CHAPTER 11 - RS485 COMMUNICATION

11.1 Introduction

Inverter can be controlled and monitored by the sequence program of the PLC or other master module.

Drives or other slave devices may be connected in a multi-drop fashion on the RS-485 network and may be monitored or controlled by a single PLC or PC. Parameter setting and change are available through PC.

- Features

Inverter can be easily applied for factory automation because operation and monitoring is available by User-program.

* Parameter change and monitoring is available via computer.
  (Ex: Accel/Decel time, Freq. Command etc.)
* Interface type of RS485 reference:
1) Allows the drive to communicate with any other computers.
2) Allows connection of up to 31 drives with multi-drop link system.
3) Noise-resistant interface.

Users can use any kind of RS232-485 converters. The specifications of converters depend on the manufacturers. Refer to the converter manual for detailed specifications.

- Before installation

Before installation and operation, this should be read thoroughly. If not, it can cause personal injury or damage to other equipment.

11.2 Specification

- Performance specification

Item	Specification
Communication method	RS485
Transmission form	Bus method, Multi drop Link System
Applicable inverter	SV-iG5A series
Converter	RS232 converter
Connectable drives	Max 31
Transmission distance	Max. 1,200m (Within 700m Recommend)

- Hardware specification

Item	Specification
Installation	Use S+, S- terminals on control terminal block
Power supply	Use Insulated power from the inverter power supply

- Communication specification

Item	Specification
Communication speed	19,200/9,600/4,800/2,400/1,200 bps selectable
Control procedure	Asynchronous communication system
Communication system	Half duplex system
Character system	ASCII (8 bit)
Stop bit length	Modbus-RTU: 2 bit LS Bus: 1 bit
Sum check	2 byte
Parity check	None

11.3 Installation

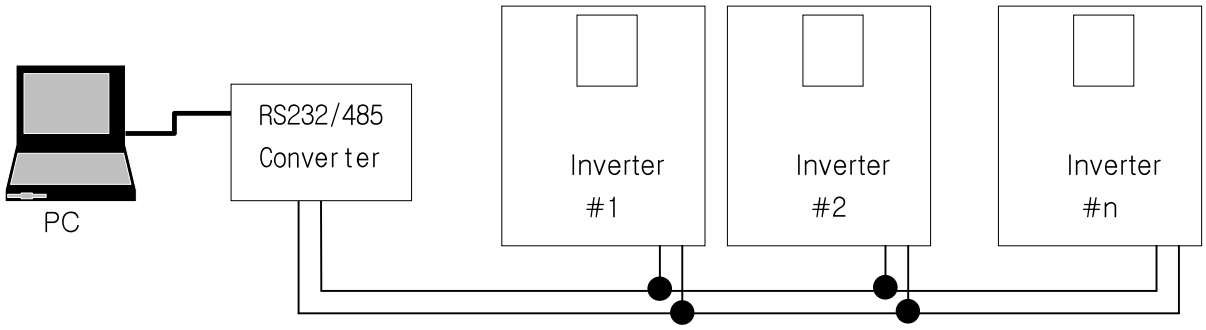
- Connecting the communication line

Connect the RS-485 communication line to the inverter's (S+), (S-) terminals of the control terminals.
Check the connection and turn ON the inverter.
If the communication line is connected correctly set the communication-related parameters as the following:

- DRV-03 [Drive mode]: 3(RS485)
- DRV-04 [Freq. mode]: 7(RS485)
- I/O-60 [Inv. Number]: 1~250 (If more than 1 inverters are connected, be sure to use different numbers for each inverter)
- I/O-61 [Baud-rate]: 3 (9,600 bps as Factory default)
- I/O-62 [Lost Mode]: 0 - No action (Factory default)
- I/O-63 [Time-Out]: 1.0 sec (Factory default)
- I/O-59 [Comm. Prot]: 0 - Modbus-RTU, 1 – LS BUS

- Computer and inverter connection

System configuration



- The number of drives to be connected is up to 31 drives.
- The specification of length of communication line is max. 1200m. To ensure stable communication, limit the length below 700m.

