Chapter 7 High Speed Link

7.1 Introduction

The High Speed Link is a kind of communication system between **GLOFA PLC communication module.** It can send and receive data by setting up High Speed Link parameter. It is also data transmission service in which a user can exchange data by setting up data volume, period, area and save area of TX/RX in parameter. But, the High Speed Link service can have influence on other communication modules using the same module with it because it uses subnet broad service. Therefore, if a user wants little influence on other modules and efficiency maximization of communication, the user should set up data of nearly the maximum settable numbers (400 bytes) of TX/RX per High Speed Link block. Like that, it is a right way of setting to reduce total block numbers used. To use all the functions, you must download by setting the basic parameter. (See 6.2 Setup of Parameter)

High Speed Link function is as follows.

- ***High Speed Link Block Setting*** : A user can set 64 blocks, 32 for TX and 32 for RX each, if there are several RX/TX areas. Up to 200 words per block can be set. Thus, the maximum link dot number is 12,800 words.
- ***TX/RX Period Setting*** : TX/RX period can be set by a user by each block, and he can also set TX/RX period from 200㎳ to 10 sec for the areas where especially fast RX/TX is required, or not. Therefore, he can raise whole communication efficiency.
- ***TX/RX Area Setting*** : A user can set TX/RX area by each data block according to his I/O MAP.
- ***High Speed Link Information*** : As it offers a user High Speed Link information by user keyword of GMWIN, it is easy to build reliable communication.

Table 7.1 is showing High Speed Link dot numbers per communication device type.

Classification		Maximal communication bit numbers	Maximal transmitting bit numbers	Maximal block numbers	Maximal bit numbers per block
Enet module	G3L-EUEA	12,800	6,400	64 개(0-63)	200
	G4L-EUEA	12,800	6,400	64 개(0-63)	200

[Table 7.1] Maximal Communication length per Device Type

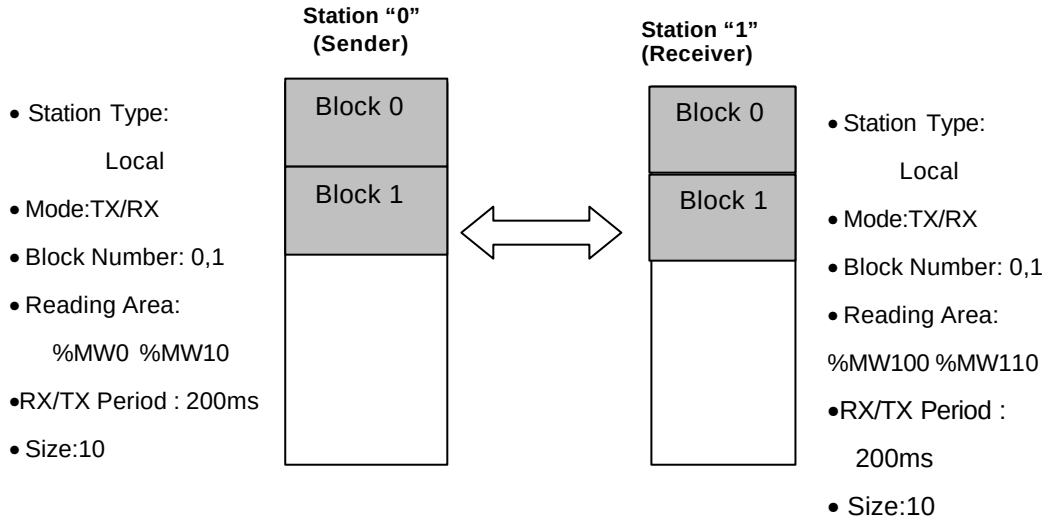
In Table 7.1, the unit of basic link length is 1 word.

7.2. High Speed Link

7.2.1 TX/RX Data Processing of High Speed Link

How to use the High Speed Link is described through a setting example, in which Ethernet modules of "0" station and "1" station have the same data with each other.

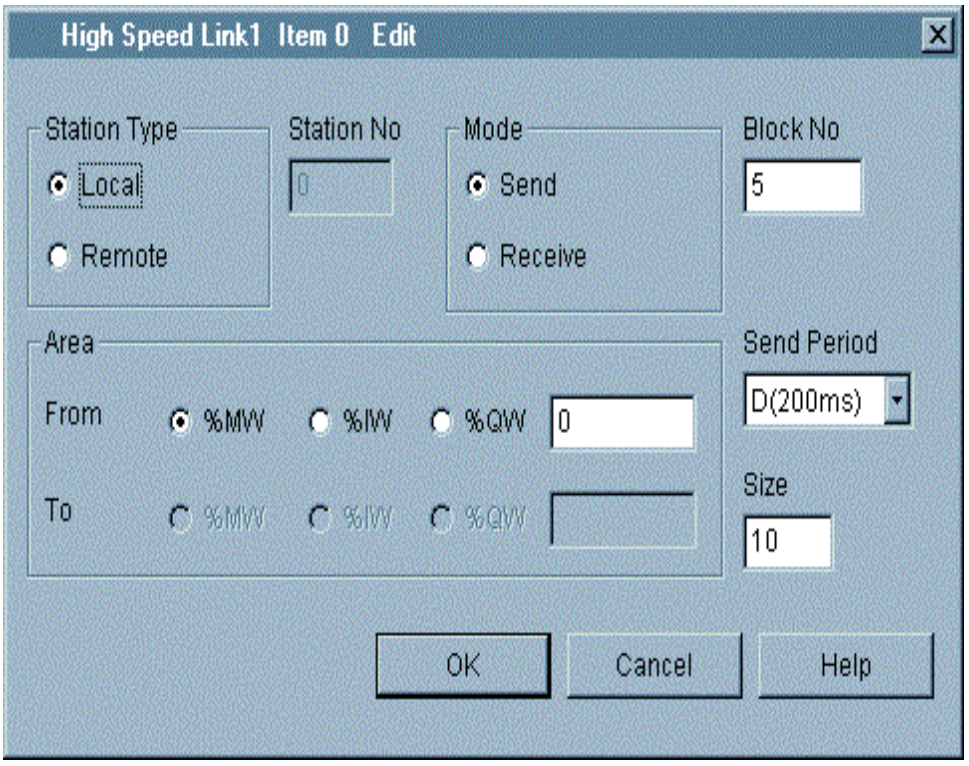
Example) Station "0" sends 10 words of %MW0 data with block number "0". The data sent to station "1" is saved in %MW10. The station "1" receives 10 words of %MW0 data from station "0" and then, it saves them in %MW100, and sends 10 words of %MW110 data to block number "1".



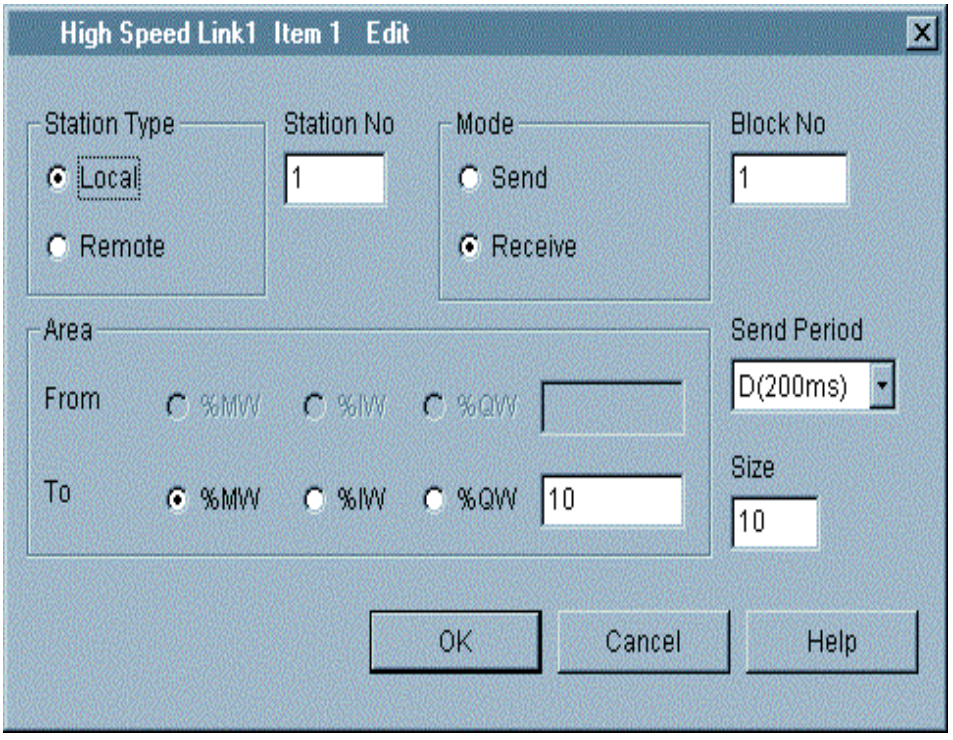
[Figure 7.2.1(A)] Block Diagram of Data Flow

There are 32 block numbers for sending, 32 for receiving in high-speed parameter to send and receive data, and a user can use block numbers by specifying them from 0 to 31 for sending and receiving of data. When sender sends data, it decides only which data it should read, and to which block it should send it without specifying partner station's number. In the example, assuming that the station "0" specifies %MW0 data as the area to be read, sending as mode in its parameter, and then sends data voluntarily through block number "0". On the other hand, the station **"1"** sets receiving as mode, "0" as station number, 0 as block number, and %MW100 as save area in High Speed Link parameter. But, a special attention should be given in this case that receiver should receive the data with the same block number as the sender sent. As the sender can send various

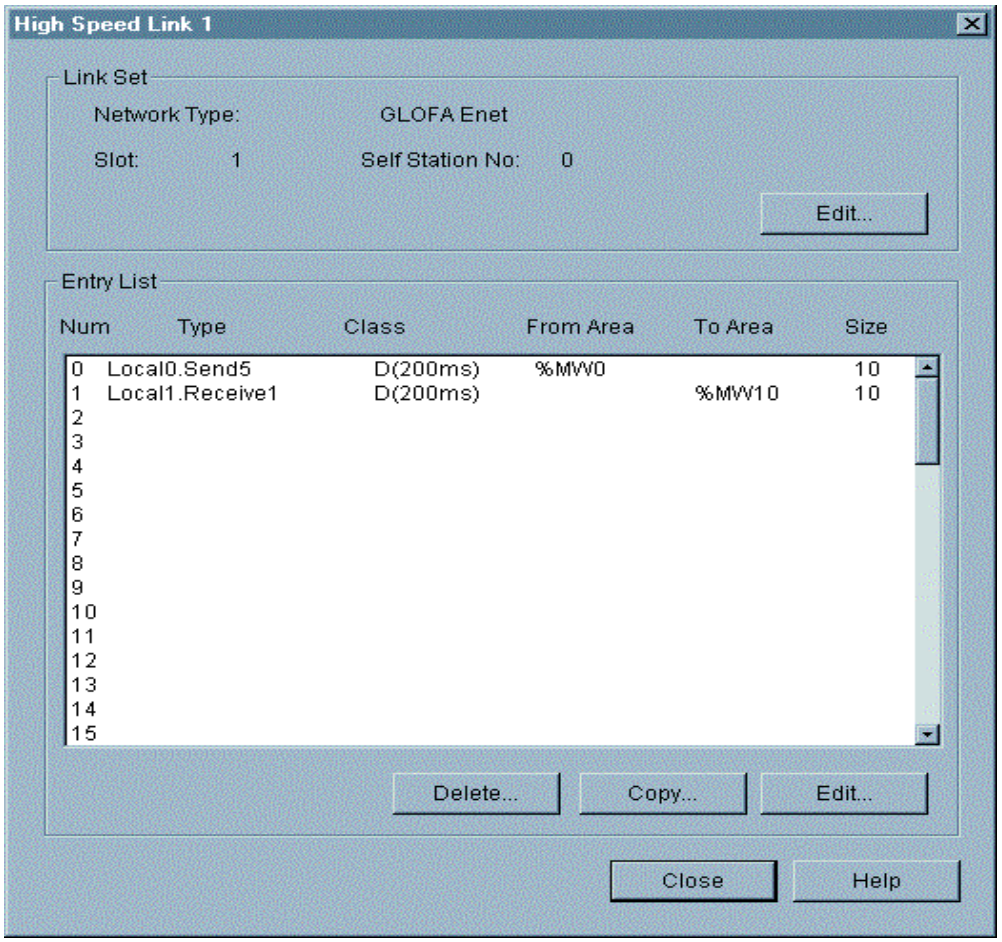
block numbers with various station numbers, the receiver can receive the required data only after he confirms which data of sender is sent in which block, and then sends data through the appropriate block number. On the contrary, the station "1" should only set the data to be sent corresponding to sending setup of the station "0", and the station "0" should only set receiving setup corresponding to that of the station "1".



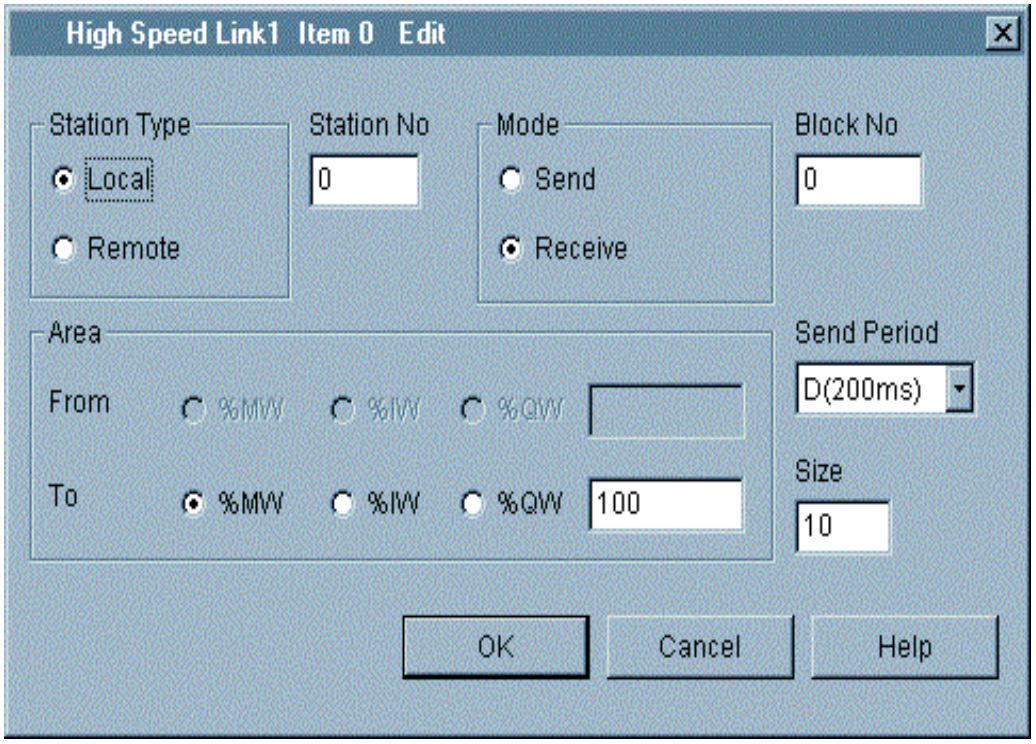
Sending Setup of station " 0"



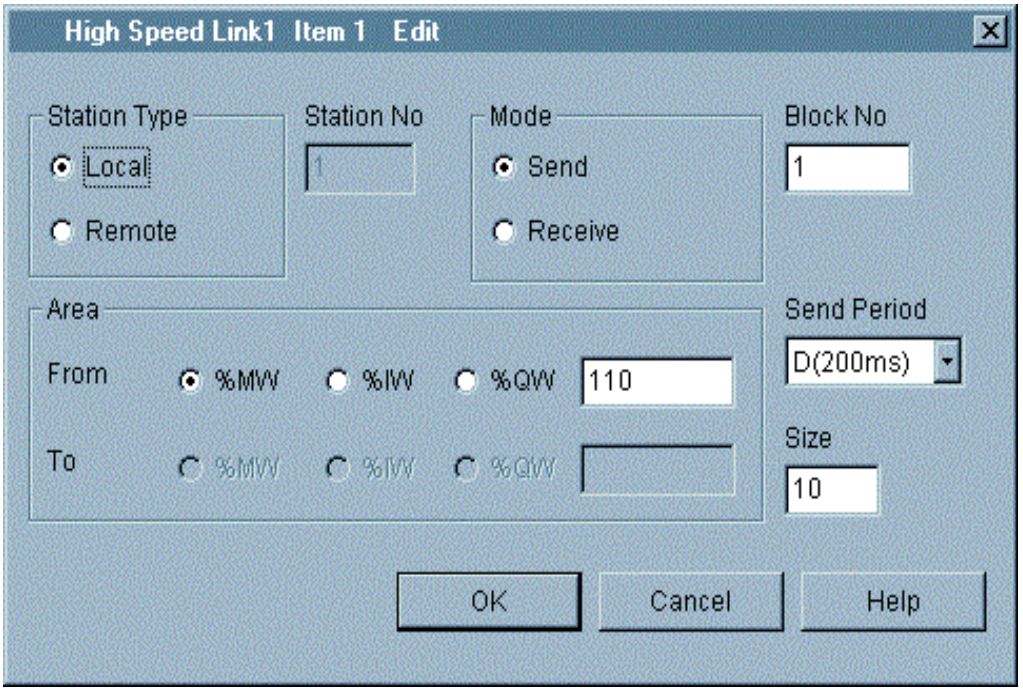
Receiving Setup of Station " 0"



