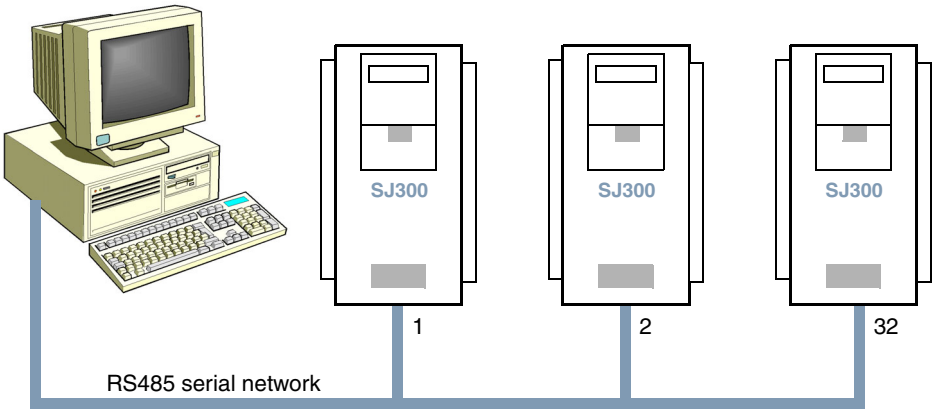
Serial Communications

B

In This Appendix.... page

Introduction

SJ300 inverters have a built-in RS485 serial communications interface. This serial communications function provides a way of controlling from 1 to 32 inverters on a common serial network. In a typical application, a host computer or controller is the master and each of the inverter(s) is a slave, as shown in the figure below.

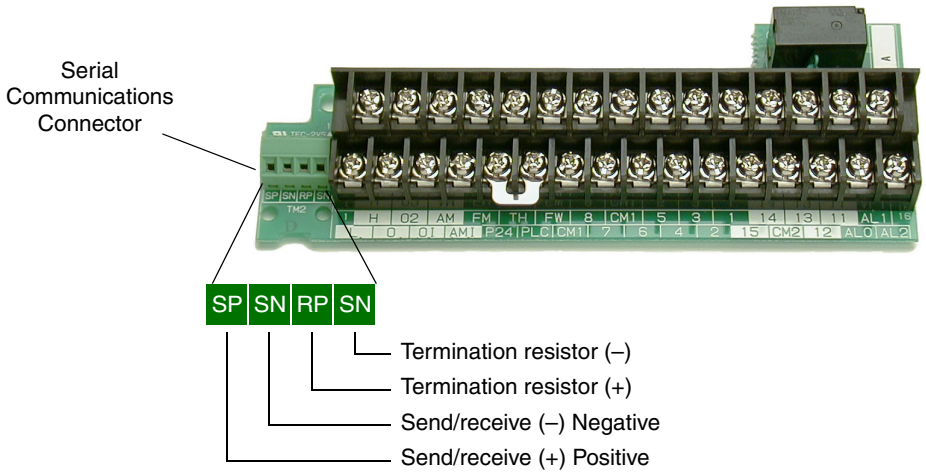


The specifications for SJ300 Series RS485 serial communications are in the following table:

