminated before communication can resume.

4.4 EtherCAT Process Data Object (PDO)

A synchronous EtherCAT communication utilizes the process data object (PDO). Process data includes TxPDO, which is transmitted from an inverter to the EtherCAT master, and RxPDO, which is transmitted from the EtherCAT master to an inverter.

* When the LS Profile is in use, users can customize the data defined in the object dictionary by remapping the object dictionary using the configuration data COM31-COM38 and COM51-COM58. When the CiA402 Profile is in use, the object dictionary

data "Control word," "vl target velocity," "Status word," and "vl velocity actual value" are fixed and cannot be customized.

The S100 EtherCAT communication module provides such data in XML files. These files should first be recognized by the EtherCAT master unit during the installation and test drive phases. By analyzing these information files on the slave units, optimal control over the network can be achieved.

5   Profile

5.1   CiA 402 Drive and Motion Control Device Profile

Only Velocity Mode is supported.

5.2   Finite State Automation (FSA)

The following diagram explains the EtherCAT communication statuses and transitions between different statuses when the CiA 402 profile is used.
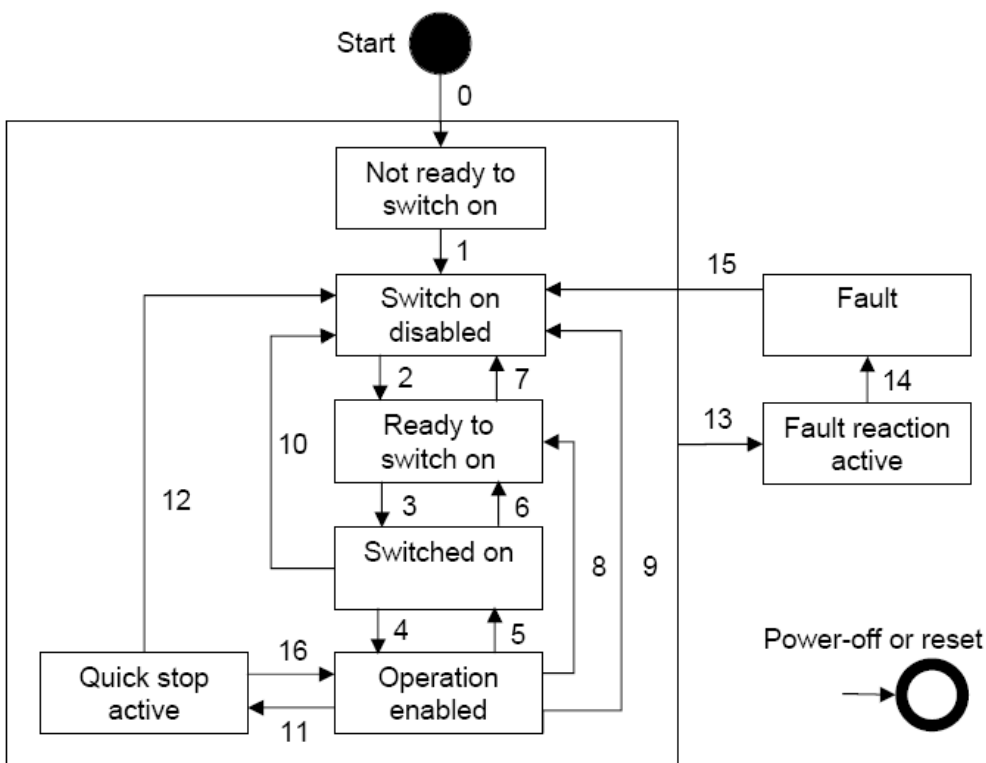
Not ready to switch on: The EtherCAT hardware and memory stack are being initialized.

Switch on disabled: The device cannot be switched on.

Ready to switch on: The device is ready to be switched on.

Switched on: The device is switched on and ready for operation. It is waiting for a run command.

Operation enabled: The motor is operating.

Quick stop active: The motor is being stopped, or it has been stopped.

The following table explains inverter operations for different statuses.

Transition	Event	Action
0	Automatic transition	Self-diagnosis and initialization of variables.
1	Automatic transition	EtherCAT communication is ready.
2	Transition to operation mode	None
3	Switch on command is received.	None
4	Enable operation command is received.	Motor operation
5	Disable operation command is received.	Performs a free run stop.
6	Shut down command is received.	None
7	Disable voltage command is received.	None
8	Shut down command is received.	Performs a free run stop.
9	Disable voltage command is received.	Performs a free run stop.
10	Disable voltage command, or Quick Stop command is received.	Performs a free run stop.
11	Quick Stop command is received.	Decelerates according to the deceleration time set at Quick Stop.
12	Disable voltage command is received.	Performs a free run stop.
13	Inverter trip occurred.	Performs a trip sequence.
14	Automatic transition	Performs a trip sequence.
15	Reset command is received, or the trip condition is resolved.	Transitions to "Switch on disabled" status.
16	Enable operation command is received.	Operates the motor again.

* The command inputs on the keypad are not available during a free run stop.

* Please use the Quick Stop with setting the 604A:001 'vl velocity Quick Stop:Delta' in CiA402 object dictionary.

5.3   CiA 402 Object Dictionary

5.3.1   Error codes (Object: 0x603F)

Index: 0x603F

A service data object (SDO) is used to identify the fault trip types when an inverter fault trip occurs.

The following table lists the error codes that are used to respond to inverter fault trips (refer to inverter addresses 0h0330, 0h0331, 0h0332, 0h0333, and 0h0334 for details).

* When a fault trip occurs, the S100 inverter transmits the following error codes and an emergency code which includes the error code and the error register.

Error codes

Fault Code Number	Description
0x0000	None
0x1000	UNDEFINED
0x2220	Inverter OLT
0x2310	OverCurrent1
0x2330	Ground Trip
0x2340	OverCurrent2
0x3130	In Phase Open
0x3210	Over Voltage
0x3220	Low Voltage
0x4000	NTC Open
0x4310	Over Heat
0x5000	HWDiag
0x5001	No Inverter
0x5450	Fuse Open
0x6300	Para Write Trip
0x7001	Fan Trip
0x7011	OptionTrip1
0x7021	IO Board Trip
0x7022	XIO Trip
0x7120	No Motor Trip
0x7310	EncorderTrip
0x9001	External Trip
0x9002	BX(비상정지)
0xFF01	Thermal
0xFF03	Out Phase Open
0xFF04	Over Load
0xFF05	Under Load

Fault Code Number	Description
0xFF06	Thermal Trip
0xFF07	Pre PID Fail
0xFF0A	Lost Command
0xFF0B	Lost Keypad
0xFF0E	ANY WARNING

Error Register (Object: 0x1001)

Code Number	Description
0x01	generic error
0x02	Current error
0x04	Voltage error
0x08	Temperature error
0x10	Communication error
0x20	Device profile specific error
0x40	Reserved
0x80	Manufacture specific error

5.3.2   Control word (Object: 0x6040)

Index: 0x6040

The following table lists the bit control words.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Nu	nu	Nu	nu	Nu	r	nu	H	fr	rr	ur	Er	eo	Qs	ev	so

so: Switch on
ev: Enable voltage
qs: Quick stop
eo: Enable operation
er: Enable ramp
ur: Unlock ramp
rr: Reference ramp
fr: Fault reset
h: Halt
r: Reserved
nu: Not used

Bits 4 through 7 are used for the operation mode commands.

The following table lists the command bits in the Finite State Automation status (refer to **5.2 Finite State Automation (FSA)** for detailed information).

Command	Control word bits					Transitions
	Bit 7	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**	
Shutdown	0	X	1	1	0	2, 6, 8
Switch on	0	0	1	1	1	3
Switch on + enable operation	0	1	1	1	1	3 + 4 (NOTE)
Disable voltage	0	X	X	0	X	7, 9, 10, 12
Quick stop	0	X	0	1	X	7, 10, 11
Disable operation	0	0	1	1	1	5
Enable operation	0	1	1	1	1	4, 16
Fault reset	⌐	X	X	X	X	15
NOTE Automatic transition to Enable operation state after executing SWITCHED ON state functionality.						

Numbers listed in the Transitions column indicate the inverter operation numbers that are in the inverter operation table at **5.2 Finite State Automation (FSA)**.

The following table explains the command bits in the Enable Operation status.

