

Chapter 1 Introduction

This User's Manual describes for the entire network of MASTER-K PLC system technically and in detail. Network of MASTER-K PLC system is MASTER-K Fnet and the characteristics are as follows :

MASTER-K Fnet

This is situated at lower level of CIM network structure, and an open network system based on IEC/ISA Fieldbus of which standardization is in proceeding. Main characteristics of this network are reduction of the price for installation and maintenance, variety of system configuration, ease of maintenance and repair, and ease of system modification. This network supports electric network(twisted pair cable) which is cheap and easy to install and optical network(optical cable) which has great performance at the place that electric environment is very poor, for variety of system configuration. This also provides the option module that is composed of repeater, optical/electric converter, and active coupler, in order to combine suitably these two networks according to the use.

Remark

1. MASTER-K Fnet is abbreviated as Fnet for simplicity of description.
2. Program in this User's Manual has been prepared on the basis of KGLWIN V1.3.

1. Introduction

Modules configuring MASTER-K Fnet are classified as Table 1.1 according to the cable used. This may be referred to when user configures network.

Table 1.1 Type of MASTER-K PLC communication module

Network	Module	Type of connection cable	Name of communication module		Mounting base
MASTER-K Fnet	Master module (FMM)	Twisted pair (electric)	Interface	G0L-FUEA	Computer
				K7F-FUEA	K1000S
				K4F-FUEA	K300S
				K3F-FUEA	K200S
		Optical		K7F-FUOA	K1000S
	Slave module (FSM)	Twisted pair (electric)	Remote I/O	K7F-RBEA	K1000S
				K4F-RBEA	K300S
		Optical		G0L-SMQA	Single
				G0L-SMIA	Single
				G0L-SMHA	Single
				K7F-RBOA	K1000S
	Option module	Twisted pair	Repeater	G0L-FREA	Single
		Optical/Twisted pair	Optical/electr ic converter	G0L-FOEA	Single
		Optical	Active coupler	G0L-FACA G0L-FAPA G0L-FABA	Single
				G0C-T	Twisted pair cable
		Cable	Cable	G0C-F	Optical fiber cable

Chapter 2 Terms and concepts of communication

2.1 Description of terms

■ **Master module(Fnet Master Module ; FMM)**

Fnet communication module mounted at I/O position of main base.

■ **Slave module(Fnet Slave Module; FSM)**

Fnet communication module and stand-alone module mounted at CPU position of main base.

■ **Option module(Fnet Option Module)**

Fnet communication module used for signal conversion, extension of communication distance, and regeneration and amplification of signal.

■ **Local station**

The station that GMWIN is directly connected in order to download, monitor, and debug programs in the same network including CPU.

■ **Remote station**

The opposite concept to local station, the other station to communicate with local station

■ **Remote I/O station**

Input/output area that the remote communication module of PLC system instead of CPU of PLC refreshes I/O module mounted on remote station by receiving I/O data from master station.

■ **Fnet**

Fieldbus is the lowest network connecting control device and instrumentation device, and the specification adopts three layers from seven layers of OSI. Three layers consist of the physical layer which consists of H2(1Mbps, electric), H1(31.23Kbps, electric), optical, and wireless, etc., the data link layer which adopts scheduled and circulated token bus, the application layer which plays a role of application, and additional user layer.

2. Terms and Concepts of communication

■ Token

The right to transmit data of self station through controlling the right of accessing to physical medium.

■ SAP(Service Access Point)

The factor to determine the characteristic of service used in communication, and to connect upper application layer with data link layer according to their characteristics. LSAP is divided into SSAP, which is SAP's own station and DSAP, which is SAP of other station. (LSAP = SSAP + DSAP, used for Mnet only)

■ Fnet station number

The station number of communication module(K7F-FUEA,... etc.) adopting Fnet specification. The station number used in Fnet is set by the switch attached on the front of communication module, and used as station number of all services including *high speed link* service differently from the station number used for Mnet.

■ Active coupler

This is a module connecting optical module each other when optical network is configured, and the optical distributor, which has function of regeneration and amplification of optical communication signal additionally.

■ Repeater

This is used to extend the distance of cable for electric communication network, extends the distance of communication with regeneration and amplification of electric communication signal.

■ E.O.C(Electric/Optical Converter)

This module converts optical communication signal to electric communication signal, or electric communication signal to optical communication signal, and has additional functions of regeneration and amplification of signal.

■ Manchester Biphase-L

Data modulation method used in Fnet. Data is encoded and transmitted by using Manchester-I code, Received data encoded by Manchester will be decoded and converted.

■ CRC(Cyclic Redundancy Check)

This is the one of error detection methods, which is an error detection method used most frequently for synchronizing transmission, and also called as cyclic code method.

■ Terminal resistance

This is used to adjust mutual impedance of transmitting part and receiving part on physical layer, and terminal resistance of Fnet is 110Ω , 1/2W and terminal resistance of Mnet is 75Ω , 1/4W.

■ High speed link

This is used among MASTER-K PLC communication modules only, and used to transmit and receive data at high speed, and executes communication by setting *high speed link* parameter of GMWIN.

■ KGLWIN(Programming and debugging tool)

This software enables user to program in order to fit to the system, and to download, run, stop, and debug in MASTER-K PLC CPU module.

■ FAM(FA Manager)

This software package is situated at upper level in factory automation, and enables user to connect with networks of several types, and enables user to execute *high speed link*, reading/writing variable, and download/upload program by mounting Fnet module of computer.

■ Segment

Local network which connects all stations by using the same token, without using any connecting device(Gateway, EOC, Repeater).

■ Network

Entire communication system, configured by one segment or more, that uses the same token.

