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1. Overview

The DEV drive supports RS232/RS485 and CANOpen communication to config the drive or control the motor.
This manual is for RS232/RS485 protocol only. For CANopen please reference to DEV CANOpen manual.
The DEV supports three types of protocol:

1. Standard Modbus: Standard Modbus: Read(03), Write(06), Multiple write(16).
2. Multi-drive(Encoder only): Customized protocol based on the standard Modbus for position/speed control up to 4 motors (2 DEV drives) in one command message to have a better synchronization among the controlled motors for AGV or AMR applications.
3. Multi-drive lite: Customized protocol based on the standard Modbus for speed control up to 4 motors (2 DEV drives) in one command message to have a better synchronization among the controlled motors for AGV or AMR applications.

The drive parameter setting is required to use Multi-drive or Multi-drive lite protocol.
Standard Modbus protocol can be used in any operation mode (includes Multi-drive and Multi-drive lite mode).

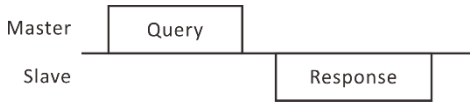
NOTE When using Multi-drive/Multi-drive lit, The ID of channel 2 motor (M2) is the channel 1 motor (M1) ID +1.

2. Standard Modbus communication mode

Modbus protocol communication is based on the single-master / multi-slave method. Messages are sent in one of two method below:

Unicast mode

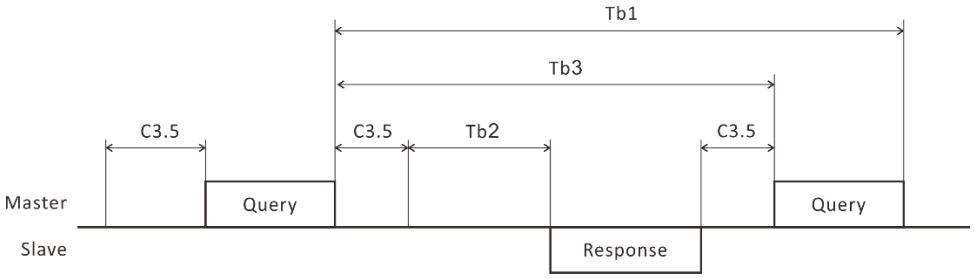
The master sends a query to only one slave.
The slave processes the request then returns a response.



Broadcast mode

The master can send a query to all the slaves with slave ID as 0 in the message.
Each slave processes the request but does not return a response.

Communication Timing



Character	Name	Description
Tb1	Timeout duration	If the slave does not receive any query over the interval set by the parameter 05-17, a timeout error is generated (default = no timeout monitor).
Tb2	Transmission waiting time	The time after the slave switches its communication line to the transmission mode upon receiving a query from the master. It is about 3 ~ 3ms. In Modbus RTU, the actual transmission waiting time is the C3.5 + processing time + Tb2.
Tb3	Broadcasting interval	The minimum interval between the broadcasting query and the next query. A time equal to or longer than the silent interval (C3.5) plus 5ms is required.
C3.5	Silent interval	The interval between queries. If this time is less than 3.5 characters long, the drive may not respond. The silent interval should be 1.75ms when the baud rate is over 19200 bps. **NOTE** Silent interval can be set by parameter 09-21 to make it shorter than the standard Modbus protocol to a minimum of 0.5ms.

2.1 Query message

Query message structure

ID	FC	Data	CRC
8 bits	8 bits	N x 8 bits	16 bits

ID (Slave ID)

Specify the slave address in unicast mode.
If the slave ID is set to o, the master sends a query to all slaves (broadcast mode).

FC (Function Code)

The drive supports following Modbus function code:

FC (Function Code)	Description	Broadcast
03h	Read from holding registers (1 to 16).	No
06h	Write to a holding register.	Yes
10h (16)	Write to multiple holding registers (1 to 16).	Yes

Data

Set data associated with the function code. The data length varies depending on the function code.

CRC (Error Check)

The error check is based on the CRC-16 method. If the calculated CRC-16 value matches the error check in the message, the slave determines that the message is normal.
CRC-16 calculation method

1. Calculate an XOR value with FFFFh and the first byte of the message (Slave ID).
2. Shift the result of step 1 by 1 bit to the right (fill zero to the left).
3. If the result of step 2 is not zero, calculate an XOR with the result and A001h.
4. Repeat step 2 ~ 3 for all the 8-bits of the byte.
5. Repeat step 2 to 4 for all byes. Switch the high byte and low byte of the result to put into the message.

2.2 Response message format

There are three types of slave responses: Normal response, no response, exception response.
The response message structure is the same as the query message.

ID	FC	Data	CRC
8 bits	8 bits	N x 8 bits	16 bits

2.2.1 Normal response

The slave processes the received query from the master then returns a response.

2.2.2 No response

The slave may not return a response to the query sent by the master.
The cause of the no response as follows:

Transmission error

Cause of transmission error	Description
Framing error	Stop bit is not the same as the setting of the drive.
Parity error	Parity is not the same as the setting of the drive.
Mismatched CRC	The calculated value of CRC-16 was found not matching the error check value in the message.
Invalid message length	The message length is over the limitation.

Other than transmission error

Cause	Description
Broadcast	If the query was broadcast (ID=0), the slave executes the request but does not return a response.
Mismatched slave ID (address)	The slave ID in the query is not the same as the setting of the drive.

2.2.3 Exception response

When the slave cannot execute the request of the query properly, it returns an exception response with the exception code indicating why the request cannot be executed properly. The exception response format is:

ID	FC + 80h	EC (exception code)	CRC
8 bits	8 bits	8 bits	16 bits

The function code in the exception response is the sum of query function code and 80h. For example: Query function code 03h → Exception function code: 83h

EC(例外碼)

顯示無法處理的原因。

EC	COMM Error Code	Cause	Description
01h	88h	Invalid function	The function code is not supported.
02h		Invalid register address	The register address is out of range,
033	8Ch	Invalid data	The data or data length is out of range. The number of requested registers is over 16 in the query.
04h	85h 8Ch 8Dj	Slave error	The slave cannot execute the request because one of the following status: Timeout (85h) Parameter setting out of range (8Ch) The command cannot be executed during the motor running status (8Dh).

Example of exception response

Master		
Slave ID		01h
Function Code		06h
Data	Register address (upper)	01h
	Register address (lower)	00h
	Data value (upper)	FFh
	Data value (lower)	FFh
CRC (lower)		89h
CRC (upper)		86h

Slave		
Slave ID		01h
Function Code		86h
Data	Exception code	04h
CRC (lower)		43h
CRC (upper)		A3h

2.3 Modbus function code

2.3.1 Read holding register (03h)

The function code to read holding registers. Up to 16 successive registers (16x16bits) can be read in one query.

Example

Read channel 1 motor (M1) operation data for speed of No.0 and No.1 in the EEP.

內容	Register (hex)	Data (hex)	Data (Decimal)
M1 digital speed No.0 (upper)	03h	0Bh	3000
M1 digital speed No.0 (lower)	00h	B8h	
M1 digital speed No.1 (upper)	03h	0Bh	3000
M1 digital speed No.1 (lower)	01h	B8h	

Query

Field name		Data	Description
Slave ID		01h	Slave ID = 1
Function Code		03h	Read holding registers
Data	Register address (upper)	03h	The register address to start reading from.
	Register address (lower)	08h	
	Data value (upper)	00h	The number of holding registers to read. (2 = 0002h)
	Data value (lower)	02h	
CRC (lower)		45h	Calculated CRC-16.
CRC (upper)		8Dh	

Response

Field name		Data	Description
Slave ID		01h	Same as query
Function Code		03h	Same as query
Data	Data byte count	04h	2 * the number of holding registers in the query.
	Value read from holding register address (upper)	0Bh	Value read from holding register address 0308h
	Value read from holding register address (lower)	B8h	
	Value read from holding register address+1 (upper)	0Bh	Value read from holding register address 0309h
	Value read from holding register address+1 (lower)	B8h	
CRC (lower)		7Fh	Calculated CRC-16.
CRC (upper)		70h	

2.3.2 Writing to a holding register (06h)

The function code to data to write to a holding register.

Example

Write operation data for speed No.0 to the RAM address.

Description	Register address (hex)	Data value (hex)	Decimal value
Digital speed No.0 RAM (upper)	3Fh	01h	300
Digital speed No.0 RAM (lower)	08h	2Ch	

Query

Field name		Data	Description
Slave ID		01h	Slave ID = 1
Function Code		06h	Writing to a holding register
Data	Register address (upper)	3Fh	The register address to be written.
	Register address (lower)	08h	
	Written data value (upper)	01h	Written value for the holding register.
	Written data value (lower)	2Ch	
CRC (lower)		04h	Calculated CRC-16.
CRC (upper)		51h	

Response

Field name		Data	Description
Slave ID		01h	Same as query
Function Code		06h	Same as query
Data	Register address (upper)	3Fh	Same as query
	Register address (lower)	08h	
	Written data value (upper)	01h	Same as query
	Written data value (lower)	2Ch	
CRC (lower)		04h	Calculated CRC-16.
CRC (upper)		51h	

2.3.3 Writing to multiple holding registers (10h)

The function code to write data to up to 16 successive holding registers.

Example

Write to the RAM of operation dara for speed No.0 to No.3 to the slave with ID set to 2.

Description	Register address (hex)	Data value (hex)	Decimal value
Digital speed No.0 RAM (upper)	3Fh	01h	300
Digital speed No.0 RAM (lower)	08h	2Ch	
Digital speed No.1 RAM (upper)	3Fh	02h	600
Digital speed No.1 RAM (lower)	09h	58h	
Digital speed No.2 RAM (upper)	3Fh	01h	300
Digital speed No.2 RAM (lower)	0Ah	2Ch	
Digital speed No.3 RAM (upper)	3Fh	02h	600
Digital speed No.3 RAM (lower)	0Bh	58h	

Query

Field name		Data	Description
Slave ID		02h	Slave ID = 2
Function Code		10h	Writing to holding registers
Data	Register address (upper)	3Fh	Register address to start writing from
	Register address (lower)	08h	
	Number of registers (upper)	00h	Number of registers to be written from the starting register address.
	Number of registers (lower)	04h	
	Daya byte count	08h	2 * the number of holding registers to write.
	Written value for holding register address (upper)	01h	Written value for holding register address 3F08h
	Written value for holding register address (lower)	2Ch	
	Written value for holding register address+1 (upper)	02h	Written value for holding register address 3F09h
	Written value for holding register address+1 (lower)	58h	
	Written value for holding register address+2 (upper)	01h	Written value for holding register address 3F0Ah
	Written value for holding register address+2 (lower)	2Ch	
	Written value for holding register address+3 (upper)	02h	Written value for holding register address 3F0Bh
	Written value for holding register address+3 (lower)	58h	
CRC (lower)		8Dh	Calculated CRC-16.
CRC (upper)		D5h	

Response

Field name		**Data**	**Description**
Slave ID		02h	Same as query
Function Code		10h	Same as query
Data	Register address (upper)	3Fh	Same as query
	Register address (lower)	08h	
	Number of registers (upper)	00h	Same as query
	Number of registers (lower)	04h	
CRC (lower)		4Ch	Calculated CRC-16.
CRC (upper)		2Fh	

3. Registers, operation data, and parameters

3.1 Operation commands

Registers for standard Modbus to control the motor. These registers are RAM only.

Register (Hex)	Name	Description	Read/Write
1400h	NET-IN (remote NET-IN)	A bit field that each bit can be assigned to an input function by parameter 09-01 ~ 09-15. The active logic state of each bit can be set by parameter 09-16. (1 as active by default). Set the bit to 1 to make the assigned input status to 1. Clear the bit to 0 to make the assigned input status to 0.	R/W

Register (hex)									
1400h	**Upper**	**Bit 15**	**Bit 14**	**Bit 13**	**Bit 12**	**Bit 11**	**Bit 10**	**Bit 9**	**Bit 8**
		NET-X15	NET-X14	NET-X13	NET-X12	NET-X11	NET-X10	NET-X9	NET-X8
	Lower	**Bit 7**	**Bit 6**	**Bit 5**	**Bit 4**	**Bit 3**	**Bit 2**	**Bit 1**	**Bit 0**
		NET-X7	NET-X6	NET-X5	NET-X4	NET-X3	NET-X2	NET-X1	NET-X0

3.2 Maintenance commands

Commands to reset alarm, clear alarm history and configure some parameters to be effective. Write a one to the register to process the maintenance commands.