Bit	Value	Description
4 (Enable Ramp)	0	Maintains the current operation.
	1	Operates the inverter according to the command bits.
5 (Unlock Ramp)	0	Holds the output frequency.
	1	Accelerates to the frequency reference.
6 (Reference Ramp)	0	Inputs "0" as the frequency reference.
	1	Inputs the set value as the frequency reference.
8 (Halt)	X	Not used.
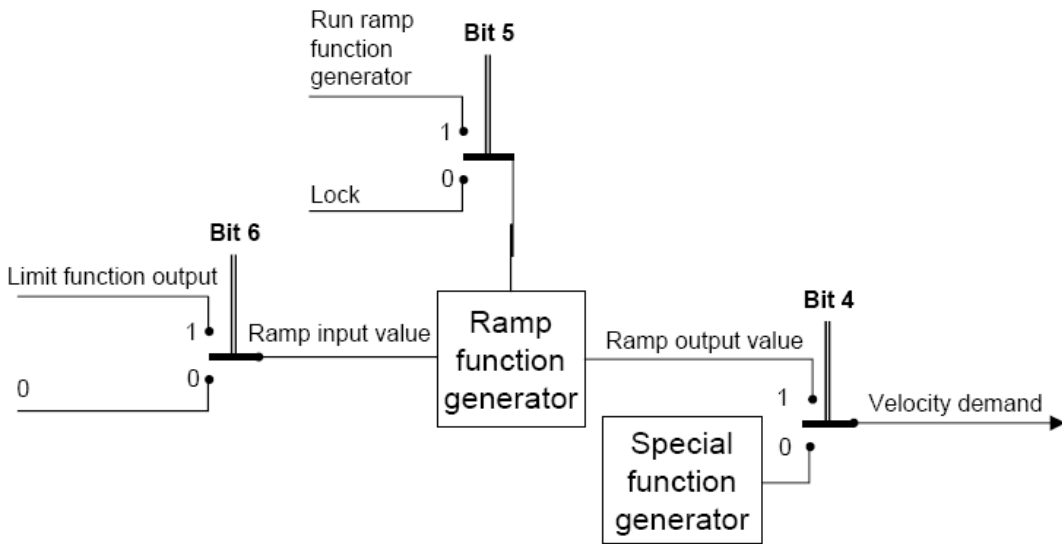
5.3.3 Status word (Object: 0x6041)

Index: 0x6041

The following table lists the bit control words.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
nu	nu	nu	Nu	lla	tr	rm	nu	w	sod	qs	Ve	f	oe	so	rtso

rtso: Ready to switch on
so: Switched on
oe: Operation enabled
f: Fault (Trip)
ve: Voltage enabled
qs: Quick stop
sod: Switch on disabled
w: Warning
rm: Remote
tr: Target reached
ila: Internal limit active
nu: Not used

The following table lists the bit settings for the FAS statuses.

Status word	PDS FSA state
xxxx xxxx x0xx 0000$_b$	Not ready to switch on
xxxx xxxx x1xx 0000$_b$	Switch on disabled
xxxx xxxx x01x 0001$_b$	Ready to switch on
xxxx xxxx x01x 0011$_b$	Switched on
xxxx xxxx x01x 0111$_b$	Operation enabled
xxxx xxxx x00x 0111$_b$	Quick stop active
xxxx xxxx x0xx 1111$_b$	Fault reaction active
xxxx xxxx x0xx 1000$_b$	Fault

5.3.4   vl target velocity (Object: 0x6042)

Index: 0x6042

Function: Target speed
Unit: rpm
Basic format: 0
Setting range: -30,000 to 30,000
(Negative values are for reverse operations and positive values are for forward operations. The setting range may vary depending on the inverter parameter settings).

Object description

Attribute	Value
Index	6042$_h$
Name	*vl* target velocity
Object Code	Variable
Data Type	Integer16
Category	Conditional: mandatory if *vl* is supported

Entry description

Attribute	Value
Subindex	00$_h$
Access	Rw
PDO Mapping	See /CiA402-3/
Value Range	Integer16
Default Value	0000$_h$

5.3.5 vl velocity demand (Object: 0x6043)

Index: 0x6042

Function: The current target speed
Unit: rpm
Basic format: 0
Setting range: -30,000 to 30,000
(Negative values are for reverse operations and positive values are for forward operations. The setting range may vary depending on the inverter parameter settings.)

Object description

Attribute	Value
Index	6043$_h$
Name	*vl* velocity demand
Object Code	Variable
Data Type	Integer16
Category	Conditional: mandatory if *vl* is supported

Entry description

Attribute	Value
Subindex	00$_h$
Access	ro
PDO Mapping	See /CiA402-3/
Value Range	Integer16
Default Value	No

5.3.6 vl velocity actual value (Object : 0x6044)

Index: 0x6044

Function: Sets the current operation speed
Unit: rpm
Basic format: 0
Setting range: -30,000 to 30,000

(Negative values are for reverse operation and positive values are for forward operation. The setting range may vary based on the inverter parameter settings.)

Object description

Attribute	Value
Index	6044$_h$
Name	*vl* velocity actual value
Object Code	Variable
Data Type	Integer16
Category	Conditional: Mandatory if *vl* is supported

Entry description

Attribute	Value
Subindex	00$_h$
Access	ro
PDO Mapping	See /CiA402-3/
Value Range	Integer16
Default Value	No

5.3.7   vl velocity min max amount (Object :0x6046)

This object is not supported by S100 inverters to prevent confusion, although it is included in the CiA402 profile. Inverter parameters ADV 24, ADV 25, and ADV26 perform the same function as this object.

5.3.8   vl velocity Acceleration (Object :0x6048)

Index: 0x6048

Function: Sets the acceleration time
Unit: Sec.

Basic format: 0.0

Setting range: 0.0 to 600.0 (The setting range may vary based on the inverter parameter settings.)

$$vl\ velocity\ acceleration\ = \frac{delta\ speed}{delta\ time}$$
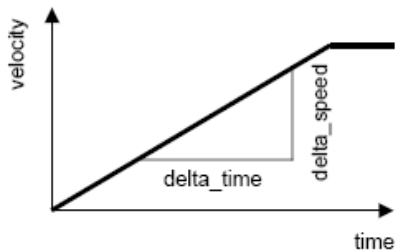
Transfer characteristic of the velocity acceleration

As explained in the figure above, this object is used to set the acceleration time using the speed and time differences (delta [Δ] speed and delta [Δ] time).

This setting is not configurable for the S100 inverter. To ensure reliable inverter operation, the "delta_speed" is fixed as the "Max Speed."

Object description

Attribute	Value
Index	6048$_h$
Name	*vl* velocity acceleration
Object Code	Record
Data Type	*vl* velocity acceleration deceleration
Category	Conditional: Mandatory if *vl* is supported

Entry description

Attribute	Value
Subindex	02$_h$
Description	Delta time
Entry Category	Mandatory
Access	rw

PDO Mapping	See /CiA402-3/
Value Range	Unsigned16
Default Value	Manufacturer specific

5.3.9　vl velocity Quick Stop (Object :0x604A)

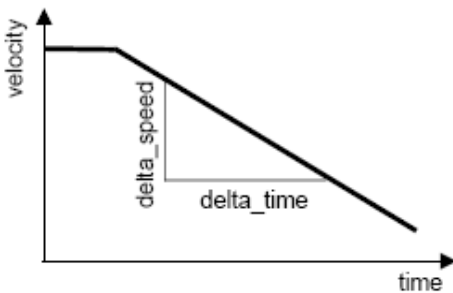### Index: 0x604A

Function: Sets the Quick Stop time
Unit: sec
Basic format: 0.0
Setting range: 0.0 to 600.0 (The setting range may vary based on the inverter's parameter settings.)
Default setting: 100 (10 sec.)

$$velocity\ quick\ stop = \frac{delta\ speed}{delta\ time}$$

Transfer characteristic of the quick stop deceleration

As explained in the figure above, this object is used to set the Quick Stop deceleration time using the speed and time differences (delta [Δ] speed and delta [Δ] time).

This setting is not configurable for the S100 inverter. To ensure reliable inverter operation, the "delta_speed" is fixed as the "Max Speed."

Object description

Attribute	Value
Index	604A$_h$
Name	*vl* velocity quick stop
Object Code	Record
Data Type	*vl* velocity acceleration deceleration
Category	Conditional: Mandatory if *vl* is supported

Entry description

Attribute	Value
Subindex	02$_h$
Description	Delta time
Entry Category	Mandatory
Access	rw
PDO Mapping	See /CiA402-3/
Value Range	Unsigned16
Default Value	Manufacturer specific

5.3.10 Modes of operation (Object: 0x6060)

Index: 0x6060

This object indicates the inverter's operation modes. The setting value is fixed as "0x02 (frequency converter)."

5.3.11 Modes of operation display (Object: 0x6061)

Index: 0x6061

This object indicates the inverter's operation modes. The setting value is fixed as "0x02 (frequency converter).

