

EV INVERTER SERIES

MODBUS Manual



110V 0.2 - 0.75KW
(0.2 - 1HP)
220V 0.2 - 2.2KW
(0.2 - 3HP)
440V 0.75 - 2.2KW
(1 - 3HP)

TECO   **Westinghouse**

Rev. 1.00

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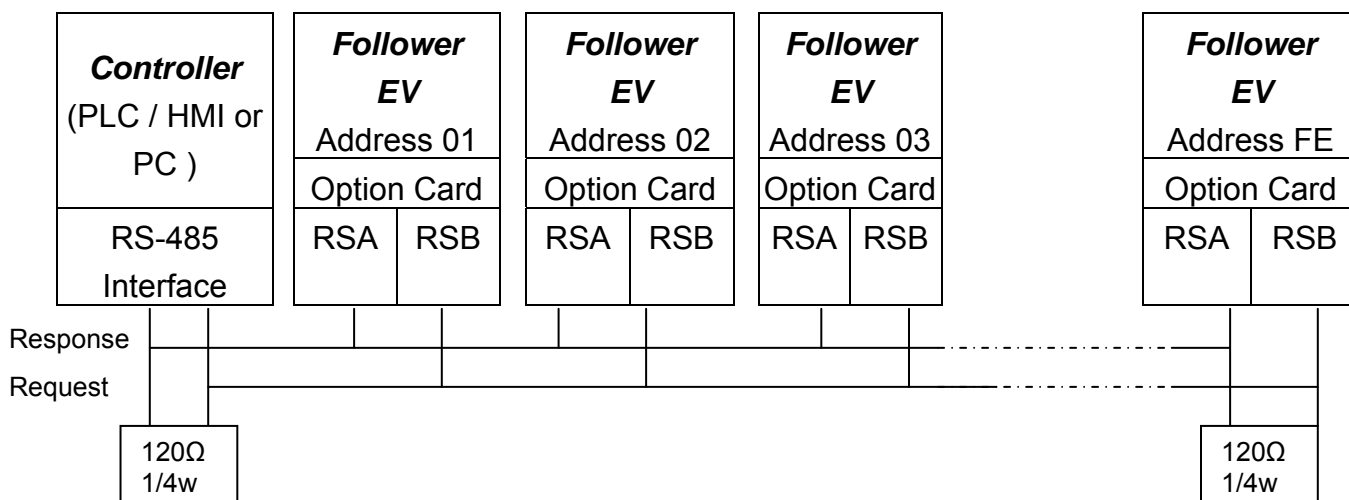
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1. Communication Data Frame

The **EV** series inverter can communicate with a **PC** or **PLC** using, **Modbus ASCII Mode & Mode RTU, RS485 or RS232** protocols.

Frame length maximum 80 bytes.

1.1 Hardware installation



**** Terminate the communications line with a (120 ohm, 1/4 watt) resistor at both ends.**

1.2 Data Format Frame

1.2.1 Data Frame for ASCII Mode

STX(3AH)	Start Bit = 3AH
Address Hi	Communication Address(Station):
Address Lo	
Function Hi	Function Code (command):
Function Lo	
Command Start Address	Command Start byte: 4-digit ASCII Code
Command Start Address	
Command Start Address	

Command Start Address	
Data Frame for ASCII Mode <i>con't</i>	
Data length	The length of the command: 4-digit ASCII Code
Data length	
Data length	
Data length	
LRC Check Hi	LRC Check Code: 2-digit ASCII Code
LRC Check Lo	
END Hi	End Byte: END Hi=CR(0DH), END Li = LF(0AH)
END Lo	

1.2.2 Data Frame for RTU Mode

MASTER (PLC etc.) sends request to FOLLOWER, and the FOLLOWER sends a response to the MASTER. The data received is illustrated here.

The data length varies depending on the command (Function).