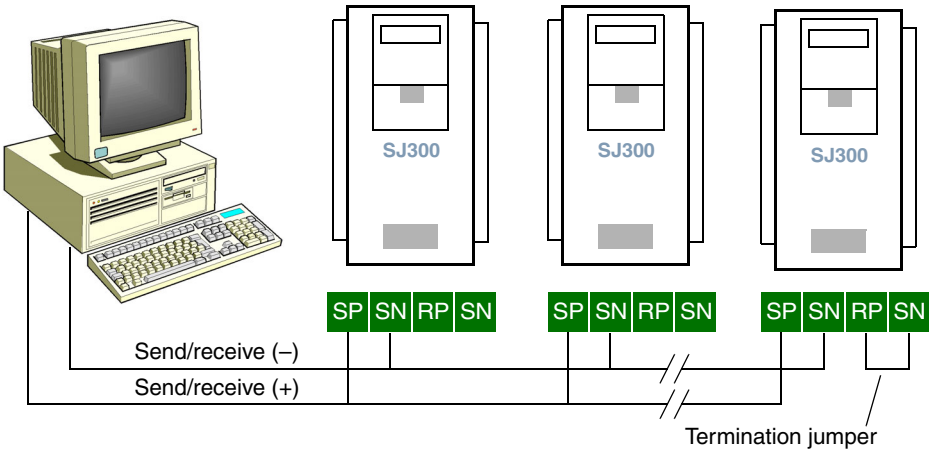
Item	Specifications	User-selectable
Transmission speed	2400 / 4800 / 9600 / 19200 bps	✔
Communication modes	Half duplex (one device transmits at a time)	✘
Synchronization	Direct current transmission	✘
Character code	ASCII codes	✘
LSB placement	Transmits LBB first	✘
Electrical interface	RS485 differential transceiver	✘
Data bits	7 or 8 bits	✔
Parity	None / even / odd	✔
Stop bits	1 or 2 bits	✔
Start convention	One-way start from host device command	✘
Wait time for response	10 to 1000 ms	✔
Connections	Station address numbers from 1 to 32	✔
Error check	Overrun / Fleming block check code / vertical or horizontal parity	✘

Serial Connection Diagrams

The serial connector is to the left of the control logic connector as shown below:



Each device requires just two connections for data transmission and reception. Additionally, the device at each physical end of the wiring requires a termination resistor. The SJ300 has built-in termination resistors that become part of the circuit when you add a jumper as shown.



TIP: Each slave device on the serial network must have a unique node address, set by parameter C072. If this is a new application, we recommend connecting one new device at a time and checking the communications after each addition.

Serial Network Parameter Settings

Several parameter settings are necessary to configure serial communications, listed below.

Function Code	Item	Value	Description
C070	Data command source	02	Digital operator
		03	RS485 connector
		04	Expansion card #1
		05	Expansion card #2
C071	Baud rate	02	Loop-back test
		03	2400 bps
		04	4800 bps
		05	9600 bps
		06	19200 bps
C072	Node address	1 to 32, FF	1 to 32 – Node or station address (unique to each inverter or device) FF – Automatic broadcast (to all nodes on transmit, allowed only on certain commands (refer to each command description in this appendix)
C073	Data bits	07	7 bits
		08	8 bits
C074	Parity	00	none
		01	Even parity
		02	Odd parity
C075	Stop bits	01	1 bit
		02	2 bits
C078	Wait time	0 to 1000	0 to 1000 ms time that the inverter waits to respond to network master

For inverters on the same network, some settings must match from inverter to inverter. These include:

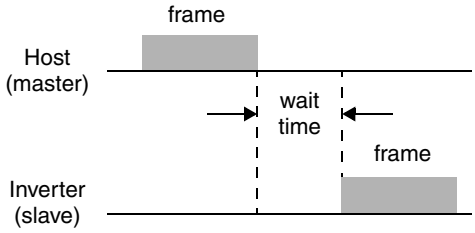
- Baud rate
- Data bits
- Parity
- Stop bits

However, the node address on each inverter must be unique, used only once on the network.

Communications Protocol

Introduction to Command List

The network master sends a frame to initiate communications with a slave, as shown in the figure to the right. After the set waiting time (per parameter C078, the inverter responds.



The following table lists the commands, single-character codes sent to a particular device on the network.

Command Code	Description	User-selectable
00	Forward / Reverse / Stop command	✔
01	Setting of frequency in standard profile	✔
02	Setting of intelligent terminal state	✔
03	Read all monitor data (block read)	—
04	Read inverter status	—
05	Read trip history	—
06	Read a single parameter value	—
07	Write a single parameter value	✔
08	Set inverter parameters to default values	✔
09	Verifies that the requested setting can be written to EEPROM.	—
0A	Writes a parameter value to EEPROM	✔
0B	Requests the recalculation of internal constant	✔

NOTE: Use of command 08 – set inverter parameters to default values first requires setting the initialization mode parameter B084 to 01 (initializes parameters only) or 02 (initializes parameters and clears the trip history).

Command – 00

The 00 command controls the Forward, Reverse and Stop mode of the inverter. You must set parameter A002=03 in order for serial communications control of the inverter to apply.