5.3.12 Supported drive modes (Object: 0x6502)

Index: 0x6502

This object indicates the inverter's operation modes. The setting value is fixed as "0x02 (frequency converter).

5.4   Service Data Objects for the S100 Inverter

When the LS-PROFILE is used, these objects can be mapped as process data objects (PDO3) using the settings at parameters COM31 through COM38 and COM51 through COM58. If the CiA402 profile is used, these objects can only be used for accessing service data objects.

5.4.1   Common Area Service Data Object (SDO) Address

Inverter Monitoring Area

The inverter monitoring area refers to the common read-only parameters located at 0h300 through 0h37F.

In the CiA402 profile, the index base address is 0x3300 and the subindex address is [(communication address - 0h300) + 1].

Ex.) Data at 0h0310 can be read from index 0x3300 (subindex: 0x11).
* Using the EDS file provided by LS, you can conveniently access the data by name.

Inverter Control Area

The inverter control area refers to the common parameters located at 0h380 through 0h3DF, which are used exclusively for inverter control.

In the CiA402 profile, the index base address is 0x3380 and the subindex address is [(communication address - 0h380) + 1].

Ex.) Data at 0h0389 can be read from index 0x3380 (subindex: 0x0A).

Inverter Memory Control Area

The inverter memory control area refers to the common parameters located at 0h3E0 through 0h3FF, which are used exclusively for inverter memory control.

In the CiA402 profile, the index base address is 0x33E0 and the subindex address is [(communication address - 0h3E0) + 1].

Ex.) Data at 0h03E1 can be read from index 0x33E0 (subindex: 0x02).

Caution) Before configuring a memory control area parameter, ensure that the

previous parameter setting value is "0." If the setting value is not "0," you must set it to "0" first, then reset it to the desired value. If you try to change the setting value of a memory control parameter whose previous setting value is not "0," the change will not take effect.

Ex.) At 0h03E0 (index:0x33E0, subindex: 0x01), if the parameter setting is "1:Yes," you must change it to "0:No," and then set it to "1:Yes" again to save the inverter parameters.

5.4.2   Service Data Object Address for Keypad Parameter Area

For the keypad parameters, the parameter group decides the index address and the subindex is the code number.

The following table lists the index addresses by parameter groups.

Index	Area
0x3000	Common Area Parameter
0x3300	Extended Common Monitor
0x3380	Extended Common Control
0x33E0	Extended Common Memory Control
0x4100	DRV Group
0x4200	BAS Group
0x4300	ADV Group
0x4400	CON Group
0x4500	IN Group
0x4600	OUT Group
0x4700	COM Group
0x4800	APP Group
0x4B00	PRT Group
0x4C00	M2 Group
0x4D00	USS Group
0x4E00	USF Group

Ex.) You can access index 0x4500 and subindex 0x05 to read the parameter setting at In (input) group code number 5 (In05, V1 Monitor[V]).

5.5 Process Data Objects for the S100 Inverter

The S100 Ethercat uses the PDOs defined for a frequency converter in the Drive and Motion Control features of the CiA 402 profile.

5.5.1 Receive Process Data Object (RPDO)

The RPDOs in the CiA 402 profile are as follows.

RPDO number	Type	Description
1	Mandatory	Control PDS FSA* and Target velocity (vl)
3	Optional	Manufacturer specifications

*PDS FAS: Power Drive System Finite State Automaton

The S100 EtherCAT supports only RPDO1 and RPDO3.

The RPDO addresses are as follows:

The communication parameter object index address of RPDO1 is 0x1600.

The communication parameter object index address of RPDO3 is 0x1602.

The subindex parameters in the object are identical.

The following table lists the RPDO1 parameters.

Subindex	Description	
0x00	Function	Number of Entries
	Access	Ready only
	Default setting	2
0x01	Function	Mapping Entry 1
	Access	Read only
	Default setting	0x60400010; RPDO data1 address
0x02	Function	Mapping Entry 2
	Access	Read only
	Default setting	0x60420010; RPDO data2 address

RPDO MAPPING

In the S100 CiA402 profile, the map is fixed and cannot be modified by users.

· **RPDO1 Mapping**

The RPDO is set in the CiA 402 profile. The index address is 0x1600

The following table shows the map settings for RPDO1.

Subindex	Setting value	Parameter index	Parameter subindex	Parameter name
0x01	0x60400010	0x6040	0	Control word
0x02	0x60420010	0x6042	0	vl target velocity

· **RPDO3 Mapping**

The PDO is set in the LS Drive profile. The index address is 0x1602.

The following table shows the map settings for RPDO3.

Subindex	Setting value	Parameter index	Parameter subindex	Parameter name
0x01	0x50000110	0x5000	1	Para Control - 1 Data Value
0x02	0x50000210	0x5000	2	Para Control - 2 Data Value
0x03	0x50000310	0x5000	3	Para Control - 3 Data Value
0x04	0x50000410	0x5000	4	Para Control - 4 Data Value
0x05	0x50000510	0x5000	5	Para Control - 5 Data Value
0x06	0x50000610	0x5000	6	Para Control - 6 Data Value
0x07	0x50000710	0x5000	7	Para Control - 7 Data Value
0x08	0x50000810	0x5000	8	Para Control - 8 Data Value

Para Control –x Data Values are the values to be written to the parameter addresses for COM-51 through COM-58.

After the S100 SDO addresses are set to parameters COM-51 through COM-58 by accessing the SDO, a PDO communication becomes available with the setting values set in the PDO3 objects.

5.5.2   Transmit Process Data Object (TPDO)

The TPDOs in the CiA 402 profile are as follows.

TPDO number	Type	Description
1	Mandatory	Controls PDS FSA and Target velocity (vl)
2	Optional	Manufacturer specifications

The S100 EtherCAT communication supports only TPDO1 and TPDO3.

The RPDO addresses are as follows:
The communication parameter object index address of TPDO1 is 1x1A00.
The communication parameter object index address of TPDO2 is 0x1A02.
The subindex parameters in the object are identical.

The following table lists the TPDO1 parameters.

Subindex	Description	
0x00	Function	Number of Entries
	Access	Ready only
	Default setting	2
0x01	Function	Mapping Entry 1
	Access	Read only
	Default setting	0x60410010; TPDO data1 address
0x02	Function	Mapping Entry 2
	Access	Read only
	Default setting	0x60440010; TPDO data2 address

TPDO MAPPING

In the S100 CiA402 profile, the map is fixed and cannot be modified by users.

· **TPDO1 Mapping**

The TPDO set in the CiA 402 profile. The index address is 1x1A00.
The following table shows the map settings for PDO1

Subindex	Setting value	parameter Index	Parameter Subindex	Parameter name
0x01	0x60410010	0x6041	0	Statusword
0x02	0x60440010	0x6044	0	vl velocity actual value

· **TPDO3 Mapping**

The PDO is set in the LS Drive Profile. The index address is 0x1A02.
The following table shows the map settings for PDO3.

Subindex	Setting value	Parameter index	Parameter subindex	Parameter name
0x01	0x50100110	0x5010	1	Para Status - 1 Data Value
0x02	0x50100210	0x5010	2	Para Status - 2 Data Value
0x03	0x50100310	0x5010	3	Para Status - 3 Data Value
0x04	0x50100410	0x5010	4	Para Status - 4 Data Value
0x05	0x50100510	0x5010	5	Para Status - 5 Data Value
0x06	0x50100610	0x5010	6	Para Status - 6 Data Value
0x07	0x50100710	0x5010	7	Para Status - 7 Data Value
0x08	0x50100810	0x5010	8	Para Status - 8 Data Value

Para Control –x Data Values are the values to be read from the parameter addresses for COM-31 through COM-38. After the S100 SDO addresses are set to parameters COM-31 through COM-38 by accessing the SDO, a PDO communication becomes available with the setting values set in the PDO3 objects.

* While using CiA402 or LS profile communication, Keypad control is not recommended to prevent command collision. (It operates in predefined motion when controlling the inverter with communication system. Controlling the inverter randomly with key pad may cause errors in systematic operation.)

* It may prevent false operation if KeyPad is set to 1000 FWD when target velocity is set to -1000FWD.

* Please change the control word to 0x0F when using CiA402.

* It is not requested the additional setting when using the LS profile.

6   EtherCAT Communication Module and the Keypad Parameters

To run the S100 inverter using the EtherCAT communication module, set DRV-06 (Cmd Source) to [4 Fieldbus] using the keypad. To provide a frequency reference via the EtherCAT communication module, set DRV-07 (Freq Ref Src) to [8 Fieldbus].