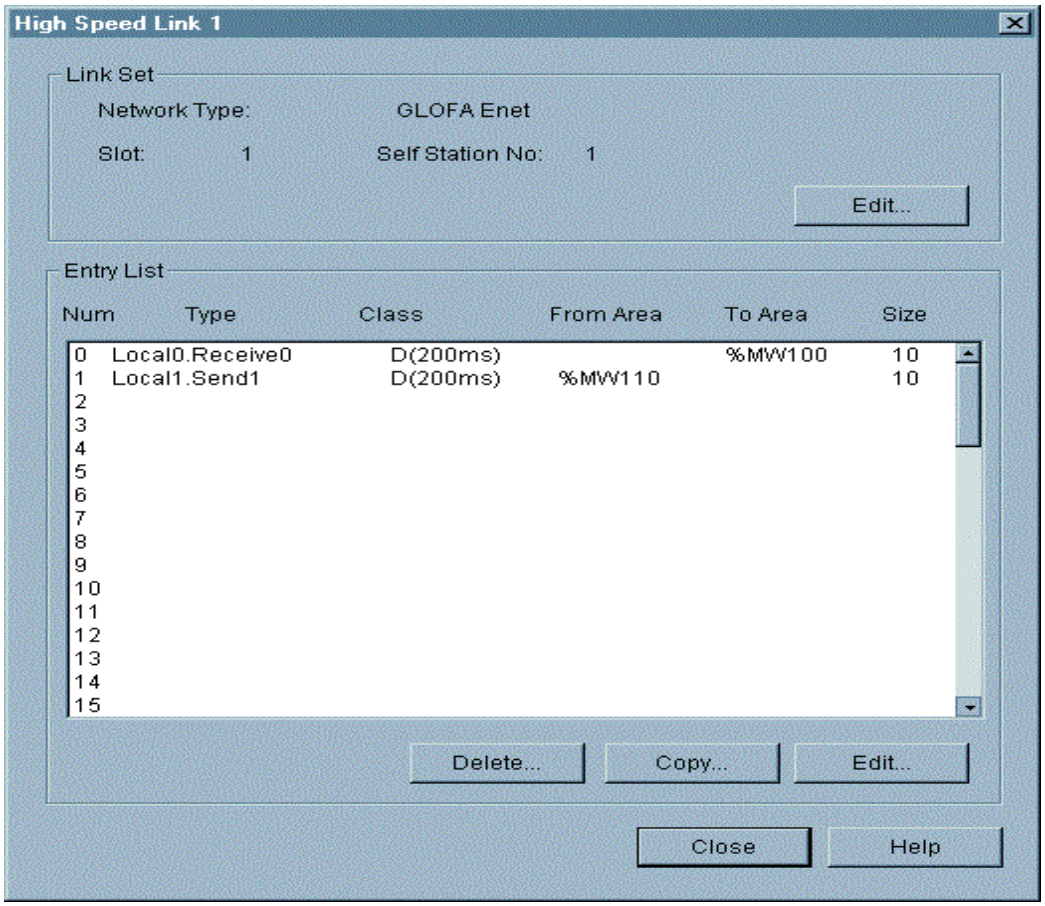
Setup of Sending and Receiving of Station " 0"



Receiving Setup of Station " 1"

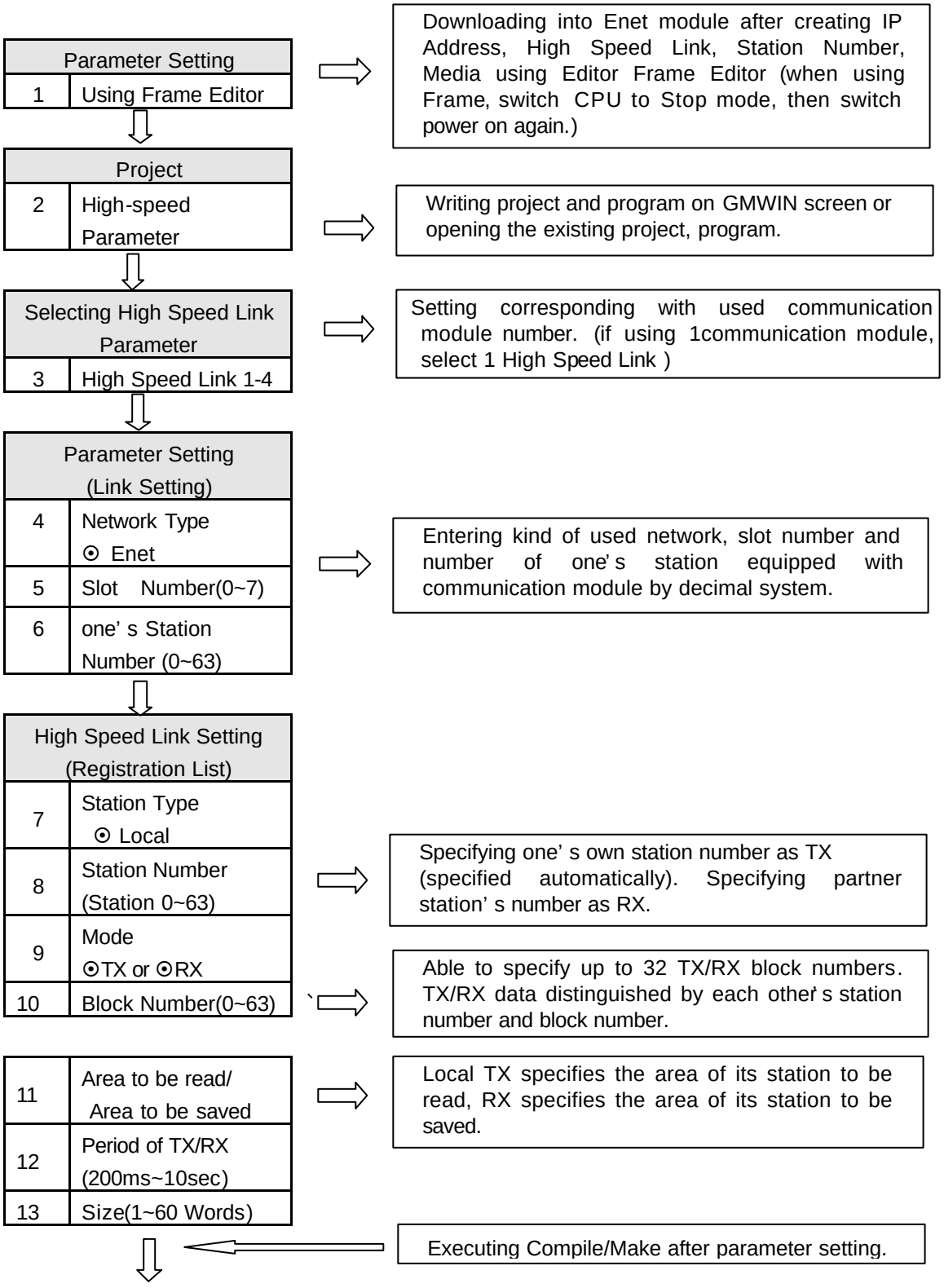


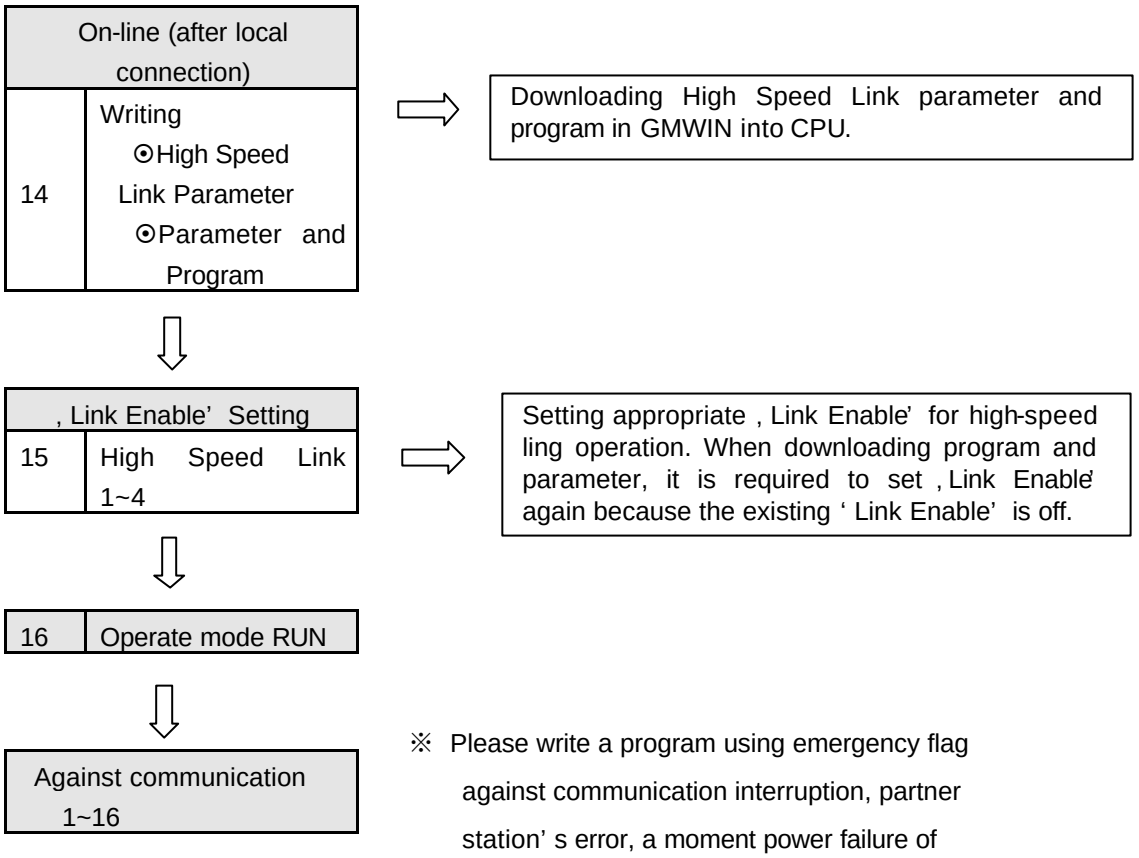
Sending Setup of Station " 1"



Setup of Sending and Receiving of Station " 1"

7.2.2 Operation Order by High Speed Link





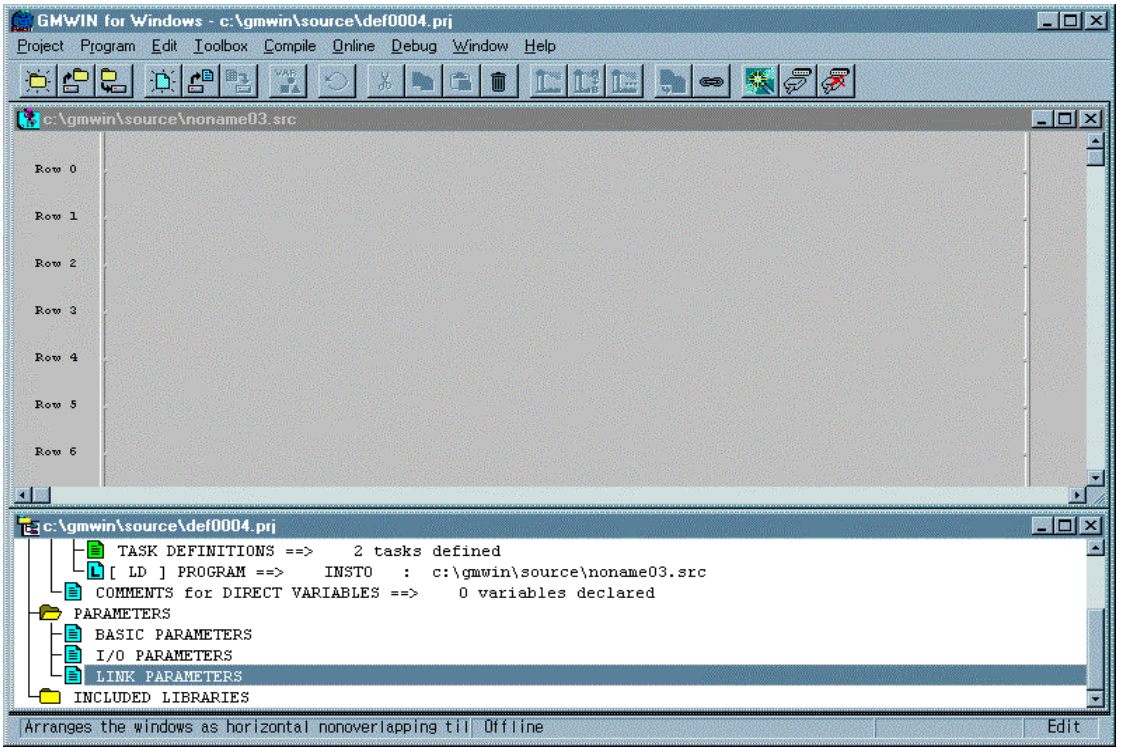
※ Please write a program using emergency flag against communication interruption, partner station' s error, a moment power failure of remote module at time of communication.

7.2.3 Setting High Speed Link Parameter

The High Speed Link parameter sets its appropriate items by selecting link parameter on GMWIN project screen. Setting order and function of each item are as follows:

1) Setting GMWIN Project

If High Speed Link parameter is selected on basic project screen like figure 7.2.3(A). The basic screen of the link parameter like figure 7.2.3(B) appears, and then the appropriate items can be here selected.

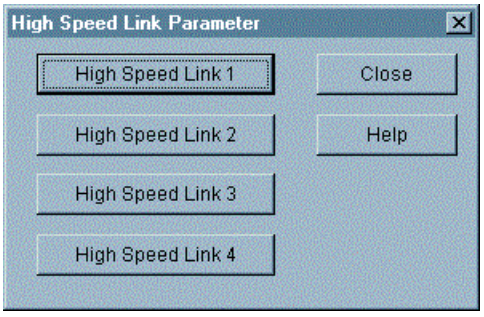


[Figure 7.2.3(A)] Basic Screen of GMWIN Project

2) Selecting Link Parameter

A) Method of Setting

Go into , Setting Parameter' by selecting the appropriate parameter on the basic screen like figure 7.2.3(B).



[Figure 7.2.3(B)] The Basic Screen of High Speed Link Parameter

B) Setting Function

The High Speed Link items of figure 7.2.3(B) means the maximum communication modules to be equipped according to CPU kind of PLC. For example, as GLOFA-GMR/GM1/GM2/GM3 CPU can equip maximum 4 communication modules, it can set High Speed Link 1 to 4. But, as for GLOFA-GM4 CPU, it can equip only maximum 2 communication modules, High Speed Link 1 and 2 buttons are marked with deep color,

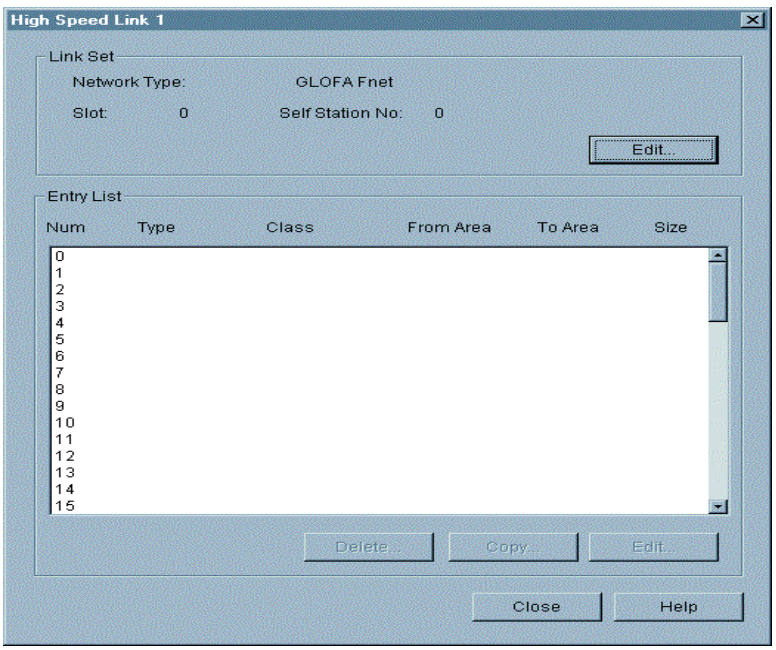
and it is impossible for the rest to set. At this time, the High Speed Link number has nothing to do with equipped slot number, and a user should set slot number on 'Setup' for each parameter, and to set only one High Speed Link parameter for each communication module. Table 7.2.3(A) displays communication device to be equipped and maximum number of equipment for each CPU of GLOFA .

Classification	Communication module to be equipped	Maximum Number of Device to be equipped	Remark
GLOFA-GMR/GM1	G3L-EUEA	4 devices	Able to be equipped with other communication modules.
GLOFA-GM2			
GLOFA-GM3			
GLOFA-GM4	G4L-EUEA	2 devices	

[Table 7.2.3(A)] Relation of Communication Module Equipment by each CPU Device

3) Setting Link Parameter

If you select the appropriate parameter on basic screen for parameter setting in figure 7.2.3(B), initial screen for High Speed Link parameter setting appears like the figure 7.2.3(C).

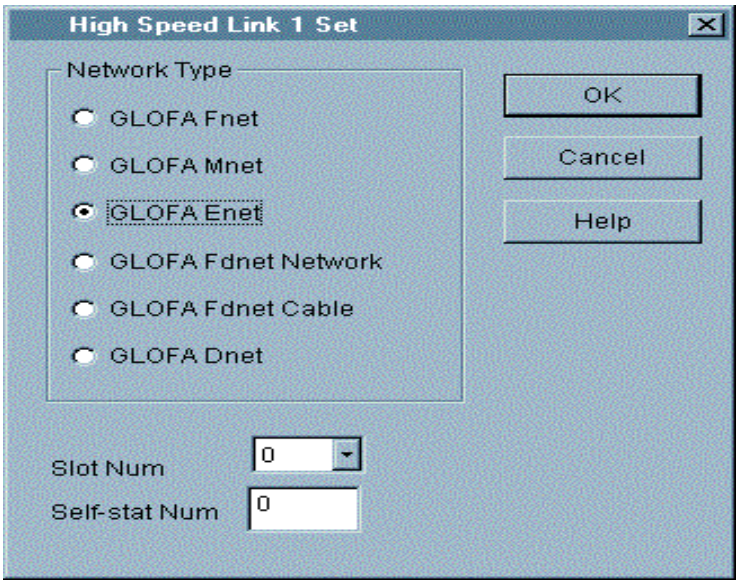


[Figure 7.2.3(C) Initial Screen for Parameter Setting

The initial screen for Parameter setting is composed of ‚Link Setup' and ‚Registration List', and the method and function of setup by each item are as follows.

A) Setting High Speed Link

'Setting High Speed Link' is an item in which you set up the basic item of communication module to be set up in parameter setting, and you select 'Modify' button of link setting in figure 7.2.3(C), and then you should set up module type, slot number, your own station's number respectively in figure 7.2.3(D).



[Figure 7.2.3(D)] Screen for High Speed Link Setting

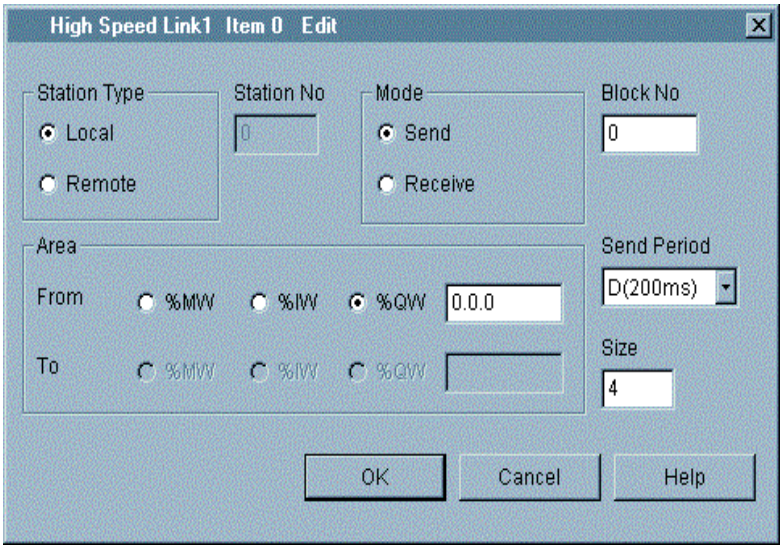
Network Type : You set up the kind of communication module equipped, and should setup Enet.

