

Dry Vacuum Pump User-Available Communicating Specification

ESR Series
EST Series
ESA Series
EST200WN-TE
A300W-T/A300WM-IU
VOS Series
EV-S Series
EV-M Series

Approved by	Checked by	Prepared by
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Revision history

Rev.	Date	Changed contents	Approved by	Prepared by
0	2004/5/14	First issue.	Iijima	Yashiro
1	2004/5/28	Addition of interface connectors.	Iijima	Yashiro
2	2004/8/31	Addition of an analog data table for each model.	Iijima	Yashiro
3	2005/2/23	Change of the description about invalid analog data.	Iijima	Yamasaki
4	2007/3/7	Addition of EST200WN-TE.	Kido	Yashiro
5	2007/5/21	Addition of A300W-T/A300W-M.	Kido	Yamasaki
6	2007/8/1	Addition of VOS Series. Name change from A300W-M to A300WM-IU	Kido	Yamasaki
7	2007/9/21	Addition of descriptions about the response checksum for the analog read command "M20."	Kido	Yashiro
8	2008/5/7	There is no change in contents. Only Revision number is changed. (To match it with the Japanese edition)	Kido	Yamasaki
9	2008/11/19	Analog data content correction.	Kido	Yashiro
10	2009/3/19	Addition of EV-S Series. Alarm code list correction. Correct checksum for "M20" command.	Kido	Yashiro
11	2011/3/3	Addition of EV-M Series.	Oyama	Yashiro
12	2011/3/25	Addition of ESA80WN.	Oyama	Yashiro
13	2011/4/29	Addition of ESA25XW,ESA30XW.	Oyama	Yashiro

1. Applicable models

The communication specifications are applicable to ESR, EST, ESA Series, EST200WN-TE, A300W-T/A300WM-IU, VOS Series, and EV-S EV-M Series.

2. Specifications

(1) Communication

Table 1-1 Communication specifications

Electrical interface	RS-232C
Synchronization method	Start/stop method
Communication speed	9600 bps
Data length	8 bits
Stop bit	1 bit
Parity	None
Error control	Checksum
Busy control	None

(2) Interface connector

Connector on the pump side: D-sub 9-pin general serial port connector (male)

Connector assignment

Pin No. (pump side)			D-sub 9-pin (for PC/AT-compatible machines)		
2	TxD	_____	2	RxD	
3	RxD	_____	3	TxD	
5	GND	_____	5	GND	
7	CTS	_____	7	RTS	
8	RTS	_____	8	CTS	

(3) Frame

All commands and responses are transmitted with the following frame structure.

STX	TEXT	ETX	SUM *1	CR
0x02	ASCII characters (0x20 - 0x7f)	0x03	0x03 - 0x46	0x0D

*1 See Appendix A and B.

Fig. 1-1 Frame structure

(4) Data to be sent

ASCII codes are used.

	Character	ASCII code
Number	0 to 9	0x30 - 0x39
	A to F	0x41 - 0x46
Alphabet (Uppercase)	A to O	0x41 - 0x4F
	P to Z	0x50 - 0x5A
Control code	STX	0x02
	ETX	0x03
	CR	0x0D

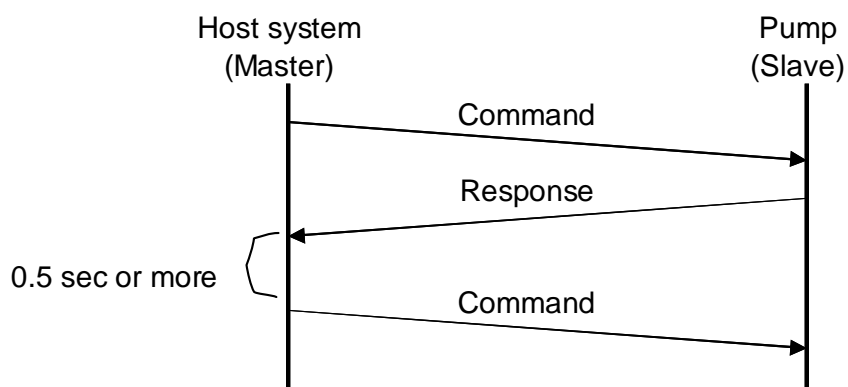
3. Protocol

The host system is defined as master while the pump is defined as slave.

Communication is established when the host system sends commands to the pump, and the pump responds to them (the pump does not send data independently).

