1) Parameter writing

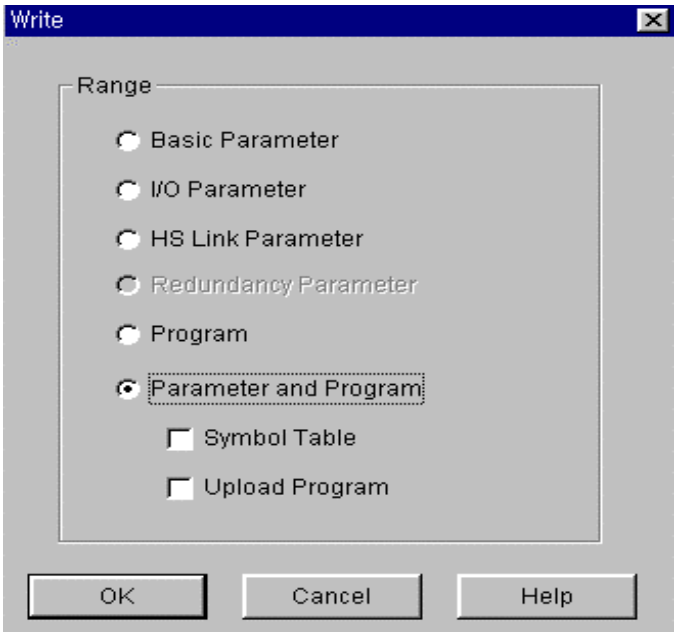


Fig. 6.2.5(A) Screen of parameter download

If *high speed link* parameter prepared by user is stored to project file of GMWIN, and the writing is selected after connection with PLC through the on-line connecting of GMWIN basic menu, the writing window in Fig. 6.2.5(A) is opened. If *high speed link* parameter or parameter and program is selected in figure, and parameter downloading is performed, the appropriate contents is downloaded.
At this time, the link enable that is *high speed link* starting information becomes off. Therefore, inevitably click on the appropriate item of *high speed link* 1~4 in link enable setting.

Remark

Before downloading parameter to CPU, carry out compile.

2) *High speed link* starting

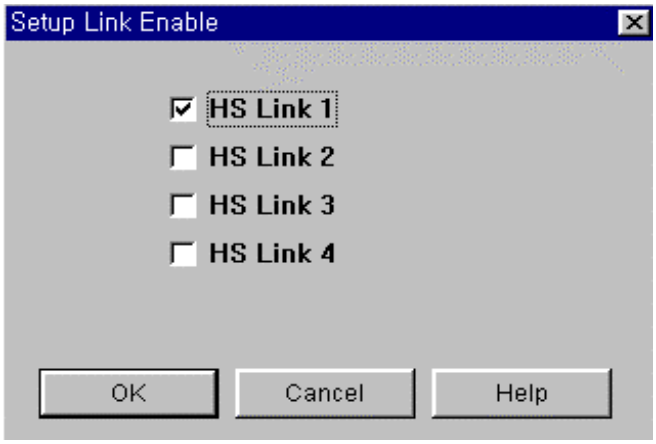


Fig. 6.2.5(B) Link enable setting

After parameter writing, *high speed link* is maintained to the stop status. Since, thus, user sets link enable, the *high speed link* is performed.
Link enable setting is possible in the stop mode of PLC only. Also, if *high speed link* enable setting is started, *high speed link* is performed regardless of PLC operation mode. Parameter and link enable information are preserved even if power is off due to battery back-up in PLC CPU.

Table 6.2.5 Relation between PLC mode and *high speed link*

Segment	Parameter downloading	Link enable setting	*High speed link* operation	Remark
PLC RUN	×	×	○	Only if *high speed link* enable, it is operated.
PLC STOP	○	○	○	
PLC PAUSE	×	×	○	
PLC DEBUG	×	×	○	

6.2.6 Relation between *high speed link* and CPU mode switch

Once *high speed link* enable setting is started, the *high speed link* performs the *high speed link* regardless of PLC operation mode. Therefore, output data can not be controlled by operation of other station or self station mode switch if data is sent from parameter Tx/Rx area to direct output(%Q area) through the *high speed link*. To control it, data from other station must be received into %M area, and this data must become output. Thus controlling by mode switch becomes possible.

6.2.7 Communication status information of *high speed link*

1) *High speed link* information function

To confirm the reliability of data read from other station, it provides user with the information which can check the state of *high speed link* service. Namely, there are entire high seed link information of RUN_LINK and LINK_TROUBLE, and individual information of HS_STATE, TRX_MODE, DEVICE_MODE, and ERROR which shows communication state according to 64 registered items of in parameter. User can use the above information for emergency or maintenance and repair combining with *high speed link* Tx/Rx data in type of key word in preparing program.

Table 6.2.7 *High speed link* information

Segment	**RUN_LINK**	**LINK-TROUBLE**	**Tx/Rx status (TRX_MODE)**	**Operation mode (DEV_MODE)**	**Error (DEV_ERROR)**	***High speed link* status (HS_STATE)**
Type of information	Entire information	Entire information	Individual information	Individual information	Individual information	Individual information
KEYWORD (□=number of *high speed link*, 1~4)	_HS□RLINK	_HS□LTRBL	_HS□TRX[n] (n=individual parameter No. 0~63)	_HS□ MOD[n] (n= individual parameter No. 0~63)	_HS□ERR[n] (n= individual parameter No. 0~63)	_HS□ STATE[n] (n= individual parameter No. 0~63)
Data type	BIT	BIT	BIT-ARRAY	BIT-ARRAY	BIT-ARRAY	BIT-ARRAY
Monitoring	Possible	Possible	Possible	Possible	Possible	Possible
Program use	Possible	Possible	Possible	Possible	Possible	Possible

(1) RUN_LINK(_HS□RLINK)

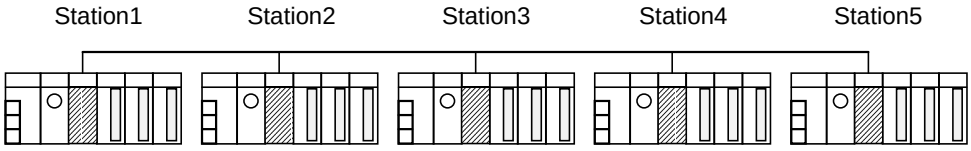
This is entire information indicates whether *high speed link* is made using parameter configured by user. Once it becomes 'On', the contact is maintained to 'On' until link enable becomes 'Off'. When it is under the following conditions, it becomes 'On'.