FOLLOWER Address
Function Code
DATA
CRC CHECK
Signal Interval

**** The drive response time is 10ms.**

1.3 Follower Address

00H: Broadcast to all the drivers

01H: to the No. 01 Driver

0FH: to the No.15 Driver

10H: to the No.16 Driver

and so on....., Max to No. 254 (FEH)

1.4 Function Code

03H: Read the register contents

06H: Write a WORD to register

08H: Loop test

10H: Write several data to register (complex number register write)

2. CMS (Checksum and time-out definition)

2.1 LRC

Ex. ADDRESS	01H
FUNCTION	03H
COMMAND	01H
	00H
DATA LENGTH	0AH

	0FH-----two's complement
Checksum =	F1H
CS(H) =	46H (ASCII)
CS(L) =	31H (ASCII)

2.2 CRC CHECK :

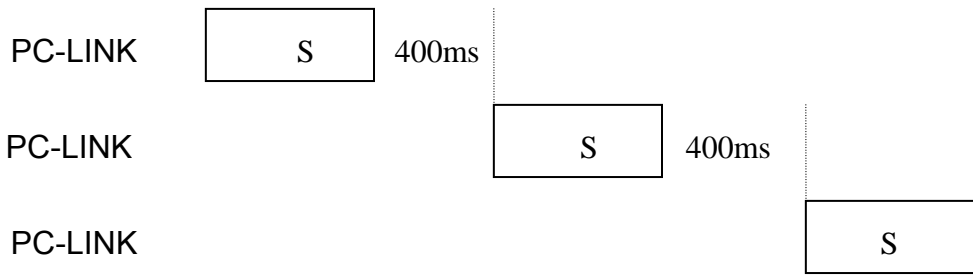
CRC check code is calculated from the FOLLOWER Address to end of the data. The calculation method is illustrated as follow:

- (1) Load a 16-bit register with FFFF hex (all 1's). Call this the CRC register.
- (2) Exclusive OR the first byte of the message with the low-order byte of the 16-bit CRC register, putting the result into the CRC register.
- (3) Shift the CRC register one bit to the right (toward the LSB), Zero-filling the MSB, Extract and examine the LSB.
- (4) (If the LSB was 0): Repeat Step (3) If the LSB is a "1": Exclusive OR the CRC register with the polynomial value of A001 hex (1010 0000 0000 0001).
- (5) Repeat Steps (3) and (4) until 8 shifts been performed. When this is done, a complete byte is processed.
- (6) Repeat Steps (2) through (5) for next byte of the message. Continue doing this until all bytes have been processed. The final content of the CRC register is the CRC value. Now append the 2 Byte CRC Checksum to the end of the message. The low-order byte will be transmitted first, followed by the high-order byte.

● **CRC calculation application program**

```
UWORD ch_sum ( UBYTE long , UBYTE *rxdbuf ) {  
    BYTE i = 0;  
    UWORD wkg = 0xFFFF;  
    while ( long-- ) {  
        wkg ^= rxdbuf++;  
    for ( i = 0 ; i < 8; i++ ) {  
        if ( wkg & 0x0001 ) wkg = ( wkg >> 1 ) ^ 0xa001;  
        else wkg = wkg >> 1;  
    }  
    }  
    return( wkg );  
}
```

2.3 TIME-OUT (400ms) & RETRY (max.: 2 times)



PC – LINK

When a time-out, checksum error is detected, the drive will retry a maximum of two times, and if the error is still present the display will show “**ERR6**”.

3. Error code

ASCII Mode	
STX	‘:’
Address	‘0’
	‘1’
Function	‘8’
	‘6’
Exception code	‘5’
	‘1’
LRC Check	‘2’
	‘8’
END	‘CR’
	‘LF’

RTU Mode		
SLAVE Address		02H
Function		83H
Exception code		52H
CRC-16	High	C0H
	Low	CDH

During a communication error the drive will response with an Exception Code and send a message back to the main system consisting of a Function Code that is “ANDED (and 80h)” with 80 Hex.