Register(hex)	Command	Description	W/R
0A00h	Alarm reset	Resets the alarms that are present. Some alarms cannot be reset with this function but with recycling the power only.	R/W
0A22h	Clear the alarm history	Clear the alarm record.	R/W
0A26h	Clear the comm error history	Clear the communication error records.	R/W
0A27h	Configuration	Executes the parameter recalculation and make the setting to be effective.	R/W

3.3 Monitor commands

Commands to monitor operation data and the motor status. All the monitor commands are read only.
There are two types of monitor commands: dynamic data and monitor data.

3.3.1 Dynamic data

Dynamic data is for the A_HMI software to monitor the drive. Set the parameter 09-17 “Watch data page” to switch between different pages. Each page shows 16 data.
It is suggested to use monitor data instead for the communication control.

Register (hex)	ID	09-17 Setting	Field Name	Description	Range
0000h	01	0 to 3	M1 motor state	Channel 1 motor operation state.	0: STOP 2: RUN 3: EBRAKE 4: FREE 5: FAULT 6: WAIT/INHIBIT 7: MOVING(SERVO

					ON) 8: SLIGHT-POS-KEEPING 9: STO
0001h	02	0 to 2	Reserved	-	-
		3	M1 CMD Speed	Target speed of the channel 1 motor.	0 ~ 65535 r/min
0002h	03	0 to 3	M1 Speed	The current speed of channel 1 motor.	0 ~ 65535 r/min
0003h	04	0 to 3	M1 Alarm No.	The present alarm code of channel 1 motor.	Refer to “A1 -Protect and alarm code
0004h	05	0 to 3	M1 Direction	The current operation direction of channel 1 motor.	0: CW 1: CCW
0005h	06	0 to 2	M1 CMD Speed	Target speed of the channel 1 motor.	0 ~ 65535 r/min
		3	M1 Op. Data No.	The current operation data No. of channel 1 motor set by D0/D1. No. = D1*1 + D0	0 ~ 3
0006h	07	0 to 2	Reserved	-	-
		3	M1 Hall count	The count for hall signal edge change which increases 1 in CW operation and decreases 1 in CCW operation.	-32767 ~+32768 counts
0007h	08	0 to 3	M1 Output PWR	The current output power of channel 1 motor.	0 ~ 65535 W
0008h	09	0	Direct digital input status (Xn) low byte	Each digit as a digital input state (lower). Unit=X0, ten=X1, hundred=A0X, thousand=A1X, Ten thousand=XH0	0 = OFF 1 = ON
		1	Direct digital output status (Yn) low byte	Each digit as a digital output state (lower). Unit=Y0, ten=Y1, hundred=YH0, thousand=YH1, Ten thousand=YH2	0 = OFF 1 = ON
		2	Reserved	-	-
		3	Direct IO input status Bit	A binary bit field that each bit as an I/O state.Bit0=X0, Bit1=X1, Bit2=A0X, Bit3=A1X, Bit4=XH0, Bit5=XH1, Bit6=XH2, Bit7=XH3, Bit8=STO1, Bit9=STO2, Bit10~Bit15=Reserved.	0 = OFF 1 = ON
0009h	10	0/3	DC BUS Voltage	The current main power DC bus voltage.	0 ~ 65535 (0.01VDC)
		1	M1 ACC Time	Channel 1 motor acceleration time (from 0 to 3000RPM).	0 ~ 65535 (0.1sec)
		2	Reserved	-	-
000Ah	11	0	M1 Current	Channel 1 motor phase current.	0 ~ 65535 (0.01A)
		1	M1 DEC Time	Channel 1 motor deceleration time (from 3000 to 0 RPM).	0 ~ 65535 (0.1sec)
		2	M1 CMD POS(H)	The target position Index/Reg(H) of channel 1 motor.	0 ~ 65535
		3	M1 Avg Current	Channel 1 motor averaged phase current.	0 ~ 65535 (0.01A)
000Bh	12	0/3	M1 output %	Channel 1 motor output % +: The output torque and the motor operation direction are the same. -: The output torque and the motor operation direction are	-1000 ~ +1000 (0.1%)

				opposite.	
		1	Reserved	-	-
		2	M1 CMD POS(L)	The target position Pos/Reg(L) of channel 1 motor.	0 ~ 65535
000Ch	13	0	M1 Avg Current	Channel 1 motor averaged phase current.	0 ~ 65535 (0.01A)
		1	A0X input voltage	The current voltage of analog input A0X.	0 ~ 65535 (0.01V)
		2	Reserved	-	-
		3	M1 CMD pos(H)	The target position Index/Reg(H) of channel 1 motor.	0 ~ 65535
000Dh	14	0	M1 Tq limit	Channel 1 motor torque limit current setting.	0 ~ 65535 (0.01A)
		1	Reserved	-	-
		2	Reserved	-	-
		3	M1 CMD pos(L)	The target position Pos/Reg(L) of channel 1 motor.	0 ~ 65535
000Eh	15	0/1	Reserved	-	-
		2/3	M1 POS (H)	The position Index/Reg(H) of channel 1 motor.	0 ~ 65535
000Fh	16	0/1	Reserved	-	-
		2/3	M1 POS(L)	The position Pos/Reg(L) of channel 1 motor.	0 ~ 65535
0010h	17	0 to 3	M2 motor state	Channel 2 motor operation state.	0: STOP 2: RUN 3: EBRAKE 4: FREE 5: FAULT 6: WAIT/INHIBIT 7: MOVING(SERVO ON) 8: SLIGHT-POS-KEEPING 9: STO
0011h	18	0 to 2	Reserved	-	-
		3	M2 CMD Speed	Target speed of the channel 2 motor.	0 ~ 65535 r/min
0012h	19	0 to 3	M2 Speed	The current speed of channel 2 motor.	0 ~ 65535 r/min
0013h	20	0 to 3	M2 Alarm No.	The present alarm code of channel 2 motor.	Refer to “A1 -Protect and alarm code
0014h	21	0 to 3	M2 Direction	The current operation direction of channel 2 motor.	0: CW 1: CCW
0015h	22	0 to 2	M2 CMD Speed	Target speed of the channel 2 motor.	0 ~ 65535 r/min
		3	M2 Op. Data No.	The current operation data No. of channel 2 motor set by D0/D1. No. = D1*1 + D0	0 ~ 3
0016h	23	0 to 2	Reserved	-	-
		3	M2 Hall count	The count for hall signal edge change which increases 1 in CW	-32767 ~+32768

				operation and decreases 1 in CCW operation.	counts
0017h	24	0 to 3	M2 Output PWR	The current output power of channel 2 motor.	0 ~ 65535 W
0018h	25	0	Direct digital input status (Xn) high byte	Each digit as a digital input state (upper). Unit=XH1, ten=XH2, hundred=XH3, other bits=Reserved.	0 = OFF 1 = ON
		1	Direct digital output status (Yn) high byte	Each digit as a digital output state (upper). Unit=YH3, other bits=Reserved.	0 = OFF 1 = ON
		2	Reserved	-	-
		3	Direct IO output status Bit	A binary bit field that each bit as an output state. Bit0=Y0, Bit1=Y1, Bit2=YH0, Bit3=YH1, Bit4=YH2, Bit5=YH3, Bit6 ~Bit15=Reserved.	0 = OFF 1 = ON
0019h	26	0/3	DC BUS Voltage	The current main power DC bus voltage.	0 ~ 65535 (0.01VDC)
		1	M2 ACC Time	Channel 2 motor acceleration time (from 0 to 3000RPM).	0 ~ 65535 (0.1sec)
		2	Reserved	-	-
001Ah	27	0	M2 Current	Channel 2 motor phase current.	0 ~ 65535 (0.01A)
		1	M2 DEC Time	Channel 2 motor acceleration time (from 3000 to 0 RPM).	0 ~ 65535 (0.1sec)
		2	M2 CMD POS(H)	The target position Index/Reg(H) of channel 2 motor.	0 ~ 65535
		3	M2 Avg Current	Channel 2 motor averaged phase current.	0 ~ 65535 (0.01A)
001Bh	28	0/3	M2 output %	Channel 2 motor output % +: The output torque and the motor operation direction are the same. -: The output torque and the motor operation direction are opposite.	-1000 ~ +1000 (0.1%)
		1	Reserved	-	-
		2	M2 CMD POS(L)	The target position Pos/Reg(L) of channel 2 motor.	0 ~ 65535
001Ch	29	0	M2 Avg Current	Channel 2 motor averaged phase current.	0 ~ 65535 (0.01A)
		1	A1X input voltage	The current voltage of analog input A1X.	0 ~ 65535 (0.01V)
		2	Reserved	-	-
		3	M2 CMD pos(H)	The target position Index/Reg(H) of channel 2 motor.	0 ~ 65535
001Dh	30	0	M2 Tq limit	Channel 2 motor torque limit current setting.	0 ~ 65535 (0.01A)
		1	Reserved	-	-
		2	Reserved	-	-
		3	M2 CMD pos(L)	The target position Pos/Reg(L) of channel 2 motor.	0 ~ 65535
001Eh	31	0/1	Reserved	-	-
		2/3	M2 POS (H)	The position Index/Reg(H) of channel 2 motor.	0 ~ 65535

001Fh	32	0/1	Reserved	-	-
		2/3	M2 POS(L)	The position Pos/Reg(L) of channel 2 motor.	0 ~ 65535

3.3.2 Motor state description

No.	Motor State	Conditions (ParameterM1/M2)	Magnetic Brake Output*1
0	STOP	The stop state of the motor when in speed or duty control mode (01-11/01-27=0 or 1) and the slight-position-keeping is not in use (08-11= 0: free or 1: phase short). The input signal of operation is OFF (S/S, FWD, REV etc.).	Lock
2	RUN	Motor operation in CW or CCW when in speed or duty control mode.	Release
3	BRAKE	When EBRAKE (input or command) is ON, the drive shorts the phase of the motor to brake the motor. Priority lower than FREE, FAULT, and SERVO-OFF.	Release during motor decelerating. Lock after motor stops.
4	FREE	When FREE (input or command) is ON, the drive turns off all the output to the motor. Priority lower than FAULT and SERVO-OFF.	Release (closed circuit).
5	FAULT	When an alarm generates, the motor stops, and the state will be FAULT. There will be no output from the drive to the motor. Priority lower than SERVO-OFF.	Release when the FREE is ON otherwise it locks.
6	WAIT/INHIBIT (SERVO OFF)	The drive output is disabled when one of the follow conditions holds: SERVO-ON (input or command) is OFF when parameter 01-10/01-26 is 1 or 2 (Enable by SERVO-ON input). Main power (B+) is lower than the under-voltage protect value。	Release when 01-10/01-26 is 2. Release when 01-10/01-26 is 0 or 1 and FREE is ON
7	MOVING(SERVO ON)	The motor is in position control mode when 01-11/01-27 is 2 and SERVO-ON is ON. This is state is for encoder motor only.	Release.
9	SLIGHT-POS-KEEPING	The drive holds the motor position when it stops with a max of 50% rated torque when 01-15/01-13 is set to 2 (slight-position-keeping).	Release.
*1. Magnetic Brake Output: Release = closed circuit, Lock = open circuit.			

3.3.3 Monitor data

Register for users to monitor the operation data through communication (RS232/RS485).

