MOTOR CONTROL

REGAL

MDHP Series High Performance Variable Frequency Drive

CC-Link Option Manual

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Introduction

The CC-Link Master can operate the VS1AP drive and monitor the state of VS1AP in the CC-Link network through the VS1AP CC-Link communication option board.
The VS1AP CC-Link option supports version 1.10 of CC-Link.

1. Specification of CC-Link Communication Option Board

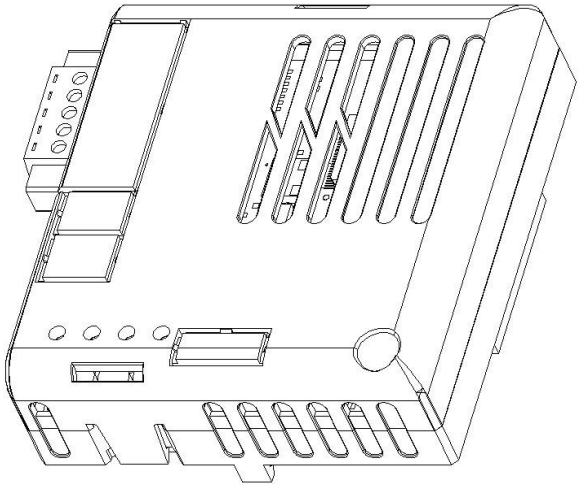
Transmission Speed	156k, 625k, 2.5M, 5M, 10Mbps
Station Type	Remote device station
Number of Occupied Stations	1 station
Version	V1.10
The Number of Station connected	(1 X a) + (2 X b) + (3 X c) + (4 X d) ≤ 64 a: Number of modules occupying 1 station b: Number of modules occupying 2 station c: Number of modules occupying 3 station d: Number of modules occupying 4 station (16 X A) + (54 X B) + (88 X C) ≤ 2304 A: Number of remote I/O stations ---------- Max. 64 B: Number of remote device stations ---------- Max. 42 C: Number of Local/Intelligent device stations ------ Max. 26
Interface	5 pin pluggable connector
Cable	CC-Link dedicated cable, Compatible dedicated cable with CC-Link Ver 1.10
External Diameter	Less than 8.0 mm

2. Product Components

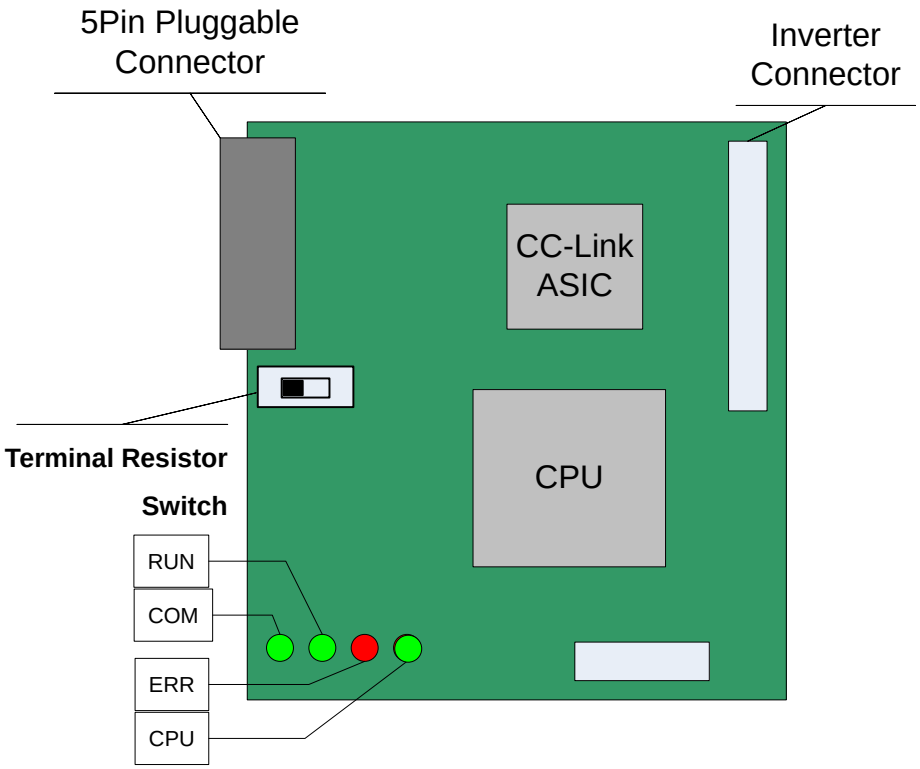
- VS1AP CC-Link communication option board 1 ea
- Screw for fixing on the inverter 1 ea
- VS1AP CC-Link User Manual 1 ea