① When link enable becomes 'On'.

② When all of parameter registration list settings are normal.

③ When all data corresponding to parameter registration list are sent/received in accordance with the set period.

④ When status of all other stations set in parameter are RUN, and at the same time there is no error.



(a) Configuration of *high speed link* system

Station 1	Station 2	Station 3	Station 4	Station 5
Transmission: 2 words Receive : 2 words (Station No. '2') Receive : 2 words (Station No. '3')	Transmission : 2 words Receive : 2 words (Station No. '1') Receive : 2 words (Station No. '4')	Transmission : 2 words Receive : 2 words (Station No. '1') Receive : 2 words (Station No. '5')	Transmission : 2 words	Transmission : 2 words

(b) Example of *high speed link* parameter setting

Fig. 6.2.7(A) Conditions of RUN_LINK On

Fig. 6.2.7(A) shows configuration of *high speed link* system to explain the conditions that RUN_LINK set to 'On'. It is supposed that 5 communication modules are connected with network as (a) of Fig. 6.2.7(A) and *high speed link* is made with the parameters set as Figure (b). In this system, the conditions that RUN_LINK of station 1 becomes 'On' are as follows :

① Link-enable of self station(station 1) is 'On'.

② State of self station(station 1) is RUN.

③ Self station(station 1) has no error.

④ Data configured with transmission parameter of self station(station 1) are transmitted in accordance with transmission period.

⑤ Receive data of station 2 or 3 are received in accordance with receive period.

⑥ Operation mode of other station(station 2 or 3) which receives from self station(station 1) is RUN mode and has no error, and transmits and receives in accordance with Tx/Rx period.

⑦ When operation mode of another station(4, 5 station) that is set in other station(2, 3 station) is not RUN mode and not error state, and communication is made according to TR period.

If above all of 7 items are met, RUN_LINK of station 1 is set to 'On'. If many PLC performs interlock operation through *high speed link*, user can verify reliability using RUN_LINK contact. Once RUN_LINK contact is set to 'On', it maintains the state until link-enable is set to 'Off'. User, therefore, must also use LINK_TROUBLE information contact in the following item for abnormal state monitoring such as communication error.

(2) LINK_TROUBLE(_HS□LTRBL)

If RUN_LINK is 'On' and the case that doesn't comply with the condition of RUN_LINK to be 'On' is occurred, LINK_TROUBLE is set to 'On', and if the condition is removed it is set to 'Off'.

(3) State of Tx/Rx(_TRX□STATE[0~63])

If each parameter operation for individual parameter registration No.(0~63) is performed exactly in accordance with Tx/Rx period, the appropriate bit is set to 'On', but if it is not performed in accordance with Tx/Rx period, the appropriate bit is set to 'Off'.

(4) Operation mode(_HS□MODE[0~63])

This mode shows parameter operation mode information according to individual parameter registration No.(0~63). If the station configured in registration item is RUN mode, the appropriate bit is set to 'On'. In STOP/PAUSE/DEBUG mode, the appropriate bit is set to 'Off'.

(5) Error(_HS□ERR[0~63])

This mode shows parameter error information according to individual parameter registration No.(0~63). Error shows overall situation that PLC can't operate user program normally. If this is set to 'Off, it means other station's PLC performs normal operation, and if this is set to 'On', it means other station's PLC is under abnormal operation.

(6) State of *high speed link*(_HS□STATE[0~63])

This shows overall information for registered list by overall of individual item information. Namely, This is set to 'On' if Tx/Rx state of appropriate list is normal, operation mode is RUN, and has no error. This is set to 'Off' if Tx/Rx state of appropriate list doesn't comply with above items.

Remark

Among keyword contents used in items of (1)~(6)

□: : Shows number(1,2,3,4) of *high speed link* used in parameter setting(If communication module mounted is 1 unit, 1 is normally used).

[0~63] : Shows registration number of individual parameter in left side of Fig. 6.2.4(E)(This can be used to monitor communication state according to each parameter of 0~63)..

2) Information monitor of *high speed link*

The current *high speed link* state can be monitored by using monitor function after connection of GMWIN on-line. How to monitor is divided into two : the one is to select variable monitor in monitor menu ; the other is to select link parameter monitor.

(1) Variable monitor

Variable monitor is a function that can monitor by selecting only the required item through flag monitor function of GMWIN. The sequence is as follows :

① Select variable monitor in monitor item of on-line.

② Select ⊙Flag in variable registration screen of Fig. 6.2.7(B).

③ Select and register the *high speed link* information flag by one and one that user wants to directly monitor in variable and flag list screen (Because _HSxSTATE[n], _HSxERR[n], _HSxMOD[n], _HSxTRX[n] are array flag, enter the registration No. in parameter that user wants to directly monitor).

※ '×' means *high speed link* No., which has a range of 1~4 in GM1/GM2/GM3 PLC CPU, a range of 1~2 in GM4 CPU, and only 1 available in GM5 CPU. [n] is the number(0~63) of individual parameter.

If the closing selected after variable registration in Fig. 6.2.7(B), monitor screen of Fig. 6.2.7(C) is displayed, and monitoring is started.