Slot Number : You set up the position of communication module equipped. (Slot 0-7)

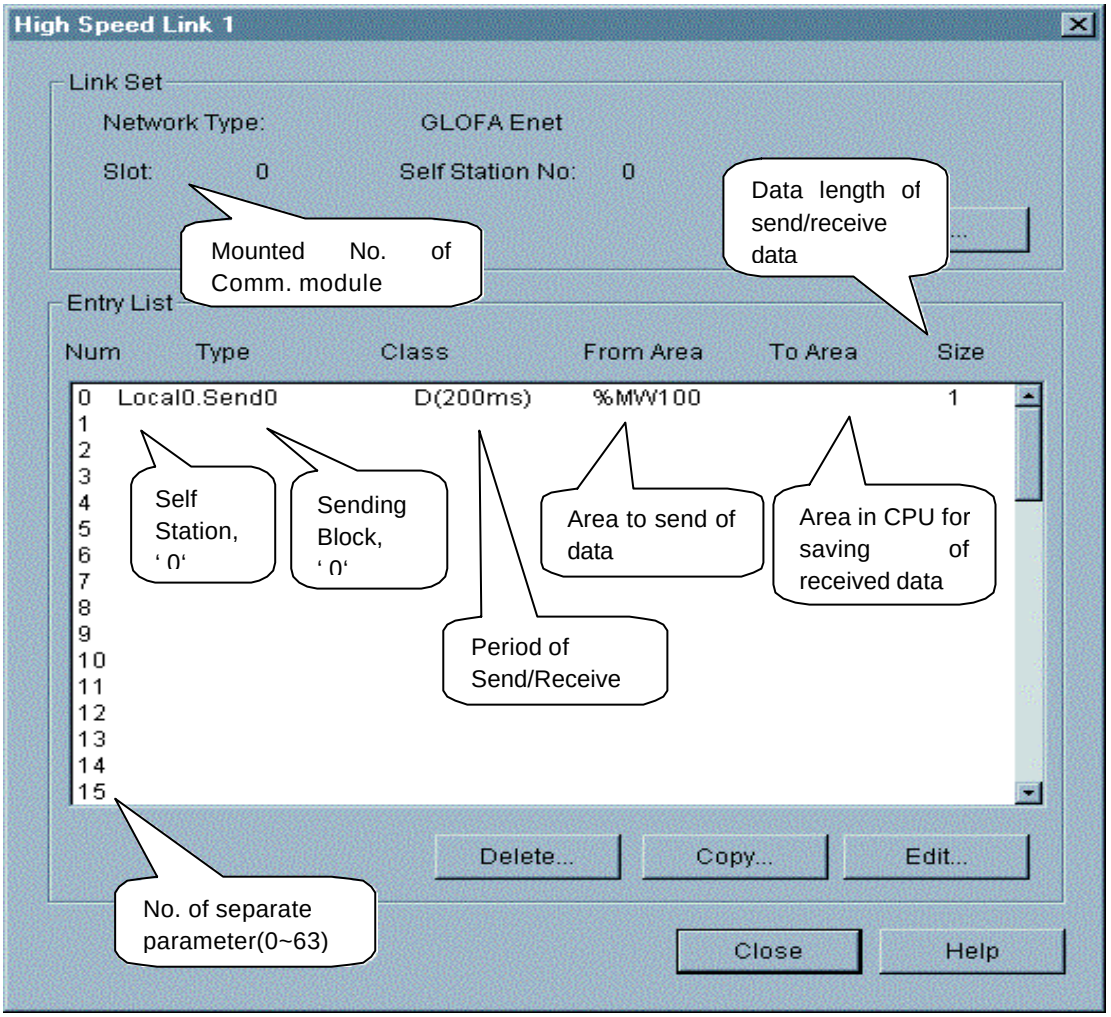
One's Station Number : It has the range of '0' to 63 as station number used for High Speed Link. As one's station number is a proper number, in which it distinguishes communication modules within the same network system, you should not use repeated station number. You also have to use it after you assign station number. (One's station number has to be set up corresponding to the station number for High Speed Link set with frame editor. If not, the station number set with frame editor will be set as the station number for high –speed line).

B) Setting Registration List

Registration List is an area where you register RX/TX information of real data. You should set up from registration number '0' in registration list area after setting link. Major setting items is shown on the upper part of menu of registration list. If an user selects (double click) the appropriate list in the figure 7.2.3(C), he can set up the appropriate item in the 'Modify' window for High Speed Link like the figure 7.2.3(E). The 'b' screen of the figure 7.2.3(E) displays the screen of registration list when TX parameter of local station '0' is set in 'a' screen. You can modify parameter by double click the appropriate registration number on the screen of the figure 7.2.3(E).



a. 'Modify' Screen for High Speed Link Item



b. An Example of Setting Screen for TX Parameter Setting

[Figure 7.2.3(E)] A Screen for Parameter Setting of High Speed Link

The function of each registration items in , a' in the figure 7.2.3(E) is as follows:

- ***Registration Number*** : It means, 0' in, Modify 0 in High Speed Link item 1'. It is also a serial number showing registered order, and you can set 64 from ' 0' to ' 63'. It has nothing to do with the TX/RX order.

- ***Station Type*** : A item, in which you determine the station type you want to perform TX/RX with. Local is set in Enet system.

- ***Station Number*** : When sending data of setting item, you set your station number, and when receiving them, you should set partner station number. When

sending data, your station number is automatically set, and only when receiving them, you have to set the partner station number.

- ***Mode*** : An item, in which you determine the TX/RX possibility of data the appropriate block. **Maximum 32** for each TX/RX can be set, if setting is over 32, an error occurs.

- ***Block Numbe*** : A parameter set to receive and send a lot of data from various area from and to one station, and it also plays a role to distinguish data from a variaty of block. The station number and block number set from sending station is transferred with TX data, and destination station saves appropriate data in receiving area only when the number of station and block set in receiving parameter of High Speed Link are the same each other, you should set the block number with the station number all in RX/TX station. The block number can be set maximum 32 settings from '0' to '31' for each TX/RX toward one station. When setting block number, **you should not set a variety of the same block numbers toward the same station number.**

- ***Area*** : When sending data, you set an area where you read data to be sent. when receiving them, you set an area where you save the data sent. Table 7.2.3(B) shows the area to be set.

Mode / Station type		TX			RX			Remark
		%IW	%QW	%MW	%IW	%QW	%MW	
Local	Area to be read	O	O	O	X	X	X	Area is CPU memory
	Area to be saved	X	X	X	O	O	O	It means the area.

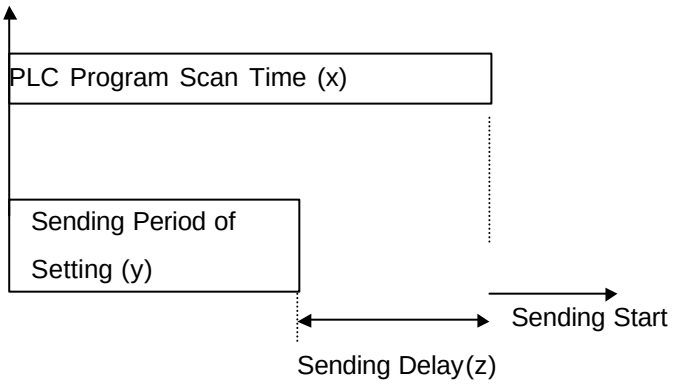
[Table 7.2.3(B)] Setting Area According to the Station Type

- ***Size*** : It means the size of data to perform TX/RX. Its unit is 1 word (16 dots). You can set maximum 200 words for Enet system. In case that data size set from the receiving mode is smaller than the sent data, only the set size can be saved in the saving area. Therefore, you can use by receiving selectively the necessary ones of the data sent from sending station.

- ***TX/RX Period*** : The High Speed Link is a service, that performs TX/RX at the very time of end of PLC program set by user. Thus, when the time of PLC program scan is short like within several ㎳, communication module transfers data according to the program scan, and the increase of

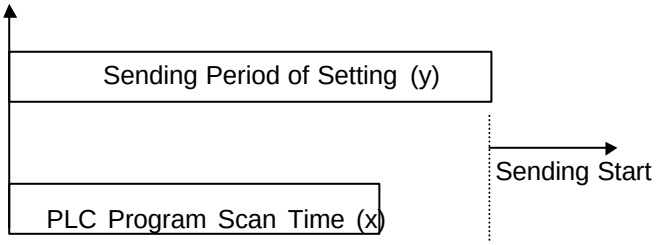
communication volume due to that cause lowering of efficiency for whole communication system. To avoid it, it enables a user to set RX/TX period, and the range of setting is minimum 200㎳ to maximum 10sec. When you do not set, the basic value of 200㎳ is set automatically. TX/RX period means sending period when the appropriate block is set as sending, otherwise, when it is set as receiving, it means period of checking period of data receiving of the appropriate block.

Sending period is parameter that determines the period of data transferring. For example, the sending data set with its basic value of 200㎳ is sent once per 200㎳. If PLC program scan time is longer than the set sending period, it is sent at the time of the end of PLC program scan, and sending period becomes the same as the scan time of PLC program. [Figure 7.2.3(F)].



Sending Delay Time : (z = x - y) ㎳

a. Delay time of sending data when PLC program scan is longer than sending period.



Sending Delay time : (z = 0) ㎳

b. Delay time of sending data when PLC program scan shorter than sending period.

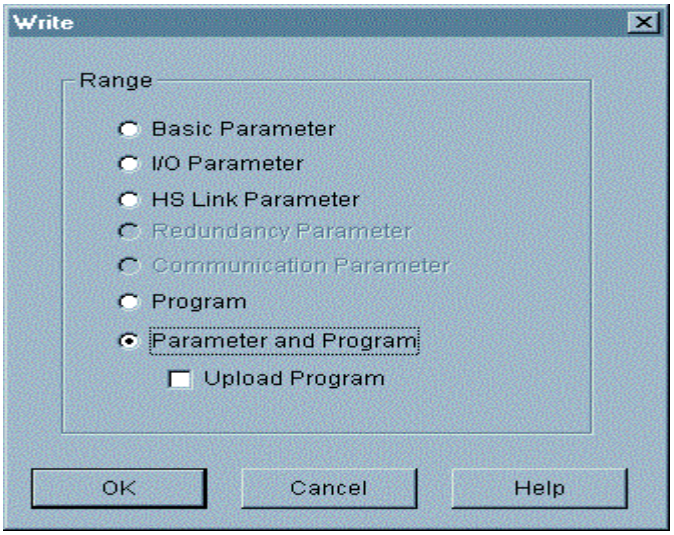
[Figure 7.2.3(F)] PLC Program Scan and sending Period

In case of data sending, when the appropriate block data is received on the set time, the appropriate TRX_MODE flag of link information should be on, and if not, it should be off, then, it makes run-link and link trouble contact. Therefore, you can check whether data are sent normally even after you set above the sending period of the appropriate block set from partner station. TX/RX time becomes different from the total amount of number of block for High Speed Link setting and volume of TX/RX data per block and the total amount of communications such as communication stations of network, let alone the time of PLC program scan. Therefore, if you set TX/RX period, you should set them referring to ‘Speed Calculation of High Speed Link’ in Chapter 7.2.6.

7.2.4 Operation of High Speed Link

After High Speed Link parameter is set, you can start high-speed service by downloading parameter with PLC CPU parameter. If you have changed High Speed Link parameter, first execute 'MAKE' from 'Compile' menu of GMWIN, and start High Speed Link after downloading parameter.

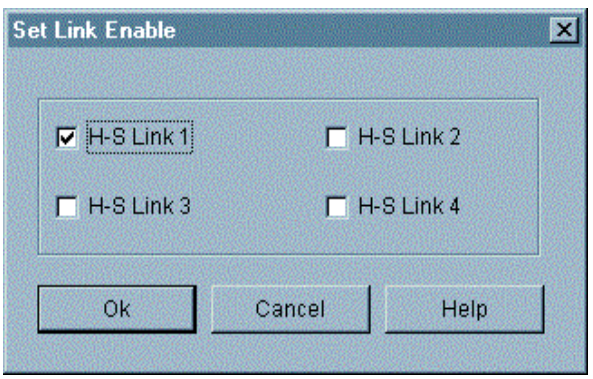
1) Parameter Download



[Figure 7.2.4(A)] Parameter Download Screen

A user should save high-speed parameter edited by him in project file of GMWIN. If you select 'Writing' after you are connected with PLC in on-line of MWIN main menu, the 'Writing' screen of figure 7.2.4(A) appears. If you download parameter by selecting High Speed Link parameter or parameter and program in the figure, the parameter is downloaded with program or alone. At this time, 'LINK Enable' as operation information of High Speed Link becomes off. Therefore, if the program is downloaded, you must turn on again the appropriate parameter in the setting of 'Link Enable'.

2) Operation of High Speed Link



[Figure 7.2.4(B)] Link Enable Setting

If parameter download is finished, and if you set ‘Link Enable’ of on-line menu of GMWIN, ‘Link Enable’ command is delivered into PLC, and now, it is ready for operation

It is only possible for you to set, Link Enable’ only at stop mode of PLC. If the High Speed Link is operated by setting ‘Link Enable’, you can perform High Speed Link without any relation with PLC action mode, parameter and information of ‘Link Enable’ is backed up in PLC CPU. Therefore, data will be kept at the power failure. Table 7.2.4(A) is describing the relation of PLC mode and High Speed Link action.

Classification	Parameter Download	Link Enable Setting	High Speed Link Action	Remark
PLC Run	X	X	O	It is acting only at the time of ‘High Speed Link Enable’.
PLC Stop	O	O	O	
PLC Pause	X	X	O	
PLC Debug	X	X	O	

[Table 7.2.4(A)] Relation of PLC mode and High Speed Link

7.2.5 High Speed Link Information

1) High Speed Link Information Function

As High Speed Link service performs data exchange between more than 2 communication stations, it offers you the method to confirm the High Speed Link service status as High Speed Link information. With this, you can confirm the reliability of data read from partner station through the High Speed Link. That is, communication module offers you the information by High Speed Link whether the High Speed Link is acting with the parameter set by you at the fixed time after putting together the data collected till that time. Link information consists of the followings: Run-Link (_HSxRLINK) with which you are able to know whole information of communication network; individual information such as _HSxSTATE, _HSxTRX, _HSxMOD, _HSxERR, which informs you whole information of Link Trouble (_HSxLTRBL) and communication status by 64 registration lists within parameter. You can use the above information in form of keyword when editing program, and monitor the status of High Speed Link using its information monitor. When you operate a variety of PLC by using the High Speed Link, you should use it after you confirm reliability of TX/RX data by using High Speed Link information such as Run-Link and Link Trouble. Table 7.2.5(A) shows function and definition of High Speed Link information.

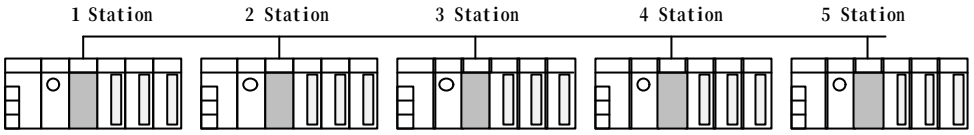
Classification	Run-Link	Link-Trouble	RX/TX Status	Action Mode	Error	High Speed Link Status
Information kind	Total Information	Total Information	Individual Information	Individual Information	IndividualInformation	Individual Information
Keyword Name (x=HS_Link Number)	_HSxRLINK	_HSxLTRBL	_HSxTRX[n] (n=0..63)	_HSxMOD[n] (n=0..63)	_HSxERR[n] (n=0..63)	_HSxSTATE[n] (n=0..63)
Data Type	Bit	Bit	Bit-Array	Bit-Array	Bit-Array	Bit-Array
Available Monitor	Possible	Possible	Possible	Possible	Possible	Possible
Program Use	Possible	Possible	Possible	Possible	Possible	Possible

[Table 7.2.5(A)] High Speed Link Information

A) Run-Link (_HSxRLINK)

Total Information showing whether the High Speed Link is normally operated by the parameter by you. It is also a kind of contact containing ' On' status till ' Link Enable' is turned off once it is turned on. It is turned ' On' under the following condition.

① When , Link Enable' is ' On' .
② When registration list setting of parameter is normally set.
③ When All the data in the registration list of parameter is sent and received corresponding to the ser period.
④ When the status of all the partner stations set in parameter is in ' RUN' and there is no error at the same time.



(a) Configuration of High Speed Link System

Station 1	Station 2	Station 3	Station 4	Station 5
TX: 2 Words RX: 2 Words (2 stations) RX: 2 Words (3 Stations)	TX: 2 Words RX: 2 Words (1 station) RX: 2 Words (4 stations)	TX: 2 Words RX: 2 Words (1 station) RX: 2 Words (5 stations)	TX: 2 Words	TX: 2 Words

(b) An Example of Parameter Setting of High Speed Link of Each Station

[Figure 7.2.5(A)] Condition of Run-Link On

Figure 7.2.5(A) is showing a configuration example of High Speed Link system to describe the condition of ' Run-Link On' . If 5 communication modules are connected with network such as ' a' of the figure 7.2.5(A), and are in the the High Speed Link status with the parameter contents such as the figure ' b' , the condition of ' Run Link O' in one station is as follows:

① When Link-Enable is , On' in one' s station (1 station).
② When One' s station (1 station) is in , RUN' status.
③ When One' s station (1 station) is not in the error status.
④ When TX parameter data set in one' s station (1 station) is sent corresponding to the TX period.
⑤ When Data received from the station 2,3 are received corresponding to the RX period.
⑥ When the action modes of partner station (station 2, 3) sending data to one' s station are

in , RUN' mode, and are not in error status, and performs communication corresponding to the RX/TX period.

⑦ When Other partner stations' (station 4, 5) action modes set in the partner station' s parameter (station 2, 3) of ones station (station 1) are in , RUN' mode, and are not in error status, and performs communication corresponding to the RX/TX period.

If all the conditions meet the qualification, RUN-Link of one' s station is , On' . If you use RUN-Link contact in connection of program in the system, in which PLC of several stations are operating connected with each other through High Speed Link, you can conduct the mutual monitoring of data sent received and reliable communication. But, once ' RUN-Link' contact is ' On' it contains ' On' till Link-Enable is ' Off' . Therefore, if you monitor of abnormal status like communication error, you should use information contact of link trouble of the following item together.