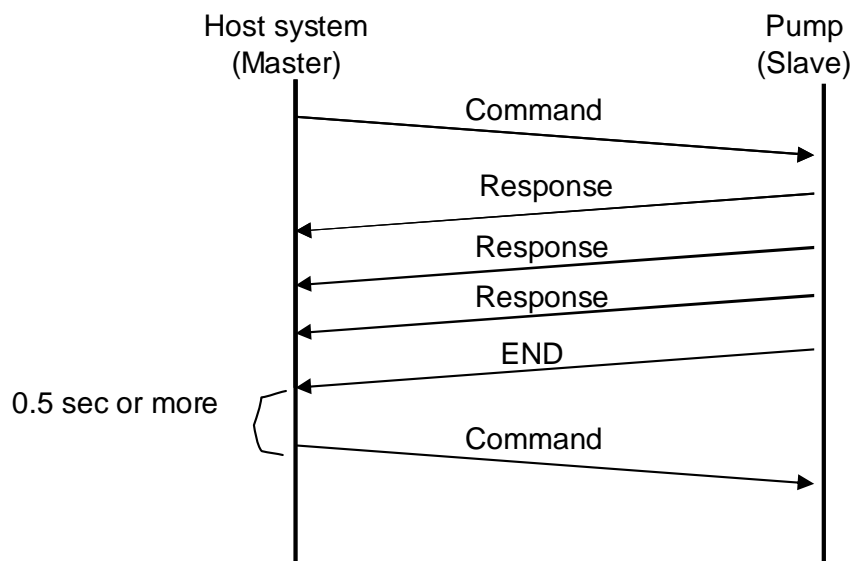
(1) Normal sequence (response: OK or NG)

The host system must wait 0.5 second or more between receiving a response and sending the next command if it sends commands successively.



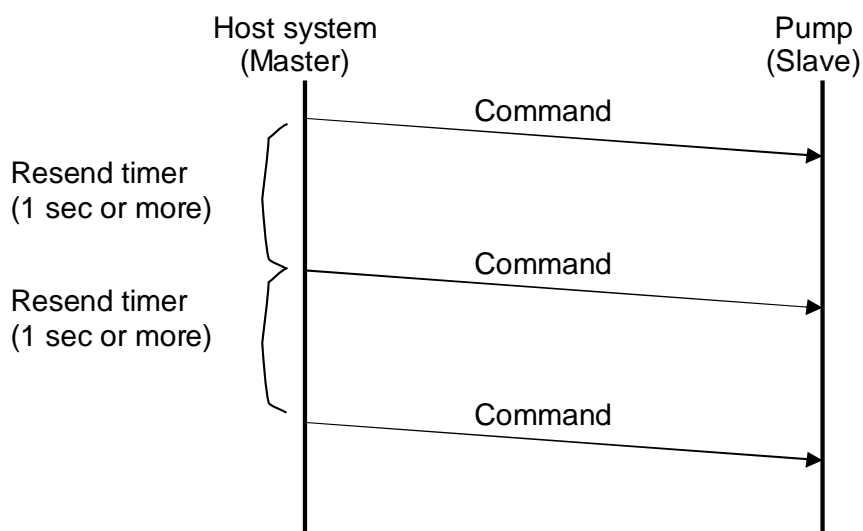
(2) Normal sequence (sending END after sending successive responses)

The host system must wait 0.5 second or more between receiving an "END" response and sending the next command if it sends commands successively.



(3) Abnormal sequence (communication cable breakage, pump failure, etc.)

The host system must wait one second or more before resending a command if the pump does not respond to it.



4. Details of commands and responses

4.1 Commands

Command name	Command	Description	Control mode
Start	S20	Starts MP/BP.	Only in COM.
Stop	S21	Stops MP/BP.	Only in COM.
Reset	S22	Resets the pump.	All
Normal/power-saving mode switching	S23	Switches the pump operation mode.	Only in COM.
Motor speed setting for normal and power-saving modes	S24	Sets the motor speed for normal and power-saving modes.	Only in COM.
Analog data read	M20	Reads analog data selected by the user.	All
Operation status read	M21	Reads the MP/BP operation status (normal or power-saving) and Alarm/Warning data.	All

4.2 Command check

Check item	Description	Response
Sum check error	The sum data of the received command is not agreed.	None
Format error	The data length of the received command is not agreed.	None
Receiving an undefined command	An undefined command is received.	None
Parameter error	Any parameter of the received command is not defined.	Sending NG.
Control mode	The control mode is conditional.	Sending NG.