The frame format of command 00 follows the timing diagram and specification table.

Frame format

STX	Node	Command	Data	BCC	[CR]

Element	Description	Size	Value
STX	Control code (STart of TeXt)	1 byte	STX (0x02)
Node	Node (station) address of inverter	2 bytes	01 to 32, and FF (broadcast to all nodes)
Command	Transmission command	2 bytes	00
Data	Transmission data	1 byte	00 = Stop command 01 = Forward command 02 = Reverse command
BCC	Block check sum code	2 bytes	Exclusive OR of Node, Command, and Data
[CR]	Control code (carriage return)	1 byte	[CR] (0x0D)

The example below shows a transmission to the inverter at address Node 1 to rotate the motor in the forward direction.

(STX) | 01 | 00 | 1 | (BCC) | [CR] —to ASCII→ 02 | 30 31 | 30 30 | 31 | 33 30 | 0D

Command – 01

The 01 command sets the output frequency for the standard profile. You must set parameter A003=01 in order for serial communications control of the inverter to apply.

The frame format of command 01 follows the timing diagram and specification table.

Frame format

STX	Node	Command	Data	BCC	[CR]

Element	Description	Size	Value
STX	Control code (STart of TeXt)	1 byte	STX (0x02)
Node	Node (station) address of inverter	2 bytes	01 to 32, and FF (broadcast to all nodes)
Command	Transmission command	2 bytes	01
Data	Transmission data	6 bytes	ASCII code for ten times the frequency (accommodates two decimal places)
BCC	Block check sum code	2 bytes	Exclusive OR of Node, Command, and Data
[CR]	Control code (carriage return)	1 byte	[CR] (0x0D)

The example below shows a transmission to the inverter at address Node 1 to set the output frequency for 5 Hz. We use a value of 500 in ASCII to represent 5.00 Hz.

(STX) | 01 | 01 | 000500 | (BCC) |

—to ASCII→ 02 | 30 31 | 30 31 | 30 30 30 35 30 30 | 30 35 |

Command – 02

The 02 command assigns the function of the intelligent input terminals.

The frame format of command 02 follows the timing diagram and specification table.

Frame format

STX	Node	Command	Data	BCC	[CR]

Element	Description	Size	Value
STX	Control code (STart of TeXt)	1 byte	STX (0x02)
Node	Node (station) address of inverter	2 bytes	01 to 32, and FF (broadcast to all
Command	Transmission command	2 bytes	02
Data	Transmission data	16 bytes	(see table below)
BCC	Block check sum code	2 bytes	Exclusive OR of Node, Command, and Data
[CR]	Control code (carriage return)	1 byte	[CR] (0x0D)

The 16-byte data string is specified in the following table:

Data (Hex)	Description	Data (Hex)	Description
0000000000000001	[FW] Forward command	0000000001000000	[PIDC] PID integrator reset
0000000000000002	[RV] Reverse command	0000000002000000	—
0000000000000004	[CF1] Multi-speed 1	0000000004000000	[CAS] control gain switching function
0000000000000008	[CF2] Multi-speed 2	0000000008000000	[UP] remote control increment speed
0000000000000010	[CF3] Multi-speed 3	0000000010000000	[DWN] remote control decrement speed
0000000000000020	[CF4] Multi-speed 4	0000000020000000	[UDC] remote control clear up/down
0000000000000040	[JG] Jog operation	0000000040000000	—
0000000000000080	[DB] Dynamic braking	0000000080000000	[OPE] Force from operator terminal
0000000000000100	[SET] set 2nd motor	0000000100000000	[SF1] Multi-speed bit-level
0000000000000200	[2CH] 2-stage adjustable speed	0000000200000000	[SF2] Multi-speed bit-level
0000000000000400	—	0000000400000000	[SF3] Multi-speed bit-level
0000000000000800	[FRS] Free-run stop	0000000800000000	[SF4] Multi-speed bit-level
0000000000001000	[EXP] External trip	0000001000000000	[SF5] Multi-speed bit-level
0000000000002000	[USP] Unattended start protection	0000002000000000	[SF6] Multi-speed bit-level
0000000000004000	[CS] Commercial power change	0000004000000000	[SF7] Multi-speed bit-level
0000000000008000	[SFT] Software lock	0000008000000000	[OLR] Overload restriction setting
0000000000010000	[AT] analog input voltage/current	0000010000000000	[TL] Torque limit
0000000000020000	[SET3] Set 3rd motor	0000020000000000	[TRQ1] Torque limit select 1
0000000000040000	[RS] Reset	0000040000000000	[TRQ2] Torque limit select 2
0000000000080000	—	0000080000000000	[PPI P/PI] inverter mode select
0000000000100000	[STA] 3-wire Start	0000100000000000	[BOK] Brake confirmation
0000000000200000	[ST]P 3-wire Hold	0000200000000000	[ORT] Orientation (home) command
0000000000400000	[F/R] 3-wire FWD/REV	0000400000000000	[LAC] Linear Accel/decel Cancel
0000000000800000	[PID] PID enable	0000800000000000	[PCLR] Position error clear
—	—	0001000000000000	[STAT] Pulse train input enable