B) Link-Trouble (_HSxLTRBL x=High Speed Link Number (1~4))

A total information displaying whether High Speed Link is normally operated by the parameter set by you as a user. It becomes ' On' if RUN-Link is not under the condition of ' On' , and if it is recovered in the status of ' On' , it becomes ' Off' .

C) RX/TX Status (_HSxTRX[0..63] x=High speed Link Number (1~4))

Individual information showing action status by registration list of High Speed Link parameter, and also showing maximum 64 of RX/TX information by registration list. If RX/TX action toward registration item is done corresponding to RX/TX period, appropriate ' Bit' becomes ' On' , if not, it becomes ' Off' the other way,

D) Action Mode (_HSxMODE[0..63] x=High Speed Link Number (1~4))

Individual information showing action status by registration list of High Speed Link parameter, and also showing maximum 64 of action mode information by registration list as maximum registration numbers. If the station set in the registration item is in ' Run' mode, appropriate ' Bit' becomes ' On' , if it is in Stop/Pause/Debug mode, it becomes ' Off' .

E) Error (_HSxERR[0..63] x=High Speed Link Number (1~4))

Individual information showing action status by registration list of High Speed Link parameter, and also showing maximum 64 error information by registration list as maximum registration number. The ' Error' displays the status overall, in which PLC does not perform user program normally. ' Off' means that partner station' s PLC is normally acting, and ' On' means that the partner station

is in the abnormal status.

F) High Speed Link Status (_HSxSTATE[0..63] x=High Speed Link Number (1~4))

Individual information showing action status by registration list of High Speed Link parameter, and also showing maximum 64 High Speed Link status by registration list as maximum registration number. That is, if RX/TX status of the appropriate list is normal, and action mode is in ' Run' status, and there is no error, it becomes ' On. But, if not, it becomes ' Off' .

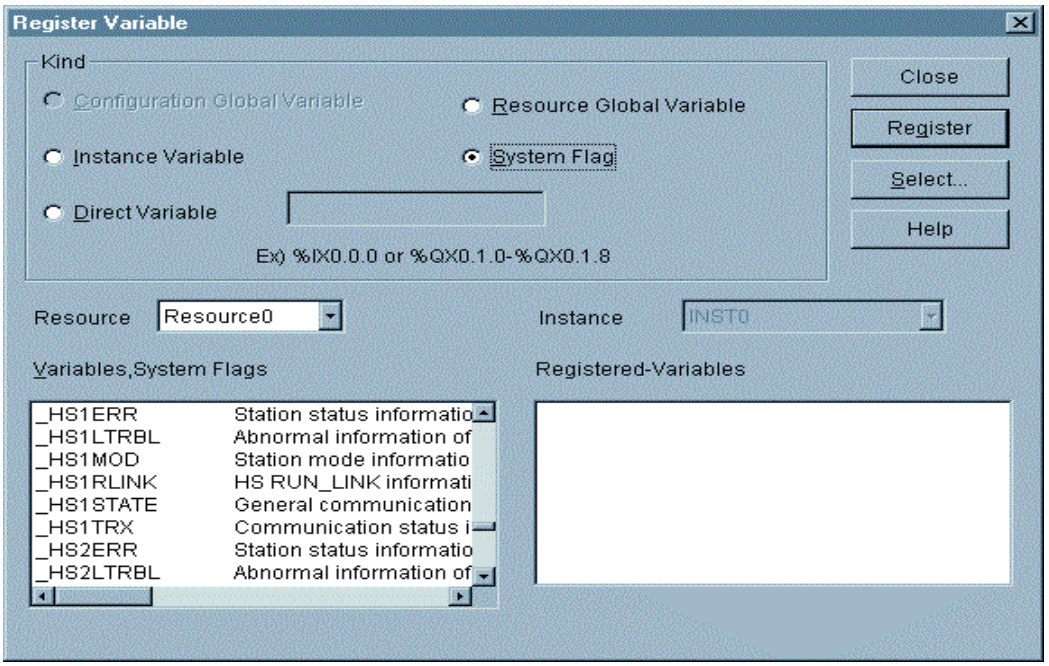
2) Information Monitor of High Speed Link

You can monitor the High Speed Link information using monitoring function after on-line connection to GMWIN. There are two ways to do it: To select variable monitor from the monitoring menu and to monitor link parameter.

A) Variable Monitor

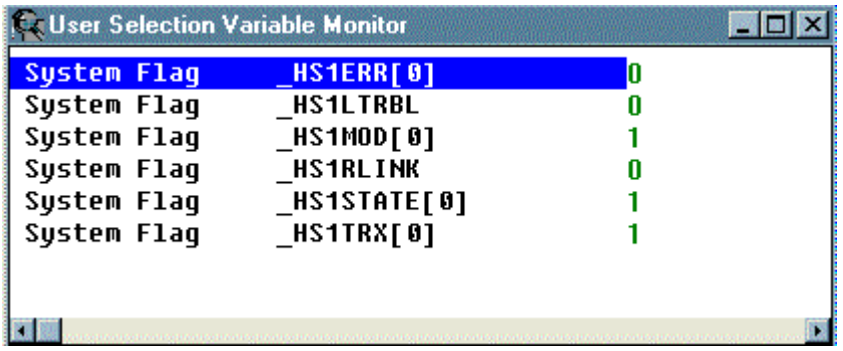
Variable Monitor is a function to monitor only by selecting the necessary items by means of GMWIN flag monitor function. If the variable registration screen like figure 7.2.5(B) appears after selection of variable monitor from on-line monitor item, you can select , Flag' and then register directly each high-speed information flag from the list of variable and flag registration. At this time, as _HSxSTATE[n], _HSxERR[n], _HSxMOD[n], _HSxTRX[n] are flags for , Array' type, you should select directly the array number, and the array number means the registration number within parameter. ' x' means High Speed Link number. It has the range of 1 ~ 4 at GM1/2/3 PLC CPU, and 1 ~ 2 at GM4 PLC CPU, and only number 1 is valid at GM5 PLC CPU.

If you select , Close' in the figure 7.2.5(B) after variable registration. A monitor screen of the figure 7.2.5(C) appears, and then you can monitor by pressing ' Start' from the tool box displayed on the right separately.



[Figure 7.2.5(B)] Screen for Variable Registration of High Speed Link Information

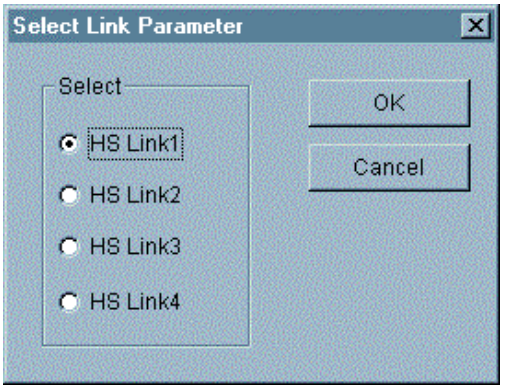
the figure 7.2.5(C) shows monitoring results by monitoring the first parameter of High Speed Link 1.



[Figure 7.2.5(C)] Monitoring Screen for High Speed Link Information (Variable Registration)

B) Link Parameter Monitoring

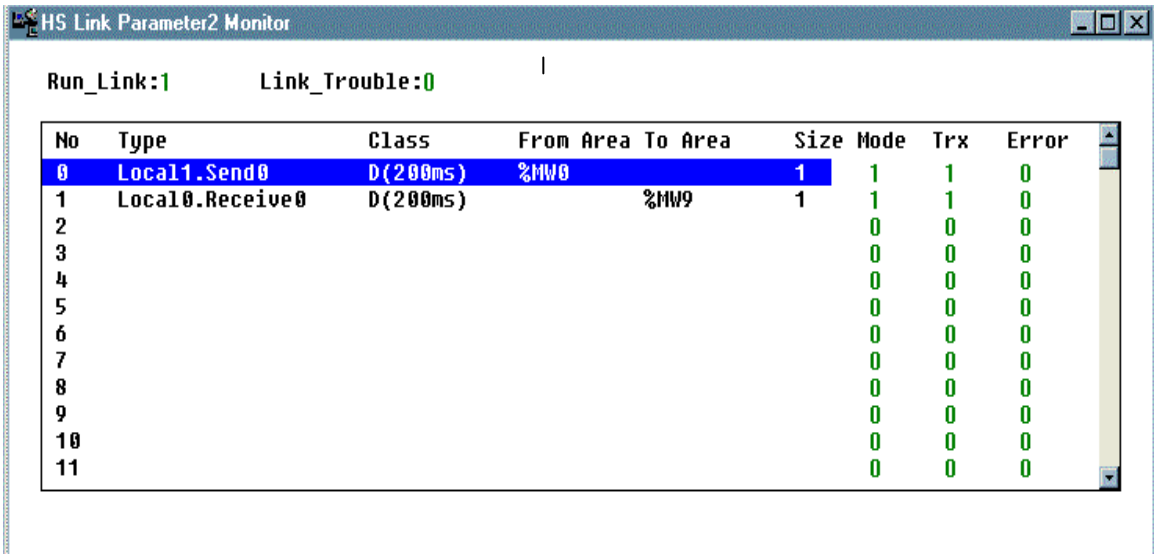
If you select link parameter item from monitoring menu of on-line connection of GMWIN, a screen for selection of link parameter like figure 7.2.5(D) appears. If you click ‘OK’ by selecting the item you want among the parameters set by you, a screen for monitoring high-speed parameter like the figure 7.2.5(E) is open, and the set registration list is showing with it monitored.



[Figure 7.2.5(D)] Screen for Selection of Link Parameter

In link parameter monitoring, total information of RUN-Link, Link Trouble is displayed on the screen top like in figure 7.2.5(E), mode (action mode), communication (RX/TX status), individual information of error are displayed with registration number as many as set numbers.

The figure 7.2.5(E) is showing monitoring screen after you have set 5 High Speed Link parameters to parameter number.



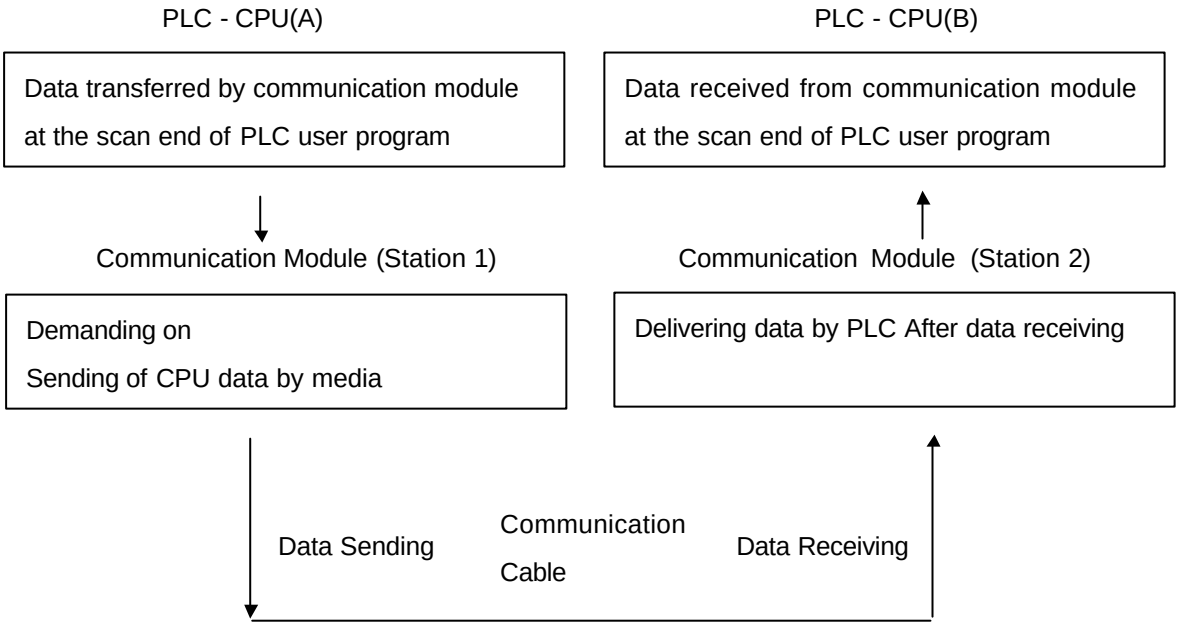
[Figure 7.2.5(E)] Monitoring Screen of High Speed Link Parameter

The High Speed Link parameter set by you and information are all monitored after you have selected High Speed Link information like in the figure 7.2.5(E). So, you can monitor High Speed Link status with I/O data because set individual information value is monitored together.

7.2.6 Speed Calculation of High Speed Link

1) Introduction

The transfer rate of High Speed Link data can be fixed according to various factors. That is because the data of a block go through the same path like the figure 7.2.6(A) till they are saved in the RX area of other stations after they are sent from a station.



[Figure 7.2.6(A)] Data Transfer Path by Communication Module

If you want to send data to other stations using communication like in the figure 7.2.6(A), they go through 3 paths. The spent time on each path is crucial for sending time.

Table 7.2.6(A) shows major path of data transfer and the crucial factors influencing on time by each path.

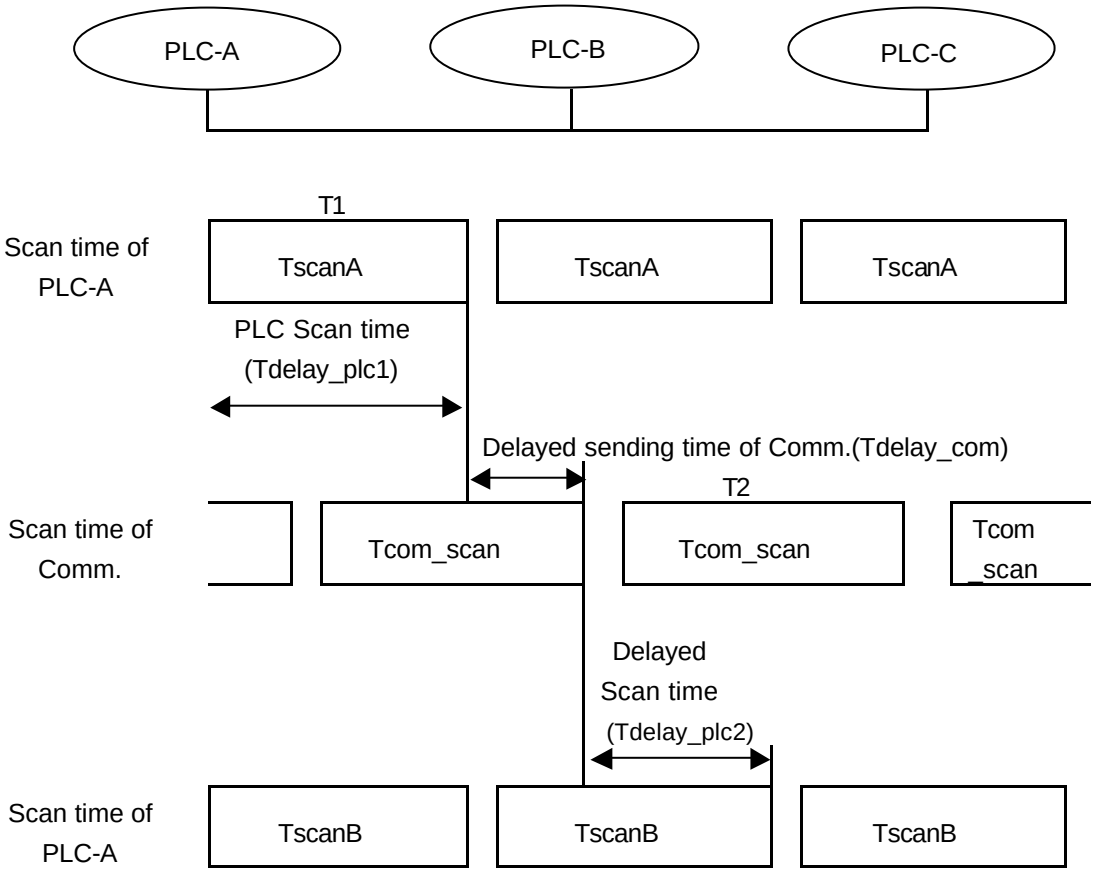
Item	Path	Factor Iinfluencing on Time
1	PLC CPU(A) → Communication Module (Station 1)	Program Scan Time of PLC-A
2	Communication Module (Station 1)→ Communication Module (Station 2)	Communication Scan Time+Communication O/S Scan Time
3	Communication Module (Station 2) → PLC CPU(B)	Program Scan Time of PLC-B

[Table 7.2.6(A)] Data Transfer Path and Time Factor

Data transfer from PLC CPU to communication module or from communication module to PLC CPU is done at the finish time of PLC user program, scan time of PLC user program becomes a crucial factor for data transfer. If you select ' PLC Information' of on-line menu of GMWIN, you are able to know the maximum, minimum and current time of program scan. Furthermore, if

communication module wants to send its data, it must perceive free time of communication cable, and it is fixed according to IEEE standards 802.3.

The figure 7.2.6(B) shows point of sending time according to PLC program scan time and communication scan time.



[Figure 7.2.6(B)] Relation between PLC Scan Time and Communication Scan Time

In the figure 7.1.6(B), PLC-A station transfers TX data by means of communication module at T1, and it is a point of time when the program of PLC-A is finished. Therefore, the time is delayed as much as delay_plc1. Communication module can transfer data after waiting for the communication

scan delay time (Tdelay_com) after it receives data from PLC. It can be delayed as much as Tcom_Scan1 for the longest time delay. In PLC-B as well, as communication module transfers received data after waiting for 2 hours (Tdelay_plc2) to PLC, delay factor as much as maximum Tscan2 comes into existence. Like the figure 7.2.6(A) and figure 7.2.6(B), Communication delay time is fixed according to a variety of fluents such as total number of communication stations, program volume OS scan time of communication module. As it is difficult to calculate the value of such fluents, a method is presented here for a user to calculate easily.

2) Method of Speed Calculation of High Speed Link

You define High Speed Link as the maximum time spent by a block of data from PLC-A to PLC-B using an example of the figure 6.2.7(B). You calculate as follows after you group speed calculation of High Speed Link into a complicated system, in which sending data numbers of more than 10 communication stations are over 512 bytes, a simple system, in which as there are less than 10 communication stations, sending data numbers are under 512 bytes.

A) Simple System

You can calculate speed calculation of High Speed Link using the simple calculation system like the formula 7.2.6(A), in which total number of communication stations is under 10, and total volume of sending data is under 512 bytes.

