

General Specifications

Model ALE111 Ethernet Communication Module



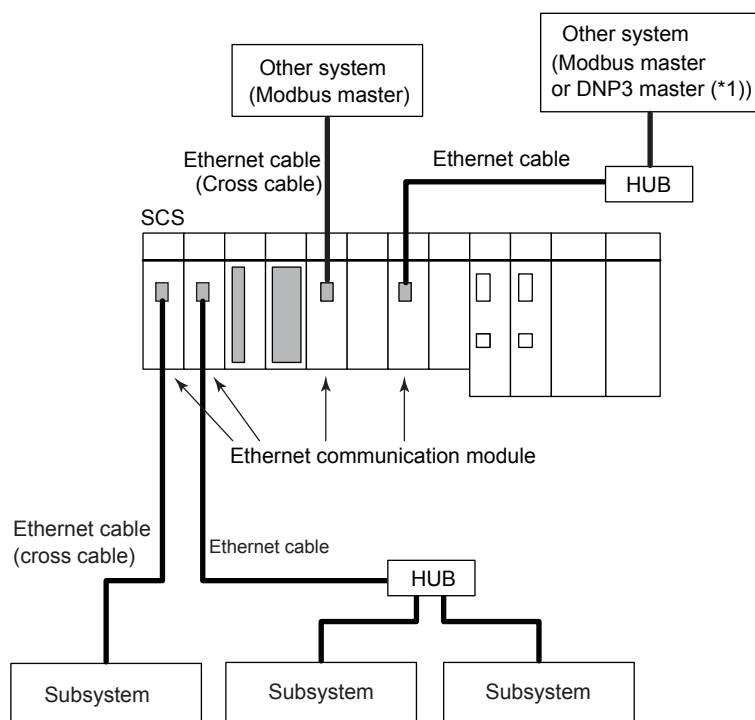
GS 32P06K51-01EN

■ GENERAL

This document describes about Model ALE111 Ethernet communication module used with a safety control station (SCS) for performing Modbus communication and DNP3 communication.

By using the SCS's Modbus slave communication function, the data in SCS can be set or referred to by the Modbus master which is as separate system from SCS via a Ethernet communication module. Furthermore, the subsystem data such as from sequencers can be set or referred to via a Ethernet communication module using SCS's subsystem communication function.

This Ethernet communication module can be mounted on a safety control unit and a safety node unit.



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*1: ALE111 communication module mounted on SSC57□ can be connected to a DNP3 master.

Figure System configuration example of the Ethernet communication module

■ HARDWARE SPECIFICATIONS

Hardware specifications of ALE111 Ethernet communication module are as shown below. This module is interference-free module that has no interference with the safety loop.

Table Ethernet communication module hardware specification

Item	Specifications
Model	ALE111 (*1)
Physical layer interface	IEEE 802.3 10BASE-T Half-duplex
Connection method	Point-to-point
Connector	RJ-45
Transmission speed	10 Mbps
Transmission route	100 ohm twisted-pair cable (not shielded)
Transmission distance	1 segment, 100 m (in between SCS and other systems, or SCS and HUB)
Installation method	Mounted on S2SC70□, SSC60□, SSC50□, SSC57□, or SNB10D
No. of ports	One port
Media access control	CSMA/CD
Communication functions (*2)	Modbus slave communication function, DNP3 slave function, subsystem communication function.
Current consumption	0.5 A
Weight	Approx. 0.3 kg

*1: ALE111 style code S1 and unit revision U:2 or later must be used.

*2: A unit of SCS is capable of handling multiple communication functions: however, different types of communication functions cannot be simultaneously performed on a Ethernet communication module.

■ OPERATING ENVIRONMENT

● For Modbus slave communication function and subsystem communication function

Hardware requirements

The Ethernet communication module runs on the following SCS.

S2SC70S, S2SC70D, SSC60S, SSC60D, SSC50S, SSC50D, SSC57S, SSC57D

Software requirements

The Ethernet communication module runs on the control functions on the following SCS.