The arrangement of the terminal assignment data permits you to assign all inputs in a single command. The example below shows a transmission to the inverter at address Node 1 to set the Forward command, Multi-speed 1 and Multi-speed 2.

Sum the three data strings:

0x0000000000000001
+ 0x0000000000000004
+ 0x0000000000000008
= 0x000000000000000D

(STX) | 01 | 02 | 0x000000000000000D | (BCC) | (CR) → to ASCII

02 | 30 31 | 30 31 | 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 30 | 68 | 30 35 | 0D

Command – 03

The 03 command reads the monitor data as a single block.

The frame format of command 03 follows the diagram and specification table. The transmit frame has no data field.

Transmit frame format

STX	Node	Command	BCC	[CR]

Element	Description	Size	Value
STX	Control code (STart of TeXt)	1 byte	STX (0x02)
Node	Node (station) address of inverter	2 bytes	01 to 32
Command	Transmission command	2 bytes	03
BCC	Block check sum code	2 bytes	Exclusive OR of Node, Command, and Data
[CR]	Control code (carriage return)	1 byte	[CR] (0x0D)

The receive frame has a 104-byte data field, containing values for 13 items.

Receive frame format

STX	Node	Data	BCC	[CR]

Element	Description	Size	Value
STX	Control code (STart of TeXt)	1 byte	STX (0x02)
Node	Node (station) address of inverter	2 bytes	01 to 32
Data	Transmission data	104 bytes	(see next table)
BCC	Block check sum code	2 bytes	Exclusive OR of Node, Command, and Data
[CR]	Control code (carriage return)	1 byte	[CR] (0x0D)

The data in the receive frame contains 8-byte values for 13 items, listed in the table below:

No.	Monitor Item	Units	Multiplier
1	Output frequency	Hz	100
2	Output current	A	10
3	Direction of rotation	—	—
4	PID feedback monitor	%	100
5	Intelligent input monitor	—	—
6	Intelligent output monitor	—	—
7	Frequency converting monitor	—	100
8	Output torque monitor	%	1
9	Output voltage monitor	V	10
10	Electric power monitor	kW	10
11	Reserved	—	—
12	Run Mode time monitor	hours	1
13	Power ON time monitor	hours	1

The eight bytes for intelligent input or intelligent output data have a bit set in the data field for each I/O point that is ON, according to the following table:

Terminal	Monitor Item	Data
[FW]	Forward input	00000001
[1]	Input 1	00000002
[2]	Input 2	00000004
[3]	Input 3	00000008
[4]	Input 4	00000010
[5]	Input 5	00000020
[6]	Input 6	00000040
[7]	Input 7	00000080
[8]	Input 8	00000100
[AL]	Alarm relay	00000001
[11]	Output 1	00000002
[12]	Output 2	00000004
[13]	Output 3	00000008
[14]	Output 4	00000010
[15]	Output 5	00000020

Command – 04

The 04 command reads the status of the inverter. The frame format of command 04 follows the diagrams and specification tables. The transmit frame has no data field.

