Chapter 13 The Applications for FB-PLC Link Function

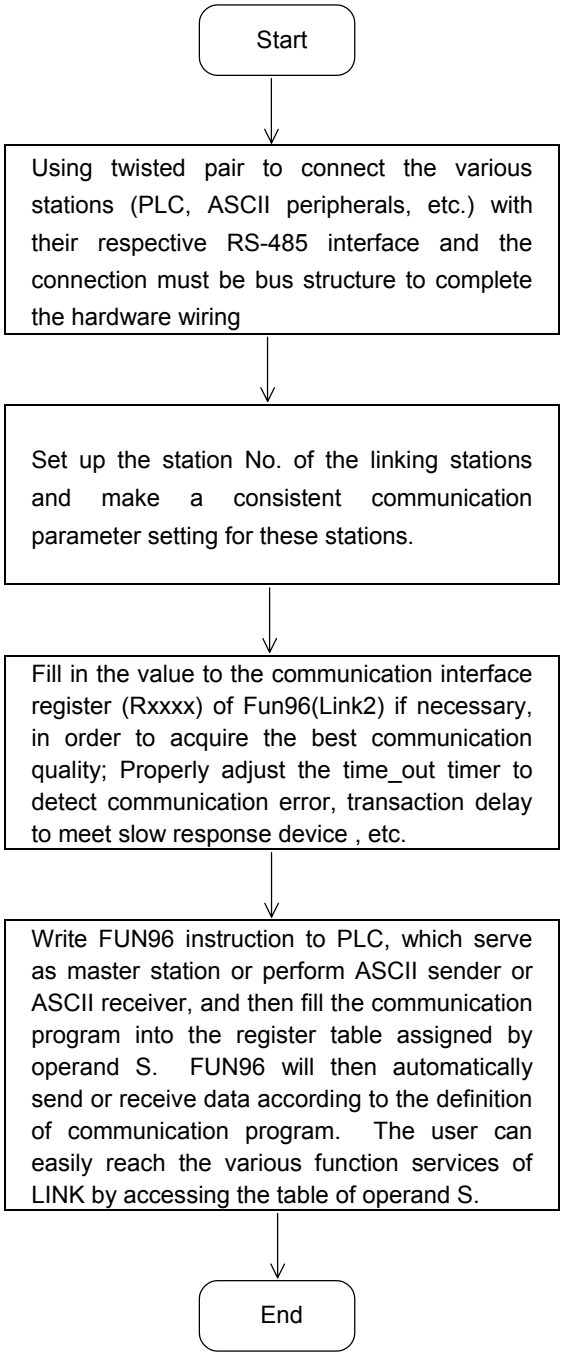
As previously revealed in Chapter 12 that the FB-PLCs connect through the two communication ports - port1 or port2 - to make multi_drop link operation (both of the ports must be applied in the “ladder diagram control interface”). Of which, Port 2 is controlled by FUN96 “LINK2” instruction while Port 1 by FUN97 (LINK1). For the application of connecting multiple stations, Port2 has a built-in RS-485 interface for multiple stations linkage that can directly link to other PLCs or peripherals with identical RS-485 interface. However, since Port1 has a built-in RS-232 interface that allows one on one links only, it must employ the FB-485 communication adaptor to convert the RS-232 interface into a multiple linking RS-485 interface before it can pave multiple linkages to other RS-485 equipment.

The FUN96 (LINK2) instruction provides MD0 to MD3 four kinds of instruction mode, and the FUN97 (LINK1) instruction provides MD0 to MD2 three kinds of instruction mode. Except that the MD3 mode of FUN96 is a “High Speed Link Network” mode, the others are for “Ordinary Network Link” mode. Except that the setting of maximum speed transferring rate could be different, the other parameters, operations, and usages for “Ordinary Network Link” of FUN96 & FUN 97 are similar. The following list enlisted the description for the difference on various instruction modes for the two LINK instructions of FUN96 and FUN97.

<table>
<tr><th colspan="2">Item
Category</th><th>Baud Rate</th><th>Data Length</th><th>Transmitting code</th><th>Error detection</th><th>Command processing speed</th></tr>
<tr><td rowspan="2">FUN96
(LINK2)</td><td>High Speed LINK
（MD3）</td><td>38.4Kbps
|
614.4Kbps</td><td>8bits</td><td>Binary code</td><td>CRC-16</td><td>Immediately</td></tr>
<tr><td>Ordinary LINK
（MD0～MD2）</td><td>4.8Kbps
|
614.4Kbps</td><td rowspan="2">7 or 8bits
Adjustable</td><td rowspan="2">ASCII code</td><td rowspan="2">Checksum</td><td rowspan="2">Processing during Housekeeping</td></tr>
<tr><td>FUN97
(LINK1)</td><td>Ordinary LINK
（MD0～MD2）</td><td>600bps
|
38.4Kbps</td></tr>
</table>

13.1 Application for FUN96 (port2) instruction

13.1.1 Procedure for FUN96 (LINK2) usage

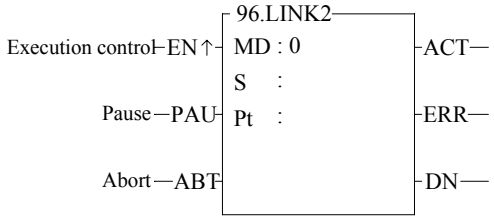


- Please refer to section 12.5 for the explanation on hardware wiring layout for communication port.
- Station number can be set to any one between 1 to 254 without replication. The setting of station No. can be performed under PROLADDER or No. 5 of the function item of Configuration in FP-07.
- For communication parameter, please refer to section 12.6.2 for description of communication parameter setting.
- Please refer to program example in section 13.1.2 for description and definition of interface processing signals.
- Please refer to program example in section 13.1.2 for description of definition and usage of the operand S.

13.1.2 Explanation of respective modes and application program example for FUN 96 (LINK2)

This section will base on the four instruction modes (MD0 to MD3) of FUN96 (LINK2) instruction to explain their usages, with respective practical application program examples.

FUN 96 LINK2	Convenient instruction for FUN96(LINK2): MD0 communication network (which makes PLC as the master station in CPU LINK network through Port2)	FUN 96 LINK2



MD : 0, serves as master station for Fatek CPU LINK (employs Fatek communication protocol)

S : Starting register of communication program (see example for its explanation)

Pt : Starting register for instruction operation (see example for its explanation). It controls 8 registers, the other programs can not repeat in using.

Operand \ Range	HR	ROR	DR	K
	R0 | R3839	R5000 | R8071	D0 | D3071	
MD				0～3
S	○	○	○	
Pt	○	○*	○	

Descriptions

1. FUN96 (LINK2): MD0 instruction provides data sharing among the Fatek PLCs.
2. The master PLC may through its built-in RS-485 interface connects with 254 slave PLCs and share data with each other.
3. Only the master PLC needs to use LINK2 instruction (thus, port2 defined as "ladder diagram control interface") while the other slave PLCs need not to use the instruction (thus, defined as "standard interface").
4. It employs the program coding method or table filling method to plan for the data flow controls; i.e. from which one of the slave PLC to get which type of data and save them to the master PLC, or from the master PLC to write which type of data to the assigned slave PLC. It needs only seven registries to make definition; every seven registers define one packet of data transaction.
5. When execution control 〝EN↑〞 changes from 0→1 and both inputs Pause “PAU” and Abort “ABT” are 0, and if Port2 hasn’t been controlled by other FUN96 instructions (i.e. M1962 = 1), this instruction will control the Port2 immediately and set the M1962 to be “0” (which means it is being occupied), then going on a packet of data transaction immediately. If Port2 has been controlled (M1962 = 0), then this instruction will enter into the standby status until the controlling FUN96 instruction complete its transaction or pause/abort its operation to release the control right (M1962=1), and then this instruction will become enactive, set M1962 to be 0, and going on the data transaction immediately.
6. While in transaction processing, if operation control “PAU” becomes 1, this instruction will pause and release the control right (M1962 set to be 1) after it finishes the on going transaction. Next time, when this instruction takes over the transmission right again , it will keep going on the next packet of data transaction (this means that the pause operation is based on a packet of data transaction).
7. While in transaction processing, if operation control “ABT” becomes 1, this instruction will halt immediately and release the control right (M1962 set to be 1). Next time, when this instruction takes over the transmission right again, it will restart from the first packet of data transaction.
8. While it is in the data transaction, the output indication “ACT” will be ON.
9. If there is error occurred when it finishes a packet of data transaction, the output indication “ERR” will be ON.
10. If there is no error occurred when it finishes a packet of data transaction, the output indication “DN” will be ON.

FUN 96 LINK2	Convenient instruction for FUN96(LINK2): MD0 communication network (which makes PLC as the master station in CPU LINK network through Port2)	FUN 96 LINK2

【Interface signals】

M1962: This signal is generated from CPU.
ON, it represents that Port2 is free and ready.
OFF, it represents that Port2 is occupied, data transaction is going.

M1963: This signal is generated from CPU.
When the communication program completed the last packet of data transaction, M1963 will be ON for a scan time (for successive data transaction).
When the communication program completed the last packet of data transaction, M1963 will be ON (for single packet of data transmission).

R4053: Response delay time setting (the unit is in mS and the default is 4; it means 4mS delay);
When slave PLC or PLC linking through Port2 with computer, man machine interface (MMI), or graphic supervisor, you may set the response delay time. Since Port2 is designed as high speed RS-485, it replies at immense speed with nearly no bit of time wasted. Therefore, it must have response delay so that computer, MMI, or graphic supervisor could be in time to receive data replied by PLC without loss.

R4157: The Port2 Rx/Tx Time-out setting. The system will produce pertaining setting value according to R4158 communication parameter setting; the user needs not to set it.

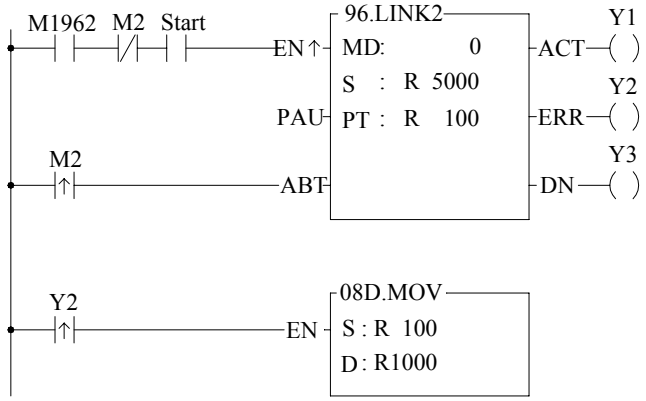
R4158: The register for communication parameter setting of Port2.
(please refer to section 12.6.2 for Port2 communication parameter setting descriptions)

R4159: The content of Low Byte defines the Time-out span of LINK2 instruction; its unit is 0.01 second
(the default is 50, which means 0.5 second)
The LINK2 instruction (only master PLC needs) employs Time-out span to judge whether the slave PLC on line or not. When the master PLC sent out the read/write command to the slave PLC, the slave PLC didn't reply within this period means that there is abnormal event in communication called Time-out. When there are multi-PLCs linking, properly adjust this value (greater than 1 scan time of the slave PLC with the longest scann time) to shorten the communication response time among the active linking PLCs if there are many slave PLCs power off (The time-out cases will happen).

: The content of High Byte defines the transmission delay time between two packets of data transaction for LINK2 instruction; its unit is 0.01 second (the default is 0). For point to point link, this value can be set as 0 to shorten the communication transaction time and promote the communication efficiency. In the case of linking multi-PLCs and if the scan time of master PLC is far longer than any slave PLC, this value can be set to 0 to shorten the communication transaction time and promote the communication efficiency. When there are multi-PLCs to link in parallel by using master/slave method and the scan time of master PLC is close to that of slave PLCs, it must properly adjust this value (greater than 1 scan time of the slave PLC with the longest scan time) to reach the best, error-free communication quality.

FB-PLC acts as the master of Fatek CPU LINK network through Port 2

Program example Automatic cycling transmission



- Configure R5000～R5199 as the read only register (ROR)before programming,after then, when storing program, the ladder program will automatically contains the communication program .
- When ABT is not controlled, it is not necessary to input the M2 contact instruction.
- When there is communication error, gets and stores the error message to R1000 & R1001 would be helpful for error analysis or logging.

Description

● Explanation for operand S of FUN96: MD0 (R5000 just only for example,other registers can be used also)

R5000: Starting register of communication program (data transaction table) by filling table method (Not easy)

R5000	Total transactions	• Low Byte is valid; one transaction takes 7 registers to describe, which means 7 registers define a packet of data transaction.
R5001	Slave station No. which is about to transact with	• Low Byte is valid, 0～254 (0 means that master PLC broadcasts the data to all slave PLC, the slave PLC does not reply).
R5002	Command code	• Low Byte is valid; =1, means reading data from slave PLC; =2, means writing data to slave PLC.
R5003	Data length of this transaction	• Low Byte is valid; the range is 1～64. It defines the data length of this transaction.
R5004	Data type of Master PLC	• Low Byte is valid, and its range is 0 to 13; it defines the data type of master PLC (see next page).
R5005	Starting reference of Master PLC	• Word is valid; it defines the starting address of data (master).
R5006	Data type of slave PLC	• Low Byte is valid, and its range is 0 to 13; it defines the data type of slave PLC (see next page).
R5007	Starting reference of Slave PLC	• Word is valid; it defines the starting address of data (slave).
R5008	Slave station No. which is about to transact with	Description of the 2_nd packet of transaction
R5009	Command Code	
R5010	Data length of this transaction	
R5011	Data type of Master PLC	
R5012	Starting reference of Master PLC	
R5013	Data type of slave PLC	
R5014	Starting reference of Slave PLC	

FUN96:MD0 program example

FB-PLC acts as the master of Fatek CPU LINK network through Port 2

● Master/Slave data type, code and reference number

Data code	Data type	Reference number
0	X (discrete input)	0～255
1	Y (discrete output)	0～255
2	M (internal relay M)	0～1911
3	S (step relay S)	0～999
4	T (timer contact)	0～255
5	C (counter contact)	0～255
6	WX (word of discrete input ,16 bits)	0～240, it must be the multiple of 8.
7	WY (word of discrete output ,16 bits)	0～240, it must be the multiple of 8.
8	WM (word of internal relay,16 bits)	0～1896, it must be the multiple of 8.
9	W S (word of step relay,16 bits)	0～984, it must be the multiple of 8.
10	TR (timer register)	0～255
11	CR (counter register)	0～199
12	R (data register Rxxxx)	0～3839
13	D (data register Dxxxx)	0～3071

Note: The data type for master and slave must be consistent. i.e. if the master station is any value between 0 to 5, the slave station must also be any value between 0 to 5; if the master station is any value between 6 to 13, the slave station must also be any value between 6 to 13.

● Explanation for operand Pt of FUN96:MD0 (R100 just only for example,other registers can be used also)

	High Byte	Low Byte
R100	Result code	Transaction No.
R101	Station number	Command code
R102	For internal operation	
R103	For internal operation	
R104	For internal operation	
R105	For internal operation	
R106	For internal operation	
R107	For internal operation	

- Result code indicates the transaction result; 0= normal, other value =abnormal.
- Transaction No. indicates which one is in processing (beginning from 0).
- Station number: the slave station No. which is in transaction.
  Command code
  =44H, reading successive discrete status from slave PLC.
  =45H, writing successive discrete status to slave PLC.
  =46H, reading successive registers from slave PLC.
  =47H, writing successive registers to slave PLC.
- R104's B0=1, Port2 has been occupied and this instruction is waiting to acquire the transmission right for data transaction.
  B4=1, this instruction is not first time performing.
  B12, output indication for "ACT"
  B13, output indication for "ERR".
  B14, output indication for "DN".

Result code: 0, this transaction is successful.
2, data length error (data length is 0 or greater than 64 in one transaction).
3, command code error (command code is greater than 2).
4, data type error (data type is greater than 13, please refer to data type code).
5, reference number error (please refer to reference number).
6, inconsistence in data type (e.g. master station is 0～5 while slave is 6～13).
A, communicating, but no response from slave station (Time-out error).
B, communication error (received error data).

FB-PLC acts as the master of Fatek CPU LINK network through Port 2

- To make it easy to edit, read, and maintain the communication program, we have extended following related instructions under FUN96:MD0, 3 and FUN97:MD0 instructions. The user may edit, and modify the communication program directly in PROLADDER (if you are intending to edit the communication program with the PROLADDER in DOS version, key in the complete FUN96 or FUN97 instruction and then move cursor to position of FUN96 or FUN97 instruction and press “ALT” “Z” at the same time and it will display and allow to edit the communication program. While editing the communication program, simultaneously pressed “Shift” “INS” means to insert a frame of data transaction at the cursor position; simultaneously pressed “Shift” “DEL” means to delete the cursor position indicated frame of transaction; simultaneously pressed “ALT” “INS” or “Shift” “+” means to append a frame of data transaction to the bottom).

Extension instructions for communication

Frame No.	Instruction	Operand	Explanation
nnn	Station#	Station number (xxx)	Describing the station number of slave PLC which is about to transact with. Station number=0, The master PLC broadcasts the data to all slave PLCs and slave PLCs will not reply while in FUN96:MD 0 or FUN97:MD 0. (Station No. can’t be 0 for FUN96:MD3) Station number=1~254 For FUN96:MD0 or FUN97:MD0, it means the station number of the slave PLC which is about to transact with the master PLC; For FUN96:MD3, it means station number of the PLC that is about to broadcast in high speed CPU link.
	Command	Read	Master PLC read data from the slave PLC.
		Write	Master PLC write data to the slave PLC.
			(Read,Write can only be used for FUN96:MD0 or FUN97:MD0)
		H_Link	High speed CPU link (only for FUN96:MD3, and it must employ H_link for all transactions; can not mix with Read, and Write when using)
	Length	1～64 or 1～32	Data length of this transaction. For FUN96:MD0 or FUN97:MD0, the length is 1～64. For FUN96:MD3, the length is 1～32.