11.4 Operation

- Operating steps

Check whether the computer and the inverter are connected correctly.
Turn ON the inverter. But do not connect the load until stable communication between the computer and the inverter is verified.
Start the operating program for the inverter from the computer.
Operate the inverter using the operating program for the inverter.
Refer to “Troubleshooting” if the communication is not operating normally.

*User program or the “DriveView” program supplied from LS Industrial Systems can be used as the operating program for the inverter.

11.5 Communication protocol (MODBUS-RTU)

Use Modbus-RTU protocol (Open protocol).

Computer or other hosts can be Master and inverters Slave. Inverter responds to Read/Write command from Master.

Supported function code

Function code	Description
0x03	Read Hold Register
0x04	Read Input Register
0x06	Preset Single Register
0x10	Preset Multiple Register

Exception code

Function code		Description
0x01		ILLEGAL FUNCTION
0x02		ILLEGAL DATA ADDRESS
0x03		ILLEGAL DATA VALUE
0x06		SLAVE DEVICE BUSY
User define	0x14	1.Write Disable (Address 0x0004 value is 0). 2.Read Only or Not Program during Running.

11.6 Communication protocol (LS BUS)

- Basic format

Command message (Request):

ENQ	Drive No.	CMD	Data	SUM	EOT
1 byte	2 bytes	1 byte	n bytes	2 bytes	1 byte

Normal response (Acknowledge Response):

ACK	Drive No.	CMD	Data	SUM	EOT
1 byte	2 bytes	1 byte	n * 4 bytes	2 bytes	1 byte

Negative response (Negative Acknowledge Response):

NAK	Drive No.	CMD	Error code	SUM	EOT
1 byte	2 bytes	1 byte	2 bytes	2 bytes	1 byte

Description:

Request starts with “ENQ” and ends with “EOT”.

Acknowledge Response starts with “ACK” and ends with “EOT”.

Negative Acknowledge Response starts with ”NAK” and ends with “EOT”.

“Drive Number” is the number of drives and indicated in 2 bite ASCII-HEX.

(ASCII-HEX: Hexadecimal consists of ‘0’ ~ ‘9’, ‘A’ ~ ‘F)

CMD: Capital letter

Character	ASCII-HEX	Command
'R'	52h	Read
'W'	57h	Write
'X'	58h	Request for monitoring
'Y'	59h	Action for monitoring

Data: ASCII-HEX

Ex) when data value is 3000: 3000 (dec) → '0' 'B' 'B' '8'h → 30h 42h 42h 38h

Error code: ASCII (20h ~ 7Fh)

Receive/Send buffer size: Receive= 39 bite, Send=44 bite

Monitor register buffer: 8 Word

SUM: to check the communication error

SUM= ASCII-HEX format of lower 8 bit of (Drive No. + CMD + DATA)

Ex) Command Message (Request) for reading one address from address "3000"

ENQ	Drive No	CMD	Address	Number of address to read	SUM	EOT
05h	"01"	"R"	"3000"	"1"	"A7"	04h
1 byte	2 bytes	1 byte	4 bytes	1 byte	2 bytes	1 byte

SUM = '0' + '1' + 'R' + '3' + '0' + '0' + '0' + '1'

= 30h + 31h + 52h + 33h + 30h + 30h + 30h + 31h

= 1A7h (Control values such as ENQ/ACK/NAK are excluded.)

- Detail communication protocol

1) Request for Read: Request for read successive 'N' numbers of WORD from address "XXXX"

ENQ	Drive No	CMD	Address	Number of address to read	SUM	EOT
05h	"01" ~ "1F"	"R"	"XXXX"	"1" ~ "8" = n	"XX"	04h
1 byte	2 bytes	1 byte	4 bytes	1 byte	2 bytes	1 byte

Total bite = 12

The quotation marks (" ") means character.