St = P_ScanA + C_Scan + P_ScanB ---------- [Formular 7.2.6(A)]

(St = maximum transfer time of High Speed Link
P_ScanA = maximum program scan time of plc A
P_ScanB = maximum program scan time of plc B
C_Scan = maximum communication scan time)

Using formular 6.1, C_Scan can be got with the following simple formular.

C_Scan = Th × Sn ---------- [Formular 7.2.6(B)]

(Th = Time of data transfer from a media per 1 station (IEEE standards 802.3)
Sn = Total Station Number : Total Communication Number)

B) complicated System

You can calculate speed calculation of High Speed Link using the complicated calculation system like the formula 7.2.6(C) in which total number of communication stations is over 10, and total volume of sending data is over 512 bytes.

St = Et ×To ×Ntx + Mf ----------[Formular 7.2.6(C)]

{ Et = Effective Tx Ratio(Effective Transfer Ratio)

To = Octet time (Transfer Time of 1 Byte)

Ntx = Total Tx number

Mf = Margin Factor}

Each term is determined as follows:

① Et = St × Nf ---------- [Formular 7.2.6(D)]

{St = Total Communication Station Number

Nf = Constant Value as Network Factor according to Communication System Characteristics, and 1.5 in Enet System}

② To = {Octet time. Spent time when 1 byte of data is transferred through serial data. Its value is as follows}

- Enet : 0.8 ㎲}

③ Ntx = It means total TX data number, and it is calculated including variables service number. It is determined as follows.

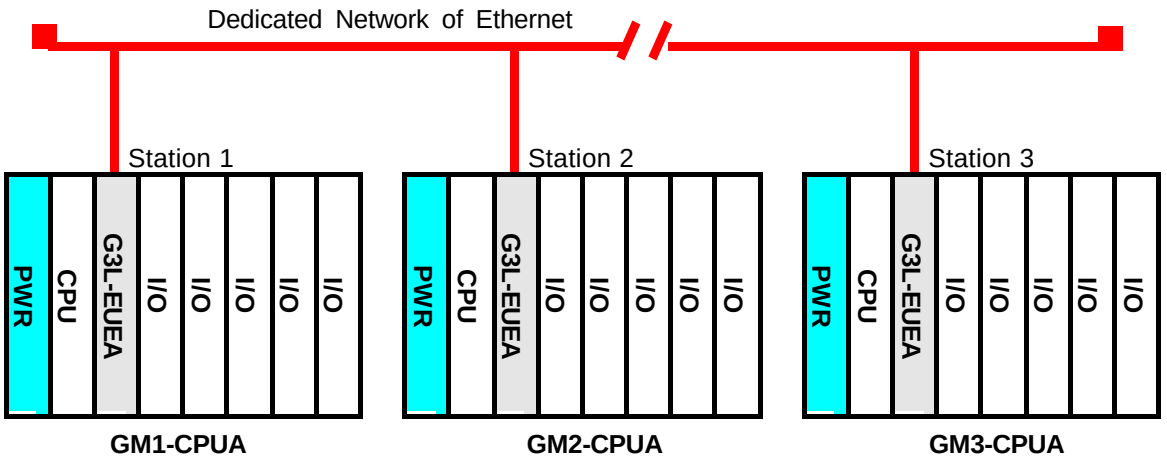
- Enet : Sum of TX bytes number of High Speed Link + FB + Service data number of one' s station × 1,024

④ Mf = Margin factor. It is namely margin value for factors not expressed by above formulas such as O/S scan time of communication module, and it is determined as follows.

- Enet : 25 ㎳

7.2.7 An Example of High Speed Link between PLC of Enet

Setting method of High Speed Link parameter is here described to perform data communication through I/O structure like table 7.2.7(A) in the GLOFA Enet system below.



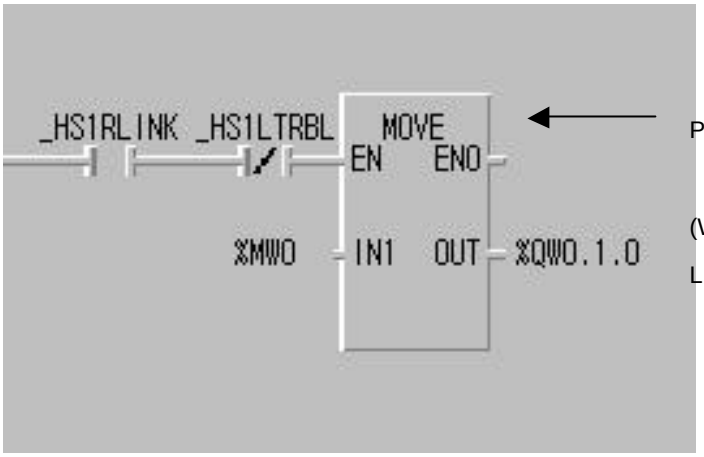
[Figure 7.2.7(A)] I/O Structure and RXTX Data

Structure of TX/RX		I/O Structure (All Stations are equal)	TX Area	RX Area
GM1	TX	Slot 0 : Enet Slot 1 : Output 32dots Slot 2 : Input 32 dots	%IW0.2.0(4Word)	--
(Station1)	RX : <-- GM2		--	%MW0(4Word)
GM2	TX		%IW0.2.0(4Word)	--
(Station2)	RX : <-- GM3		--	%MW0(4Word)
GM3	TX		%IW0.2.0(4Word)	--
(Station 3)	RX : <-- GM1		--	%MW0(4Word)

[Table 7.2.7(A)] I/O Structure and TX/RX Data

In the example, GM1/2/3 CPU all send 4 words as input value of slot number 2, and they output data sent from partner station with output module of slot number 1 after saving them in %MW0. Parameter configuration of High Speed Link and program to exchange data as above are described in the figure 7.2.7(B) and figure 7.2.7(C). The figure 7.2.7(B) is an example to ‘MOVE’ data saved in %MW0 to %QW0.1.0 using monitoring flag of High Speed Link RX/TX.

A) Editing User Program



[Figure 7.2.7(B)] User Program for the Example (GM1/2/3 are common)

The figure 7.2.7(B) is a program of example 1. It allows the system to output RX data, %MW0, through output module of slot number 1 when the High Speed Link is normal (_HS1RLINK=1,_HS1LTRBL=0). If you use the program in mixing with the information of Run-Link and Link Trouble like the figure 7.2.7(B), you can raise reliability of your work.

B) Setting Parameter of High Speed Link

In the system like the figure 7.2.7(A), you, as a user, should edit a map for RX/TX data like the table 7.2.7(A) after writing first a user program like the figure 7.2.7(B) in order to allow stations 1,2,3 to exchange data like the table 7.2.7(A). You also have to edit parameter of High Speed Link, and then you should download with PLC to send and receive data like the table 7.2.7(A). You are able to start the High Speed Link according to the following order.

① Download station number and parameter (using frame editor), Connect communication cable.
② Edit user program (for each station).
③ Editing a map to send and receive data.
④ Set parameter in , Setting High Speed Link parameter' of GMWIN.
⑤ Perform , Compile' and , Make' in compile menu.
⑥ Execute , Writing program and parameter' in on-line menu.
⑦ Set , High Speed Link Enable' corresponding to the setting number by selecting , Link Enable' in on-line menu.

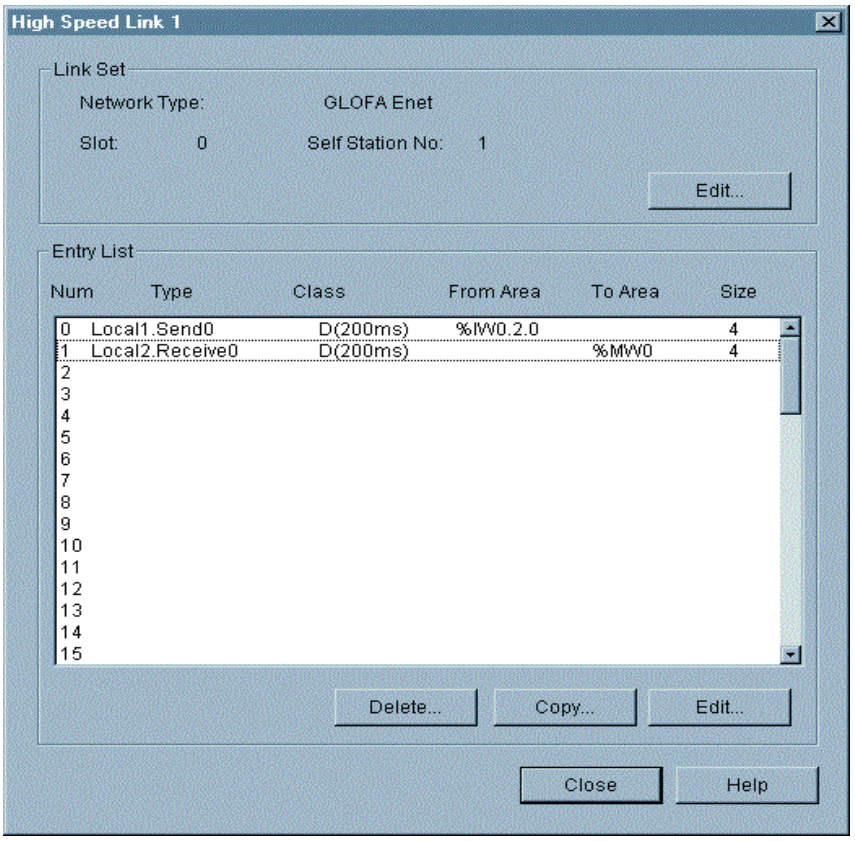
⑧ Change mode into , Run' in on-line menu.

⑨ Check for High Speed Link status through link parameter monitor.

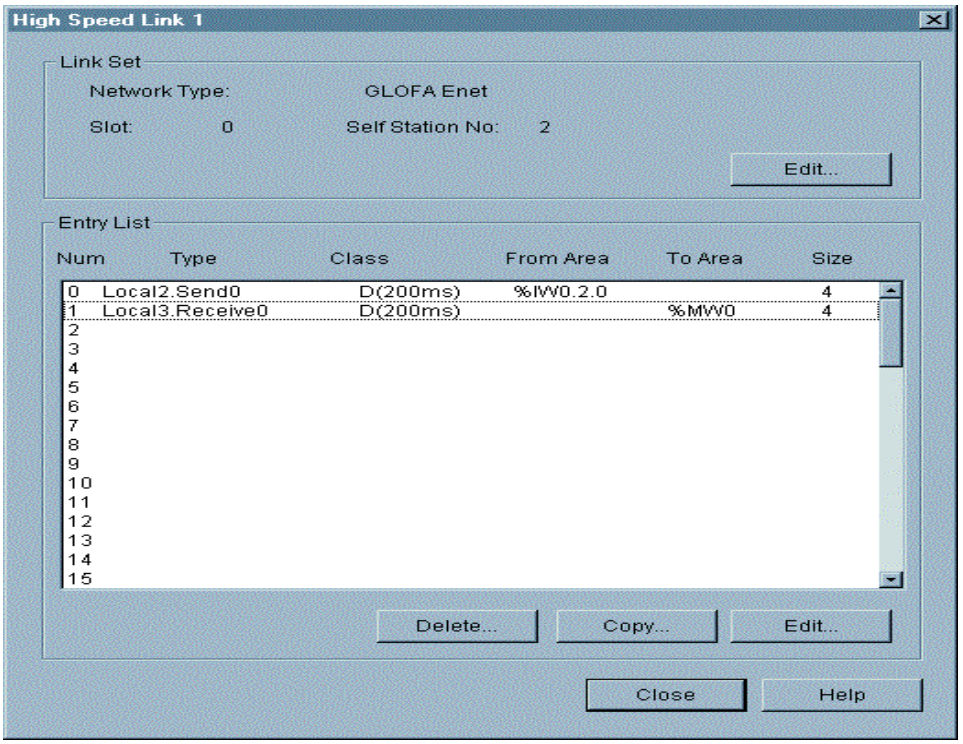
⑩ If an error occurs, repeat the procedures from the number 1.

Parameter of the High Speed Link for the example system is set as follows. You set basic item by selecting 'Modify' of link setting on the screen of High Speed Link setting like the figure 7.2.7(C). First, set module type as 'GLOFA Enet', and select 'OK' after setting installation position of Enet module and station number of the High Speed Link, and then complete the setting of the High Speed Link.

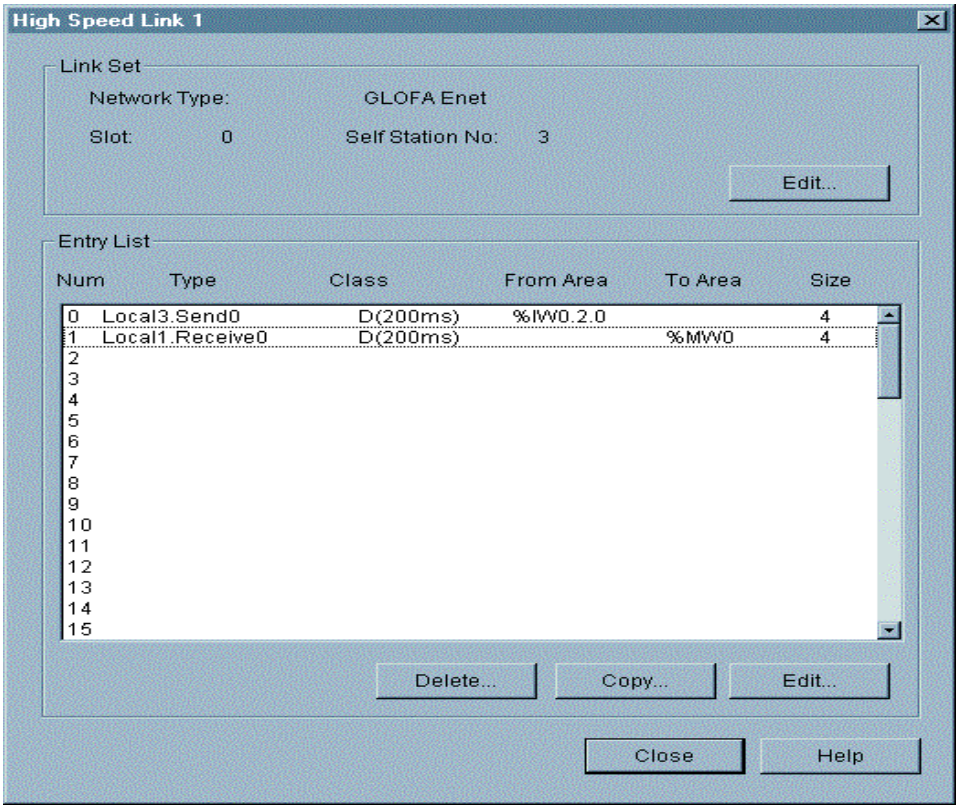
After that, set RX/TX parameter setting from number ,0' on the registration list of the figure 7.2.7(C). For example, the station type for station '1' is local. And as RX/TX are all composed of '0 block, RX/TX are configured with one parameter respectively. After you set RX/TX area according to the RX/TX map, you set further RX/TX period by calculating RX/TX time according to '7.2.6 Speed Calculation of High Speed Link'. Here, 200㎳ is set as basic value. a, b, c of the figure 7.2.7(C) are showing the results, in which parameter in GM1,GM2,GM3 is set with the above method.



a. Parameter of High Speed Link of GM1 (Station 1)



b. Parameter of High Speed Link or GM2 (Station 2)



c. Parameter of High Speed Link of GM3 (Station 3)

[Figure 7.2.7(C)] Examples of Parameter setting for High Speed Link

If you download in the on-line menu into the appropriate PLC, and set 'Link Enable' after editing program and parameter and performing 'Make' in compile menu like the figure 7.1.7(B) and figure 7.2.7(C), the High Speed Link begins to perform RX/TX according to the set parameter, and then you can start the system after you turn on PLC mode as 'Run'.

If you download parameter of the High Speed Link, 'Link Enable' becomes automatically 'Disable'. Therefore, you have to make 'Link Enable' enabled. But, it is only possible to set 'Link Enable' only at stop mode of PLC. (you should download station number into Enet module for each CPU in frame editor)

C) How to Determine Speed of High Speed Link.

The system of examples is a simple system, in which communication modules of 3 stations sends and receives data of 4 words each. Thus, period setting of RX/TX can be easily gained using the formula of speed calculation for simple system in 'Speed Calculation' of Chapter 7.2.6.

Namely, in formula: St = P_ScanA + C_Scan + P_ScanB

(St = maximum transfer time of High Speed Link
P_ScanA = maximum program scan time of plc A
P_ScanB = maximum program scan time of plc B
C_Scan = maximum communication scan time)

P_ScanA, P_ScanB are scan time of GM1, GM2 PLC. Thus, supposing that the time is 5㎳ each in the example above, (it is possible to confirm it by selecting 'On-line/PLC Information/System Information' of GMWIN)

Formula C_Scan = Th × Sn

(Th = Time of data transfer from a media per 1 station (IEEE standards 802.3)
Sn = Total Station Number : Total Communication Number)

Here, as Sn = 3, Th is 2.3㎳ in Enet, CScan = 6.9 ㎳, thus, St = P_ScanA(=5㎳) + P_ScanB(=5㎳) + CScan(6.9 ㎳) = 16.9㎳. It means that you should set RX/TX period above 17㎳.

7.3 High Speed Link of Redundancy System

7.3.1 Introduction

Redundant system using Enet module is **network redundancy** that sends and receives the same data at the same time with 2 same networks configured Enet module by communication like the figure 5.3(A) of chap.5. High Speed Link Redundancy of redundant system performs by adding special function to the existing High Speed Link service. For basic setting of High Speed Link and operation, see ' 7.2 High Speed Link' .

The difference between redundant system and single system is as follows:

1) Communication Length

Communication dot to be set in a block of redundant CPU (GMR-CPUA) is fixed at **maximum 59 words** in all networks of GLOFA.