Code	Description	Keypad display	Setting range	Factory default	Type/ Units	Adj. during run
CNF-30	Display the type of installed option module.	Option-1 Type	-	EtherCAT (CiA402)		Read only
DRV-06	Set the command source.	Cmd Source	"FieldBus"	"FX/RX-1"		N
DRV-07	Set the source of the frequency reference.	Freq Source	"FieldBus"	"Keypad-1"		N
DRV-08	Set the torque reference source.	Trq Source	"FieldBus"	"Keypad-1"		N
COM-06	Display the option module version.	FBus S/W Ver	-	-	X.XX	Read only
COM-09	EtherCAT communication module's indicator status	FBus LED	-	-	-	N
COM-11	Select the profile type (CiA402 Profile/LS Profile).	Opt Parameter 2	0-1	0: CiA402 Profile 1:LS profile	X	N
COM-30	Number of the TPDO data to be read by the EtherCAT master device	Para Status Num	0-8	3	X	N
COM-31	Address of the TPDO data to be read by the EtherCAT master device	Para Status - 1	0x0000-0xFFFF	0x000A	0xXX XX Hex	N
COM-32	Address of the TPDO data to be	Para Status - 2	0x0000-0xFFFF	0x000E	0xXX XX	N

Code	Description	Keypad display	Setting range	Factory default	Type/ Units	Adj. during run
	read by the EtherCAT master device				Hex	
COM-33	Address of the TPDO data to be read by the EtherCAT master device	Para Status - 3	0x0000-0xFFFF	0x000F	0xXX XX Hex	N
COM-34	Address of the TPDO data to be read by the EtherCAT master device	Para Status - 4	0x0000-0xFFFF	0x0000	0xXX XX Hex	N
COM-35	Address of the TPDO data to be read by the EtherCAT master device	Para Status – 5	0x0000-0xFFFF	0x0000	0xXX XX Hex	N
COM-36	Address of the TPDO data to be read by the EtherCAT master device	Para Status – 6	0x0000-0xFFFF	0x0000	0xXX XX Hex	N
COM-37	Address of the TPDO data to be read by the EtherCAT master device	Para Status – 7	0x0000-0xFFFF	0x0000	0xXX XX Hex	N
COM-38	Address of the TPDO data to be read by the EtherCAT master device	Para Status - 8	0x0000-0xFFFF	0x0000	0xXX XX Hex	N
COM-50	Number of the RPDO data to be controlled by the EtherCAT master device	Para Control Num	0-8	2	X	N

Code	Description	Keypad display	Setting range	Factory default	Type/ Units	Adj. during run
COM-51	Address of the RPDO data to be controlled by the EtherCAT master device	Para Control -1	0x0000-0xFFFF	0x0005	0xXX XX Hex	N
COM-52	Address of the RPDO data to be controlled by the EtherCAT master device	Para Control -2	0x0000-0xFFFF	0x0006	0xXX XX Hex	N
COM-53	Address of the RPDO data to be controlled by the EtherCAT master device	Para Control -3	0x0000-0xFFFF	0x0000	0xXX XX Hex	N
COM-54	Address of the RPDO data to be controlled by the EtherCAT master device	Para Control -4	0x0000-0xFFFF	0x0000	0xXX XX Hex	N
COM-55	Address of the RPDO data to be controlled by the EtherCAT master device	Para Control -5	0x0000-0xFFFF	0x0000	0xXX XX Hex	N
COM-56	Address of the RPDO data to be controlled by the EtherCAT master device	Para Control -6	0x0000-0xFFFF	0x0000	0xXX XX Hex	N
COM-57	Address of the RPDO data to be controlled by the EtherCAT master device	Para Control -7	0x0000-0xFFFF	0x0000	0xXX XX Hex	N
COM-58	Address of the RPDO data to be controlled by the EtherCAT master device	Para Control -8	0x0000-0xFFFF	0x0000	0xXX XX Hex	N

Code	Description	Keypad display	Setting range	Factory default	Type/ Units	Adj. during run
COM-94	Apply changes.	Comm Update	"No" "Yes"	"No"	-	N
PRT-12	Set the operation mode for a Lost Command condition	Lost Cmd Mode	"None" "Free-Run" "Dec" "Hold Input" "Hold Output" "Lost Preset"	"None"	-	N
PRT-13	Set the Lost Command time.	Lost Cmd Time	0.1-120.0	1.0	x.x sec	N
PRT-14	Set the Lost Preset speed.	Lost Preset F		0	Hz/Rpm	N

7   EtherCAT Communication Module-related Keypad Parameters

7.1   CNF Group

[CNF-30] Option-1 Type: Display the module type installed in option slot 1.

It detects and displays the type of communication module that is installed in the S100 inverter. "EtherCAT"** is displayed when the S100 EtherCAT communication module is installed.

** "Comm Option" may be displayed depending on the Keypad software version.

7.2   DRV Group

[DRV-06] Cmd Source: Selects the command source

This selects the command source for the S100 inverter operation. Set DRV-06 to [4 FieldBus] to select the EtherCAT communication module as the command source.

[DRV-07] Freq Ref Src: Sets the frequency reference source.

This selects the source of the frequency reference for the S100 inverter. Set DRV-07 to [8 FieldBus] to select the EtherCAT communication module as the source of the frequency reference.

7.3 COM Group

- **COM 09 FBus LED**

This parameter is used to display the EtherCAT communication module's indicator status on the Keypad screen.

0Bit : RUN LED (Green)
1Bit : ERROR LED (Red)
2Bit : LINK in LED (Green)
3Bit : LINK out LED (Green)

LED name	RUN	ERR	LINK in	LINK out
LED status	OFF	ON	ON	ON

- **COM 94 Comm Update**

This parameter is used to apply the parameter setting changes on the Keypad to the EtherCAT communication module. Select "Yes" to apply changes.

- **COM 11 Opt Parameter2**

This parameter is used to select a profile.
Setting Range: 0 to 1
0: CiA 402 Drive and Motion Control   Velocity Mode   (Frequency Converter PDO1)
1: LS Device Profile (PDO3)
Default: "0" (CiA 402 Profile)

- **Para Status Num**

This parameter can be configured only if COM 11 is set to "1" (LS Device Profile).
You can configure this parameter to set the number of parameters to receive from the master unit. This parameter is hidden when the CiA 402 profile is selected at COM-11.

- **COM 31–38 Para Status**

This parameter can be configured only if COM 11 is set to "1" (LS Device Profile).
Select 8 parameter addresses to receive the parameter values from the master unit using TPDO3. This parameter is hidden when the CiA 402 mode profile is selected at COM-11.

· **COM-50 Para Control Num**

This parameter can be configured only if COM 11 is set to "1" (LS Device Profile).
Set COM-50 to decide the number of parameters to be transmitted to the master unit.
This parameter is hidden when the CiA 402 mode profile is selected at COM-11.

· **COM 51–58 Para Control**

This parameter can be configured only if COM 11 is set to "1" (LS Device Profile).
Select 8 parameter addresses and write the parameter values to the master unit using
RPDO3. This parameter is hidden when the CiA 402 Mode profile is selected at COM-11.

· **Setting the Parameters for Lost Command Conditions**

When the NMT status of the S100 EtherCAT is "Operation" and "Pre-operation," the
EtherCAT communication module assumes normal network communication where the
master and slave units are linked. When the NMT status becomes any status other
than "Operation" or "Pre-operation," the inverter enters the Lost Command condition
after the lost command time set at PRT-13 has elapsed. The Lost Command condition
is available only when both or either the command reference and/or the source of
frequency reference is set to "Fieldbus."

· **PRT-12 Lost Cmd Mode**

None: The inverter does not perform actions when the Lost Command condition is
met.

Free-Run: When the Lost Command condition is met, the motor performs a free-run
stop and the inverter outputs a Lost Command fault trip.

Dec: When the Lost Command condition is met, the motor performs a deceleration
stop and the inverter outputs a Lost Command fault trip.

Hold Input: When the Lost Command condition is met, the inverter operates the motor
using the last speed reference received and outputs a Lost Command warning.

Hold Output: When the Lost Command condition is met, the inverter maintains the
current motor speed and outputs a Lost Command warning.

Lost Preset: When the Lost Command condition is met, the inverter runs the motor at
the speed set at PRT-14 and outputs a Lost Command Warning.