FUN96:MD0 program example

FB-PLC acts as the master of Fatek CPU LINK network through Port 2

Frame No.	Instruction	Operand	Explanation
nnn	M_Start	X0 ～ X255 Y0 ～ Y255 M0 ～ Y1911 S0 ～ S999 T0 ～ T255 C0 ～ C255 WX0 ～ WX240 WY0 ～ WY240 WM0 ～ WM1896 WS0 ～ WS984 TR0 ～ TR255 CR0 ～ CR199 R0 ～ R3839 D0 ～ D3071	Describing the data type & reference number of this packet of transaction for the master PLC. (for FUN96:MD0 or FUN97:MD0) The number for WX, WY, WM, and WS must be the multiple of 8.
	S_Start	X0 ～ X255 Y0 ～ Y255 M0 ～ Y1911 S0 ～ S999 T0 ～ T255 C0 ～ C255 WX0 ～ WX240 WY0 ～ WY240 WM0 ～ WM1896 WS0 ～ WS984 TR0 ～ TR255 CR0 ～ CR199 R0 ～ R3839 D0 ～ D3071	Describing the data type & reference number of this frame of transaction for the slave PLC. (for FUN96:MD0 or FUN97:MD0) The number for WX, WY, WM, and WS must be the multiple of 8.
	Start	R0～R3839 D0～D3071	Data type & reference number for high speed CPU link transaction (for FUN96:MD3)

FB-PLC acts as the master of Fatek CPU LINK network through Port 2

Example: Programming for data transaction with instruction method

R5000: Starting register of communication program (It's very easy to plan the data flow by this method)

Content of registers	Description	Planning the transaction with extended instructions
R5000:5	5 packet of transactions in total.	Total transactions:5
R5001:0 R5002:2 R5003:16 R5004:12 R5005:500 R5006:13 R5007:0	Broadcasting from master PLC Write data to all slave PLCs Length of data is 16 Data type of master PLC is R Reference number of master PLC is 500, i.e. R500 Data type of slave PLC is D Reference number of slave PLC is 0, i.e. D0	000 Station# 0 Command Write Length 16 M_start R500 S_start D0
• Masater PLC broadcasts the R500～R515 to all slave PLCs' D0～D15		
R5008:2 R5009:1 R5010:10 R5011:12 R5012:20 R5013:12 R5014:200	The slave PLC in transaction is the station No.2 Read data from slave PLC Data length is 10 Data type of master PLC is R. Reference number of master PLC is 20, i.e. R20 Data type of slave PLC is R Reference number of slave PLC is 200, i.e. R200	001 Station# 2 Command Read Length 10 M_start R20 S_start R200
• Read R200～R209 from slave PLC No.2 to R20～R29 of master PLC		
R5015:3 R5016:1 R5017:20 R5018:2 R5019:1000 R5020:2 R5021:100	The slave PLC in transaction is the station No.3 Read data from slave PLC Data length is 20 Data type of master PLC is M. Reference number of master PLC is 1000, i.e. M1000 Data type of slave PLC is M Reference number of slave PLC is 100, i.e. M100	002 Station# 3 Command Read Length 20 M_start M1000 S_start M100
• Read M100～M119 from slave PLC No.3 to M1000～M1019 of master PLC		
R5022:4 R5023:2 R5024:20 R5025:2 R5026:1000 R5027:3 R5028:100	The slave PLC in transaction is the station No.4 Write data to slave PLC Data length is 20 Data type of master PLC is M. Reference number of master PLC is 1000, i.e. M1000 Data type of slave PLC is S Reference number of slave PLC is 100, i.e. S100	003 Station# 4 Command Write Length 20 M_start M1000 S_start S100
• Master PLC writes M1000～M1019 to S100～S119 of slave PLC No.4, i.e. to write from M100～M119 of slave PLC No. 3 to S100～S119 of slave PLC No.4		
R5029:4 R5030:1 R5031:4 R5032:9 R5033:0 R5034:6 R5035:0	The slave PLC in transaction is the station No.4 Read data from slave PLC Data length is 4 (4 words this situation) Data type of master PLC is WS. Reference number of master PLC is 0, i.e. WS0 Data type of slave PLC is WX Reference number of slave PLC is 0, i.e. WX0	004 Station# 4 Command Read Length 4 M_start WS0 S_start WX0
• Read X0～X63 of slave PLC No.4 to S0～S63 of master PLC		

FUN96:MD0 program example

FB-PLC acts as the master of Fatek CPU LINK network through Port 2

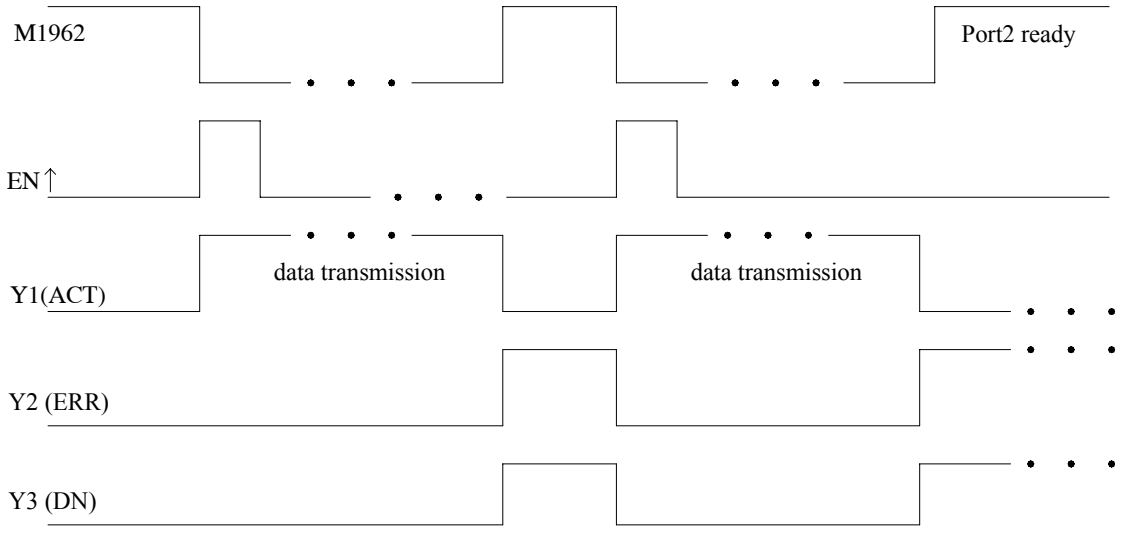
Explanation on program example

1. When execution control 〝EN ↑ 〞 changes from 0→1, and Port2 is not occupied by other FUN96 (M1962 ON) and M2=OFF, LINK2 instruction will start the data transaction. The M1962 is OFF during data transaction, and when the transaction is finished, the M1962 becomes ON. Employ the OFF←→ON change of M1962 (FUN96 execution control "EN ↑"=0→1 means starting) may automatically starts for every frame of data transaction successively (when the last packet of transaction is completed, it will automatically return to the first packet of transaction to obtain the automatic cycling transmission).
2. When abort control M2 changes from 0→1, it aborts transmission immediately (if the data is in transmitting, it will stop transmitting immediately). Next time when starts the transaction, it will begin from the first packet of transactions.

● Output indication

"ACT" ON: The Y1 ON, transaction is going
"ERR" ON: The Y2 ON, error occurred in previous packet of transaction (refer to result code).
"DN" ON: The Y3 ON, previous packet of transaction is completed and is error free.

● Waveform of input control and output indication



Note 1: Of Y2 and Y3, only one of them will be in ON status and not both to be ON at the same time.
2: After the last frame of transaction completed, the M1963 will be ON for one scan time.

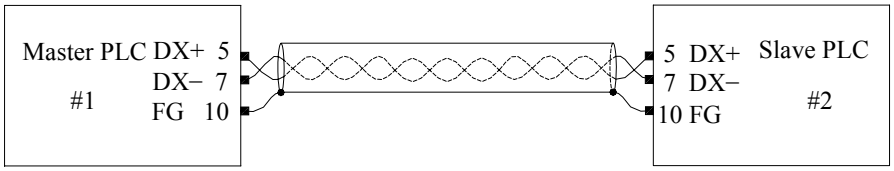
FB-PLC acts as the master of Fatek CPU LINK network through Port 2

〈Point to point wiring〉 Point to point link of master PLC and slave PLC through RS-485.

The communication port of PLC is a 15 Pin D-Sub female connector, therefore a 15 Pin D-Sub cable with both ends to be male connector is needed to link the PLCs.

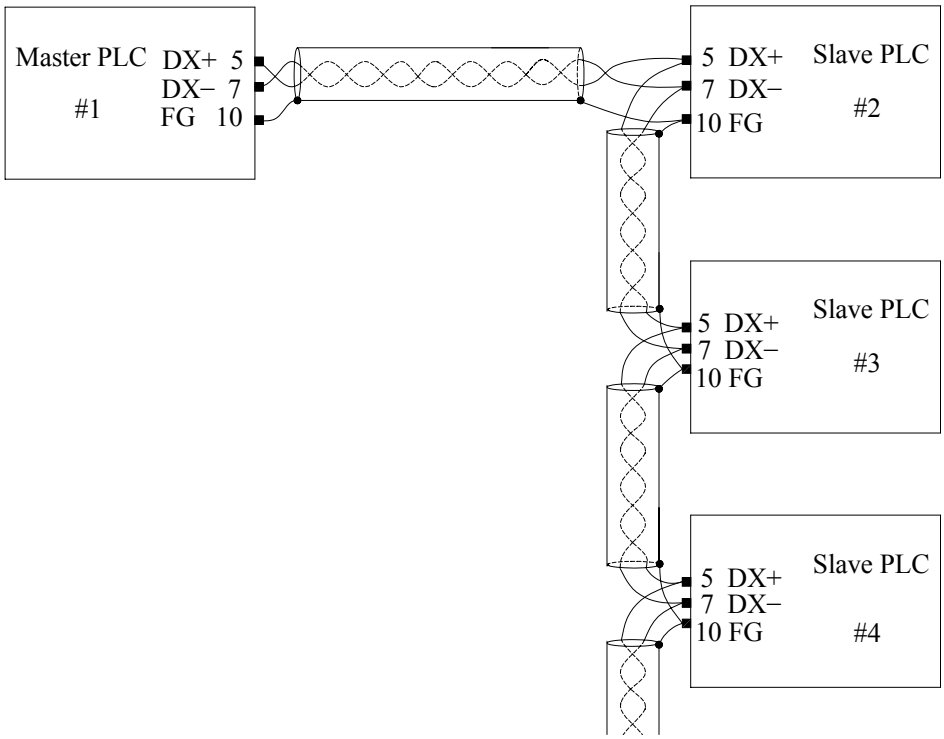
Connecting as follows:

PIN_5（DX+）⟷ PIN_5（DX+）
PIN_7（DX−）⟷ PIN_7（DX−）
PIN_10（FG）⟷ PIN_10（FG）



Note: It's more easy to use FB-485P2 adapter (with terminal block) to connect multi-stations in parallel.

〈Multi_drop wiring〉 Master PLC links with multi slave PLCs through built-in RS-485.

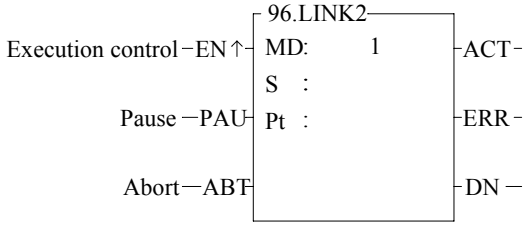


【Cautions】

1. The RS-485 wiring must employ twisted pair as the transmission cable.
2. Star topology of the wiring must be avoided ; it must be cascaded with stations one after one.
3. The outer layer of weaved net for twisted pair must connect to the FG (to prevent from interference and decrease the common mode interference).
4. Avoid the wiring operation when the PLC is in "RUN" mode, the interference from human body may cause the PLC into "STOP" mode that need to be shut down and restart again.

FUN96:MD1 instruction guide

FUN 96 LINK2	Convenient instruction for FUN96(LINK2): MD1 (Which makes PLC serve as “ASCII sender” through Port2)	FUN 96 LINK2



MD : 1, link with intelligent peripherals that equipped with ASCII interface.

S : Starting register for data transmission table (see example for explanation)

Pt : Starting register for instruction operation (see example for explanation). It controls 8 registers at least, the other programs cannot repeat in use.

Range / Ope-rand	HR R0 ~ R3839	ROR R5000 ~ R8071	DR D0 ~ D3071	K
MD				0～3
S	○	○	○	
Pt	○	○*	○	

Descriptions

1. FUN96(LINK2):MD1 instruction provides the Fatek PLC to act as the ASCII sender to link with the intelligent peripherals that equipped with ASCII interface.
2. A master PLC may connect to multi sets of peripherals that have identical communication protocol through built-in RS-485 interface.
3. The communication protocol/format is written with LADDER program, which must be consistent with the linked ASCII peripherals.
4. When execution control “EN ↑ ” turns from 0→1 and both pause “PAU” and abort “ABT” are 0, and if Port2 is not controlled by other FUN96 instruction (which means M1962=1), this instruction will control Port2 immediately and set M1962 to be “0” (being controlled) to proceed data transaction. If Port2 is being controlled (M1962=0), this instruction will enter into the wait state until the other controlling FUN96 instruction complete or pause/abort its operation and released the control right (M1962=1), and this instruction will enact again out of wait state to set the M1962 to be “0” and proceed the transmission transaction.
5. During transaction, if the pause “PAU” becomes 1, this instruction will pause and release the control right (set M1962 to be 1) after it completed the transmitting of the on-going data transmission.
6. During transaction, if the abort “ABT” becomes 1, this instruction will halt the transmission and release the control right immediately (set M1962 to be 1).
7. While transaction is going, the output indication “ACT” will be ON.
8 When a packet of data transaction is finished (transmission finished or "transmit then receive" completed), if there is error occurred, the output indication “ERR” will be ON.
9 When a packet of data transaction is finished (transmission finished or "transmit then receive" completed), if there is no error occurred, the output indication “DN” will be ON.

Convenient instruction for FUN96 (LINK2): MD1
(Which makes PLC serve as “ASCII sender” through Port2)

【Interface signals】

M1962: This signal is generated from CPU
ON means Port2 is ready.
OFF means Port2 is busy.

M1963: This signal is generated from CPU; the same as M1962.
ON, it means data transaction has been completed.

R4148: High byte of R4148, Time-out setting for receiving, which is used to determine whether a packet of data has been received completely. The unit is 0.001 second and default is 0CH(12mS).
Detailed description will be followed.

R4157: Port2 Rx/Tx time-out setting; the system will base on R4158 communication parameter to acquire the pertaining set point, hence the user need not to set.

R4158: The register for communication parameter setting of port 2.
(refer to section 12.6.2 for explanation on Port2 communication parameter setting)

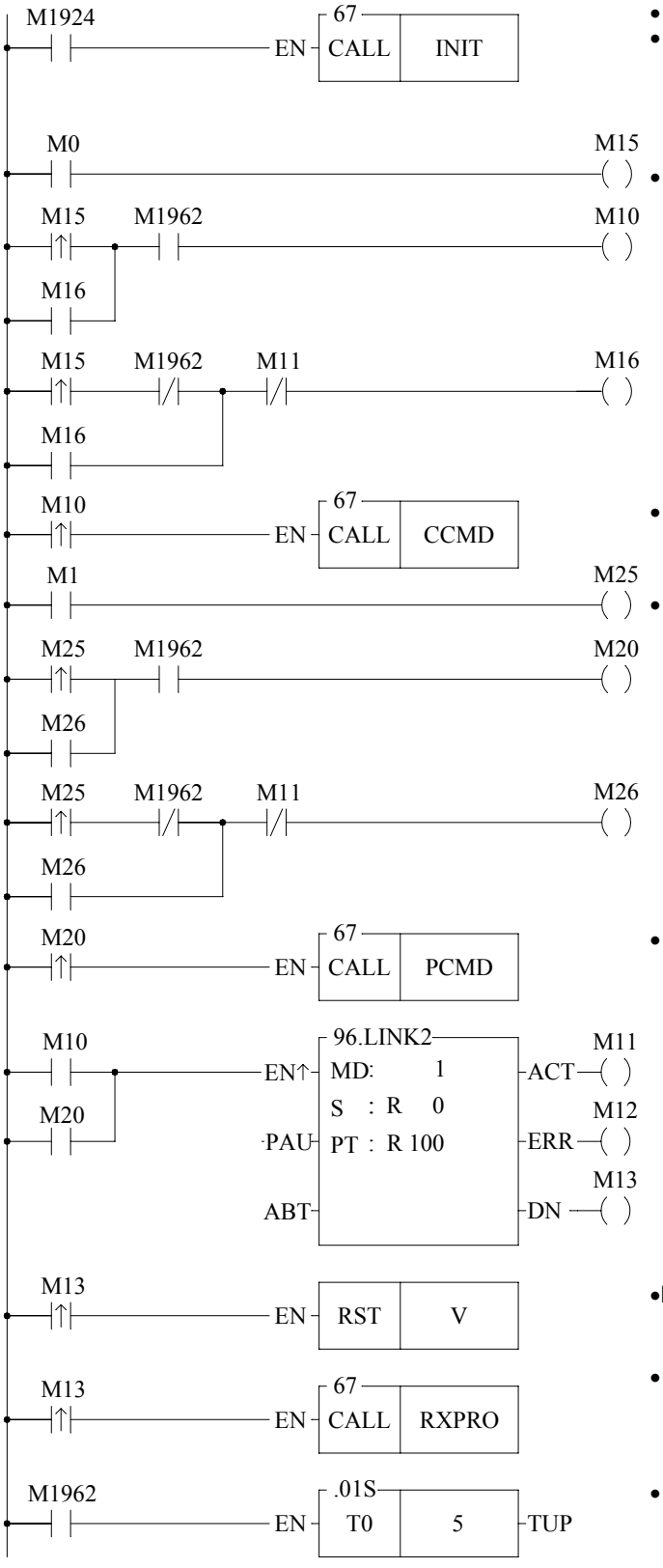
R4159: Low byte of R4159, it defines the Time-out span of link2 instruction; the unit is 0.01 second (the default is 32H, i.e. 0.5 second)
LINK2 instruction depends on Time-out span to detect whether the communication partner is free from error on line; when the LINK2 MD1 setting is in "transmit then receive" mode (example will be followed), the Time-out error will occur if PLC send a packet of data to the peripheral but it didn’t reply within this duration.
When LINK2 MD1 setting is "transmit" only (example will be followed), low byte of R4159 is meaningless.

: High byte of R4159, for FUN96:MD1, the recommended setting is 0.

FUN96:MD1 Program example

FB-PLC serves as “ASCII sender” through Port2

Program example PLC link to Inverter through Port2



- Calls the subroutine of turn on initialization
- The greatest benefit of initialization subroutine is that the default for registers are fully automatically set by program, free from manual setting.

- M0 ON, it gives the control command.

- When M10 changes from 0→1, it sends out the control command: R600 is the revolving operation command; R601 for the revolving frequency.
- M1 ON, it gives the command for parameter setting.

