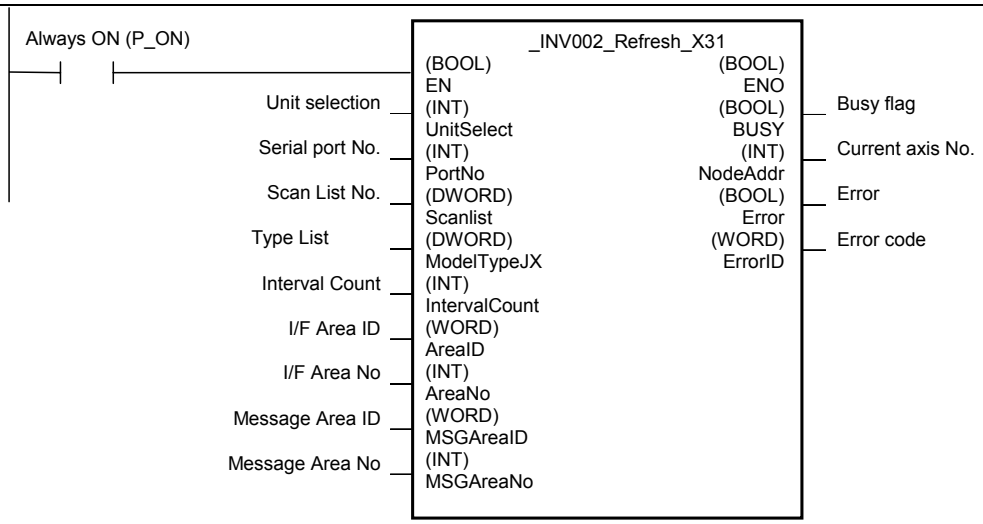
INV 002	Status Refresh: INV002_Refresh_X31

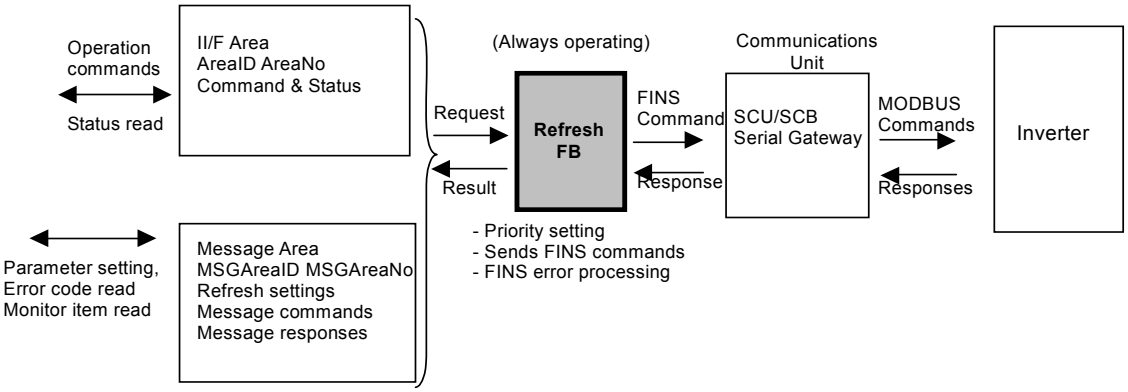
Basic function	Refreshes the Inverter status.	
Symbol		
File name	Lib\FBL\omronlib\Inverter\INVRT\Serial\INV002_Refresh_X31.cxf	
Applicable models	Inverters	MX2 Series and JX Series, MX Series ,
	CPU Unit	CS1*-CPU**H Unit version 3.0 or higher CJ1*-CPU**H Unit version 3.0 or higher CJ1M-CPU** Unit version 3.0 or higher CP1H CP1L (except 10 points CPU)
	Serial Communications Units/Boards	CS1W-SCU21-V1, CJ1W-SCU21-V1, CJ1W-SCU41-V1 Unit Version 1.2 or higher CS1W-SCB21-V1 and CS1W-SCB41-V1 Unit Version 1.2 or higher CP Series CPU serial port
	CX-Programmer	Version 5.0 or higher

Conditions for usage

This FB can be used with the system connected by the following Serial connection. The serial port must support FINS command for Serial Gateway function.