RS4F1500 Safety Control Function (for S2SC70□)
 RS4F1300 Safety Control Function (for SSC60□)
 RS4F1100 Safety Control Function (for SSC50□)
 RS4F1170 Safety Control Function (for SSC57□)

Engineering requirements

Engineering work can be performed with RS4E5100 safety system engineering and maintenance function.

● For DNP3 slave function

Hardware requirements

The Ethernet communication module runs on the following SCS.

SSC57S, SSC57D

Software requirements

The Ethernet communication module for DNP3 communication runs on the control functions on the following SCS.

RS4F1170 Safety Control Function (for SSC57□)

Engineering requirements

Engineering work can be performed with RS4E5100 safety system engineering and maintenance function with RS4E5700 FAST/TOOLS integration package.

■ INSTALLATION ENVIRONMENT

RS4F1500 safety control function (for S2SC70□)

No. of communication modules to be mounted (*1)	Max. 2 units/SCS (*2) (for Modbus slave communication function)
	Max. 4 units/SCS (*2) (for subsystem communication function)

- *1: Since Modbus slave communication function and subsystem communication function modules can be mounted on the same SCS, the maximum number of communication modules is 6 units/SCS.
 *2: This is the sum of ALR111, ALR121, and ALE111.

RS4F1300 safety control function (for SSC60□)

No. of communication modules to be mounted (*1)	Max. 2 units/SCS (*2) (for Modbus slave communication function)
	Max. 4 units/SCS (*2) (for subsystem communication function)

- *1: Since Modbus slave communication function and subsystem communication function modules can be mounted on the same SCS, the maximum number of communication modules is 6 units/SCS.
 *2: This is the sum of ALR111, ALR121, and ALE111.

RS4F1100 safety control function (for SSC50□)

No. of communication modules to be mounted (*1)	Max. 2 units/SCS (*2) (for Modbus slave communication function)
	Max. 4 units/SCS (*2) (for subsystem communication function)

- *1: Since Modbus slave communication function and subsystem communication function modules can be mounted on the same SCS, the maximum number of communication modules is 6 units/SCS.
 *2: This is the sum of ALR111, ALR121, and ALE111.

RS4F1170 safety control function (for SSC57□)

No. of communication modules to be mounted (*1)	Max. 2 units/SCS (*2) (*3) (for Modbus slave communication function)
	Max. 2 units/SCS (*3) (for DNP3 slave function)
	Max. 4 units/SCS (*2) (for subsystem communication function)

- *1: Since Modbus slave communication function, DNP3 slave communication function, and subsystem communication function modules can be mounted on the same SCS, the maximum number of communication modules is 8 units/SCS.
 *2: This is the sum of ALR111, ALR121, and ALE111.
 *3: At ProSafe-RS R4.01 or earlier, only one module of ALE111 for DNP3 slave function is available per SCS.