1.1) Acknowledge Response:

ACK	Drive No	CMD	Data	SUM	EOT
06h	"01" ~ "1F"	"R"	"XXXX"	"XX"	04h
1 byte	2 bytes	1 byte	N * 4 bytes	2 byte	1 byte

Total bite = 7 + n * 4 = Max 39

1.2) Negative Acknowledge Response:

NAK	Drive No	CMD	Error code	SUM	EOT
15h	"01" ~ "1F"	"R"	"**"	"XX"	04h
1 byte	2 bytes	1 byte	2 bytes	2 bytes	1 byte

Total bite = 9

2) Request for Write:

ENQ	Drive No	CMD	Address	Number of address to read	Data	SUM	EOT
05h	“01”~ “1F”	“W”	“XXXX”	“1” ~ “8” = n	“XXXX…”	“XX”	04h
1 byte	2 bytes	1 byte	4 bytes	1 byte	n * 4 bytes	2 byte	1 byte

Total bite = 12 + n * 4 = Max 44

2.1) Acknowledge response:

ACK	Drive No	CMD	Data	SUM	EOT
06h	“01” ~ “1F”	“W”	“XXXX…”	“XX”	04h
1:byte	2:bytes	1:byte	n * 4 bytes	2 bytes	1 byte

Total bite = 7 + n * 4 = Max 39

Note

When Request for Write and Acknowledge Response is exchanged between PC and Inverter for the first time, previous data is returned. From the second time of transmission, the current data will be returned.

2.2) Negative response:

NAK	Drive No	CMD	Error code	SUM	EOT
15h	“01” ~ “1F”	“W”	“**”	“XX”	04h
1 byte	2 bytes	1 byte	2 bytes	2 bytes	1 byte

Total bite = 9

3) Request for Monitor Register

This is useful when constant parameter monitoring and data updates are required.

Request for Register of ‘n’ numbers of Address (not consecutive)

ENQ	Drive No	CMD	Number of address to read	Address	SUM	EOT
05h	“01” ~ “1F”	“X”	“1” ~ “8”=n	“XXXX…”	“XX”	04h
1 byte	2 bytes	1 byte	1 byte	n * 4 byte	2 byte	1 byte

Total bite = 8 + n * 4 = Max 40

3.1) Acknowledge Response:

ACK	Drive No	CMD	SUM	EOT
06h	“01” ~ “1F”	“X”	“XX”	04h
1 byte	2 bytes	1 byte	2 bytes	1 byte

Total bite = 7

3.2) Negative Acknowledge Response:

NAK	Drive No	CMD	Error code	SUM	EOT
15h	“01” ~ “1F”	“X”	“**”	“XX”	04h
1 byte	2 bytes	1 byte	2 bytes	2 bytes	1 byte

Total bite = 9

4) Action Request for monitor register: Request for read of address registered by monitor register.

ENQ	Drive No	CMD	SUM	EOT
05h	“01” ~ “1F”	“Y”	“XX”	04h
1 byte	2 bytes	1 byte	2 bytes	1 byte

Total bite = 7

4.1) Acknowledge response:

ACK	Drive No	CMD	Data	SUM	EOT
06h	“01” ~ “1F”	“Y”	“XXXX…”	“XX”	04h
1 byte	2 bytes	1 byte	n * 4 bytes	2 bytes	1 byte

Total bite= 7 + n * 4 = Max 39

4.2) Negative response:

NAK	Drive No	CMD	Error code	SUM	EOT
15h	“01” ~ “1F”	“Y”	“**”	“XX”	04h
1 byte	2 bytes	1 byte	2 bytes	2 bytes	1 byte

Total bite = 9

5) Error code

Error code	Description
“IF”	When master is sending codes other than Function code (R, W, X, Y).
“IA”	When parameter address does not exist
“ID”	When Data value exceeds its permissible range during ‘W’ (Write).
“WM”	When the specific parameters cannot be written during ‘W’ (Write). (For example, in the case of Read Only, Write disabled during Run)
“FE”	When frame size of specific function is not correct and Checksum field is wrong.

