RS485/Modbus-RTU Option Card for SV-iP5A/iV5 Series

Read this manual carefully before using the RS485/Modbus–RUT Option Card and follow the instructions exactly.

After reading this manual, keep it at handy for future reference.

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Thank you for purchasing LS RS485/Modbus-RTU Option Card!

SAFETY PRECAUTIONS

- Always follow safety precautions to prevent accidents and potential hazards from occurring.

- In this manual, safety messages are classified as follows:

⚠ **WARNING**   Improper operation may result in serious personal injury or death.

⚠ **CAUTION**   Improper operation may result in slight to medium personal injury or property damage.

- Throughout this manual we use the following two illustrations to make you aware of safety considerations:

⚠   Identifies potential hazards under certain conditions
Read the message and follow the instructions carefully.

⚡   Identifies shock hazards under certain conditions
Particular attention should be directed because dangerous voltage may be present.

- Keep operating instructions handy for quick reference.
- Read this manual carefully to maximize the performance of SV-iP5A series inverter and ensure its safe use.

⚠ **CAUTION**

- **Do not touch the CMOS components unless the board is grounded.**
  Otherwise, ESD could cause break down of CMOS components.
- **Do not change the communication cable when the inverter power is turned on.**
  Otherwise, there is a danger of connecting error and damage to the board.
- **Make sure to precisely insert the connector of inverter and option board**
  Otherwise, there is a danger of connecting error and damage to the board.
- **Check the parameter unit when setting the parameters.**
  Otherwise, there is a danger of connecting error and damage to the board.

1.   INTRODUCTION

SV-iP5A/iV5 inverter can be controlled and monitored by the sequence program of the PLC or other master module. The option card provides a terminal block for an RS-485/Modbus-RTU interface. Drives or other slave devices may be connected in a multi-drop fashion on the RS-485/Modbus-RTU network and may be monitored or controlled by a single PLC or PC.

1.1. Features

Inverter can be easily applicable to Factory Automation because operation and monitoring is available by User-program.

* Parameter setting and monitoring is available via computer.
   (Ex: Freq. Command, Run/Stop etc.)

* Interface type of RS485 reference:
  1) Allows the drive to communicate with any other computers.
  2) Allows one computer to control up to 31 drives with multi-drop link system.
  3) Noise-resistant interface.

Users can use any kind of RS232/485 converters. The specifications and performances of converters depend on the manufacturers, but the basic functions are the same. Refer to the converter manual for detailed specifications and instructions on how to use.

1.2. Before Installation

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

2.   SPECIFICATION
2.1. Performance specification

Items	Specifications
Communication method	RS485 (RS232/485 converter)
Transmission form	Bus method, Multi-drop Link System
Applicable inverter	SV-iP5A/iV5 series
Converter	Converter with RS232 card embedded
Number of inverters connected	Maximum 31 drives connectable [note1]
Transmission distance	Max. 1200m (Less than 700m recommended) [note2]

[note1] The number of inverters to be connected is up to 31.

[note2] The specification of length of the communication cable is max. 1200m. To ensure stable communication, limit its length below 700m.

2.2. Hardware Specifications

Items		Specifications
Installation		Use option connector on the inverter control board
Power Supply	Control B/D	From inverter power supply
	Comm. B/D	From control board (insulated)

2.3. Communication Specification

Items	Specifications
Communication speed	1200 /2400/4800/9600/19200/38400 bps Selectable
Control procedure	Asynchronous communication system
Communication system	Half duplex system
Character system	RS485 : ASCII(8bit), Modbus-RTU : Binary (7/8 bit)
Start/Stop bit	Start 1bit, Stop 1/2bit
Error check	RS485 : Checksum(2byte) Modbus-RTU : CRC16(2byte)
Parity check	Even/Odd

3. PRODUCT DETAIL
3.1. Layout and detail

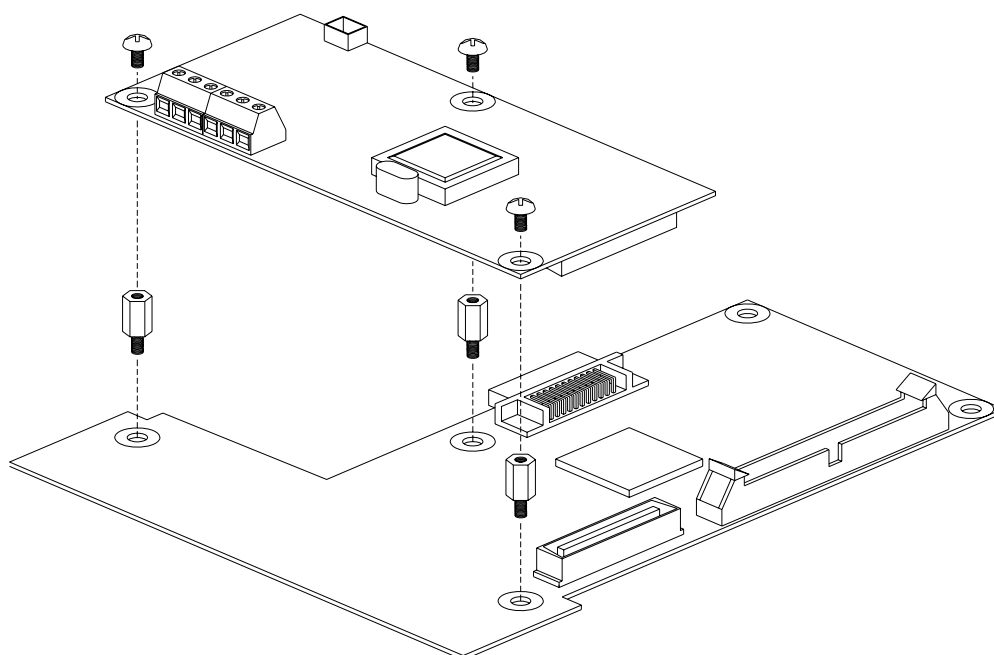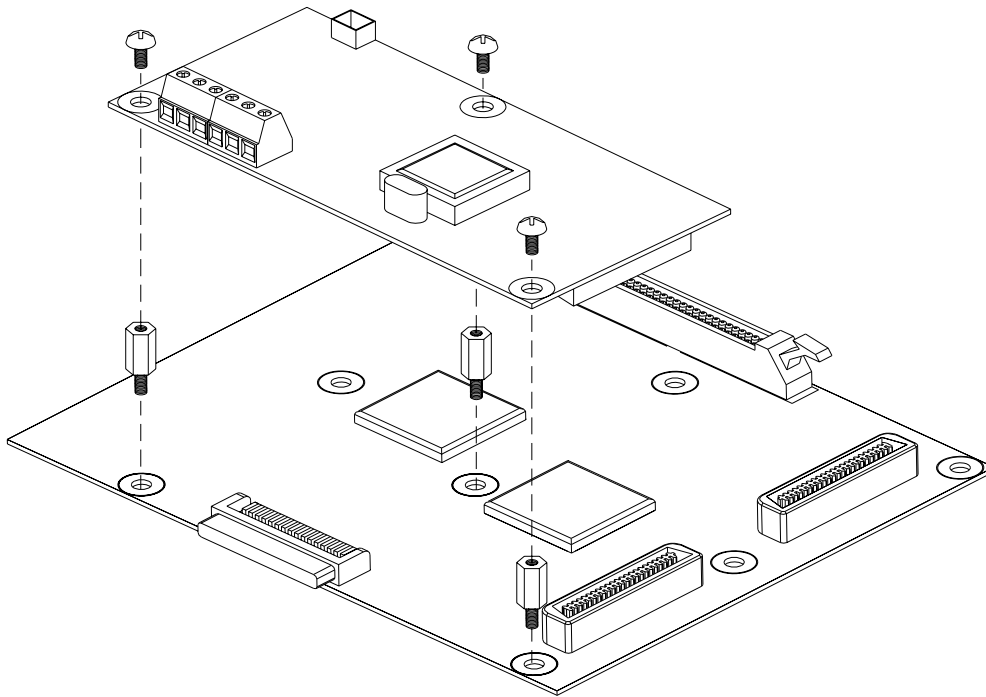| Name	Description		
Connector	Connector to inverter main PCB		
Signal connection terminal	Communication signal connection terminal	P	Comm. signal - high
		N	Comm. signal – low
		GND	Comm. Ground
		S	Shield
		T1	Connect a internal termination resistor
		T2	Short T1 and T2