3. Installation of the VS1AP CC-Link Option

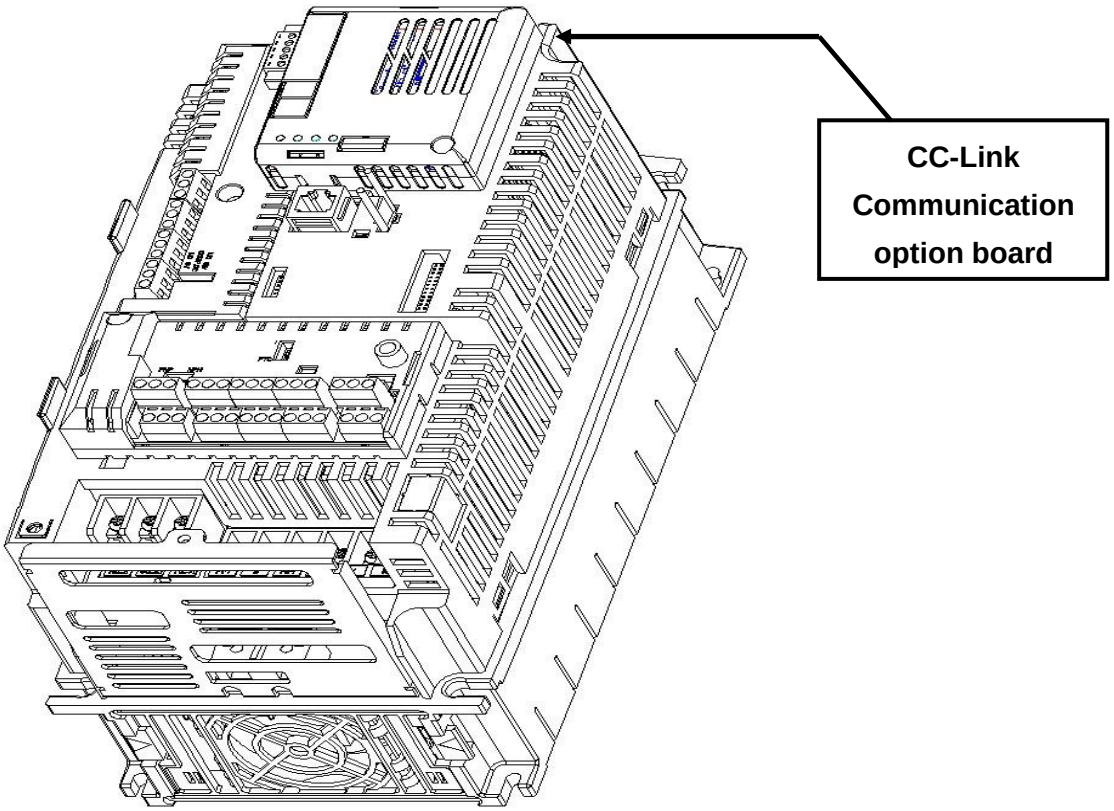
(1) The VS1AP CC-Link Option Module



(2) VS1AP CC-Link Option Board Layout

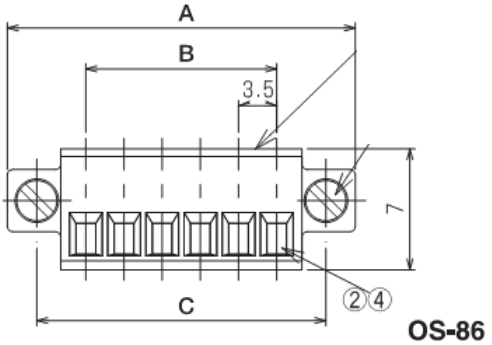


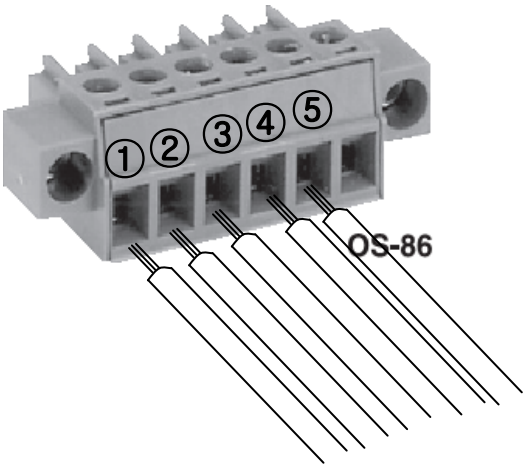
(3) Mounting the communication option board on VS1AP drive



(4) CC-Link signal connector structure and wiring method

①DA (Blue) ②DB (White) ③DG (Yellow) ④SLD (Shielded twisted Cable) ⑤FG





<Connector Structure> **<Wiring Method>**

※Signal connector OSADA OS-86-5P must be used for VS1AP CC-Link communication option board. (5-Pin connector)