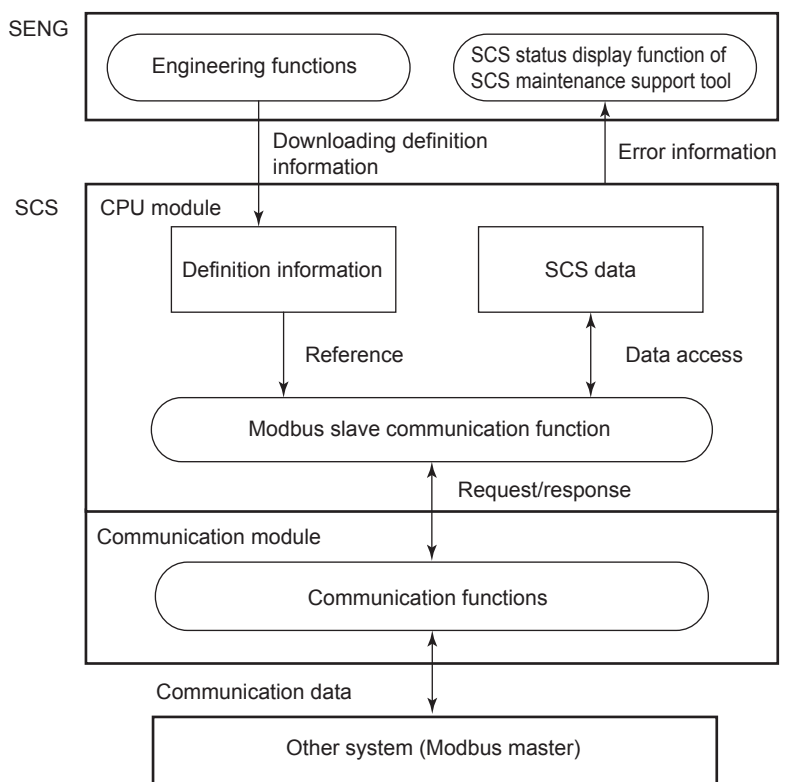
■ MODBUS SLAVE COMMUNICATION FUNCTION

Modbus slave communication function enables ProSafe-RS a Modbus communication where an SCS acts as a Modbus slave and communicates with a Modbus master which is a different system from ProSafe-RS.

● Relationship between SCS and Modbus master

Communication module's definition information, Modbus device addresses, mapping definition of SCS data, and so on are to be downloaded using engineering function of a safety engineering station (SENG).

When a data is sent from an external Modbus master (external device), the SCS's CPU receives it through its Ethernet communication module. The SCS's CPU sends a response message using the Modbus slave communication function to the Modbus master in response to the data request. The SCS maintenance support tool displays error information and notifies the error status using the SCS status display function when an error in the Ethernet communication module and communication content occurs.



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Figure Flow of data in other system

● Specification of communication function

Connection method : Ethernet connection via hubs. Or, with a 10BASE-T connection, a crossover cable can also be used for a peer-to-peer connection without a hub.
 Transmission protocol: Conforms to OPEN Modbus/TCP SPECIFICATION Release 1.0, 29 March 1999 Andy Swales Schneider Electric protocol
 No. of connection: Max. 2/SCS
 Transaction: 1/connection
 Communication protocol: TCP/IP

Table List of applicable devices

Device type	Device name	Communication capacity (per communication)	Read	Write
Bit device	Coil	32 words	Y	Y
	Input relay		Y	N
Word device	Input register	124 words	Y	N
	Maintenance register		Y	Y

Y: Applicable

N: Not applicable

● Dual-redundant communication

The dual-redundant configuration of the network can be available by establishing an independent transmission path from the Modbus master for every two the Ethernet communication modules mounted in the SCS. These Ethernet communication modules are configured as single.

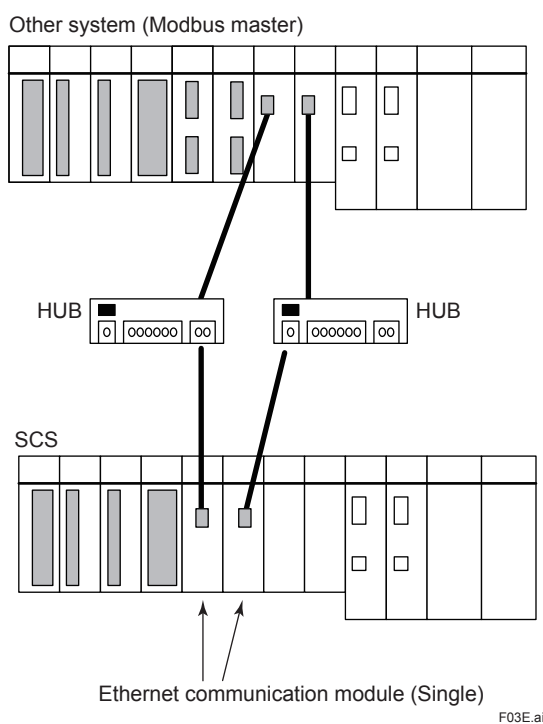


Figure Dual-redundant configuration of the Ethernet communication module (for dual-redundant network configuration)

■ DNP3 SLAVE FUNCTION

DNP3 slave function is one of the external communication functions. This function let a safety control station (SCS) to act as a DNP3 slave and communicates with a DNP3 master such as SCADA or other system. This function is used for SSC57 and interference-free.