2.2 Concept of Fnet communication

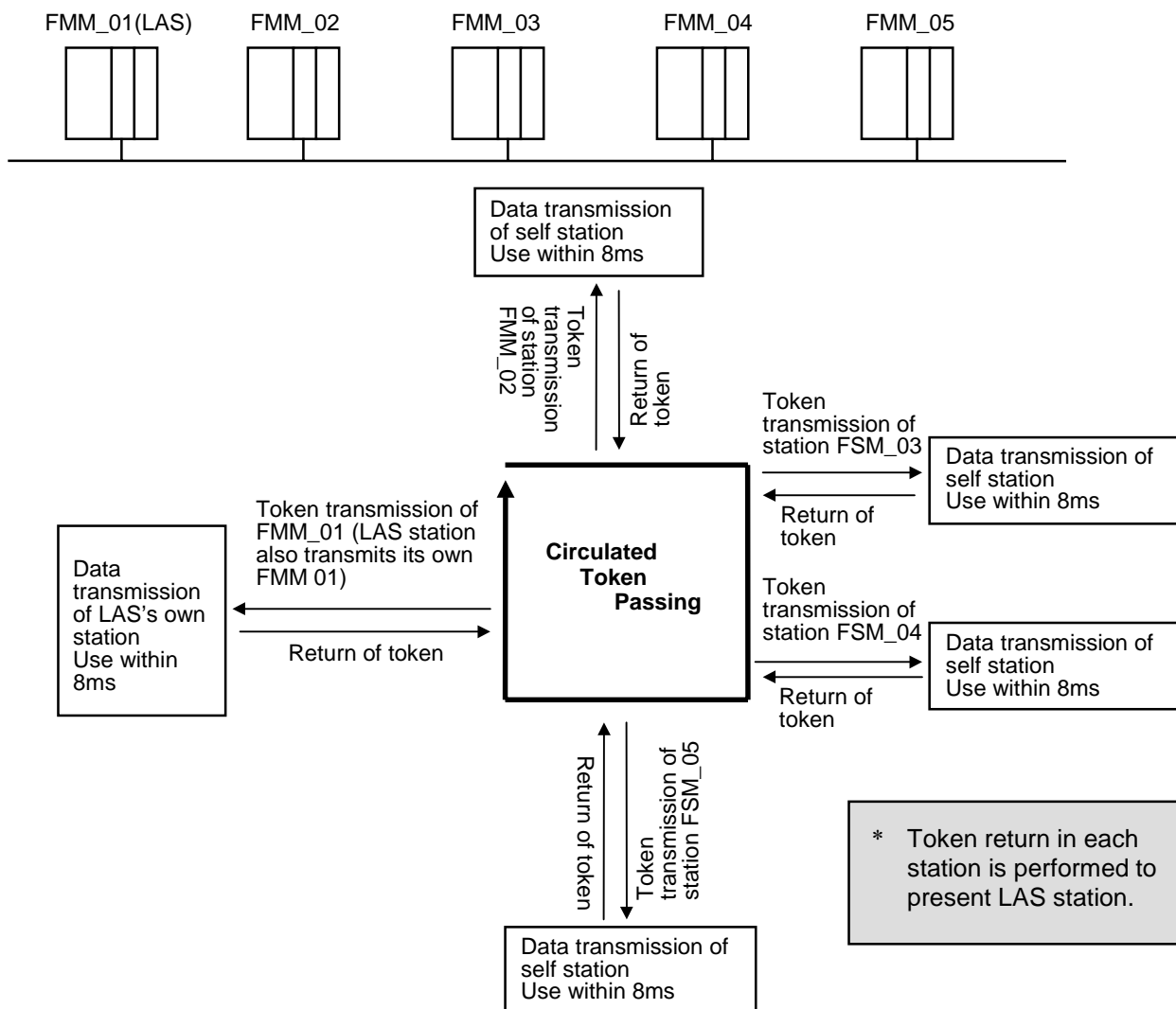
The method of Fnet communication is token distribution method by LAS(Link Active Scheduler). One of FMM communication modules can be LAS, but FSM communication modules cannot be LAS.

2.2.1 How to generate and move LAS

Among communication modules, LAS can be generated under the following conditions :

- 1) Among the stations connected to network, FMM communication module that the power is turned on first obtains LAS.
- 2) When the power become on at the same time among the stations connected to network, the communication module with the lowest station number obtains LAS.
- 3) If the present LAS station becomes down during normal communication, the communication module of the lowest station number among the rest of FMM station, obtains LAS.
- 4) Only one LAS exists through the entire network.

2.2.2 How to assign token(Suppose that the Station FMM_01 is LAS)



Chapter 3 General specifications

3.1 General specifications of communication module(Fnet)

General specifications of MASTER-K series are as follows :

Table 3.1 General specification

No.	Item	Spec.					Related spec.
1	Operating temp.	0℃ ~ +55℃					
2	Storage temp.	-25℃ ~ +70℃					
3	Operating moist.	5~95% RH, non-condensing					
4	Storage moist.	5~95% RH, non-condensing					
5	Vibration	For discontinuous vibration					ICE 1131-2
		Frequency	Acceleration	Amplitude	Number		
		10 ≤ f < 57Hz	-	0.075mm	Each 10 times in X,Y,Z directions		
		57 ≤ f < 150Hz	9.8 □ {1G}	-			
		For continuous vibration					
		Frequency	Acceleration	Amplitude			
		10 ≤ f < 57Hz	-	0.035mm			
		57 ≤ f < 150Hz	4.9 □ {0.5G}	-			
6	Impact	● Max. impact acceleration: 147 □ (15G) ● Authorized time : 11ms ● Pulse wave : Sign half-wave pulse (each 3 times in X,Y,Z directions)					IEC 1131-2
7	Noise	Square wave Impulse noise	± 1,500V				Test spec. reference within LG Industrial Systems
		Static electric discharging	Voltage : 4kV (Contact discharging)				IEC 1131-2, IEC 801-2
		Radiation electric field noise	27~500 MHz, 10V/m				IEC 1131-2, IEC 801-3
		Fast transient/burst noise	Segment	Power module	Digital input/output (24V or more)	Digital input/output (less than 24V) Analog input/output communication interface	IEC 1131-2, IEC 801-4
			Voltage	2kV	1kV	0.25 kV	
8	Ambient conditions	No corrosive gas and dust					
9	Height	Up to 2,000m					
10	Pollution level	2 or less					
11	Cooling type	Natural air cooling					

Remark

1. IEC(International Electro-technical Commission) : International non-governmental association, which establishes international standards in the field of electric and electronics.
2. Pollution level : This is an indication showing pollution of surrounding environment, which determines insulation performance of device, and generally the pollution level 2 means the conditions in which only non-conductive pollution occurs.
But, temporary conduction may occur according to condensing.