- Serial Communications Unit (SCU) Version1.2 or higher
- Serial Communications Board (SCB) Version1.2 or higher
- Serial port on CP Series CPU unit

This FB sets the priorities of the commands sent from the user program (other FBs) and sends FINS commands to the SCU or SCB.



■ CX-Programmer Settings

PLC Settings ”Comms Instructions Settings in FB” in the CPU Settings Tab

- Response timeout should be set for the serial gateway funtion of the port to 300msec
- Retry counts (default 0)

■ Shared Resources

- Communications port (internal logic port)
- PLC Area specified as I/F Area AreaID and AreaNo.(IOM/DM/EM)
- PLC Area specified as Message Area MSGAreaID and MSGAreaNo. (DM/EM)

■ Setting Parameters

- Serial Communications Unit or Serial Communications Board must be used.
- Parameters for Serial Communications Unit or Serial Communication Board must be set.
- These parameters must be the same value as inverter parameters.
- Communications mode must be set to 6: Macro mode or 9: Serial Gateway.
- Using CPU serial port, select the port which supports Serial Gateway.
- An Easy way to set above is to use the FB _INV600_SetComm.

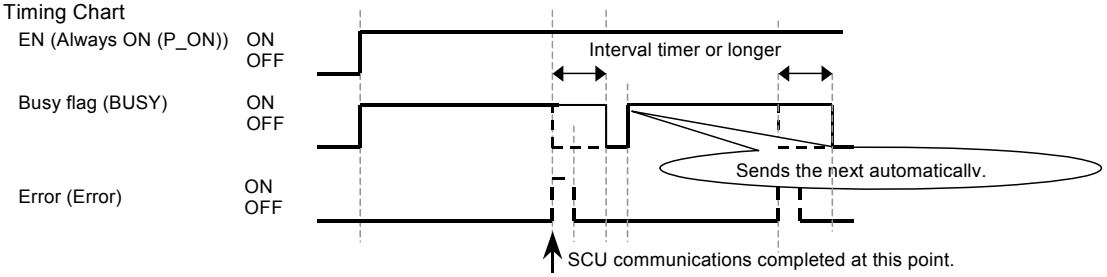
■ Inverter Settings

- For wiring method, refer to the manual of the applicable inverter.
- Communications Unit Settings on the CPU Unit
- Set all inverters on the same MODBUS line to the same communications settings.

<Example (MX2)>
Baud rate (C071= 05) = 9600 bit/s
Data = 8bit
Start = 1bit
Stop = 1bit
Parity (C074= 01) = Even

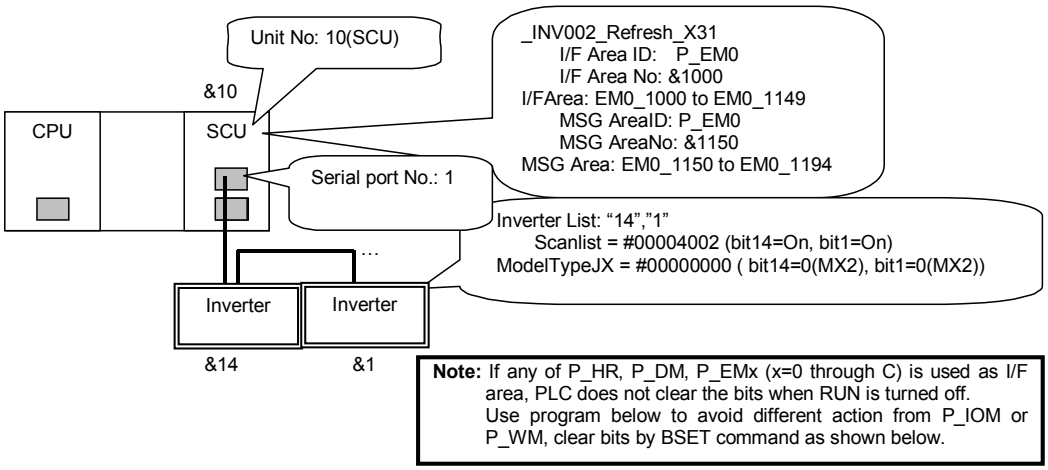
For details of the parameters, refer to the manual of the applicable inverter.