4.3 Details of commands

4.3.1 Start command (S20)

Supported by all models (ESR, EST, ESA, EST200WNTE, A300W-T/A300WM-IU, VOS, EV-S and EV-M).

(1) Command

1	3	1	1	2	1	9 bytes in total
STX	S20	Pump	ETX	SUM	CR	

Pump: Target pump (1 byte) MP: M/BP: B

Example) MP START

1	3	1	1	2	1	9 bytes in total
STX	S20	M	ETX	SUM	CR	

(2) Response

1	2	1	2	1		1	2	1	2	1	7 bytes in total
STX	OK	ETX	SUM	CR	OR	STX	NG	ETX	SUM	CR	
(Successfully processed)						(Unsuccessfully processed)					

4.3.2 Stop command (S21)

Supported by all models (ESR, EST, ESA, EST200WNTE, A300W-T/A300WM-IU, VOS, EV-S and EV-M).

(1) Command

1	3	1	1	2	1	9 bytes in total
STX	S21	Pump	ETX	SUM	CR	

Pump: Target pump (1 byte) MP: M/BP: B

Example) BP STOP

1	3	1	1	2	1	9 bytes in total
STX	S21	B	ETX	SUM	CR	

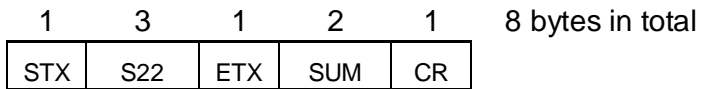
(2) Response

1	2	1	2	1		1	2	1	2	1	7 bytes in total
STX	OK	ETX	SUM	CR	OR	STX	NG	ETX	SUM	CR	
(Successfully processed)						(Unsuccessfully processed)					

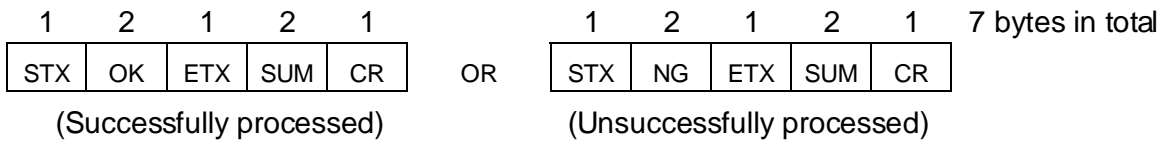
4.3.3 Reset command (S22)

Supported by all models (ESR, EST, ESA, EST200WNTE, A300W-T/A300WM-IU, VOS, EV-S and EV-M).

(1) Command



(2) Response



4.3.4 Normal/power-saving mode switching command (S23)

Supported by ESR, VOS, EV-S and ESA100W

(not supported by EST200WN-TE/KE, ESA25D, ESA70WD, ESA25XW, ESA30XW and A300W-T/A300WM-IU).

For EST, ESA300W, ESA500W and EV-M, this command is available only for BP.

(1) Command

1	3	1	1	2	1	9 bytes in total
STX	S23	Run Status		ETX	SUM	CR

Run Status: Operation mode setting

N: Normal mode/S: Powersaving mode

Example) Switching to power-saving mode

1	3	1	1	2	1	9 bytes in total
STX	S23	S	ETX	SUM	CR	

(2) Response

1	2	1	2	1	1	7 bytes in total
STX	OK	ETX	SUM	CR		
(Successfully processed)						OR
1	2	1	2	1		
STX	NG	ETX	SUM	CR		
(Unsuccessfully processed)						

4.3.5 Motor speed setting command for normal and power-saving modes (S24)

Supported by ESR, VOS, EV-S and ESA100W

(not supported by EST200WN-TE/KE, ,ESA25XW,ESA30XW ,ESA25D and ESA70WD).

For EST, ESA300W, ESA500W, A300W-T/A300WM-IU and EV-M, this command is available only for BP.

(1) Command

1	3	1	1	2	1	2	1	12 bytes in total
STX	S24	Pump	Run Status	Speed	ETX	SUM	CR	

Pump: Target pump (1 byte) MP: M/BP: B

(For ESA, this cannot be set to MP.)