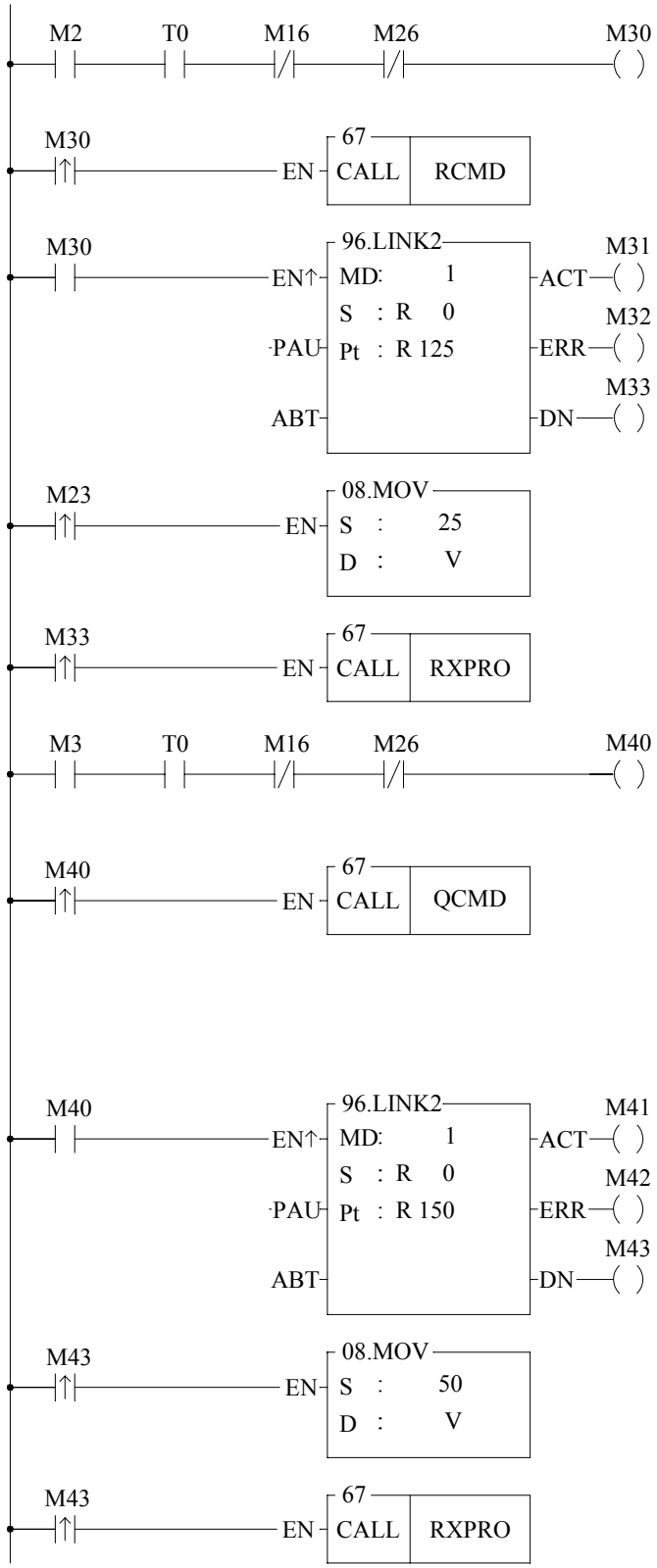
- When M20 changes from 0→1, it sends out the parameter setting command: R602 is the parameter number; R603 for the parameter data.

- Pointing to the receiving registers while the reply from the inverter being receivied.

- Process the received replying messages from inverter.

- Delay for 0.05 second before it can give another command to read parameter or read inverter status.

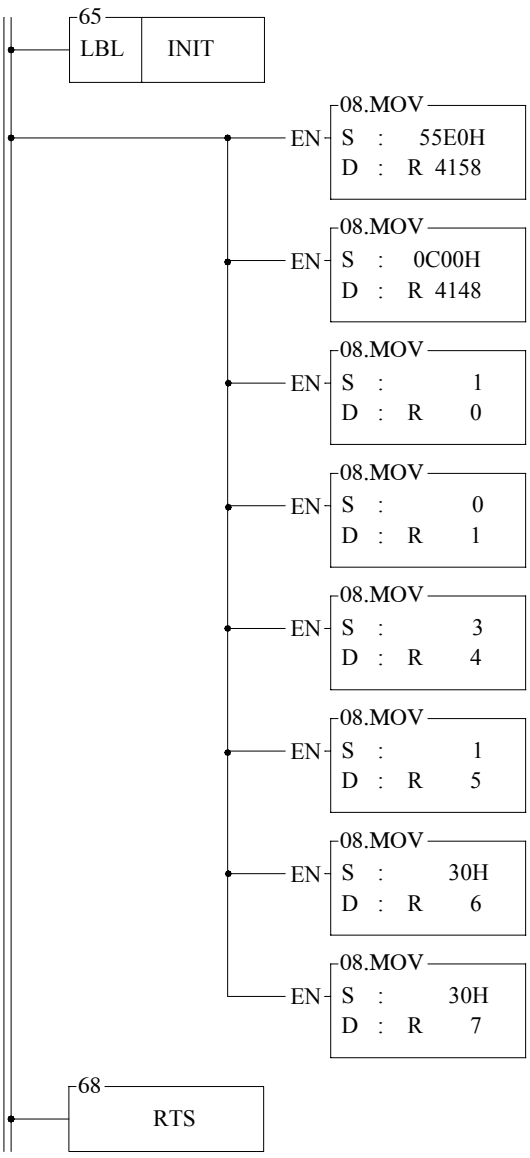
FB-PLC serves as “ASCII sender” through Port2



- M2 ON, if no new command given to do control and parameter setting etc., it will continuously read the parameters.
- When M30 changes from 0→1, it sends out the command to read parameters. :R604 is parameter number.
- Inverter responding value :R611.
- Pointing to the receiving registers while the reply from the inverter being receivied.
- Processing the received responding message from the inverter
- M3 ON, if no new command given to do control and parameter setting etc., it will continuingly read the status of inverter.
- When M40 changes from 0→1, it sends out the command to read inverter status. R605 is the inverter status reading code.
- Inverter responding value: R611 (NN=00, 01, 02).
- Inverter responding value: R611, R612, R613 (NN=03).
- Pointing to the receiving registers while the reply from the inverter being receivied.
- Processing the responding message received from the inverter

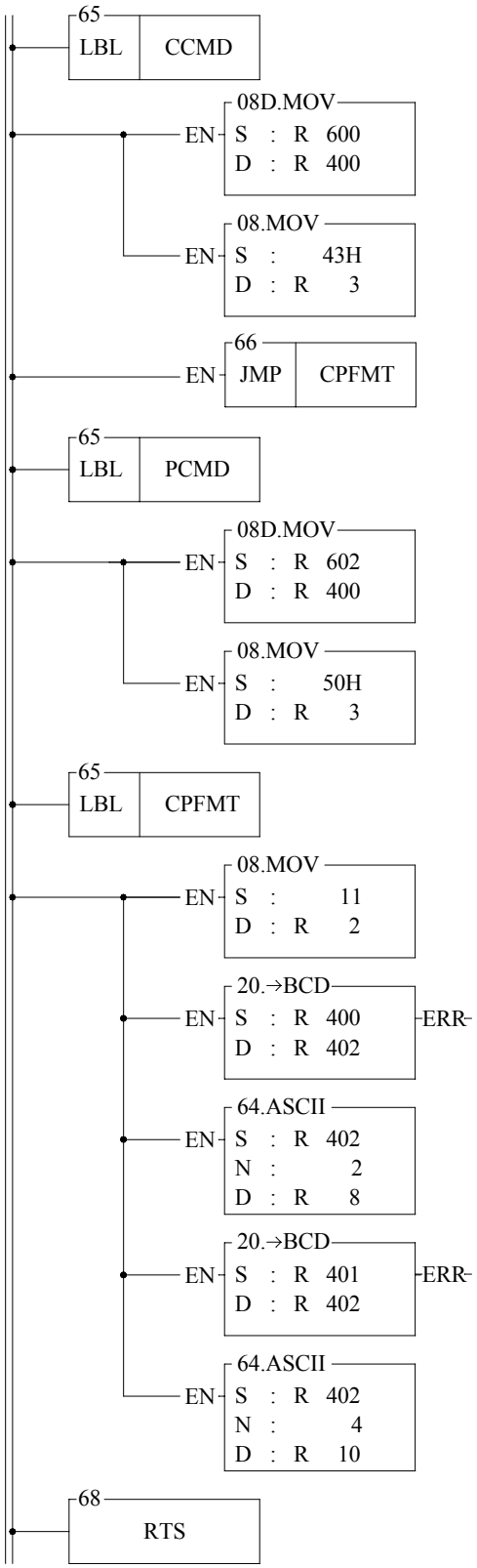
FUN96:MD1 Program example

FB-PLC serves as “ASCII sender” through Port2



- The setting of communication parameter
  Baud Rate :4800 bps
  Data Bit :8 Bit
  Parity :Odd
  Stop Bit :1 Bit
- The Time-out span setting is 12 mS.
- Sets the LINK2:MD1 to be "transmit then receive" mode.
- Set the receiving of LINK2:MD1 to be free from starting and ending code
- Check sum (fixed to be 03H)
- Single station command (01H)
- The address of inverter is “00”.

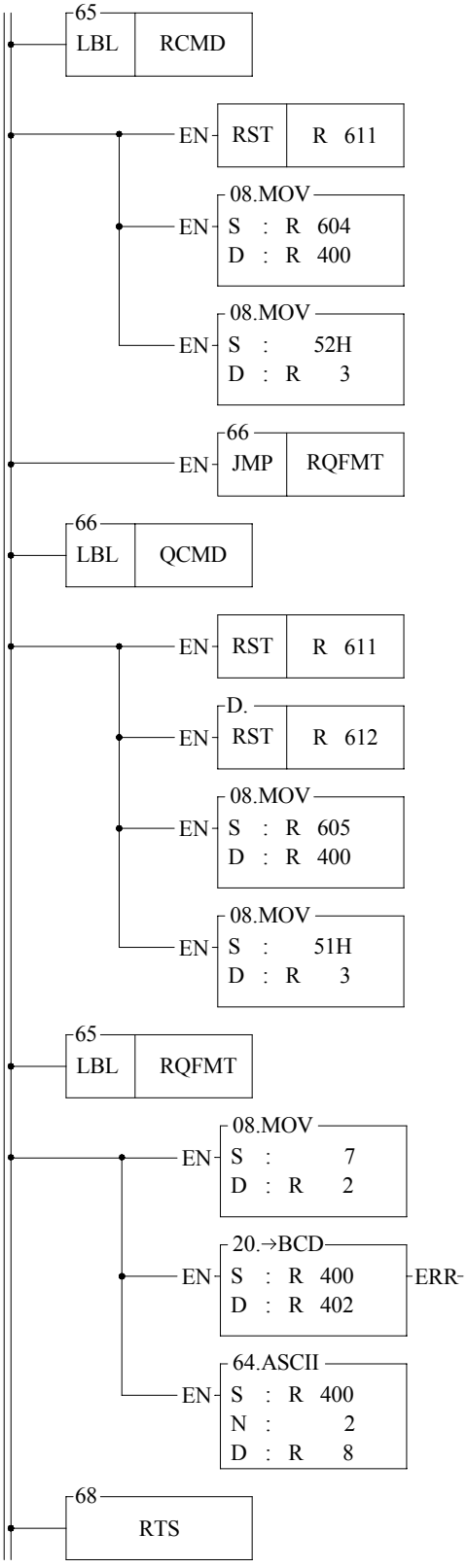
FB-PLC serves as “ASCII sender” through Port2



- Control command; command format: “C S A UU MM FFFF”
- R6000 is the revolving operation command.
- R601 is the frequency of revolving.
- The ASCII code of “C”
- Parameter setting command;command format: “P S A UU NN DDDD”.
- R602 is the parameter number.
- R603 is the parameter data.
- The ASCII code of “P”
- The length of data for transmission is 11.
- R400=MM or NN
  Converts MM or NN to be decimal code.
- Converts the decimal code to be ASCII code and store it into R8, and R9.
- R401=FFFF or DDDD; transforms FFFF or DDDD to be decimal code.
- Transforms the decimal code to be ASCII code and stores it into R10, R11, R12, and R13.

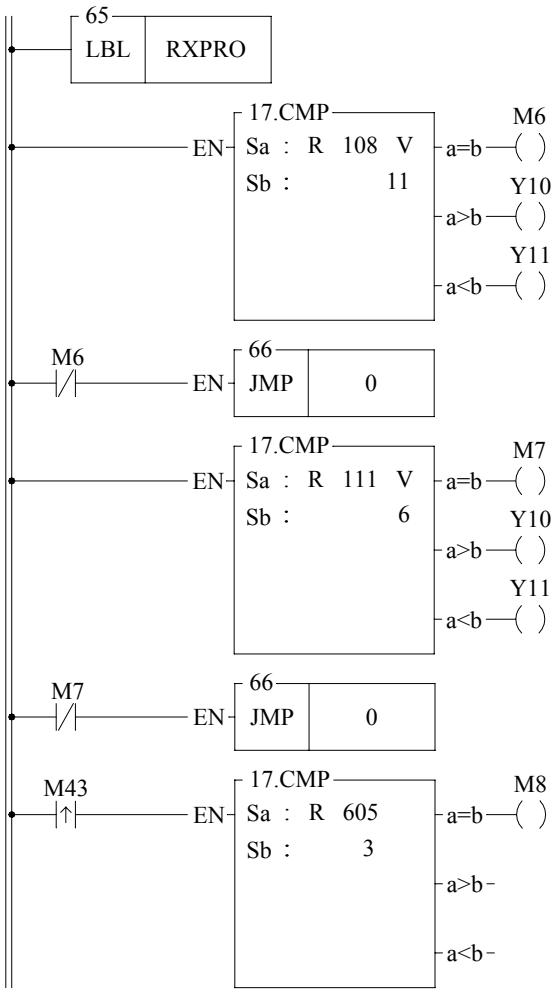
FUN96:MD1 Program example

FB-PLC serves as “ASCII sender” through Port2



- Parameter reading command; command format: “R S A UU NN”
- Clear the inverter responding data from register.
- R604 is the parameter number.
- The ASCII code for “R”.
- Inverter status reading command; command format: “Q S A UU NN”
- Clear the inverter responding data from register.
- R605 is the reading code for inverter status reading.
- The ASCII code for “Q”.
- The length of data for transmission is 7.
- R400= NN
  Transforms NN to be decimal code.
- Transformed the decimal code to be ASCII code and stores it into R8, and R9.

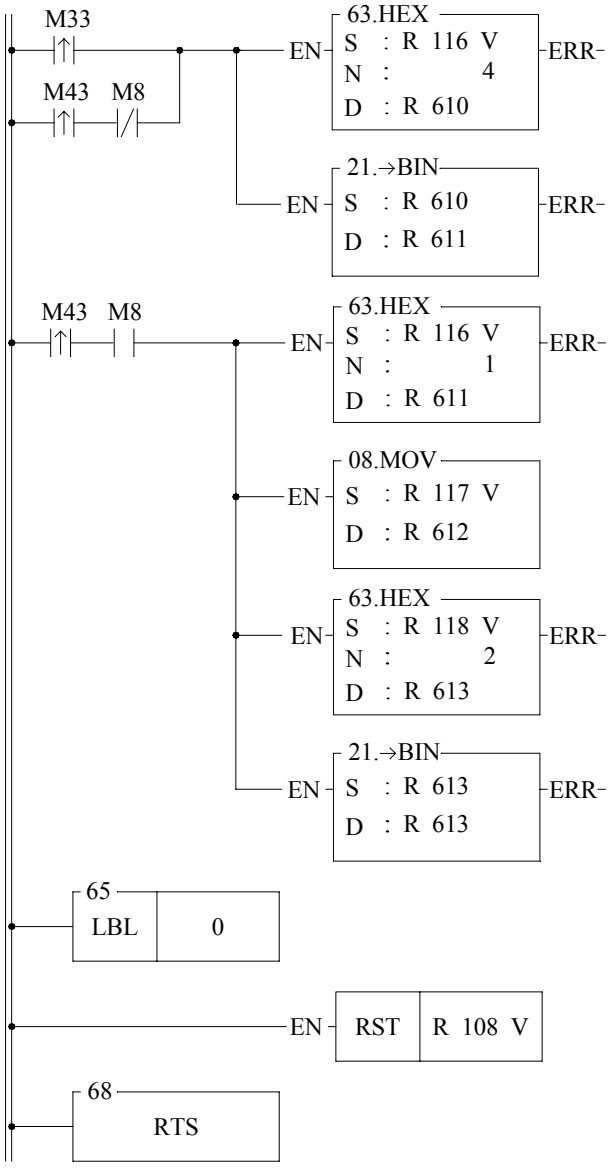
FB-PLC serves as “ASCII sender” through Port2



- To judge whether the responding data length is correct or not, if it is abnormal, then Y10 or Y11 is ON.
- To judge whether the responding command is correct or not, if it is abnormal, then Y10 or Y11 is ON.
- To judge whether the inverter status code is 03 or not, if yes, then M8 is ON.

FUN96:MD1 Program example

FB-PLC serves as “ASCII sender” through Port2



- Converts the received ASCII code to be decimal code.
- Converts the decimal code to be binary code.
- The reading code for inverter status is 03.
- After the received data being processed, clears the received data length register to be 0.

FB-PLC serves as “ASCII sender ” through Port2

● Explanation of FUN96: MD1 parameter S.

R0: Starting register of data transmission table (R0 just only for example)

R0	Transmit only/transmit then receive	• Low byte is valid, 0: transmit only, no response from the counter partner. 1: transmit then receive the responding message.
R1	Starting /Ending code of receiving	• High byte: Describing the starting code of responding message while receiving Low byte: Describing the ending code of responding message while receiving.
R2	Length of transmission	• The maximum length of data to be transmitted is 511.
R3	Data 1	• Low byte is valid
R4	Data 2	• Low byte is valid
R5	Data 3	• Low byte is valid
R7	Data 4	• Low byte is valid
•		
•		
•		
	Data N	• Low byte is valid

Note 1: When selecting the transmit-only mode, the Starting /Ending code of receiving is meaningless.

2: When it is in the "transmit then receive" mode, before the starting of transmission, it must first to estimate the starting and ending code of responding message from communication partner and write them into the receiving starting/ending code register (e.g. R1=0203H, 02H stands for starting code and 03H for ending code), so as to ensure the receiving to be free from error. The communication protocol with starting/ending code makes the identifying of every packet of messages easy, and the communication program is simple and efficient.

3: When it is in the "transmit then receive" mode, fills the high byte of starting/ending code register with 0 if no starting code in responding message; if no ending code in responding message, fills 0 to the low byte of starting/ending code register. Adjusts the high byte of R4148 (Time-out span) to judge whether a packet of data has been received completely; the unit is 0.001 second (the default is 0CH, 12mS).
The communication protocol without ending code depends on Time-out span to tell whether it has received completely a packet of data (the setting of Time-out must be greater than the maximum response delay time between data bytes when communication partner is replying), thus it may ensure the receiving of the whole packet to be complete. Generally speaking, the data in transmitting is transmitted one byte after another continuously; therefore, if there is pause (greater than Time-out duration), it means the packet of message is transmitted completely.

FUN96:MD1 Program example

FB-PLC serves as “ASCII sender” through Port2

● Explanation of FUN96:MD1 parameter Pt.