Transmit frame format

STX	Node	Command	BCC	[CR]

Element	Description	Size	Value
STX	Control code (STart of TeXt)	1 byte	STX (0x02)
Node	Node (station) address of inverter	2 bytes	01 to 32
Command	Transmission command	2 bytes	04
BCC	Block check sum code	2 bytes	Exclusive OR of Node, Command, and Data
[CR]	Control code (carriage return)	1 byte	[CR] (0x0D)

The receive frame has an 8-byte data field, containing values for three trip items (plus a reserved field).

Receive frame format

STX	Node	Data	BCC	[CR]

Element	Description	Size	Value
STX	Control code (STart of TeXt)	1 byte	STX (0x02)
Node	Node (station) address of inverter	2 bytes	01 to 32
Data	Transmission data	8 bytes	(see next table)
BCC	Block check sum code	2 bytes	Exclusive OR of Node, Command, and Data
[CR]	Control code (carriage return)	1 byte	[CR] (0x0D)

Trip data is organized as shown. The table below lists the codes and their meanings.

Data field contents

Status A	Status B	Status C	(reserved)

Code	Status A Definition	Status B Definition	Status C Definition
00	Initial status	On stopping	—
01	—	On running	Stop
02	On Stopping	On tripping	Deceleration speed
03	On running	—	Constant speed
04	On free-run stop	—	Acceleration speed
05	On jog	—	Forward
06	On dynamic braking	—	Reverse
07	On retry	—	Reverse from forward
08	On trip	—	Forward from reverse
09	On under-voltage	—	Forward start
10	—	—	Reverse start

Command – 05

The 05 command reads the inverter's trip history. The frame format of command 05 follows the diagrams and specification tables. The transmit frame has no data field.

Transmit frame format

STX	Node	Command	BCC	[CR]

Element	Description	Size	Value
STX	Control code (STart of TeXt)	1 byte	STX (0x02)
Node	Node (station) address of inverter	2 bytes	01 to 32
Command	Transmission command	2 bytes	05
BCC	Block check sum code	2 bytes	Exclusive OR of Node, Command, and Data
[CR]	Control code (carriage return)	1 byte	[CR] (0x0D)

The receive frame has a 440-byte data field. This consists of an 8-byte total accumulated number of trip events, followed by six 72-byte strings for the six most recent trip events as shown below.

Receive frame format

STX	Node	Data	BCC	[CR]

Data field contents

Total count	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6

Element	Description	Size	Value
STX	Control code (STart of TeXt)	1 byte	STX (0x02)
Node	Node (station) address of inverter	2 bytes	01 to 32
Data	Transmission data	440 bytes	(see next table)
BCC	Block check sum code	2 bytes	Exclusive OR of Node, Command, and Data
[CR]	Control code (carriage return)	1 byte	[CR] (0x0D)

The nine bytes of data for each trip event history is listed below. The data contains the multiplier to adjust the decimal point. Divide the data by that factor to derive the actual value.

No.	Monitor Item	Units	Multiplier
1	Trip factor	—	—
2	Inverter Status A	—	—
3	Inverter Status B	—	—
4	Inverter Status C	—	—
5	Output frequency	Hz	10
6	Accumulated Run Mode time	hours	1
7	Output current	A	10
8	Output voltage	V	10
9	Power ON time	hours	1

For Command 05, bytes 2, 3, and 4 of the event history are status codes A, B, and C, respectively. The tables below provide status code descriptions.

Data field contents

	byte 2	byte 3	byte 4	
	Status A	Status B	Status C	

Code	Status A Definition	Status C Definition
00	Initial status	On reset
01	—	On stopping
02	On Stopping	On deceleration
03	On running	Constant speed
04	On free-run stop	On acceleration
05	On jog	On 0 Hz running
06	On dynamic braking	On running
07	On retry	On dynamic braking
08	On trip	On overload restriction
09	On under-voltage	—

Bit	Status B Definition	Error Code
0	Ground fault	E14
1	IGBT error, U phase	E30
2	Under-voltage error	E09
3	Over-voltage protection	E07
4	Thermal trip	E21
5	IGBT error, V phase	E30
6	IGBT error, W phase	E30
7	Gate array error	E23

Command – 06

The 06 command reads a single parameter value from the inverter, which is specified by the data field this read command.