Figure 1. SV-iP5A RS485/Mudbus-RTU Option Card Installation

Figure 2. SV-iV5 RS485/Modbus-RTU Option Card Installation

3.2. Status LED

CPU LED	Indicates the option card works normally.	
RXD LED	Receiving 485 signal	
TXD LED	Sending 485 signal	
ERR LED	Blinking intermittently	Receiving wrong DATA (Normal operation)
	Blinking simultaneously with CPU LED	DPRAM communication malfunction
	Blinking oppositely to CPU LED	Network Connection TimeOut

4. INSTALLATION
4.1. Installing RS485/Modbus-RTU card

① Connect RS485/Modbus-RTU communication card connector to the option connector inside the inverter control board. (See Figure 1, 2). Make sure that the support is well connected. Is the position of the support is not right, it means that the option card is not connected right.

② Power up the inverter after verifying the option card is installed properly.

③ When powering up the inverter, CPU LED is blinking per second after all LEDs blink one after another.

④ If "CPU LED" is not blinking, power down the inverter swiftly and check for the proper installation of the option card.

(**Caution**: The inverter and option card may get damaged in case that power is applied to the inverter for a long time when CPU LED is not blinking.)

 * If this problem occurs continuously, contact LS distributors.

⑤ Check displayed < COM-01 > for SV-iP5A and < EXT_01 > for SV-iV5 are set to RS485.

⑥ Set the parameters as below when the above steps are all done.

1. SV-iP5A Setting

Parameter code	Display	Setting Value
< COM-01 >	Opt B/D	RS485 displayed automatically
< COM-02 >	Opt mode	Set Commands controlled via communication
< I/O- 90 >	Inv. No.	1~250 (Verify the assigned number is not duplicated)
< I/O- 91 >	Baud rate	9600 bps (Factory default)
< I/O- 92 >	COM Lost Cmd note3)	User setting
< I/O- 93 >	COM Time Out note3)	1.0 sec (Factory default)

2. SV-iV5 Setting

Parameter code	Display	Setting Value
< EXT_01 >	Opt B/D	RS485 displayed automatically
< FUN_01 >	Run/Stop Src	Option
< FUN_02 >	Spd Ref Sel	Option
< I/O_95 >	Inv Number	1~250 (Verify the assigned number is not duplicated)
< I/O_96 >	485 Baud Rate	9600 bps (Factory default)
< I/O_97 >	Lost Command note3)	User setting
< I/O_98 >	Comm. Timer note3)	1.0 sec (Factory default)

note3) It is used for Emergency Stop when communication between inverter and Master is not done properly. It is activated when communication is not done even once for the set time. It indicates the inverter is not controlled by Remote. Set this value for safety.

⑦ Power down the inverter for the connection of converter when step⑥ is finished.

⑧ If the inverter is to be placed at the end of the network trunk line, install a jumper on the option card to enable the termination resistor (120 Ω). (See the Figure 3).

4.2. RS232-485 Converter Installation

The installation of converters depends on the manufacturers. Refer to the converter installation manual for detailed converter installation.

4.3. Connection guide for the communication card, the computer and the converter

4.3.1. System Configuration

Communication System Configuration
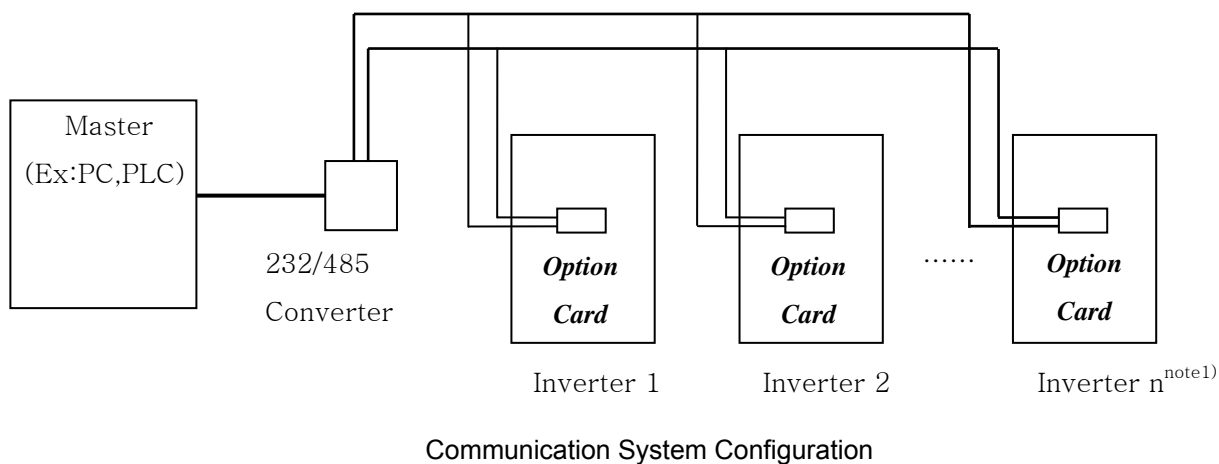
4.3.2. Termination Configuration