	High Byte	Low Byte	
R100	Result code	0	• The result code stores the operation result, 0=Normal; the other values, Abnormal.
R101	For internal operation use		• For internal operation use: it is the registers require to be used by CPU when performing LINK2 instruction.
R102	For internal operation use		
R103	For internal operation use		
R104	For internal operation use		• The B0 of R104 is 1 means that Port2 is busy; this instruction is waiting to take the transaction right B12= “ACT” output indication B13= “ERR” output indication B14= “DN” output indication.
R105	For internal operation use		
R106	For internal operation use		
R107	For internal operation use		
R108	Total amount of data received		• The total amount of data byte that is received (the register for received data length; it includes the starting and ending code that is received).
R109	1		• The first byte of data received (if there is the starting code, it is the starting code); High byte =0.
R110	2		• The second byte of data received; High byte =0.
	3		• The third byte of data received; High byte =0.
	N		• The N_th byte of data received (if there is the ending code, it is the ending code); High byte =0.

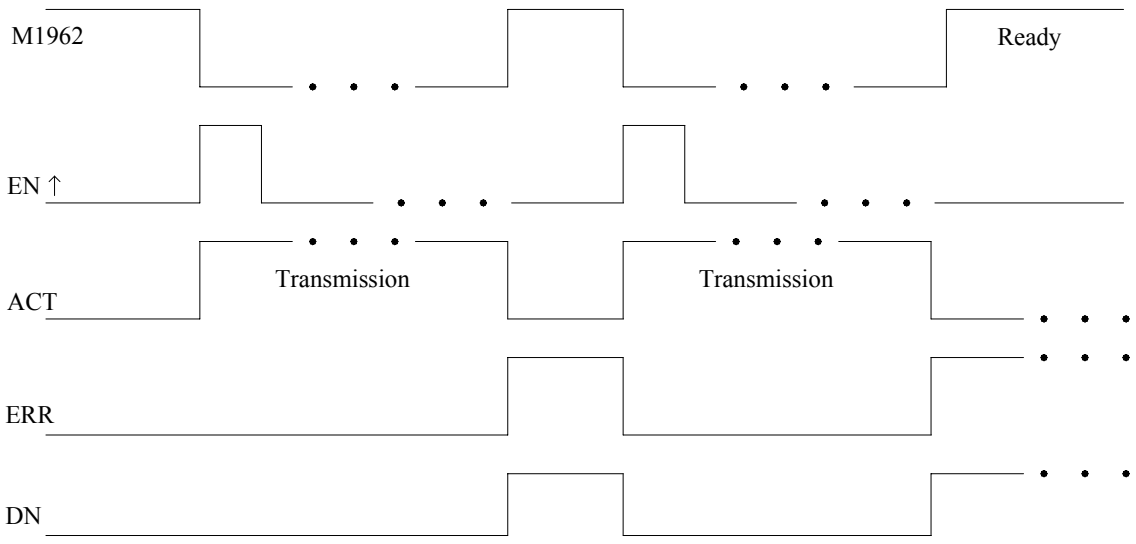
Result code: 0, transaction is successful.

2, data length error (the value is 0, or the packet of transaction is greater than 511)

A, no response from the counter partner.

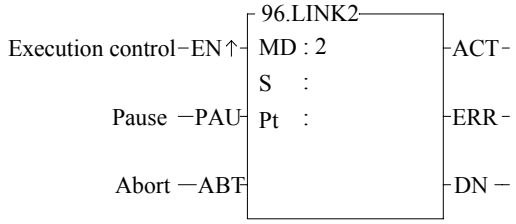
B, communication abnormal (received error data)

● The waveform for input control and output indication



Note: Of “ERR” and “DN”, only one of them will be in ON status and not both to be ON at the same time.

FUN 96 LINK2	Convenient instruction for FUN96(LINK2): MD2 (Which makes PLC serve as “ASCII receiver” through Port2)	FUN 96 LINK2



MD : 2, PLC waiting to receive the message sent by intelligent peripherals

S : Starting register of data transmission table (see example for explanation)

Pt : Starting register for instruction operation (see example for explanation). It controls 8 registers at least, the other programs cannot repeat in using.

Operand \ Range	HR	ROR	DR	K
	R0 | R3839	R5000 | R8071	D0 | D3071	
MD				0～3
S	○	○	○	
Pt	○	○*	○	

Descriptions

1. FUN96: MD2 instruction provides Fatek PLC with ability to receive message sent by peripherals with ASCII interface at any time.
2. The communication protocol is written with LADDER program, which must be consistent to the ASCII peripherals.
3. When execution control “EN ↑ ” turns from 0→1 and both pause “PAU” and abort “ABT” are 0, and if Port2 is not controlled by other FUN96 instruction (which means M1962=1), this instruction will control Port2 immediately and set M1962 to be “0” (being controlled). If Port2 is being controlled (M1962=0), this instruction will enter into the wait state until the other controlling FUN96 instruction complete or pause/abort its operation and released the control right (M1962=1), and this instruction will enact again out of wait state to enter into the receiving state and set the M1962 to be “0”.
4. When the operation pause “PAU” or abort “ABT” becomes 1, it gives up the receiving immediately (M1962 ON).
5. While it is in the receiving state, the output indication “ACT” is ON.
6. When a packet of data transaction finished (receive finished or receive then transmit completed), if there is error occurred, the output indication “ERR” will be ON for one scan time.
7. When a packet of data transaction finished (receive finished or receive then transmit completed), if there is no error occurred, the output indication “DN” will be ON for one scan time.

FUN 96 LINK2	Convenient instruction for FUN96(LINK2): MD2 (Which makes PLC serve as “ASCII receiver” through Port2)	FUN 96 LINK2

【Interface signals】

M1962 : This signal is generated from CPU.
ON means Port2 is ready.
OFF means Port2 is busy.

R4148 : High Byte, the setting point for Time-out span on receiving; it is used to judge whether a packet of data has been received completely. Its unit is 0.001 second (the default is 0CH, 12 mS) (detailed explanation will be followed).

R4157 : The Port2 Rx/Tx Time-out setting. The system will produce pertaining setting value according to R4158 communication parameter; the user needs not to set it

R4158 : The register for communication parameter setting of Port2. (please refer to section 12.6.2 for communication parameter setting descriptions)

R4159 : The Low Byte defines the Time-out span of FUN96:MD2 instruction; its unit is 0.01 second (the default is 32H, which means 0.5 second). When the PLC received the message and must respond to it (receive then transmit mode), but the LADDER program is unable to process and send out the responding message during this period of time, the CPU will give up response this time and automatically restore back to receiving state. When FUN96:MD2 is set to be "receive only" mode (example to be followed), this value is meaningless.

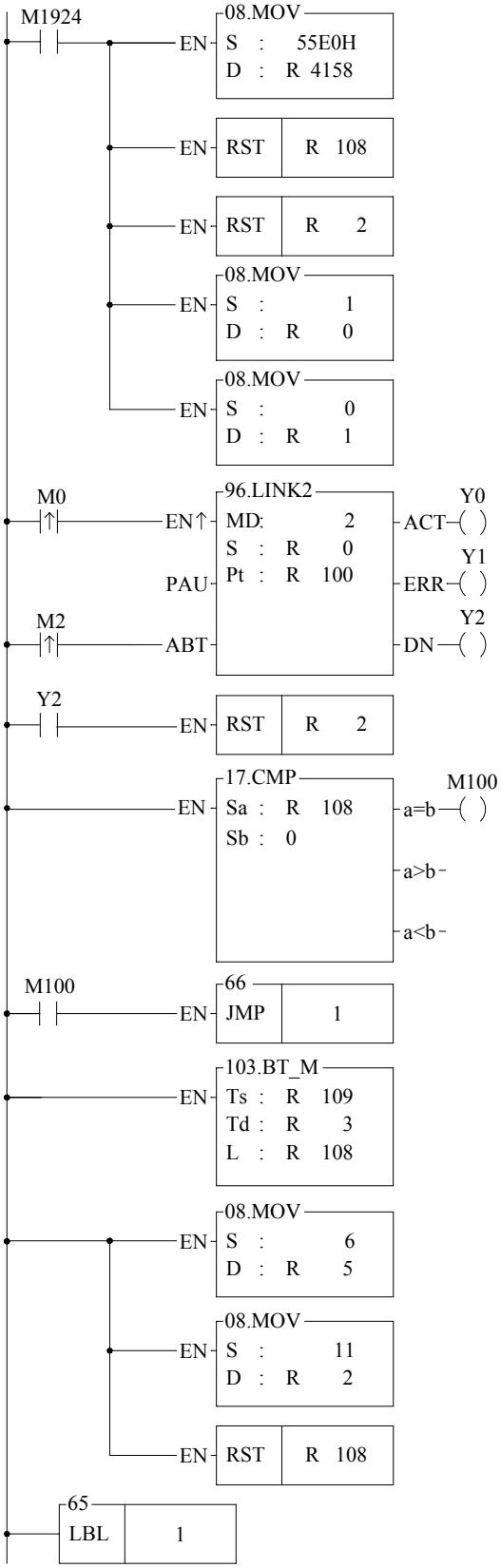
: High Byte, it is meaningless while FUN96:MD2

Note 1: Once FUN96:MD2 activated, it will stay in receiving state all the time; unless the input signal of PAU” or “ABT” becomes ON, then it will jump out of receiving state and stop receiving and waiting for next time it will be activated again.

2: When there is change on Starting/Ending code for receiving, it must make the input signal of PAU” or “ABT” becomes ON once, and re-activate the receive control “EN ↑ ” from 0→1 to start message receiving

FB-PLC serves as “ASCII receiver” through Port2

Program example The PLC simulates the Inverter to reply the received data to the Master PLC which sent out the data.



- Communication parameter setting:
  Baud Rate:4800，Data Bit:8
  Parity: Odd，Stop Bit:1
- Clear the length of receiving data to be 0.
- Clear the length of reply data to be 0
- Set the receiving mode to be “receive then transmit”
- Set the receiving message to be free from starting code and ending code.
- When transmitting complete, clear the length of transmitting (for receive only mode, this instruction is not needed)
- Determines whether a new packet of message is received; if yes, M100=OFF and process the received data.
- Copy all of the received data to reply registers.
- R108 is the length of received data.
- The responding command is 6.
- Fill in the length of reply data which is equal to 11, to start the reply transmission.
- Clear the length of received data (ready to receive new data).

FUN96:MD2 program example

FB-PLC serves as “ASCII receiver” through Port2

● FUN96: MD2 explanation of parameter S.

R0: Starting register for data receiving table (R0 just only for example)

R0	Receive only/Receive then transmit	• Low Byte is valid, 0: "receive only" mode. 1: "receive then transmit" mode.
R1	Starting/Ending code of receiving	• High Byte : Describing the starting code of receiving Low Byte : Describing the ending code of receiving.
R2	Length of reply data	• Maximum of length is 511. It will satrt to transmitte the reply data as long as the length is not 0.
R3	Reply data 1	• Low Byte is valid
R4	Reply data 2	• Low Byte is valid
• • •		
	Reply data N	• Low Byte is valid

Note 1: When selecting the "receive only" mode, CPU fills the received data into the receiving registers and set the length after it has received a packet of message, and starts to receive the next packet of message immediately.

2: When selecting the "receive then transmit" mode, CPU fills the received data into the receiving registers and set the length after it has received a packet of message; then it starts to wait for the reply data length which is not zero to start transmitting reply data (therefore when select this mode, it must control the reply data length to be zero before the reply data completely filled into the reply registers; when the reply data fills into the reply registers finished, it may then set the length of reply data).

3: It must fills the starting code and ending code into the starting/ending code register before the starting of receiving (e.g. R1=0A0DH, 0AH stands for starting code and 0DH for ending code), so as to ensure it to be free from receiving error.
The communication protocol with starting/ending code makes the identifying of every packet of messages easy, and the communication program is simple and efficient.

4: If the receiving message without starting code, fills the high byte of starting/ending code with 0; if the receiving message without ending code, fills the low byte of starting/ending code with 0. Adjusting High Byte of R4148 (Time-out span) to detect whether a packet of message has been received completely, the unit is 0.001 second (default is 0CH, 12 mS). The communication protocol without ending code depends on Time-out span to tell whether it has received completely for a packet of data (the setting point of Time-out must be greater than the maximum delay time between data bytes to be received), thus it may ensure the receiving of the whole packet to be completed. Generally speaking, the data in transmitting is transmitted one byte after another continuously; therefore, if there is pause (greater than Time-out duration), it means that the packet of message is transmitted completely.

5:When selecting "receive only" mode, if the message received has no ending code, the interval between every packet of data sent by the sending party must be greater than the receiver’s receiving Time-out span, otherwise the receiving party won’t be able to distinguish between each packet of data correctly.

FB-PLC serves as “ASCII receiver” through Port2

● FUN96:MD2 explanation of parameter Pt.

	High Byte	Low Byte	
R100	Result code	0	• The result code stores the operation result, 0=Normal; the other values, abnormal
R101	For internal operation use		• For internal operation use: it is the registers required to be used when performing LINK2 instruction.
R102	For internal operation use		
R103	For internal operation use		
R104	For internal operation use		• The B0 of R104 is 1 means that Port2 is being occupied, this instruction is waiting to get the control right of Port2. B12= “ACT” indication B13= “ERR” indication B14= “DN” indication
R105	For internal operation use		
R106	For internal operation use		
R107	For internal operation use		
R108	Length of received data		• The total amount of data byte that has received (the register for received data length; it includes the starting and ending code that has received).
R109	1		• The first Byte of received data (if there is the starting code, it is the starting code); • High Byte＝0
R110	2		•The second Byte of received data; High Byte =0.
•			
•			
•			
	N		• The N_th Byte of received data (if there is ending code, it is the ending code); • High Byte＝0

Note: When CPU received a packet of message, it filled the data to receiving registers and set up the received data length. Before the LADDER program starts to receive, you may clear the register of received data length to be 0; it means the receiving of a new packet of message when compared and found that the received data length is not zero. After the LADDER program gets the received data, it clears the received data length register to be 0. Just compare to see the received data length register is not zero means the receiving of a packet of new message, and so it may easily to process the receiving action.

Result code: 0, data transaction is successful.
2, the data length is error (the value is 0, or the transaction is greater than 511)
A, unable to reply message within Time-out span ("receive then transmit" mode).
B, communication abnormal (received error data)

FUN96:MD2 program example

FB-PLC serves as “ASCII receiver” through Port2

- Explanation of input control

  1. When the execution control input M0 change from 0→1, if Port2 is not controlled by other FUN96 (M1962 ON) and it enters into the receiving state immediately (M1962 keeping OFF all the time)
  2. When "ABT" input M2 changes from 0→1, it jumps out of receiving state (M1962 ON)

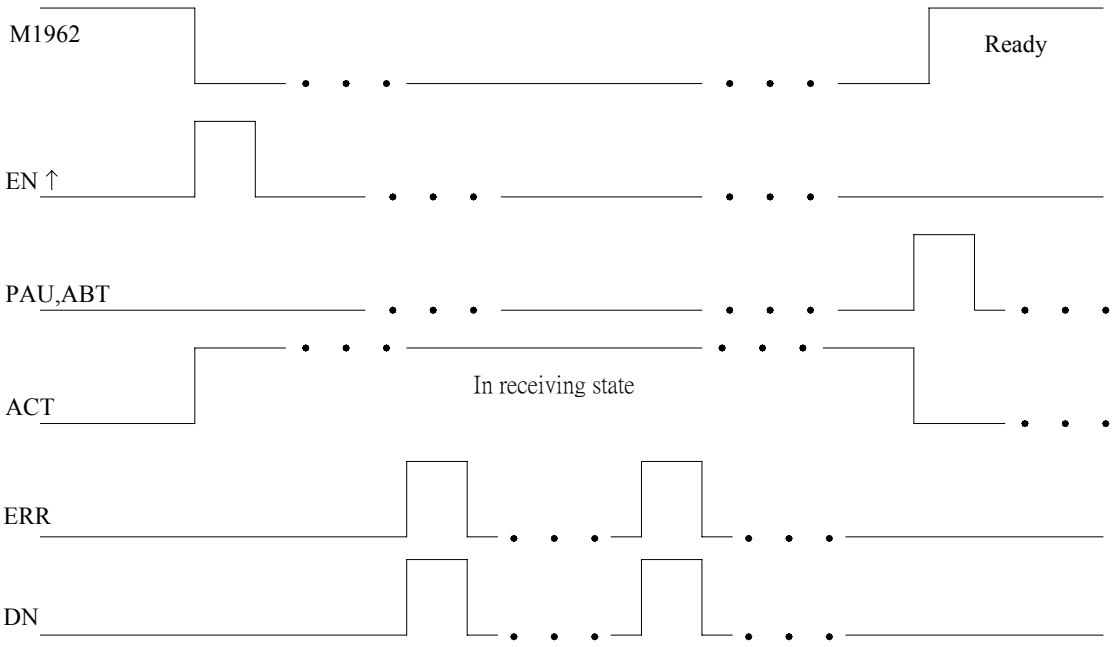
- Output indication

  “ACT” ON : In receiving state

  “ERR” ON : Error occurred in previous packet of transaction, it will be ON for a scan time

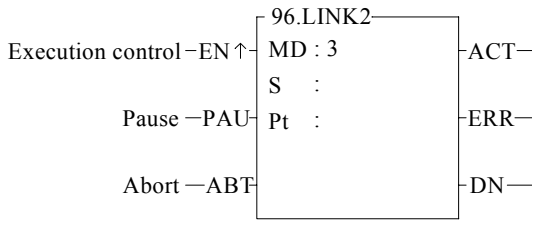
  “DN” ON : The previous packet of transaction completed without error, ON for a scan time.

- Waveform of input control and output indication



Note: Of “ERR” and “DN”, there is only one will be ON; not both to be ON.

FUN 96 LINK2	Convenient instruction for FUN96(LINK2): MD3 communication link (it makes the PLC serve as the master of "Fatek high speed CPU LINK network" through Port2)	FUN 96 LINK2



MD : 3, high speed linking between Fatek PLC and PLC

S : Starting register for communication program (example illustrated).

Pt : Starting register for instruction operation (example illustrated), it controls 8 registers and the other program can not repeat in use.