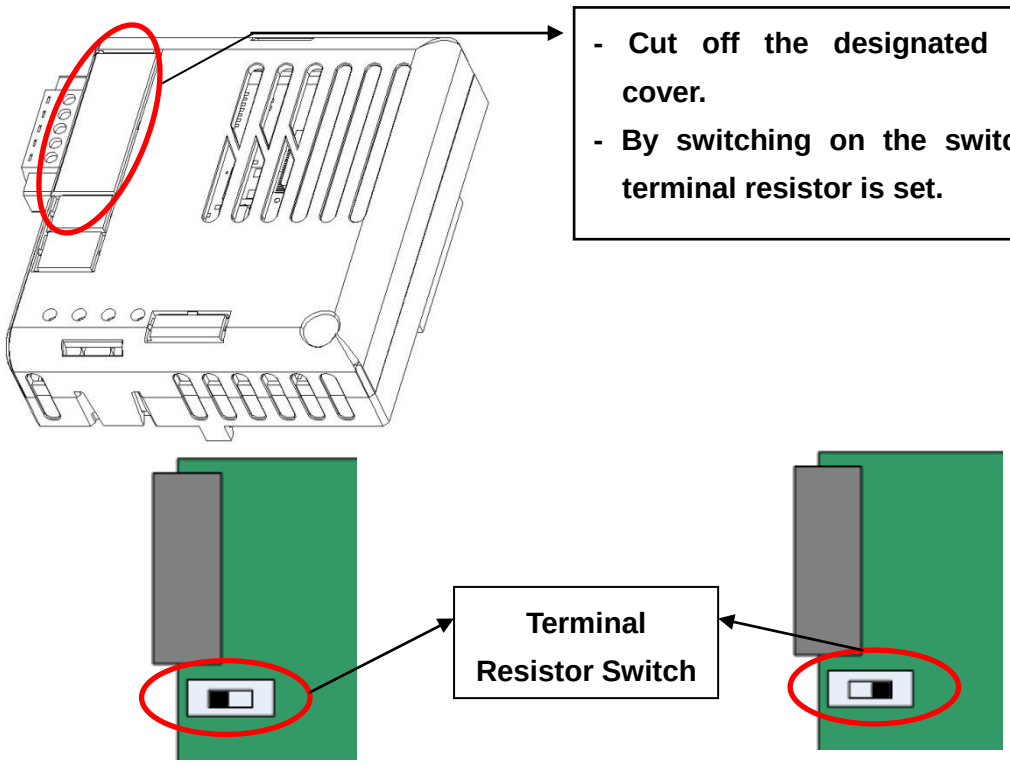
4. Network Connection

Connection terminal of communication cable

No.	Signal	Description	Cable Color
1	DA	Transmitted/Received data	Blue
2	DB	Transmitted/Received data	White
3	DG	Signal ground	Yellow
4	SLD	Shielded cable	Shielded twisted Cable
5	FG	Frame ground	-

<Setting method of terminal resistor>

※If the VS1AP CC-Link communication option board is placed at the end of the network, the last option board must turn On the setting switch of terminal resistor. Terminal resistor is 110 Ω 1/2W.



When the switch of terminal resistor is placed in left side (Off)
→ Terminating resistor is not used.

When the switch of terminal resistor is placed in right side (On)
→ Terminating resistor is used.

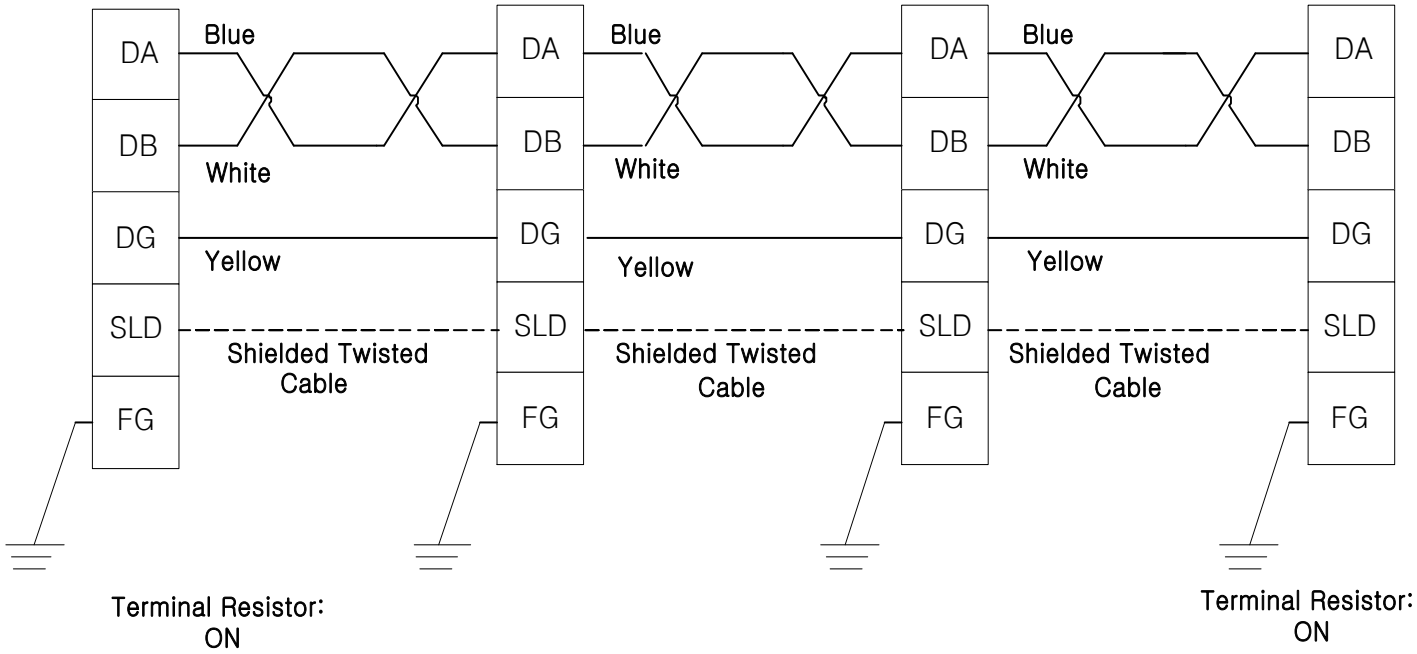
<Hardware Installation>

Warning) Configure the communication network after turn off the power of inverter

Wiring of CC-Link communication cable

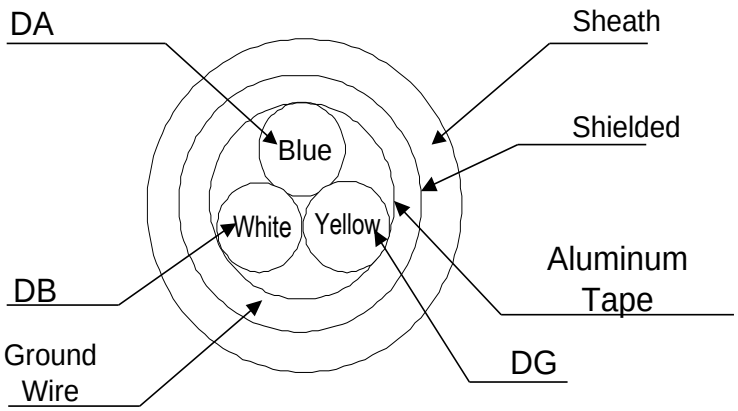
Connect the dedicated CC-Link communication cable to terminal block as following procedure.

To reduce the noise, CC-Link communication board at both ends of the network has to be terminated. Turn on the setting switch of terminal resistor on CC-Link communication board.