Error Code	Description
51	Function Code Error
52	Address Error
53	Data Amount Error
54	Data Over Range
55	Writing Mode Error

4.0 Inverter Control

4.1 Command Data (Readable and Writable)

Register Code	Bit	Content
00E6H	0	Operation Command 1 : Run 0 : Stop
	1	Reverse Command 1 : Reverse 0 : Forward
	2	External Fault 1 : Fault (EFO)
	3	Fault Reset 1 : Reset
	4	Jog Command 1 : JOG
	5	Multi-function Command S1 1 : ON
	6	Multi-function Command S2 1 : ON
	7	Multi-function Command S3 1 : ON
00E7H		Frequency Command
00E8H		Remote Keypad Used
00E9H		(Reserved)
00EAH		(Reserved)
00EBH		(Reserved)
00ECH		(Reserved)
00EDH		(Reserved)
00EEH		(Reserved)

(Note) Bits that are not used are defined as “0”, registers defined as “NOT USED”, are read only.

4.2 Monitor Data (Read Only)

Register No.	Content			
00EFH	Bit	Description	1	0
	0	Operation state	Run	Stop
	1	Direction state	Reverse	Forward
	2	Inverter operation prepare state	ready	unready
	3	Abnormal	Abnormal	
	4	DATA setting error	Error	
	5-F	(not used)		
00F0H	Fault Description			
	Code	Description	Code	Description
	00	The inverter is normal	01	Inverter over heat (OH)
	02	Over current at stop (OC)	03	Under voltage (LV)
	04	Over voltage (OV)	05	External BB (b.b.)
	06	CPU interrupted (CT)	07	PID feedback signal loss (PID)
	08	EEPROM abnormal (EPR)	09	Inverter over load (OL2)
	10	Motor over load (OL1)	11	Emergency stop (E.S.)
	12	(unused)	13	Over current at constant speed (OCC)
	14	Over current during accelerating (OCA)	15	Over current during decelerating (OCD)
	16	Over current at startup (OCS)	17	Under voltage during running (LVC)
	18	Over voltage at constant speed / decelerating (OVC)	19	Inverter over heat at constant speed (OHC)
	20	Stop at 0 Hz (SP0)	21	Direct start disable (SP1)
	22	Control panel emergency stop (SP2)	23	Keypad operation error (ER1)
	24	Parameter setting error (ER2)	25	Analog converting error (ER4)
	26	Modifying the parameter in communication (ER5)	27	Communication failure (ER6)
	28	Incorrect parameter setting (ER7)	29	Factory setting error (ER8)
	30	Copy (CPY)	31	Compare (CPR)
	32	Copy error (EP1)	33	Compare error (EP2)
	34	Inverter over speed (OVS)	35	Over current limit (OCL)

	36~45	(not used) Define as "0"			
--	-------	--------------------------	--	--	--

Register No.	Content				
00F1H	Bit		Description	1	0
	Sequence input status	0	Terminal S1	Closed	Opened
		1	Terminal S2	Closed	Opened
		2	Terminal S3	Closed	Opened
		3	Terminal S4	Closed	Opened
		4	(not used)		
		5	(not used)		
	Contact output	6	Terminal AIN	Closed	Opened
		7	Multi-function output 1(RELAY1)	ON	OFF
8-F		(not used)			
00F2H	Frequency command (100/1Hz)				
00F3H	Output frequency (100/1Hz)				
00F4H	Output voltage command (10/1V)				
00F5H	Output DC voltage command (1/1V)				
00F6H	Output current (10/1A)				
00F7H	PID Feedback value (100% / Max output frequency, 10/1%)				
00F8H	PID input value (100% / Max output frequency, 10/1% , sign attached)				
00F9H	TM2 AIN input value (100% / 10V) *1				
00FAH	Keypad AIN input value (100% / 10V) *1				
00FBH	Remote keypad used				
00FCH	Remote keypad used				
00FDH	(Reserved)				
00FEH	(Reserved)				
00FFH	(Reserved)				

(Note) Do not write data in the reserved registers.

5. Function Code

5.1 Read Data from Holding Register [03H]

Read the data from a register at a specified address.

Example: Read the frequency reference command from address 1.