- Inverter Node address (C072) on a MODBUS line must be unique.
- Refer to the Users Manual for each inverter series for parameter access method.
- For the setting method, refer to “SYSMAC CS/CJ Series Serial Communications Boards and Serial Communications Units Operation Manual (W336). “

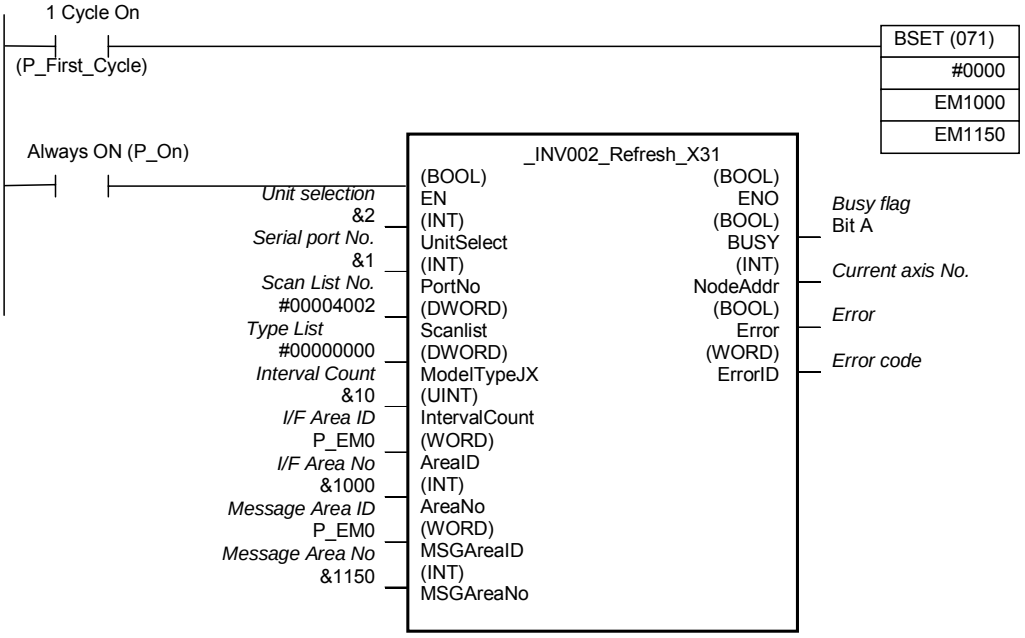
Function description	Sets priorities of the requests sent from the user program (FB Library for INV) and processes according to the order. • Dedicated areas will be reserved so that status could be checked and commands could be sent in each FB Library. • Requested Write and Read will be executed in the order of the priority. ■ Internal Operation (1) Commands specified in the Command Area (Input Variables) are written into the Coils 0001 and 0002 for the inverter. (2) Bits in the Status Area (Output Variables) will be read from the coils 000F on . (3) The order will be changed to match that in the Status Area (Output Variables) and status will be output. This FB takes several cycles to finish processing. Monitoring the Output Variable BUSY allows the user to check the processing status. For cases of possible congestions in serial communications due to retries at communications error or Support Software connection, this FB will perform the following controls: • Always selects 1 item from scanlist input for communications. • When the communications buffer inside the SCU or SCB is full, the retry will be executed in the next cycle. • The priority will be in the order of Message in DM, Command in CIO, and Status in CIO. The next item will be selected when a series of serial communications is completed. • If the inverter does not receive normal MODBUS communications (even for another Unit No.) within 2 seconds (this can be changed by setting the parameter), a communications timeout error will occur on the inverter. To avoid this, connect the Always ON (P_ON) input to EN of this FB so that some communications are always in progress.
FB precautions	• When processing is completed, the Busy flag (BUSY) will be turned OFF and the Error (Error) will be turned ON depending on the condition only for 1 cycle. Use these flags to detect the completion of processing of the FB. Timing Chart  • One instance is needed for each communication port. • This FB executes communications via the serial port. The FB will automatically send another message when BUSY turn output of itself turn off. • A busy flag (BUSY) is ON while this FB is in the middle of processing, either waiting for response message or waiting for Interval timer to time up. • Only 1 message can be buffered at the serial port. The Serial Communication unit has 2 buffers per hardware port. If 3rd message arrive, Serial Communication Unit would return a “buffer full” response immediately. When this happen, another program or the Support software is using the same port. Tune the Interval timer to let other program steal the port when monitoring does not affect the system. • And only 8 programs in the CPU unit can send message at a time. To avoid lock out, tune the whole system avoid 8 requests working at the same time. For this FB, change interval timer to let another application use the logical port. • Messages take approximately 40ms average (at 19.2kbps). Since commands are given higher priority, the delay in error detection will be 40ms * (No. of Connected inverters). The longest possible delay can be twice as long. Therefore, make sure to give thorough consideration to the response characteristics (such as the time from error detection until stopping operation, etc.) for safety.
EN input condition	Connect the EN input to the Always ON flag (P_ON).
Restrictions **Input variables**	• Use Always ON (P_ON) input to EN. • When any input variable is out of range, ENO will be turned OFF and the FB will not be executed. • ENO is turned off when the input variable is outside the range, and the FB is not executed. For example, the I/F area and MSG area can not use same memory. AreaNo value should not cross over the upper limits of selected area (CIO, HR, W, etc.) Crossing over the EM bank memory boundary, would also determined as “input outside the range”. • The I/F area uses DM or EM, clear the area when program starts. (See program in Application Example below.) A previous operation remains in the memory which would cause an unexpected starts.
Output variables	Output data will be refreshed while EN is ON. When EN is turned OFF, the previous status will be maintained.