<Communication Cable Feature>

We recommend the cable as below described cable. If not, we can not guarantee the performance of CC-Link.

Items	Specification	
Type	Shielded twisted cable note1)	
The number of Cable Core	3	
Conductor Size	20AWG	
Conductor Resistor (20℃)	37.8Ω / km or less	
Insulation Resistor	10000MΩ / km or more	
Withstanding Voltage	DC500 V 1 minute	
Capacitance (1 kHz)	60 nF / km or less	
Characteristic Impedance note2)	1MHz	110 ± 15Ω
	5MHz	110 ± 6Ω
Cross Section		
External Diameter	7 mm	

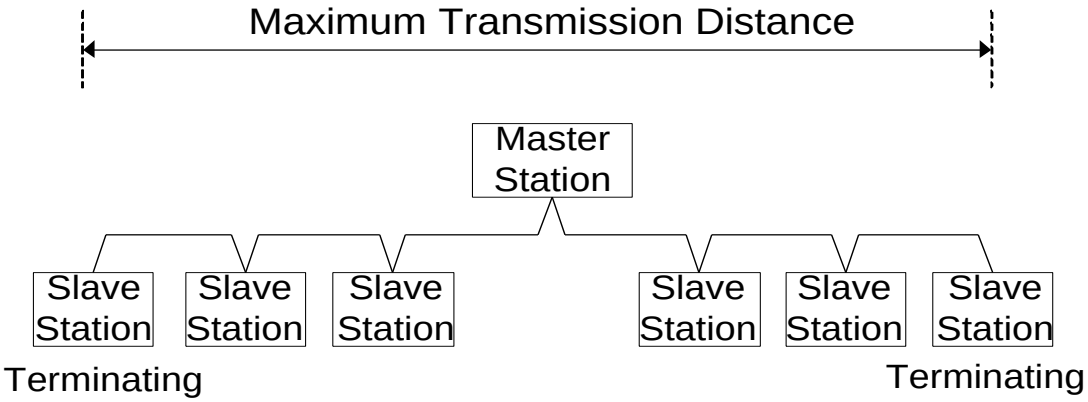
note1) PVF EV-AMESB recommended

note2) Measuring Method of Characteristic Impedance

- Cable Length: 100m or more

Measuring method is not designated, but Open/Short method has to measure the characteristic impedance in range within each specified frequency by approximate value which is measured value.

<Maximum Transmission Distance>



Baudrate	156kbps	625kbps	2.5Mbps	5Mbps	10Mbps
Cable Length between Stations	20m or more				
Max. Transmission Distance	1200m	900m	400m	160m	100m

Maximum Time-Delay for CC-Link Communication

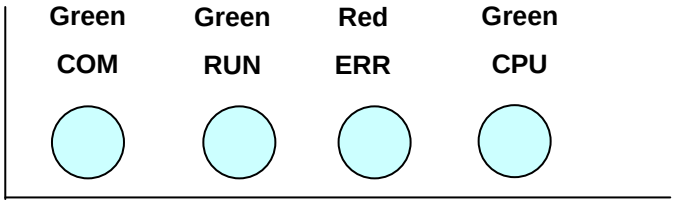
The table below contains the maximum time-delays for each profile that are available with the CC-Link communication option card. The time-delay is the time taken to process data and return it to the master PLC.

When the master PLC communication cycle time is less (shorter) than the maximum time-delay, accurate communication from the CC-Link cannot be guaranteed. To guarantee communication accuracy, the master PLC's communication cycle time must be more (longer) than the maximum time-delay.

Mode	Maximum Time-delay for CC-Link Communication
Profile1	80 msec
Profile2	15 msec

5. LED Display

3 green LEDs and 1 red LED on the CC-Link communication board displays the status of CC-Link communication board. LED is organized as following.



LED Name	Color	Function
COM	Green	**On** – Communication transmitting/receiving. **Off** – Communication transmitting/receiving is not established. Check if the communication cable is connected correctly.
RUN	Green	**On** – Station ID and Baud Rate is normally set and Refresh data is received normally. **Off** – CC-Link communication is not established. Check if COM-09(Station ID) and COM-10(Baud rate) is set correctly.
ERR	Red	**On** – CRC Error **Off** – Normal State
CPU	Green	**Flickering at the 1 second interval** – It means that CC-Link communication board is energized and the status is normal. **Off** – It means that CC-Link communication board is de-energized or CC-Link communication board has a fault.
		Flickering at the 200m second interval – It means that the changed value of Station ID and Baudrate is not saved successfully in internal memory of CPU.
		Flickering at the 2 second interval – It means that the interface communication between CC-Link communication board and inverter has an error.

6. Trouble Shooting

LED Display				Cause	Countermeasure
COM	RUN	ERR	CPU		
OFF	OFF	OFF	OFF	Power supply is not energized.	Check if the communication board is installed on the inverter. Check if the inverter is turned On.
-	-	-	Flickering with 200m cycle	Abnormal saving in internal memory	Check if communication cable and power supply cable is separated. After the power of inverter is turned Off, and then energize the power of inverter.
-	-	-	Flickering with 2 s	Abnormal Interface communication between communication board and inverter	Check if communication cable and power supply cable is separated. After the power of inverter is turned Off, and then energize the power of inverter.
OFF	OFF	-	Flickering with 1 s	Communication is not established.	Check if communication cable is connected correctly.
-	OFF	-	Flickering with 1 s	The value of StationID and Baudrate is not correct.	Set the value of Station ID and Baudrate correctly, and then do Comm Update.
-	ON	Flickering	Flickering with 1 s	After Communication board is turned On, the value of Station ID and Baudrate is changed.	Change the value of Station ID and Baudrate to the previous value or Do Comm Update to apply the changed value of Station ID and Baudrate.
ON	ON	Flickering	Flickering with 1 s	CRC Error Occurrence	CRC error is occurred by influenced of noise. Check if communication cable and power supply cable is separated.