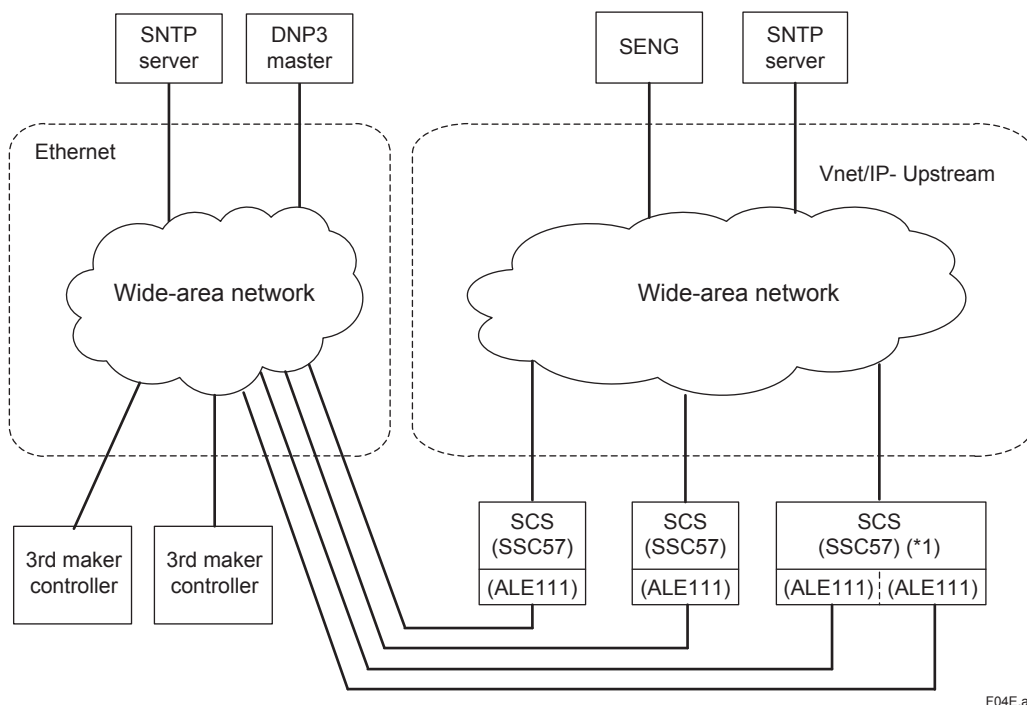
This function supports duplexed interface for DNP3 communication and is available from ProSafe-RS R4.02 or later. The SCS is enabled to communicate with a single DNP3 master via two ALE111 communication modules.

● Relationship between SCS and DNP3 master

To use the DNP3 slave function, use DNP3 communication FBs. By assigning instances of DNP3 communication FBs to DNP3 data, SCS data can be referred to or set from the DNP3 master. The SCS generates and buffers an event that includes a time stamp and data the moment a variable of the application logic changes. When a communication failure occurs, data loss can be prevented because the DNP3 master can read the relevant event from the event buffer following the recovery.

The time synchronization between ProSafe-RS and DNP3 master is mandatory to synchronize the event time stamp of the ProSafe-RS by using SNTP server or DNP3 communication. In case of using DNP3 communication for the synchronization, time error is "1 second + the scan period of the application logic" at the maximum.

The following figure shows an example of configuration of a DNP3 communication system where the SENG, SCS, and SNTP server are connected through the Vnet/IP-Upstream network.



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*1: ProSafe-RS R4.02 or later is required.