Application example

Refreshes data for the system below.
(Communications with the inverter are established via the Serial Communications Unit with the Unit No. 10.)



Note: If any of P_HR, P_DM, P_EMx (x=0 through C) is used as I/F area, PLC does not clear the bits when RUN is turned off.
Use program below to avoid different action from P_IOM or P_WM, clear bits by BSET command as shown below.



Related manuals

- SYSMAC CS/CJ Series Serial Communications Boards and Serial Communications Units Operation Manual (W336)

■ **Variable Table**

Input Variables

Name	Variable name	Data type	Default	Range	Description
EN	EN	BOOL	FALSE		ON (1): Starts FB OFF (0): Does not start FB
Unit selection	UnitSelect	INT	&0	&0 to &15, #BBBB, #CCCC	Specify the connected Unit and serial port. **For CP Series CPU Serial port:** Unit selection (UnitSelect) #CCCC Serial port No. (PortNo) 1: Port 1, 2: Port 2 **For SCB:** Unit selection (UnitSelect) #BBBB Serial port No. (PortNo) 1: Port 1, 2: Port 2 **For SCU:** Unit selection (UnitSelect) Unit No. (&0 to &15) Serial port No. 1: Port 1
Serial port No.	PortNo	INT	&1	&1 to &2	
Scan List	Scanlist	DWORD	#00000000		The list of inverter node number. Each bit represents the node numbers Bit1=Node1, Bit2=Node2 … Bit11=Node31
ModelType List	ModelTypeJX	DWORD	#00000000		Type of inverter: 0: MX2 1: MX or JX . Each bit represents the node numbers
Interval Count	IntervalCount	UINT	&0	&0 to &65535	Extends “Busy=On” for ×10 ms The value is required when more than 5 serial ports are used, or when other NS-SAP or PC software shows a communication error frequently. 20 to 100 would be appropriate. This FB stays busy until interval timer counts up. Timer may be longer than expected since the PLC timer assures the minimum value. A zero would turn off “Busy” immediately after response message is received.
I/F Area ID	AreaID	WORD	#0082		P_CIO (#00B0): CIO Area P_WR (#00B1): Work Area P_HR (#00B2): Holding Area P_DM (#0082): DM Area P_EM0 (#0050) to P_EMC (#005C): EM Area bank 0 to C
I/F Area No	AreaNo	WORD	&0		Beginning word of the I/F Area
Message Area ID	MSGAreaID	WORD	#0082		P_CIO (#00B0): CIO Area P_WR (#00B1): Work Area P_HR (#00B2): Holding Area P_DM (#0082): DM Area P_EM0 (#0050) to P_EMC (#005C): EM Area bank 0 to C
Message Area No.	MSGAreaNo	INT	&0		Beginning word of the Message Area