· **PRT-13 Lost Cmd Time**
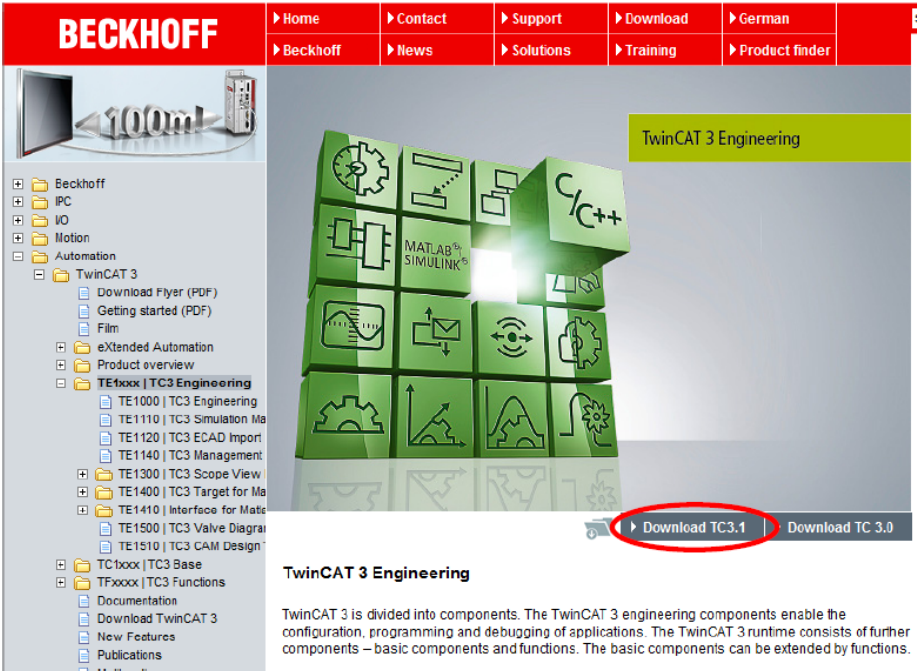
During EtherCAT network communication, the inverter enters the Lost Command condition if the MNT state enters anything other than the Operation or Pre-operation status and if the condition is maintained after exceeding the time set at PRT-13.

· **PRT-14 Lost Preset F**

If PRT-12 (Lost Cmd Mode) is set to "Lost Preset," the inverter operates the motor using the preset speed set at PRT-14 when it enters the Lost Command mode.

8   Installing and Running TwinCAT 3.0

8.1   How to install

Please input the required fields and select "Register".

Beckhoff will send an email including the link to download the software.   Please access the link and download the software.

After downloading, please execute the setup file.
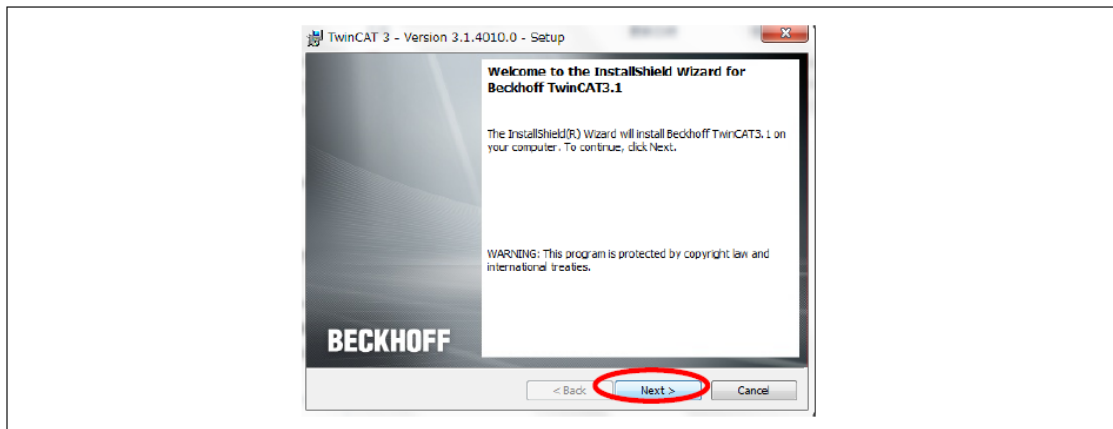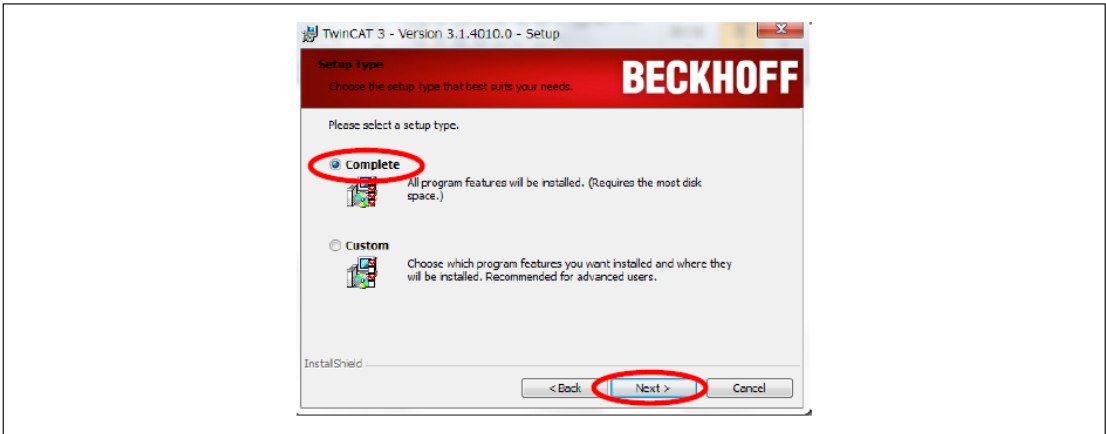
Please complete the installation wizard. **Important Note:** be sure to select "Complete" installation.
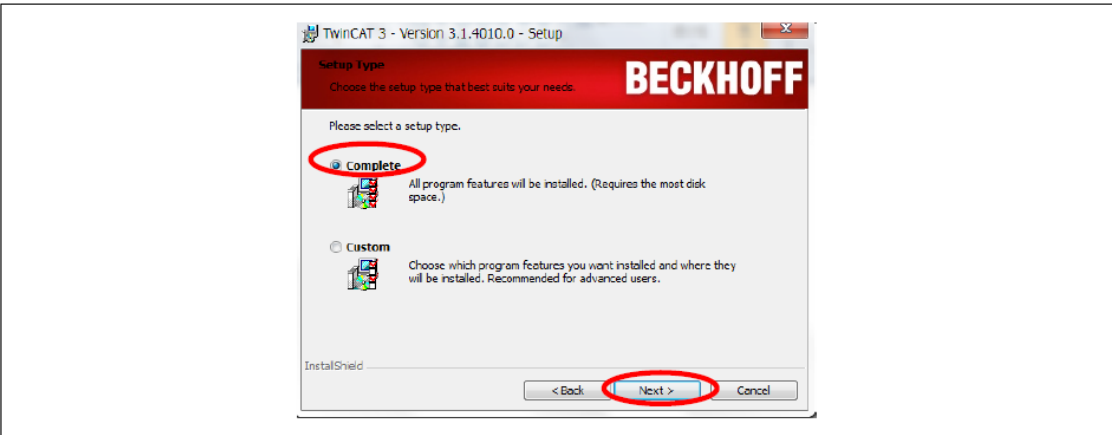
8.2   Adding TwinCAT 3.0 Ethernet Protocol

Follow the instructions below to activate the TwinCAT XAE software.

From the Task Tray, click **TwinCAT Config Mode** > **TwinCAT XAW] (VS2010)**. Or, from the Start menu, click **Beckhoff** > **TwinCAT3** > **TwinCAT XAE (VS2010)**.
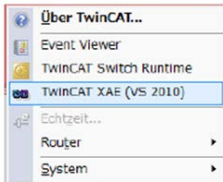
Click the **TwinCAT** menu, and then click **Show Realtime Ethernet Compatible Devices….**
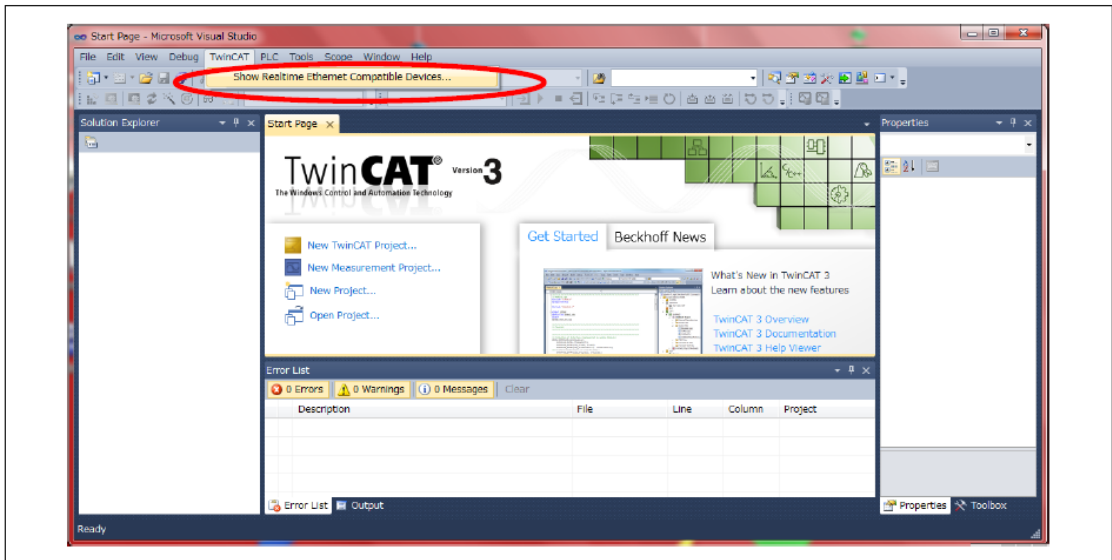
In the installation dialog window, compatible devices appear in the "Installed and ready to use devices" list. If all devices appear in the Incompatible devices list, the Ethernet adapter installed in the PC cannot be used with TwinCAT 3.0. Replace the Ethernet adapter if this is the case.