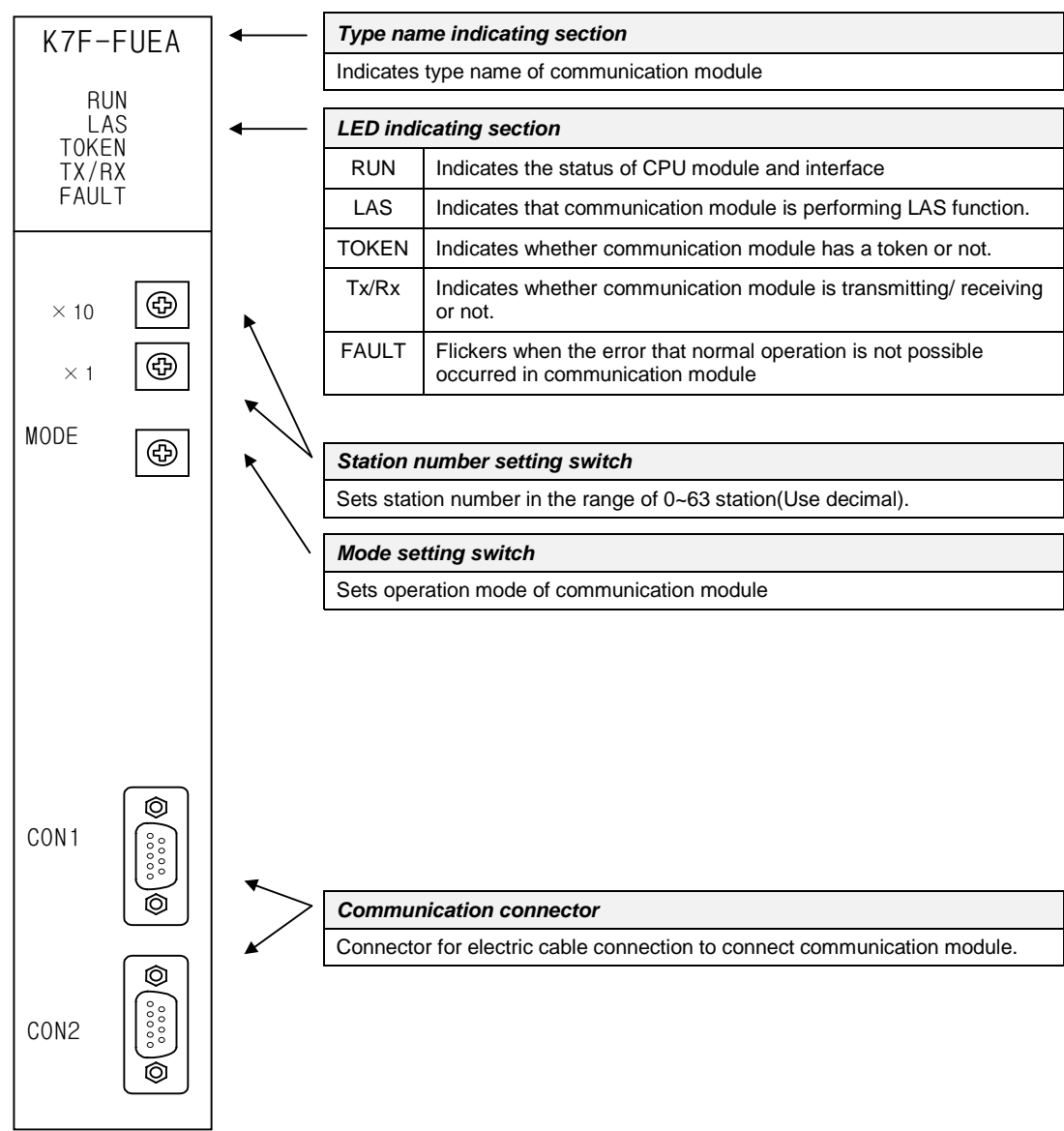
3.2 Structure and configuration

This describes the structure and configuration for representative type of Fnet and Mnet module.