Output Variables

Name	Variable name	Data type	Range	Description
ENO	ENO	BOOL		
Busy flag	BUSY	BOOL	&0 to &1	0: Communications completed (OFF at least for 1 cycle) 1: Communications in progress
Current axis No.	NodeAddr	INT		Axis No. of the axis currently being executed or previously executed.
Error	Error	BOOL	&0 to &1	0: Other than the below 1: An error has occurred in the inverter.
Error code	ErrorID	WORD	0 to FFFF	FINS communication response code from the serial port. See “Errors” for more information.

■ **Data Table**

(1)I/F Area

Contents in Word n = AreaID, AreaNo.

n	Data
+0	Command/Status data for axis no. 1
+1	Frequency reference for axis No. 1
+2	Command/Status data for axis no. 2
+3	Frequency reference for axis No. 2
+4	Command/Status data for axis no. 3
+5	Frequency reference for axis No. 3
+6	Command/Status data for axis no. 4
+7	Frequency reference for axis No. 4
+8	Command/Status data for axis no. 5
+9	Frequency reference for axis No. 5
+10	Command/Status data for axis no. 6
+11	Frequency reference for axis No. 6
: :	: :
+62	Command/Status data for axis no. 31
+63	Frequency reference for axis No. 31

Command and Status Data (W: Command, R: Status)

Bit	Contents	R/W
00	Run Forward command: 0 = Stop, 1 = RunFw	W
01	Run Reverse command: 0= Stop, 1 = RunRev	W
02	Error reset	W
03	Operation: (1: Operating)	R
04	Only with MX2 avail., Zero speed: (1: Zero speed)	R
05	Frequency matching: (1: Matched)	R
06		R
07		R
08	Frequency detection 2: (1: Output frequency ≥)	R
09	Inverter operation ready: (1: READY)	R
10	Only with MX2 avail., during DC bus undervoltage (UV) detection: (1: UV detected)	R
11		
12		R
13	Overload	R
14	Overtorque detection (1: Overtorque detected)	R
15	Fault (1: Fault detected) or no communication	R

(2) MSG Area for messages

Contents in Word m = MSGAreaID, MSGAreaNo

m	15 to 8 (Upper byte)	7 to 0 (Lower byte)	Remark
+0	Message execution status		1: Waiting for data for response area of n+36 0: Other (Write-protected)
+1	Message access right acquire		01 is written when starting access. Cleared to 00 when reading response is completed.
+2 : +22	Message response area 21 words : Message response area		Read only (Only the Refresh FB can write here) External FB such as *_INV201_ParameterWrite* receive response use this area
+23 : +44	Message command area 22 words : Message command area		Write area (Refresh FB will not write here) External FB such as *_INV201_ParameterWrite* request message uses this area.