11.7 Parameter code list <Common area>

<Common area>: Area accessible regardless of inverter models (Note 3)

Address	Parameter	Scale	Unit	R/W	Data value
0x0000	Inverter model			R	0: SV-iS3 1: SV-iG 2: SV-iV 3: SV-iH 4: SV-iS5 5:SV-iV5 7: SV-iG5 8: SV-iC5 9: SV-iP5 A: SV-iG5A
0x0001	Inverter capacity			R	FFFF 0.4kW 0000 0.75kW 0002 1.5kW 0003 2.2kW 0004 3.7kW 0005 4.0kW 0006 5.5kW 0007 7.5kW 0008 11.0kW 0009 15.0kW 000A 18.5kW 000B 22.0kW
0x0002	Inverter Input Voltage			R	0: 220V class 1: 440V class
0x0003	S/W Version			R	(Ex) 0x0010: Version 1.0 0x0011: Version 1.1
0x0004	Parameter Lock			R/W	0: Lock (default) 1: Unlock
0x0005	Frequency Reference	0.01	Hz	R/W	Starting freq. ~ Max. freq.
0x0006	Run Command			R/W	BIT 0: Stop (0->1) BIT 1: Forward run (0->1) BIT 2: Reverse run (0->1)
				W	BIT 3: Fault reset (0->1) BIT 4: Emergency stop (0->1)
				-	BIT 5, BIT 15: Not used
				R	BIT 6~7: Output freq. arrival 0(Terminal), 1 (keypad) 2(Reserved), 3 (communication) BIT 8~12: Freq. command 0 : DRV–00, 1: Not used, 2~8: Multi-Step frequency 1~7 9: Up, 10: Down, 11: UDZero, 12: V0, 13: V1, 14: I, 15: V0+I, 16: V1+I, 17: Jog, 18: PID, 19: Communication, 20 ~ 31: Reserved
0x0007	Acceleration Time	0.1	sec	R/W	See Function List.
0x0008	Deceleration Time	0.1	sec	R/W	
0x0009	Output Current	0.1	A	R	
0x000A	Output Frequency	0.01	Hz	R	
0x000B	Output Voltage	0.1	V	R	

Address	Parameter	Scale	Unit	R/W	Data value
0x000C	DC Link voltage	0.1	V	R	See Function List.
0x000D	Output power	0.1	kW	R	
0x000E	Inverter status			R	BIT 0: Stop BIT 1: Forward running BIT 2: Reverse running BIT 3: Fault (Trip) BIT 4: Accelerating BIT 5: Decelerating BIT 6: speed arrival BIT 7: DC Braking BIT 8: Stopping Bit 9: not Used BIT10: Brake Open BIT11: Forward run command BIT12: Reverse run command BIT13: REM. R/S BIT14: REM. Freq.
0x000F	Trip information			R	BIT 0: OCT BIT 1: OVT BIT 2: EXT-A BIT 3: EST (BX) BIT 4: COL BIT 5: GFT (Ground Fault) BIT 6: OHT (Inverter overheat) BIT 7: ETH (Motor overheat) BIT 8: OLT (Overload trip) BIT 9: HW-Diag BIT10: EXT-B BIT11: EEP (Parameter Write Error) BIT12: FAN (Lock & Open Error) BIT13: PO (Phase Open) BIT14: IOLT BIT15: LVT
0x0010	Input terminal status			R	BIT 0: P1 BIT 1: P2 BIT 2: P3 BIT 3: P4