Register	No.	Field name	Description	Range
4600h	1	M1 Motor State	Channel 1 motor operation state.	0: STOP 2: RUN 3: EBRAKE 4: FREE 5: FAULT 6: WAIT/INHIBIT 7: MOVING(SERVO ON) 8: SLIGHT-POS-KEEPING 9: STO
4061h	2	M1 Alarm No.	The present alarm code of channel 1 motor.	Refer to "**錯誤! 找不到參照來源。錯誤! 找不到參照來源。**"
4602h	3	M1 Op. Data No.	The current operation data No. of channel 1 motor set by D0/D1. No. = D1*1 + D0	0 ~ 3
4603h	4	M1 CMD Speed	Target speed of the channel 1 motor.	CCW ~ CW = -32767 ~ +32768 r/min 0 = Stop
4604h	5	M1 Speed	The current speed of channel 1 motor.	
4605h	6	Direct IO input status Bit	A binary bit field that each bit as an I/O state.Bit0=X0, Bit1=X2, Bit2=A0X, Bit3=A1X, Bit4=XH0, Bit5=XH1, Bit6=XH2, Bit7=XH3, Bit8=STO1, Bit9=STO2, Bit10~Bit15=Reserved.	0 = OFF 1 = ON
4606h	7	M1 Output PWR	The current output power of channel 1 motor.	0 ~ 65535 W
4607h	8	DC BUS Voltage	The current main power DC bus voltage.	0 ~ 65535 (0.01VDC)
4608h	9	M1 output %	Channel 1 motor output % +: The output torque and the motor operation direction are the same. -: The output torque and the motor operation direction are opposite.	-1000 ~ +1000 (0.1%)
4609h	10	M1 Avg Current	Channel 1 motor averaged phase current.	0 ~ 65535 (0.01A)
460Ah	11	M1 Tq limit	Channel 1 motor torque limit current setting.	0 ~ 65535 (0.01A)
460Bh	12	M1 ACC Time	Channel 1 motor acceleration time (from 0 to 3000RPM).	0 ~ 65535 (0.1sec)
460Ch	13	M1 DEC Time	Channel 1 motor deceleration time (from 3000 to 0 RPM).	0 ~ 65535 (0.1sec)
460Dh	14	A0X input voltage	The current voltage of analog input A0X.	0 ~ 65535 (0.01V)
460Eh	15	A1X input voltage	The current voltage of analog input A1X.	0 ~ 65535 (0.01V)
460Fh	16	XH0 Duty	The PWM duty when XH0 is PWM input.	0 ~ 1000 (0.1%)
4610h	17	XH0 Frequency	The pulse frequency when XH0 as pulse input.	0 ~ 65535 (Hz)
4611h	18	Direct IO output status Bit	A binary bit field that each bit as an output state. Bit0=Y0, Bit1=Y1, Bit2=YH0, Bit3=YH1, Bit4=YH2, Bit5=YH3, Bit6 ~Bit15=Reserved.	0 = OFF 1 = ON

4612h	19	M1 Hall count	The count for hall signal edge change which increases 1 in CW operation and decreases 1 in CCW operation.	-32768 ~+32767 counts
4613h	20	M1 CMD POS(H)	The target position Index/Reg(H) of channel 1 motor.	0 ~ 65535
4614h	21	M1 CMD POS(L)	The target position Pos/Reg(L) of channel 1 motor.	0 ~ 65535
4615h	22	M1 POS (H)	The position Index/Reg(H) of channel 1 motor.	0 ~ 65535
4616h	23	M1 POS(L)	The position Pos/Reg(L) of channel 1 motor.	0 ~ 65535
4617h	24	XH1 Duty	The PWM duty when XH1 is PWM input.	0 ~ 1000 (0.1%)
4618h	25	XH1 Frequency	The pulse frequency when XH1 as pulse input.	0 ~ 65535 (Hz)
4619h ~ 461Fh	26 ~ 32	Reserved	-	-
4A00h	1	M2 motor state	Channel 2 motor operation state.	0: STOP 2: RUN 3: EBRAKE 4: FREE 5: FAULT 6: WAIT/INHIBIT 7: MOVING(SERVO ON) 8: SLIGHT-POS-KEEPING 9: STO
4A61h	2	M2 Alarm No.	The present alarm code of channel 2 motor.	Refer to “A1 -Protect and alarm code
4A02h	3	M2 Op. Data No.	The current operation data No. of channel 2 motor set by D0/D1. No. = D1*1 + D0	0 ~ 3
4A03h	4	M2 CMD Speed	Target speed of the channel 2 motor.	CCW ~ CW = -32767 ~ +32768 r/min 0 = Stop
4A04h	5	M2 Speed	The current speed of channel 2 motor.	
4A05h	6	Direct IO input status Bit	A binary bit field that each bit as an I/O state.Bit0=X0, Bit1=X2, Bit2=A0X, Bit3=A1X, Bit4=XH0, Bit5=XH1, Bit6=XH2, Bit7=XH3, Bit8=STO1, Bit9=STO2, Bit10~Bit15=Reserved.	0 = OFF 1 = ON
4A06h	7	M2 Output PWR	The current output power of channel 2 motor.	0 ~ 65535 W
4A07h	8	DC BUS Voltage	The current main power DC bus voltage.	0 ~ 65535 (0.01VDC)
4A08h	9	M2 output %	Channel 2 motor output % +: The output torque and the motor operation direction are the same. -: The output torque and the motor operation direction are opposite.	-1000 ~ +1000 (0.1%)
4A09h	10	M2 Avg Current	Channel 2 motor averaged phase current.	0 ~ 65535 (0.01A)
4A0Ah	11	M2 Tq limit	Channel 2 motor torque limit current setting.	0 ~ 65535 (0.01A)
4A0Bh	12	M2 ACC Time	Channel 2 motor acceleration time (from 0 to 3000RPM).	0 ~ 65535 (0.1sec)

4A0Ch	13	M2 DEC Time	Channel 2 motor acceleration time (from 3000 to 0 RPM).	0 ~ 65535 (0.1sec)
4A0Dh	14	A0X input voltage	The current voltage of analog input A0X.	0 ~ 65535 (0.01V)
4A0Eh	15	A1X input voltage	The current voltage of analog input A1X.	0 ~ 65535 (0.01V)
4A0Fh	16	XH2 Duty	The PWM duty when XH2 is PWM input.	0 ~ 1000 (0.1%)
4A10h	17	XH2 Frequency	The pulse frequency when XH2 as pulse input.	0 ~ 65535 (Hz)
411h	18	Direct IO output status Bit	A binary bit field that each bit as an output state. Bit0=Y0, Bit1=Y1, Bit2=YH0, Bit3=YH1, Bit4=YH2, Bit5=YH3, Bit6 ~Bit15=Reserved.	0 = OFF 1 = ON
4612h	19	M2 Hall count	The count for hall signal edge change which increases 1 in CW operation and decreases 1 in CCW operation.	-32768 ~+32767 counts
4613h	20	M2 CMD POS(H)	The target position Index/Reg(H) of channel 2 motor.	0 ~ 65535
4614h	21	M2 CMD POS(L)	The target position Pos/Reg(L) of channel 2 motor.	0 ~ 65535
4615h	22	M2 POS (H)	The position Index/Reg(H) of channel 2 motor.	0 ~ 65535
4A616h	23	M2 POS(L)	The position Pos/Reg(L) of channel 2 motor.	0 ~ 65535
4A17h	24	XH3 Duty	The PWM duty when XH3 is PWM input.	0 ~ 1000 (0.1%)
4A18h	25	XH3 Frequency	The pulse frequency when XH3 as pulse input.	0 ~ 65535 (Hz)
4A19h ~ 4A1Fh	26 ~ 32	Reserved	-	-

3.3.4 Alarm history

Register		ID	Field name	Description	Range
M1	**M2**				
3300h	3310h	01	Alarm history 1	The most recent alarm code.	Refer to "**錯誤! 找不到參照來源。錯誤! 找不到參照來源。**"
3301h	3311h	02	Alarm history 2	Alarm history from the second recent to the oldest.	
3302h	3312h	03	Alarm history 3		
3303h	3313h	04	Alarm history 4		
3304h	3314h	05	Alarm history 5		
3305h	3315h	06	Alarm history 6		
3306h	3316h	07	Alarm history 7		
3307h	3317h	08	Alarm history 8		
3308h	3318h	09	Alarm history 9		
3309h	3319h	10	Alarm history 10		

3.3.5 COMM error history

The most recent 10 records of communication error code. COMM error history can be monitored by the A-HMI PC software in the "COM Error" page.
The COMM error records does not save in EEPROM. The record will be lost and reset after power off.

Register	ID	Field name	Description	Range
4800h	01	COMM Error history 1	The most recent COMM error code.	132(84h): Package format error or wrong check sum. 133(85h): Timeout. 136(88h): Invalid command (unsupported). 140(8Ch): Data out of range. 141(8Dh): Command execution denied (Some commands cannot be executed in some cases like motor in operation).
4801h	02	COMM Error history 2	COMM error history from the second recent to the oldest.	
4802h	03	COMM Error history 3		
4803h	04	COMM Error history 4		
4804h	05	COMM Error history 5		
4805h	06	COMM Error history 6		
4806h	07	COMM Error history 7		
4807h	08	COMM Error history 8		
4808h	09	COMM Error history 9		
4809h	10	COMM Error history 10		

3.4 Operation data and parameters

There are two register types for parameter and operation data, RAM and EEP address.
It takes 20msec for the EEP writing operation but less than 5msec to update the RAM data.
Please write to the RAM address for motor control and only use EEP address for parameter setting purpose.

The effective (Eff.) column indicates the timing for the data to become effective:
A: Effective immediately.
B: Effective after stopping the operation.
C: Effective after executing the configuration
D: Effective after turning the power ON again.

The mode column indicates which of the control mode is be affected by the parameter:
S: Speed mode
D: Duty mode
P: Position mode (encoder model only)

3.4.1 Operation data and Torque limit function

Operation data can be used to set the speed, output duty (duty mode only), torque limit current, acceleration, or deceleration for the motor operation.
Users can preset the operation data in EEP or set the RAM address through communication (RS232/RS485/CAN) during operation.
There are 4 data per operation data which can be selected by the operation data No. set by the D0, D1 (input or command) indexing.

ID	Field name	Register (hex)		Description	Range	Default	Effective
		EEP	RAM				
03-01 ~ 03-04	M1 Speed No.0 ~ M1 Speed No.3	0300h ~ 0303h	3F00h ~ 3F03h	Ch1 motor speed for digital indexing and position control.	60 ~ 10000 r/min	3000	A
03-05 ~ 03-08	M1 Duty No.0 ~ M1 Duty No.3	0304h ~ 0307h	3F04h ~ 3F07h	Ch1 motor output duty for digital indexing for duty mode.	0 ~ 1000 (1=0.01%)	100	A
03-09 ~ 03-12	M1 Tq Limit No.0 ~ M1 Tq Limit No.3	0308h ~ 030Bh	3F08h ~ 3F0Bh	Ch1 motor torque limit for digital indexing.	0 ~ 2000 (1=0.01%)	2000	A
04-01 ~ 04-04	M1 ACC Time No.0 ~ M1 ACC Time No.3	0400h ~ 0404h	4000h ~ 4004h	Ch1 motor acceleration time. Speed: 0 to 3000 RPM Duty: 0 to 100.0%	100 ~ 15000 (1=1ms)	1000	A
04-05 ~ 04-08	M1 DEC Time No.0 ~ M1 DEC Time No.3	0404h ~ 0407h	4004h ~ 4007h	Ch1 motor deceleration time. Speed: 3000 to 0 RPM Duty: 100.0 to 0%	100 ~ 15000 (1=1ms)	1000	A
03-17 ~ 03-20	M2 Speed No.0 ~ M2 Speed No.3	0310h ~ 0313h	3F10h ~ 3F13h	Ch2 motor speed for digital indexing and position control.	60 ~ 10000 r/min	3000	A
03-21 ~ 03-24	M2 Duty No.0 ~ M2 Duty No.3	0314h ~ 0317h	3F14h ~ 3F17h	Ch2 motor output duty for digital indexing for duty mode.	0 ~ 1000 (1=0.01%)	100	A
03-25 ~ 03-28	M2 Tq Limit No.0 ~ M2 Tq Limit No.3	0318h ~ 031Bh	3F18h ~ 3F1Bh	Ch2 motor torque limit for digital indexing.	0 ~ 2000 (1=0.01%)	2000	A
04-17 ~ 04-20	M2 ACC Time No.0 ~ M2 ACC Time No.3	0410h ~ 0413h	4010h ~ 4013h	Ch2 motor acceleration time. Speed: 0 to 3000 RPM Duty: 0 to 100.0%	100 ~ 15000 (1=1ms)	1000	A
04-25 ~ 04-28	M2 DEC Time No.0 ~ M2 DEC Time No.3	0418h ~ 041Bh	4018h ~ 401Bh	Ch2 motor deceleration time. Speed: 3000 to 0 RPM Duty: 100.0 to 0%	100 ~ 15000 (1=1ms)	1000	A