■ **Errors**

(1) The FINS response code among ErrorID. (Major cause extract from a manual Example

ErrorID	MRC	Master Code	SRC	Sub Code		Probable causes	Corrective Measure
0000	00	Completion without a fault	00	Completion without a fault	---	---	• If Error=ON then _INV002_Refresh have invalid input value. • Check UnitSelect and PortNo
0204	02	Remote node error	04	Remote node is BUSY	A timeout has occurred. CIO word n+8/n+18 bit05=1 (Time Out)	The serial gateway cannot be executed as an interrupt between protocol macro steps.	IntervalCount value should be greater or other communication should take more interval (CX-Drive,NS-SAP,PMCR Command)
0205	02	Remote node error	05	Response Timeout	Bit05 in CIO word n+8/n+18 (Serial gateway timeout)	• The serial gateway timeout or message frame is destroyed by noise. • Send/Receive frame was discarded	If timeout occur, • Check timeout setting of SCU. • Check noise condition. • Discard error so that this FB INV002 can self retry
0206	02	Remote node error	06	Transmission path error	CIO word n+8/n+18 bit07 (FCS Check error) or bit02 (Parity error)	・A CRC error or a parity error occurred at serial gateway while Modbus-RTU command is converted.	Check noise condition • Use shielded twisted-pair cables • lay power lines separately • If your application can wait, Discard error to let retry
0401	04	Service Unsupported	01	Undefined command	The serial port does not support Serial-Gateway(FINS:2804) Modbus-RTU	The unit version does not support Serial-Gateway for Modbus-RTU The PLC parameter set incorrectly	• Check PLC system parameter • PLC DIP-SW set to TOOLBUS • Check unit version
10XX	10	Command format error	--	--	A CMND command used in the FB is not working properly.	A memory used as temporaries over written by some other program	The internal memory of the FB must not used by some other program.
11XX	11	Parameter error	--	--	A CMND command used in the FB is not working properly.	A memory used as temporaries over written by some other program	The internal memory of the FB must not used by some other program.
2605	26	Command error	05	Service Already executing	---	The service is being executed. (A sixth FINS command is received by the serial port, when 5 commands already waiting to be executed)	A greater IntervalCount value or set other conflicting device to slow down. (CX-Drive,NS-SAP, PMCR command, etc.)
2607	26	Command error	07	No Execution Right	Serial gateway prohibition	Serial Gateway is prohibited (bit8 of CIO word n+9/n+19 is ON)	If prohibited, turn OFF bit 04/12 in CIO word n (Serial gateway prohibit word.)

(2)Major cause of timeout

Indicators	Probable causes	Corrective Measure
SD RD COM never flashing	SYSMAC cannot start communication	Check ErrorID and above for trouble shooting.
SD RD COM All of them flashing individually.	The node responds too early so that SYSMAC cannot respond.	Tune inverter node response speed so that they answer slowly.
SD COM flashing RD stays off Timeout occur frequently	The PLC serial port is sending but no receiver exists.	Check the specified node if it work correctly.
	Transmit frame is invalid.	Check the message field when directly writes into the MSGarea.
	PLC serial port configuration (frame type, speed, etc) is different from the specified unit.	Check the configuration for PLC and inverters.
	・ Cable connection problem ・ RS-422/485 terminators set incorrectly ・ Adapters such as NT-AL001works	・ Check the cables ・ Terminators on SYSMAC supposed to be Off Turn on the terminator switches on inverters for 2 of the END nodes. Other inverters should keep switches Off. SYSMAC have different terminator value from MODBUS. When it would be needed to terminate near SYSMAC, please use external terminator register.
	The specified unit (Inverter) have hardware problem	Replace the specific node.
Sometimes timeout occur		Test the line by using loop back frame. If the test fails, replace the unit/boards.
	The noise occur and error is checked	・ Change cable to twisted-pair with shield ・ lay power lines separately ・ If your application can wait, Discard error to let retry

■ **Revision History**

Version	**Date**	**Contents**
1.0	2005.4.22	Original production
1.1	2005.7.22	Support CJ1M CPU
1.2	2006.4.28	Support CP1H CPU serial port
2.0	2007.	(The content of Version 1.11 is the same as Version 1.2.) Support CP1L CPU serial port
X15	2010	A defect is corrected. Any combination other than AreaID=P_CIO,MSGAreaID=P_DM were not working. The acquisition bank of EM calculation mistake is corrected. Supports only 15 inverters Type MX2 or JX, MX
X31	2010	Supports 31 inverters type MX2 or JX, MX

■ **Note**

This document explains the function of the function block.