Transmit frame format

STX	Node	Command	Data	BCC	[CR]

Element	Description	Size	Value
STX	Control code (STart of TeXt)	1 byte	STX (0x02)
Node	Node (station) address of inverter	2 bytes	01 to 32
Command	Transmission command	2 bytes	06
Data	Parameter specified to be read	4 bytes	(see tables below)
BCC	Block check sum code	2 bytes	Exclusive OR of Node, Command, and Data
[CR]	Control code (carriage return)	1 byte	[CR] (0x0D)

The receive frame includes an ACK (acknowledge) character, followed by an 8-byte data field.

Receive frame format

STX	Node	ACK	Data	BCC	[CR]

Element	Description	Size	Value
STX	Control code (STart of TeXt)	1 byte	STX (0x02)
Node	Node (station) address of inverter	2 bytes	01 to 32
ACK	Control code (ACKnowledge)	1 byte	ACK (0x06)
Data	Parameter value	8 bytes	Value of parameter times ten, returned as ASCII char. code, except for H003 and H203 (see table below)
BCC	Block check sum code	2 bytes	Exclusive OR of Node, Command, and Data
[CR]	Control code (carriage return)	1 byte	[CR] (0x0D)

Use the codes in the table below to return parameters for H03 and H203 (motor capacity selection).

Code Data	00	01	02	03	04	05	06	07	08	09	10
U.S. mode (B85=00, 02)	0.2 kW		0.4		0.75		1.5	2.,2		3.7	
EU mode (B85=01)	0.2 kW	0.37		0.55	0.75	1.1	1.5	2.2	3.0		4.0
Code Data	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**
U.S. mode (B85=00, 02)	5.5 kW	7.5	11	15	18.5	22	30	37	45	55	75
EU mode (B85=01)	5.5 kW	7.5	11	15	18.5	22	30	37	45	55	75

Command – 07

The 07 command sets a parameter value equal to the value specified in the transmission.The frame format of command 07 follows the diagram and specification table.

Frame format

STX	Node	Command	Parameter	Data	BCC	[CR]

Element	Description	Size	Value
STX	Control code (STart of TeXt)	1 byte	STX (0x02)
Node	Node (station) address of inverter	2 bytes	01 to 32, and FF (broadcast to all nodes)
Command	Transmission command	2 bytes	07
Parameter	Function code of parameter	4 bytes	F002..., A001..., B001..., C001..., H003..., P001...
Data	Transmission data	8 bytes	Value of parameter times ten as ASCII char. code, except for H003 and H203 (see table below)
BCC	Block check sum code	2 bytes	Exclusive OR of Node, Command, and Data
[CR]	Control code (carriage return)	1 byte	[CR] (0x0D)

Note that the parameter F001, the output frequency, can be set more directly with host command 01 instead of with this command. Use the codes in the following table for setting parameters associated with H003 and H203.

Code Data	00	01	02	03	04	05	06	07	08	09	10
U.S. mode (B85=00, 02)	0.2 kW		0.4		0.75		1.5	2.,2		3.7	
EU mode (B85=01)	0.2 kW	0.37		0.55	0.75	1.1	1.5	2.2	3.0		4.0
Code Data	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**
U.S. mode (B85=00, 02)	5.5 kW	7.5	11	15	18.5	22	30	37	45	55	75
EU mode (B85=01)	5.5 kW	7.5	11	15	18.5	22	30	37	45	55	75

Command – 08

The 08 command initializes the inverter parameters to the factory default values. First, you must set B84 (use command 07) to specify whether you want to clear the trip history at the same time. Also, set B85 to specify the country code for the initialization (use command 07).

The frame format of command 08 follows the diagram and specification table.

Frame format

STX	Node	Command	BCC	[CR]

Element	Description	Size	Value
STX	Control code (STart of TeXt)	1 byte	STX (0x02)
Node	Node (station) address of inverter	2 bytes	01 to 32, and FF (broadcast to all nodes)
Command	Transmission command	2 bytes	08
BCC	Block check sum code	2 bytes	Exclusive OR of Node, Command, and Data
[CR]	Control code (carriage return)	1 byte	[CR] (0x0D)

Command – 09

The 09 command verifies whether or not it is possible to set a particular parameter in the EEPROM. The frame format of command 08 follows the diagram and specification table.