Torque limit function

ID	Field name	Register (hex)		Description	Def.	Eff.	Mode
		EEP	RAM				
03-13 03-29	M1 Torque Limit Alarm M2 Torque Limit Alarm	030Ch 031Ch	3F0Ch 3F1Ch	The alarm setting of torque limit function. * The setting is affected by parameter "05-15 Overload Protect" When 05-15 Bit1 is 0: 0: Continuous output (No alarm) 1 ~ 65535: Overload alarm activates when the output current > Tq limit value over the overboost time and motor stalled (speed 0) over this duration (Unit: ms). When 05-15 Bit1 is 1: 0: Overload alarm activates when the Tq limit activates. 1 ~ 65535: Overload alarm activates when the output current > Tq limit value over the duration of overboost time + this setting (Unit: ms).	3000	C	S/D/P
03-14 03-30	M1 Tq Limit Overboost Time M2 Tq Limit Overboost Time	030Dh 031Dh	3F0Dh 3F1Dh	Tq limit activates to decrease output current to the limited value when the output current is higher than Tq limit over this duration (Unit: 0.1 sec)	300	C	S/D/P
03-15 03-31	M1 Tq Limit Recovery Time M2 Tq Limit Recovery Time	030Eh 031Eh	3F0Eh 3F1Eh	Tq limit deactivates when the output current is lower than the limited value over this duration (Unit: 0.1 sec)	600	C	S/D/P

Advanced operation data

ID	Field name	Register (hex)		Description	Range	Default	Effective
		EEP	RAM				
04-09 ~ 04-12	M1 ACC Time Rate No.0 ~ M1 ACC Time Rate No.3	0408h ~ 040Bh	4008h ~ 400Bh	Ch1 motor acceleration change rate (time for acceleration change from 0 to the set value). (Ineffective in position mode).	1 ~ 15000 (1ms) 1 = not in use	1	A
04-13 ~ 04-16	M1 DEC Time Rate No.0 ~ M1 DEC Time Rate No.3	040Ch ~ 040Fh	400Ch ~ 400Fh	Ch1 motor deceleration change rate (time for deceleration change from 0 to the set value). (Ineffective in position mode).	1 ~ 15000 (1ms) 1 = not in use	1	A
04-21 ~ 04-24	M2 ACC Time Rate No.0 ~ M2 ACC Time Rate No.3	0414h ~ 0417h	4014h ~ 4017h	Ch2 motor acceleration change rate (time for acceleration change from 0 to the set value). (Ineffective in position mode).	1 ~ 15000 (1ms) 1 = not in use	1	A
04-29 ~ 04-32	M2 DEC Time Rate No.0 ~ M2 DEC Time Rate No.3	041Ch ~ 041Fh	401Ch ~ 401Fh	Ch2 motor deceleration change rate (time for deceleration change from 0 to the set value). (Ineffective in position mode).	1 ~ 15000 (1ms) 1 = not in use	1	A

3.4.2 Motor parameter

ID	Field name	Register (hex)		Description	Def.	Eff.	Mode
		EEP	RAM				
01-01 01-17	M1 Motor/Sensor type M2 Motor/Sensor type	0100h 0110h	3D00h 3D10h	Bit Field: Motor type(bit0,1): 0=BLDC, 1 =Brushed DC Sensor type(bit2,3,4): 0=default, 1=Hall sensor, 2=INC ENC, 3=Hall+ENC Brushed DC motor type can only support duty mode. Bit2,3,4 is for encoder feedback only.	0	D	S/D/P
01-02 01-18	M1 Hall sequence M2 Hall sequence	0101h 0111h	3D01h 3D11h	Hall u edge to the motor back emf. 0: B sequence (rising edge) 1: A sequence (falling edge)	1	D	S/D/P
01-03 01-19	M1 Motor poles M2 Motor poles	0102h 0112h	3D02h 3D12h	Number of rotor poles in 2/4/8/10	8	D	S/D/P
01-04 01-20	M1 No load full speed M2 No load full speed	0103h 0113h	3D03h 3D13h	Motor full speed when rated voltage is applied. 0 ~ 65535 r/min	4188	C	S
01-05 01-21	M1 CW definition M2 CW definition	0104h 0114h	3D04h 3D14h	0: view from motor shaft side 1: view from motor bottom side	0	C	S/D/P
01-06 01-22	M1 Encoder resolution M2 Encoder resolution	0105h 0115h	3D05h 3D15h	Pulse per revolution per channel. 0 ~ 65535 pulse per rev	2500	D	S/D/P
01-07 01-23	Reserved	0106h 0116h	3D06h 3D16h	Reserved	0	D	S/D/P
01-08 01-24	Reserved	0107h 0117h	3D07h 3D17h	Reserved	10	D	S/D/P
01-09 01-25	Reserved	0108h 0118h	3D08h 3D18h	Reserved	35	D	S/D/P
01-10 01-26	M1 Drive Enable M2 Drive Enable	0109h 0119h	3D09h 3D19h	The drive can only output to the motor after enabled. 0: Enable when power up. 1: Enable by SERVO-ON input. MBRAKE is controlled by FREE input. 2: Enable by SERVO-ON input. MBRAKE is released in SERVO-OFF state.	0	C	S/D/P
01-11 01-27	M1 Control mode M2 Control mode	010Ah 011Ah	3D0Ah 3D1Ah	0: Speed (closed-loop) 1: Duty (open-loop) 2: Position (Multi-drive)	0	C	S/D/P
01-12 01-28	M1 Duty/Speed control source M2 Duty/Speed control source	010Bh 011Bh	3D0Bh 3D1Bh	0: A1X/A2X (Analog input) 1: Digital (Parameter Indexing) 2: XH0 PFM(Pulse frequency) 3: XH0 PWM 4: Multi-Drive Lite	0	C	S/D
01-13 01-29	M1 Position control method M2 Position control method	010Ch 011Ch	3D0Ch 3D1Ch	0: Multi-CMD	0	C	P
01-14 01-30	M1 Action when input under threshold. M2 Action when input under threshold.	010Dh 011Dh	3D0Dh 3D1Ch	Operation when analog / pulse input is smaller than threshold: 0: stop 1: run with min speed	0	C	S/D

01-15 01-31	M1 Position keeping M2 Position keeping	010Eh 011Eh	3D0Eh 3D1Eh	Position keeping setting when stopped in speed/duty mode. 0: Free (position keeping disabled) 1: Servo-lock (encoder model) 1: short brake (hall model) 2: Slight-position-keeping (hall model)	1	C	S/D
01-16 01-32	M1 Encoder offset M2 Encoder offset	010Fh 011Fh	3D0Fh 3D1Fh	When using ENC+HALL type feedback. The phase angle between ENC and HALL in 0 ~ 360deg.	0	C	S/D/P

3.4.3 Operation and command parameter

ID	Field name	Register (hex)		Description	Def.	Eff.	Mode
		EEP	RAM				
02-01	Max speed	0200h	3E00h	Only effective when parameter 01-12/01-28 is 0,2 or 3. Speed upper limit when set by analog / pulse input. 100 ~ 10,000 r/min.	3000	C	S/D
02-02	Min speed	0201h	3E01h	Only effective when parameter 01-12/01-28 is 0,2 or 3. Speed lower limit when set by analog / pulse input. Encoder model: 1 ~ 10,000 r/min Hall model: 60 ~ 10,000 r/min	85	C	S/D
02-03	Analog ACC/DEC time max (Reserved)	0202h	3E02h	The max setting for ACC/DEC time set by analog input. Time in msec for 3000r/min or 100% duty change (Range 100 ~ 15,000 msec).	1000	C	S/D
02-04	Analog ACC/DEC time min (Reserved)	0203h	3E03h	The min setting for ACC/DEC time set by analog input. Time in msec for 3000r/min or 100% duty change (Range 100 ~ 15,000 msec).	1000	C	S/D
02-05	Analog torque limit max (Reserved)	0204h	3E04h	The max setting for torque limit set by analog input in 0.10%.	2000	C	S/D
02-06	Analog torque limit min (Reserved)	0205h	3E05h	The min setting for torque limit set by analog input in 0.10%.	100	C	S/D
02-07	Max duty	0206h	3E06h	Only effective when parameter 01-12/01-28 is 0,2 or 3. The max setting for output duty set by analog input in 0.10%.	1000	C	D
02-08	Min duty	0207h	3E07h	Only effective when parameter 01-12/01-28 is 0,2 or 3. The min setting for output duty set by analog input in 0.10%.	0	C	D
02-09	Analog input range	0208h	3E08h	0: 0~5V 1: 0~10V	0	C	S/D
02-10	External command signal gain	0209h	3E09h	Only effective when parameter 01-12/01-28 is 0,2 or 3. Analog input 0 ~ 10,000 r/min(100%) per V PFM input 0 ~ 10,000 r/min(100%) per 200Hz PWM input 0 ~ 10,000 r/min(100%) per 10%	708	C	S/D
02-11	External command signal threshold	020Ah	3E0Ah	Only effective when parameter 01-12/01-28 is 0,2 or 3. Analog/PFM/PWM threshold (unit: 0.01V / 2Hz / 0.1%).	10	C	S/D
02-12	External command signal threshold speed	020Bh	3E0Bh	Only effective when parameter 01-12/01-28 is 0,2 or 3. The speed setting of command at threshold value.	85	C	S/D

				(unit: r/min)			
02-13	Reserved	020Ch	3E0Ch	Reserved	0	-	-
02-14	Position data type	020Dh	3E0Dh	0: Index(turns) + pulse If 10,000 steps/r: -32,768 ~ +32,767 index, 0 ~ 10,000 steps 1: Step(upper) + Step(lower) If 10,000 PPR: -327,680,000 ~ +327,670,000 steps	0	C	S/D/P
02-15	Speed display data refresh rate	020Eh	3E0Eh	The update rate of motor speed register in dynamic data and monitor data (*does not affect control response). 0: 10Hz 1: 20Hz 2: 50Hz 3: 100Hz	0	C	S/D/P
02-16	Reserved	020Fh	3E0Fh	Reserved	0	-	-
02-17	Single / dual mode	0210h	3E10h	0: Drive two independent motor. One by each ch. 1: Drive a single motor with two channel in parallel (feedback signal to M1 connector).	0	D	S/D/P
02-18	Rated Output %	0211h	3E11h	Set the rated output ratio depends on the motor. 500 ~ 1000 (Unit:0.1%)	1000	D	S/D/P
02-19	PWM Freq	0212h	3E12h	The output PWM frequency. Do not change. Please contact our support if you need to change this parameter.	2	D	S/D/P
02-20 ~ 02-32	Reserved	0213h ~ 021Fh	3E13h ~ 3E1Fh	Reserved	-	-	-

3.4.4 Protect parameter

ID	Field name	Register (hex)		Description	Def.	Eff.	Mode
		EEP	RAM				
05-01	Reserved	0500h	4100h	Reserved	2	C	S/D/P
05-02	Initial operation error	0501h	4101h	Alarm when main power supply was cycled during START/STOP, FWD, REV input is ON. 0: initial operation error disabled 1: initial operation error enabled	0	C	S/D/P
05-03	Motor feedback signal alarm	0502h	4102h	Hall model: 0: disabled 1, 2: enabled Encoder model: 0,1: position overflow alarm enabled. 2: position overflow alarm disabled.	2	C	S/D/P
05-04	Over speed alarm	0503h	4103h	Generates an alarm when the motor speed is higher than this value. 0: disabled 1 ~ 10,000 r/min	4300	C	S/D/P
05-05 ~	Reserved	0504h ~	4104h ~	Reserved	-	-	-