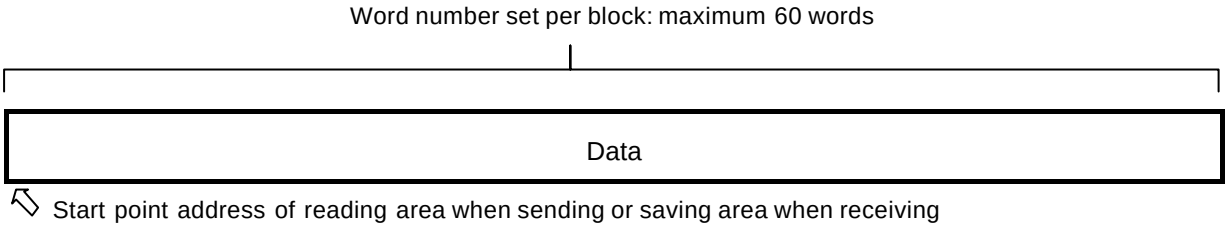
Comparision of CPU with redundant configuration	Redundant CPU (GMR-CPUA)	Redundancy of GM1/2/3 CPU (GMx-CPUA,x=1,2,3)	In case of single system
Maximum number of words to be set per block	Enet: 59words Mnet: 59words Fnet: 59words Fdnet:59words	Enet: 200words Mnet: 200words (excluding x=4) Fnet: 60words Fdnet:60words	Enet: 200words Mnet: 200words Fnet: 60words Fdnet:60words

[Table 7.3.1(A)] Communication Length of Redundancy System per Block

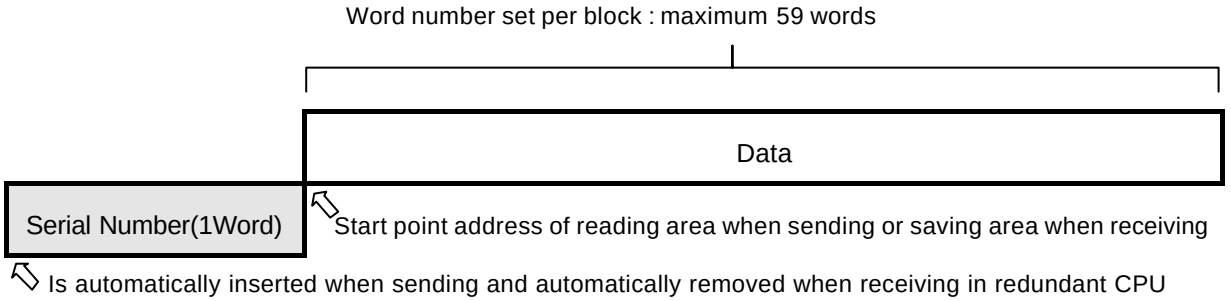
2) Communication Data Format

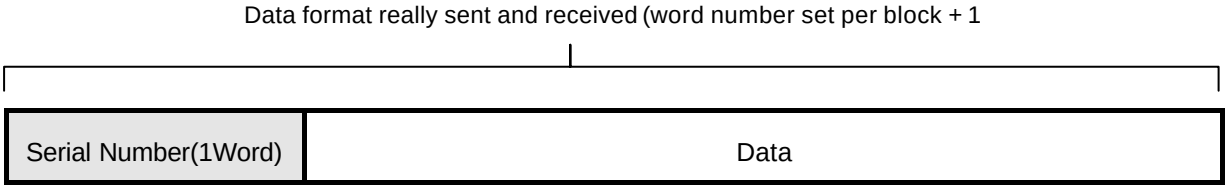
If the number of TX/RX area set in High Speed Link parameter and block are used in redundant system, serial number for redundant process should be placed for the first word of data area.

A) Single System (Existing System : GM1/2/3/4)

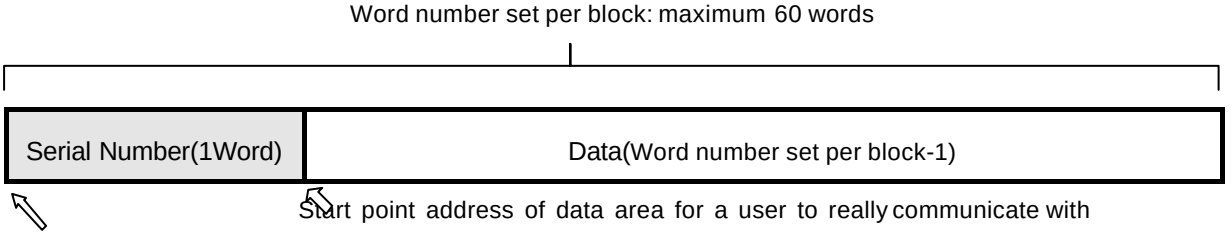


B) In Case of redundant System of CPU (In Case of GMR-CPUA)



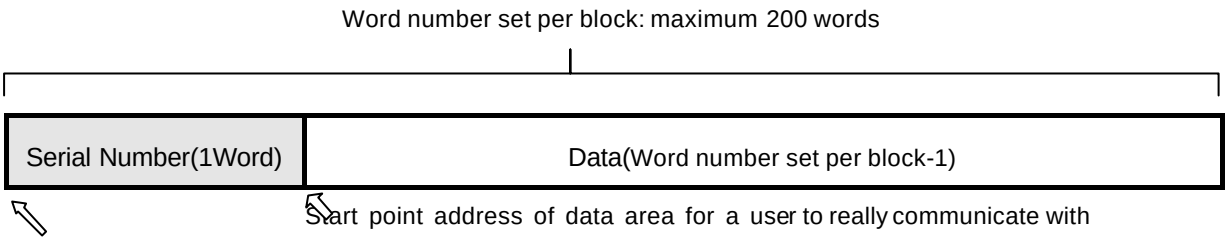


C) In Case of Communication with GMR-CPUA in GM1/2/3 CPU with Network redundancy



In this serial number, 1 added value must be written in this place from user program at every period of RX/TX of the appropriate block when sending. When receiving, the serial number set from the partner station' s CPU is recorded.

D) In Case of Communication with GM1/2/3/4 CPU in GM1/2/3 CPU with Network Redundancy



In this serial number, 1 added value must be written in this place from user program at every period of RX/TX of the appropriate block when sending. When receiving, the serial number set from the partner station' s CPU is recorded.

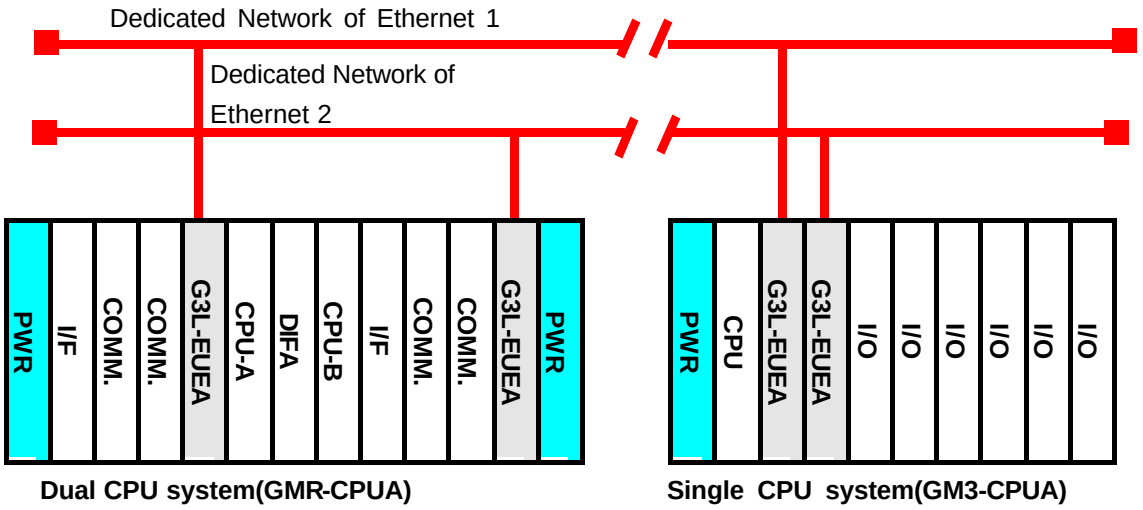
Remark

Note1) When you perform High Speed Link through redundancy in **GM1/2/3 CPU** system, you have to use %M area.

7.3.2 Use of HS_LINK

1) HS_LINK in Redundant CPU System (GMR-CPUA)

Setting and operation of HS_LINK in redundant CPU system is the same as that of single system.



[Figure 7.3.2(A)] Configuration of redundant System

In redundant CPU system, redundant CPU performs a HS_LINK parameter at the same time. In the above figure, as the same configuration of communication module and system are placed in both sides, the both CPU and the communication module perform a program and a communication parameter.

Remark

Note1) When you configure dual system wiht Ethernet, HS_LINK station number of both Enet communication modules, which are installed in a base at the same time, must be set equally. That is, the system configuration of both networks and parameter setting must be the same. But, IP address can be set differently.

- TX of HS_LINK

TX of HS_LINK in dual CPU system sends data by communication module to the TX area set in parameter through each communication module with serial number added at every

period of TX. The serial number increases in accordance with both CPU synchronization, and each block has its own serial number. As processing of the serial number is automatically performed, you do not need any work in user program additionally.

- RX of HS_LINK

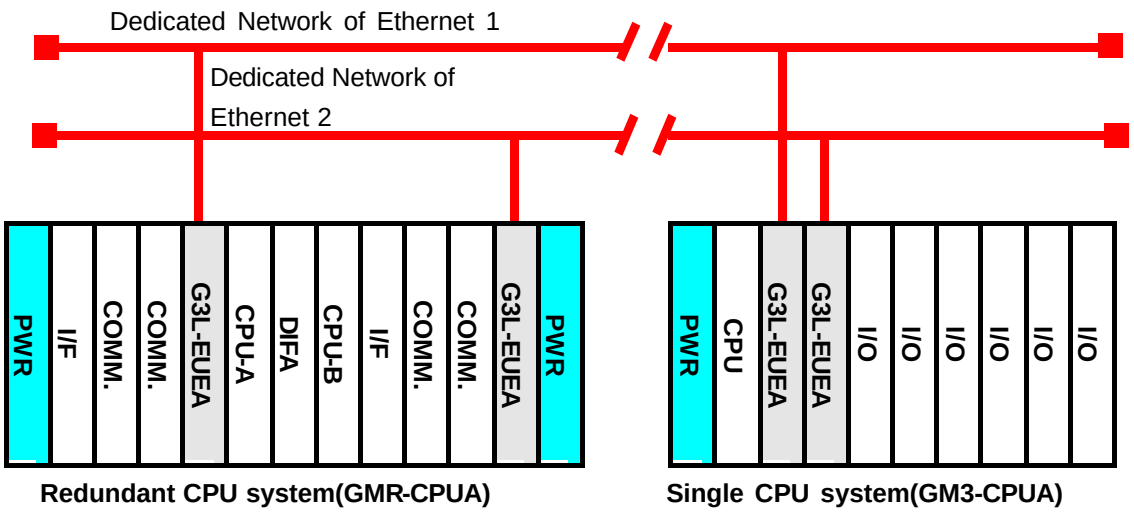
In RX of HS_LINK, serial number and data from communication module are processed in each CPU. Process of the serial number of RX data is automatically performed. Therefore, you do not have any additional job to do in user program.

The method to process RX data of each CPU is as follows. Each CPU allows to save the latest data of two data (the data with larger number of two RX data) received through communication module A and B from partner station. In case that data of only one side is received, it compares them with current serial number. If the data are larger than these, they will be saved.

- Process of HS_LINK Information

HS_LINK information registers the information made in communication module A communication module B by OR (operation) in flag of HS_LINK information. If you execute HS_LINK information monitor, you can see each information of communication module A communication module B.

2) HS_LINK in Single CPU System (GM1/2/3)



[Figure 7.3.2(B)] Configuration of Dual System

The parameters with the same contents are performed in two communication modules of the single CPU system. In the figure above, as two communication modules are installed, communication parameter with the same contents are processed in both the communication modules.

When you set parameter in the single CPU system, you have to know the following.

Remark

Note1) The station numbers of two Enet communication modules are the same. (Both networks have the same configuration). IP address can be set the same or with as another class.
Note2) You should assign HS_LINK in each communication modules. (Example: 1 HS_LINK, 2 HS_LINKs).
Note3) Setting of each block set in High-speed must be the same except RX area and slot number.
Note4) RX area of blocks set in both parameters should not be doubled between two parameters.
Note5) The TX block number of parameter set as TX block must be at least more than 2. (including serial number)

- TX of HS_LINK

TX of HS_LINK sends data to each communication module after it fixes serial number added by each TX period in TX area set from the parameter in single CPU. For serial number, you should write the data added at each TX into serial number position of data in user program.

- RX of HS_LINK

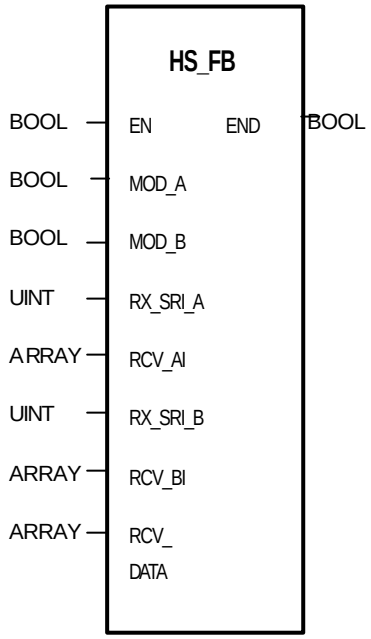
Rx of HS_LINK reads received serial number and data from both sides, and compares their serial numbers, and then edits HS_FB to save the latest data (ones with larger serial number) of both data.

- Information Processing of HS_LINK

As Information process of HS_LINK manages information of each communication module using in HS_FB, it does not send data of abnormal _HSx_MODE,_HSx_RLINK,_HSx_TRX of the two communication modules (of two networks). Therefore, when you edit user program, please edit it using information flag of HS_LINK like the example of chap. 7.3.3, and then you can secure the reliability.

3) Function Block HS_FB (RX Program of the Latest Data of HS_LINK)

It compares data input through two communication modules using HS_FB in redundant library of Function Block, and select the data entered first. Description of each function is as follows:

Function Block	Description
	**Input** EN : Demanding Execution of Function Block from Positive Edge (0 →1) MOD_A : Used to confirm if HS_LINK parameter of Communication module A is in normal RUN (HSxMODE[y]) MOD_B : Used to confirm if HS_LINK parameter of communication module B is in normal RUN (HSxMODE[y]) RX_SRI_A : Specifies word area with serial number in RX data of HS_LINK of communication module A. RCV_AI : Specifies RX area of HS_LINK of communication module A. RX_SRI_B : Specifies word area with serial number in RX data of HS_LINK of communication module B. RCV_BI : Specifies RX area of HS_LINK of communication module B. **Output** ENO : On if Function Block is normally operating. RCV_DATA : Specifies the area to save the last data after comparing HS_LINK input data of communication module A and B.

EN

It is active at positive edge as condition of HS_FB start.

MOD_A, MOD_B

Uses HS_LINK flag HSxMODE[y] to confirm if HS_LINK parameter of communication module A and B is normally operating. As action mode information of individual HS_LINK parameter, the appropriate bit of this flag is 'ON' if the station set in the registration is in 'RUN' mode, and if it is in STOP/PAUSE/DEBUG mode, it becomes 'Off'. The alphabet x in the flag means the number of the currently used HS_LINK number. That is, when editing HS_LINK parameter, it is possible to set from HS_LINK1 to HS_LINK4. It is for

setting parameter to each communication module because it is possible to install up to communication modules into base board. User records currently used HS_LINK (setting range ; x=1~4). In flag, you perform RX/TX toward each station after editing total 64 individual parameters in HS_LINK parameter. The alphabet y means the appropriate parameter number of RX parameter to be applied in the current HS_LINK parameter.

RX_SRI_A, RX_SRI_B

Specifies the area of serial number in HS_LINK data received from communication module A and B. For example, the communication module A receives HS_LINK data sent from partner station from %MW10 to %MW20, and when the communication module B receives from %MW30 to %MW40, it writes head address of received data because serial number is fixed at the data head sent from the partner station to select them. In RX_SRI_A namely, as in case of the figure 7.3.3(B), it defines %MW10 as data position using variables such as HS_RX_SRI_A (data type: UINT), and in RX_SRI_B, it also defines %MW30 as data position using variables such as RX_SRI_B (data type: UINT).

RCV_AI, RCV_BI

It specifies the rest head address in HS_LINK data sent from partner station except serial number. For example, when it receives data in communication module A from %MW10 to %MW20, communication module B receives from %MW30 to %MW40, as in the figure below, data of the communication module A specifies %MW11 to %MW20 as positioning using ARRAY variable such as RCV_A (data type:WORD), and communication module B specifies %MW31 to %MW40 as positioning using ARRAY variable such as RCV_B (data type:WORD).

ENO

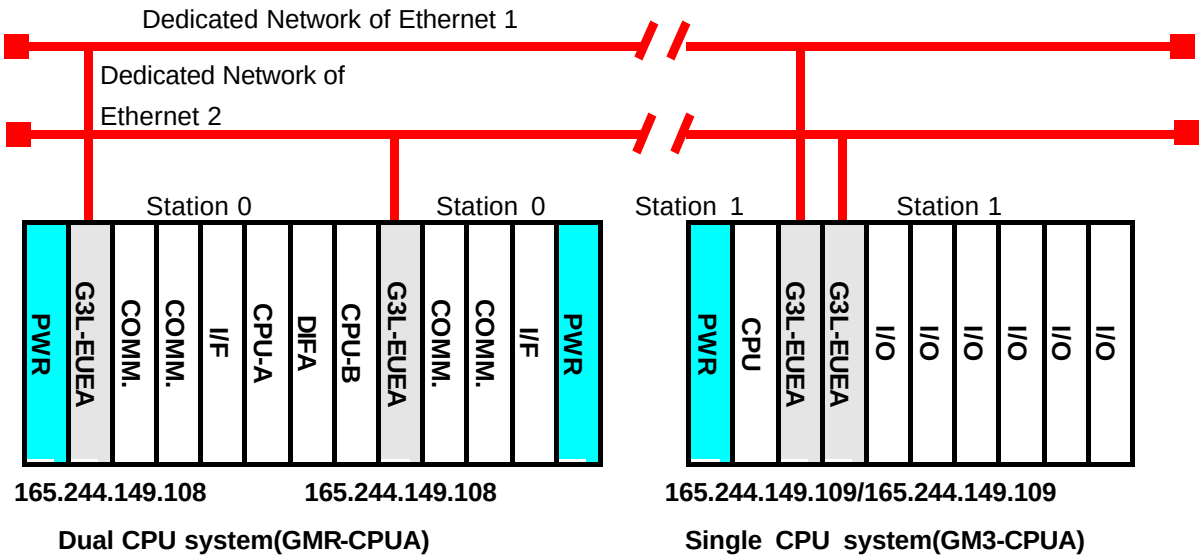
' On' when Function Block is normal.

_RCV_DATA

It finally saves data received late after comparing the data serial number input from two communication modules. As in the example of the figure, it specifies the position to be used by the final user using ARRAY variable such as HS_RDATA. (data type: WORD)

7.3.3 Example between Redundant CPU and GM3 for HS_LINK

Following system configuration is an example in which it performs HS_LINK with communication redundancy in redundant PLC and GM3 PLC.