3.2.1 Fnet master module structure : K7F-FUEA, K7F-FUOA, K4F-FUEA, K3F-FUEA

1) K7F-FUEA, K7F-FUOA, K4F-FUEA

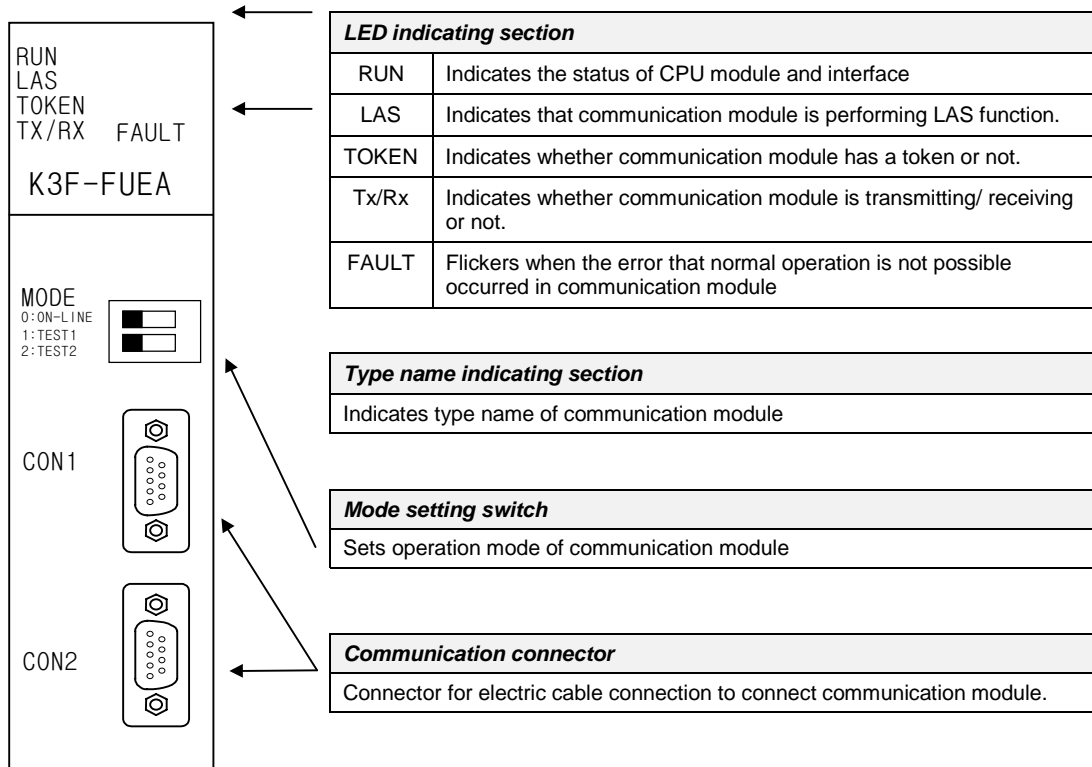
Ex. of K7F-FUEA



Remark

- 1. In the figure shown above, connector of K7F-FUOA is made of optical connector.
- 2. For mode setting switch, see 3.2.6 Fnet mode setting.