S   GND   T2   T1   N   P

Figure 3. Termination Configuration

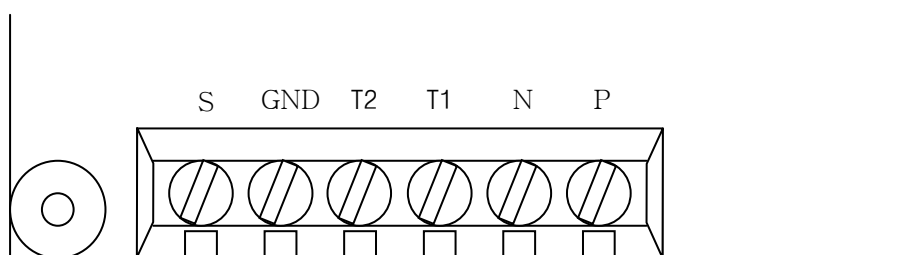| Pin	S	GND	T2	T1	N	P
Role	Shield	Ground	Termination		Signal line	

S   : Use only one point in the whole network lines for grounding.

Connect to the screw next to the shield terminal when grounding through the inverter.

GND   : Ground of communication terminal.

T1, T2 : If the option card is installed within the inverter which is to be placed at the end of the network trunk line, short terminals T1 and T2. This allows the internal termination resistor (120Ω) to be connected.

4.3.3. Communication Protocol Selection (RS485/Modbus-RTU)

● Setting method

The Modbus-RTU protocol is selected when the No.1(among the DIP switches located on the lower right corner of the option card) is ON, and RS485 protocol is selected when the No.1 is OFF. That's the same for both SV-iP5A, SV-iV5.

(At this time the On/Off status of the No.2, 3, 4 DIP switches has not an effect on the protocol selection.)
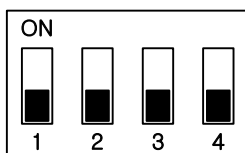
→ RS485 protocol selection

→ Modbus-RTU protocol selection

- Precautions when setting

  Even if the Master's protocol is changed during communication between Master and slaves (LS inverters), the communication is resumed automatically in case of adjusting the DIP switch on the option card in accordance with the master's protocol.

5. COMMUNICATION PROTOCOL

- Use RS485 protocol (for LS only) and Modbus-RTU protocol. RS485 and Modbus-RTU protocol are Open protocol. For more information, contact LS distributor.
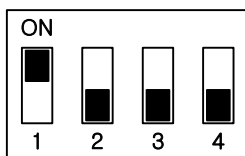- Computer or other host acts as Master while inverters act as slaves. The inverter responds to Read/Write command from Master.

5.1. RS485 Protocol

5.1.1. Basic format

- Command message (Request):

ENQ	Inverter No.	CMD	Data	SUM	EOT
1 byte	2 byte	1 byte	n byte	2 byte	1 byte

- Normal response (Acknowledge Response):

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

- Negative response (Negative Acknowledge Response):

NAK	Inverter No.	CMD	Error code	SUM	EOT
1 byte	2 byte	1 byte	2 byte	2 byte	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".

 * "Inverter Number" represents the number of Inverters and indicates in 2 byte ASCII-HEX.

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

 * CMD: Capital letter ("IF Error" when small letter is used.)

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

* Data: ASCII-HEX

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

* Error code: ASCII (20h ~ 7Fh)

* Receive/Send buffer size: Receive= 39 byte, Send=44 byte

* Monitor register buffer: 8 Word

* SUM: to check the communication error

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

Ex) Command Message (Request) for reading one address from address "9000"

ENQ	Inverter No.	CMD	Address	Number of address	SUM	EOT
05h	"01"	"R"	"3000"	"1"	"AC"	04h
1	2	1	4	1	2	1

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

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

= 1A7h (Except Control value: ENQ, ACK, NAK, etc.)

5.1.2. Detailed Read protocol

● Request for Read: Request for reading Word data of the successive 'n' number from address "XXXX"

ENQ	Inverter No.	CMD	Address	Number of Address	SUM	EOT
05h	"01" ~ "1F"	"R"	"XXXX"	"1" ~ "8" = n	"XX"	04h
1	2	1	4	1	2	1

Total byte = 12,   The quotation marks ("   ") mean character.

● Acknowledge Response:

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

Total byte = 7 + n * 4 = Max. 39

● Negative Acknowledge Response:

NAK	Inverter No.	CMD	Error code	SUM	EOT
15h	"01" ~ "1F"	"R"	"**"	"XX"	04h
1	2	1	2	2	1

Total byte = 9

5.1.3. Detailed Write protocol

● Request for Write:

ENQ	Inverter No.	CMD	Address	Number of Address	SUM	EOT	EOT
05h	"01" ~ "1F"	"W"	"XXXX"	"1" ~ "8" = n	"XXXX…"	"XX"	04h
1	2	1	4	1	n * 4	2	1

Total byte = 12 + n * 4 = Max. 44

● Acknowledge response:

ACK	Inverter No.	CMD	Data	SUM	EOT
06h	"01" ~ "1F"	"W"	"XXXX…"	"XX"	04h
1	2	1	n * 4	2	1

Total byte = 7 + n * 4 = Max. 39

● Negative response:

NAK	Inverter No.	CMD	Error code	SUM	EOT
15h	"01" ~ "1F"	"W"	"**"	"XX"	04h
1	2	1	2	2	1

Total byte = 9

5.1.4. Detailed Monitor Register protocol

● Monitor Register

* Request for Monitor Register:

Monitor Register has the function to update data periodically after assigning the necessary data to be monitored continuously.

Request for registering the 'n' number of Address (non-successive)

ENQ	Inverter No.	CMD	Number of Address	Address	SUM	EOT
05h	"01" ~ "1F"	"X"	"1" ~ "8"=n	"XXXX…"	"XX"	04h
1	2	1	1	n * 4	2	1

Total byte = 8 + n * 4 = Max 40

* Acknowledge Response:

ACK	Inverter No.	CMD	SUM	EOT
06h	"01" ~ "1F"	"X"	"XX"	04h
1	2	1	2	1

Total byte = 7

* Negative Acknowledge Response:

NAK	Inverter No.	CMD	Error code	SUM	EOT
15h	"01" ~ "1F"	"X"	"**"	"XX"	04h
1	2	1	2	2	1

Total byte = 9

● Monitor Action

* Action Request for Monitor Register:

Request for reading data of address registered by Monitor Register.