Transmit frame format

STX	Node	Command	BCC	[CR]

Element	Description	Size	Value
STX	Control code (STart of TeXt)	1 byte	STX (0x02)
Node	Node (station) address of inverter	2 bytes	01 to 32
Command	Transmission command	2 bytes	09
BCC	Block check sum code	2 bytes	Exclusive OR of Node, Command, and Data
[CR]	Control code (carriage return)	1 byte	[CR] (0x0D)

The receive frame includes an ACK (acknowledge) character, followed by a 2-byte data field with the result.

Receive frame format

STX	Node	ACK	Data	BCC	[CR]

Element	Description	Size	Value
STX	Control code (STart of TeXt)	1 byte	STX (0x02)
Node	Node (station) address of inverter	2 bytes	01 to 32
ACK	Control code (ACKnowledge)	1 byte	ACK (0x06)
Data	Parameter value	2 bytes	00 = setting not allowed, 01 = setting is allowed
BCC	Block check sum code	2 bytes	Exclusive OR of Node, Command, and Data
[CR]	Control code (carriage return)	1 byte	[CR] (0x0D)

Command – 0A

The 0A command sets a value in the EEPROM.

The frame format of command 0A follows the diagram and specification table.

Frame format

STX	Node	Command	BCC	[CR]

Element	Description	Size	Value
STX	Control code (STart of TeXt)	1 byte	STX (0x02)
Node	Node (station) address of inverter	2 bytes	01 to 32, and FF (broadcast to all nodes)
Command	Transmission command	2 bytes	0A
BCC	Block check sum code	2 bytes	Exclusive OR of Node, Command, and Data
[CR]	Control code (carriage return)	1 byte	[CR] (0x0D)

Command – 0B

The 0B command recalculates the inverter's internal motor constants. Use this function after the base frequency or any Hxxx parameters are changed via the serial link commands.

The frame format of command 0B follows the diagram and specification table.

Frame format

STX	Node	Command	BCC	[CR]

Element	Description	Size	Value
STX	Control code (STart of TeXt)	1 byte	STX (0x02)
Node	Node (station) address of inverter	2 bytes	01 to 32
Command	Transmission command	2 bytes	0B
BCC	Block check sum code	2 bytes	Exclusive OR of Node, Command, and Data
[CR]	Control code (carriage return)	1 byte	[CR] (0x0D)

Communications Reference Information

Inverter Affirmative Reply

The standard affirmative reply from the inverter uses the ACK character (acknowledge) in the data field. The frame format of this reply follows the diagram and specification table.

Frame format

STX	Node	ACK	BCC	[CR]

Element	Description	Size	Value
STX	Control code (STart of TeXt)	1 byte	STX (0x02)
Node	Node (station) address of inverter	2 bytes	01 to 32
ACK	Control code (ACKnowledge)	1 byte	ACK (0x06)
BCC	Block check sum code	2 bytes	Exclusive OR of Node and ACK
[CR]	Control code (carriage return)	1 byte	[CR] (0x0D)

Inverter Negative Reply

The standard negative reply from the inverter uses the NAK character (negative acknowledge) in the data field. The frame format of this reply follows the diagram and specification table.

Frame format

STX	Node	NAK	Error code	BCC	[CR]