Run Status: Operation mode (1 byte)

N: Normal mode/S: Powersaving mode

Speed: Motor speed setting (2 bytes)

Set the first two digits of the desired motor speed.

Example) If the desired motor speed is 4500 rpm, set the speed to "45."

If the desired motor speed is 3200 rpm, set the speed to "32."

Example) Setting the MP motor speed for normal mode to 4500 rpm.

1	3	1	1	2	1	2	1	12 bytes in total
STX	S24	M	N	45	ETX	SUM	CR	

(2) Response

1	2	1	2	1		1	2	1	2	1	7 bytes in total
STX	OK	ETX	SUM	CR	OR	STX	NG	ETX	SUM	CR	
(Successfully processed)						(Unsuccessfully processed)					

4.3.6 Analog data read command (M20)

Supported by all models (ESR, EST, ESA, EST200WNTE, A300W-T/A300WM-IU, VOS, EV-S and EV-M).

(1) Command

1	3	8								1	2	1	16 bytes in total
STX	M20	AD1	AD2	AD3	AD4	AD5	AD6	AD7	AD8	ETX	SUM	CR	

AD1 to AD8: Analog data acquisition bit (8 bytes)

AD1 to AD8 indicate the information of analog data acquisition. Each corresponds to bits 31 to 28, bits 27 to 24, bits 23 to 20, bits 19 to 16, bits 15 to 12, bits 11 to 8, bits 7 to 4, and bits 3 to 0 in order. The analog code indicates the bit position (see the analog code list in (3) for analog codes).

1: Acquires analog data corresponding to the analog code.

0: Not acquire analog data corresponding to the analog code.

Example) Acquiring analog data corresponding to the analog codes 01, 02, 03, 04 and 07.

AD1	AD2	AD3	AD4	AD5	AD6	AD7	AD8
0	0	0	0	0	0	9	E

9				E			
1	0	0	1	1	1	1	0
07	06	05	04	03	02	01	00

Analog data acquisition bit

Analog code

(2) Response

1	2	7							1	2	1	14 bytes in total
STX	Analog Code	Analog Data							ETX	SUM	CR	

.

.

1	3	1	2	1	8 bytes in total
STX	END	ETX	SUM	CR	

Analog Code: See the analog code list in (3) (2 bytes).

Analog Data: Analog data corresponding to the analog code (7 digits including the decimal point, which may not be included) (7 bytes).

If the number of digits is less than 7, spaces () are added.

SUM: See Appendix B (response checksum for the analog data read command "M20")

Example) Response to analog data read for the analog codes 00,01,03,05,08,11,12,14,15,19, and 20.

1	2	7	1	2	1
STX	00	1500	ETX	SUM	CR

14 bytes in total
Total running time 1500h

1	2	7	1	2	1
STX	01	4.75	ETX	SUM	CR

14 bytes in total
BP power 4.75KW

1	2	7	1	2	1
STX	03	6.0	ETX	SUM	CR

14 bytes in total
BP motor speed 6.0kmin-1

1	2	7	1	2	1
STX	05	2.5	ETX	SUM	CR

14 bytes in total
BP current 2.5A

1	2	7	1	2	1
STX	08	120	ETX	SUM	CR

14 bytes in total
MP casing temp. 120

1	2	7	1	2	1
STX	11	10.0	ETX	SUM	CR

14 bytes in total
Cooling water flow 10.0L/min

1	2	7	1	2	1
STX	12	25.8	ETX	SUM	CR

14 bytes in total
Pump N2 flow 25.8Pam3/s

1	2	7	1	2	1
STX	14	35.4	ETX	SUM	CR

14 bytes in total
Back pressure 1 35.4KPa

1	2	7	1	2	1
STX	15	130	ETX	SUM	CR

14 bytes in total
Heater1 130

1	2	7	1	2	1
STX	19	12.4	ETX	SUM	CR

14 bytes in total
Vacuum pressure 12.4KPa

1	2	7	1	2	1
STX	20	160	ETX	SUM	CR

14 bytes in total
Cooler 1 160

1	3	1	2	1
STX	END	ETX	SUM	CR

8 bytes in total

(3) Analog code list

The list below shows codes and units for analog data.