2) K3F-FUEA



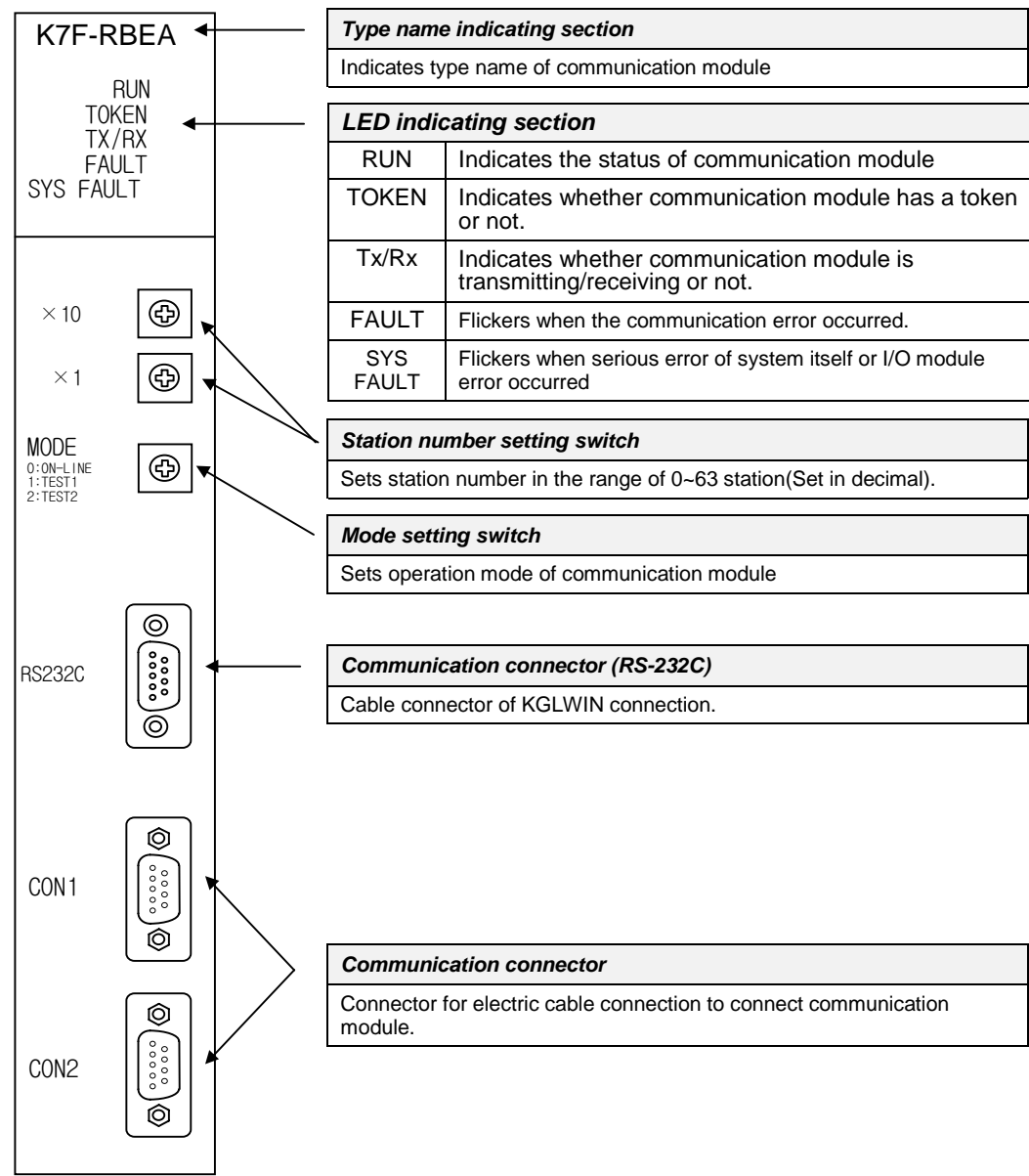
Remark

1. The station number setting switch is placed in the case.

3. General specifications

3.2.2 Fnet slave module structure : K7F-RBEA, K7F-RBOA, K4F-RBEA

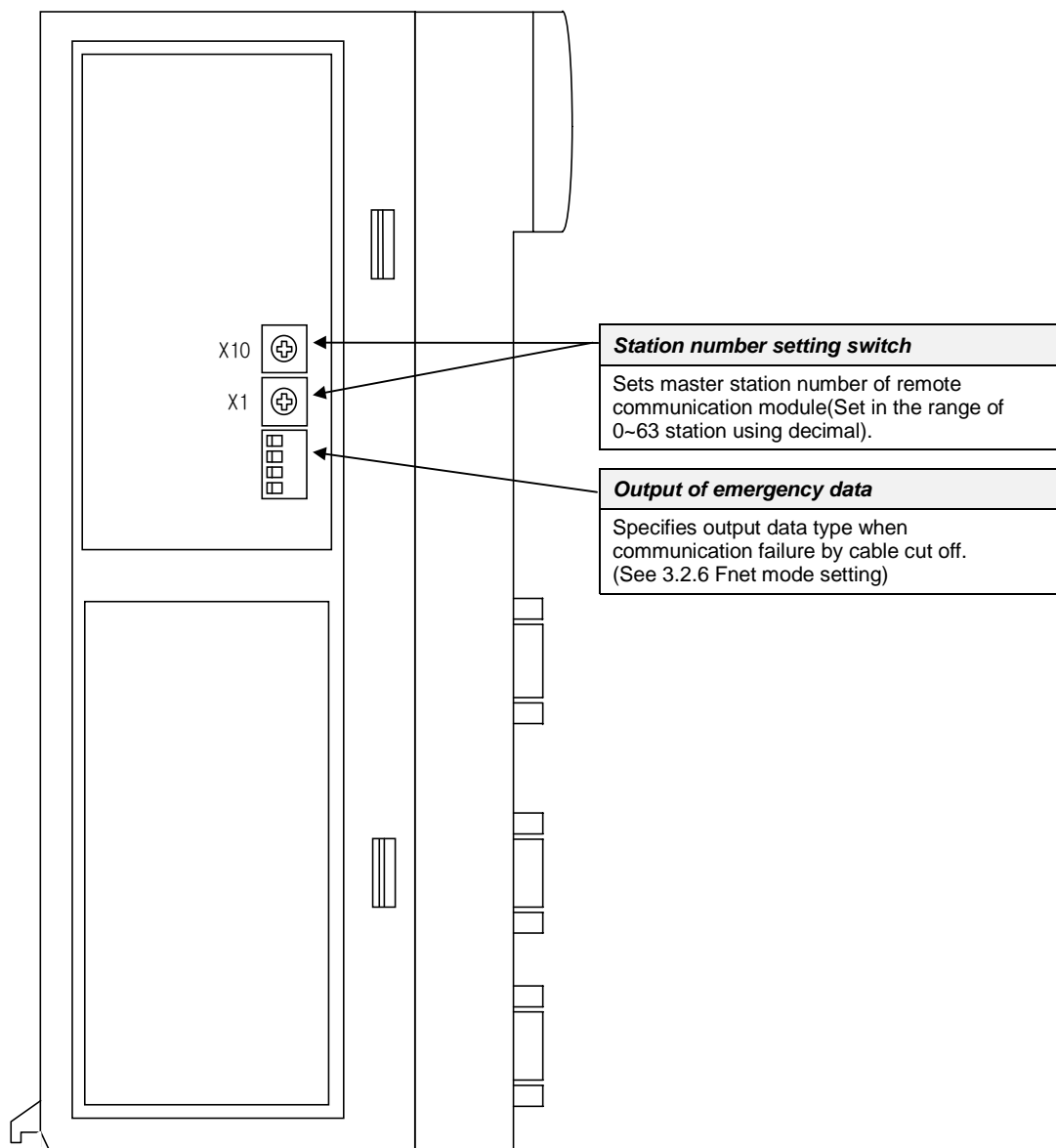
1) Front part(Ex. K7F-RBEA)