It does not provide information of restrictions on the use of Units and Components or combination of them. For actual applications, make sure to read the operation manuals of the applicable products.

■ **Hardware Configuration**

The SYSDRIVE inverters can be used on the port witch supports MODBUS protocol by the Serial Gateway functions.
Any of the following covers the function.

- Serial port on Serial Communications Unit (SCU)
- Serial port on Serial Communications Board (SCB)
- Serial port on CP Series CPU Unit

The following unit versions must be used.

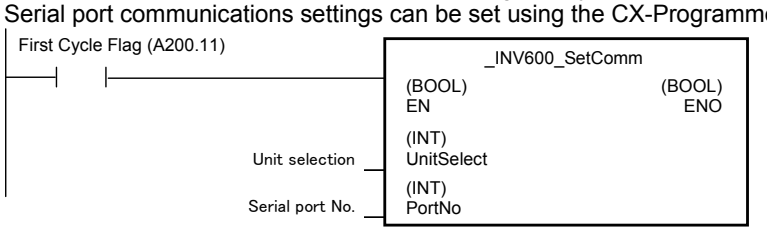
	Unit version
Serial Communications Unit (SCU)	1.2 or later
Serial Communications Board (SCB)	1.2 or later
CP series CPU	1.0 or later

■ **Communications Settings**

All of the components wired on the same serial communication line with the inverters, must be operated under MODBUS –RTU protocol. Their communication settings must be kept to one setting in order to work correctly.
To make it easy to unify the setting, use the settings , listed in the following table.

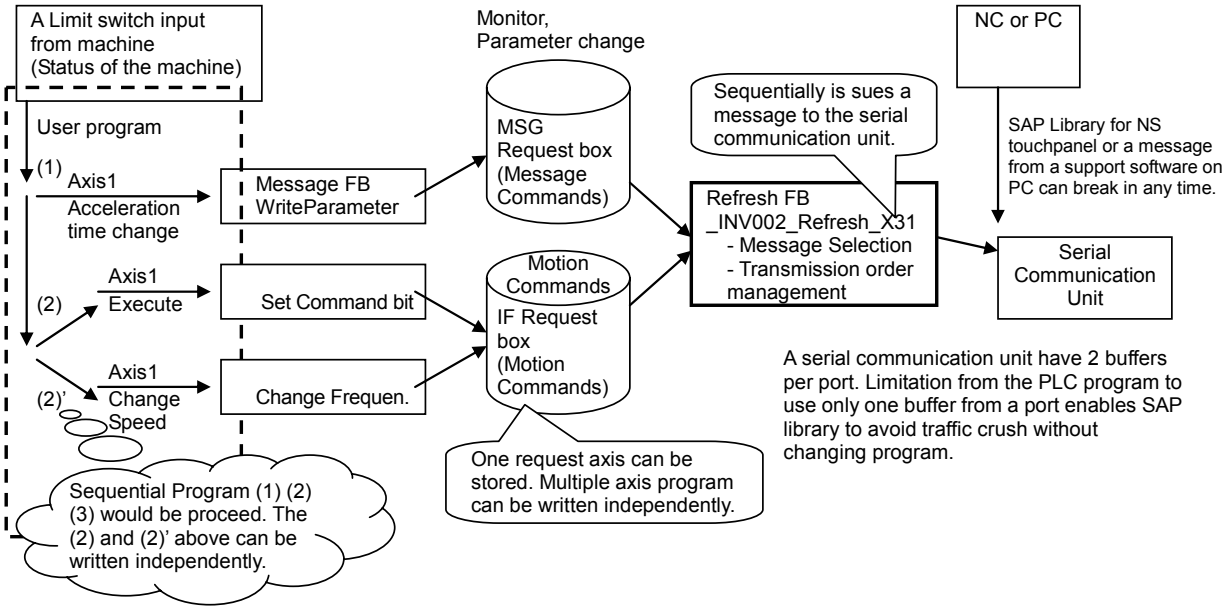
Communications mode	Serial Gateway Mode
Baud rate	9,600 bps
Data length	8 bits
Parity	Even
Stop bits	1 bit
Start code	1 bit
Delay	0 (Default)

Response timeout should be set for the serial gateway funtion of the port to 300msec.
Serial port communications settings can be set using the CX-Programmer or using the following function block.