Refer to the following link for a list of compatible Ethernet adapters:

http://infosys.beckhoff.com/content/1033/tcsystemmanager/reference/ethercat/html/ethercat_supnetworkcontroller.htm?id=18955
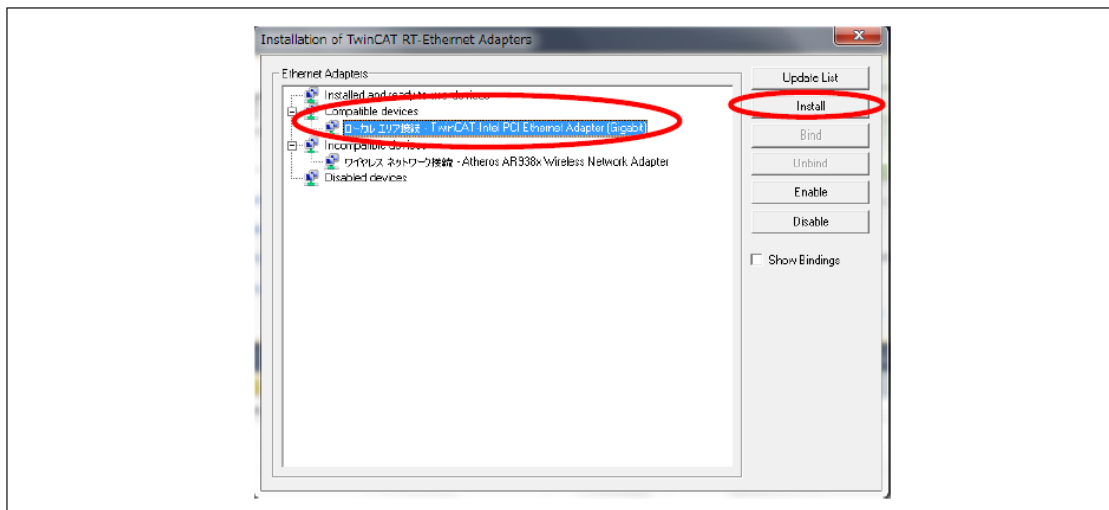
Select an adapter under the Installed and ready to use devices list, and them click **Install.**
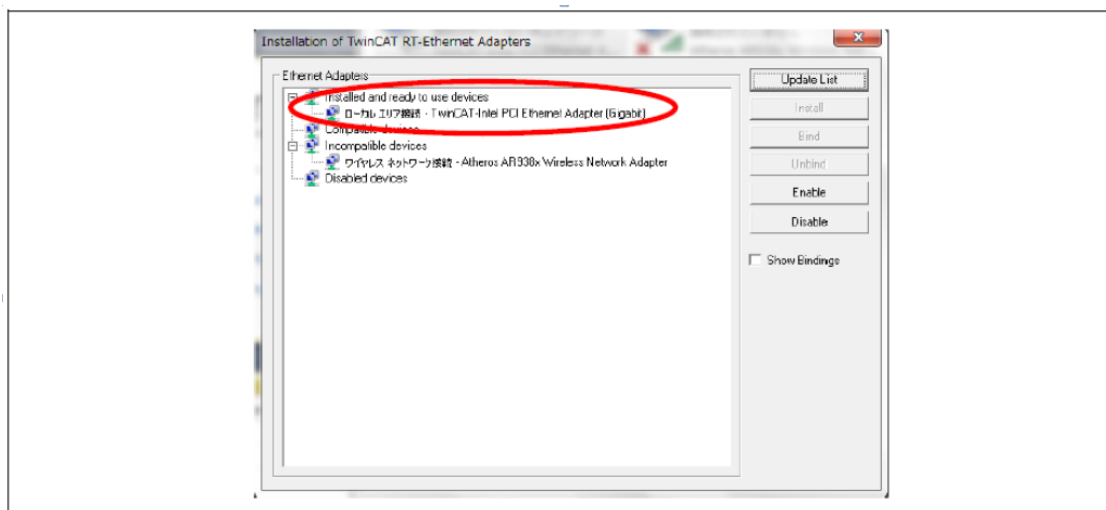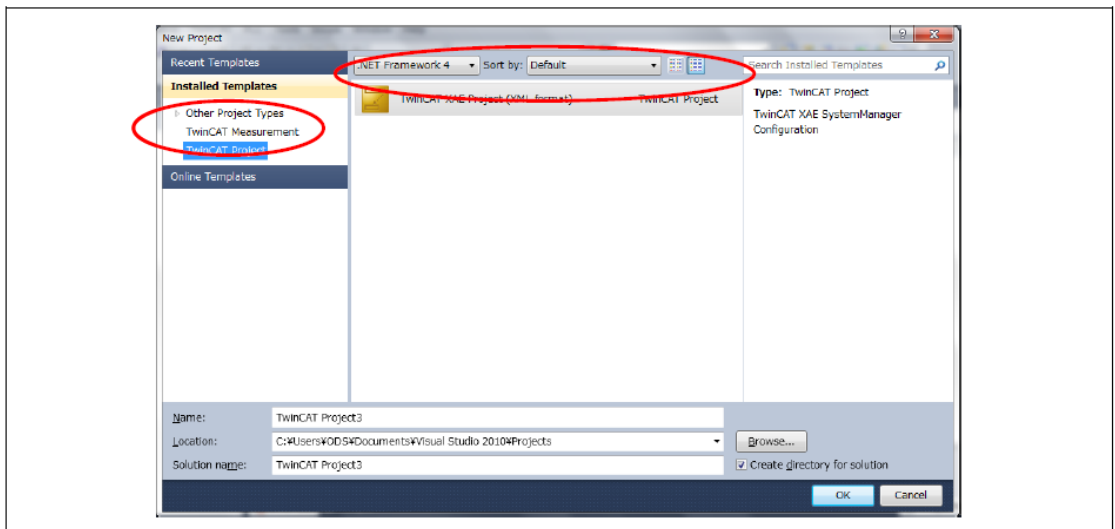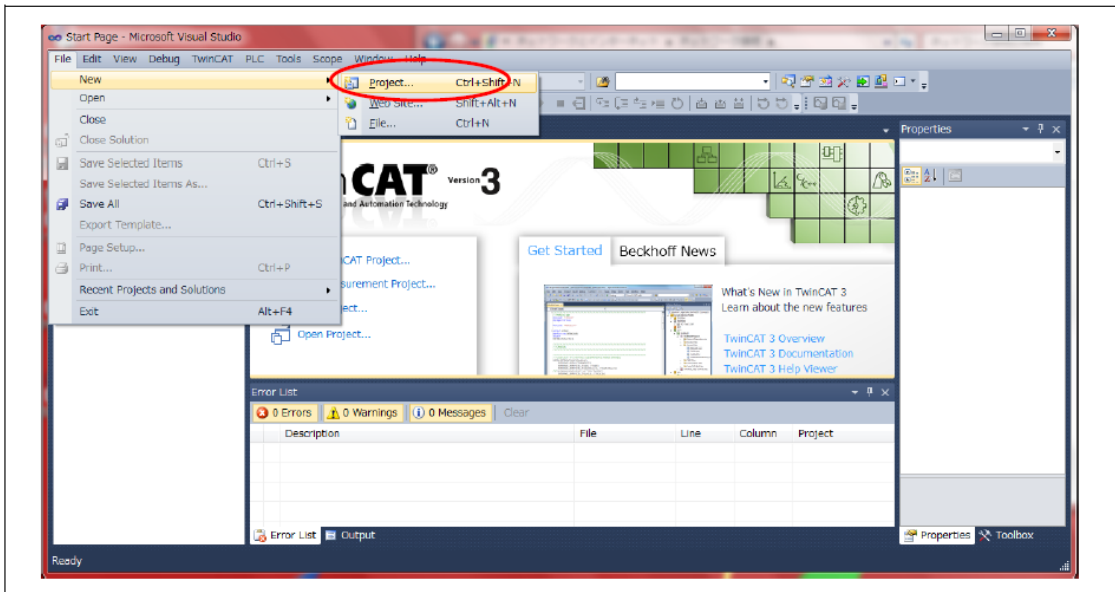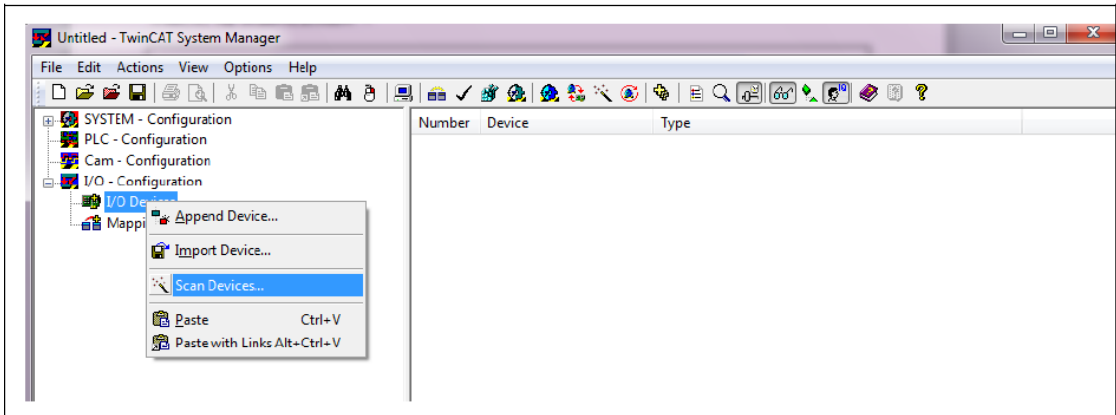