Remark

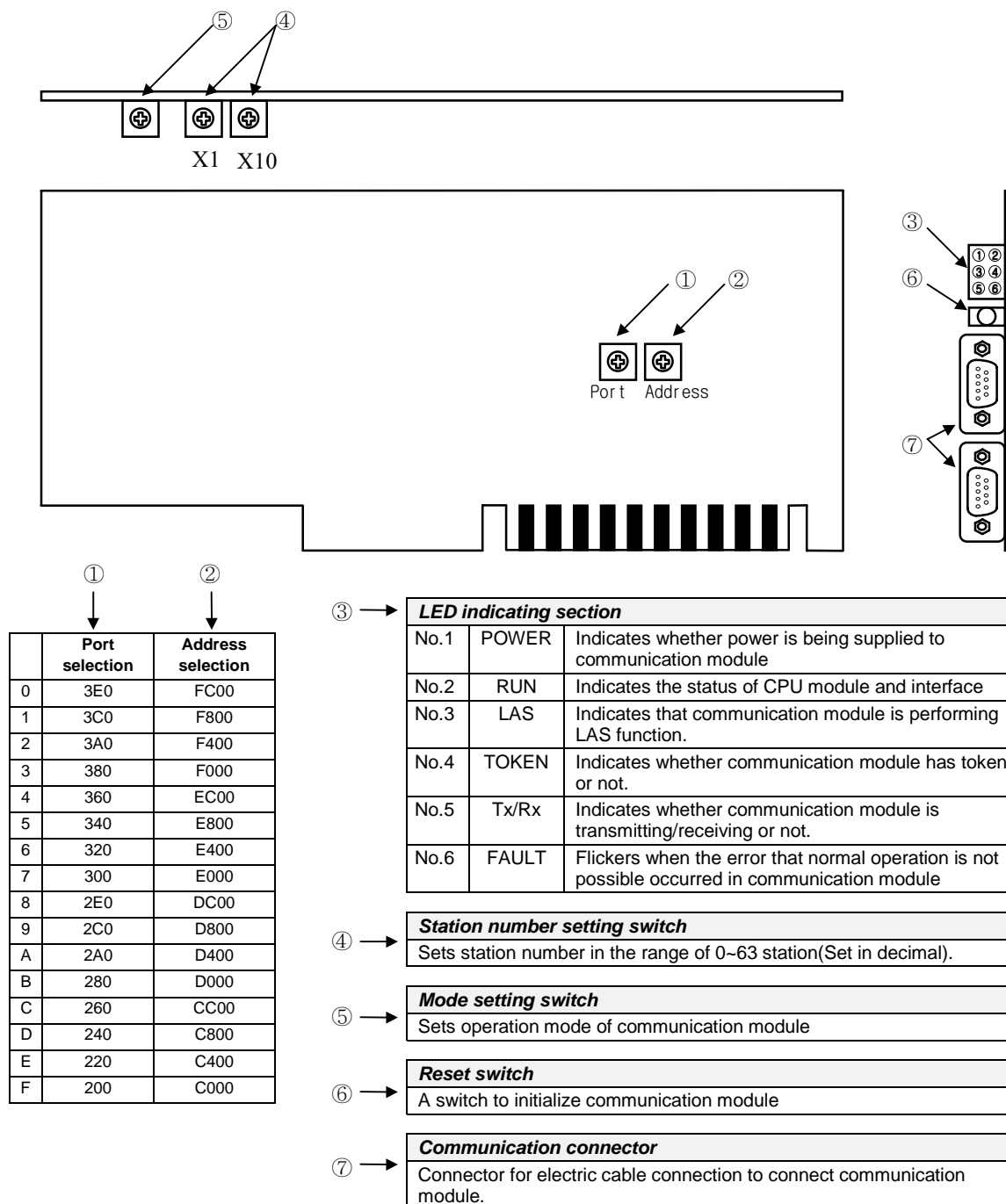
In the figure shown above, connector of K7F-RBOA is made of optical connector, and there is no RS-232C port in K4F-RBEA.

2) Side part(Ex. K7F-RBEA)



3. General specifications

3.2.3 Fnet Computer interface module structure : G0L-FUEA



Remark

1. For mode setting switch, see 3.2.6 Fnet mode setting.
2. Port is set to No.5(340) and address is set to No.9(D800) by factory default.
3. This should be set in order not to be duplicated with other device area of computer previously used, and add DEVICE=C:\WINDOWS\EMM386.EXE NOEMS X=D800-D8FF(if address has been set to No.9(D800)) in CONFIG.SYS to use set area for not continuous or extended area of computer but this module.

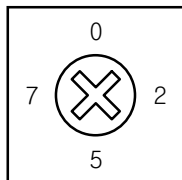
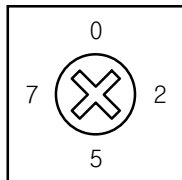
3.2.4 Fnet LED signal name and indication content

Device type	LED Name	Meaning of LED indication	LED On	LED Off
K7F-FUEA K7F-FUOA K4F-FUEA K3F-FUEA GOL-FUEA	RUN	Indicates the status of CPU module and interface	Normal	Abnormal
	LAS	Indicates that communication module is performing LAS function.	In proceeding	
	TOKEN	Indicates whether communication module has token or not.	Has	Does not have
	Tx/Rx	Indicates whether communication module is transmitting/receiving or not.	Flicker during communication	
	FAULT	Indicates the status of communication module.	Abnormal	Normal
K7F-RBEA K7F-RBOA K4F-RBEA	RUN	Indicates the status of communication module.	Normal	Abnormal
	TOKEN	Indicates whether communication module has token or not.	Has	Does not have
	Tx/Rx	Indicates whether communication module is transmitting/receiving or not.	Flicker during communication	
	FAULT	Indicates whether communication error exists or not.	Abnormal	Normal
	SYS FAULT	Indicates whether system error or I/O module error occurred or not.	Abnormal	Normal
GOL-SMQA GOL-SMIA GOL-SMHA	PWR	Indicates power status.	Power On	Power Off
	TRX	Indicates Tx/Rx or not of communication module.	Flicker during communication	
	ERR	Indicates communication error or not.	Abnormal	Normal

* For details on LED, see Appendix A1, LED indication.

3.2.5 Fnet station number setting

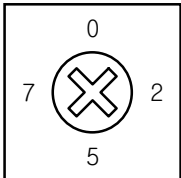
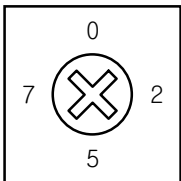
1) Local station number setting

Applied Device type	Detailed drawing of station number switch	Description						
K7F-FUEA K7F-FUOA K7F-RBEA K7F-RBOA K4F-FUEA K4F-RBEA K3F-FUEA G0L-FUEA G0L-SMQA G0L-SMIA G0L-SMHA	<div><div>× 10</div><div></div></div> <div><div>× 1</div><div></div></div>	<div>(1) Station number can be set from 0 to 63(Decimal).</div> <div>(2) Station number setting (Factory default is 0)</div> <table><tr><th>Switch</th><th>Setting</th></tr><tr><td>X 10</td><td>Sets ten's figure of station number</td></tr><tr><td>X 1</td><td>Sets one's figure of station number</td></tr></table> <div>(3) GM6 : The station setting switch is placed in the case.</div>	Switch	Setting	X 10	Sets ten's figure of station number	X 1	Sets one's figure of station number
Switch	Setting							
X 10	Sets ten's figure of station number							
X 1	Sets one's figure of station number							

3. General specifications

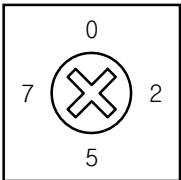
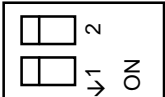
2) Master station number setting

Sets station number of Fnet master module, which can transmit and receive *high speed link* data in Fnet slave module(Station number switch is located inside of case).