05-06		0505h	4105h				
05-07	Encoder Alarm Detect	0506h	4106h	0: Disabled X: Generates an alarm when detects encoder signal error X times continuously	1	C	S/P/D
05-08 ~ 05-09	Reserved	0507h ~ 0508h	4107h ~ 4108h	Reserved	-	-	-
05-10	Over voltage	0509h	4109h	OVP alarm trigger voltage (should be set higher than over voltage recover). 1500 ~ 9000 (0.01V)	8500	C	S/D/P
05-11	Over voltage recover (RGN voltage)	050Ah	410Ah	Voltage for OVP alarm to be able to reset. (should be set lower than over voltage). 1500 ~ 9000 (0.01V) *The regenerative output is active when BUS voltage reaches this setting.	7300	C	S/D/P
05-12 ~ 05-14	Reserved	050Bh ~ 050Dh	410Bh ~ 410Dh	Reserved	-	-	-
05-15	Overload protect	050Eh	410Eh	Bitfield to set actions during over-current or torque limit. Bit0: Over-current protect action. 0: Foldback and continuous output (No alarm) 1: Alarm Bit1: torque limit protect action (action is related to parameter “03-13/03-29 torque limit alarm”) When 05-15 Bit1 is 0: 03-13/03-29 = 0: Continuous output (No alarm) 03-13/03-29 = 1 ~ 65535: Overload alarm activates when the output current > Tq limit value over the overboost time and motor stalled (speed 0) over this duration (Unit: ms). When 05-15 Bit1 is 1: 03-13/03-29 = 0: Overload alarm activates when the Tq limit activates. 03-13/03-29 = 1 ~ 65535: Overload alarm activates when the output current > Tq limit value over the duration of overboost time + this setting (Unit: ms).	0	C	S/D/P
05-16	Over power protect	050Fh	410Fh	0: Foldback and continuous output (No alarm) 1: Alarm	0	C	S/D/P
05-17	RS485 timeout	0510h	4110h	0: Disabled 1,000 = Alarm after timeout for 1000ms	0	C	S/D/P
05-18	RS485 alarm	0511h	4111h	Generates an alarm when the number of RS485 error is greater than this setting. 0: disabled 1 ~ 10: 1 ~ 10 times	0	C	S/D/P
05-19	RS232 timeout	0512h	4112h	0: Disabled 1,000 = Alarm after timeout for 1000ms	0	C	S/D/P
05-20	RS232 alarm	0513h	4113h	Generates an alarm when the number of RS232 error is greater than this setting. 0: disabled	0	C	S/D/P

				1 ~ 10: 1 ~ 10 times			
05-21	COMM error action	0514h	4114h	0: Alarm (motor stop) 1: Clear Net-IO 2: Alarm (motor stop) + clear Net-IO	0	C	S/D/P
05-22	RGN protect	0515h	4115h	0: disabled 1,000 = Generate an alarm when RGN activates for over 1,000ms. (Can only be reset by cycling the power)	2000	C	S/D/P
05-23 ~ 05-31	Reserved	0516h ~ 051Eh	4116h ~ 411Eh	Reserved	-	-	-
05-32	Channel Alarm Mode	051Fh	411Fh	0: M1 and M2 alarm independently 1: Both channel alarm when either one of the channels alarms (Error code is “15 EXT ERROR”)	0	C	S/D/P

3.4.5 I/O parameter

ID	Field name	Register (hex)		Description	Default	Eff.	Mode
		EEP	RAM				
06-01	Input X0 function	0600h	4200h	The function setup of direct inputs 0: NC (X0, X1) 0: A-IN (A0X, A1X) 0: PWM-IN (XH0~XH3) 1: START/STOP (FWD) 2: CCW/CW (REV) 5: FREE 6: STOP-MODE 7: EBRAKE/ALM-RST 8: ALM-RST 9: STOP-MODE2 10: D0 11: D1 13: EBRAKE 14: SERVO-EN 17: STOP 21: EXT-ERROR The functions above affect both channels. Function value + 100: affects channel M1 only. Function value + 200: affects channel M2 only. Ex: 101 is START/STOP(FWD) for M1 only.	101	C	S/D/P
06-02	Input X1 function	0601h	4201h		201	C	S/D/P
06-03	Input X2 (A0X) function	0602h	4202h		0	C	S/D/P
06-04	Input X3 (A1X) function	0603h	4203h		0	C	S/D/P
06-05	Input X4 (XH0) function	0604h	4204h		102	C	S/D/P
06-06	Input X5 (XH1) function	0605h	4205h		0	C	S/D/P
06-07	Input X6 (XH2) function	0606h	4206h		202	C	S/D/P
06-08	Input X7 (XH3) function	0607h	4207h		8	C	S/D/P
06-09	X8 (STO1)	0608h	4208h	Reserved	23	C	S/D/P
06-10	X9 (STO2)	0609h	4209h	Reserved	24	C	S/D/P
06-11 ~ 06-14	X10 (Always ON IN0) ~ X13 (Always ON IN1)	060Ah ~ 060Dh	420Ah ~ 420Dh	The state of the input function assigned to these virtual inputs will be ON. The setting items are the same as direct inputs. NOTE: Do not assign START/STOP, FWD, REV to these inputs unless you do it on purpose to make the motor start running right after power on.	0	C	S/D/P`
06-15	SC/CC mode (Start-stop/direction mode)	060Eh	420Eh	0: SC mode. Use START/STOP, CCW/CW inputs. 1: CC mode. Use FWD, REV inputs.	0	C	S/D/P

06-16	Input logic	060Fh	420Fh	Set the logic for input terminals, where each bit corresponds to an input logic. 0: open-circuit/high-active, 1: closed-circuit/low-active Bit 0: X0 logic Bit 1: X1 logic Bit 2: X2 (A0X) logic Bit 3: X3 (A1X) logic Bit 4: X4 (XH0) logic Bit 5: X5 (XH1) logic Bit 6: X6 (XH2) logic Bit 7: X7 (XH3) logic Bit 8: X8 (STO1) logic Bit 9: X9 (STO2) logic Bit 10~ 15: Reserved	64767	C	S/D/P
06-17	Output Y0 function	0610h	4210h	The function setup of direct outputs 0: NC 1: SPD-OUT 2: ALM-OUT 3: BUSY-OUT 4: VA-OUT 5: EN-OUT 6: ALM-PULSE 7: BUS-ALM-PULSE 11: RUN-OUT 12: DIR-OUT 13: VA-OUT2 14: VA-EN-OUT The functions above affect M1 channel only. Function value + 100: affects channel M1 only. Function value + 200: affects channel M2 only. Ex: 202 is ALM-OUT for M2 only.	102	C	S/D/P
06-18	Output Y1 function	0611h	4211h		202	C	S/D/P
06-19	Output Y2 (YH0) function	0612h	4212h		0	C	S/D/P
06-20	Output Y3 (YH1) function	0613h	4213h		101	C	S/D/P
06-21	Output Y4 (YH2) function	0614h	4214h		0	C	S/D/P
06-22	Output Y5 (YH3) function	0615h	4215h		201	C	S/D/P
06-23 ~ 06-28	Reserved	0616h ~ 061Bh	4216h ~ 421Bh	Reserved	-	-	-
06-29	MBRAKE (Electromagnetic brake) control	061Ch	421Ch	0: Holding voltage same as the main power supply. Other: Tens/one digit: holding % Thousand/hundreds digit: Starting time in 0.1 sec Setting Example: 50: release voltage = 50% PWM of the main power 2050: release voltage = 100% main power for 2.0 sec for releasing and then drop to 50% PWM for holding. *Do not change this setting unless you verified the requirements to release the electromagnetic brake you are using.	0	C	S/D/P
06-30	Speed in range (VA)	061Dh	421Dh	VA-OUT outputs ON, when the difference between actual and command motor speed is less than this value. Setting range" 0 to 1,000 r/min.	100	C	S/D/P
06-31	EN-OUT speed	061Eh	421Eh	EN-OUT outputs ON, when the motor speed is higher than this value. Setting range: 200 to 10,000 r/min	1000	C	S/D/P
06-32	Output logic	061Fh	421Fh	Set the logic for output terminals, where each bit corresponds to an output logic. Bit 0: Y0 logic Bit 1: Y1 logic Bit 2: Y2 (YH0) logic	65535	C	S/D/P

				Bit 3: Y3 (YH1) logic Bit 4: Y4 (YH2) logic Bit 5: Y5 (YH3) logic Bit 6 ~ 15: Reserved			

3.4.6 Control PID parameters

ID	Field name	Register (hex)		Description	Default	Eff.	Mode
		EEP	RAM				
07-01	Reserved	0700h	4300h	Reserved	-	-	-
07-02	M1 Control Constant Kp	0701h	4301h	Value: 1 ~ 65535	16	C	S/D/P
07-03	M1 Velocity Ctrl. Const. 1	0702h	4302h	Value: 1 ~ 65535	1024	C	S/D/P
07-04	M1 Velocity Ctrl. Const. 2	0703h	4303h	Value: 1 ~ 65535	0	C	S/D/P
07-05 ~ 07-16	Reserved	0704h ~ 070Fh	4304h ~ 430Fh	Reserved	-	-	-
07-17	Reserved	0710h	4310h	Reserved	-	-	-
07-18	M2 Control Constant Kp	0711h	4311h	Value: 1 ~ 65535	16	C	S/D/P
07-19	M2 Velocity Ctrl. Const. 1	0712h	4312h	Value: 1 ~ 65535	1024	C	S/D/P
07-20	M2 Velocity Ctrl. Const. 2	0713h	4313h	Value: 1 ~ 65535	0	C	S/D/P

3.4.7 Communication parameters

ID	Field name	Register (hex)		Description	Default	Eff.	Mode
		EEP	RAM				
09-01	NET-X0 function	0900h	4500h	NET-X input function setting. The state of each input is set by the corresponding bit in the register 1400h. 0: NC1: START/STOP (FWD) 2: CCW/CW (REV) 5: FREE 6: STOP-MODE 7: EBRAKE/ALM-RST 8: ALM-RST 9: STOP-MODE2 10: D0 11: D1 13: EBRAKE 14: SERVO-EN 17: STOP 21: EXT-ERROR The functions above affect both channels. Function value + 100: affects channel M1 only. Function value + 200: affects channel M2 only. Ex: 102 is ALM-OUT for M1 only.	101	C	S/D/P
09-02	NET-X1 function	0901h	4501h		102	C	S/D/P
09-03	NET-X2 function	0902h	4502h		105	C	S/D/P
09-04	NET-X3 function	0903h	4503h		108	C	S/D/P
09-05	NET-X4 function	0904h	4504h		201	C	S/D/P
09-06	NET-X5 function	0905h	4505h		202	C	S/D/P
09-07	NET-X6 function	0906h	4506h		205	C	S/D/P
09-08	NET-X7 function	0907h	4507h		208	C	S/D/P
09-09	NET-X8 function	0908h	4508h		0	C	S/D/P
09-10	NET-X9 function	0909h	4509h		0	C	S/D/P
09-11	NET-X10 function	090Ah	450Ah		0	C	S/D/P
09-12	NET-X11 function	090Bh	450Bh		0	C	S/D/P
09-13	NET-X12 function	090Ch	450Ch		0	C	S/D/P

09-14	NET-X13 function	090Dh	450Dh		0	C	S/D/P
09-15	NET-X14 function	090Eh	450Eh		0	C	S/D/P
09-16	NET-X input logic	090Fh	450Fh	Set the logic for NET-X inputs, where each bit corresponds to an NET-X logic. Bit 0: NET-X0 ~ Bit14: NET-X14	0	C	S/D/P
09-17	WatchData Select	0910h	4510h	Set the dynamic data and monitor data display page (0000h ~ 0020h).	0	C	S/D/P
09-18	RS485 protocol	0911h	4511h	0: MODBUS RTU 1: MODBUS ASCII	0	D	S/D/P
09-19	RS485/CAN ID	0912h	4512h	RS485 slave ID of M1 (M2 ID = M1 ID + 1) CAN Node ID (ID=1 when this value is 0).	1	D	S/D/P
09-20	RS485/CAN Baud-Rate	0913h	4513h	Unit: BPS RS485:0=9.6k, 1=19.2k, 2=38.4k, 3=57.6k, 4=115.2k CAN:0=100K, 1=125K, 2=250K, 3=500K, 4=1000K	4	D	S/D/P
09-21	RTU C3.5 min	0914h	4514h	Modbus RTU silent interval setting (Modbus standard min is 1.75ms) 0=1.75ms, 1=1.50ms, 2=1.25ms, 3=1.00ms, 4=0.5ms, 5=0.50ms	0	C	S/D/P
09-22 ~ 09-25	Reserved	0915h ~ 0918h	4515h ~ 4518h	Reserved	-	-	-
09-26	CANOpen PDO Mapping	0919h	4519h	0 = PDO Mapping 1, please refer to CANOpen manual for details.	0	D	S/D/P
09-27	CANOpen TPDO Trigger	091Ah	451Ah	Bit0~3: TPDO1 Bit4~7: TPDO2 Bit8~11: TPDO3 Bit12~15: TPDO4 0 = Asynchronous (upon receipt of the matting TPDO) 1 ~ 4 = 1 to 4 SYNC signal received 5 = Asynchronous (upon receipt of TPDO1) 6 = Asynchronous (upon receipt of TPDO2) 7 = Asynchronous (upon receipt of TPDO3) 8 = Asynchronous (upon receipt of TPDO4) 9= ASYNC 10ms, 10= ASYNC 25ms, 11= ASYNC 50ms, 12= ASYNC 100ms, 13= ASYNC 250ms, 14= ASYNC 500ms, 15= ASYNC 1000ms	4352	D	S/D/P
09-28	CANOpen RPDO Trigger	091Bh	451Bh	Bit0~3: RPDO1 Bit4~7: RPDO2 Bit8~11: RPDO3 Bit12~15: RPDO4 0 = Asynchronous (upon receipt of the matting RPDO) 1 ~ 4 = 1 to 4 SYNC signal received	0	D	S/D/P
09-29	CANOpen HeartBeat	091Ch	451Ch	0: Off 1 ~ 65535: 1 ~ 65535ms	0	D	S/D/P
09-30	CANOpen Mode	091Dh	451Dh	Bit0: 0=11Bit-ID, 1=29Bit-ID Bit1: 0=Enter Operation State after power-on, 1=Enter Pre-operation State after power-on	0	D	S/D/P