[Figure 7.3.3(A)] Redundant CPU and Network redundancy of GM3 PLC

A user defines data of RX/TX as follows:

RX/TX Structure		Reading Area	Saving Area	Block Number
Redundant CPU (Station 0)	TX: 10words	%MW0	--	0
	RX: 59words	--	%MW100	1
GM3 CPU (Station 1)	TX: 60words	A side: %MW0 B side: %MW0	--	1
	RX: 11words	--	A side: %MW100 B side: %MW200	0

[Table 7.3.3(A)] Dada Definition to communicate

- Operation Order

① Assign station number of communication module (G3L-EUEA) (use frame editor) and connect communication cable.

② Edit user program (edit by each PLC)

③ Edit map of data RX/TX ([see table 6.1.10(A)])

④ Set parameter in , HS_LINK parameter setting' . Of GMWIN.

⑤ Perform , Compile' and , MAKE' in compile menu' .

⑥ Execute program and , parameter writing' in on-line menu.

⑦ Set suitable HS_LINK Enable for selecting number by selection of , HS_LINK Enable' in on-line.

⑧ Change mode into , RUN' in on-line menu.

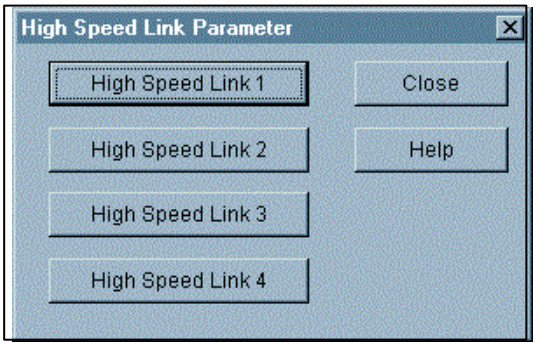
⑨ Check for HS_LINK status through link parameter monitor.

⑩ If an error occurs, repeat the process from number 1.

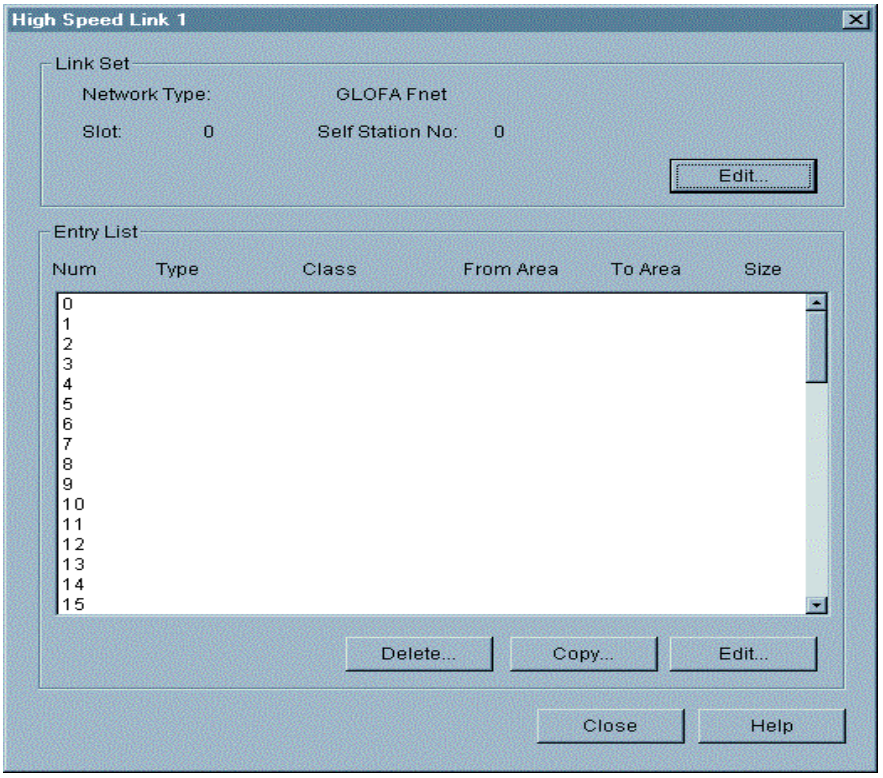
1) Program Editing of Redundant CPU(GMR-CPUA) Side

A) Select first HS_LINK.

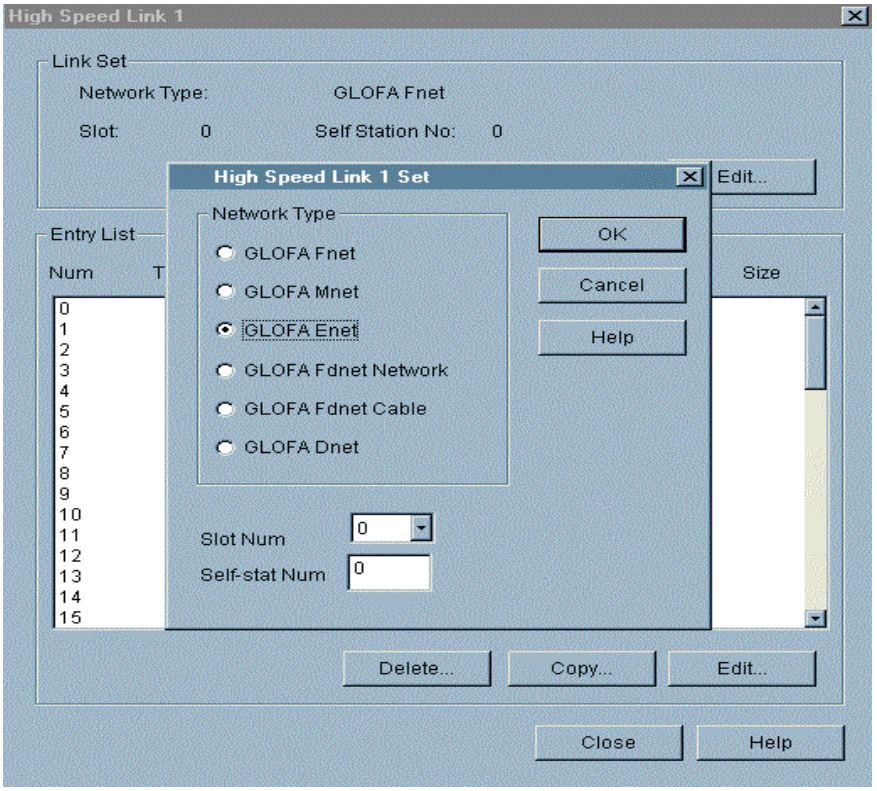
If you select (doubleclick) HS_LINK parameter in project after opening or editing newthe project for redundancy, following screen appears. Select now one of 4 HS_LINK1~4. HS_LINK1 is here selected.



B) If you select HS_LINK1 on the above screen, following screen appears.

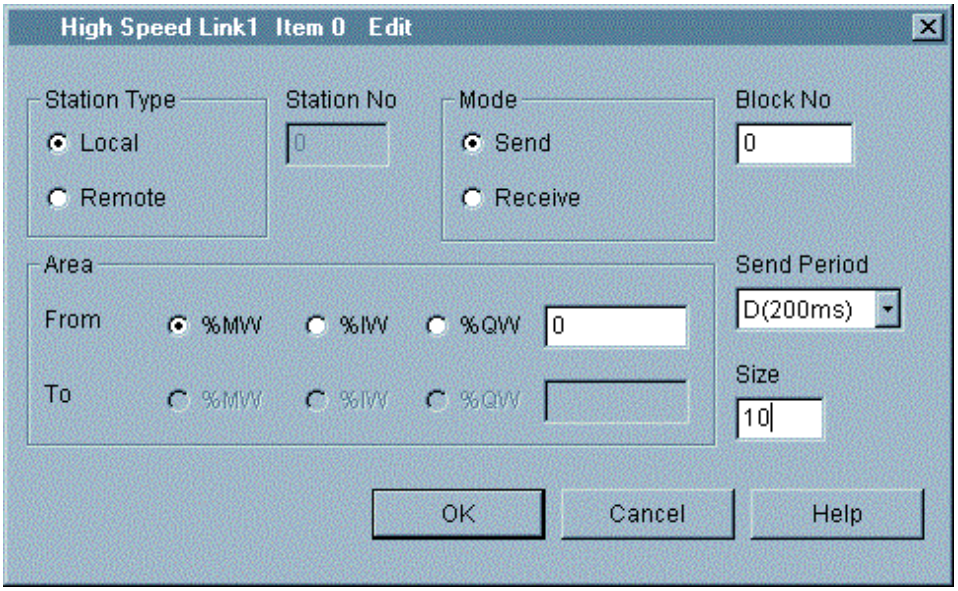


C) Set link setting as follows after selection of , Modify' of link setting on the B screen.

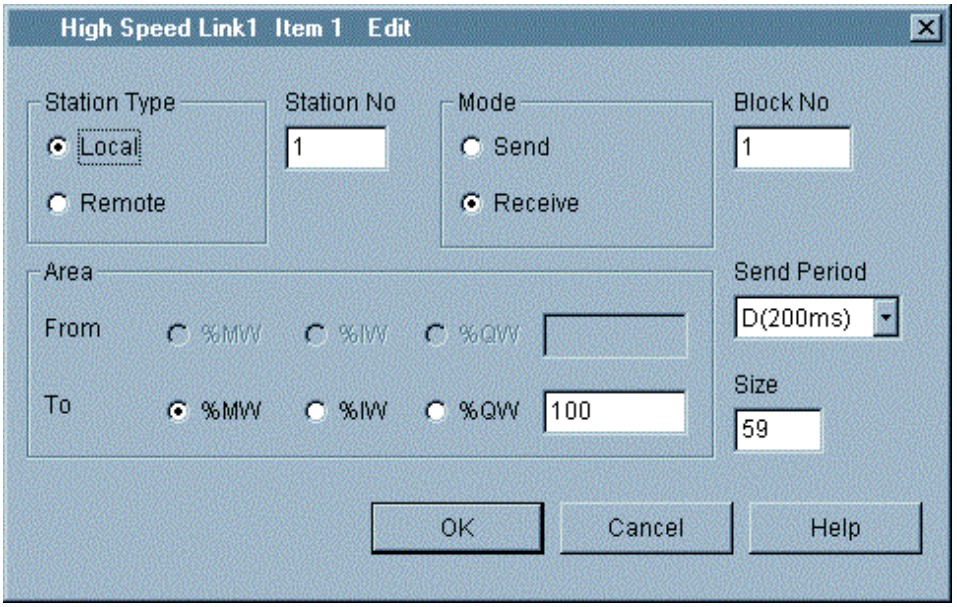


D) Set RX/TX parameter after selection (doubleclick) of number 0 in registration list.

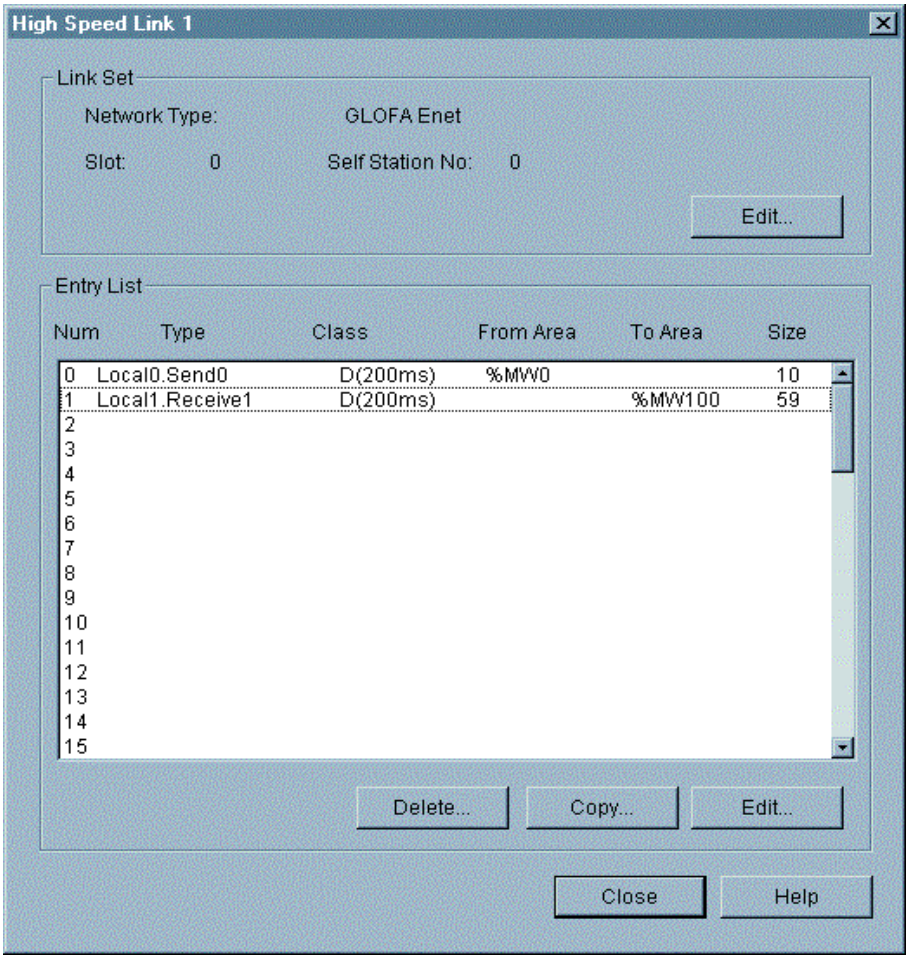
For TX parameter



For RX parameter

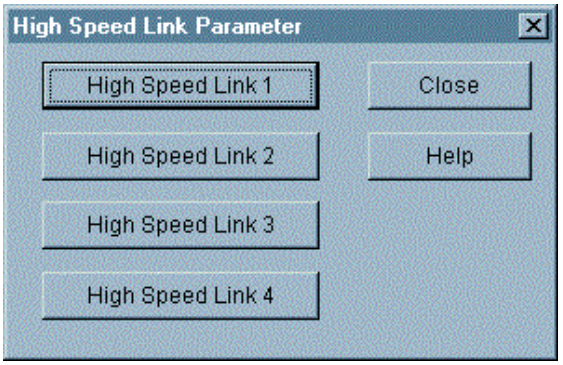


E) The following is set if the operation 1 to 4 is all executed.

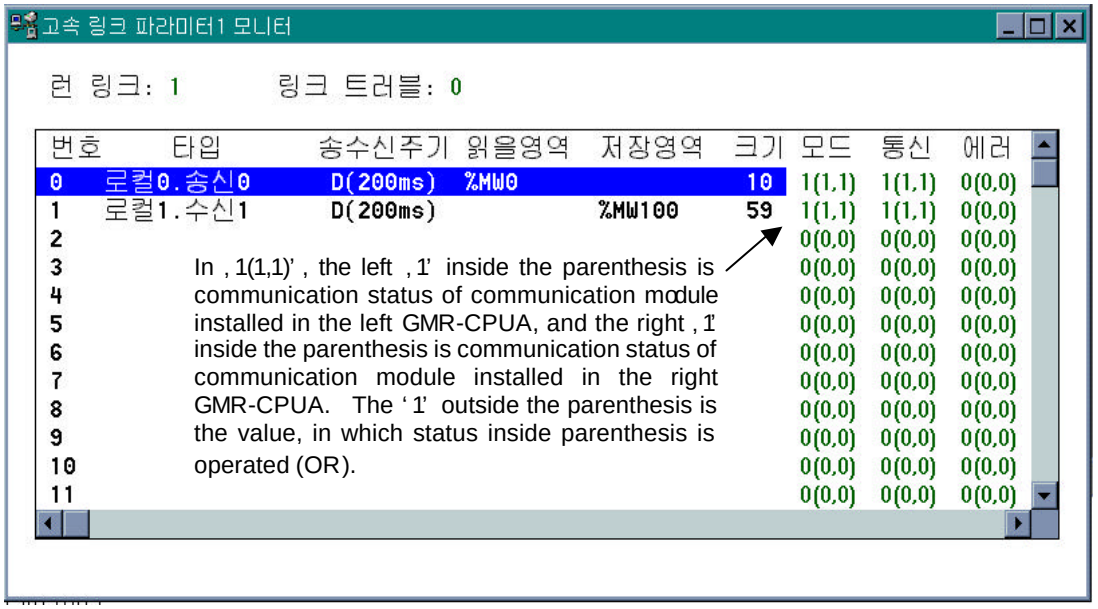


F) Now, select , Close' after setting HS_LINK parameter setting. Next, after editing user program and executing , Compile/Make' , write PLC program.

G) set as follows after selecting , On-line/ Link-Enable setting' .



G) Confirm whether the communication for the set parameter is normally operating by selecting , On-line/Link parameter' and Monitor/HS_LINK1 after positioning PLC mode as RUN. (the appropriate program and HS_LINK parameter in partner station must be normally operating after download as well).

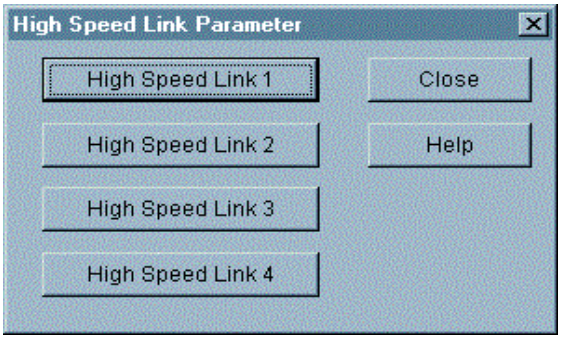


In above screen, if communication of ' Run Link' mode is '1' , ' Link Trouble is '0' , it means normal communication status. The above screen shows that communication with partner station is normal. To confirm the value to be communicated, select direct variable %MW100 in On-line/Monitor/Variable Monitor' .