Address	Parameter	Scale	Unit	R/W	Data value
0x0010	Input terminal status				BIT 4: P5 BIT 5: P6 BIT 6: P7 BIT 7: P8
0x0011	Output terminal status			R	BIT 0~3: Not Used BIT 4: MO (Multi-Output with OC) BIT 5~6: Not Used BIT 7: 3ABC
0x0012	V1	0~3FF		R	Value corresponding to 0V ~ +10V
0x0013	V2	0~3FF		R	Value corresponding to 0V ~ -10V input when Setting FreqMode to 2
0x0014	I	0~3FF		R	Value corresponding to 0 ~ 20mA input
0x0015	RPM			R	See Function List.
0x001A	Unit display			R	Not Used
0x001B	Pole number			R	Not Used
0x001C	Custom Version			R	Not Used
0x001D	Trip information-B			R	BIT 0: COM (I/O Board Reset) BIT 1: FLTL BIT 2: NTC BIT 3: REEP BIT 4: OC2 BIT 5: NBR BIT 6 ~ 15: Not Used
0x001E	PID Feedback		Hz /%	W	Writes feedback amount when feedback is set by communication in PID drive.
0x0100 ~ 0x0107	Read address register			R	0x0100: 166 0x0101: 167 0x0102: 168 0x0103: 169 0x0104: 170 0x0105: 171 0x0106: 172 0x0107: 173
0x0108 ~ 0x010F	Write address register			W	0x0108: 174 0x0109: 175 0x010A: 176 0x010B: 177 0x010C: 178 0x010D: 179 0x010E: 180 0x010F: 181

Note 1) The changed value in Common area affects the current setting but returns to the previous setting when power is cycled or Inverter is reset. However, changing value is immediately reflected in other parameter groups even in the case of Reset or Power On/Off.

Note 2) S/W version of Common area is displayed in 16 bit, while that of parameter area is displayed in 10 bit.

11.8 Troubleshooting

Refer to Troubleshooting when RS-485 communication error occurs.

Check points	Corrective measures
Is the power provided to the converter?	Provide electric power to the converter.
Are the connections between converter and computer correct?	Refer to converter manual.
Is Master not polling?	Verify the master is polling the inverter.
Is baud rate of computer and inverter correctly set?	Set the correct value in accordance with“11.3 Installation”.
Is the data format of user program* right?	Revise User Program (Note1).
Is the connection between converter and communication card right?	Check for GF the correct wiring in accordance with“11.3 Installation”.

(Note 1) User program is User-made S/W for PC.

11.9 Miscellaneous

ASCII Code List

Character	Hex	Character	Hex	Character	Hex	Character	Hex	Character	Hex
A	41	a	61	0	30	:	3A	DLE	10
B	42	b	62	1	31	;	3B	EM	19
C	43	c	63	2	32	<	3C	ACK	06
D	44	d	64	3	33	=	3D	ENQ	05
E	45	e	65	4	34	>	3E	EOT	04
F	46	f	66	5	35	?	3F	ESC	1B
G	47	g	67	6	36	@	40	ETB	17
H	48	h	68	7	37	[	5B	ETX	03
I	49	i	69	8	38	\	5C	FF	0C
J	4A	J	6A	9	39	]	5D	FS	1C
K	4B	k	6B	space	20		5E	GS	1D
L	4C	l	6C	!	21		5F	HT	09
M	4D	m	6D	"	22		60	LF	0A
N	4E	n	6E	#	23	{	7B	NAK	15
O	4F	o	6F	$	24	|	7C	NUL	00
P	50	p	70	%	25	}	7D	RS	1E
Q	51	q	71	&	26	~	7E	S1	0F
R	52	r	72	'	27	BEL	07	SO	0E
S	53	s	73	(	28	BS	08	SOH	01
T	54	t	74	)	29	CAN	18	STX	02
U	55	u	75	*	2A	CR	0D	SUB	1A
V	56	v	76	+	2B	DC1	11	SYN	16
W	57	w	77	,	2C	DC2	12	US	1F
X	58	x	78	-	2D	DC3	13	VT	0B
Y	59	y	79	.	2E	DC4	14		
Z	5A	z	7A	/	2F	DEL	7F		