

INSTRUCTION MANUAL

Turbo Molecular Pump

Model

Serial Communication

for UTM1200/1600/4300 Series

Before using this product, be sure to read this operation manual.

Keep this manual with care to use at any time.

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Table of contents

A1	GENERAL SPECIFICATION	A-1
A2	PUMP TO COMPUTER CONNECTION	A-2
A2.1	Communication Cable Connection	A-2
A2.2	RS-485 Multi-drop Settings	A-2
A2.3	ON-LINE Request	A-2
A3	SERIAL COMMUNICATIONS PROTOCOL	A-3
A3.1	Basic Message Structure	A-3
A3.2	Character to Character Time-out : 0.1 sec.	A-3
A3.3	Command to Answer Time-out : 1 sec.	A-4
A3.4	Command Transmission Specification	A-4
A3.5	Receiving Sequence	A-4
A3.6	Using the Checksum Byte	A-4
A4	TABLE OF COMMANDS	A-5
A5	COMMAND DESCRIPTION	A-13
A5.1	Operation Mode	A-13
A5.2	Operation	A-14
A5.3	Run Status	A-15
A5.4	Parameters	A-16
A5.5	Timer	A-16
A5.6	History	A-16
A5.7	Settings	A-17
A5.8	Shared Answer	A-17
A5.9	RS-485 Settings	A-18
A6	RS-232C COMMANDS / ANSWERS (SEND AND RECEIVE Examples)	A-19
A8	TROUBLESHOOTING	A-23
A8.1	No Message can Transmit and Receive	A-23
A8.2	Sending and Receiving are Done, But Receivable Messages are Invalid	A-23
A8.3	Characters Get Disordered from Time to Time, Then Resulting in CHECKSUM Error	A-23

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A1 GENERAL SPECIFICATION

This product contains serial interfaces conforming to RS-232C and RS-485 specifications. The following functions are available by connecting a computer with communication capacity to these interfaces and creating the appropriate software.

The RS-232C and RS-485 interfaces can be used simultaneously, permitting simultaneous access from two computers. Also, the RS-485 interface permits multi-drop connections, allowing multiple power supplies to be connected to a single computer.

This instruction manual is described about software operation. Refer to instruction manual of turbo molecular pump for hardware specification.

1. Checking current operation mode : The serial interfaces allow the user to check the status of current operation mode. In REMOTE mode, the user can change the operation mode to RS-232C or RS-485.
2. Operation : START, STOP and RESET operations are available in the RS-232C or RS-485 operation mode. Also, the speed setting can be made using the set value write function.
3. Checking turbo molecular pump run status : The serial interfaces allow the user to check the current turbo molecular pump's running status (Normal rotation, Accelerating, Decelerating, failure occurrence, etc.).
4. Reading parameters : The serial interfaces allow the user to read a variety of turbo molecular pump parameters such as pump rotational speed and motor current which are stored in the control system.
5. Receiving events : The control system can transmit status commands for events such as failure occurrences, rotation start and stop, and attainment of normal rotation speed.
6. Reading history data : The serial interfaces allow the user to read the alarm history data.
7. Reading and writing timer data : The serial interfaces allow the user to read the timer and counter values and to reset the counters.
8. Reading and writing settings data : The serial interfaces allow the user to read and change settings.

A2 PUMP TO COMPUTER CONNECTION

A2.1 Communication Cable Connection

Turn off the power switch and the computer to be connected. Connect the Serial connector to the communications port of the computer with a cable, referring to Instruction manual of the pump.

A2.2 RS-485 Multi-drop Settings

The RS-485 interface multi-drop function is used to connect multiple turbo molecular pump to a single computer. Turn off the multi-drop function if the RS-485 is used instead of RS-232C to extend the communication cable length.

When the multi-drop function is turned on, the network ID portion of the sent character strings (Refer to Section A3 "SERIAL COMMUNICATIONS PROTOCOL") is enabled and the event communication function that notifies the pump status to the connected computer is disabled.

Refer to Section A5 "COMMAND DESCRIPTION" RS-485 Settings for details about the setting method.

A2.3 ON-LINE Request

When control the turbo molecular pump via serial communication, need to send ON-LINE request command from customer equipment.

Meanwhile use the serial communication as only monitor the status of the pump, it does not need to send ON-LINE request command.

Refer to Section A5.1 "Operation Mode" for detail about ON-LINE request command.

A3 SERIAL COMMUNICATIONS PROTOCOL

Communications software, between the turbo molecular pump and customer equipment should be design according to the following specifications.

A3.1 Basic Message Structure

A basic transmit and receive message begins with the characters "MJ" and ends with a carriage return code (0dH : xxH means hexadecimal code). (Refer to Table A-1.)