7. Quick Communication Start

Install the CC-Link communication board while inverter power supply is turned off. After inverter power supply turns on, check if CNF-30 parameter is ‘CC-Link’. Connect to the network with communication cable via CC-Link communication board.

(1) Set the Station ID of inverter at parameter COM-7 FBus ID.

(2) Set Baudrate at COM-10 Opt .

(3) Set to ‘Yes’ at COM-94 Comm Update.

Check if RUN LED of CC-Link Communication board is turned On. If not, Check if the parameter value of COM-7 and COM-1 of Keypad is correct.

8. Keypad Parameter related with CC-Link Communication

Code	Parameter Name	Initial Value	Range
CNF-30	Option-1 Type	-	-
DRV-06	Cmd Source	Fx/Rx-1	Keypad Fx/Rx-1 Fx/Rx-2 Int. 485 FieldBus PLC
DRV-07	Freq Ref Src	Keypad-1	Keypad-1 Keypad-2 V1 I1 V2 I2 Int. 485 Encoder FieldBus PLC
PRT-12	Lost Cmd Mode	None	None FreeRun Dec Hold Input Hold Output Lost Preset
PRT-13	Lost Cmd Time	1.0sec	0.1~120.0sec
PRT-14	Lost Preset F	0.00Hz	0.00~400.00Hz
COM-06	FBus S/W Ver	-	-
COM-07	FBus ID	1	0~64
COM-09	FBus LED	-	-

Code	Parameter Name	Initial Value	Range
COM-10	Opt Parameter1	0	0 (156k) 1 (625k) 2 (2.5M) 3 (5M) 4 (10M)
COM-31 ~COM-38	Para Status-1 ~ Para Status-8	-	0x0000 ~ 0xFFFF
COM-51 ~COM-58	Para Control-1 ~ Para Control-8	-	0x0000 ~ 0xFFFF
COM-94	Comm Update	No	No Yes

(1) Option-1 Type (CNF-30)

✓ It displays the name of communication board installed on the inverter.

✓ It displays 'CC-Link' when CC-Link communication board is installed correctly and there is no fault.

(2) Cmd Source (DRV-06)

✓ It sets the run command source of inverter

✓ The parameter sets to 'Fieldbus' when it commands Run/Stop operation to inverter by CC-Link communication.

(3) Freq Ref Src (DRV-07)

✓ It sets the frequency command source of inverter.

The parameter sets to 'Fieldbus' when it commands Command frequency by CC-Link communication.

(4) Lost Cmd Mode (PRT-12)

✓ It designates the Run mode when Lost Command is occurred during the time of PRT-13 Lost Cmd Time.

None: It does anything when Lost Command is occurred.

FreeRun: After the status of inverter is changed to Lost Command, motor will free-run to stop and Trip will be occurred.

Dec: After the status of inverter is changed to Lost Command, motor will decelerate to stop and Lost Command Stop will be occurred.

Hold Input: Running with the last Run command and Lost Command Warning will be occurred.

Hold Output: Running with the current run speed and Lost Command Warning will be occurred.

Lost Preset: Running with the preset value of PRT-14 and Lost Command Warning will be occurred.

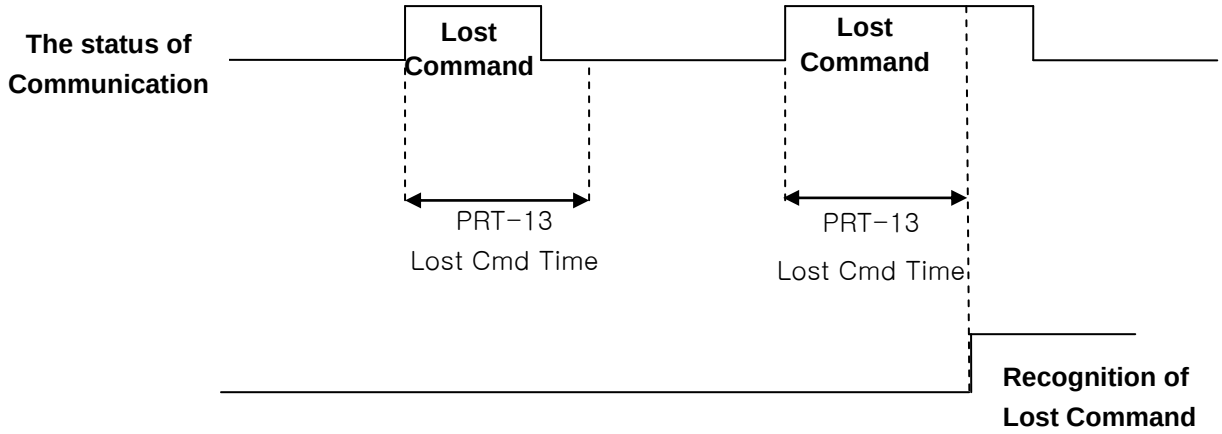
(5) Lost Preset F (PRT-14) – Lost Preset Frequency

✓ When PRT-12 Lost Cmd Mode is set to Lost Preset, inverter will operate with the frequency which is set in Lost Preset F at Lost Preset Frequency occurred.

(6) Lost Cmd Time (PRT-13) – Decision time of Lost Preset Frequency

✓ If Preset Frequency is lost for the preset time of PRT-13 Lost Cmd Time, it is recognized to Lost Preset Frequency.

✓ If the communication is restored within the time of PRT-13 Lost Cmd Time, it is not recognized to error.



(7) FBus S/W Ver (COM-06)

✓ It displays the version of communication board installed on the inverter.