ENQ	Inverter No.	CMD	SUM	EOT
05h	"01" ~ "1F"	"Y"	"XX"	04h
1	2	1	2	1

Total byte = 7

* Acknowledge response:

ACK	Inverter No.	CMD	Data	SUM	EOT
06h	"01" ~ "1F"	"Y"	"XXXX…"	"XX"	04h
1	2	1	n * 4 byte	2 byte	1 byte

Total byte = 7 + n * 4 = Max 39

* Negative response:

NAK	Inverter No.	CMD	Error code	SUM	EOT
15h	"01" ~ "1F"	"Y"	"**"	"XX"	04h
1	2	1	2	2	1

Total byte = 9

5.1.5. Error code

Error code	Display	Description
ILLEGAL FUNCTION	IF	When the command received cannot be executed in the option card. It means that there is no corresponding command.
ILLEGAL DATA ADDRESS	IA	When parameter address received is invalid. When monitor is executed without Monitor Register.
ILLEGAL DATA VALUE	ID	When the DATA received is invalid.
WRITE MODE ERROR	WM	In case of Read Only or Write Disabled during operation.
FRAME ERROR	FE	When the frame size, internal Num or Sum is incorrect.
TIME OUT ERROR	TO	When DPRAM communication does not work within a certain time.
DPRAM OFF LINE	DO	When DPRAM is Off Line.
INVALID ID NUMBER	IN	When Inverter Number is incorrect.
UNDEFINED CONDITION	UC	Except for the above cases.

※ TO Error: Occurs when trying to communicate while the inverter is initializing. Operates normally after initialization.

5.2. Modbus-RTU Protocol

● Use Modbus-RTU protocol. Modbus-RTU protocol is Open protocol.

● Computer or other host acts as Master while inverters act as slaves. The inverter responds to Read/Write command from Master.

5.2.1. Available Function code

Function code	Description
0x03	Read Hold Register
0x04	Read Input Register

0x06	Preset Single Register
0x10	Preset Multiple Register

5.2.2. Exception code

Exception 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.

5.3. Baud Rate

1200, 2400, 4800, 9600, 19200, 38400 bps (Default value: 9600bps)

5.4. Broadcast Function

● The broadcast function is used when Command is given to all inverters connected to network.

● In the case of RS485, all inverters run without response (Slave->Master) when Command is given to Inverter Number 255(0xFF).

● In the case of Modbus-RTU, all inverters run without response (Slave->Master) when Command is given to Inverter Number 0(0x00).

6.   TROUBLE SHOOTING

Refer to this chapter when occurring problem in communication with computer while using this option card.

● CPU LED malfunction

Expected State	The inverter is not working normally or the inverter and the option card are not connected properly.
Corrective Measures	1. Verify the power is applied to the inverter. 2. Verify the option card is installed properly within the inverter when the inverter is working normally.

● RXD and TXD LEDs malfunction

Check Points	Corrective Measures
Is the power applied to the converter?	Apply power to the converter.
Is the connection between the converter and computer correct?	Refer to the converter manual
Is the communication card installed within the inverter properly?	Refer to "4 Installation".
Does Master start the communication?	Start the communication.
Is the communication speed setting of the inverter correct?	Refer to "4 Installation".
Is the data format of User program correct?	Modify User program [note4].
Is the connection between the converter and the option card correct?	Refer to "4. Installation".

[note4] User program is User-made S/W for PC.

● ERR LED is working

State	Corrective Measures
Blinking intermittently	In case that the option card is receiving wrong data due to Noise or other causes. It is normal.

Blinking oppositely to CPU LED	Network is not communicated during TimeOut setting. Verify the state of Master. (SV-iP5A : I/O-93, SV-iV5 : I/O_98)
Blinking simultaneously CPU LED	In case of occurring the communication trouble between the option card and the inverter. Power up and down the inverter. If this problem occurs continuously, contact LS distributor.

● Concerning the frequency (speed)/Run command by the option card, please refer to COM group for SV-iP5A and FUN group for SV-iV5.

* Refer to COM group of iP5A, FUN group of iV5 for Frequency(Speed)/Run command given by the option card.

7. PARAMETER CODE (All parameter addresses are Hex values)

<Common Area> : Common Area is addresses to be used commonly regardless of inverter models. Some addresses are used only for specific inverter models. [note5]

[note5] When the data is changed by Common Area parameter, its data is not saved.

That is, the changed data is effective in the present state but the data is reset to the previous value after the inverter is reset or powered On / Off.

Even though the inverter is reset or powered On / Off, the changed data is effective in case of changing the data by each group parameter, not the Common Area.

7.1. SV-iP5A Parameter Code

7.1.1 SV-iP5A Common Area

Address	Parameter	Unit	R/W	Data value			
0x0000	Inverter model	-	R	9 : SV-iP5A			
0x0001	Inverter capacity	-	R	SV-iP5A 4: 5.5 5: 7.5 6: 11 7: 15 8: 18.5 9: 22 A: 30 B: 37 C: 45 D: 55 E: 75 F: 90 10: 110 11: 132 12: 160 13: 220 14: 280 15: 315 16: 375 17: 450 (Unit : kW)			
0x0002	Inverter	-	R	0: 220V Class 1: 440V Class			
0x0003	S/W Version	-	R	0100h : Ver 1.00, 0110h : Ver 1.10			
0x0005	Freq. Command	0.01Hz	R/W				
0x0006	Run/Stop Command	-	R/W	BIT 0	Stop		
				BIT 1	Forward Run (FX)		
				BIT 2	Reverse Run (RX)		
				BIT 3	Fault Reset (0→1)		
				BIT 4	Emergency Stop		
				BIT 5	Not Used		
			R	BIT 6	Run/Stop Command Information	0	Terminal
						1	Keypad
				BIT 7		2	Option
						3	Int. 485
				BIT 8	Freq. Command Information	0~16	Multi-step Speed Freq. (0.2~16)
						17~19	UpDown Operation (Up, Down, UD Zero)
				BIT 9		20~21	Not used
				BIT 9		22~25	Analog Operation (V1, V1S, I, V1I)