Applied Device type	Detailed drawing of station number switch	Description						
K7F-RBEA K7F-RBOA K4F-RBEA G0L-SMQA G0L-SMIA G0L-SMHA	<div><div>× 10</div><div></div></div> <div><div>× 1</div><div></div></div>	<div>(1) Station number can be set from 0 to 63(Decimal).</div> <div>(2) Station number setting (Factory default is 0)</div> <table><tr><th>Switch</th><th>Setting</th></tr><tr><td>X 10</td><td>Sets ten's figure of station number</td></tr><tr><td>X 1</td><td>Sets one's figure of station number</td></tr></table>	Switch	Setting	X 10	Sets ten's figure of station number	X 1	Sets one's figure of station number
Switch	Setting							
X 10	Sets ten's figure of station number							
X 1	Sets one's figure of station number							

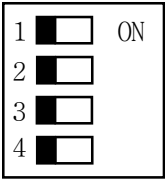


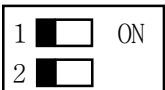


3.2.6 Fnet mode setting

1) Test mode

Applied Device type	Detailed drawing of mode switch	Description								
K7F-FUEA K7F-FUOA K7F-RBEA K7F-RBOA G0L-FUEA	<div>MODE</div> <div>0:ON LINE 1:TEST 1 2:TEST 2</div> 	<div>(1) Mode can be set from 0 to 2. (GM6 : 0 ~ 3)</div> <div>(2) Mode setting (Factory default is 0)</div> <table><tr><th>Mode</th><th>Function</th></tr><tr><td>0</td><td>Performs normal operation</td></tr><tr><td>1</td><td>Sets the unit as data transmitting station in communication test</td></tr><tr><td>2</td><td>Sets the unit as data transmitting station in communication test</td></tr></table>	Mode	Function	0	Performs normal operation	1	Sets the unit as data transmitting station in communication test	2	Sets the unit as data transmitting station in communication test
Mode	Function									
0	Performs normal operation									
1	Sets the unit as data transmitting station in communication test									
2	Sets the unit as data transmitting station in communication test									
K4F-FUEA K4F-RBEA	<div>MODE</div> <div>0:ON-LINE 1:TEST1 2:TEST2</div> 	<div>* For details, see chapter 7, Diagnosis function.</div>								

2) Emergency data output setting

In Fnet slave module, when the communication with remote station is cut off by remote station error or line error during communication, setting of these switches specifies an operation between latching I/O data in slave module and outputting optional user-defined data.

Applied Device type	Detailed drawing of mode switch	Description	
K7F-RBEA K7F-RBOA		Mode 	Function Latches the last data during communication error.
			Outputs user-defined data during communication error (Default is data reset).
K4F-RBEA G0L-SMQA G0L-SMIA G0L-SMHA		Mode 	Function Latches the last data during communication error.
			Outputs user-defined data during communication error (Default is data reset).

Remark

- All of the switches are set to off by factory default.
- User can input user-defined data for communication error in KGLWIN.
(Refer to 6.6.7, Setting emergency output data of remote module.)

Chapter 4 Transmission specifications

4.1 Transmission specifications of Fnet

4.1.1 Transmission specifications of Fnet master module

Product of Fnet master module : K7F-FUEA, K7F-FUOA, K4F-FUEA, K3F-FUEA, G0L-FUEA

Table 4.1.1 Transmission specifications of Fnet master module

Item		Specification
Transmission speed		1Mbps common in Fnet module
Encoding type		Manchester Biphase-L
Electric	Transmission distance (per segment)	Max. 750m
	Transmission distance (during using repeater)	Max. 750m × (6 repeater + 1) = 5.25 km
	Transmission line	Twisted pair shielded cable
Optical	Transmission distance (per segment)	Max. 3km
	Transmission distance (during using EOC)	Max. 3km × (6 EOC +1) = 21km
	Transmission line	Optical cable
Max. number of station connection		Master + slave = 64 station (At least one master should be connected)
Max. size of protocol		256 byte
Access type of communication right		Circulated token passing
Communication type		Connection oriented service Connectionless service
Frame error check		CRC 16 = $X^{15} + X^{14} + X^{13} + \dots + X^2 + X + 1$

4. Transmission specifications

4.1.2 Transmission specifications of Fnet slave module

Product of Fnet slave module : **K7F-RBEA, K7F-RBOA, K4F-RBEA, G0L-SMQA, G0L-SMIA, G0L-SMHA**

Table 4.1.2 Transmission specifications of Fnet slave module

Item		Specification
Transmission speed		1Mbps
Encoding type		Manchester Biphase-L
Electric	Transmission distance (per segment)	Max. 750m
	Transmission distance (during using repeater)	Max. 750m × (6 repeater + 1) = 5.25km
	Transmission line	Twisted pair shielded cable
Optical	Transmission distance (during segment)	Max. 3km × (6 EOC +1) = 21km
	Transmission line	Optical cable
Max. number of stations connected		Link master class + Remote slave class = 64
Max. size of protocol		256 byte
Access type of communication right		Circulated token passing
Communication type		Connection oriented service Connectionless service

4.1.3 Transmission specifications of Fnet option module

Product of Fnet option module : **G0L-FREA, G0L-FOEA, G0L-FACA**

1) Repeater (G0L-FREA)