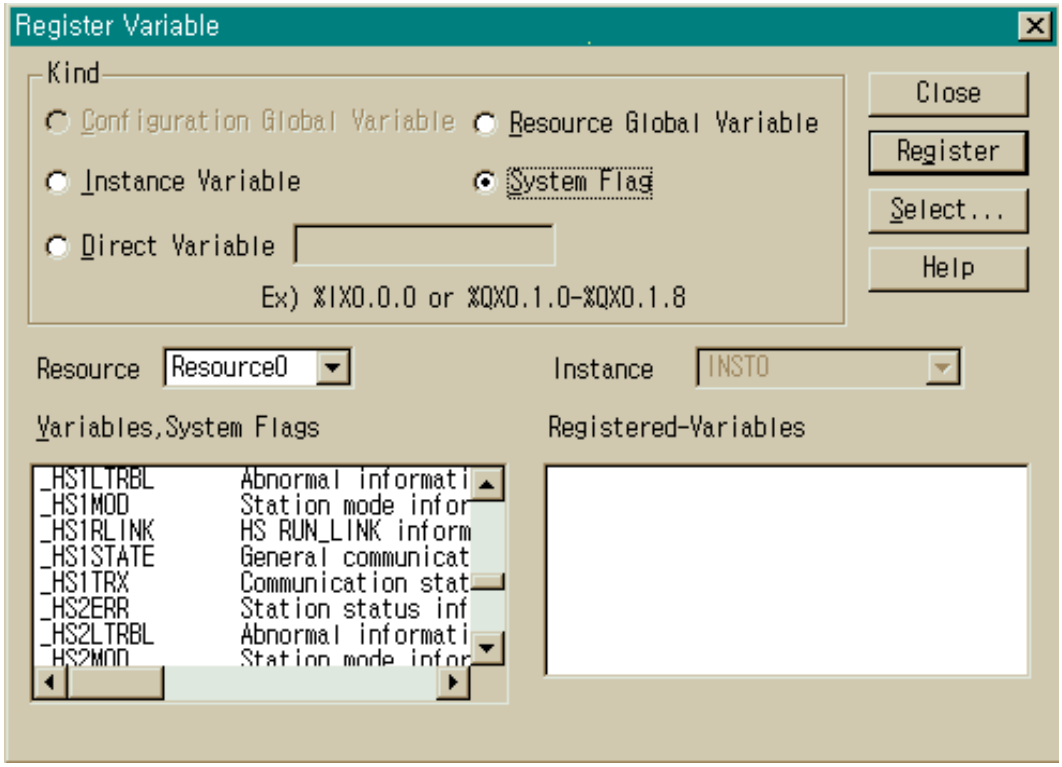


Fig. 6.2.7(B) Variable registration screen of *high speed link* information

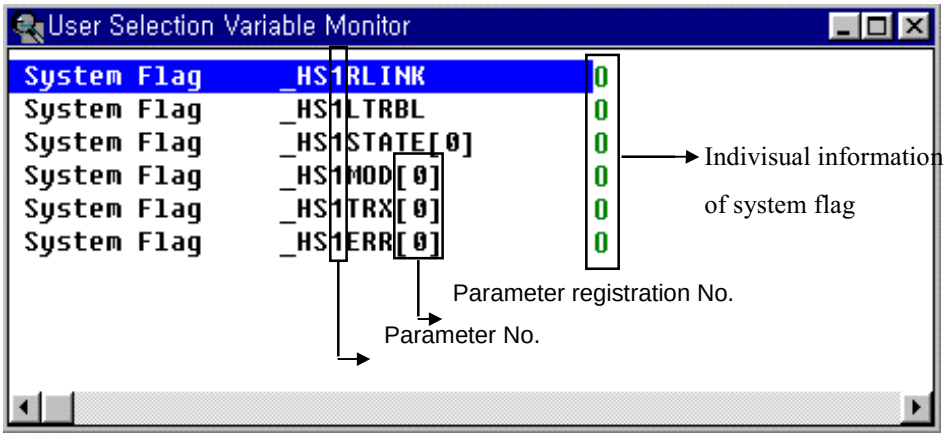


Fig. 6.2.7.(C) Monitor screen of *high speed link* information(variable registration)

(2) Link parameter monitor

This is a function that can directly monitor communication state in the parameter item set. If link parameter item is selected in monitor menu of GMWIN on-line connection, Selecting screen of link parameter as Fig. 6.2.7(D) is displayed.

If user selects a required item of parameter numbers, and clicks on the OK button, monitor screen of *high speed link* parameter in Fig. 6.2.7(E) is opened, and the registration list set is monitored and displayed in screen.

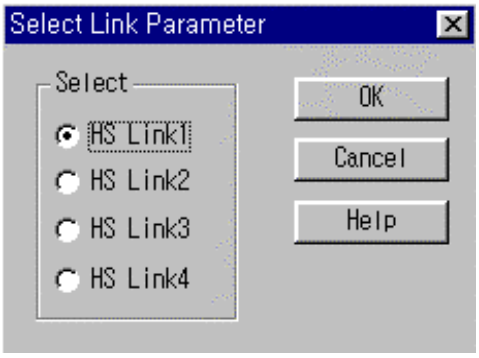


Fig. 6.2.7(D) Selecting screen of link parameter

For link parameter monitor of Fig. 6.2.7(E), the entire information on RUN-LINK and LINK-TROUBLE is displayed in upper part of screen, and the individual information on mode(operation mode), communication mode(Tx/Rx state), and error is displayed in each parameter item set.