Address	Parameter	Unit	R/W	Data value				
				BIT 10		26	Pulse	
						27	Sub	
				BIT 11		28	Int. 485	
						29	Option	
				BIT 12		30	Jog	
						31	PID	
				BIT 13	Not Used			
				BIT 14	Not Used			
				BIT 15	Set when Network malfunction occurs			
0x0007	Acceleration Time	0.1 sec	R/W					
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					
0x000C	DC Link Voltage	0.1 V	R					
0x000D	Output Power	0.1 kW	R					
0x000E	Operating Status	-	R	BIT 0	Stop			
				BIT 1	Forward Run (FX)			
				BIT 2	Reverse Run (RX)			
				BIT 3	Fault (Trip)			
				BIT 4	Accelerating			
				BIT 5	Decelerating			
				BIT 6	Speed Arrival			
0x000E	Operating Status	-	R	BIT 7	Forward Command			
				BIT 8	DC Braking			
				BIT 9	Not Used			
				BIT10	Brake Open			
				BIT11	Forward Run Command			
				BIT12	Reverse Run Command			
				BIT13	REM. R/S (Int. 485, OPT)			
				BIT14	REM. Freq. (Int. 485, OPT)			
				BIT15	Not Used			
0x000F	Trip Information	-	R	BIT 0	OCT1			
				BIT 1	OV			
				BIT 2	EXT-A			
				BIT 3	BX			
				BIT 4	LV			
				BIT 5	Not Used			
				BIT 6	GF(Ground Fault)			
				BIT 7	OH (Inverter overheat)			
				BIT 8	ETH (Motor overheat)			
				BIT 9	OLT (Overload trip)			
				BIT10	HW-Diag			
				BIT11	Not Used			
				BIT12	OCT2			
				BIT13	OPT (Option error)			
				BIT14	PO (Phase Open)			
				BIT15	IOLT			
0x0010	Input Terminal Information	-	R	BIT 0	M1			
				BIT 1	M2			

Address	Parameter	Unit	R/W	Data value	
				BIT 2	M3
				BIT 3	M4
				BIT 4	M5
				BIT 5	M6
				BIT 6	M7
				BIT 7	M8
				BIT 8	P4
				BIT 9	P5
				BIT 10	P6
				BIT11~15	Not Used
0x0010	Output Terminal Information	-	R	BIT 0	AUX1
				BIT 1	AUX2
				BIT 2	AUX3
				BIT 3	AUX4
				BIT 4	Q1 (OC1)
				BIT 5	Q2 (OC2)
				BIT 6	Q3 (OC3)
				BIT 7	30AC
				BIT 8~15	Not used
0x0012	V1	-	R	0 ~FFC0	
0x0013	V2	-	R	0 ~FFC0	
0x0014	I	-	R	0 ~FFC0	
0x0015	RPM	-	R		
0x001A	Unit display	-	R	0 : Hz, 1 : Rpm	
0x001B	Pole number	-	R		
0x001C	Custom Version	-	R		

※ **Refer to the main manual for the communication address regarding iP5A Function Code.**

7.1.2 iP5A Communication Option Setting

< COM Group >

Address	NO.	Description	Default	Maximum	Minimum
9601	COM-01	Opt B/D	0	7	0
9602	COM-02	Opt mode	0	3	0
9603	COM-03	Opt Version	0022h: Ver 2.2	-	-
963C	COM-60	Parity/Stop	0	3	0

* Inverter Number or communication speed is set in I/O-90, 91.

COM-01 [Opt B/D]

● Indicates the type of the option card installed.

● This value is automatically displayed when the option card is installed.

COM-02 [Opt Mode]

● Determines whether Run/Stop and Freq. command are set via communication.

Setting	Display	Description
0	None	None command
1	Command	Run/Stop command via communication

2	Freq	Frequency command via Communication
3	Cmd + Freq	Run/Stop and Frequency command via Communication

COM-03 [Opt Version]

- Displays the version of the option card.

COM-60 [Parity/Stop]

- Sets Stop Bit or Parity Check

Setting	Display	Description
0	8None/1Stop	Data: 8bit, Stop: 1bit, Parity: None.
1	8None/2Stop	Data: 8bit, Stop: 2bit, Parity: None
2	8Even/1Stop	Data: 8bit, Stop: 1bit, Parity: even
3	8 Odd/1Stop	Data: 8bit, Stop: 1bit, Parity: odd

7.2. SV-iV5 Parameter Code

7.2.1 SV-iV5 Common Area

Address	Parameter	Unit	R/W	Data value	
0x0000	Inverter Model	-	R	5: SV-iV5	
0x0001	Inverter Capacity	-	R	SV-iV5 2:2.2 3:3.7 4:5.5 5:7.5 6:11 7:15 8:18.5 9:22 A:30 B:37 C:45 D:55 E:75 F:90 10:110 11:132 12:160 14:220 (unit : kW)	
0x0002	Inverter Input Voltage	-	R	0: 220V class 1: 440V class	
0x0003	Version	-	R	0100h : Ver.1.00 0110h : Ver.1.10	
0x0005	Frequency Command	0.01Hz	R/W	0x0502 instead of Not Used	
0x0006	Run Command	-	R/W	0x0500 instead of Not Used	
0x0007	Acceleration Time	0.1 sec	R/W	SV-iV5 : used in Device Net[note6]	
0x0008	Deceleration Time	0.1 sec	R/W	SV-iV5 : used in Device Net[note6]	
0x0009	Output Current	0.1 A	R		
0x000A	Output Frequency	0.01 Hz	R	SV-iV5 : used in Device Net[note7]	
0x000B	Output Voltage	0.1 V	R		
0x000C	DC Link Voltage	0.1 V	R		
0x000D	Output Power	0.1 kW	R		
0x000E	Operating Status	-	R	Bit00	Stop
				Bit01	Forward Run (FX)
				Bit02	Reverse Run (RX)
				Bit03	Fault (Trip)
				Bit04	Accelerating

				Bit05	Decelerating
				Bit06	Speed Arrival
				Bit07	Inverter run ready [note8]
				Bit08	Stopping
				Bit09	Encoder Direction Check [note9]
				Bit10	Torque Limiting
				Bit11	Forward Run Command [note10]
				Bit12	Reverse Run Command [note10]
				Bit13	Option Run/Stop Command
				Bit14	Option Frequency Command
				Bit15	PID Enable [note11]
0x000F	Trip Information	-	R	Bit00	Over Current (OCT U, V, W)
				Bit01	Over Voltage(OV)
				Bit02	Not Used
				Bit03	BX
				Bit04	Low Voltage(LV)
				Bit05	Fuse Open(FO)
				Bit06	Ground Fault(GF)
				Bit07	Inverter Over Heat(IOH)
				Bit08	E-Thermal(ETH)
				Bit09	Over Load(OLT)
				Bit10	HW-Diag
				Bit11	External-B(EXT-B)
				Bit12	Over Current2 (Arm Short U, V, W)
				Bit13	Option Error
				Bit14	Encoder Error
				Bit15	Inverter Over Load(IOLT)
0x0010	Input Terminal Information	-	R	Bit00	FX
				Bit01	RX
				Bit02	BX
				Bit03	RST
				Bit04	Not Used
				Bit05	Not Used
				Bit06	Not Used
				Bit07	Not Used
				Bit08	P1
				Bit09	P2