Table 4.1.3(A) Transmission specifications of repeater

Item	Specification
Communication speed	1Mbps
Encoding type	Manchester Biphase-L
Transmission line(Cable)	Twisted pair shielded cable
Max. extension distance per module	750m
Max. number of repeater between stations	6 units
Max. distance between stations	5.25km(when 6 repeater is installed)
Frame error check	$CRC\ 16 = X^{15} + X^{14} + X^{13} + \dots + X^2 + X + 1$

2) Electric/Optical converter (G0L-FOEA)

Table 4.1.3(B) Transmission specifications of electric/optical converter

Item	Specification
Communication speed	1Mbps
Encoding type	Manchester Biphase-L
Transmission line(Cable)	Optical cable, twist pair cable
Max. transmission distance	3km(Optical)/750m(electric)
Function of signal regeneration	Regenerating, Reshaping function
Frame error check	$CRC\ 16 = X^{15} + X^{14} + X^{13} + \dots + X^2 + X + 1$

3) Active coupler (Product : G0L-FACA)

Table 4.1.3(C) Transmission specification of active coupler

Item	Specification
Communication speed	1Mbps
Encoding type	Manchester Biphase-L
Transmission line(Cable)	Optical cable
Max. transmission distance	3km
Function of signal regeneration	Regenerating, Reshaping function
Frame error check	$CRC\ 16 = X^{15} + X^{14} + X^{13} + \dots + X^2 + X + 1$

4. Transmission specifications

4.3 Cable specifications

4.3.1 Twisted pair cable for Fnet

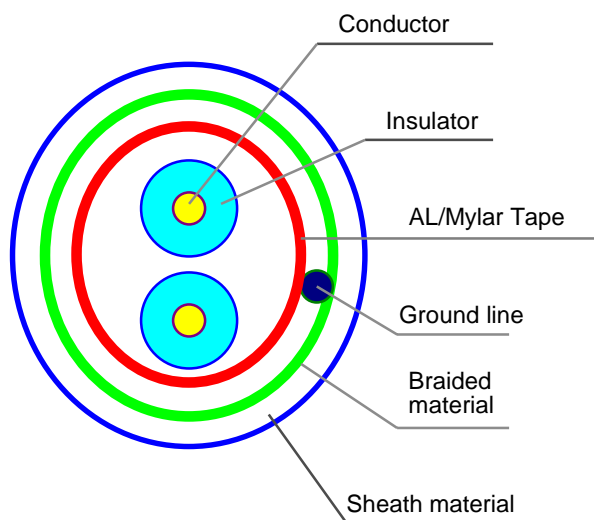
Type name of product : G0C-T□□□ (□□□ is length of cable, unit : m)

Ex.) Twisted pair cable 10m : G0C-T010

Table 4.3.1 Specifications of twisted pair cable for Fnet

Cable contents				
Product name		Low Capacitance LAN Interface Cable		
Type name		LIREV-AMESB		
Size		2 × 1.0mm (GS 92-3032, 18 AWG)		
Maker		LG CABLE CO.,LTD		
Electric characteristics				
Item		Unit	Characteristic	Test Condition
Conductor resistance		Ω/km	21.8 or less	Normal Temp.
Withstanding voltage(DC)		V/min	Withstands at 500V for 1 minute	In air
Insulation resistance		MEGA Ω-km	1,000 or more	Normal Temp.
Static electricity capacity		pF/m	45 or less	1 kHz
Characteristic impedance		Ω	120 ± 12	10 MHz
Characteristics in appearance				
Conductor	Number of core	CORE	2	
	Specification	AWG	18	
	Configuration	NO./mm	1/1.0	
	Outer diameter	mm	1.0	
Insulator	Thickness	mm	0.9	
	Outer diameter	mm	2.8	

● Structural drawing



4.3.2 Optical cable for Fnet

Type name : G0C-F□□□ (□□□ is length of cable, unit : m)

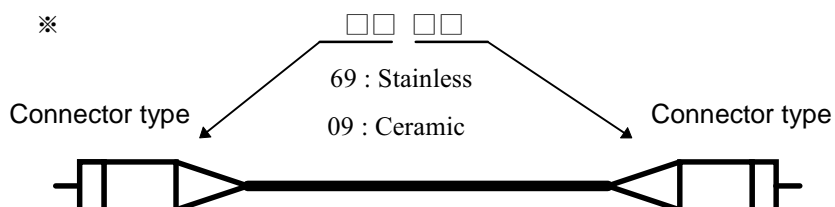
Ex.) Optical cable 10m : G0C-F010

Table 4.3.2 Specifications of optical cable

Cable contents	
Type name	Y22□□□□ : For indoor (for Bi-directional communication) D22□□□□ : For outdoor (for Bi-directional communication)
Connector type	ST - Type
Maker	Hewlett Packard(H.P)

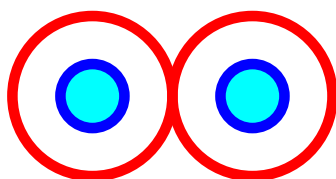
Segment		For indoor(standard)	For outdoor(standard)
		Y22□□□□	D22□□□□
Outer diameter (mm)		2.9 × 5.8	4.8
Min. Radius of curvature	Loaded (cm)	5.0	7.5
	Unloaded (cm)	3.0	4.8
Weight(Kg/m)		16	21

Contents	Characteristic	Unit
Core	62.5	μm
Cladding	125	μm
Max. attenuation	5	dB/km
Standard attenuation	4.5	dB/km

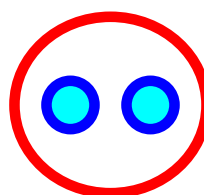


Ex.) If the cable type is Y226969, connector type is ST and the shape is stainless at both of the connectors.

● Outside drawing of optical cable



For indoor(Y22□□□□)



For outdoor(D22□□□□)