Figure System configuration example of a DNP3 communication system

● Specification of communication function

Connection method: Ethernet connection via a hub.
 Transmission protocol: DNP3 SPECIFICATION DEVICE PROFILE Version 2013 November-2013
 No. of connection: 1 DNP3 master/SCS (Dual-redundant communication is not supported)
 Transaction: 1/connection
 Communication protocol: TCP/IP

Table Applicable data

Function blocks for DNP3	DNP3 data	Size	Read	Write
DNP3_BI	Binary input	Total 1000 data	Y	N
DNP3_BO	Binary output		Y	Y
DNP3_CT_16, DNP3_CT_32	Binary counter, frozen counter		Y	Y (*1)
DNP3_AI_16, DNP3_AI_32, DNP3_AI_SF	Analog input		Y	N
DNP3_AO_16, DNP3_AO_32, DNP3_AO_SF	Analog output		Y	Y

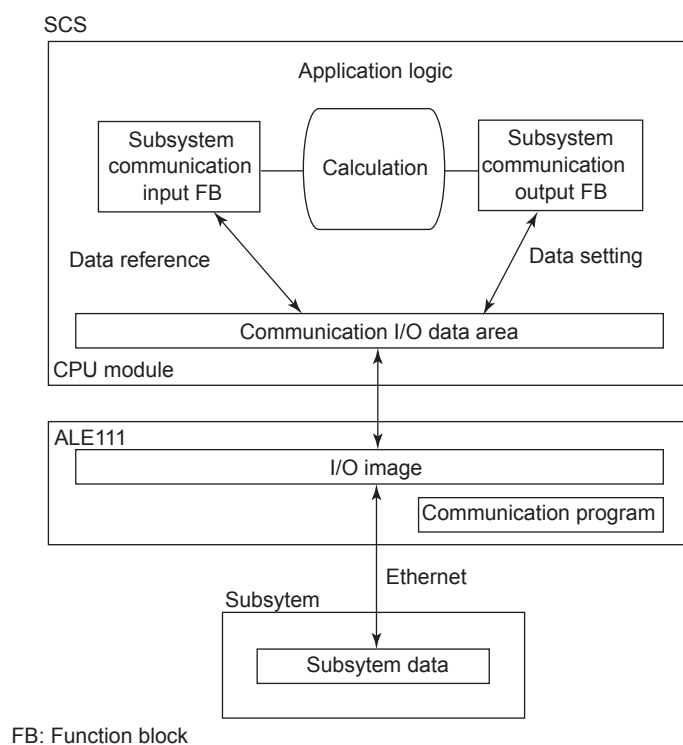
*1: Frozen counter only

■ SUBSYSTEM COMMUNICATION FUNCTION

Modbus communication is adopted as the subsystem communication function for ProSafe-RS that allows an SCS to act as a Modbus master to communicate with the subsystem as a Modbus slave.

● Relationship between SCS and a subsystem

The Ethernet communication module communicates with subsystems at the predefined intervals and stores the subsystem data in the communication modules' I/O image. The subsystem communication function of SCS accesses the communication module asynchronously from them, and refers to or sets the I/O image. The application logic of SCS reads data from the communication I/O data area when the communication input FB is executed, and writes the calculation data to the communication I/O data area when the communication output FB is executed.



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Figure Flow of data in a subsystem

● Specification of communication function

Connected device:

FCN: NFCEP100

FCJ: NFJT100

GC8000

FA-M3: F3SP71-4N, F3SP76-7N

Connection method:

Ethernet connection via a hub. Or, with a 10BASE-T connection, a crossover cable can also be used for a peer-to-peer connection without a hub.

Applicable devices:

By Yokogawa – STARDOM FCN and FCJ, GC8000, FA-M3

Transmission protocol:

Conforms to OPEN Modbus/TCP SPECIFICATION Release 1.0, 29 March 1999 Andy Swales Schneider Electric protocol

Communication protocol: TCP/IP

No. of subsystem stations: Max. 30 stations/ALE111

No. of communication definition: 128 definitions/ALE111

No. of communication data item (*1): Max. 2000 data / SCS (*2)

*1: This data is assigned to the communication I/O FB.