				Bit10	P3
				Bit11	P4
				Bit12	P5
				Bit13	P6
				Bit14	P7
				Bit15	Not Used
0x0011	Output Terminal Information	-	R	Bit00	30A – 30C
				Bit01	1A – 1B
				Bit02	2A – 2B
				Bit03	OC1 - EG
				Bit04~15	Not Used
0x0012	Analog Input 1	-	R	Analog Input 1 (main manual Ai1) -100.0%(FC17h).~.100.0%(03E8h)	
0x0013	Analog Input 2	-	R	Analog Input 2 (main manual Ai2) -100.0%(FC17h) ~ 100.0%(03E8h)	
0x0014	Analog Input 3	-	R	Analog Input 3 (main manual Ai3) -100.0%(FC17h) ~ 100.0%(03E8h)	
0x0015	RPM	-	R	Reverse speed: 1's complement [note12]	
0x0017	Speed Command	Hz	R/W	SV-iV5 : used in Device Net [note13]	
0x001D	Speed Command1	RPM	R	Target Speed Command	
0x001E	Speed Command2	RPM	R	Ramp Speed Command [note14]	
0x001F	Speed Controller Input Command	RPM	R	Speed Controller Reference Speed [note15]	
0x0020	Motor Speed	RPM	R	note12)	
0x0021	Torque Reference	0.1%	R	Torque Reference [note16]	
0x0022	Torque Feedback	0.1%	R	Torque Feedback [note17]	
0x0023	No-Load Current	0.1%	R	PAR_26 Flux-Curr's % (Read : 0x050A [note28] during operation)	
0x0024	PID Reference	0.1%	R	PID Reference [note18]	
0x0025	PID Feedback	0.1%	R	PID Feedback [note19]	
0x0026	PID Output	0.1%	R	PID Output [note20]	
0x0027	Inverter Temperature	deg	R	Inverter Temperature	

note6) Because other series (iS5, iG5, etc.) use addresses 0x0007 and 0x0008 for the Acceleration & Deceleration Time in Device Net, same addresses are used for iV5. Besides Device Net, Acceleration & Deceleration Time of addresses 0x0503 and 0x0504 may be used for SV-iV5.

note7) Hz is used for the motor speed feedback, only when communicating via Device Net.

note8) Indicates that the inverter is at a state of operating without trip. Indicates '1' before, during, after operation, when there is no trip.

note9) Indicates'0'when at stop (bit0='1'), '1' when at forward run (bit1='1'), '0'at reverse run (bit2='1')

When it is not connected right, it indicates '0' when at forward run (bit1='1'), '1'at reverse run (bit2='1')

note10) The relationship between Bit10 Forward Command, Bit11 Reverse Command, Bit01 Forward Run(FX), and Bit02 Reverse Run(RX) are as follows. Bit10, Bit11 indicate information of the present run command and Bit01, Bit02 indicate the present operation status. For example, if stop command is put in while running forward, Bit11 Forward Command would be '0,' but Bit01 Forward Run (FX) would be '1'when decelerating and be'0'after it stops.

When Reverse Run command is put in, while running forward at a speed of 1800 RPM, Bit11 Reverse command and Bit01 Forward Run (FX) remain '1' until the rotating direction of the motor changes, decelerating from 1800 RPM.

note11) Indicates '1,' when CON_20 Proc PID Enb(0x7514) is set to Enable('1') and when it's running (bit13='1'). It indicates '0' at stop.

note12) For SV-iV5, both positive and negative direction speed get indicated. For the positive direction speed, if it is 1800 RPM, it gets indicated as 0708h and 1800 as decimal number. For the negative direction speed, if it is -1800 RPM, it gets indicated as F8F7h. This negative number is expressed as 1's complement and the absolute value gets calculated as below.

$(FFFFh – F8F7h)_{(10)} = 0708h_{(10)} = 1800$

A negative sign gets in front of this absolute value and -1800RPM is the end result.

The calculation of the negative speed is as below.

Speed (RPM) = $(FFFFh – FXXXh(\text{received negative speed data}))_{(10)} \times (-1)$

note13) When communicating via Device Net, speed command is given with Hz.

note14) Checks up with the PostRamp Ref value during run. Speed is displayed by absolute value.

note15) Checks up with the PreRamp Ref value during run. Indicate speed by classifying signs and refer to note11.

note16) Checks up with the DIS_01's Torque Ref value during run. Calculate with 2's complement since negative torque value comes out during reverse run.

ex) When the read value is FE0Ch, it gets calculated as follows.

$\text{Torque(\%)} = (FFFFh\text{-}FE0Ch + 0001h)_{(10)} \times (-1)$

$= (01F3h + 0001h)_{(10)} \times (-1)$

$= (01F4h)_{(10)} \times (-1)$

$= -500$

It is –50% since the unit is 0.1%

The formula would be,

Torque (%) = $(FFFFh – FXXXh \text{ (received negative torque data)} + 0001h)_{(10)} \times (-1)$

note17) Default DISPLAY checks up as Tq. For the calculation, refer to note15.

note18) When CON_20 Proc PID Enb is set to Enable, read during run and save the value of 0x050B PID input command. DIS_04 Process PID output checks up at Ref/FB's Process PID command value. It reads and saves the value of 0x050B PID input command only during run, so in case of chaged value of the 0x050B PID input command at stop, you'll still be able to know the former command value through the 0x0024 PID Reference value. In this case, a value other than the DIS_04's Process PID command value gets saved and saves the same DIS_04's Process PID command

value after reading the value from 0x050B when starting Run.

note19) When CON_20 Proc PID Enb is set to Enable, it checks up with DIS_04 Process PID output Ref/FB's Process PID F/B value.

note20) When CON_20 Proc PID Enb is set to Enable, it checks up with DIS_04 Process PID output Ref/FB's Process PID output value.