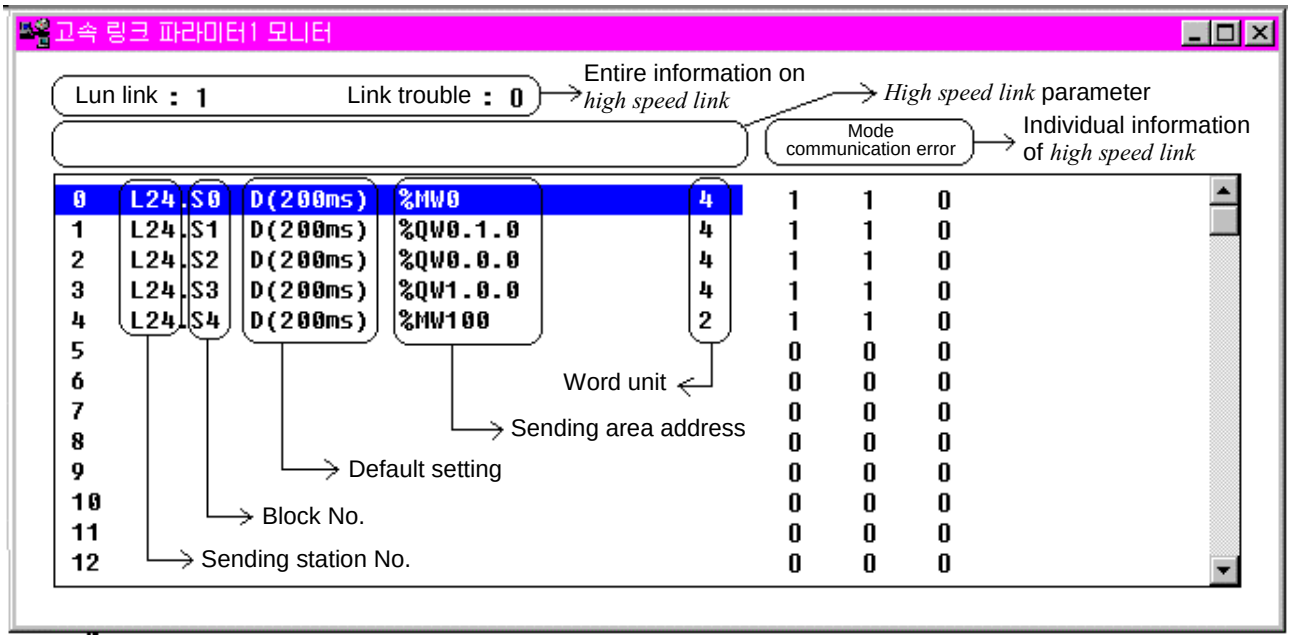


Fig. 6.2.7(E) Monitor screen of *high speed link* parameter(Example)

The values monitored in Fig. 6.2.7(E) mean the following :

① ***RUN-LINK:1*** : Indicates the integrated information that the current state(24 station) of self station is link enable 'On' and RUN state, and the communication of No.0,1,2,3,4 set by parameter has not any error and is in normal operation in accordance with the sending period.
If even one of these conditions is not met, RUN-LINK becomes '0'.

② ***LINK-TROUBLE:0*** : Means that there is no link trouble in No.0,1,2,3,4 set by parameter. If there is error in even one place of No.0~4, or RUN-LINK is out of conditions of 'On', it becomes '1'.

③ ***Mode 1***: Indicates that the station(24 stations) set by the appropriate parameter registration number is RUN mode. If mode is STOP/PAUSE/DEBUG, it becomes '0'.

④ ***Communication 1*** : Indicates that normal communication with the contents set by the appropriate parameter registration number is performed.

⑤ ***Error 0*** : Indicates that communication with the contents set by the appropriate parameter registration number has not any error.

6.2.8 Speed calculation of *high speed link*

1) Introduction

Transmission speed of *high speed link* data be determined by many factors. Sending data from one communication station to the other station is performed in the following path.

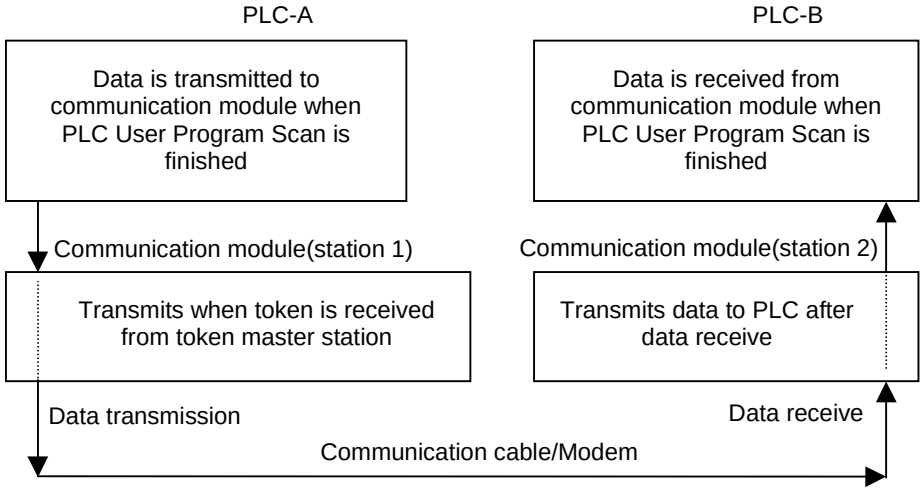


Fig. 6.2.8 Data sending path through communication module

Three paths should be passed to transmit data to other station through communication as Fig. 6.2.8(A), and transmission time is determined by the total time taken according to each path. Main path of data transmission and the elements that affect the taken time according to each path are as Table 6.2.8.

Table 6.2.8 Data transmission path and time elements

Path	Time affecting elements
PLC CPU(A) → Communication module(station 1)	Scan time of PLC-A program
Communication module(station 1) → Communication module(station 2)	Scan time of communication + Scan time of communication O/S
Communication Module(station 2) → PLC CPU(B)	Scan time of PLC-B program

In data transmission between PLC CPU and communication module, because it is transmitted on the time when PLC user program is finished, scan time of PLC user program becomes main element of data transmission. If user selects PLC information in On-line menu of GMWIN, user can know Max./Min./current scan time of program through program scan time.

Communication module should obtain communication right, namely, token to transmit data of itself, and this is determined according to token rotation time. After that, Tx/Rx of data is performed, so this time also be included in communication delay time

Fig. 6.2.8(B) shows transmission time according to the scan time of PLC program and communication scan time.