*2: This is the sum of communication data of ALR111, ALR121 and ALE111. Max. 500 data / SCS before ProSafe-RS R4.03.00

Table Applicable devices

Device type	Device name	Communication capacity (per communication)	Read	Write
Bit device	Coil	Read: 125 words	Y (*1)	Y
	Input relay	Write: 50 words	Y	N
Word device	Input register	Read: 125 words	Y	N
	Maintenance register	Write: 100 words	Y (*1)	Y
Other device	Specific coil (*2)	1 word	Y	N
	Communication status		Y	N

Y: Applicable N: Not applicable

*1: This device may not be able to read some function codes.

*2: This device is not supported by GC8000 and FA-M3.

● Dual-redundant communication

The dual-redundant configuration can be provided by setting the Ethernet communication modules on an adjacent slot.

Each of the two ALE111 modules communicates with the subsystem and reads the subsystem input image data into the module. An SCS accesses the control communication module to read and use these data; however, it does not access the stand-by communication module. When the SCS detects a control communication module error or subsystem communication failure, the SCS switches its control to the stand-by module from which to read data.

A control communication module outputs data to a subsystem. The control communication module writes data to the subsystem at the specified intervals when an SCS sets the data in it. Meanwhile, the stand-by communication module re-reads and retains the output image data when it accesses the subsystem at the specified interval. This equalizes the data between the control and stand-by communication modules. When an error is detected, the SCS switches its control to the stand-by module through which the SCS continues to output data to the subsystem.