■ **Refresh Function**

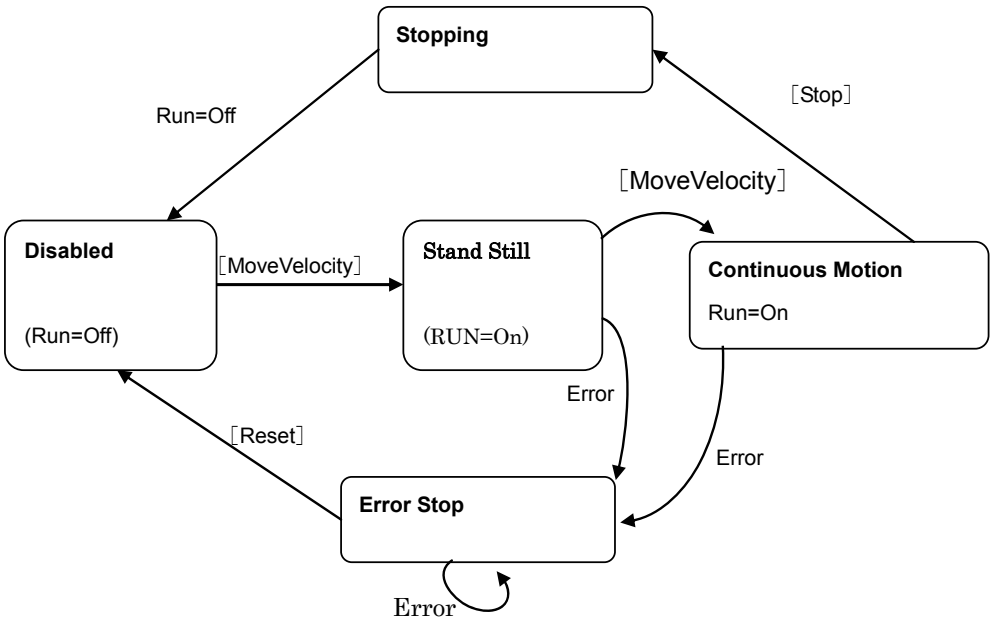
The PLC work under a cycle action of 1ms to solve output value from the Ladder program. The output value is calculated every cycle. On the other hand, inverters communication takes 20ms to 40ms per message. For this reason, the Ladder program can not control the status by sending the bit images from the OUT command. The message should be selected and important message should be sent quickly.



For the reason above, those FB libraries are divided into groups to avoid difficulty caused by serial communication unit traffic control. Leave the traffic control to INV002_Refresh_X31 and the user program can be written just by focusing on the machine status.

■ **State Transitions**

FB other than INV002_Refresh_X31 controls the motor state as shown in following diagram.



［FB Name］

Example: old _INV032_MoveVelocity_Hz will not work with X31 inverter FB.

STATUS: The status is shown in **Gothic** characters. The status cannot be checked by [ReadStatus] FB.

.

・ [ReadParameter], and [WriteParameter] are independent to status above and available all the time. (Some parameters may not be changed during operation. See each manuals for inverters.)

・ The transition above is controlled on PLC memory. The FB INV002_Refresh_X31 will communicate with each inverters to share status and command between PLC memory and inverters. Therefore INV002_Refresh_X31 should be active all the time.

・ Inverters would mark an error if C077 is set (Warning) if communication is stopped for 2 seconds. Any of the Inverters must be called by the PLC within every 2 seconds to avoid the warning. The FB INV002_Refresh_X31 is designed to send message continuously. Next message will be sent automatically after “Interval” value cycles when a response message is received. Set the value “Interval” to send message in less than 2 seconds would avoid error.