Range / Operand	HR	ROR	DR	K
	R0 | R3839	R5000 | R8071	D0 | D3071	
MD				0～3
S	○	○	○	
Pt	○	○*	○	

Descriptions

1. FUN96(LINK2): MD3 instruction provides high speed data sharing between Fatek PLC and other PLC (data response time will not be influenced by the scan time of PLC).
2. A master PLC can link with 254 slave PLCs at the most to share data through its built-in RS-485 interface.
3. LINK2 instruction is required only by master PLC, not by the slave PLC.
4. The station number of master PLC must be No.1, or it should be assigned by R4054 register if which is not No.1 but need to be as the master.
5. The setting of M1958 for slave PLC must be ON (M1958 OFF is for non-high speed link), but it's not necessary for master PLC.
6. In high speed linking, the maximum Baud Rate is 614.4K bps and minimum is 38.4K bps (adjustable); the data length is fixed at 8 Bits. Data is transmitted with binary code (which is twice time as fast as ASCII Code), and the error checking is adopting CRC-16, which is more reliable than Checksum.
7. The principle of high speed linking data transmission is based upon the COMMON DATA MEMORY concept to design; e.g. as the master PLC sent out the content of R0 to R31, .the contents of R0～R31 for all the slave PLCs will be the same as the master's; when slave PLC no.2 sent out the contents of R32～R47, the R32～R47 contents of master PLC and other slave PLCs will be the same as PLC station no.2's, etc.
8. When PLC is in STOP mode, the Port2 enters into the standard interface mode that it can connect to PROLADDER, MMI, or graphic supervisor (the communication parameter is set by R4158).
9. It employs the program coding or table filling method to plan for data flow control; i.e. for what kind of data being sent from which PLC station to all the PLC on line, it takes only 7 registers (5 of which is being physically used, and 2 reserved) to define; every 7 registers define once communication transaction.
10. When execution control "EN ↑ " changes from 0→1 and both pause "PAU" and abort "ABT" are 0, this instruction will control Port2 and set M1962 to be "0" (being controlled) and processing the data transaction immediately, suppose the Port2 is not controlled by other FUN96 instruction (M1962=1). If Port2 is being controlled (M1962=0), this instruction will enter into wait state until the controlling FUN96 instruction complete the transmission or pause/abort the operation to release the controlling right (M1962=1); then it enacts from wait state, engages in the transmitting transaction and sets M1962 to be "0".
11. When pause "PAU" or abort "ABT" of input is 1, it jumps out of high speed data link immediately (M1962 ON).
12. Within the high speed linking, the output indication "ACT" is ON; Port2 is unable to accept any other FUN96 instruction.
13. When there is error occurred while it is starting the high speed linking, the output indication "ERR" will be ON, and the high speed linking will not be performed.

FUN 96 LINK2	Convenient instruction for FUN96(LINK2): MD3 communication link (it makes the PLC serve as the master of "Fatek high speed CPU LINK network" through Port2)	FUN 96 LINK2

【Interface signals】

M1958 : While in the PLC high speed data linking, slave PLC must set M1958 ON (not necessary for master PLC) For non high speed data linking of PLC, the slave PLC must set M1958 OFF.

M1962 : The signal is generated from CPU.
ON represents the Port2 is available for FUN96 command.
OFF represents the Port2 is engaged in high speed linking; it can't take any other FUN96 instruction.

M1963 : The signal is generated from CPU.
When M1967 is ON (this signal is controlled by the user program) and after the last packet of communication transaction is completed, the CPU sets M1962 and M1963 ON, and the high speed data transmission will be stopped; it must control "ABT" (transmission abort) to be ON, and then restart execution control "EN ↑ " to change from 0→1 before the high speed linking can restart.
When M1967 is OFF (this signal is controlled by the user program), the high speed data transmission will automatically restart a new transmission from the first packet of communication transaction (M1962 and M1963 is keeping OFF state) after the last packet of communication transaction is completed.

M1967 : One-time or cycling control (controlled by the user program)
ON, one cycle, it will stop after the last packet of data transaction is performed completely.
OFF, successive cycles, it will restart from first packet of transaction when it has finished the last packet of transaction.

R4054 : It assigns the PLC station which is not no.1 to act as the master of high speed linking.

	High byte	Low byte	
R4054	55	Station number.	H

When the station number of the PLC is not number 1, fills its station number (low byte of R4055 stores the station number) into the low byte of R4054 and writes to high byte of R4054 with 55H, and then controls the execution control input "EN ↑ " from 0→1; even though the PLC station which is not no.1, it can still be the master station for high speed linking.

R4055 : When high byte of R4055 is not 55H,Low byte of R4055 shows the station number of PLC.
When high byte of R4055 is 55H,Low byte of R4055 defines the station number of PLC.

R4058 : Showing the station number of slave PLC which is abnormal while high speed linking (0: Represents normal; if many slave PLC were abnormal in the mean time, it is possible to see only one number; after the debugging of abnormal and clear R4058 to be 0 until the value of R4058 keeping to be 0, it will then network works normal). In communication transaction program or table, it must exist the case for slave station to send data to other stations then can the master PLC detect whether the slave station is online without error; if in the communication transaction program or table, there is only the master station sending data to slave stations, the master PLC can't detect whether slave PLC is on line without error. The user must employ programming skill to add abnormal detecting program to the master PLC and slave PLC to do the error checking (as a matter of fact, the program is very simple; just makes the PLC, which is sending data, to create an ON⟷OFF variation signal. Once the receiving PLC does not detect the ON⟷OFF variation signal in a period of time, it means that there is communication error).

FB-PLC acts as the master of “Fatek high speed CPU LINK network” through Port2

R4059 : Error logging of abnormal slave PLC while high speed linking.

	High byte	Low byte	
R4059	Abnormal code	Abnormal count	H

Low byte: Abnormal count summation

High byte: Abnormal code

OAH, No response from slave station

OBH, Error data (CRC Error)

20H, rarity Error

40H, Framing Error

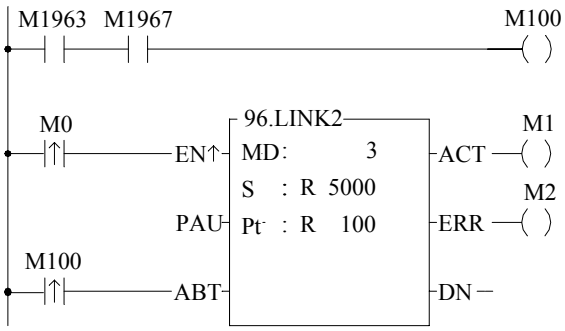
80H, Over_Run Error

Explanation for the checking method for abnormal communication is the same as that for R4058.

R4160 : Port2 Rx/Tx Time-out setting (in high speed linking). The system will base on the setting of R4161 communication parameter to produce pertaining set point; the user need not to set it.

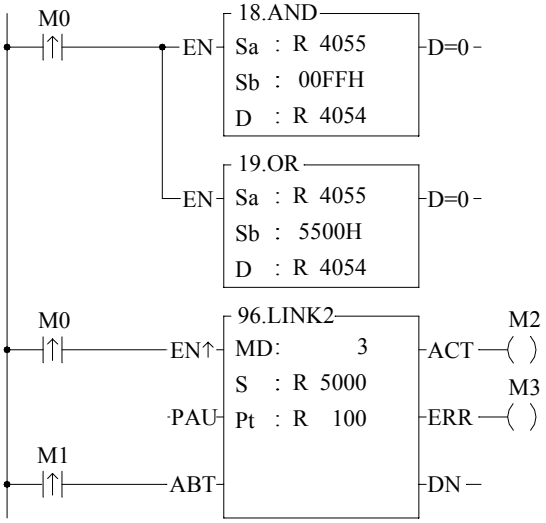
R4161 : communication parameter setting register for LINK2 high speed linking.
(please refer to explanation for Port2 communication parameter setting in section 12.6.2)

Program example 1 PLC no. 1 serves as the master of high speed data linking



- Planning R5000 ～ R5199 to be ROR, the communication program will be stored together with LADDER program.
- When M1967 is ON, performs one cycle transmission. It must start the abortion, then restart M0 before it can perform high speed data link again.

Program example 2 PLC which station number is not no.1 serves as the master of high speed data linking.



- Get PLC station number and write it into R4054
- Set the high byte for R4054 to be 55H
- Planning R5000～R5199 to be ROR, the communication program will be stored together with LADDER program.
- When ABT is not controlled, M1 instruction needs not to input.

FUN96:MD3 program example

FB-PLC acts as the master of “Fatek high speed CPU LINK network” through Port2

Program example 3 The same machine sets or equipments (with same LADDER program) perform multi-station data collection or distributed control through RS-485 high speed linking.

The principle for high speed data linking is based on COMMON DATA MEMORY concept to design; while designing, it must devise a successive data block and evenly distributed to respective PLCs to do data exchange among PLCs. e.g.:

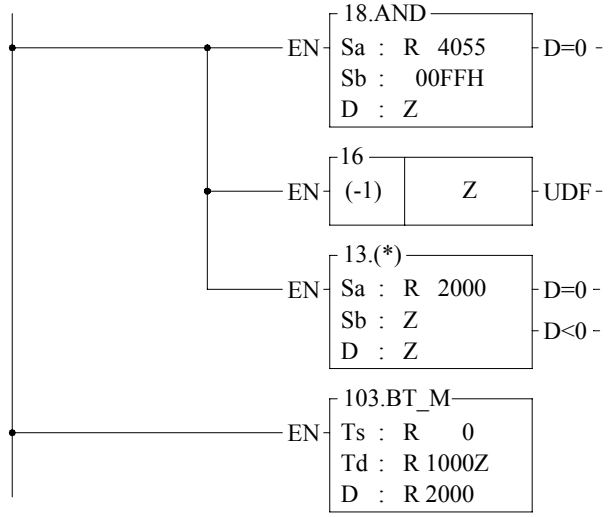
R1000～R1031: The data block of PLC no. 1 (through high speed linking, the other PLCs' content of R1000～R1031 become the same as that of PLC no.1).

R1032～R1063: The data block of PLC no. 2 (through high speed linking, the other PLCs' content of R1032～R1063 become the same as that of PLC no.2).

• •
• •
• •

For example, get the production data (stored at R0～R31) from each machine set, and collectively gathering R1000～R1639 (suppose there are 20 sets linking) stored in master PLC through RS-485 high speed data linking; it needs merely the master PLC of high speed linking to connect to MMI or graphic supervisor, then it can monitor and store, for follow up processing, the production data of respective machine sets with real time effect.

Note: If it is simply for data collection and monitoring and no need to do real time control, employs the FUN96: MD0 can easily and concisely accomplish the assignment; when requiring real time control or supervisoring , it must employ FUN96: MD3 to accomplish a speedy, precisely controlling demand.



- Get PLC station number and write it in pointer Z
- Station number deducts 1
- R2000 = Length of data to be sent from each station (e.g. 32)
- data length * (station number–1): Directing to the apportioned data block of this station.
- Move production data from respective stations to the apportioned data block of respective stations, and transmitting it to all other PLCs on line through high speed data linking.

FB-PLC acts as the master of “Fatek high speed CPU LINK network” through Port2

● Explanation for parameter S of FUN96: MD3

R5000: Starting register for communication program (data transmission table)

R5000	Packets of data transaction	• Low Byte is valid. A packet of transmission demands 7 registers to describe; i.e. 7 registers define a packet of data.
R5001	Station number to be transmitted	• Low Byte is valid. 1～255.
R5002	Command code	• Low Byte is valid. It can only be 4 (high speed linking command).
R5003	Length of this packet of data	• Low Byte is valid. 1～32, defines the data length of one transaction.
R5004	Data type	• Low Byte is valid. 12＝R; 13＝D.
R5005	Data starting reference	• Word is valid. Defines starting number of working data.
R5006	Reserved	• Code for data type / Data starting reference 12: R data register 0～3839 13: D data register 0～3071
R5007	Reserved	
R5008	Number of station to be transmitted	Description for the second packet of transmission (transaction)
R5009	04	
R5010	Length of this packet of data	
R5011	Data type	
R5012	Data starting reference	
R5013	Reserved	
R5014	Reserved	

● Explanation for parameter Pt of FUN96: MD3

	High Byte	Low Byte
R100	Result code	
R101	For internal working use	
R107	For internal working use	

Result code: 0: Correct format
2: Data length error (Length is 0 or greater than 32)
3: Command code error (Command is not equal to 4)
4: Data type error (Data type is not 12 nor 13)
5: Data reference error

FUN96:MD3 program example

FB-PLC acts as the master of “Fatek high speed CPU LINK network” through Port2

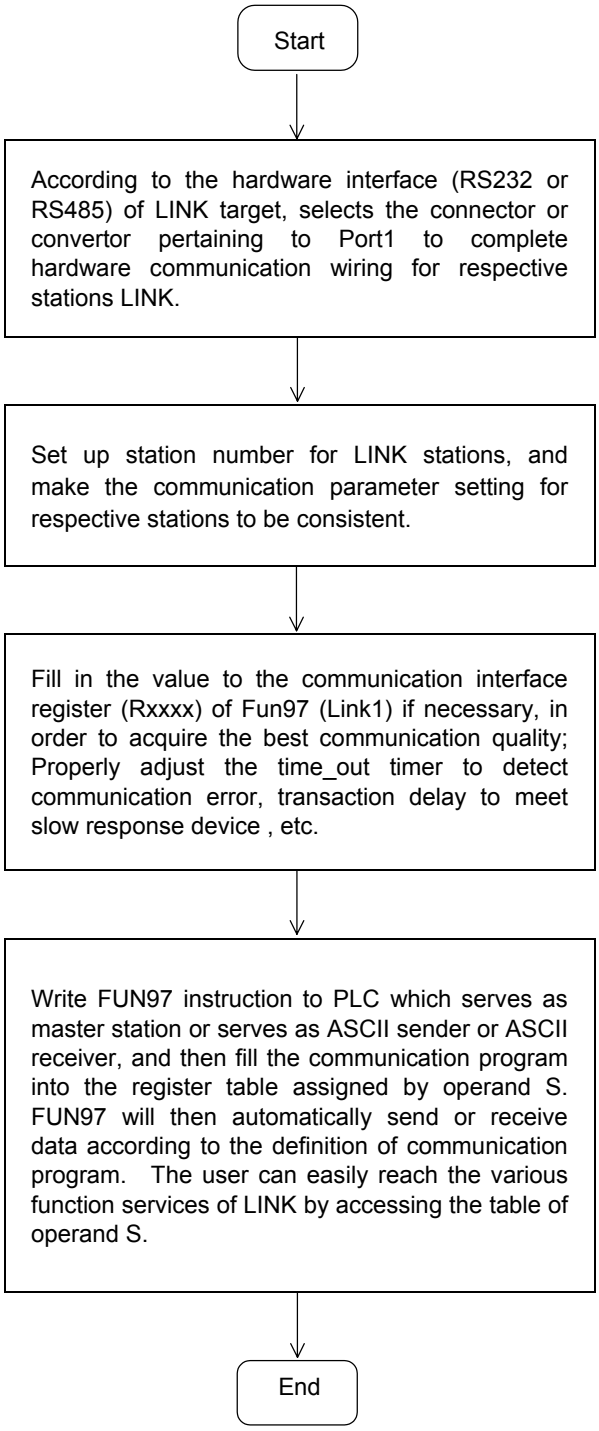
Example for communication transaction planning

Content of registers	Description	Planning the communication transaction with extended communication instructions
R5000:4	4 packets of transaction in total	Total Sets:4 (4 packets of transaction in total)
R5001:1 R5002:4 R5003:32 R5004:12 R5005:1000 R5006: R5007:	PLC No. 1 (master PLC) High speed linking command Data length is 32 Data type is R Data number is 1000, i.e. R1000 Reserved Reserved	000 Station# 1 Command HS_Link Length 32 Start R1000
• The master PLC broadcasts R1000～R1031 to the R1000～R1031 of all stations		
R5008:2 R5009:4 R5010:32 R5011:12 R5012:1032 R5013: R5014:	PLC No. 2 (slave PLC) High speed linking command Data length is 32 Data type is R Data number is 1032, i.e. R1032 Reserved Reserved	001 Station# 2 Command HS_Link Length 32 Start R1032
• PLC of station no.2 broadcasts R1032～R1063 to the R1032～R1063 of all stations		
R5015:3 R5016:4 R5017:32 R5018:12 R5019:1064 R5020: R5021:	PLC No. 3 (slave PLC) High speed linking command Data length is 32 Data type is R Data number is 1064, i.e. R1064 Reserved Reserved	002 Station# 3 Command HS-Link Length 32 Start R1064
• PLC of station no.3 broadcasts R1064～R1095 to the R1064～R1095 of all stations		
R5022:21 R5023:4 R5024:6 R5025:13 R5026:500 R5027: R5028:	PLC No. 21 (slave PLC) High speed linking command Data length is 6 Data type is D Data number is 500, i.e. D500 Reserved Reserved	003 Station# 21 Command HS_Link Length 6 Start D500
• PLC of station no.21 broadcasts D500～D505 to the D500～D505 of all stations		

Note: For the explanation of extension instructions for communication, please refer to page13-7.

13.2 Application of FUN97 (port1) instruction

13.2.1 Procedure for FUN97 (LINK1) usage



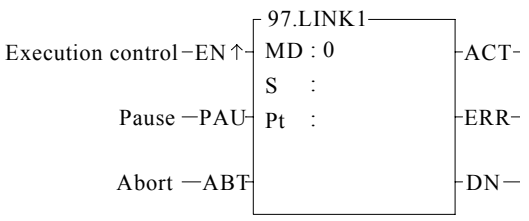
- Please refer to communication cable (connector) of section 12.1
- Station number can be any one between 1～254 without repetition. The setting of station number may be performed under PROLADDER or function item 5 (configuration) of FP-07's system function.
- The communication parameter of Port1 is set by the value of R4146 register. Please refer to Port1 communication parameter of section 12.6.2 for details.
- Please refer to example in section 13.2.2 for definition and explanation of interface processing signal.
- Please refer to example in section 13.2.2 for definition and usage of parameter S.

13.2.2 Explanation of respective modes and application program example for FUN97 (LINK1)

This section illustrates with practical application program to show usages for 3 instruction modes (MD0～MD2) of FUN97(LINK1) instruction.

FUN97:MD0 instruction guide

FUN 97 LINK1	Convenient instruction for FUN97(LINK1): MD0 communication network (which makes PLC as the master station in CPU LINK network through Port1)	FUN 97 LINK1



MD: 0, acts as master station of Fatek CPU LINK (employs Fatek communication protocol)

S : Starting register for communication program (example illustrated).

Pt : Starting register for instruction operation (example illustrated); it controls 8 registers, and the other programs can not repeat in using.

Range / Operand	HR	ROR	DR	K
	R0 | R3839	R5000 | R8071	D0 | D3071	
MD				0～2
S	○	○	○	
Pt	○	○*	○	

Descriptions

1. FUN97(LINK1):MD0 instruction provides data sharing among the Fatek PLCs.
2. A master PLC can pass through RS-485 (FB-485) interface to connect with 254 slave PLCs and share data with each other.
3. Only the SW1 of master PLC CPU board has to be set as 1=OFF, 2=ON (turn off setting and restart).
4. Only the master PLC needs to employ LINK1 instruction, the slave PLCs need not to.
5. It employs the program coding method or table filling method to plan for the data flow controls; i.e. from which one of the slave PLC to get which type of data and save them to the master PLC, or from the master PLC to write which type of data to the assigned slave PLC. It needs only seven registries to make definition; every seven registers define one packet of data transaction.
6. When execution control 〝EN↑〞 changes from 0→1 and both inputs Pause “PAU” and Abort “ABT” are 0, and if Port1 hasn’t been controlled by other FUN97 instructions (i.e. M1960 = 1), this instruction will control the Port1 immediately and set the M1960 to be “0” (which means it is being occupied), then going on a packet of data transaction immediately. If Port1 has been controlled (M1960 = 0), then this instruction will enter into the standby status until the controlling FUN97 instruction complete its transaction or pause/abort its operation to release the control right (M1960=1), and then this instruction will become enactive, set M1960 to be 0, and going on the data transaction immediately.
7. While in transaction processing, if operation control “PAU” becomes 1, this instruction will pause and release the control right (M1960 set to be 1) after it finishes the on going transaction. Next time, when this instruction takes over the transmission right again , it will keep going on the next packet of data transaction (this means that the pause operation is based on a packet of data transaction).
8. While in transaction processing, if operation control “ABT” becomes 1, this instruction will halt immediately and release the control right (M1960 set to be 1). Next time, when this instruction takes over the transmission right again, it will restart from the first packet of data transaction.
9. While it is in the data transaction, the output indication “ACT” will be ON.
10. If there is error occurred when it finishes a packet of data transaction, the output indication “ERR” will be ON.
11. If there is no error occurred when it finishes a packet of data transaction, the output indication “DN” will be ON.
12. The connecting pin No.3(RTS) of Port1 must be short to connect to pin No.4(CTS).