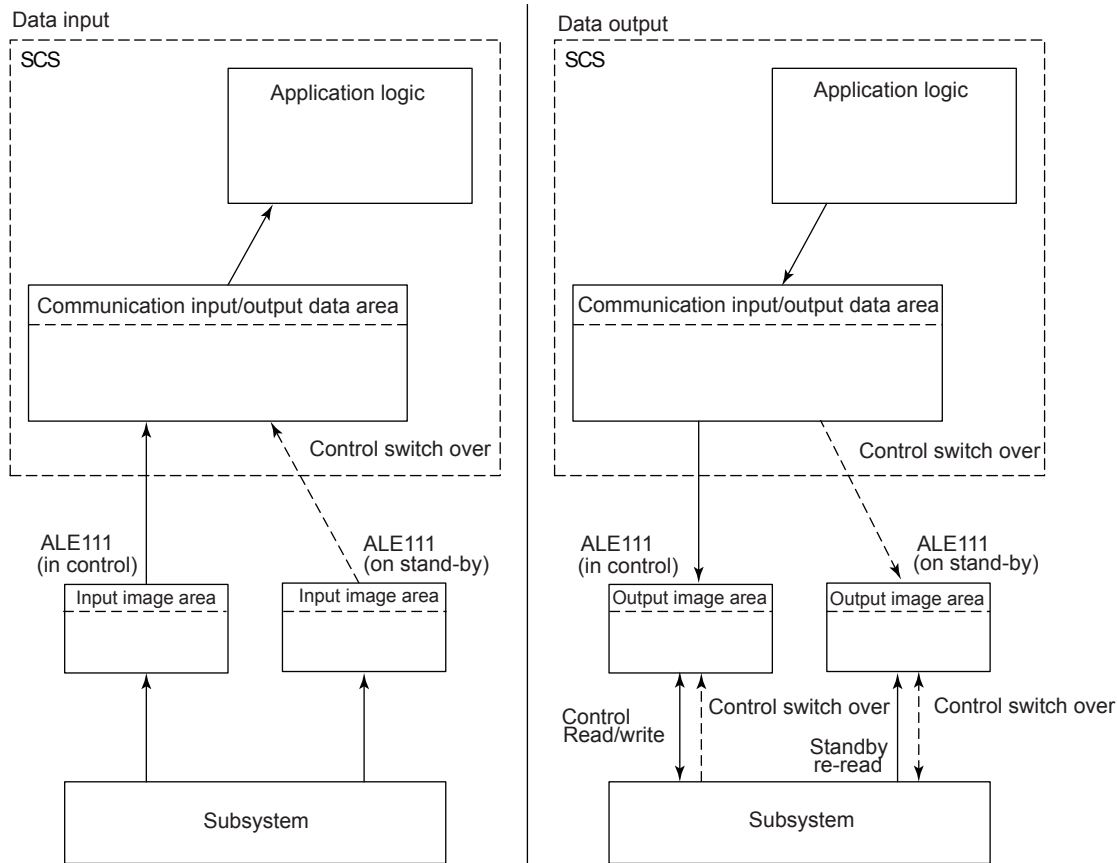


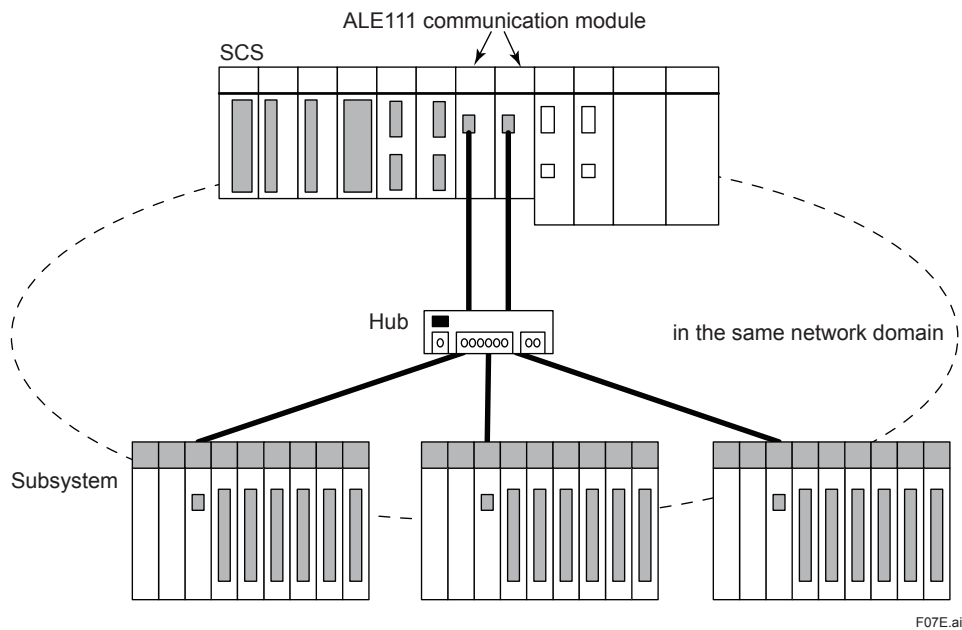
Figure Data flow in dual-redundant configuration

● Dual-redundant configuration

There are two types in ALE111 dual-redundant configuration.

Ethernet communication module dual-redundant configuration

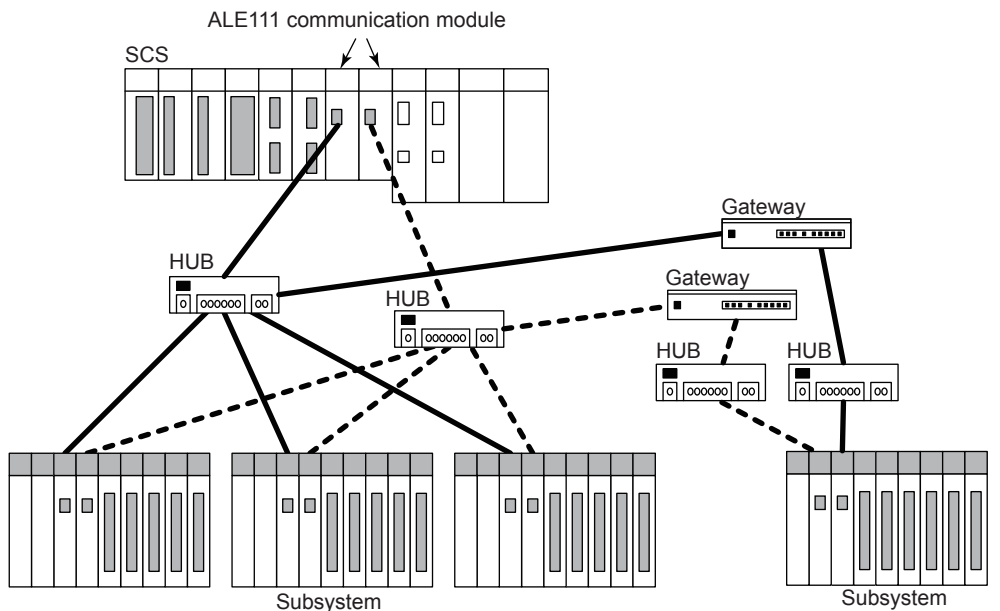
Insert a pair of ALE111 on an SCS to make them work in the same network domain.