The first message to be sent is referred as the COMMAND, while the reply to the command is referred as the ANSWER.

Table A-1 Basic Structure of Commands and Answers

Character	Hex. code	Description	Number of bytes
M	4d	Command header characters	2
J	4a		
0	30	Network ID	2
1	31	Multi-drop function OFF : 01 fixed Multi-drop function ON : 01 to 32	
X	xx	Command Characters	2
X	xx		
		Sub-command Characters Varies depending on commands and answers	X
f	xx	Checksum characters (Calculation result by Section A3.6 enters it.)	2
f	xx		
CR	0d	Carriage return character	1

A3.2 Character to Character Time-out : 0.1 sec.

Delays between characters, in the answer message, longer that 0.1 sec., shall be considered as a transmission line failure and special considerations should be made to re-send the message.

A3.3 Command to Answer Time-out : 1 sec.

Delays between COMMAND and ANSWER messages, longer than 1 sec., shall be considered as a transmission line failure and special considerations should be made to re-send the message.

The turbo molecular pump re-sends a COMMAND, if it does not receive an ANSWER within a one second period.

A3.4 Command Transmission Specification

A command sent before an answer is sent, will be ignored by the turbo molecular pump, until a reply to the first command is sent. However, this does not apply after a transmission time-out occurs between command and answer. (If processing is performed normally, an answer is returned within 100 msec.)

A3.5 Receiving Sequence

The character string from the turbo molecular pump unit is received after the COMMAND character string is sent. When the carriage return code (0dH) is received, the received character string is checked from the beginning and the portion from the initial command header "MJ" to the carriage return code received last is processed as an answer.

Initialize the receive buffer after the answer character string is acquired from the receive buffer. The read user memo (described below) may receive the same "MJ" as the command header character string in the answer character string. Therefore, interpret the character string from the first "MJ" appearing in the receive buffer to the carriage return as the answer character string.

A3.6 Using the Checksum Byte

Always calculate the checksum for a received character string and compare it with the checksum byte data to confirm that the character string was received correctly. Conduct error processing such as re-sending the command when a character string is received with an incorrect checksum.

Calculation Example

In the received character string "MJ01LS97\r" ("\r" represents the carriage return code), the check sum code is represented by the last two characters : "97".

The checksum for the received character string is calculated as follows. The result shows that the received character string is correct.

	'M'	'J'	'0'	'1'	'L'	'S'		
Checksum =	4dH +	4aH +	30H +	31H +	4cH +	53H	= 197H	= 97H

A4 TABLE OF COMMANDS

Table A-2 Table of Commands

Type	Command / answer	Name	Command character string	Sub-command character string		
Operation mode	Command	Operation mode check	LS	None		
		On-line request	LN	None		
		Off-line request	LF	None		
	Answer	Local	LL	None		
		Remote	LR	None		
		RS-232C	LC	None		
		RS-485	LD	None		
Operation request	Command	START operation	RT	None		
		STOP operation	RP	None		
		RESET operation	RR	None		
	Answer	Acceleration start	RA	None		
		Deceleration start	RB	None		
		Failure occurred	RF	aa	*1	
		Failure elimination	RC	None		
		Operation invalid	RV	None		
Run status	Command	Run status check	CS	None		
	Answer	Stop	NS	aa	*1	
		Acceleration	NA	aa	*1	
		Normal rotation	NN	aa	*1	
		Deceleration	NB	aa	*1	
		Failure-Stop	FS	aa	*1	
		Failure-Free run	FF	aa	*1	
		Failure-Regenerative braking	FR	aa	*1	
			Failure-Deceleration	FB	aa	*1
	Command	Read alarm list	CF	aa	*5	
Answer	Send alarm list	CA	aabb	*6		
	No alarm list	CV	aa	*5		
Parameters	Command	Read parameter	PR	aa	*2	
	Answer	Send parameter	PA	aabbbb	*3	
		Invalid parameter number	PV	aa	*2	
Event	Command	Failure occurred	EF	aa	*1	
		Rotation start	ER	None		
		Rotation stop	ES	None		
		Normal rotation	EN	None		
	Answer	Event confirmation	EC	aa	*4	