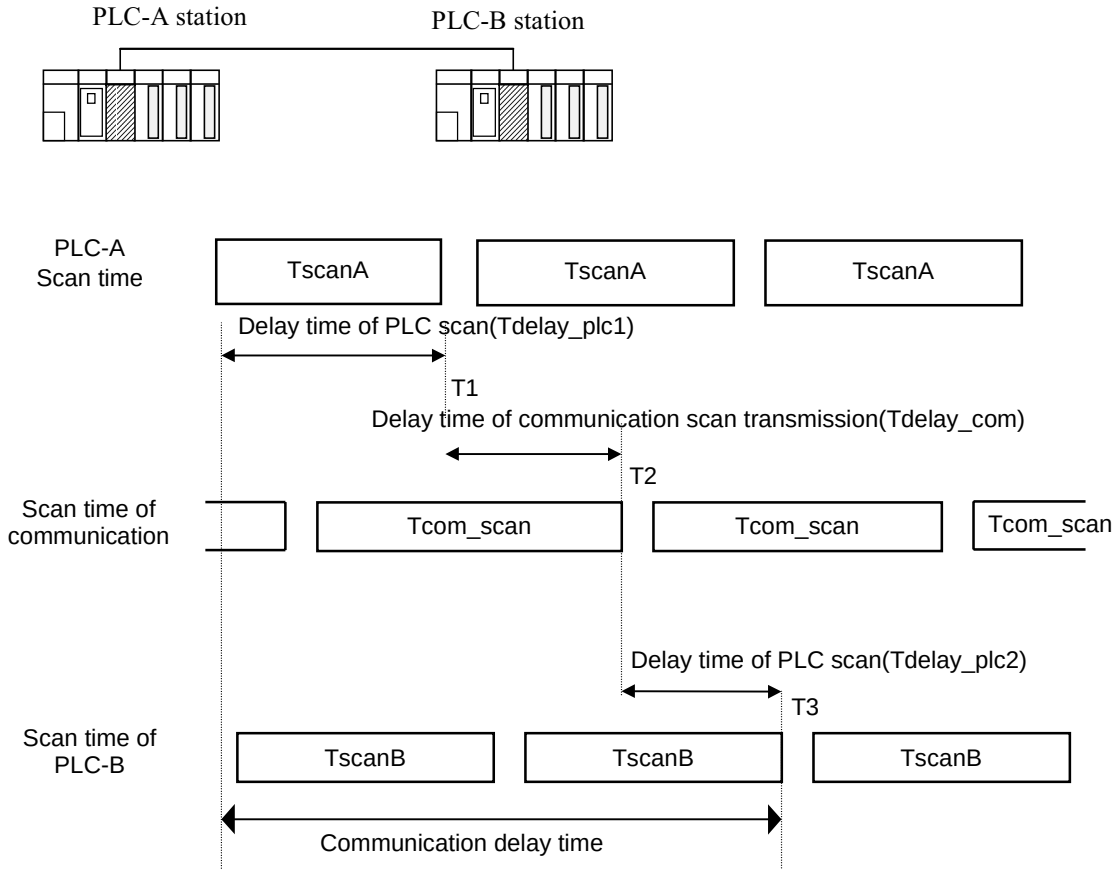


Fig. 6.2.8(B) Relation between PLC and communication in scan time

In Fig. 6.2.8(B), the total communication delay time is T1+T2+T3. Communication delay time is determined by the entire number of communication stations, the program size, the O/S scan time of communication module, and the others. But these variables are difficult to calculate. Therefore, the following simple example of communication speed in *high speed link* can be presented.

2) How to calculate speed of *high speed link*

Speed of *high speed link* in fig.6.2.8(B) supposes that it is to calculate the Max. time required to be taken when data of one block is transmitted from PLC-A to PLC-B. Communication delay time that is depending on entire communication station number and program size can be calculated with two different cases : the one is complicated system that number of stations is 10 or more and number of data to be sent exceeds 512 byte ; the other is simple system of the less. The calculations are as follows :

(1) Simple system

In a simple system that the number of entire communication stations is less than 10 and the size of transmission data is 512 byte or less, the speed of *high speed link* can be calculated with a simple equation as follows :

St = P_scanA + C_scan + P_scanB .....[Equation 6.2.8(A)]

St = Max. transmission time of *high speed link*
P_scanA = Max. program scan time of PLC A
C_scan = Max. communication module scan time
P_scanB = Max. program scan time of PLC B

And each item can be calculated as followings :

① C_scan = Th × Sn .....[Equation 6.2.8(B)]

Th = Token hold time : token using time per 1 station
Sn = Total station number : Entire communication station number

② Token hold time(Th)= ┬ Fnet : 8ms
└ Mnet : 2.3ms

(2) Complicated system

In a complicated system that the number of entire communication stations is 10 or more and the size of transmission data is 512 byte or more, the speed of *high speed link* is calculated as the following equation.

St = Et × To × Ntx + Mf .....[Equation 6.2.8(C)]

Et = Effective Tx ratio
To = Octet time(transmission time of one byte)
Ntx = Total Tx number
Mf = Margin factor,

and each item is determined as follows :

☐ Et = St × Nf .....[Equation 6.2.8(D)]

St = total number of communication stations
Nf = Network factor, constant value according to characteristics of communication system
Fnet system : 1.5, Mnet system : 1.2

☐ To = Octet time, time taken in transmitting one byte data as a serial data, and this is determined as follows :
– Fnet : 8 ☐s,
– Mnet : 1.6 ☐s

☐ Ntx = Number of total receive data including number of variable services, and this is determined as follows :

- Fnet : Sum of transmission byte number of *high speed link* + Number of variable F/B × 256
- Mnet : Sum of transmission byte number of *high speed link* + Number of variable F/B × 1,024