09-31	CAN Mode	091Eh	451Eh	0=CAN Open	0	D	S/D/P
09-32	RS485/CAN selection	091Fh	451Fh	0=RS485 1=CAN	0	D	S/D/P

4. Multi-drive control protocol

Multi-drive is a customized RS485 protocol which is based on the customized function code of the Modbus protocol.
With Multi-drive, one can control up to 4 different drives with different operations in one message to reduce the communication delay. And each drive can respond in sequence.
Multi-drive supports both continuous(speed) and positioning operation.
NOTE When using Multi-drive, the M2 ID is M1 ID +1.
NOTE Only encoder models support multi-drive protocol.

4.1 Multi-drive parameter setting

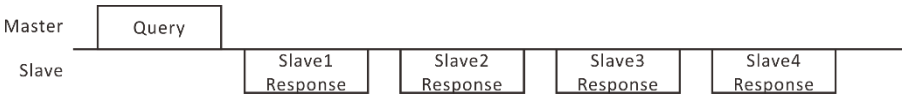
All configurations are affective only after recycling the power.
To use Multi-drive, set the parameter 01-11/01-27 “Control mode” to 2: position control.
Select the encoder position data type by parameter 02-14 “Position data type”.

4.2 Multi-drive communication mode

Based on the standard Modbus broadcast with customized function code.
The master sends a query in broadcast and the slaves respond in sequence or nothing depends on the function code in the query.

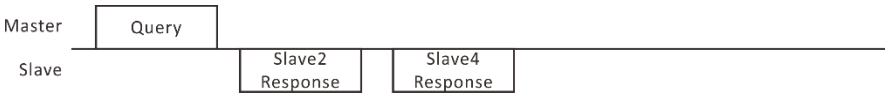
Example 1

4 slaves. All slaves with a response.



Example 2

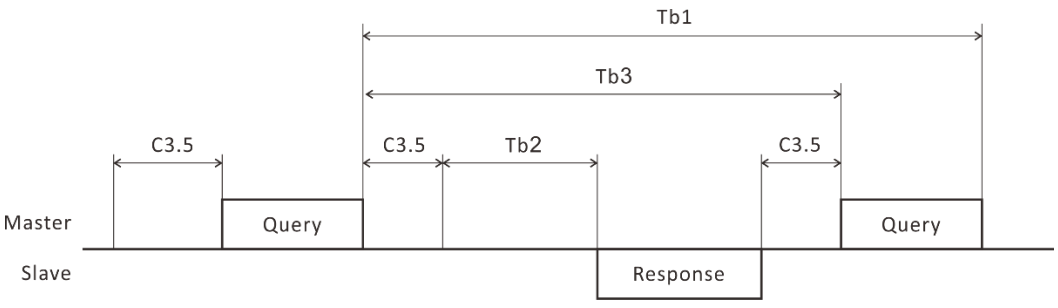
4 slaves. Only ID2 and ID4 respond.



Example 3

4 slaves. No slaves respond.

Communication Timing



Character	Name	Description
Tb1	Timeout duration	If the slave does not receive any query over the interval set by the parameter “05-17 RS485/RS232 timeout”, a timeout error is generated. (Default: no monitoring)
Tb2	Transmission waiting time	It takes about 3 to 5 msec for each slave to complete the response after the query. When using the RTU protocol, the actual transmission waiting time is C3.5 + command processing time + transmission waiting time (Tb2).

Tb3	Broadcasting interval	The minimum interval between the broadcasting query and the next query. It takes about 10 msec to control two drives with response.
C3.5	Silent interval	The interval between queries. If this time is less than 3.5 characters long, the drive may not respond. The silent interval should be 1.75ms when the baud rate is 19200 bps. (Silent intervals can be set by parameter 09-21 to make it shorter).

4.3 Multi-drive command data

There are two types of position command.

Parameter 02-14	Data	Description	Range
0 / 1	Speed (continuous operation)	The target speed of continuous (speed) operation in Multi-drive control.	-4,000 to 4,000 r/min
0	Position Index	Set the number of motor revolution (incremental). The motor shaft rotates 360 degrees per revolution. By default, 10,000 steps = 1 index	−32,768 to 32,767 rev
	Position Step	Set the target position. By default, the motor shaft rotates 0.036° per step. By default, 10,000 steps = 1 index	0 to 10,000 steps
1	Position Step(upper)	Set the target position of the motor (incremental). By default, the motor shaft rotates 0.036° per step	-327,680,000 to 327,670,000 steps (16 bits for upper and 16 bits for lower)
	Position Step(lower)		
0 / 1	Speed (position operation)	Set by operation data register with standard Modbus protocol.	-4,000 to 4,000 r/min
	Acceleration time		0.1 to 10.0 sec (0 to 3000 r/min)
	Deceleration time		0.1 to 10.0 sec (3000 to 0 r/min)
	Torque limit		0 to 200.0 %

4.3.1 Multi-drive command data format (DATAn)

Each command data is divided into high byte (DATAn-1) and low byte (DATAn-2), each with 16 bits.

Speed command data

Singed int(16 bits) with low bytes (DATAn-2) only.
Default range(unit) : -4000 to 4000 (r/min)

Position command data (when 02-14 = 0)

Upper DATAn : Position Index is signed int (16bits).
Default range(unit) : −32,768 to 32,767(rev)
Lower DATAn: Position Step is unsigned int (16bits).
Default range(unit) : 0 to 10,000 (step)

Position command data setting example (when 02-14 = 0)

Example1: Rotate CW by two and 1/4 revolution: upper=2(0002h), lower= 2500(09C5h, 1/4 rev)
Example2: Rotate CCW by two and 1/4 revolution: upper=-3(FFFDh), lower= 7500(1D4Ch, 3/4 rev)
NOTE Step is positive integer only when 02-14 = 0.

Position command data (when 02-14 = 1)

Upper DATAn and lower DATAn are combined in to a 32bit signed int position step.
Default range(unit): -327,680,000 to 327,670,000 steps

Position command data setting example (when 02-14 = 1)

Example1: Rotate CW by two and 1/4 revolution: upper= (0000h), lower=22500(57E4h)
Example2: Rotate CCW by two and 1/4 revolution: upper= -1(FFFFh), lower= -22500(A81Ch)

4.4 Multi-drive Modbus function code (FC)

Multi-drive use function code in the customized area of the standard Modbus.

FC		Function	Description
Hex	Decimal		
65h	101	Query from the master to the slaves(drives).	The master sends query with the broadcast ID (0) and the function code 65h to query up to 4 slaves in one message.
66h	102	Slave normal response.	After receiving function code 65h in broadcast, the slaves (drives) will respond in sequence on after one. Each slave responds with a function code depends on if the query can be processed normally or not. If the query can be processed normally the slave responds with function code 66h otherwise it responds with function code 67h as exception response.
67h	103	Slave exception response.	

4.5 Multi-drive query format (65h)

The message length can be different depends on the number of the slaves to control in the query.
The following example is based on the Modbus RTU.

Modbus	Message	Sample code	Bytes	Description
Slave	ID	00h	1	ID = 0. Always use broadcast mode in Multi-drive.
Function code	FC	65h	1	FC=65 for normal control command. Query from the master to the slaves.
	SubID Num	02h	1	Number of slaves to query. This will determine the length of the message. Up to 4 slaves can be queried at a time.
	SubID1	01h	1	The slave address of the first slave (drive).
	CMD1	0Ch	1	The command to the first slave (drive).
	DATA1 (upper)	0000h	2	The data of the commands to the first slave (drive).
	DATA1 (lower)	0010h	2	
	SubID2	02h	1	The slave address of the second slave (drive).
	CMD2	0Ch	1	The command to the second slave (drive).
	DATA2 (upper)	0000h	2	The data of the commands to the second slave (drive).
	DATA2 (lower)	0010h	2	
	SubID3	-	1	The same rules as above. If the Sub ID number is 1 then the message after DATA1 lower will be blank (except the CRC). If the Sub ID number is 2 then the message after DATA2 lower will be blank (except the CRC). Up to 4 slaves can be controlled in the query.
	CMD3	-	1	
	DATA3 (upper)	-	2	
	DATA3 (lower)	-	2	
	SubID4	-	1	
	CMD4	-	1	
	DATA4 (upper)	-	2	
	DATA4 (lower)	-	2	
CRC	CRC	-	2	checksum

4.6 Multi-drive response format (66h, 67h)

The slave sends response with function code 66h or 67h If the command in the query requires the slave to response (echo).
NOTE The slave sends response in sequence. If any of the slaves failed to respond, the slaves after it would not response.
NOTE The slave responds the data at the time it received and processed the query to reduce time difference between the data of each slave.

Modbus	Data	Example	Bytes	Description
Slave address	ID	01h	1	Always use broadcast mode in Multi-drive.
Function code	FC	66h or 67h	1	66h for normal response. 67h for exception response.
Data	DATA upper	0000h	2	The position of the motor. For parameter 08-15 = 0: Index + step For parameter 08-15 = 1: Step upper + step lower
	DATA lower	0010h	2	
CRC	CRC	080Eh or 35CEh	2	Add CRC-16 of the standard Modbus to the end of the message.

4.7 Multi-drive 指令列表 (CMD)

There are two categories of commands in Multi-drive, one with echo and the other with no echo (no response).
The drive will not respond if it receives a non-echo command.
The command address of non-echo = echo address + 100.
The motor can switch easily between speed and position operation mode on the fly.