Analog code	Analog data	Unit	ESR	EST	EST 200WN-TE	ESA					
						300W 500W	70WD, ESA80W-HDF	100W,100WN, ESA80W-HDF(INV)	25D	25XW	30XW
00	Total running time	H									
01	BP power	KW				x	x	x	x	x	x
02	MP power	KW				x	x	x	x	x	x
03	BP motor speed	Kmin-1					x		x	x	
04	MP motor speed	Kmin-1				x	x		x	x	
05	BP current	A	x	x	x				x		
06	MP current	A	x	x	x						
07	BP casing temp.	°C	x	OP	x	x	x		x		
08	MP casing temp.	°C									
09	Reserved	-	x	*1	*1	*1	*1	x	*1	x	x
10	Reserved	-	x	*1	*1	*1	*1	x	*1	x	x
11	Cooling water flow	L/min									
12	Pump N2 flow	Pam3/s									
13	Reserved	-	x	*1	*1	*1	*1	x	*1	x	x
14	Back pressure 1	KPa	OP	OP	OP	OP	OP	OP	OP	OP	OP
15	Heater1	°C	x	OP	OP	x	x	x	x	x	x
16	Heater2	°C	x	OP	OP	x	x	x	x	x	x
17	Heater3	°C	x	OP	OP	x	x	x	x	x	x
18	Heater4	°C	x	x	x	x	x	x	x	x	x
19	Vacuum pressure	KPa	x	x		x	x	x	x	x	x
20	Cooler 1	°C	x	x	x	x	x	x	x	x	x
21	Cooler 2	°C	x	x	x	x	x	x	x	x	x
22	Cooler 3	°C	x	x	x	x	x	x	x	x	x
23 to 31	Reserved	-	x	x	x	x	x	x	x	x	x

OP: Optional, determined by DIP switch settings.

*1 For EST and ESA, invalid data is sent. Please ignore such data.

*2 The data of MP1 is put in MP in ESA25XW and ESA30XW and the data of MP2 is put in BP. The example) The MP2 current value is put in the BP current value.

Analog code	Analog data	Unit	A300W-T	A300WM-IU	VOS	EV-S	EV-M
00	Total running time	H					
01	BP power	KW	x	x			
02	MP power	KW	x	x			
03	BP motor speed	Kmin-1					
04	MP motor speed	Kmin-1	x	x			
05	BP current	A			x	x	x
06	MP current	A			x	x	x
07	BP casing temp.	°C	x	x	x	x	OP
08	MP casing temp.	°C					
09	Reserved	-	x	x	x	x	x
10	Reserved	-	x	x	x	x	x
11	Cooling water flow	L/min					
12	Pump N2 flow	Pam3/s					
13	Reserved	-	x	x	x	x	x
14	Back pressure 1	KPa	OP	OP	x	OP	OP
15	Heater1	°C	OP	x	x	x	OP
16	Heater2	°C	OP	x	x	x	OP
17	Heater3	°C	OP	x	x	x	OP
18	Heater4	°C	OP	x	x	x	OP
19	Vacuum pressure	KPa	x	x	x	x	x
20	Cooler 1	°C		x	x	x	x
21	Cooler 2	°C		x	x	x	x
22	Cooler 3	°C		x	x	x	x
23 to 31	Reserved	-	x	x	x	x	x

4.3.7 Operation status read command (M21)

Supported by all models (ESR, EST, ESA, EST200WN-TE, A300W-T/A300WM-IU, VOS, EV-S and EV-M).

(1) Command

1	3	1	2	1	8 bytes in total
STX	M21	ETX	SUM	CR	

(2) Response

1	3	1	1	1	16	1	2	1	27 bytes in total
STX	M21	Run Status	MP Status	BP Status	Warning/Alarm	ETX	SUM	CR	

Run Status: Operation mode (1 byte)

N: Normal mode/S: Powersaving mode

MP Status: MP status (1 byte)

BP Status: BP status (1 byte)

R: Running/S: Stopped

Warning/Alarm: Warning/alarm status (16 bytes)

1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16 bytes in total
W1	W2	W3	W4	W5	W6	W7	W8	A1	A2	A3	A4	A5	A6	A7	A8	

Warning

W1 to W8 indicate warning information. Each corresponds to bits 31 to 28, bits 27 to 24, bits 23 to 20, bits 19 to 16, bits 15 to 12, bits 11 to 8, bits 7 to 4, and bits 3 to 0 (32bit data) in order. The alarm code indicates the bit position (see the alarm code list for alarm codes).

0: No warning 1: A warning has occurred.