FUN97 LINK1	Convenient instruction for FUN97(LINK1): MD0 communication network (which makes PLC as the master station in CPU LINK network through Port1)	FUN97 LINK1

【Interface processing signal】

M1960 : This signal is generated from CPU.
ON, it represents that Port1 is free and ready.
OFF, it represents that Port1 is occupied, data transaction is going.

M1961 : This signal is generated from CPU.
When the communication program completed the last packet of data transaction, M1961 will be ON for a scan time (for successive data transaction).
When the communication program completed the last packet of data transaction, M1961 will be ON (for single packet of data transmission).

R4146 : The register for communication parameter setting of Port1.
(please refer to explanation for Port1 communication parameter setting of section 12.6.2)

R4147 : The content of Low Byte defines the Time-out span of LINK1 instruction; it's unit is 0.1 second.
(the default is 5, which means 0.5 second)
The LINK1 instruction (only master PLC needs) employs Time-out span to judge whether the slave PLC on line or not. When the master PLC sent out the read/write command to the slave PLC, the slave PLC didn't reply within this period means that there is abnormal event in communication called Time-out. When there are multi-PLCs linking, properly adjust this value (greater than 1 scan time of the slave PLC with the longest scann time) to shorten the communication response time among the active linking PLCs if there are many slave PLCs power off (The time-out cases will happen).

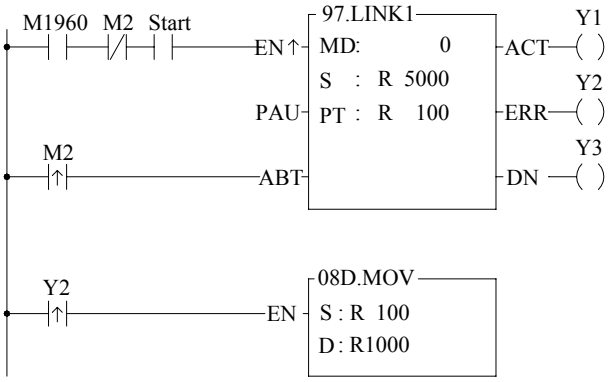
: The content of High Byte defines the transmission delay time between two packets of data transaction for LINK2 instruction; its unit is 0.01 second (the default is 0). For point-to-point link, this value can be set as 0 to shorten the communication transaction time and promote the communication efficiency. In the case of linking multi-PLCs and if the scan time of master PLC is far longer than any slave PLC, this value can be set to 0 to shorten the communication transaction time and promote the communication efficiency. When there are multi-PLCs to link in parallel by using master/slave method and the scan time of master PLC is close to that of slave PLCs, it must properly adjust this value (greater than 1 scan time of the slave PLC with the longest scan time) to reach the best, error-free communication quality.

R4148 : When Low Byte of R4147 is not 0, Low Byte of R4148 makes no effect.
When Low Byte of R4147 is 0, Low Byte of R4148 defines the Time-out span of LINK1 instruction, the unit is 0.01 second (for fine tuning ;the default is 0). The function is identical to explanation for R4147 low byte.

FUN97:MD0 Program Example

FB-PLC acts as the master of “Fatek CPU LINK network” through Port1 and FB-485

Program example Automatic cycling transmission



- Configure R5000～R5199 as the read only register (ROR)before programming, after then, when storing program, the ladder program will automatically contains the communication program .
- When ABT is not controlled, it is not necessary to input the M2 contact instruction.
- When there is communication error, gets and stores the error message to R1000 & R1001 would be helpful for error analysis or logging.

Explanation

●Explanation of parameter S for FUN97: MD0 (R5000 just only for example, other registers can be used also).

R5000: Starting register of communication program (data transaction table) by filling table method (Not easy)

R5000	Total transactions	• Low Byte is valid; one transaction takes 7 registers to describe, which means 7 registers define a packet of data transaction.
R5001	Slave station No. which is about to transact with	• Low Byte is valid, 0～254 (0 means that master PLC broadcasts the data to all slave PLC, the slave PLC does not reply).
R5002	Command code	• Low Byte is valid; =1, means reading data from slave PLC; =2, means writing data to slave PLC.
R5003	Data length of this transaction	• Low Byte is valid; the range is 1～64. It defines the data length of this transaction.
R5004	Data type of Master PLC	• Low Byte is valid, and its range is 0 to 13; it defines the data type of master PLC (see next page).
R5005	Starting reference of Master PLC	• Word is valid; it defines the starting address of data (master).
R5006	Data type of slave PLC	• Low Byte is valid, and its range is 0 to 13; it defines the data type of slave PLC (see next page).
R5007	Starting reference of Slave PLC	• Word is valid; it defines the starting address of data (slave).
R5008	Slave station No. which is about to transact with	
R5009	Command code	
R5010	Data length of this transaction	
R5011	Data type of Master PLC	Description of the 2_nd packet of transaction
R5012	Starting reference of Master PLC	
R5013	Data type of slave PLC	
R5014	Starting reference of Slave PLC	

FB-PLC acts as the master of “Fatek CPU LINK network” through Port1 and FB-485

●Master/Slave data type, code and reference number

Data code	Data type	Starting code
0	X (discrete input)	0～255
1	Y (discrete output)	0～255
2	M (internal relay M)	0～1911
3	S (step relay S)	0～999
4	T (timer contact)	0～255
5	C (counter contact)	0～255
6	WX (word of discrete input, 16 bits)	0～240, it must be the multiple of 8.
7	WY (word of discrete output, 16 bits)	0～240, it must be the multiple of 8.
8	WM (word of internal relay, 16 bits)	0～1896, it must be the multiple of 8.
9	W S (word of step relay, 16 bits)	0～984, it must be the multiple of 8.
10	TR (timer register)	0～255
11	CR (counter register)	0～199
12	R (data register Rxxxx)	0～3839
13	D (data register Dxxxx)	0～3071

Note: The data type for master and slave must be consistent. i.e. if the master station is any value between 0 to 5, the slave station must also be any value between 0 to 5; if the master station is any value between 6 to 13, the slave station must also be any value between 6 to 13.

●Explanation for operand Pt of FUN97:MD0 (R100 just only for example, other registers can be used also)

	High Byte	Low Byte
R100	Result code	Transaction No.
R101	Station number	Command code
R102	For internal working use	
R103	For internal working use	
R104	For internal working use	
R105	For internal working use	
R106	For internal working use	
R107	Internal working usage	

- Result code indicates the transaction result; 0= normal, other value =abnormal.
- Transaction No. indicates which one is in processing (beginning from 0).
- Station number: the slave station No. which is in transaction.
  Command code
  =44H, reading successive discrete status from slave PLC.
  =45H, writing successive discrete status to slave PLC.
  =46H, reading successive registers from slave PLC.
  =47H, writing successive registers to slave PLC.
- R104’s B0=1, Port1 has been occupied and this instruction is waiting to acquire the transmission right for data transaction.
  B4=1, t this instruction is not first time performing.
  B12, output indication for “ACT”
  B13, output indication for “ERR”.
  B14, output indication for “DN”.

Result code: 0, transaction is successful.
1, the setting of CPU DIP switch (SW1) is error (it must be 1=OFF, 2=ON), turn off and set as describing.
2, data length error (data length is 0 or greater than 64 in one transaction).
3, command code error (command code is greater than 2).
4, data type error (data type is greater than 13, please refer to data type code).
5, reference number error (please refer to reference number).
6, inconsistence in data type (e.g. master station is 0～5 while slave is 6～13).
A, communicating, but no response from slave station (Time-out error).
B, communication error (received error data).

FUN97:MD0 Program Example

FB-PLC acts as the master of “Fatek CPU LINK network” through Port1 and FB-485

Programming for data transaction with instruction method

(please refer to extension instructions for communication)

R5000: Starting register of communication program (It's very easy to plan the data flow by this method)

Content of registers	Description	Planning the transaction with extended instructions		
R5000:5	5 packets of transactions in total.	Total transactions:5		
R5001:0 R5002:2 R5003:16 R5004:12 R5005:500 R5006:13 R5007:0	Broadcasting from master PLC Write data to all slave PLCs Length of data is 16 Data type of master PLC is R Reference number of master PLC is 500, i.e. R500 Data type of slave PLC is D Reference number of slave PLC is 0, i.e. D0	000	Station# Command Length M_start S_start	0 Write 16 R500 D0
• Master PLC broadcasts the R500～R515 to all slave PLCs’ D0～D15				
R5008:2 R5009:1 R5010:10 R5011:12 R5012:20 R5013:12 R5014:200	The slave PLC in transaction is the station No.2 Read data from slave PLC Data length is 10 Data type of master PLC is R. Reference number of master PLC is 20, i.e. R20 Data type of slave PLC is R Reference number of slave PLC is 200, i.e. R200	001	Station# Command Length M_start S_start	2 Read 10 R20 R200
• Read R200～R209 from slave PLC No.2 to R20～R29 of master PLC				
R5015:3 R5016:1 R5017:20 R5018:2 R5019:1000 R5020:2 R5021:100	The slave PLC in transaction is the station No.3 Read data from slave PLC Data length is 20 Data type of master PLC is M. Reference number of master PLC is 1000, i.e. M1000 Data type of slave PLC is M Reference number of slave PLC is 100, i.e. M100	002	Station# Command Length M_start S_start	3 Read 20 M1000 M100
• Read M100～M119 from slave PLC No.3 to M1000～M1019 of master PLC				
R5022:4 R5023:2 R5024:20 R5025:2 R5026:1000 R5027:3 R5028:100	The slave PLC in transaction is the station No.4 Write data to slave PLC Data length is 20 Data type of master PLC is M. Reference number of master PLC is 1000, i.e. M1000 Data type of slave PLC is S Reference number of slave PLC is 100, i.e. S100	003	Station# Command Length M_start S_start	4 Write 20 M1000 S100
• Master PLC writes M1000～M1019 to S100～S119 of slave PLC No.4, i.e. to write from M100～M119 of slave PLC No. 3 to S100～S119 of slave PLC No.4				
R5029:4 R5030:1 R5031:4 R5032:9 R5033:0 R5034:6 R5035:0	The slave PLC in transaction is the station No.4 Read data from slave PLC Data length is 4 (4 words this situation) Data type of master PLC is WS. Reference number of master PLC is 0, i.e. WS0 Data type of slave PLC is WX Reference number of slave PLC is 0, i.e. WX0	004	Station# Command Length M_start S_start	4 Read 4 WS0 WX0
• Read X0～X63 of slave PLC No.4 to S0～S63 of master PLC				

Note: For explanation of extended instruction for communication format, please refer to page 13-7.

FB-PLC acts as the master of “Fatek CPU LINK network” through Port1 and FB-485

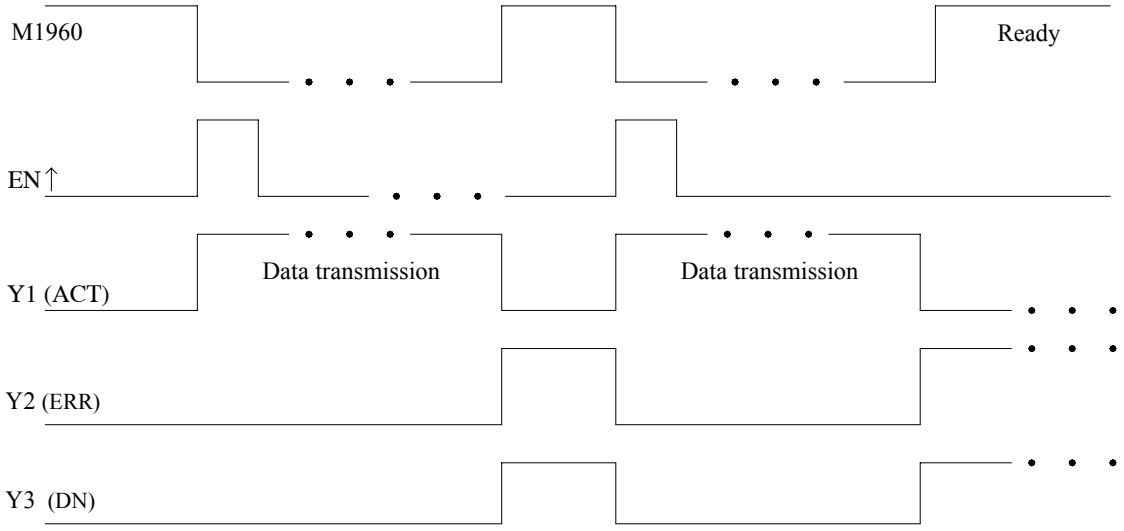
Explanation of program example

1. When execution control 〝EN↑〞 changes from 0→1, and Port1 is not occupied by other FUN97 (M1960 ON) and M2=OFF, LINK1 instruction will start the data transaction. The M1960 is OFF during data transaction, and when the transaction is finished, the M1960 becomes ON. Employ the OFF←→ON change of M1960 (FUN97 execution control “EN↑”=0→1 means starting) may automatically starts for every frame of data transaction successively (when the last packet of transaction is completed, it will automatically return to the first packet of transaction to obtain the automatic cycling transmission).
2. When abort control M2 changes from 0→1, it aborts transmission immediately (if the data is in transmitting, it will stop transmitting immediately). Next time when starts the transaction; it will begin from the first packet of transactions.

● Output indication

“ACT” ON : The Y1 ON, transaction is going
“ERR” ON: The Y2 ON, error occurred in previous packet of transaction (refer to result code).
“DN” ON: The Y3 ON, previous packet of transaction is completed and is error free.

● Waveform of input control and output indication



Note 1: Of Y2 and Y3, only one of them will be in ON status and not both to be ON at the same time.
2: After the last packet of transaction completed, the M1961 will be ON for one scan time..

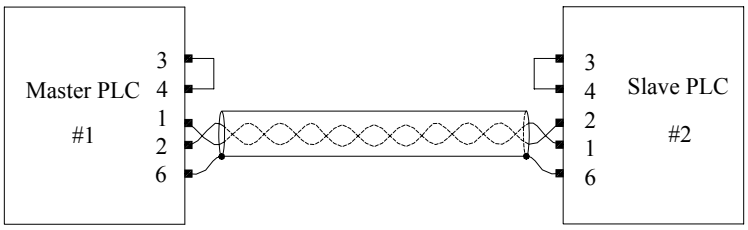
FB-PLC acts as the master of “Fatek CPU LINK network” through Port1 and FB-485

Point to point wiring Point to point link of master PLC and slave PLC through RS-232.

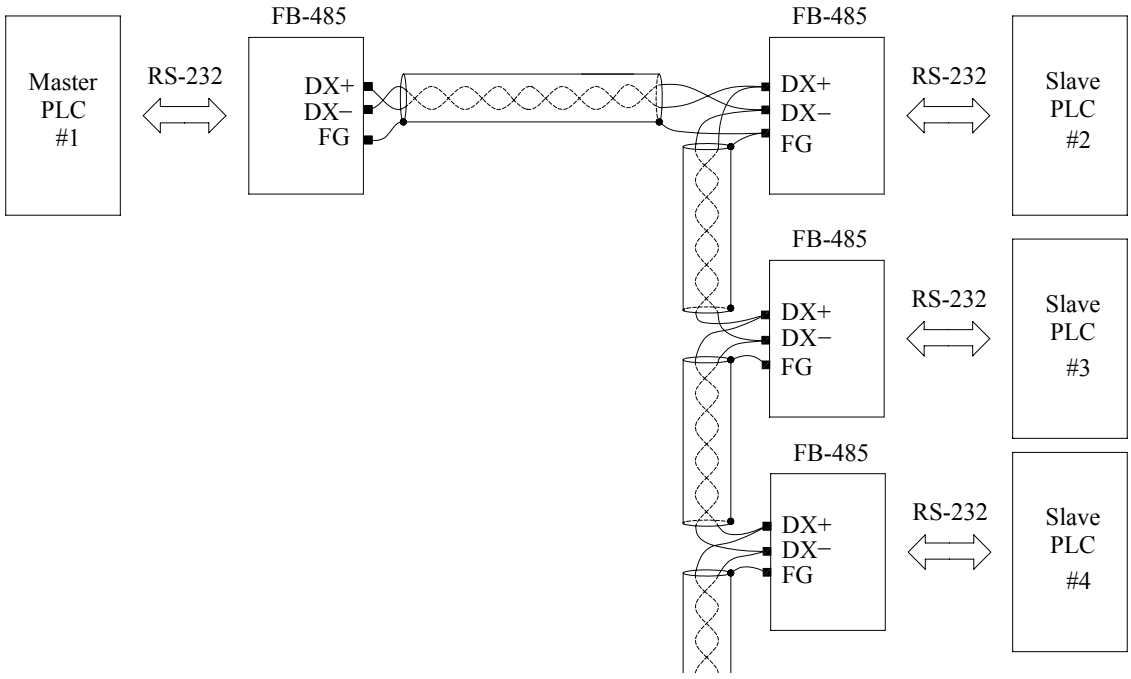
The communication port of PLC is a 15 Pin D-Sub female connector, therefore a 15 Pin D-Sub cable with both ends to be male connector is needed to link the PLCs.

The connecting is as follows:

PIN_3 shorts with PIN_4		PIN_3 shorts with PIN_4
PIN_1（RXD）	⟷	PIN_2（TXD）
PIN_2（TXD）	⟷	PIN_1（RXD）
PIN_6（SG）	⟷	PIN_6（SG）



Multi_drop wiring Pass through FB-485 (RS-232⟷RS-485) converter, the master PLC paves the data link with multi slave PLCs by way of RS-485 network.