8.3   Copying the ESI Files
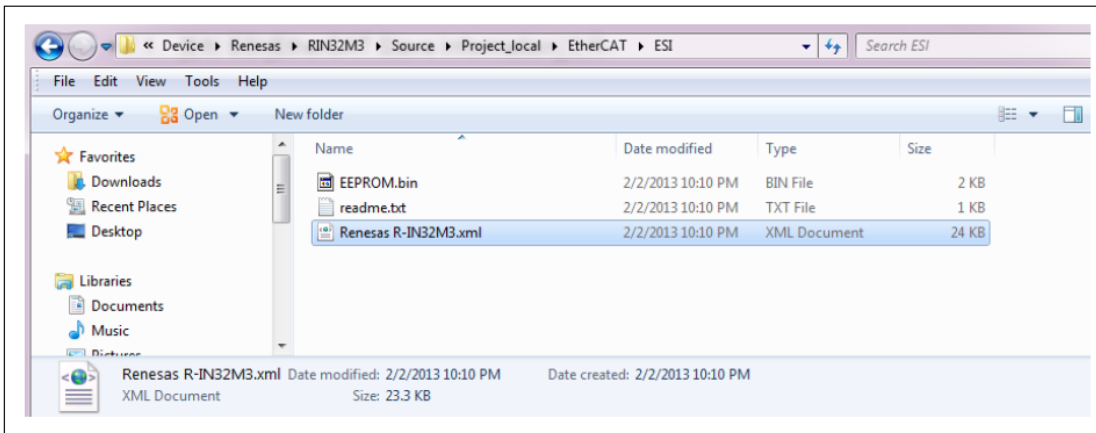
Copy the S100_EtherCAT.xml or S100_EtherCAT.eds file to the
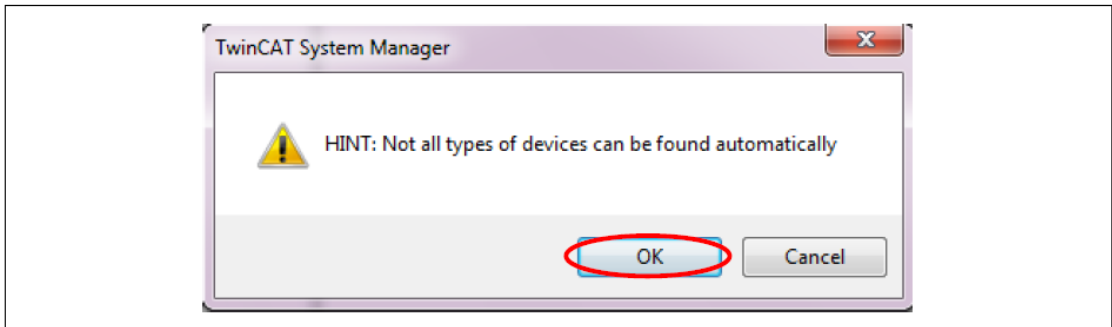\TwinCAT\Io\EtherCAT folder.
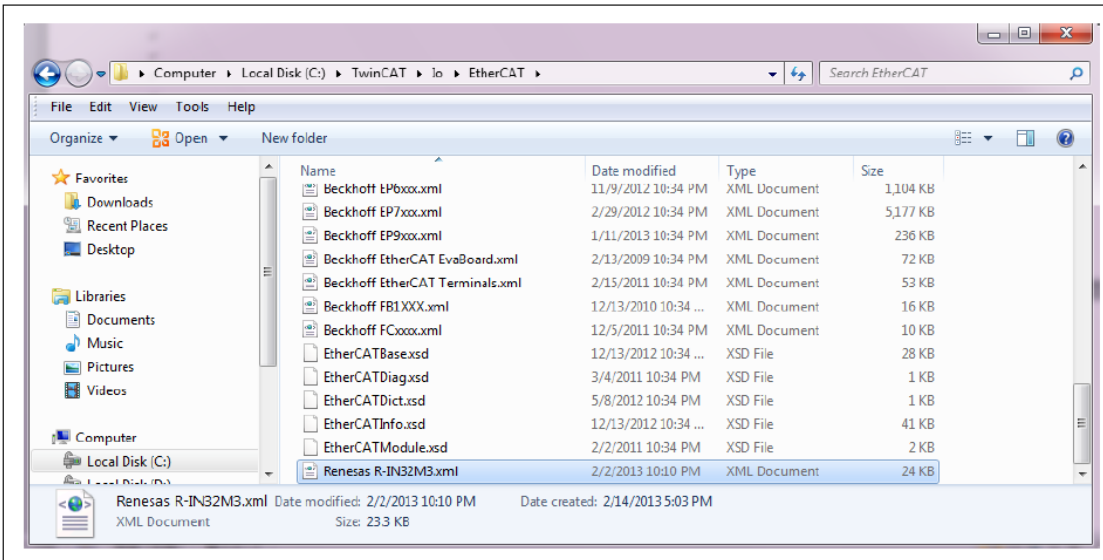
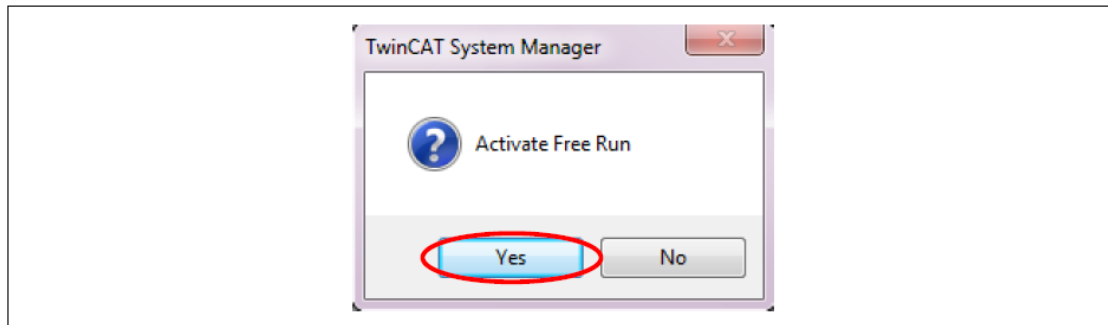Run the TwinCAT System Manager, and then click **File** > **New** to create a new project.
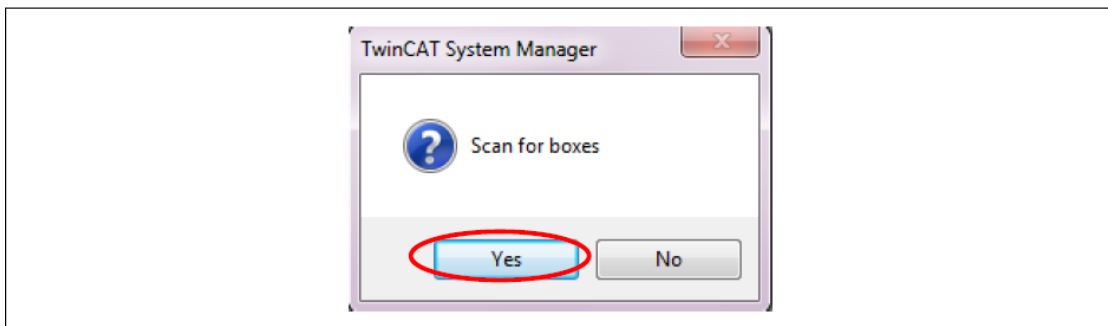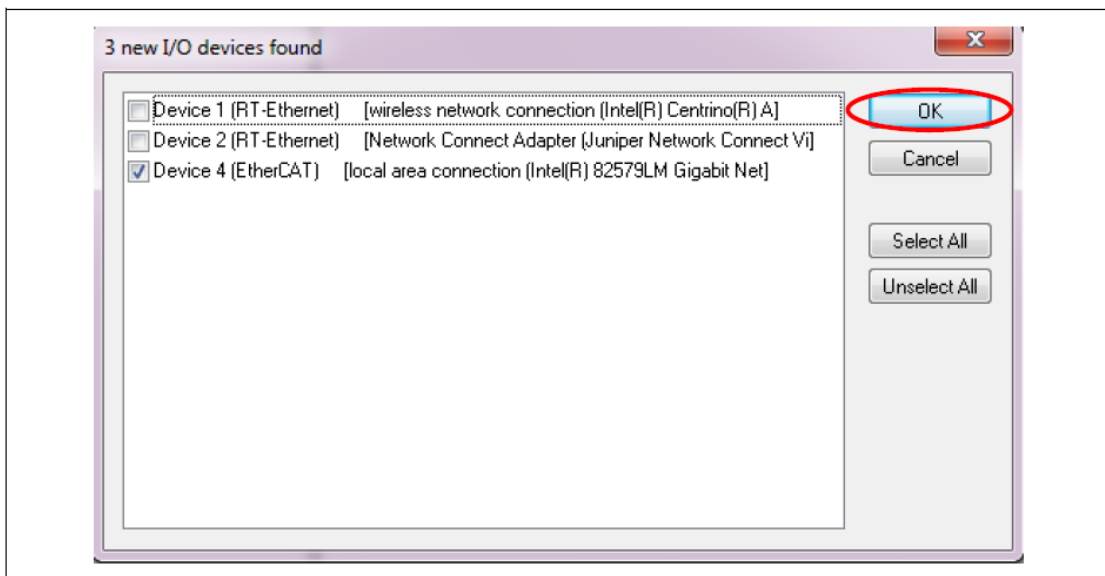
8.4   Scanning the I/O devices