(8) FBus ID (COM-07) – Station Number setting

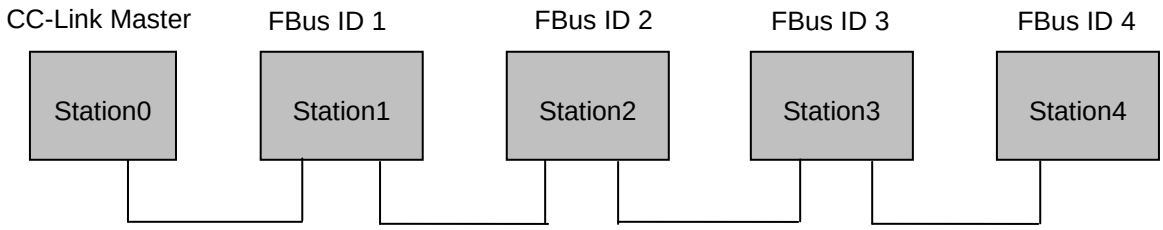
✓ It sets the Station ID of CC-Link. It can set Station Number from 0 to 64.

✓ Station ID can not be duplicated. Check if Station ID is not duplicated.

✓ The value of Station ID will be applied to CC-Link option board after Comm Update sets to 'YES'.

★★★Caution

Example of network connection)



✓ Same station numbers can not be used more than once in a network.

✓ Set the station number sequentially in order of connection. (Do not create a dead station as station 1, station 2, and station 4.)

(9) FBus LED (COM-09) – LED display for On/Off

✓ It displays the status information of CC-Link communication.

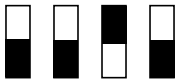
✓ It displays 4 LEDs at COM-0 FBus LED.

✓ LED status is displayed at COM-9 FBus LED parameter by keypad. 3 LEDs among 4 LEDs displayed indicates the status of CC-Link communication option board. It displays the information about CPU status, Inverter Interface disconnection and failure of saving the Station ID and Baud Rate to EEPROM in order of from right to left.

Bit	Description	Status	Causes of Status
0	CPU LED	Flicker	Normal communication
1	ERR LED	On or Flicker	Fault has occurred.
2	RUN LED	On	Communication is established.

3	COM LED	On	Data is transmitting and receiving.

Example of COM-09 LED status)



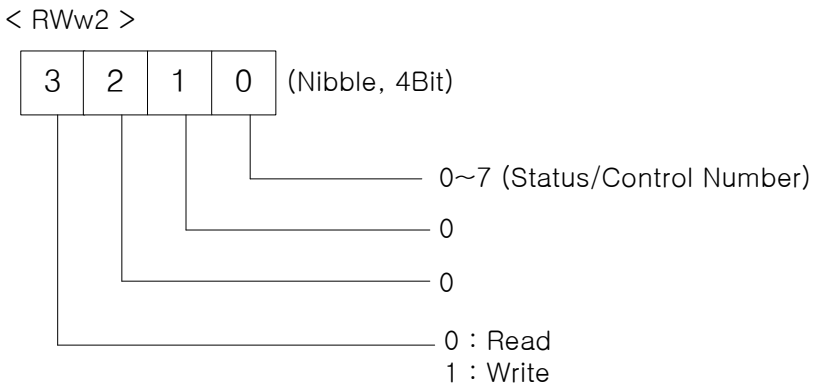
COM LED	RUN LED	ERR LED	CPU LED
OFF	OFF	ON	OFF

(10) Opt Parameter1 (COM-10) – Baud Rate setting

- ✓ It sets the parameter of Baudrate of CC-Link communication. It can be set from 0 (156 Kbps) to 4 (10 Mbps).
- ✓ The value of Baudrate will be applied to CC-Link option board after Comm Update sets to 'YES'.

(11) Para Status-1~8 (COM-31~38)

- ✓ It sets the inverter address to read in Para Status 1~8 when read operation of command code RWw2 of remote register is executed.
- ✓ It describes the method to read the Para Status 1~8 with command code RWw2.
- ✓ Input of the value of RWw2 is described as shown in the figure below. To access to Status, the value of Nibble 3, Nibble 2 and Nibble 1 must be 0.
- ✓ Nibble 0 determines which value of status will be read among Para Status 1~8. If the value of Nibble 0 is 0, it is Para Status-1. If the value of Nibble 0 is 1, it is Para Status-2.
- ✓ For example, If RWw2 sets to 0x0003, the saved value in address which is set in Para Status-4 will be read.



(12) Para Control1~8 (COM-51~58)

- ✓ It sets the inverter address to write in Para Control 1~8 when write operation of command code RWw2 of remote register is executed.
- ✓ It describes the method to write the Para Control 1~8 with command code RWw2.
- ✓ The value of Nibble 3 must be 1 (Write) to write Control.
- ✓ The value of Nibble 2 and 1 must be 0.
- ✓ Nibble 0 determines which value of status will be written among Para Control 1~8. If the value of Nibble 0 is 0, it is Para Control-1. If the value of Nibble 0 is 1, it is Para Control-2.
- ✓ For example, If RWw2 sets to 0x1004, the saved value in address RWw3 which is set in Para Status-5 will be written.

(13) Comm Update (COM-94)

- ✓ The value of COM-07 FBus ID and COM-10 Opt Parameter 1 will be applied to CC-Link option board after Comm Update sets to ‘YES’.
- ✓ The changed Station ID and communication speed will be applied to CC-Link option board after Comm Update sets to ‘YES’.

9. CC-Link Data List

Inverter occupies the buffer memory 1 station of master.

It means the input/output data information between master and inverter.