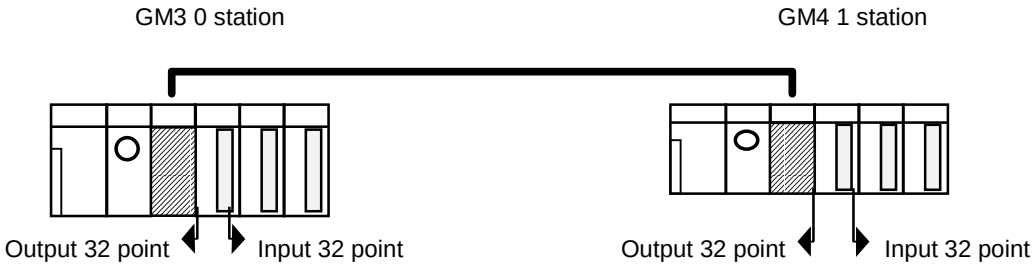
☐ Mf = Margin factor for elements which can't be expressed with above expressions, like O/S scan time of communication module, etc., and this is determined as follows :

- Fnet : 16ms,
- Mnet : 50ms

6.2.9 Ex. 1 : *High speed link* among PLCs of Fnet

Ex. 1

In GM3/GM4 base, slot 0 has communication module, slot 1 output 32-point, and slot 2 input 32-point module mounted. 32-point data(%IW0.2.0) of GM3 is sent to %MWO of GM4, and 32-point data(%IW0.2.0) of GM4 is sent to %MW100 of GM3. These are supposed.



To perform the program of Ex.1, firstly configure I/O configuration table as Table 6.2.9, and prepare *high speed link* parameter in each appropriate CPU module.

Table 6.2.9 I/O configuration and Tx/Rx flow

Tx/Rx structure		I/O configuration (All stations same)	Area to read	Storing area	Block No.	Size (word)
GM3 (station 0)	TX : →GM4	Slot 0 : communication module Slot 1 : OUT 32 point Slot 2 : IN 32 point	%IW0.2.0	--	0	2
	RX : ←GM4		--	%MW100	1	2
GM4 (station 1)	TX : →GM3		%IW0.2.0	--	1	2
	RX : ←GM3		--	%MW0	0	2

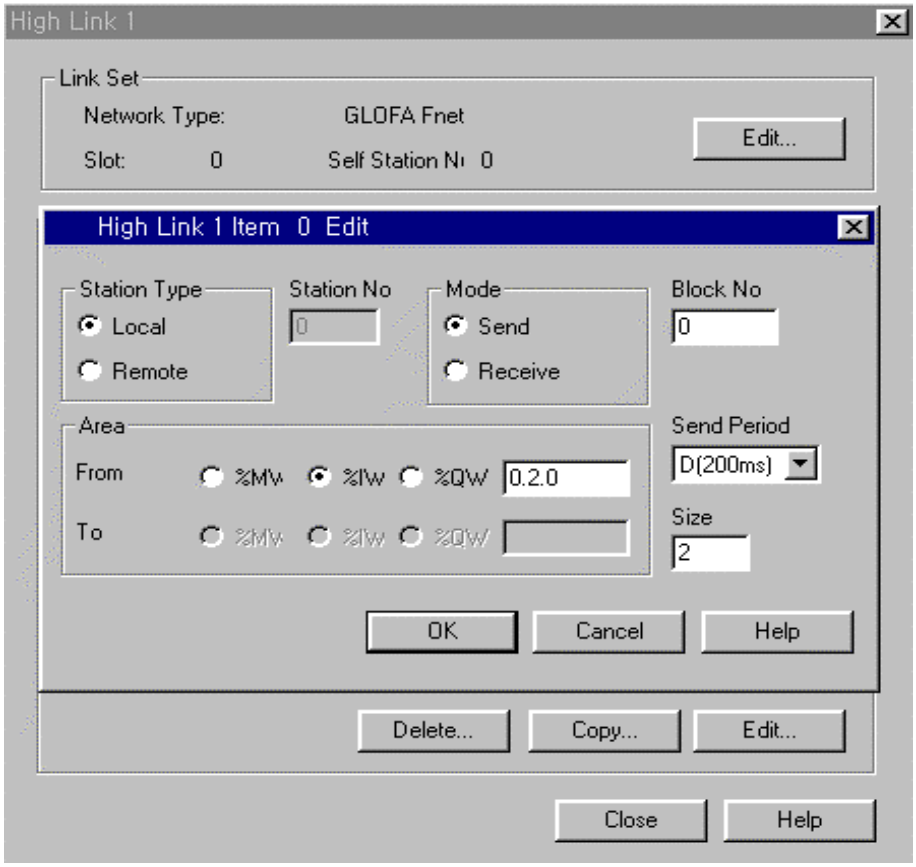
Working procedure(GM3 and GM4 are the same)

1) Allocate station No. and connect communication cable.
2) Prepare user program(for each station).
3) Prepare data Tx/Rx map of the type as Table 6.2.9.
4) Set parameter in *high speed link* parameter setting item of GMWIN.
5) Perform compile and make in compile menu.
6) Carry out program and parameter writing in on-line menu.
7) Select link enable setting in on-line menu, and set the *high speed link* enable that fits to set number.
8) Change mode into RUN in on-line menu.
9) Start monitoring in on-line menu, and verify whether RUN link has become On without error under *high speed link* monitor.
10) When error occurs, perform from 1) again.