Right-click **I/O Devices** and select **Scan Devices**. Click **OK** when the following pop-up window appears:


When a list of compatible Ethernet adapters is displayed as in the following figure, select an appropriate Ethernet port, and then click **OK**.

The S100 EtherCAT device is automatically recognized by TwinCAT after executing the procedures above.

⊘ Caution

- It is recommended to scan again whenever inverter is replaced due to damage or other reason. Please design referring to serial code(1018:004) or field bus ID(4700:007) when system construction.
- Communication order can be delayed after inverter replacement on some versions of TWINCAT. Please check the setting of slave's serial number and update TWINCAT to newest version.
- Devices-> Devices #number-> EtherCAT-> Advanced Settings…-> State Machine-> Slave Settings-> Check Serial Number
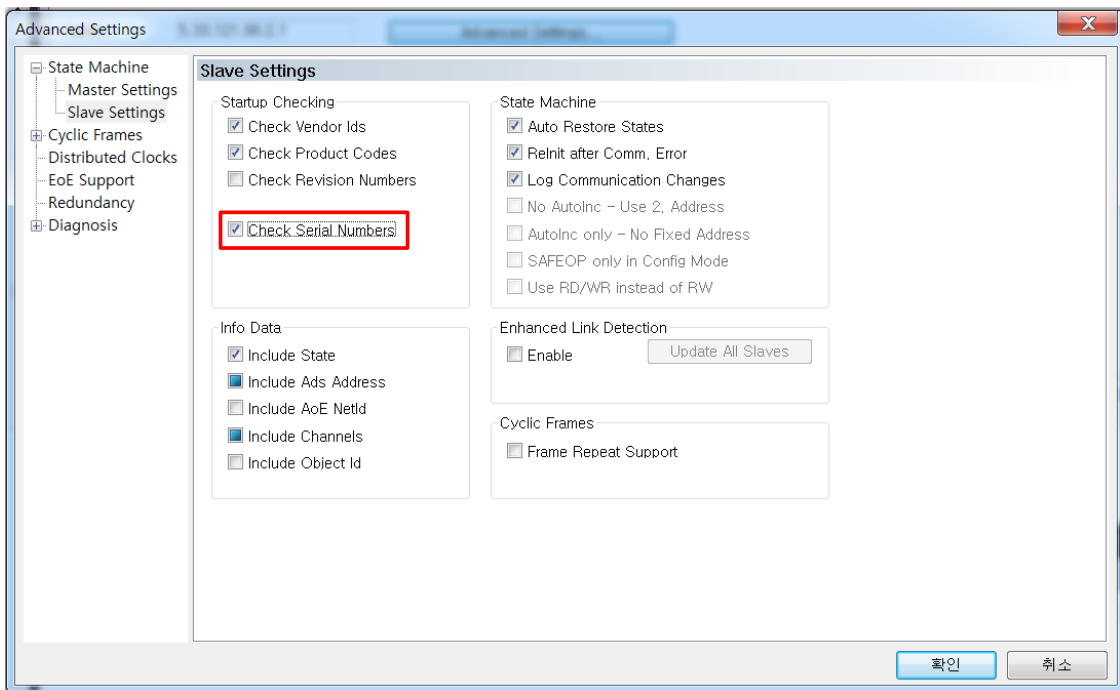
8.5 Configuring Process Data Object (PDO)

Select **S100 EtherCAT** first, and then click the **Process Data** tab on the right.
Configure PDO sync manager in the tab.

Rx PDO is transmitted to the S100 inverter from the master unit.
Tx PDO is transmitted to the master unit from the S100 inverters.
Rx PDO is assigned to Sync manager 2, and Tx PDO is assigned to Sync manager 3.

The current PDO settings of the S100 inverter are loaded to TwinCAT when you click
Load PDO info from device.

8.6 Creating a Task

Select a PDO from the PDO list box.

Modify the object mapping of the selected PDO in the PDO Context box (if necessary).

Assign the PDO selected in the Sync Manager and PDO Assignment box to the Sync
manager.

Select **PDO Assignment** and **PDO Configuration** to allow TwinCAT to transmit
settings to S100 inverters when network communication begins. In Config mode
(within TwinCAT), you can restart the network communication by reloading the I/O
device.

Right-click **Additional Tasks**, and then select **Append Task**.
Link the S100 I/O to the I/O of the appended task.

Select **Auto start** in the Task tab (Additional Tasks > Task1) if you want to operate the
S100 inverter as soon as the TwinCAT configuration is complete.

Warranty

Maker	LS Industrial Systems Co., Ltd.	Installation (Start-up) Date	
Model No.	**LV-S100 PROFInet Option Board**	**Warranty Period**	
Customer Information	Name		
	Address		
	Tel.		
Sales Office (Distributor)	Name		
	Address		
	Tel.		

Warranty period is 12 months after installation or 18 months after manufactured when the installation date is unidentified. However, the guarantee term may vary on the sales term.

IN-WARRANTY service information
If the defective part has been identified under normal and proper use within the guarantee term, contact your local authorized LS distributor or LS Service center.

OUT-OF WARRANTY service information
The guarantee will not apply in the following cases, even if the guarantee term has not expired.

- Damage was caused by misuse, negligence or accident.
- Damage was caused by abnormal voltage and peripheral devices' malfunction (failure).
- Damage was caused by improper repair or altering by other than LS authorized distributor or service center.
- Damage was caused by an earthquake, fire, flooding, lightning, or other natural calamities.
- When LS nameplate is not attached
- When the warranty period has expired.

Revision History

No	Date	Edition	Changes
1	2016.01	First Release	