7.2.2 <Reference Data(Write Data)> Area : SV-iV5 Communication Command Area

Address	Parameter	Unit	R/W	Data Value	
0x0500	Input Terminal Command[note21]	-	R/W	Bit00	Stop
				Bit01	FX
				Bit02	RX
				Bit03	RST
				Bit04	BX
				Bit05	Not Used
				Bit06	Not Used
				Bit07	Not Used
				Bit08	P1
				Bit09	P2
				Bit10	P3
				Bit11	P4
				Bit12	P5
				Bit13	P6
				Bit14	P7
				Bit15	Not Used
0x0501	Output Terminal Command[note22]	-	R/W	Bit00	1A – 1B
				Bit01	2A – 2B
				Bit02	OC1 – EG
				Bit03~15	Not Used
0x0502	Speed Command	0.1RPM	R/W	Speed Command when FUN_02 is Option (check DIS_01 PreRamp Ref) [note23]	
0x0503	Acceleration Time	0.1sec	R/W	Main Accel. Time Setting [note24]	
0x0504	Deceleration Time	0.1sec	R/W	Main Decel. Time Setting [note24]	
0x0505	Torque Command	0.1%	R/W	Torque Command when CON_26 is Option [note25]	
0x0506	Forward Torque Limit	0.1%	R/W	Forward Torque Limit [note26]	
0x0507	Reverse Torque Limit	0.1%	R/W	Reverse Torque Limit [note26]	
0x0508	Regeneration Torque Limit	0.1%	R/W	Regeneration Torque Limit [note26]	
0x0509	Torque Bias	0.1%	R/W	Torque Bias [note27]	

0x050A	No-Load Current Command	0.1%	R/W	No-Load Current Command [note28]
0x050B	PID Input Command	0.1%	R/W	PID Input Command [note29]
0x050C	Draw Input Command	0.1%	R/W	Draw Input Command [note30]

note21) You can command Run and Muti-function input via communication. If you want to use the Multi-function input command (P1 ~P7) via communication, be sure to use it after defining the multi-function input of I/O_01 ~ I/O_07.

note22) If you want to use the Output Terminal Command via communication, set the setting of the terminal that you want to use to "Not Used" from the Multi-function Output Terminals (I/O_41 ~ I/O_43). If a setting other than "Not Used" is set, the inverter operates according to the setting and cannot use the multi-function output via communication.

note23) It puts positive values only and the LCD keypad's DIS_01 PreRamp Ref differs in sign according to the direction. Maximum value gets restrained by FUN_04 Max Speed.
ex) If FUN_04 Max Speed = 1800RPM, the unit is 0.1RPM. Therefore, 18000 -> 4650h

note24) 0x0503 acceleration time value gets saved together in FUN_40 Acc Time-1(0x7428), when performing Write. However, the unit of 0x0503 is 0.1sec and FUN_40 is 0.01sec. Therefore, when saving 0064h(10.0 sec) in 0x0503, 03E8h(10.00 sec) gets saved in FUN_40. When a new value gets put in 0x0503, Write gets performed in FUN_40. When an identical value is put in 0x0503, Write does not get performed in FUN_40. Because the value gets saved in FUN_40, the acceleration time after the inverter's On/Off and before Off can be read from 0x0503. 0x0504 deceleration time and FUN_41 Dec Time-1(0x7429) are in the same relationship.

note25) Concerning Torque command, set CON_01 as "Torque," CON_26 as "Option" and it can be set during operation.

note26) CON_28 Trq Lmt Src has to be set as Option (Opt Opt Opt) in order to set the Torque Limit value via communication. Value can be checked at DIS_01 PosTrq Limit and NegTrq Limit, RegTrq Limit.

note27) Set CON_32 Trq Bias Src as Option and it can be checked with DIS_01 Torque Bias.

note28) No-Load Current command is available with % of set value in PAR_26 via communication. At this time, the set value in PAR_26 means 100% and setting below 100% is possible. The input value is to be checked through DIS_01 Flux Ref during operation.

note29) Checks up from DIS_04 Process PID controller and Feedback & Output checks during operation.

note30) The Draw function is only available after setting CON_22 to a certain value and giving the value with Analog Input or communication. In case of communication at this point, it is not changing the number of CON_22's Draw, but substituting the Analog Input value to communication. Therefore, it cannot be checked through the LCD keypad but can be checked from the changed value of the address.

7.2.3 SV-iV5 Communication Option Setting

<FUN Group>

Address	No	Description	Set Value
7401	FUN_01	Run/Stop select	Set to 3 (Option)
7402	FUN_02	Speed Command select	Set to 3 (Option)

- FUN_01,02 determine Run/Stop command at an option by the communication.
  * Run command by option uses 0x0500 of the reference data area.
  * Speed command by option uses 0x0502 of the reference data area.

<I/O Group>

Address	No	Description	Default	Setting Range
725F	I/O_95	Inverter Channel	1	1~250
7260	I/O_96	485 BaudRate (Communication Speed)	3 (9600bps)	0 (1200bps) 1 (2400bps) 2 (4800bps) 3 (9600bps) 4 (19200bps) 5 (38400bps)
7261	I/O_97	Operation method when communication command is lost	0 (None)	0 (None continue run) 1 (FreeRun stop) 2 (Stop deceleration stop)
7262	I/O_98	Lost communication command decision time	1.0s	1.0~30.0s

- I/O_95,96 sets the inverter channel and the communication speed.
- If communication command is lost when FUN_01 is 3(Option) during the time of I/O_98, the inverter runs with the value of I/O_97.

< EXT Group >

Address	No	Description	Default	Max Value	Min Value	Unit
7601	EXT_01	Opt B/D	0	7	0	
7602	EXT_02	Opt Version	0022h : Ver 2.2	-	-	
760A	EXT_10	Output Num	3	8	0	
760B	EXT_11	Output 1	0x0020	65535	0	
760C	EXT_12	Output 2	0x000E	65535	0	
760D	EXT_13	Output 3	0x000F	65535	0	
760E	EXT_14	Output 4	-	65535	0	
760F	EXT_15	Output 5	-	65535	0	
7610	EXT_16	Output 6	-	65535	0	
7611	EXT_17	Output 7	-	65535	0	
7612	EXT_18	Output 8	-	65535	0	
7613	EXT_19	Input Num	2	8	0	
7614	EXT_20	Input 1	0x0502	65535	0	
7615	EXT_21	Input 2	0x0500	65535	0	
7616	EXT_22	Input 3	-	65535	0	
7617	EXT_23	Input 4	-	65535	0	
7618	EXT_24	Input 5	-	65535	0	
7619	EXT_25	Input 6	-	65535	0	
761A	EXT_26	Input 7	-	65535	0	
761B	EXT_27	Input 8	-	65535	0	

Address		Description				Data Value
761E	EXT_30	Parity/Stop	0 (8None/1Stop)		0 (8None/1Stop) 1 (8None/2Stop) 2 (8Even/1Stop) 3 (8 Odd/1Stop)	
761F	EXT_31	Delay Time	5ms	1000ms	2ms	

EX_01 [Opt B/D]

- A kind of the option board which is installed.
- It is displayed automatically when the option board is installed.