Alarm

A1 to A8 indicate alarm information. Each corresponds to bits 31 to 28, bits 27 to 24, bits 23 to 20, bits 19 to 16, bits 15 to 12, bits 11 to 8, bits 7 to 4, and bits 3 to 0 (32-bit data) in order. The alarm code indicates the bit position + 50 (see the alarm code list for alarm codes).

0: No alarm 1: An alarm has occurred.

In this case, the bits appearing as “1” indicate that warnings have occurred. The alarm codes issued above are 19, 18, 17, 16, and 5.

31	18	5	1, 0	Bit position
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Alarm code list

Pump type	Warning		Alarm	
	No.	Description	No.	Description
Common	00	Water flow low	50	Casing temp. HH
	01		51	BP motor temp. high
	02		52	MP motor temp. high
	03		53	Water leakage
	04		54	BP thermal
	05	Casing temp. high	55	MP thermal
	06	BP-G oil level low	56	
	07	BP-M oil level low	57	
	08	MP-G oil level low	58	
	09	MP-M oil level low	59	
	10	Drv brg temp. high	60	MP no current
	11	Drvn brg temp. high	61	
	12	Oil level low	62	
	13	BOX temp. high	63	Back press. high
	14	N2 valve open	64	Power failure
	15	Cooler 1 temp. high	65	MP driver protection active
	16	Cooler 2 temp. high	66	BP driver protection active
	17	Cooler 3 temp. high	67	BP overload 2
	18	Pump N2 flow low	68	MP overload 2
	19	Exh. N2 flow low	69	BP step out
	20	Exh. trap temp. high	70	MP step out
	21	Back press. high	71	Emergency off (EMO)
	22	Heater error	72	Exh. N2 flow low
	23	BP motor temp. high	73	Water flow low continued
	24	MP motor temp. high	74	External interlock
	25	Driver temp. high	75	
	26	Communication error	76	
	27	Valve error	77	
	28		78	
	29		79	
	30		80	
	31	Other warnings	81	Other alarms

Appendix A Checksum

The checksum is a method to judge whether received data is normal. The sending node calculates the sum of data to be sent and attaches it to the data. The receiving node checks if the received sum is consistent with a sum calculated from the received data. The checksum is attached to all commands and responses. Both the master and the slave ignore data with checksum errors.

The sum is obtained by adding character codes from STX to ETX and converting the lower bits of the calculated result into ASCII format. Examples of the calculation are shown below.

Example 1

Send text	^S _x	A	b	c	^E _x
	0x02	0x41	0x62	0x63	0x03

Calculation $0x02 + 0x41 + 0x62 + 0x63 + 0x03 = 0x10B$

Pick up lower 8 bits
and convert them to ASCII.

Send frame	^S _x	A	b	c	^E _x	0	B	^C _R
	0x02	0x41	0x62	0x63	0x03	<u>0x30</u>	<u>0x42</u>	0x0D
						SUM		

Example 2

Send text ^S_xCTA_1_? ^E_x SUM = "8D" (0x38, 0x44)

$0x02 + 0x43 + 0x54 + 0x41 + 0x20 + 0x31 + 0x20 + 0x3F$
 $+ 0x03 = 0x18D$

^S _x	C	T	A	_	1	_	?	^E _x
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Appendix B Response checksum for the analog read command "M20"

The checksum of analog data to be sent/received in response to the analog data read command "M20" is obtained by adding character codes from STX to one before ETX (analog data) and converting the lower bits of the calculated result into ASCII format.

(For an "END" response, character codes from STX to ETX are added.)

Example 1

Send text	s_x	A	b	c	E_x
	0x02	0x41	0x62	0x63	0x03

Calculation $0x02 + 0x41 + 0x62 + 0x63 = 0x108$

Pick up lower 8 bits
and convert them to ASCII.

Send frame	s_x	A	b	c	E_x	0	8	C_R
	0x02	0x41	0x62	0x63	0x03	<u>0x30</u>	<u>0x38</u>	0x0D
						SUM		

Send text	s_x	E	N	D	E_x
	0x02	0x45	0x4E	0x44	0x03

Calculation $0x02 + 0x45 + 0x4E + 0x44 + 0x03 = 0xDC$

Pick up lower 8 bits
and convert them to ASCII.

Send frame	s_x	E	N	D	E_x	D	C	C_R
	0x02	0x45	0x4E	0x44	0x03	<u>0x44</u>	<u>0x43</u>	0x0D
						SUM		