ASCII Mode

Instruction Message	
STX	3AH
Follower Address	30H
	31H
Function Code	30H
	33H
Start Address	30H
	30H
	46H
	32H
Quantity	30H
	30H
	30H
	31H
LRC CHECK	30H
	39H
END	0DH
	0AH

Response Message (Normal)	
STX	3AH
Follower Address	30H
	31H
Function Code	30H
	33H
DATA number	30H
	32H
First holding register	31H
	37H
	37H
	30H
LRC CHECK	37H
	33H
END	0DH
	0AH

Response Message (Fault)	
STX	3AH
Follower Address	30H
	32H
Function Code	38H
	33H
Error Code	35H
	32H
LRC CHECK	32H
	41H
END	0DH
	0AH

RTU Mode

Instruction Message		
Follower Address		01H
Function Code		03H
Start Address	High	00H
	Low	F2H
Quantity	High	00H
	Low	01H
CRC-16	High	25H
	Low	F9H

Response Message (Normal)		
Follower Address		01H
Function Code		03H
DATA number		02H
First holding register	High	17H
	Low	70H
CRC-16	High	B6H
	Low	50H

Response Message (Fault)		
Follower Address		01H
Function Code		83H
Error Code		52H
CRC-16	High	C0H
	Low	CDH

5.2 Loop Back Test [08H]

The test function to check the transmission of the signal between MASTER and FOLLOWER.

ASCII Mode

Instruction Message	
STX	3AH
Follower Address	30H 31H
Function Code	30H 38H
Test Codes	30H 30H 30H 30H
DATA	41H 35H 33H 37H
LRC CHECK	31H 42H
END	0DH 0AH

Response Message (Normal)	
STX	3AH
Follower Address	30H 31H
Function Code	30H 38H
Test Codes	30H 30H 30H 30H
DATA	41H 35H 33H 37H
LRC CHECK	31H 42H
END	0DH 0AH

Response Message (Fault)	
STX	3AH
Follower Address	30H 31H
Function Code	38H 38H
Error Code	32H 30H
LRC CHECK	37H 35H
END	0DH 0AH

RTU Mode

Instruction Message		
Follower Address		01 H
Function Code		08H
Test Codes	High	00H
	Low	00H
DATA	High	A5H
	Low	37H
CRC-16	High	DAH
	Low	8DH

Response Message (Normal)		
Follower Address		01H
Function Code		08H
Test Codes	High	00H
	Low	00H
DATA	High	A5H
	Low	37H
CRC-16	High	DAH
	Low	8DH

Response Message (Fault)		
Follower Address		01H
Function Code		88H
Error Code		20H
CRC-16	High	47H
	Low	D8H

5.3 Write to Holding Register [06H]

Send data to a specific holding register.

(e.g.) send the frequency command 60.0Hz from the PLC to FOLLOWER with address 1.

ASCII Mode

Instruction Message	
STX	3AH
Follower Address	30H 31H
Function Code	30H 36H
Start Address	30H 30H 45H 37H
DATA	31H 37H 37H 30H
LRC CHECK	38H 42H
END	0DH 0AH

Response Message (Normal)	
STX	3AH
Follower Address	30H 31H
Function Code	30H 36H
Start Address	30H 30H 45H 37H
DATA	31H 37H 37H 30H
LRC CHECK	38H 42H
END	0DH 0AH

Response Message (Fault)	
STX	3AH
Follower Address	30H 31H
Function Code	38H 36H
Error Code	35H 32H
LRC CHECK	32H 37H
END	0DH 0AH

RTU Mode

Instruction Message		
Follower Address		01 H
Function Code		06H
Start Address	High	00H
	Low	E7H
DATA	High	17H
	Low	70H
CRC-16	High	37H
	Low	E9H

Response Message (Normal)		
Follower Address		01H
Function Code		06H
Start Address	High	00H
	Low	E7H
DATA	High	17H
	Low	70H
CRC-16	High	37H
	Low	E9H

Response Message (Fault)		
Follower Address		01H
Function Code		86H
Error Code		52H
CRC-16	High	C3H
	Low	9DH

5.4 Write to Multiple Holding Registers [10H]

Send data to multiple registers starting at a specific address.

E.g. send a frequency command 'Running forward 60 Hz.' to Follower with address 1.