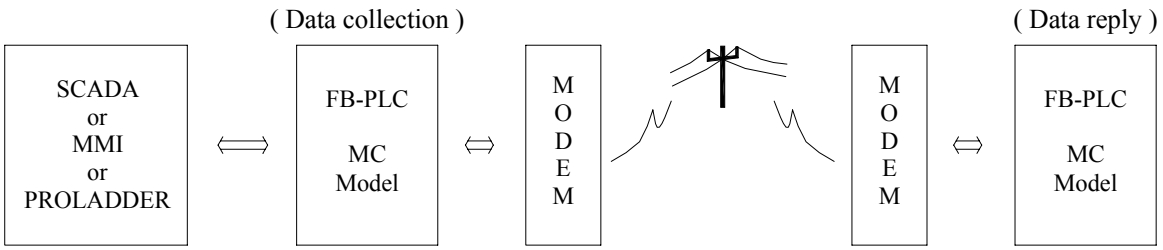


【Cautions】

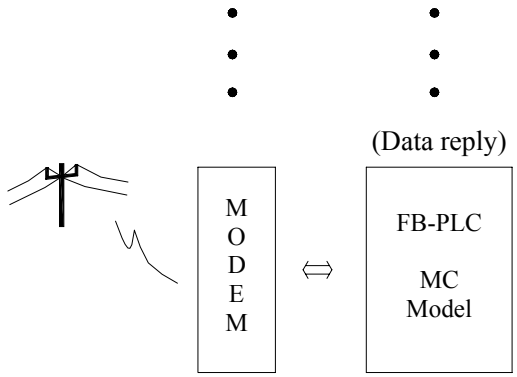
1. 1.The RS-485 wiring must employ twisted pair as the transmission cable.
2. Star topology of the wiring must be avoided; it must be cascaded with stations one after one.
3. The outer layer of weaved net for twisted pair must connect to the FG (to prevent from interference and decrease the common mode interference).

CPU Link by way of Port1 to connect to Modem.

- PLC can connect to MODEM through communication port1, and by way of telecommunication network to link and share data with remote PLC. Its application is as follows:
  - · Perform automatic data collection from the remote end.
  - · Automatically report for alarm and abnormal conditions
  - · Associate with current available graphic supervisoring software or MMI etc. standard products to constitute a wide area network automatic monitoring system. It doesn't need to develop specific designing, so as to reduce the development risk and time limit.
- Hardware configuration, and setting:



Data collecting PLC:
· DIP switch (SW1) setting for CPU
1:OFF
2:ON (LINK function)
· Don't need to store phone number within the CPU
· R4149 High Byte set to be 55H (MODEM function)



Data reply PLC:
· DIP switch (SW1) setting for CPU
1:OFF
2:ON（LINK function）
· R4149 High Byte sets to be 55H (MODEM function)
· R4140～R4145 sets the phone number for general data collecting PLC end (extension phone function allowed).
e.g. Phone number is 02-28082192, then R4140=8220H, R4141=1280H, and R4142=0E29H.
If phone number is: 02-28082192 ext 100, then R4140=2A20H, R4141=2808H, R4142=A291H, R4143=AAAAH, R4144=001AH, R4145=000EH.
· Explanation: R4140～R4145 is telephone number register for dialing;
"E" is the ending character of phone number; "A" is the dial delaying character (usually the dialing of extension number or international long distance call can be reached by making use of dial delaying, the delayed time for a delaying character is based on MODEM setting, which is about 2 second). "B" stands for "#" character (can dial B. B. CALL), and "C" stands for "*" character.
· It employs LINK1 (FUN97:MD0) instruction to write data to the general data collecting PLC or to read data from general data collecting PLC (refer to LINK1 Instruction user guide).
· The maximum communication Baud Rate can reach 38400 bps
(both of the communication ends must be consistent in setting)
· This configuration does not offer calling back function.

FUN97:MD0 Program Example

CPU Link by way of Port1 to connect to Modem.

· The wiring of PLC communication port 1 and MODEM:

Fatek PLC （DB-15）		MODEM （DB-25）
PIN 1:RXD	⟷	TXD （PIN_3）
PIN 2:TXD	⟷	RXD （PIN_2）
PIN 3:RTS	⟷	CTS （PIN_4）
PIN 4:CTS	⟷	RTS （PIN_5）
PIN 6:SG	⟷	SG （PIN_7）
		DSR （PIN_6）
		DTR （PIN_20）

【MODEM dialing interface signal】

M1959: OFF, dialing by “Tone” ON, dialing by “Pulse”

M1964: OFF→ON, dial up ON→OFF, hang up

R4163: The Low Byte of R4163 is used to control the application of X instruction while MODEM dialing.

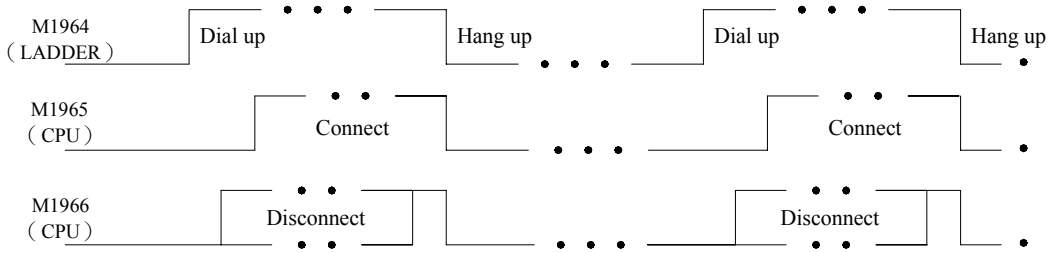
=1, it does not detect dial tone nor busy tone while MODEM dialing.

=2, it detects only dial tone but does not detect busy tone while MODEM dialing.

=3, it dials directly without detecting dial tone, but will detect busy tone after MODEM dialing.

=4, it detects both dial tone and busy tone for MODEM dialing.

For the other values, it works as 4; different country system needs to adjust the setting pertaining to the country.



Note 1: Of M1965 and M1966, there will be only one ON, not both to be ON at the same time.

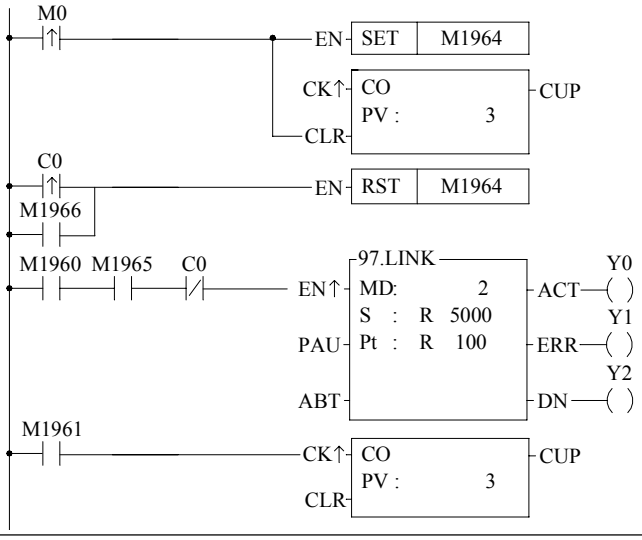
2: The waiting time for dial connection is 1 minute; if unable to connect, it will redial twice (totally 3 times). If all of the dial connection tries failed, CPU will set M1966 to be ON (connection failed).

3: When the quality of communication is not stable and easy to disconnect, you may employ the abnormal detecting function of LINK1 instruction to control M1964 redials for connection (delay time of redial must be more than 10 seconds).

4: When PLC change from RUN to STOP, the CPU will automatically change MODEM to be receiving state, which could accept the remote side dial connection.

5: When PLC is not in dialing or MODEM connection states, CPU will automatically change MODEM to be receiving state, which could accept the remote side dial connection.

〈Program example〉



· When M0 changes from 0→1, dials up.

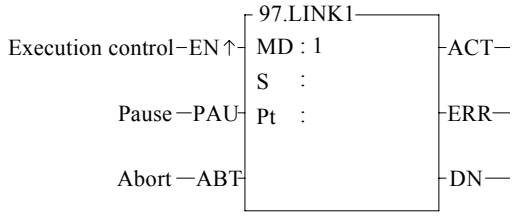
· Clears the transaction count.

· Hang up after transactions completed or connection failed.

· Planning R5000～R5199 to be ROR, the communication program will be stored together with LADDER program.

· Counting after all transactions completed

FUN 97 LINK1	Convenient instruction for FUN97(LINK1): MD1 (Which makes PLC serve as “ASCII sender” through Port1)	FUN 97 LINK1



MD : 1, link with intelligent peripherals that equipped with ASCII interface.

S : Starting register of data transmission table (see example for explanation)

Pt : Starting register for instruction operation (see example for explanation). It controls 8 registers at least, the other programs cannot repeat in using.

Range / Operand	HR	ROR	DR	K
	R0 | R3839	R5000 | R8071	D0 | D3071	
MD				0～2
S	○	○	○	
Pt	○	○*	○	

Descriptions

1. FUN97 (LINK1): MD1 instruction provides the Fatek PLC to act as the ASCII sender to link with the intelligent peripherals that equipped with ASCII interface.
2. The SW1 of CPU board must be set to 1=OFF, 2=ON (shut down setting to restart).
3. Port1 is RS-232 interface, if it is going to link to multi stations through RS-485 interface, just append an FB-485 converter (transform RS-232 to RS-485) and it will work.
4. The communication protocol/format is written with LADDER program, which must be consistent with the linked ASCII peripherals.
5. When execution control “EN ↑ ” turns from 0→1 and both pause “PAU” and abort “ABT” are 0, and if Port1 is not controlled by other FUN97 instruction (which means M1960=1), this instruction will control Port1 immediately and set M1960 to be “0” (being controlled) to proceed data transaction. If Port1 is being controlled (M1960=0), this instruction will enter into the wait state until the other controlling FUN97 instruction complete or pause/abort its operation and released the control right (M1960=1), and this instruction will enact again out of wait state to set the M1960 to be “0” and proceed the transmission transaction.
6. During transaction, if the pause “PAU” becomes 1, this instruction will pause and release the control right (set M1960 to be 1) after it completed the transmitting of the on-going data transmission.
7. During transaction, if the abort “ABT” becomes 1, this instruction will halt the transmission and release the control right immediately (set M1960 to be 1).
8. While transaction is going, the output indication “ACT” will be ON.
9. When a packet of data transaction is finished (transmission finished or "transmit then receive" completed), if there is error occurred, the output indication “ERR” will be ON.
10. When a packet of data transaction is finished (transmission finished or "transmit then receive" completed), if there is no error occurred, the output indication “DN” will be ON.
11. The connecting pin No.3 (RTS) of Port1 must be short to connect to pin No.4 (CTS).

Convenient instruction for FUN97 (LINK1): MD1
(Which makes PLC serve as “ASCII sender” through Port1)

【Interface signal】

M1960 : This signal is generated from CPU
ON means Port1 is ready.
OFF means Port1 is busy.

M1961 : This signal is generated from CPU; the same as M1960.
ON, it means data transaction has been completed.

R4146 : The register for communication parameter setting of port 1. (please refer to section 12.6.2 for communication parameter setting)

R4147 : Low byte of R4147, it defines the Time-out span of link1 instruction; the unit is 0.1 second (the default is 05H, i.e. 0.5 second)
LINK1 instruction depends on Time-out span to detect whether the communication partner is free from error on line; when the LINK1 MD1 setting is in "transmit then receive" mode (example will be followed), the Time-out error will occur if PLC sent a packet of data to the peripheral but it didn’t reply within this duration.
When LINK1 MD1 setting is "transmit" only (example will be followed), low byte of R4147 is meaningless.

: High byte of R4147, for FUN97:MD1, the recommended setting is 0.

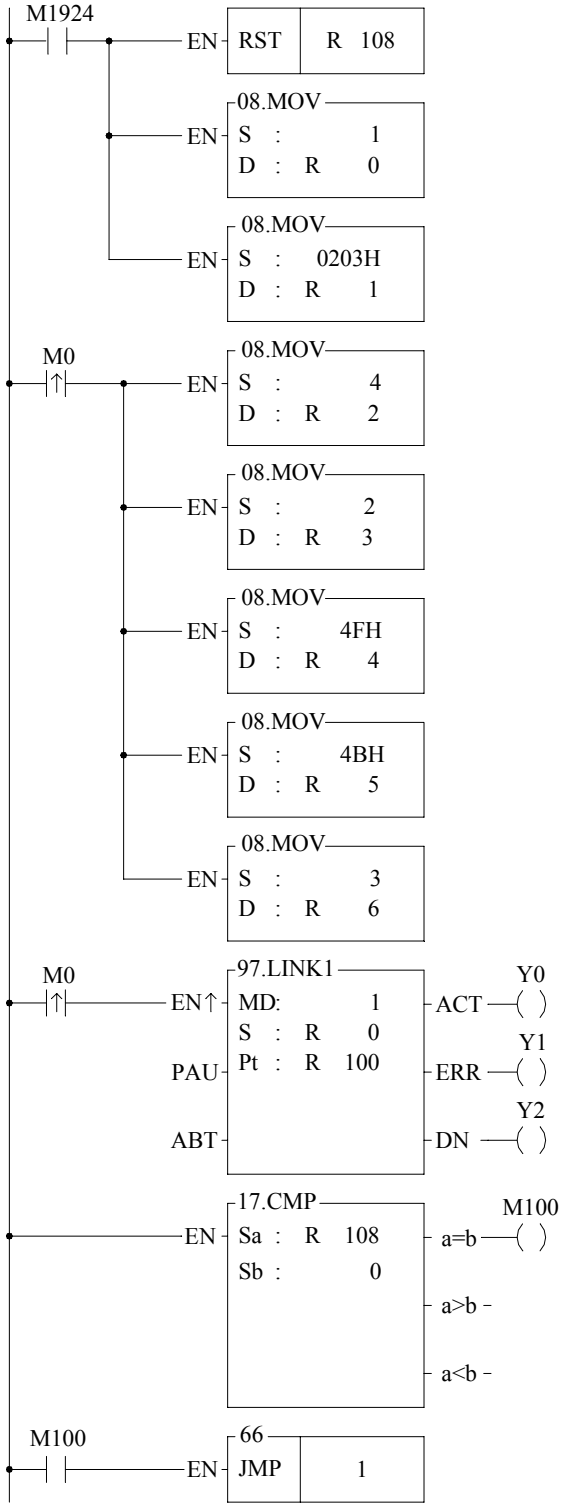
R4148 : When the low byte of R4147 is not 0, the low byte of R4148 is meaningless.
When R4147 low byte is 0, the low byte of R4148 defines the Time-out span of LINK1 instruction, the unit is 0.01 second (for fine tuning; the default is 0). Its function is the same as that described for R4147 low byte.

R4148 : High byte of R4148, Time-out setting for receiving, which is used to determine whether a packet of data has been received completely. The unit is 0.001 second and default is 0CH(12mS).
Detailed description will be followed.

FB-PLC acts as an “ASCII sender” through Port1

Program example for loop back test

PLC station A sends data to PLC station B (PLC station B sends the received original data back to the PLC station A, loopback test), and checks whether the responding message of PLC station B is the same as its original data that had sent out; therefore, it can do simple test on software and hardware of PLC Port1 whether it is normal and error free.

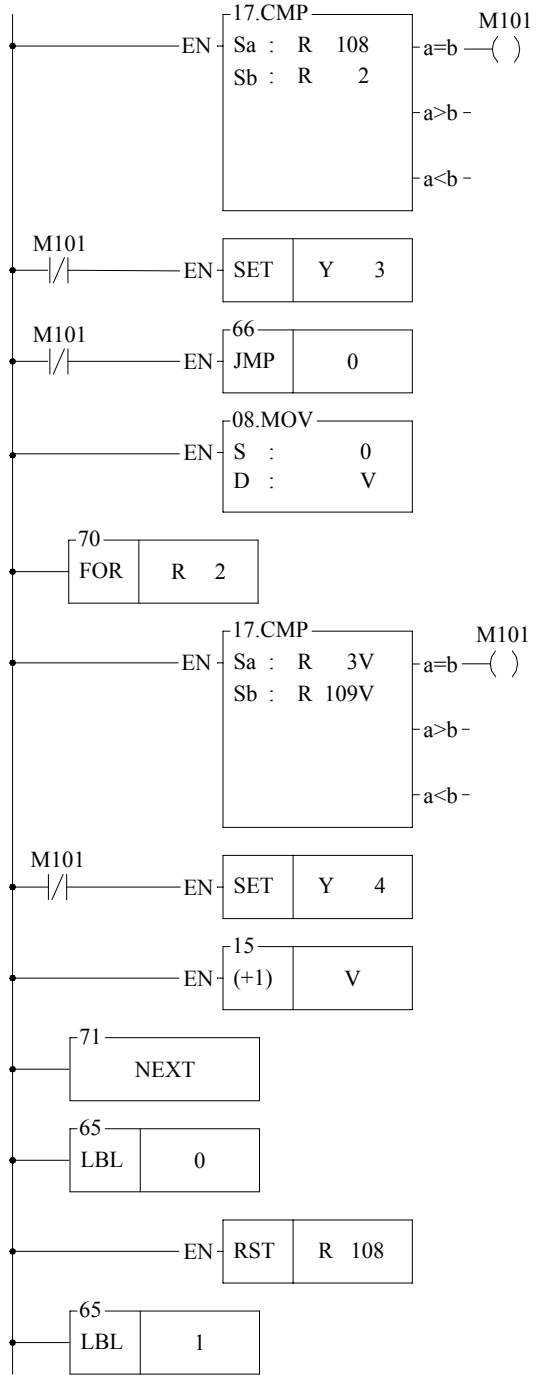


- Clears the received data length to be 0
  (for "transmit" only, this instruction is not required).
- Setting of the operation mode:
  - Set to be "transmit then receive" mode (R0=1)
- Set the starting code (02H) and ending code (03H) for responding message in receiving. (without starting and ending codes, R1=0 can also receive regularly)
- Packing data to be transmitted:
- Set the transmitting data length (R2=N).
- Fills in the data that is to be transmitted:
  - Fill in data 1 (R3= ' STX ')
  - Fill in data 2 (R4= ' O ')
  - Fill in data 3 (R5= ' K ')
  - Fill in data 4 (R6= ' ETX ')
- When selecting "transmit then receive" mode, it employs the comparing instruction to judge whether the responding message from the counter partner is received; if it is received, then M100=OFF, and it will process the received data.
  (For " transmit" mode, this program is not required)

FUN97:MD1 program example

FB-PLC acts as an “ASCII sender” through Port1

- The processing program for data received.
- For details of the data received, please refer to the explanation of following page.



- Compares the received data length and transmitted data length.
- When the length is inconsistent, it sets up the error indication.
- Clears the pointer V to be 0.
- Compares the consistency of all of the received data and transmitted data.
- Compares the received data and transmitted data one by one.
- When there is a data difference, set up the error indication.
- As the received data processed complete, clears the received data length to be 0, and gets ready to receive new data.

FB-PLC acts as an “ASCII sender” through Port1

- Explanation of parameter S for FUN97: MD1

Starting register of data transmission table (R0 just only for example)

R0	Transmit only/transmit then receive	• Low byte is valid, 0: transmit only, no response from the counter partner. 1: transmit then receive the responding message.
R1	Starting /Ending code of receiving	• High Byte : Describing the starting code of responding message while receiving Low Byte : Describing the ending code of responding message while receiving.
R2	Length of transmission	• The maximum length of data to be transmitted is 511.
R3	Data 1	• Low Byte is valid
R4	Data 2	• Low Byte is valid
R5	Data 3	• Low Byte is valid
R7 • • •	Data 4	
		• Low Byte is valid
		• Low Byte is valid
	Data N	

Note 1: When selecting the transmit-only mode, the Starting /Ending code of receiving is meaningless.