EX_02 [Opt Version]

- A version of the communication option board.

EX_10 [Output Num]

- Set the number of addresses at the read only area of the communication data.
- Set addresses from EXT_11 to EXT_18 and the values can be 1~8.

EX_19 [Input Num]

- Set the number of addresses at the write only area of the communication data.
- Set addresses from EXT_20 to EXT_27 and the values can be 1~8.

EX_30 [Parity/Stop]

- Set a Parity/Stop bit about communication.

EX_31 [Delay Time]

- It carries on the communication smoothly by selecting an appropriate delay time.

7.2.4 SV-iV5 Communication Area : SV-iV5's Communication Data Area

Address	Description	Unit	R/W	Data Value
0x0100	Select to-be-used address from EXT_10[Output Num] Save data sent from inverter to communication card Read only area	-	R	Select address from EXT_11
0x0101		-	R	Select address from EXT_12
0x0102		-	R	Select address from EXT_13
0x0103		-	R	Select address from EXT_14
0x0104		-	R	Select address from EXT_15
0x0105		-	R	Select address from EXT_16
0x0106		-	R	Select address from EXT_17
0x0107		-	R	Select address from EXT_18
0x0108	Select number of address from EXT_19[Input Num]	-	W	Select address from EXT_20
0x0109		-	W	Select address from EXT_21

0x010A	Save data sent from	-	W	Select address from EXT_22
0x010B	communication card to	-	W	Select address from EXT_23
0x010C	inverter	-	W	Select address from EXT_24
0x010D	Write only area	-	W	Select address from EXT_25
0x010E	Read impracticable	-	W	Select address from EXT_26
0x010F		-	W	Select address from EXT_27

SV- iV5 offers a read-only and a write-only area for all the external communication cards. The read-only area is the place that saves data transmitting from inverter to the communication card. User program of the master uses the area to check the information of the inverter through the communication card. You can set up a number of addresses to use (from 1 to 8) at EXT_10[Output Num].

The write-only area is saved with sending data from the communication card to inverter. It is the area where user program of the master uses to run a command which comes through the communication card. You can set up a number of addresses to use at EXT_19[Input Num].

At the communication, the read-only area is 0x0100~0x0107 and the write-only area is 0x0108~0x010F. Refer to the above table about addresses to share data.

In case of SV-iV5, areas which can be used at the communication are as follows:

1. Common area beginning with 0x0000.
2. SV-iV5 communication-only data area starting from 0x0100 of the common area.
3. Reference data area starting from 0x0500 of the common area.
4. Group address area.

There is a reason that no.2 is added above. It does not need to read 0x0001 because an ordinary read command reads from 0x0000 to 0x0002 on 485 communication. To avoid reading same area repeatedly, parameter settings are as follows. Set EXT_10 as 2, EXT_11 as 0x0000, EXT_12 as 0x0002, and then do read command with the master to read 2 addresses from 0x0100. It reads data only from 0x0000 and 0x0002.

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LS Industrial Systems Co., Ltd.   10310000704

■ **HEAD OFFICE**
Yonsei Jaedan Severance Bldg. 84-11 5 ga, Namdaemun-ro,
Jung-gu Seoul 100-753, Korea
Tel. (82-2)2034-4643~4649
Fax.(82-2)2034-4879, 2034-4885
http://eng.lsis.biz

· **LS Industrial Systems Tokyo Office >> Japan**
Address: 16th Floor, Higashi-Kan, Akasaka Twin Towers 17- 22,
2-chome, Akasaka, Minato-ku, Tokyo 107-8470, Japan
Tel: 81-3-3582-9128 Fax: 81-3-3582-2667
e-mail: jschuna@lsis.biz

· **LS Industrial Systems Dubai Rep. Office >> UAE**
Address: P.O.BOX-114216, API World Tower, 303B, Sheikh
Zayed road, Dubai, UAE.
Tel: 971-4-3328289 Fax: 971-4-3329444
e-mail: hwyim@lsis.biz

· **LS-VINA Industrial Systems Co., Ltd. >> Vietnam**
Address: LSIS VINA Congty che tao may dien Viet-Hung
Dong Anh Hanoi, Vietnam
Tel: 84-4-882-0222 Fax: 84-4-882-0220
e-mail: srjo@hn.vnn.vn

· **LS Industrial Systems Hanoi Office >> Vietnam**
Address: Room C21, 5th Floor, Horison Hotel, 40 Cat Linh,
Hanoi, Vietnam
Tel: 84-4-736-6270/1 Fax: 84-4-736-6269

· **Dalian LS Industrial Systems co., Ltd, >> China**
Address: No. 15 Liaohexi 3 Road, economic and technical
development zone, Dalian, China
Tel: 86-411-8273-7777 Fax: 86-411-8730-7560
e-mail: lixk@lgis.com.cn

· **LS Industrial Systems (Shanghai) Co., Ltd. >> China**
Address: Room E-G, 12th Floor Huamin Empire Plaza,
No. 726, West Yan'an Road, Shanghai, China
Tel: 86-21-5237-9977

· **LS Industrial Systems(Wuxi) Co., Ltd. >> China**
Address: 102-A National High & New Tech Industrial
Development Area, Wuxi, Jiangsu, China
Tel: 86-510-534-6666 Fax: 86-510-522-4078
e-mail: Xugh@lgis.com.cn

· **LS Industrial Systems Beijing Office >> China**
Address: B-tower 17th Floor, Beijing Global Trade Center building,
No. 36, BeiSanHuanDong-Lu, DongCheng-District, Beijing, China
Tel: 86-10-5825-6025

· **LS Industrial Systems Guangzhou Office >> China**
Address: Room 1403, 14th Floor, New Poly Tower, 2 Zhongshan Liu
Rad, Guangzhou, China
Tel: 86-20-8326-6754 Fax: 86-20-8326-6287
e-mail: zhangch@lgis.com.cn

· **LS Industrial Systems Chengdu Office >> China**
Address: Room 2907, Zhong Yin B/D, No. 35, Renminzhong(2)-
Road, Chengdu, China
Tel: 86-28-8612-9151 Fax: 86-28-8612-9236
e-mail: hongkonk@vip.163.com

· **LS Industrial Systems Qingdao Office >> China**
Address: 12th Floor, Guodong building, No52 Jindun Road,
Chengdu, China
Tel: 86-532-580-2539 Fax: 86-532-583-3793
e-mail: bellkuk@hanmail.net