**Figure Dual-redundant configuration of the Ethernet communication modules
(for communication modules only)**

Dual-redundant network configuration

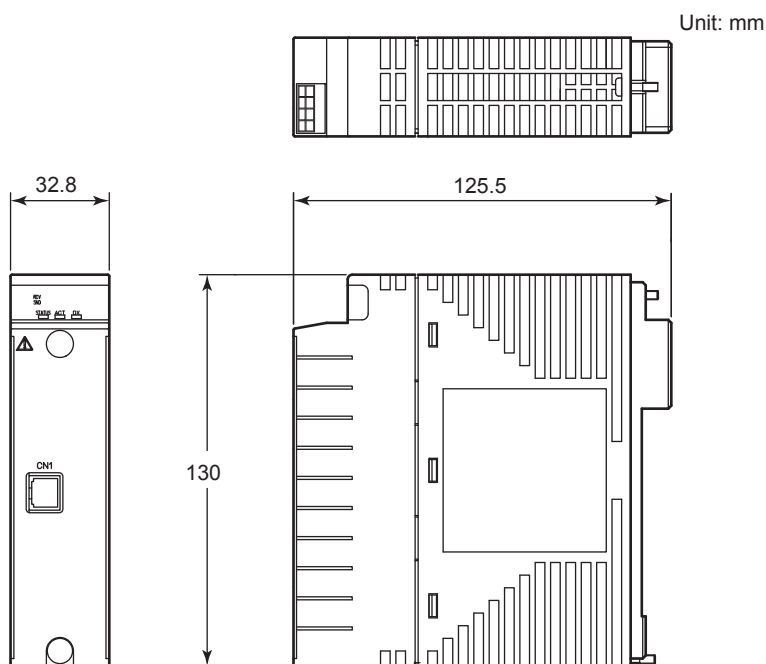
Not only ALE111 modules but also the communication interface between the network and the subsystems can also be in dual-redundant configuration. By segmenting the two ALE111 network domains, the network itself can be made dual-redundant.



**Figure Dual-redundant configuration of the Ethernet communication module
(Redundancy of the network)**

EXTERNAL DIMENSIONS

● ALE111 Ethernet communication module



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Nominal Tolerances :

When the reference dimension is over 0.5 mm and equal or less than 120 mm, its nominal tolerance is ± 0.8 mm, while its combination of nominal tolerance is ± 1.5 mm.

When the reference dimension is over 120 mm, its nominal tolerance is in accordance with JEM 1459.

MODEL AND SUFFIX CODES

		Description
Model	ALE111	Ethernet Communication Module
Suffix Codes	-S	Standard Type
	5	With no explosion protection
	E	With explosion protection
	1	With ISA Standard G3
	3	With ISA Standard G3 and temperature

CONFORMIY STANDARDS

Refer to "ProSafe-RS Standards Compliant Models" (GS 32P01B60-01EN).

ORDERING INFORMATION

Specify the model, suffix code(s).

For selecting the right products for explosion protection, please refer to TI 32S01J30-01E without fail.

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