2: When it is in the "transmit then receive" mode, before the starting of transmission, it must first to estimate the starting and ending code of responding message from communication partner and write them into the receiving starting/ending code register (e.g. R1=0203H, 02H stands for starting code and 03H for ending code), so as to ensure the receiving to be free from error. The communication protocol with starting/ending code makes the identifying of every packet of messages easy, and the communication program is simple and efficient.

3: When it is in the "transmit then receive" mode, fills the high byte of starting/ending code register with 0 if no starting code in responding message; if no ending code in responding message, fills 0 to the low byte of starting/ending code register. Adjusts the high byte of R4148 (Time-out span) to judge whether a packet of data has been received completely; the unit is 0.001 second (the default is 0CH, 12mS).
The communication protocol without ending code depends on Time-out span to tell whether it has received completely a packet of data (the setting of Time-out must be greater than the maximum response delay time between data bytes when communication partner is replying), thus it may ensure the receiving of the whole packet to be complete. Generally speaking, the data in transmitting is transmitted one byte after another continuously; therefore, if there is pause (greater than Time-out duration), it means the packet of message is transmitted completely.

FUN97:MD1 program example

FB-PLC acts as an “ASCII sender” through Port1

- Explanation of FUN97: MD1 parameter Pt.

	High Byte	Low Byte	
R100	Result code	0	• The result code stores the operation result, 0=Normal; the other values, Abnormal.
R101	For internal operation use		• For internal operation use: it is the registers required by CPU when performing LINK1 instruction.
R102	For internal operation use		
R103	For internal operation use		
R104	For internal operation use		• The B0 of R104 is 1 means that Port1 is busy; this instruction is waiting to take the transaction right B12= “ACT” output indication B13= “ERR” output indication B14= “DN” output indication.
R105	For internal operation use		
R106	For internal operation use		
R107	For internal operation use		
R108	Total amount of data received		• The total amount of data byte that is received (the register for received data length; it includes the starting and ending code that is received).
R109	1		• The first byte of data received (if there is the starting code, it is the starting code); High Byte =0.
R110	2		• The second byte of data received; High Byte =0.
	3		• The third byte of data received; High Byte =0.
• • •			
	N		• The N_th byte of data received (if there is ending code, it is the ending code); High Byte =0.

Result code: 0, transaction is successful.

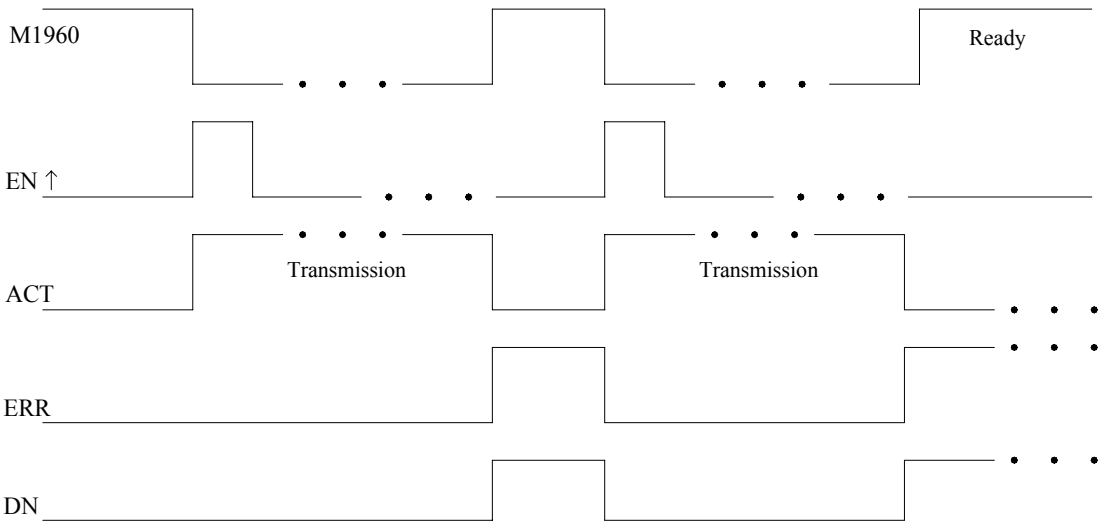
1, the setting of the DIP switch (SW1) of CPU board is error (it must be 1=OFF, 2=ON), shut down setting and restart.

2, data length error (the value is 0, or the packet of transaction is greater than 511)

A, no response from the counter partner.

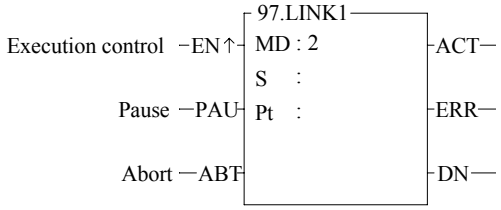
B, communication abnormal (received error data)

- The waveform for input control and output indication



Note: Of “ERR” and “DN”, only one of them will be in ON status and not both to be ON at the same time.

FUN 97 LINK1	Convenient instruction for FUN97(LINK1): MD2 (Which makes PLC serve as “ASCII receiver” through Port1)	FUN 97 LINK1



MD: 2, PLC waiting to receive the message sent by intelligent peripherals

S : Starting register of data transmission table (see example for explanation)

Pt : Starting register for instruction operation (see example for explanation). It controls 8 registers at least, the other programs cannot repeat in using.

Range / Ope-rand	HR R0 | R3839	ROR R5000 | R8071	DR D0 | D3071	K
MD				0～2
S	○	○	○	
Pt	○	○*	○	

Descriptions

1. FUN97 (LINK1): MD2 instructions provides Fatek PLC with ability to receive message sent by peripherals with ASCII interface at any time.
2. The SW1 of CPU board must be set to 1=OFF, 2=ON (shut down setting then restart).
3. The communication protocol is written with LADDER program, which must be consistent to the ASCII peripherals.
4. When execution control “EN ↑ ” turns from 0→1 and both pause “PAU” and abort “ABT” are 0, and if Port1 is not controlled by other FUN97 instruction (which means M1960=1), this instruction will control Port1 immediately and set M1960 to be “0” (being controlled). If Port1 is being controlled (M1960=0), this instruction will enter into the wait state until the other controlling FUN97 instruction complete or pause/abort its operation and released the control right (M1960=1), and this instruction will enact again out of wait state to enter into the receiving state and set the M1960 to be “0”.
5. When the operation pause “PAU” or abort “ABT” becomes 1, it gives up the receiving immediately (M1960 ON).
6. While it is in the receiving state, the output indication “ACT” is ON.
7. When a packet of data transaction finished (receive finished or receive then transmit completed), if there is error occurred, the output indication “ERR” will be ON for one scan time.
8. When a packet of data transaction finished (receive finished or receive then transmit completed), if there is no error occurred, the output indication “DN” will be ON for one scan time.
9. The connecting pin No.3 (RTS) of Port1 must be short in connection with pin No.4 (CTS).

FUN 97 LINK1	Convenient instruction for FUN97 (LINK1): MD2 (Which makes PLC serve as “ASCII receiver” through Port1)	FUN 97 LINK1

【Interface processing signal】

M1960 : This signal is generated from CPU
ON means Port1 is ready.
OFF means Port1 is busy.

R4146 : The register for communication parameter setting of Port1
(Please refer to Port1 communication parameter setting for explanation).

R4147 : The Low Byte defines the Time-out span of FUN97:MD2 instruction; its unit is 0.1 second (the default is 5, which means 0.5 second). When the PLC received the message and must respond to it ("receive then transmit" mode), but the LADDER program is unable to process and send out the responding message during this period of time, the CPU will give up response this time and automatically restore back to receiving state. When FUN97: MD2 is set to be "receive only" mode (example to be followed), this value is meaningless.

: High Byte, it is meaningless while FUN97: MD2

R4148 : When the low byte of R4147 is not 0, the low byte of R4148 is meaningless.
When R4147 low byte is 0, the low byte of R4148 defines the Time-out span of LINK1 instruction; the unit is 0.01 second (for fine tuning; the default is 0). Its function is the same as that described for R4147 low byte.

: High Byte, the setting point for Time-out span on receiving; it is used to judge whether a packet of data has been received completely. Its unit is 0.001 second (the default is 0CH, 12mS) (detailed explanation will be followed).

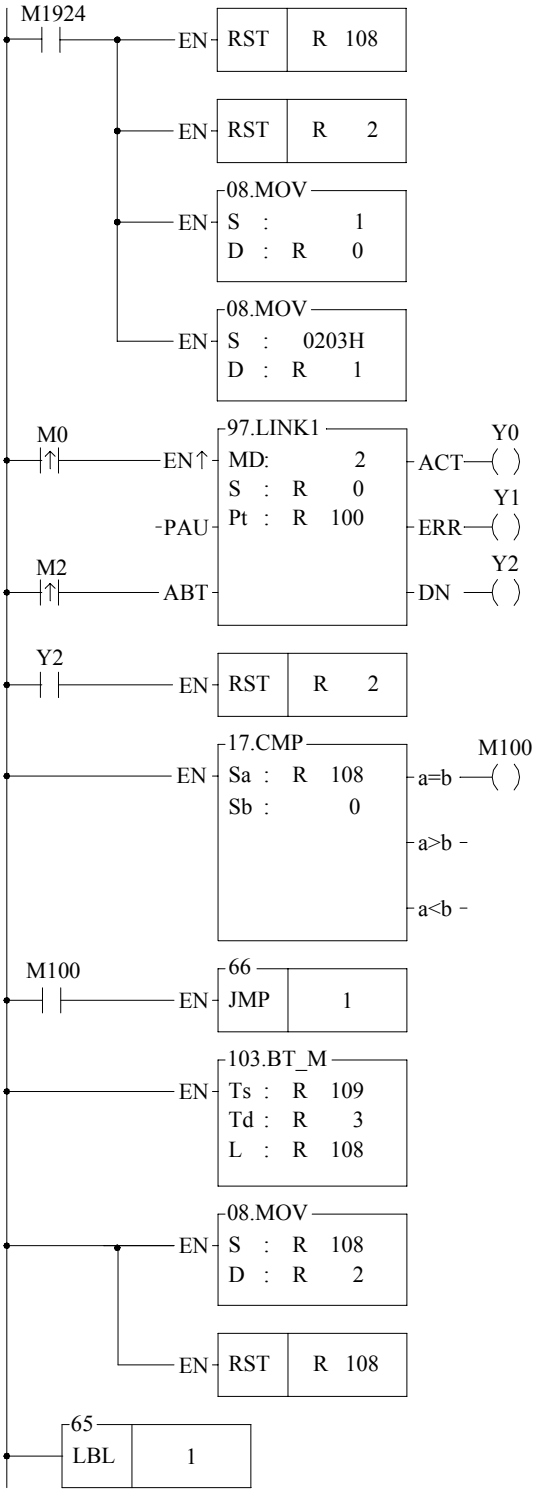
Note 1: Once FUN97: MD2 activated, it will stay in receiving state all the time; unless the input signal of PAU” or “ABT” becomes ON, then it will jump out of receiving state and stop receiving and waiting for next time it will be activated again.

2: When there is change on Starting/Ending code for receiving, it must make the input signal of PAU” or “ABT” becomes ON once, and re-activate the receive control “EN ↑ ” from 0→1 to start message receiving

FB-PLC acts as “ASCII receiver” through Port1

Program example for loop back reply

This PLC station sends back the received data to the master, which had sent out the data.



- Clears the received data length to be 0.
- Clears the transmitted data length to be 0. (for "receive' only, this program is not required).
- Sets up the operation mode:
  - Sets “receive then transmit” mode.
  - Sets up the starting code (02H) and ending code (03H) (R1=0, it will receive regularly even without the starting and ending code)
- When transmission complete, clears the transmitted data length to be 0 (for "receive" only mode, this instruction is not needed)
- While selecting "receive then transmit" mode, it employs the comparing instruction to tell whether a new packet of message is received; if it is, the M100=OFF and it will process the received data.
- Copy all of the received data to responding registers.
- R108 is the length of received data.
- After the received data processed, fills the received data length to be the sending back data length to start the responding transmission.
- Clears the received data length to be 0 (ready to receive new data).

FUN97:MD2 program example

FB-PLC acts as “ASCII receiver” through Port1

- Explanation for FUN97: MD2 parameter S

R0: Starting register for data receiving table (R0 just only for example)

R0	Receive only/Receive then transmit	• Low Byte is valid, 0: "receive only" mode. 1: "receive then transmit" mode.
R1	Starting/Ending code of receiving	• High Byte : Describing the starting code for receiving Low Byte : Describing the ending code for receiving.
R2	Length of reply data	• Maximum of length is 511. It will start to transmitter the reply data as long as the length is not 0.
R3	Reply data 1	• Low Byte is valid
R4	Reply data 2	• Low Byte is valid
•		
•		
•		
	Reply data N	• Low Byte is valid

Note 1: When selecting the "receive only" mode, CPU fills the received data into the receiving registers and set the length after it has received a packet of message, and starts to receive the next packet of message immediately.

2: When selecting the "receive then transmit" mode, CPU fills the received data into the receiving registers and set the length after it has received a packet of message; then it starts to wait for the reply data length which is not zero to start transmitting reply data (therefore when select this mode, it must control the reply data length to be zero before the reply data completely filled into the reply registers; when the reply data fills into the reply registers finished, it may then set the length of reply data).

3: It must fills the starting code and ending code into the starting/ending code register before the starting of receiving (e.g. R1=0A0DH, 0AH stands for starting code and 0DH for ending code), so as to ensure it to be free from receiving error.
The communication protocol with starting/ending code makes the identifying of every packet of messages easy, and the communication program is simple and efficient.

4: If the receiving message without starting code, fills the high byte of starting/ending code with 0; if the receiving message without ending code, fills the low byte of starting/ending code with 0. Adjusting High Byte of R4148 (Time-out span) to detect whether a packet of message has been received completely, the unit is 0.001 second (default is 0CH, 12mS). The communication protocol without ending code depends on Time-out span to tell whether it has received completely for a packet of data (the setting point of Time-out must be greater than the maximum delay time between data bytes to be received), thus it may ensure the receiving of the whole packet to be completed. Generally speaking, the data in transmitting is transmitted one byte after another continuously; therefore, if there is pause (greater than Time-out duration), it means that the packet of message is transmitted completely.

5 : When selecting "receive" only mode, if the message received has no ending code, the interval between every packet of data sent by the sending party must be greater than the receiver’s receiving Time-out span, otherwise the receiving party won’t be able to distinguish between each packet of data correctly.

FB-PLC acts as “ASCII receiver” through Port1

- Explanation for FUN97: MD2 parameter Pt

	High Byte	Low Byte	
R100	Result code	0	• The result code stores the operation result, 0=normal; the other values, abnormal
R101	For internal operation use		• For internal operation use: it is the registers required by CPU when performing LINK1 instruction.
R102	For internal operation use		
R103	For internal operation use		
R104	For internal operation use		• The B0 of R104 is 1 means that Port1 is being occupied, this instruction is waiting to get the control right of Port1. B12= “ACT” indication B13= “ERR” indication B14= “DN” indication
R105	For internal operation use		
R106	For internal operation use		
R107	For internal operation use		
R108	Length of received data		• The total amount of data byte that has received (the register for received data length; it includes the starting and ending code that has received).
R109	1		• The first byte of data received (if there is the starting code, it is the starting code); High Byte＝0
R110	2		•The second byte of data received; High Byte =0.
• • •			
	N		• The N_th byte of data received (if there is the ending code, it is the ending code); High Byte＝0

Note : When CPU received a packet of message, it filled the data to receiving registers and set up the received data length. Before the LADDER program starts to receive, you may clear the register of received data length to be 0; it means the receiving of a new packet of message when compared and found that the received data length is not zero. After the LADDER program gets the received data, it clears the received data length register to be 0. Just compare to see the received data length register is not zero means the receiving of a packet of new message, and so it may easily to process the receiving action.

Result code: 0, transaction is successful.
1. the setting for DIP switch (SW1) of CPU board is incorrect (must be 1=OFF, 2=ON), shut down setting then restart.
2, data length is error (the value is 0, or the transaction is greater than 511)
A, unable to reply message within Time-out span ("receive then transmit" mode).
B, communication abnormal (received error data)

FUN97:MD2 program example

FB-PLC acts as “ASCII receiver” through Port1

- Explanation of input control

  1. When the execution control input M0 change from 0→1, if Port1 is not controlled by other FUN97 (M1960 ON) and it enters into the receiving state immediately (M1960 keeping OFF all the time)
  2. When "ABT" input M2 changes from 0→1, it jumps out of receiving state (M1960 ON)

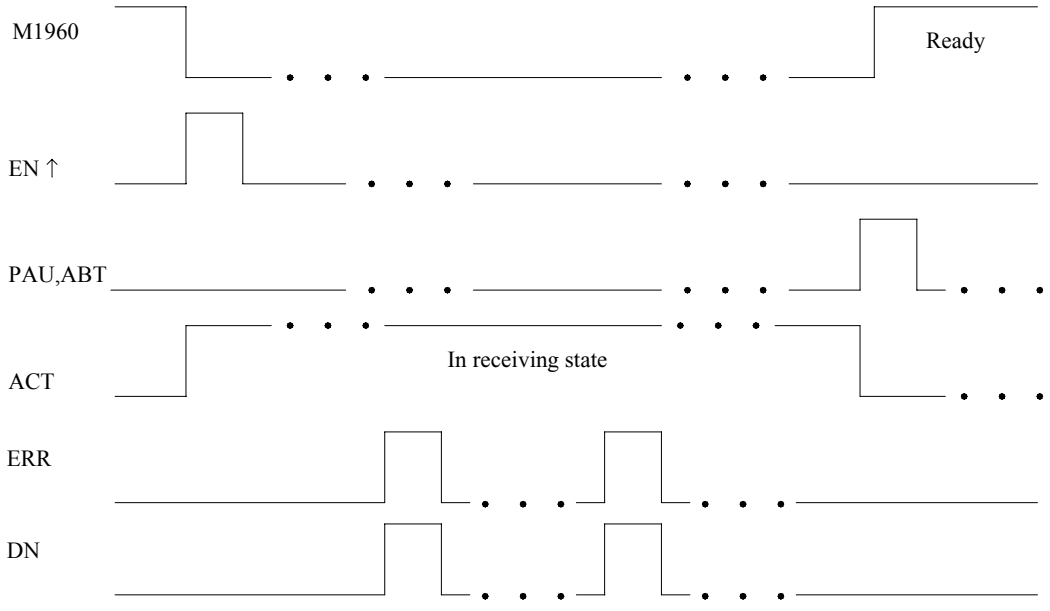
- Output indication

  “ACT” ON : In receiving state

  “ERR” ON : Error occurred in previous packet of transaction, it will be ON for a scan time

  “DN” ON : The previous packet of transaction completed without error, ON for a scan time.

- Waveform of input control and output indication



Note: Of “ERR” and “DN”, there is only one will be ON; not both to be ON at the same time.