9.1 Details of Remote Input and Output Signals

Remote Output Signals (Master unit to Inverter)		Remote Input Signals (Inverter to Master unit)	
Device No.	**Signal Function**	**Device No.**	**Signal Function**
RY0	Forward running command	**RX0**	Forward running
RY1	Reverse running command	**RX1**	Reverse running
RY2~8	N/A	**RX2**	Accelerating
		RX3	Decelerating
		RX4	Reach to preset speed
		RX5	DC Braking
		RX6	N/A
		RX7	Relay1 output terminal
		RX8	Relay2 output terminal
RY9	Output stop	**RX9**	Q1 output terminal
RYA~B	N/A	**RXA**	N/A
		RXB	N/A
RYC	Monitor command	**RXC**	Monitoring
RYD	Frequency setting command 1 (RAM)	**RXD**	Frequency setting completion 1 (RAM)
RYE	Frequency setting command 2 (EEPROM)	**RXE**	Frequency setting completion 2
RYF	Instruction code execution request	**RXF**	Instruction code execution completion (EEPROM)
RY10~19	N/A	**RX10~19**	N/A
RY1A	Error reset request flag	**RX1A**	Error status flag
RY1B	N/A	**RX1B**	Available status to run
RY1C~1F	System reservation	**RX1C~1F**	System reservation

9.2 Remote output

Remote Output Signals (Master to Inverter)		
Device No.	**Signal Function**	**Description**
RY0	Forward running command	ON Forward running start OFF Stop command
RY1	Reverse running command	ON Reverse running start OFF Stop command
RY2~8	N/A	-
RY9	Interrupting of inverter output	When it turns On, motor free-run to stop.
RYA~B	N/A	-
RYC	Monitor command	When monitor command (RYC) is switched On, the corresponding monitor value to RWw1 is saved in RWr1. RXC (Monitoring) switches On.
RYD	Frequency setting command 1 (RAM)	When frequency setting command 1 (RYD) is switched On, command frequency (RWw1) is written to RAM of the inverter. Frequency setting completion 1 (RXD) is turned On after completion of write.
RYE	Frequency setting command 2 (RAM, EEPROM)	When the frequency setting command (RYE) is switched on, the set frequency (RWw1) is written to RAM and EEPROM of the inverter. On completion of write, frequency setting completion (RXD) switches on. The set frequency is remained even if power of inverter is switched On/Off.
RYF	Request for command code execution	It requests the execution of the command code (RWw2). In case command code is Write request, the value of RWw3 is valid.
RY10~19	N/A	-
RY1A	Inverter Reset	If an inverter has a fault, RY1A is switched On. It makes that the inverter is reset to remove the trip after removing the cause of the fault.
RY1B	N/A	-
RY1C~1F	System reservation	-

9.3 Remote Input

Remote Input Signals (Inverter to Master)		
Device No.	**Signal Function**	**Description**
RX0	Forward running command	ON Forward running OFF Other than forward running (during stop or reverse running)
RX1	Reverse running command	ON Reverse running OFF Other than reverse running (during stop or forward running)
RX2	Accelerating	Accelerating when it is turned On
RX3	Decelerating	Decelerating when it is turned On
RX4	Reach to preset speed	Reach to preset speed when it is turned On
RX5	N/A	-
RX6	N/A	-
RX7	Relay1 output terminal	Terminal output when it is turned On
RX8	Relay2 output terminal	Terminal output when it is turned On
RX9	Q1 output terminal	Terminal output when it is turned On
RXA	N/A	-
RXB	N/A	-
RXC	Monitoring	Switched On when monitor data is updating. When the monitor command (RYC) is switched On, the monitor value (RWw0) is set to RWr0 and monitoring (RXC) switches On. Switched Off (RXC) when the monitor command (RYC) is switched Off.
RXD	Frequency setting completion 1 (RAM)	Switched On (RXD) when the set frequency is written to the inverter by frequency setting switching On (RYD).
RXE	Frequency setting completion 2	Switched On (RXE) when frequency command is written to the inverter by Frequency setting

Remote Input Signals (Inverter to Master)		
Device No.	**Signal Function**	**Description**
	(EEPROM)	command 2 (RYE) switching ON.
RXF	Instruction code execution completion	When the instruction code execution request (RYF) is switched on, processing corresponding to the instruction code set to RWw2is executed. The instruction code execution completion (RXF) is switched On after completion of execution of instruction code. When an instruction code execution error occurs, a value other than ‘0' is set in the reply code (RWr2).
RX10~19	N/A	-
RX1A	Trip status	It turns On when the trip of inverter has occurred.
RX1B	Available status to run	It turns On when the inverter can be available. It means that the inverter power is supplied stably and there is no fault.
RX1C~1F	System reservation	-

9.4 Remote Register

(Master to Inverter)

Remote Register	Name	Description	Request for Execution
RWw0	**Monitor code**	Set the monitor code to be referenced. By switching On the monitor command flag (RYC), the corresponding to monitored data is written set to RWr0 and Monitoring (RXC) switches On.	RYC
RWw1	**Set frequency (0.01 Hz Scale)**	Specify the set frequency. At this time, when Frequency setting command 1 (RYD) is switched On, it is stored in RAM of the inverter. When Frequency setting command 2 (RYE) is switched On, it is stored in EEPROM that it can save the set frequency even if power is switched Off and then On. To command the frequency through communication, Ref Freq Src of DRV-07 must be set to 'Fieldbus'.	RYD RYE
RWw2	**Command code**	Set the command code for execution of read/ write/ error history/ error reset, etc. of parameter. The corresponding process to command code (RWw2) is executed by switching On command code execution request flag (RYF) after completion of command code (RWw2) setting. Command code execution completion flag (RXF) switches On after completion of command execution. When command code is Write, the data of Write set in RWw3.	RYF
RWw3	**Write data**	Command code execution request flag (RYF) switches On after setting of Write data and command code.	