Command	Code (Hex)		Description	Use condition	DATA 0 = value 0	
	Echo	No-Echo			DATAn-1	DATAn-2
ISTOP	0 (00h)	100 (64h)	Stop immediately (speed mode).	Any operation	0	0
JG	10 (0Ah)	110 (6Eh)	Speed operation. • DATAn-2 > 0 for CW operation • DATAn-2 < 0 for CCW operation • DATAn-2 = 0 for stop (stop method is set by the STOP-MODE). STOP-MODE = ON: Brake and stop • STOP-MODE = OFF: Decelerate to stop.	Drive enable (SVON) Drive not functioning properly (no alarm))	0	Target speed r/min
FREE	5 (05h)	105 (69h)	Motor is not energized	Parameter 01-10 is set to 1 or 2.	0	0
SVON	6 (06h)	106 (6Ah)	Servo on	Parameter 01-10 is set to 1 or 2.	0	0
SVOFF	7 (07h)	107 (6Bh)	Servo off (can reset alarms)	Parameter 01-10 is set to 1 or 2.	0	0
IMR	11 (0Bh)	111 (6Fh)	Interrupt current operation and stop after moving for a set travel amount (distance to stop). The deceleration = (distance to stop) * 2 / (the speed at the time to start IMR).	Any operation	Travel amount (upper)	Travel amount (lower)
CS	14 (0Eh)	114 (72h)	Reset the command position and current motor position to a set value.	Servo on (SVON) when the motor is stopped or in speed mode	Position reset value (upper)	Position reset value (lower)
CMR	15 (0Fh)	115 (73h)	Set the travel amount for positioning operation. Acceleration and deceleration are set by	Not in IMR operation.	Travel amount (upper)	Travel amount (lower)

			the operation data.			
CMA	16 (10h)	116 (74h)	Set the position (from home) for positioning operation. Acceleration and deceleration are set by the operation data.	Not in IMR operation.	Command position (upper)	Command position (lower)
NULL	99 (63h)	199 (77h)	Commands to query the current position of the slave.	Any operation.	0	0

4.8 Multi-drive message examples

4.8.1 Continuous (speed) operation

Example 1

Modbus RTU, parameter 02-14=0. Slave ID1 CW for 300r/min, Slave ID2 CCW for 300 r/min

Master query

Field name		Data	Description
Slave ID		00h	0 for broadcast
Function code		65h	65h for master query
Data	Sub ID Num	02h	Number of slaves to query = 2
	Sub ID1	01h	Address of the first slave = 1
	CMD1	0Ah	JG command for the first slave.
	DATA1 (upper)	00h	012Ch = 300 r/min (CW)
		00h	
	DATA1 (lower)	01h	
		2Ch	
	Sub ID2	02h	Address of the second slave = 2
	CMD2	0Ah	JG command for the second slave.
	DATA2 (upper)	00h	FED4h = -300r/min (CCW)
		00h	
	DATA2 (lower)	FEh	
		D4h	
CRC (lower)		0Bh	Calculated CRC-16
CRC (upper)		51h	

Slave 1 (M1) response

Field name		Data	Description
Slave ID		01h	Slave address = 1
Function code		66h	Normal response.
Data	DATA1 (upper)	00h	Motor position Index = 100 Step = 5500
		64h	
	DATA2 (lower)	15h	
		7Ch	
CRC (lower)		47h	Calculated CRC-16.
CRC (upper)		6Ch	

Slave 2 (M2) response (send after slave 1/M1 response)

Field name		Data	Description
Slave ID		02h	Slave address = 2
Function code		66h	Normal response.
Data	DATA1 (upper)	00h	Motor position Index = 100 Step = 5500
		64h	
	DATA2 (lower)	15h	
		7Ch	
CRC (lower)		47h	Calculated CRC-16.
CRC (upper)		5Fh	

Example 2

Modbus RTU, parameter 02-14=0, stop immediately.

Master query

Field name		**Data**	**Description**
Slave ID		00h	0 for broadcast
Function code		65h	65h for master query
Data	Sub ID Num	02h	Number of slaves to query = 2
	Sub ID1	01h	Address of the first slave = 1
	CMD1	00h	ISTOP command
	DATA1 (upper)	00h	Data is 0 for ISTOP command.
		00h	
	DATA1 (lower)	00h	
		00h	
	Sub ID2	02h	Address of the second slave = 2
	CMD2	00h	ISTOP command
	DATA2 (upper)	00h	Data is 0 for ISTOP command.
		00h	
	DATA2 (lower)	00h	
		00h	
CRC (lower)		DEh	Calculated CRC-16.
CRC (upper)		B9h	

Slave 1 (M1) response

Field name		**Data**	**Description**
Slave ID		01h	Slave address = 1
Function code		66h	Normal response.
Data	DATA (upper)	00h	Motor position Index = 100 Step = 5500
		64h	
	DATA (lower)	15h	
		7Ch	
CRC (lower)		47h	Calculated CRC-16.
CRC (upper)		6Ch	

Slave 2 (M2) response (send after slave 1/M1 response)

Field name		**Data**	**Description**
Slave ID		02h	Slave address = 2
Function code		66h	Normal response.
Data	DATA (upper)	00h	Motor position Index = 100 Step = 5500
		64h	
	DATA (lower)	15h	
		7Ch	
CRC (lower)		47h	Calculated CRC-16.
CRC (upper)		5Fh	

4.8.2 Positioning operation

Example 1

Modbus RTU, parameter 02-14=0. Slave ID1 travel for index=300 + step=2000, slave ID2 travel for index=310 + step=1500.

Master query

Field name		Data	Description
Slave ID		00h	0 for broadcast
Function code		65h	65h for master query
Data	Sub ID Num	02h	Number of slaves to query = 2
	Sub ID1	01h	Address of the first slave = 1
	CMD1	0Fh	CMR command
	DATA1 (upper)	01h	Index = 300 Step = 2000
		2Ch	
	DATA1 (lower)	07h	
		D0h	
	Sub ID2	02h	Address of the second slave = 2
	CMD2	0Fh	CMR command
	DATA2 (upper)	01h	Index = 310 Step = 1500
		36h	
	DATA2 (lower)	05h	
		DCh	
CRC (lower)		54h	Calculated CRC-16.
CRC (upper)		B8h	

Slave 1 (M1) response

Field name		Data	Description
Slave ID		01h	Slave address = 1
Function code		66h	Normal response.
Data	DATA (upper)	00h	Motor position Index = 100 Step = 5500
		64h	
	DATA (lower)	15h	
		7Ch	
CRC (lower)		47h	Calculated CRC-16.
CRC (upper)		6Ch	

Slave 2 (M2) response (send after slave 1/M1 response)

Field name		Data	Description
Slave ID		02h	Slave address = 2
Function code		66h	Normal response.
Data	DATA (upper)	00h	Motor position Index = 100 Step = 5500
		64h	
	DATA (lower)	15h	
		7Ch	
CRC (lower)		47h	Calculated CRC-16.
CRC (upper)		5Fh	

5. Multi-drive lite control protocol

Multi-drive lite is a customized RS485 protocol which is based on the customized function code of the Modbus protocol.
With Multi-drive lite, one can control up to 4 different drives with different operations in one message. And each drive can respond in sequence.

NOTE Multi-drive lite only supports continuous(speed) or duty operation.
NOTE When using Multi-drive, the M2 ID is M1 ID +1.

5.1 Multi-drive lite parameter setting

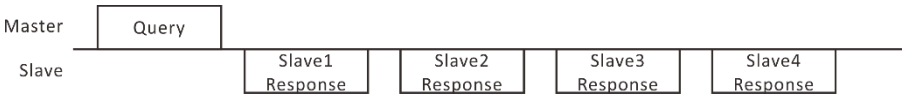
- Set parameter 01-11 “control mode” to 0 for speed operation or set it to 1 for duty operation.
- Set parameter 06-15 “SC/CC mode” to 0 for SC Mode.
- Set parameter 01-12 “speed control method” to 4 for Multi-drive lite.

5.2 Multi-drive lite communication mode

Based on the standard Modbus broadcast with customized function code.
The master sends a query in broadcast and the slaves respond in sequence or nothing depends on the function code in the query.

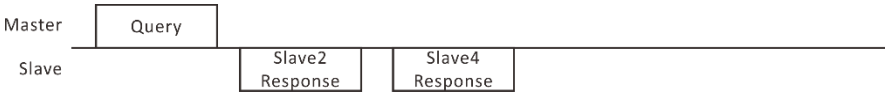
Example 1

4 slaves. All slaves with a response.



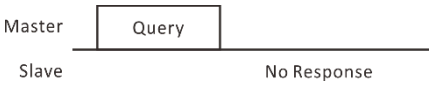
Example 2

4 slaves. Only ID2 and ID4 respond.

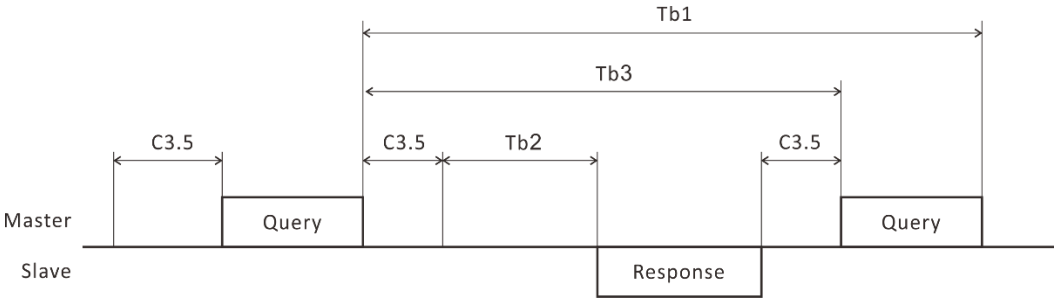


Example 3

4 slaves. No slaves respond.



Communication Timing



Character	Name	Description
Tb1	Timeout duration	If the slave does not receive any query over the interval set by the parameter “05-17 RS485/RS232 timeout”, a timeout error is generated. (Default: no monitoring)
Tb2	Transmission waiting time	It takes about 3 to 5 msec for each slave to complete the response after the query. When using the RTU protocol, the actual transmission waiting time is C3.5 + command processing time + transmission waiting time (Tb2).
Tb3	Broadcasting interval	The minimum interval between the broadcasting query and the next query. It takes about 10 msec to control two drives with response.

C3.5	Silent interval	The interval between queries. If this time is less than 3.5 characters long, the drive may not respond. The silent interval should be 1.75ms when the baud rate is 19200 bps. (Silent intervals can be set by parameter 09-21 to make it shorter).

5.3 Multi-drive lite command data

The speed (or duty in duty mode) can be set in the Multi-drive lite protocol. Other operation data can be set with the corresponding register with standard Modbus protocol.

Data		**Description**	**Default range**
16 bits	Speed / Duty	The target speed or target duty for Multi-drive lite control.	-4000 to + 4000 r/min -100.0% to 100.0%
16 bits	Acceleration time	Set by operation data register with standard Modbus protocol.	0.1 to 10.0 sec (0 to 3000r/min)
16 bits	Deceleration time		0.1 to 10.0 sec (3000 to 0r/min)
16 bits	Torque limit		0 to 200.0 %

5.4 Multi-drive lite Modbus function code (FC)

Use function code in the customized area of standard Modbus.

FC		**Function**	**Description**
Hex	**Decimal**		
41h	65	Query from the master to the slaves(drives).	The master sends query with the broadcast ID (0) and the function. code 41h to query up to 4 slaves in one message.
42h	66	Slave normal response.	After receiving function code 41h in broadcast, the slaves (drives) will respond in sequence one after one. Each slave responds with a function code depends on if the query can be processed normally or not. If the query can be processed normally the slave responds with function code 42h otherwise it responds with function code 43h as exception response.
43h	67	Slave exception response.	

5.5 Multi-drive lite query format (41h)

The message length can be different depends on the number of the slaves to control and the echo data requested in the query.

Modbus	Data	Example	Bytes	Description
Slave address	ID	00h	1	Always use broadcast mode in Multi-drive lite.
Function code	FC	41h	1	Query from the master to the slaves
Data	Sub ID Num	02h	1	Number of slaves to query. This will determine the length of the message. Up to 4 slaves can be queried at a time.
	Sub ID1	01h	1	The slave address of the first slave (drive).
	CMD1	0Ch	1	The command to the first slave (drive).
	DATA1	0000h	2	The data of the commands to the first slave (drive).
	Echo-BITF1	0001h	2	Echo bit field of the first slave. Set what data for the first slave to return in the response.
	Sub ID2	02h	1	The slave address of the second slave (drive).
	CMD2	01h	1	The command to the second slave (drive).
	DATA2	0000h	2	The data of the commands to the second slave (drive).
	Echo-BITF2	0010h	2	Echo bit field of the second slave. Set what data for the second slave to return in the response.
	Sub ID3	-	1	The same rule as above. If the Sub ID number is 1, the message after Echo-BITF1 will be blank (except the CRC). If the Sub ID number is 2, the message after Echo-BITF2 will be blank (except the CRC). Up to 4 slaves can be controlled in the query.
	CMD3	-	1	
	DATA3	-	2	
	Echo-BITF3	-	2	
	Sub ID4	-	1	
	CMD4	-	1	
	DATA4	-	2	
	Echo-BITF4	-	2	
CRC	CRC	-	2	Add CRC-16 of the standard Modbus to the end of the message.