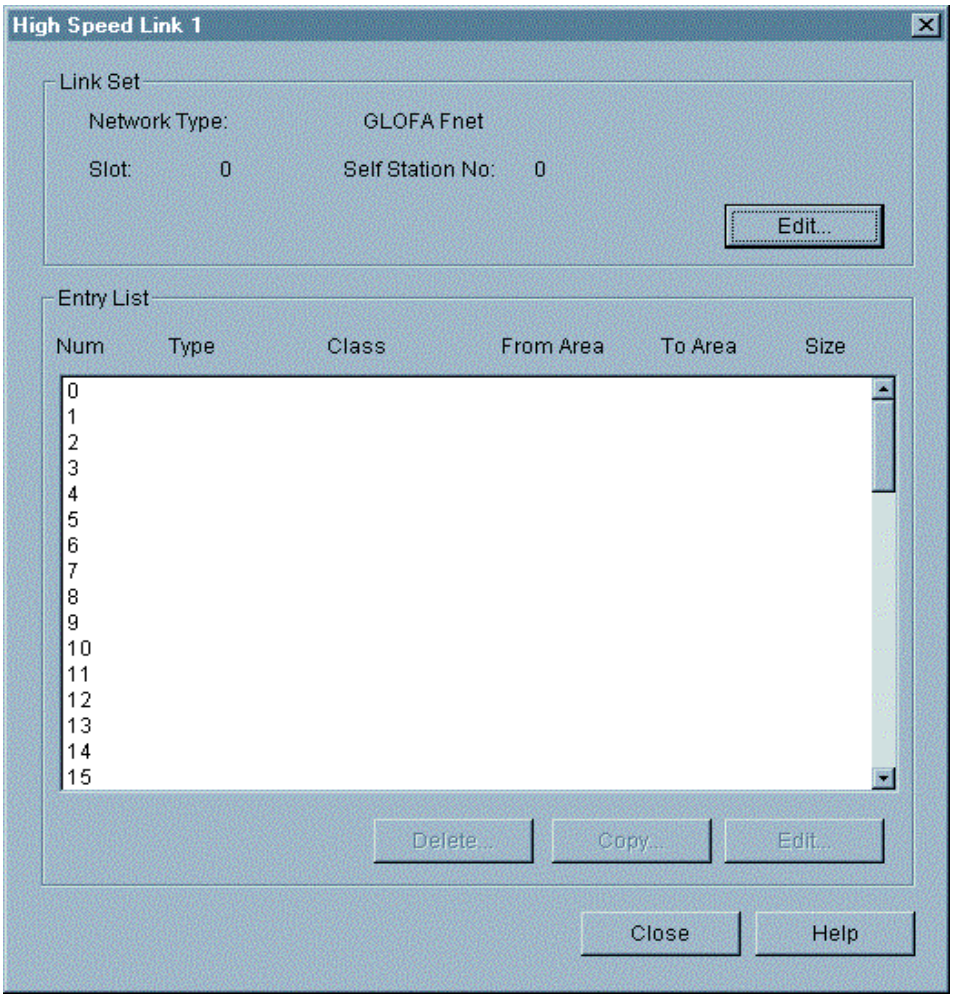
2) Program Editing of GM3 Side

A) Select HS_LINK.

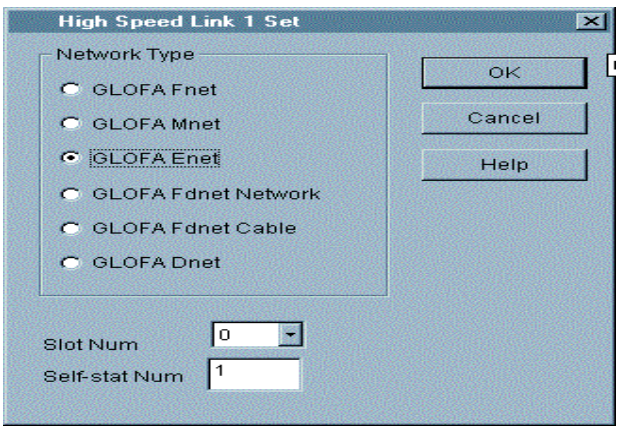
If you select (doubleclick) HS_LINK parameter in project after opening or editing new the project for GM3, following screen appears. Select now one of 4 HS_LINK1~4. HS_LINK1 is here selected to first define for the first module of 2 Enet communication module.



B) If you select HS_LINK1 on the above screen, following screen appears.

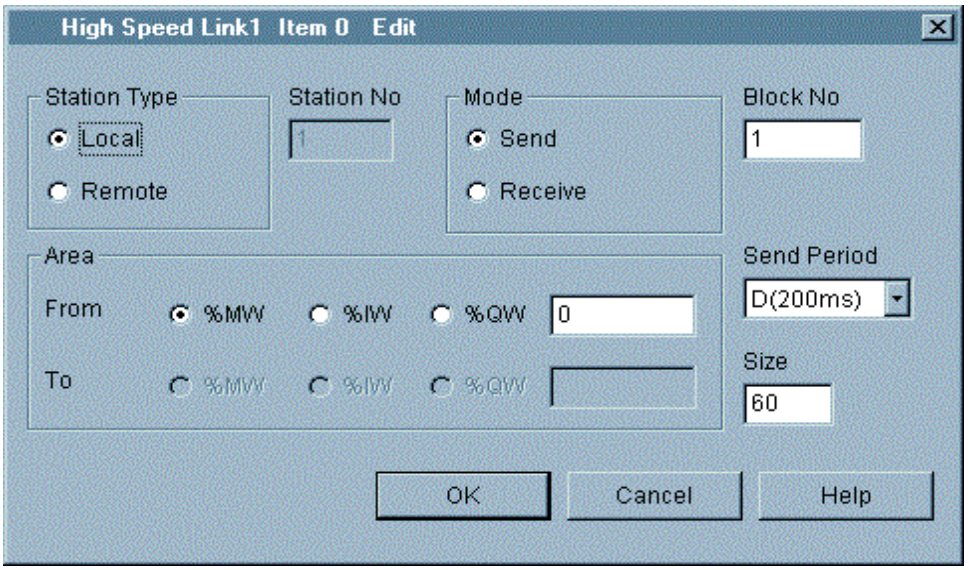


C) Select 'OK' after setting link setting as follows and selecting 'Modify' of link setting on the previous screen.

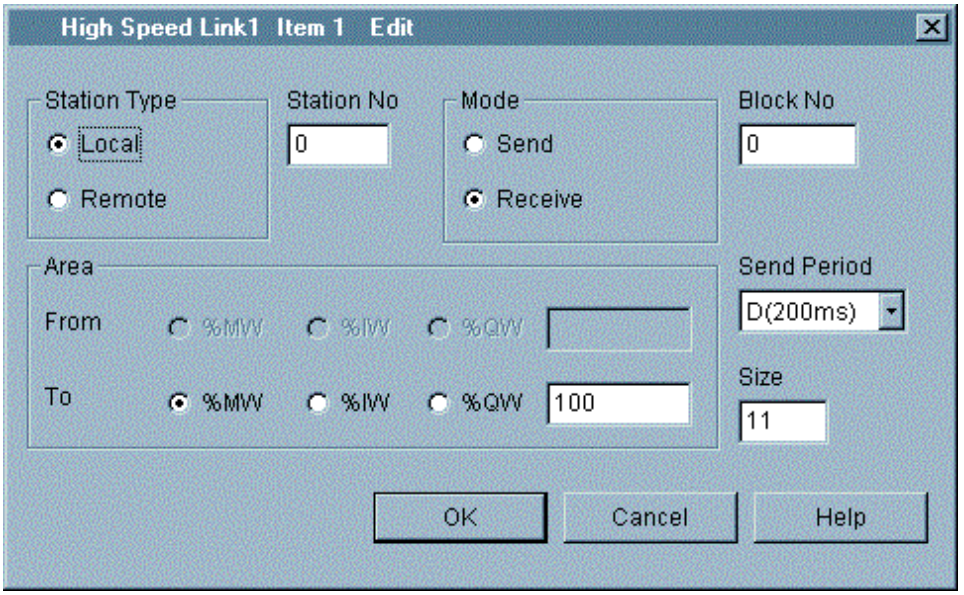


D) Set RX/TX parameter after selection (doubleclick) of number 0 in registration list.

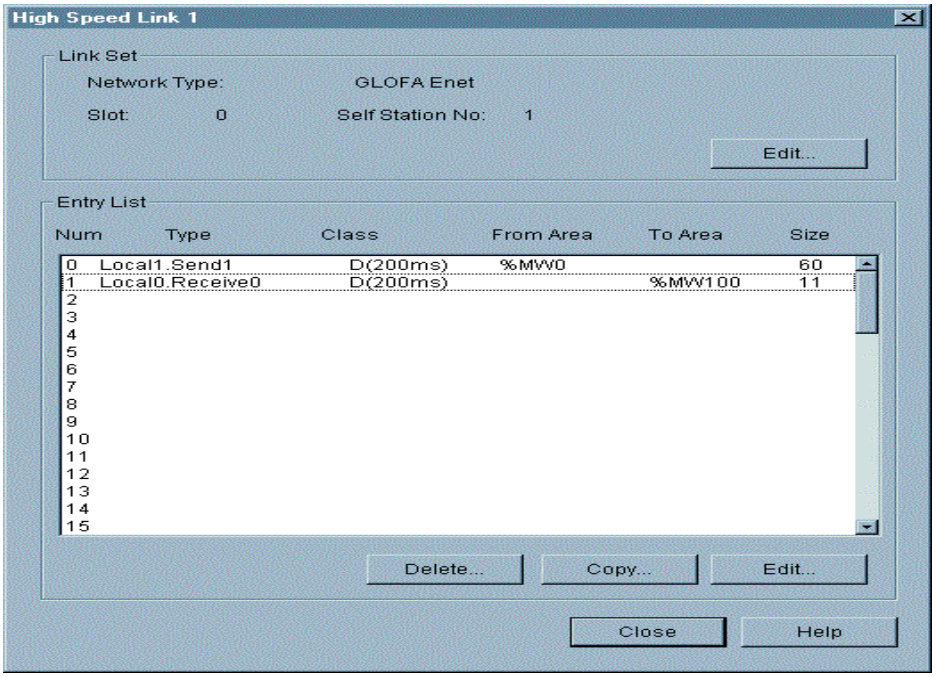
For TX Parameter



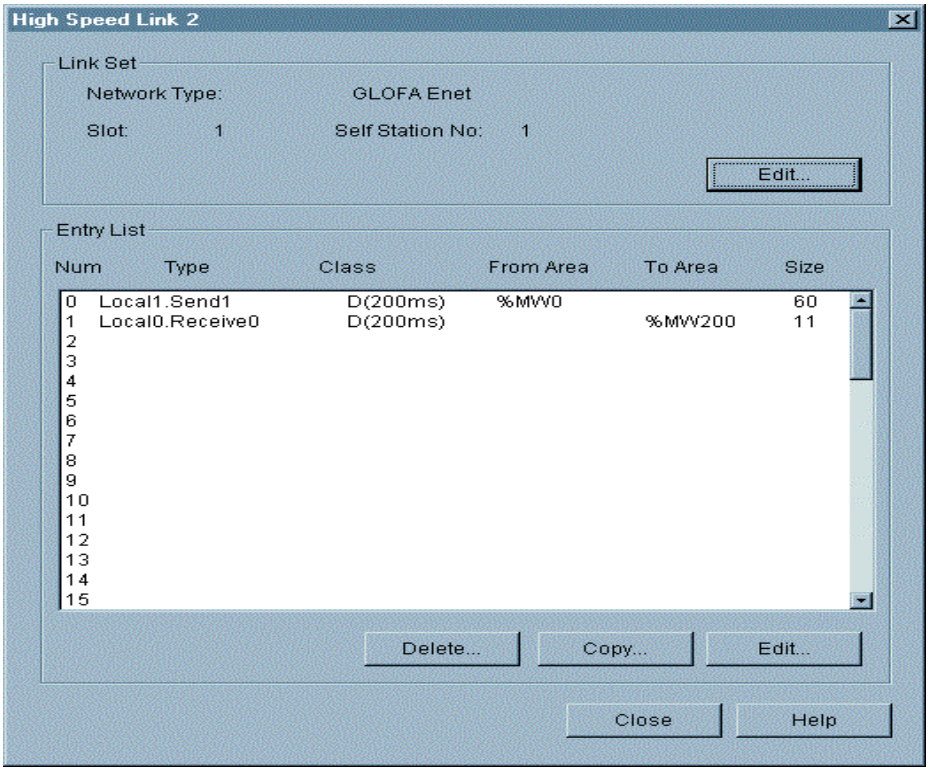
For RX Parameter (Selecting , 1' in registration list)



E) The following is set if the operation 1 to 4 is all executed.



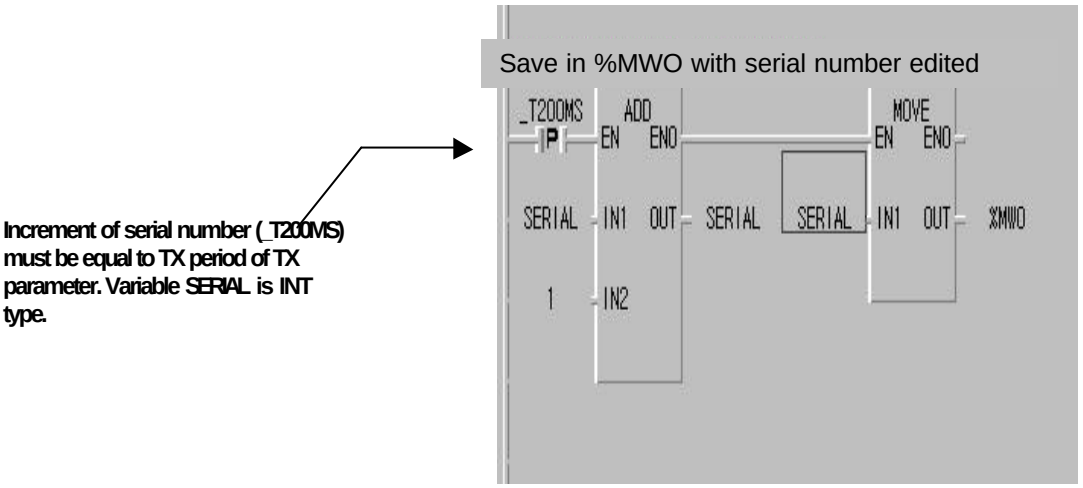
F) Now, select , Close after setting HS_LINK parameter setting of the first Enet communication module. For the second communication module, please set HS_LINK via the process from A to E. At this time, select HS_LINK 2 and slot number 1, and save saving area of RX data %MW200 not to be doubled with the saving area received in the first module. After setting, following screen appears.



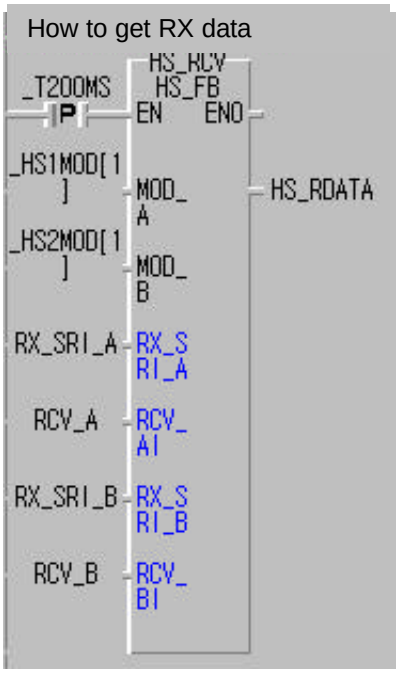
G)The following is for editing user program.

One program is to fix serial number at the first word when sending, and the other is to save only one data after comparing serial numbers of two communication modules in HS_LINK parameter.

How to fix serial number at TX



Program editing at RX



_T200MS: must be identical to RX period of RX parameter.

_HS1MOD[1]/_HS2MOD[1]: receives data when partner station's mode is '1'.

RX_SRI_A/B: variable showing serial number out of data received in each Enet module. (%MW100). Variable of UINT type

RCV_A/B: shows data area received in each Enet module. Variable of UINT Array type. Set more than volume of RX data.

HS_RDATA: area (%MW1) to save data to be finally received out of each Enet module. Variable of UINT Array type. Set more than volume of RX data. Volume of RCV_A/B is identically set.

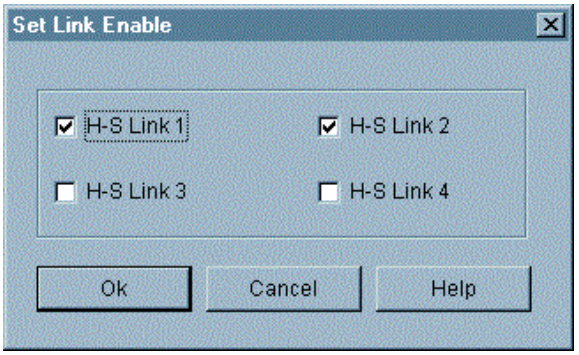
Assigned area of memory address toward variable.

RX_SRI_A : %MW100 (1word)
RCV_A : %MW101 ~ %MW110 (10word)
RX_SRI_B : %MW200 (1word)
RCV_B : %MW201 ~ %MW210 (10word)

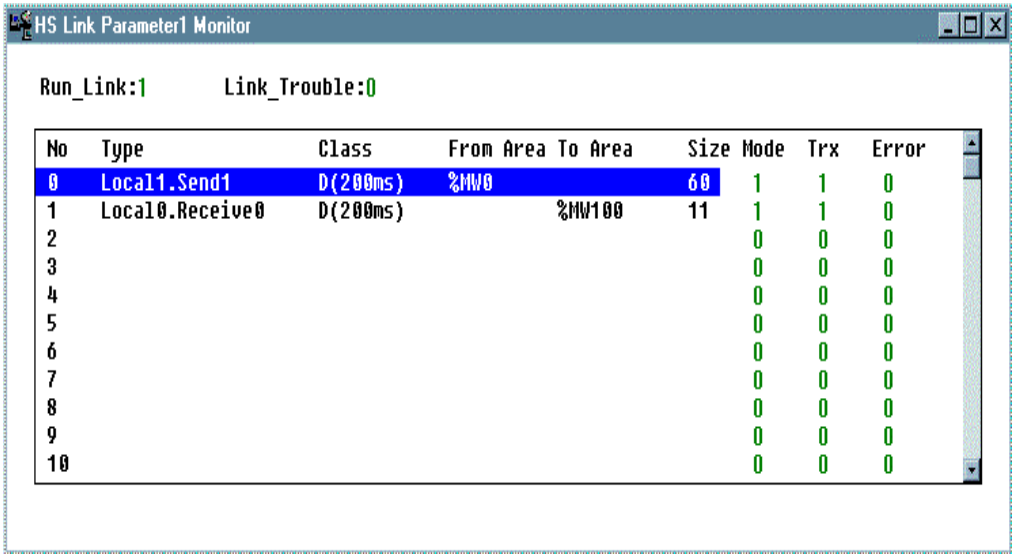
[Figure 7.3.3(B)] Example of Function Block HS_FB

H) Write in PLC after , Compile/Make' of the program above.

I) Set as follows after selecting , On-line/Link-Enable' .



J) Confirm whether the communication for the set parameter is normally operating by selecting , On-line/Link parameter' and Monitor/HS_LINK1 after positioning PLC mode as RUN.



The above screen is showing the situation of HS_LINK 1. If communication of ' Run Link' mode is ' 1' , ' Link Trouble is ' 0' , it means normal communication status.

Please confirm HS_LINK 2 with the same way. To confirm the value to be communicated, select direct variable %MW100/200 or variable RX_SRI_A/B,RCV_A/B,HS_ RDATA in On-line/Monitor/Variable Monitor' .