(Inverter to Master)

Remote register	Name	Description	Request for execution
RWr0	**Monitor data**	Monitor value specified to the upper Byte of RWw0 of monitor code is set in RWr0 and Monitoring (RXC) switches On.	RYC
RWr1	**Output frequency**	-	RYD RYE
RWr2	**Reply code**	When Command code (RWw2) and Write data (RWw3) is normal, 0x00 is set in reply code (RWr2). If not, the value from 0x01 to 0x03 is set in replay code.	RYF
RWr3	**Read data**	When command code (RWw2) is Read, the corresponding read data is set.	

9.5 Monitor code

Instance ID	Object Name		Unit
	Upper 1Byte	Lower 1Byte	
0x00	Not monitor		0.01 Hz
0x01	Output frequency		0.01 Hz
0x02	Output current		0.01 A
0x03	Output voltage		1V
0x04	N/A		
0x05	Preset frequency		0.01Hz
0x06	Run speed		1 rpm
0x07	Motor output torque		0.1%
0x08	DC Link voltage		1 V
0x09~0x0D	N/A		
0x0E	Output electric power		0.1kW
0x0F	Status of input terminal		Note1)
0x10	Status of output terminal		Note2)
0x11~0x15	N/A		
0x16	Run status of inverter		Note3)
0x17	Run time of inverter		Hour

Note1) Bit information of input terminal

RWr3

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
–	–	–	–	–	P11	P10	P9	P8	P7	P6	P5	P4	P3	P2	P1

When status of each input terminal is turned On, the value is 1.

When status of each input terminal is turned Off, the value is 0.

Note2) Bit information of output terminal

RWr3

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
–	–	–	–	–	–	–	–	–	–	Q4	Q3	Q2	Q1	R2	R1

When status of each output terminal is turned On, the value is 1.
When status of each output terminal is turned Off, the value is 0.
R1 means Relay1 and R2 means Relay2.

Note3) Bit information of inverter run status

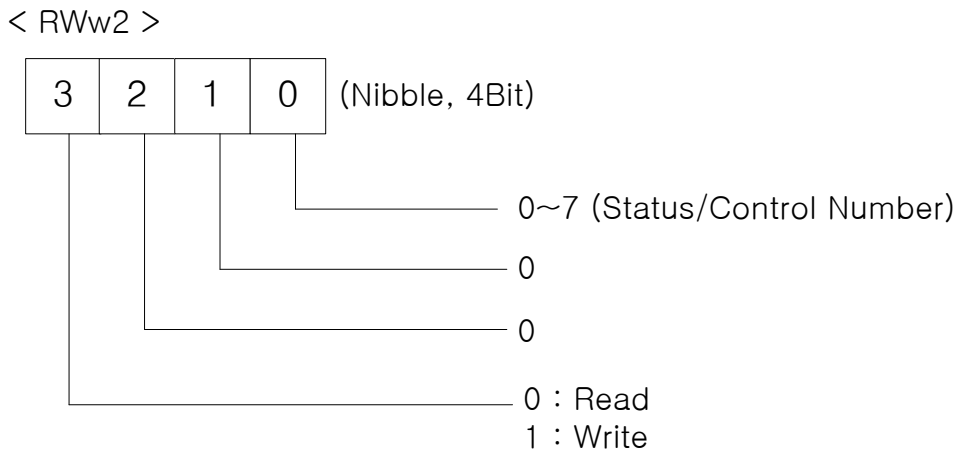
B15	0 : Normal status
B14	4 : Warning occurrence
B13	8 : Fault occurrence
B12	(It operates according to the value of PRT-30 Trip Out Mode.)
B11	-
B10	
B9	
B8	
B7	1 : Speed Searching 2 : Accelerating
B6	3 : Constant speed 4 : Decelerating
B5	5 : Deceleration to stop 6 : H/W OCS
B4	7 : S/W OCS 8 : Dwell operation
B3	0 : Stop
B2	1 : Forward running
B1	2 : Reverse running
B0	3 : DC operation (Zero speed control)

9.6 Command Codes

(1) Profile 1 Command Code

The diagram below shows the command code information when COM-11 Opt Parameter2 is set to 0 (Profile1).

Set the command code to the remote register. The command code is read, the relevant operation runs, and the resulting value is saved at the remote register RWw.



Inverter command codes are in two categories: read and write.

To run read commands, assign values between 0x0000–0x0007 to RWw2. The inverter data located at the addresses specified in COM 31-38 Para Status1- 8 are read.

To run write commands, assign values between 0x1000 -0x1007 to RWw2. The value stored at RWw3 will be written to the inverter addresses specified in COM 51-58 Para Control1–8.

(2) Profile 2 Command Code

Inverter command codes are in two categories: read and write.

To run read commands assign the inverter communication address to RWw2.

To run write commands, set the most significant bit (MSB) of the inverter communication address, and assign it to RWw2. Then, input the data to be written at RWw3.

For example, to read the value set for DRV-03 Acc Time through a command code, input 0x1103 at RWw2. Then, to set DRV-03 Acc Time to 50.0 seconds using a command code, input 0x9103 (the MSB is set) at RWw2, and then input 500 at RWw3.

9.7 Error Codes

The table below lists the error codes that are set response of monitoring and command codes to RWr2.

Error code	Description	Cause of error
0x00	Normal	A command code received from the master PLC has been correctly executed.
0x01	Write mode error	An unapproved value was written in the monitor code (RWw0) or in the command code (RWw2) register.
0x02	Invalid command error	Invalid address input at COM 31-37, Status1-8 or COM 51-58, Control1-8.
0x03	Write data range error	Write values outside of the approved range were used.
0x04	Write-protected area error	An attempt to write to a write-protected area was made.

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