5.6 Multi-drive lite commands (CMD)

Command	Code		Description	Use condition	DATA (16bits) 0 = value 0
	Hex	Decimal			
ISTOP	00h	0	Stop immediately.	Drive enable (Enable ON) FREE = OFF EBRAKE = OFF	0
JG	01h	1	Speed or duty operation (DATA is speed or duty depends on the operation mode). • DATA > 0 for CW operation. • DATA < 0 for CCW operation. • DATA = 0 for stop (stop method is set by the STOP-MODE input		Signed int (16bits) + : CW operation - : CCW operation 0 : stop Speed operation:

			STOP-MODE = ON: Brake to stop STOP-MODE = OFF: Decelerate to stop). • If DATA is less than 60 r/min but not 0, it is regard as 60 r/min.		speed r/min Duty operation: PWM Duty 0.1%
FREE	05h	5	Motor is not energized.	Any operation	0
SVON	06h	6	Servo on (motor can be energized)	Any operation	0
SVOFF	07h	7	Servo off (can reset alarms)	Parameter 01-10 is not 0	0
ALM-RST	08h	8	Reset alarm.	Parameter 01-10 is not 0	0
BRAKE	09h	9	Motor 3 phase short brake to stop.	Drive enable (Enable ON) FREE = OFF	0
NULL	63h	99	Commands to query the current position of the slave.	Any operation	0

5.7 Multi-drive lite Echo-BITF

The 16bits Echo-BITF in the FC 41h query indicates the data for the slave to return in the response.
Each bit in the Echo-BITF indicates a specific data to response with 1 indicating to return and 0 indicating no return.
For example, 0000h indicates no data to return.
0000 0000 0000 0100b (0004h) indicates to return the motor speed.
0000 0000 0110 0100b (0064h) indicates to return the motor speed, main voltage, and the output current.

<table>
<tr><th>Bit</th><th>Data to return</th><th>Description of returned content</th></tr>
<tr><td>0</td><td>Motor status</td><td>Motor status
0: STOP
2: RUN
3: EBRAKE
4: FREE
5: FAULT
6: WAIT/INHIBIT
7: MOVING(SERVO ON)
8: SLIGHT-POS-KEEPING</td></tr>
<tr><td>1</td><td>Motor Hall/ENC count</td><td>Hall: Hall count. Signed int (16bits) -32767 to 32768.
Encoder: Encoder step or encoder position.
The count increased by 1 for CW operation and decreased by 1 for CCW operation. The count overflows.</td></tr>
<tr><td>2</td><td>Motor speed</td><td>The current speed of the motor. Signed int (16bits) -32,767 to 32,768 r/min. Positive=CW operation, Negative=CCW operation.</td></tr>
<tr><td>3</td><td>Error code</td><td>The present alarm codes. Refer to “A1 -Alarm”.</td></tr>
<tr><td>4</td><td>Direct IO status</td><td>Each bit indicates a status of a direct I/O terminal. 0=OFF, 1=ON.
<table>
<tr><th>Data</th><th>Bit 7</th><th>Bit 6</th><th>Bit 5</th><th>Bit 4</th><th>Bit 3</th><th>Bit 2</th><th>Bit 1</th><th>Bit 0</th></tr>
<tr><td>Upper</td><td>BR2</td><td>BR1</td><td>YH3</td><td>YH2</td><td>YH1</td><td>YH0</td><td>Y1</td><td>Y0</td></tr>
<tr><td>lower</td><td>XH3</td><td>XH2</td><td>XH1</td><td>XH0</td><td>A1X</td><td>A0X</td><td>X1</td><td>X0</td></tr>
</table></td></tr>
<tr><td>5</td><td>Main voltage
(Power supply voltage)</td><td>The DC bus voltage. Unit=0.01 VDC.</td></tr>
<tr><td>6</td><td>Output current</td><td>The output current of the drive. Unit=0.01A.</td></tr>
</table>

5.8 Multi-drive lite response format (42h, 43h)

The slave sends response with function code 42h or 43h If the command in the query requires the slave to response (echo).
The return data and message length vary depend on the echo bit field.
NOTE The slave sends response in sequence. If any of the slaves failed to respond, then the slaves after it would not response.
NOTE The slave responds data at the time it received and processed the query to reduce time difference of the data between each slave.
Please add CRC at the end of the message when using Modbus RTU protocol.

Example 1，Echo-BITF = 0004h

Modbus	Data	Example	Bytes	Description
Slave address	ID	01h	1	Always use broadcast mode in Multi-drive lite.
Function code	FC	42h or 43h	1	42h for normal response. 43h for exception response.
Data	Echo-BITF	0004h	2	0004h = 0000 0000 0000 0100b indicates the return data is motor speed.
	DATA	0100h	2	Motor speed 256 r/min.
CRC	CRC	3994h or 0454h	2	Add CRC-16 at the end of the message.

Example 2，Echo-BITF = 0064h

Modbus	Data	Example	Bytes	Description
Slave address	ID	01h	1	Always use broadcast mode in Multi-drive lite.
Function code	FC	42h or 43h	1	42h for normal response. 43h for exception response.
Data	Echo-BITF	0064h	2	0064h = 0000 0000 0110 0100b indicates the return data is motor speed, main voltage, and output current.
	DATA1	0010h	2	Motor speed 256 r/min
	DATA2	0960h	2	Main voltage 24.00 VDC
	DATA3	0064h	2	Output current 1.00A
CRC	CRC	EF0Dh or E29Dh	2	Add CRC-16 at the end of the message.

5.9 Multi-drive lite message examples

Example 1

Modbus RTU, slave ID1 CW for 300r/min and slave ID2 CCW for 300r/min.

Master query

Field name		Data	Description
Slave ID		00h	0 for broadcast
Function code		41h	41h for master query
Data	Sub ID Num	02h	Number of slaves to query = 2
	Sub ID1	01h	Address of the first slave = 1
	CMD1	01h	JG command
	DATA1 (upper)	01h	012Ch = 300 r/min (CW)
	DATA1 (lower)	2Ch	
	Echo-BITF1 (upper)	00h	0000 0000 0011b Return motor state and hall count.
	Echo-BITF1 (lower)	03h	
	Sub ID2	02h	Address of the second slave = 2
	CMD2	01h	JG command
	DATA2 (upper)	FEh	FED4h = -300 r/min (CCW)
	DATA2 (lower)	D4h	
	Echo-BITF2 (upper)	00h	0000 0010 0011b Return motor state, hall count, and main voltage.
	Echo-BITF2 (lower)	23h	
CRC (lower)		5Dh	Calculated CRC-16
CRC (upper)		ACh	

Slave 1 (M1) Response

Field name		Data	Description
Slave ID		01h	Slave address = 1
Function code		42h	Normal response.
Data	Echo-BITF1 (upper)	00h	0000 0000 0011b Return motor state and hall count.
	Echo-BITF1 (lower)	03h	
	DATA1 (upper)	00h	The motor state was STOP at the time it received the command.
	DATA1 (lower)	00h	
	DATA2 (upper)	01h	The hall count was 500 at the time it received the command.
	DATA2 (lower)	F4h	
CRC (lower)		A7h	Calculated CRC-16
CRC (upper)		D4h	

Slave 2 (M2) response (send after slave 1/M1 response)

Field name		Data	Description
Slave ID		02h	Slave address = 2
Function code		42h	Normal response.
Data	Echo-BITF1 (upper)	00h	0000 0000 0011b Return motor state, hall count, and main voltage.
	Echo-BITF1 (lower)	23h	
	DATA1 (upper)	00h	The motor state was STOP at the time it received the command.
	DATA1 (lower)	00h	
	DATA2 (upper)	FEh	The hall count was -500 at the time it received the command.
	DATA2 (lower)	0Ch	
	DATA3 (upper)	09h	The main voltage was 24.50VDC at the time it received the command.
	DATA3 (lower)	92h	
CRC (lower)		BCh	Calculated CRC-16
CRC (upper)		78h	

Example 2

Modbus RTU, make both slave ID1 and ID2 to stop.

Master query

Field name		Data	Description
Slave ID		00h	0 for broadcast
Function code		41h	41h for master query
Data	Sub ID Num	02h	Number of slaves to query = 2
	Sub ID1	01h	Address of the first slave = 1
	CMD1	01h	JG command
	DATA1 (upper)	00h	0 = stop for JG command
	DATA1 (lower)	00h	
	Echo-BITF1 (upper)	00h	0000 0000 0100b Return motor speed.
	Echo-BITF1 (lower)	04h	
	Sub ID2	02h	Address of the second slave = 2
	CMD2	01h	JG command
	DATA2 (upper)	00h	0 = stop for JG command
	DATA2 (lower)	00h	
	Echo-BITF2 (upper)	00h	0000 0000 0100b Return motor speed.
	Echo-BITF2 (lower)	04h	
CRC (lower)		87h	Calculated CRC-16
CRC (upper)		A2h	

Slave 1 (M1) response

Field name		Data	Description
Slave ID		01h	Slave address = 1
Function code		42h	Normal response.
Data	Echo-BITF1 (upper)	00h	0000 0000 0100b Return motor speed.
	Echo-BITF1 (lower)	04h	
	DATA1 (upper)	01h	The motor speed was 300r/min(CW) at the time it received the command.
	DATA1 (lower)	2Ch	
CRC (lower)		38h	Calculated CRC-16
CRC (upper)		49h	

Slave 2 (M2) response (send after slave 1/M1 response)

Field name		Data	Description
Slave ID		02h	Slave address = 2
Function code		42h	Normal response.
Data	Echo-BITF1 (upper)	00h	0000 0000 0100b Return motor speed.
	Echo-BITF1 (lower)	04h	
	DATA1 (upper)	FEh	The motor speed was -300r/min(CCW) at the time it received the command.
	DATA1 (lower)	D4h	
CRC (lower)		78h	Calculated CRC-16
CRC (upper)		08h	

A1 - Alarm

When an alarm generates, the drive activates its protection function and cuts off the power to the motor (motor coasts to stop if not affected by other external forces). The ALM-OUT turns ON and the ALM-LED blinks (The type of alarm can be confirmed by the alarm code or the blink count of ALM-LED).
Before resetting an alarm, always remove the cause of the alarm to ensure safety and perform one of the operations below to reset the alarm.
Turn the ALM-RST OFF for more than 0.5 sec then turn it ON for another 0.5 sec then turn it OFF again.
Cycle the power. When cycling the power please turn the power off for at least 30sec or till the PWR LED go off then turn the power on again.
NOTE Some alarms can only be reset by cycling the power
NOTE The alarm cannot be reset if the drive operation command is ON (etc. START/STOP, FWD, REV input is ON). Please turn all the operation command to OFF before reset the alarm.

■ **Alarm error code register**

Channel	Dynamic data	Monitor data
M1	0003h	4601h
M2	0031h	4A01h

■ **ALM LED**

The blink count of ALM-LED indicates the alarm error code.

Error code	Protection function	Description
1	Overcurrent	Excessive current has flown through the drive. Overload or rotor locked.
2	Overload	Exceeding the rated load for more than 5 sec. Exceeding the torque limit for X sec (X may vary depends on the parameter setting).
3	Motor feedback fault	Hall or Encoder signal abnormal or disconnected.
4	Overvoltage	The input voltage exceeds the upper limit of the drive. It may be caused by regenerative braking voltage.
5	Under voltage	The input power supply voltage is under the low limit.
6	Drive overheat	The temperature of the drive is over its maximum limit.
7	Startup fault	The motor failed to start. The motor cable is not connected correctly.
8	EEP data error	Error in EEPROM data. (Can NOT be reset by ALM_RST input).
10	Motor overheat	The temperature of the motor is too high. (The MOT-OT terminal has been set to ON state.)
12	Over speed	The motor speed exceeds the set upper limit.
13	Encoder signal fault	(1) Encoder was not connected, cannot be reset with ALM-RST (2) Encoder position exceeds the range (Overflow). Before using ALM-RST to clear the alarm, CS command should be used to reset the current position
14	Prevention of operation at power on	The main power supply was cycled when the FWD input or REV input was set to ON.
15	External stop	EXT-ERROR input is ON. When parameter “05-32 Channel Alarm Mode” is set to 1, and the other channel alarms.
20	Hall sequence fault	The hall sequence was incorrect.
21	Communication error	RS232 or RS485 communication timeout. The parameter setup value exceeds its limit or the communication command was not supported.
22	Parameter error	The parameter setup value was incorrect.

Revision history

REV	Date	Remark
1.0	20230812	Preliminary.