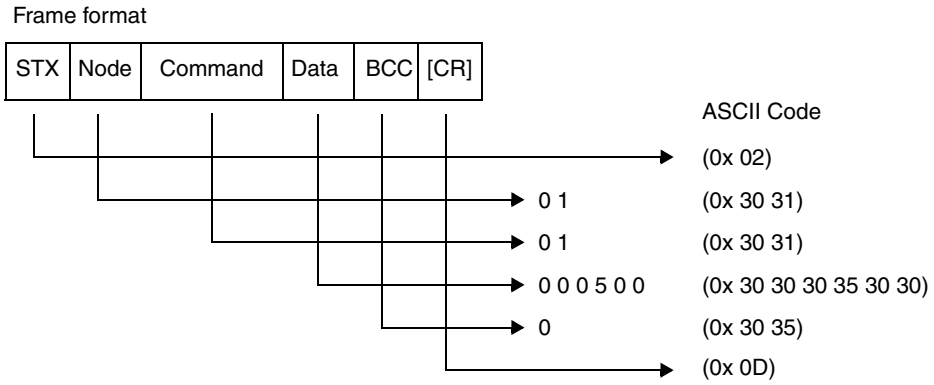
Element	Description	Size	Value
STX	Control code (STart of TeXt)	1 byte	STX (0x02)
Node	Node (station) address of inverter	2 bytes	01 to 32
Data	Error code – reason for negative acknowledge	2 bytes	(see error codes in next table)
NAK	Control code (Negative ACKnowledge)	1 byte	NAK (0x15)
Error code	Code representing error type	1 byte	(See next table below)
BCC	Block check sum code	2 bytes	Exclusive OR of Node, Data, and NAK
[CR]	Control code (carriage return)	1 byte	[CR] (0x0D)

The error codes for a NAK (negative acknowledge) are:

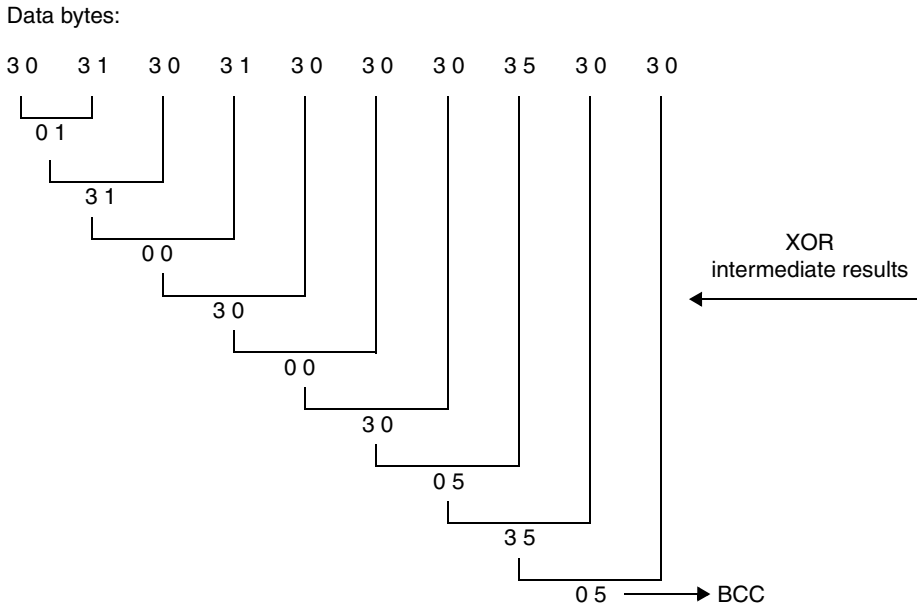
Error Code	Error Description	Error Code	Error Description
01H	Parity error	07H	Receive buffer overrun error
02H	Check sum error	08H	Receive time-out error
03H	Framing error	11H	Abnormal command code error
04H	Overrun error	13H	Test error code
05H	Protocol error	16H	Abnormal parameter code/value error
06H	ASCII code error	—	—

Block Check Code (BCC)

This section shows how the inverter protocol computes defines a BCC—block check code. The BCC is calculated for each frame transmitted and can be used to verify the integrity of data transmission. The example below shows command 01 setting the inverter frequency to 5Hz.



The block check code is computed by using the ASCII codes (shown above) and applying eXclusive OR (XOR) operations. Beginning with the first pair of bytes, the result of their XOR result is then used in an XOR operation with the third byte, and so on. For this example, the BCC calculation is shown below.



ASCII Code Table

The table below shows only the ASCII codes used for function codes and parameter data.

Character	ASCII Code	Character	ASCII Code	Character	ASCII Code
STX	0 2	4	3 4	C	4 3
ACK	0 6	5	3 5	D	4 4
CR	0 D	6	3 6	E	4 5
NAK	1 5	7	3 7	F	4 6
0	3 0	8	38	H	4 8
1	3 1	9	39	P	5 0
2	3 2	A	4 1	—	—
3	3 3	B	4 2	—	—