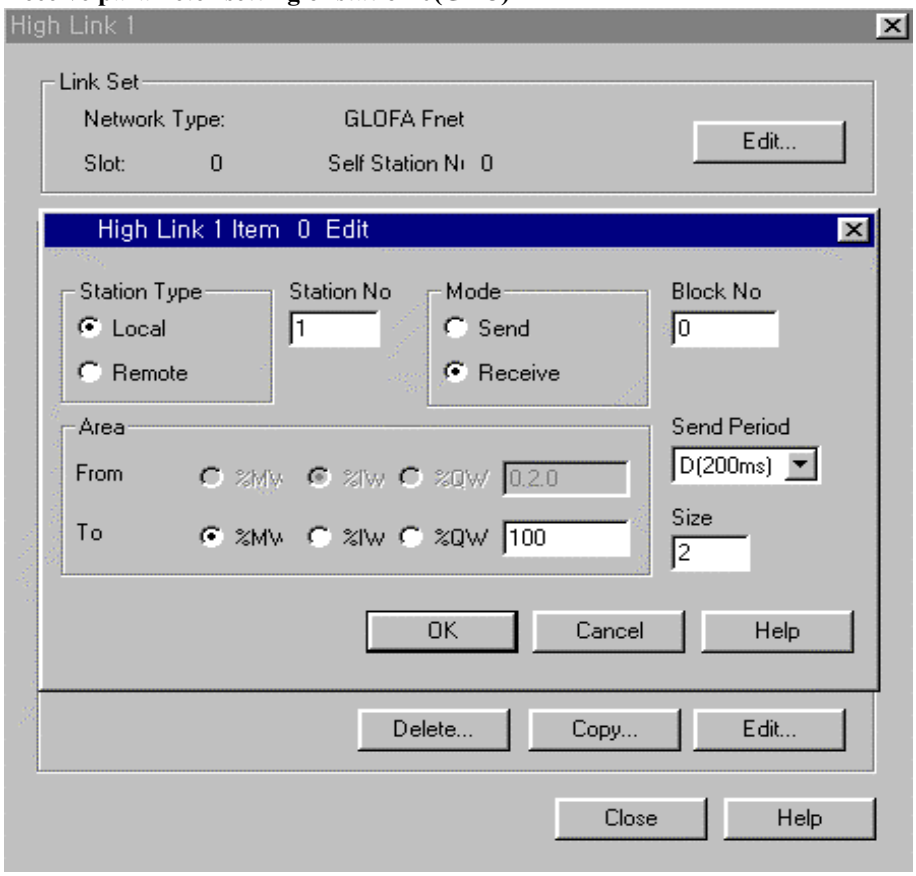
Remark

When data sent via block No. '0' from station 0 is used in station 1, the receive parameter block No. must be set to 0. That is, when data sent from other station is received, the block No. used in other station must also be equally used in receiving side.

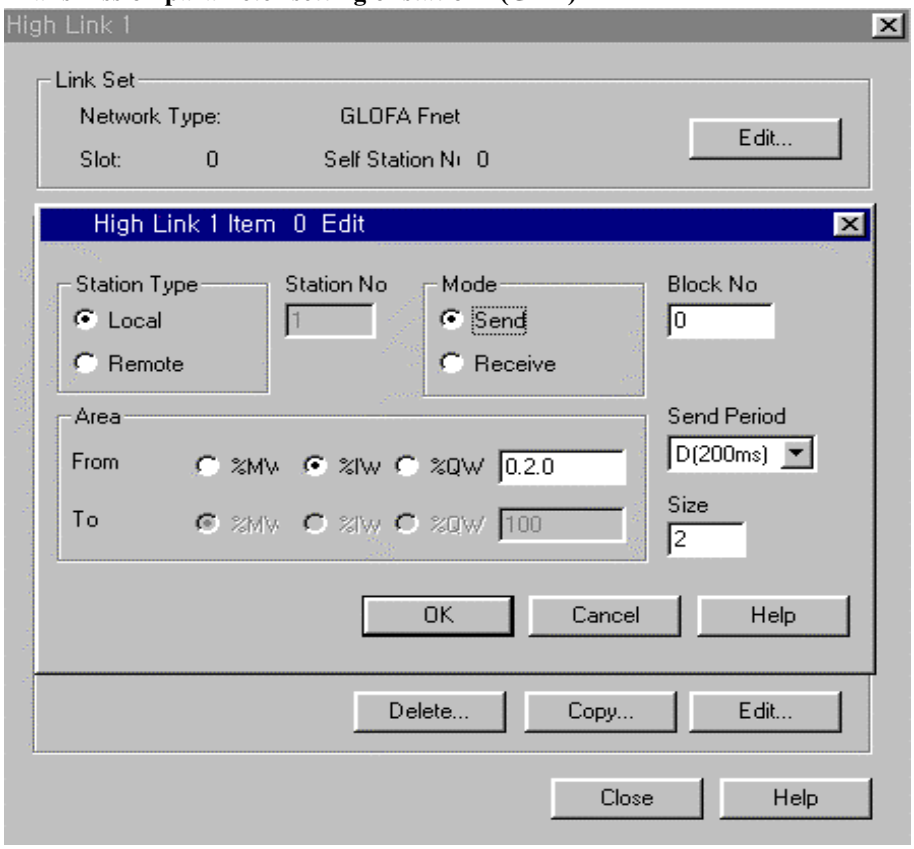
(1) Transmission parameter setting of station 0(GM3)



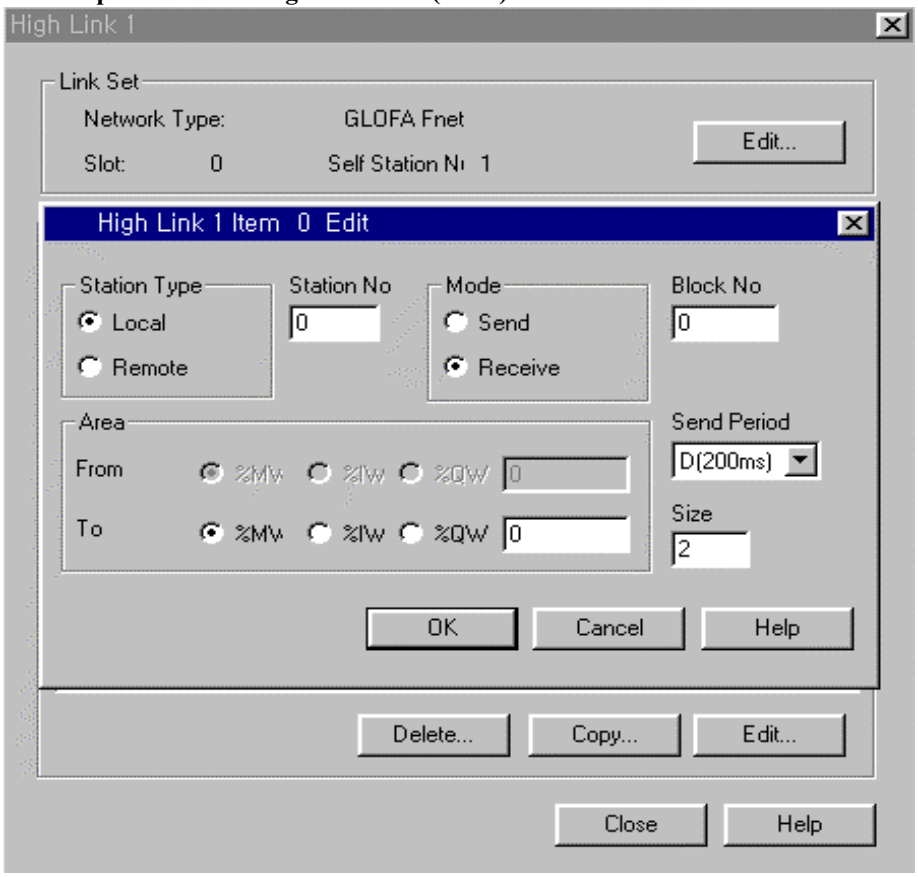
(2) Receive parameter setting of station 0(GM3)