ASCII Mode

Instruction Message	
STX	3AH
Follower Address	30H
	31H
Function Code	31H
	30H
Start Address	30H
	30H
	45H
	36H
Quantity	30H
	30H
	30H
	32H
DATA Number*	30H
	34H
First DATA	30H
	30H
	30H
	31H
Next DATA	31H
	37H
	37H
	30H
LRC CHECK	37H
	42H
END	0DH
	0AH

Response Message (Normal)	
STX	3AH
Follower Address	30H
	31H
Function Code	31H
	30H
Start Address	30H
	30H
	45H
	36H
Quantity	30H
	30H
	30H
	32H
LRC CHECK	30H
	37H
END	0DH
	0AH

Response Message (Fault)	
STX	3AH
Follower Address	30H
	31H
Function Code	39H
	30H
Error Code	35H
	32H
LRC CHECK	31H
	44H
END	0DH
	0AH

See following page for RTU Mode

RTU Mode

Instruction Message		
Follower Address		01 H
Function Code		10H
Start Address	High	00H
	Low	E6H
Quantity	High	00H
	Low	02H
DATA Number *		04H
First DATA	High	00H
	Low	01H
Next DATA	High	17H
	Low	70H
CRC-16	High	22H
	Low	19H

Response Message (Normal)		
Follower Address		01H
Function Code		10H
Start Address	High	00H
	Low	E6H
Quantity	High	00H
	Low	02H
CRC-16	High	A0H
	Low	3FH

Response Message (Fault)		
Follower Address		01H
Function Code		90H
Error Code		52H
CRC-16	High	CDH
	Low	FDH

(Note) Data numbers are the actual number times 2

6. MODBUS Register Addresses

Register No.	Function
0001H	F01
0002H	F02
0003H	F03
0004H	F04
0005H	F05
0006H	F06
0008H	F07
0007H	F08
000AH	F09
000BH	F10
000EH	F11
000FH	F12
0010H	F13
0011H	F14
0012H	F15
0092H	F16
0013H	F17
0014H	F18
0076H	F19
0077H	F20
0015H	F21
0016H	F22
0017H	F23
009FH	F24
00A0H	F25

Register No.	Function
0018H	F26
0019H	F27
001AH	F28
001BH	F29
001CH	F30
001DH	F31
001EH	F32
001FH	F33
0020H	F34
0021H	F35
0022H	F36
0023H	F37
0024H	F38
0025H	F39
0026H	F40
0027H	F41
0028H	F42
0095H	F43
0096H	F44
0099H	F45
0097H	F46
0098H	F47
00DCH	F48
00DDH	F49
00DFH	F50

Register No.	Function
002AH	F51
002BH	F52

MODBUS Register Addresses (con't)

Register No.	Function
0064H	C00
0065H	C01
0066H	C02
0067H	C03
0068H	C04
0069H	C05
006AH	C06
006BH	C07
006CH	C08
006DH	C09
006EH	C10
006FH	C11
0070H	C12
0071H	C13
009AH	C14
0007H	C15
009EH	C16
007AH	C17
007BH	C18
007CH	C19
007DH	C20
007EH	C21
000CH	C23
000DH	C24
0029H	C25

Register No.	Function
0080H	C26
0081H	C27
0082H	C28
0083H	C29
008AH	C30
008BH	C31
008CH	C32
008DH	C33
008EH	C34
008FH	C35
0090H	C36
0091H	C37
0093H	C38
0094H	C39
0072H	C40
009DH	C41
0073H	C42
0074H	C43
0075H	C44
0078H	C45
0079H	C46
0030H	C47
0084H	C48
0085H	C49
0086H	C50

Register No.	Function
0087H	C51
0088H	C52
0089H	C53
009BH	C54
009CH	C55
009BH	
009CH	
009DH	
009EH	
009FH	
00A0H	
00A1H	
00A2H	
00A3H	
00A4H	
00A5H	
00A6H	
00A7H	
00A8H	
00A9H	
00AAH	
00ABH	
00ACH	
00ADH	
00AEH	