(3) Transmission parameter setting of station 1(GM4)



(4) Receive parameter setting of station 1(GM4)



6.2.10 Ex.2 : *High speed link* of Master + Remote I/O station in Fnet

Ex. 1

Example that GM3 input module data(%IW0.1.0) is transmitted to GM4 remote output module(%QW0.0.0) and remote GM4 input module data(%IW0.1.0) is transmitted to GM3 output module(%QW0.2.0), in Fig. 6.2.10.

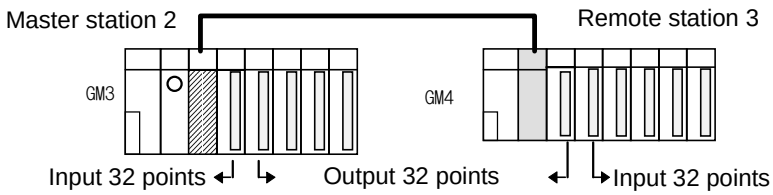


Fig. 6.2.10 Combined system of Fnet Master/Remote

Table 6.2.10 Configuration map of *high speed link* parameter

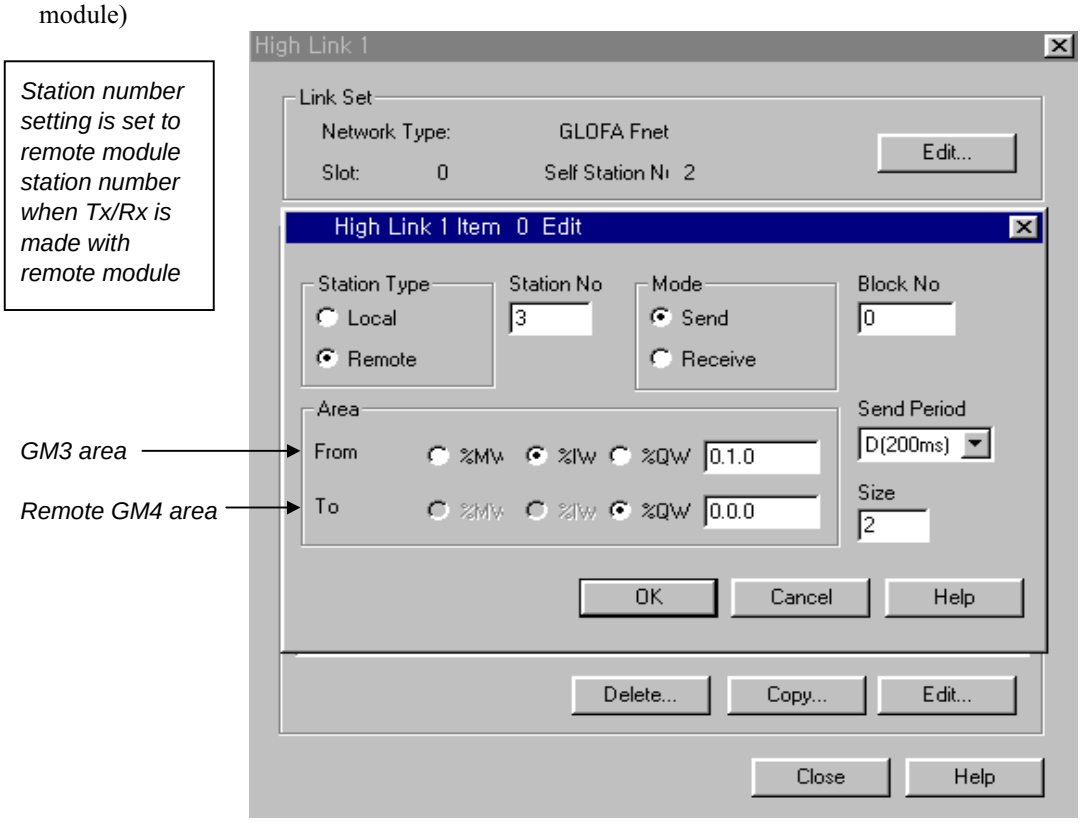
Tx/Rx structure		Area to read	Area to store	Size(word)	Block
GM3 (station 2)	TX:-->GM4	%IW0.1.0(GM3)	%QW0.0.0(GM4)	2 (32 points)	0
	RX:<--GM4	%IW0.1.0(GM4)	%QW0.2.0(GM3)	2 (32 points)	1

I/O configuration GM3 slot 0 : Communication module
slot 1 : Input 32 points
slot 2 : Output 32 points

GM4 slot 0 : Output 32 points
slot 1 : Input 32 points
Slot 0 is the right side of remote module.

(1) Transmission parameter setting of GM3 station 2 (Reads GM3 input and outputs GM4 output module)

Station number setting is set to remote module station number when Tx/Rx is made with remote module



(2) Receive parameter setting of GM3 station 2 (Reads remote GM4 input and outputs GM3 output module)