Type	Command / answer	Name	Command character string	Sub-command character string	
Timer	Command	Read timer	TR	aa	*7
		Clear timer	TC	aa	
		Write timer	TW	06aaaaa	*8
	Answer	Send timer value	TA	aabbbbccc...ccddd ...ddd	*9
		Invalid timer number	TV	aa	*7
History	Command	Read alarm history	GA	aa	*10
	Answer	Send alarm history	GB	xxx...xxx	*11
		No history data	GV	aa	*10
Settings	Command	Read settings	SR	aa	*12
		Write settings	SW	aabbbb	*13
	Answer	Send settings value	SA	aabbbb	*13
		Invalid setting number	SV	aa	*12
	Command	Read user memo	SU	None	
		Write user memo	SX	xxx...xxx	*14
	Answer	Send user memo	SF	xxx...xxx	*14
	Command	Default setting	SG	None	*17
Answer	Execute	SH	None		
RS-485 Settings	Command	Read setting value	DR	aa	*15
		Write setting value	DW	aabbbb	*16
	Answer	Transmit setting value	DA	aabbbb	*16
		Invalid setting value number	DV	aa	*15
	Command	Default setting	DD	None	*18
	Answer	Execute	DB	None	
Shared answer	Answer	Invalid command	AN	None	

- *1 aa : Failure alarm codes (hexadecimal) corresponding to the protection system.
Refer to "Table of Alarms" and "Table of Warnings" in the instruction manual of pump for details.
- *2 aa : Parameter number (decimal). Refer to Table A-3 "Table of Parameters".
- *3 aa : Parameter number (decimal). Refer to Table A-3 "Table of Parameters".
bbbb : Parameter value (decimal). Refer to Table A-3 "Table of Parameters".
- *4 aa : Confirm event command character string.
Send the unchanged command character string of the confirmed event command.
Example : Failure occurred → "EF"
- *5 aa : Alarm list number (decimal)
- *6 aa : Alarm list number (decimal)
bb : Alarm code (decimal) stored in the alarm list with the requested number.
Refer to "Table of Alarms" and "Table of Warnings" in the instruction manual of pump for details.
- *7 aa : Timer number (decimal). Refer to Table A-4 "Table of Timer".
- *8 06 (fixed) : Timer number (decimal). Refer to Table A-4 "Table of Timer".
aaaaa : Set value (decimal). Refer to Table A-4 "Table of Timer".

- *9 aa : Timer number (decimal). Refer to Table A-4 "Table of Timer".
 bbbbbb : Timer value (decimal). Refer to Table A-4 "Table of Timer".
 ccccccccc : Time when the timer updated. (YYMMDDHHMM format. Stored as Greenwich Mean Time)
 dddddddddd : Time when the timer reset. (YYMMDDHHMM format. Stored as Greenwich Mean Time)
- *10 aa : History number
- *11 xxx...xxx : Refer to Table A-5 "Alarm History Data Format".
- *12 aa : Settings number (decimal). Refer to Table A-6 "Table of Settings".
- *13 aa : Settings number (decimal). Refer to Table A-6 "Table of Settings".
 bbbb : Set value (decimal). Refer to Table A-6 "Table of Settings".
- *14 xxx...xxx : Any 20-character displayable character string.
- *15 aa : Settings number (decimal). Refer to Table A-7 "List of RS-485 Settings".
- *16 aa : Settings number (decimal). Refer to Table A-7 "List of RS-485 Settings".
 bbbb : Set value (decimal). Refer to Table A-7 "List of RS-485 Settings".
 (Refer to Section A5.9 "RS-485 Settings".)
- *17 Factory settings.

Function	Default setting	Reference
Variable Rotation Speed Setting	Rotational speed = NORMAL	Table A-6 No.03
Low Rotation Speed	Low speed = 100.0%	Table A-6 No.04 or No.08
Remote control signal operation setting	ALARM = EI-03	Table A-6 No.05
	REMOTE = EI-03	Table A-6 No.06
	STOP = REMOTE ONLY	Table A-6 No.07
Warning Output Setting	WARNING DISPLAY = ON	Table A-6 No.10

- *18 RS-485 Factory Settings.

Function	Default setting	Reference
Network ID	Network ID = 01	Table A-7 No.01 / Section A5.9
Multidrop Setting	Multidrop = OFF	Table A-7 No.02 / Section A5.9

Table A-3 Table of Parameters

No.	Name	Range	Description and format
01	Model identification number	0000 to 9999	The pump model connected. Example : TMP-X3405 → "3405"
03	Rotational speed (rpm)	0000 to 5000	Rotational speed / 10 Example : 15000 rpm → "1500"
04	Motor current	0000 to 0100	Motor drive current x 10 Example : 2.3 A → "0023"
05	Pump temperature	0000 to 0099	Pump temperature 45 degrees C. → "0045" (Valid only for a power supply with a temperature control function.)
07	Temperature control function	0000 to 0002	Temperature control function setting status "0000" : Temperature control function on "0001" : Temperature control function off "0002" : Power supply has no temperature control function
08	Temperature control set temperature	Fixed	Target value of temperature control setting Example : 65 degrees C. → "0065" (Valid only for a power supply with a temperature control function.)
09	Rotational speed (%)	0000 to 0100	Percentage of rated rotational speed. Example : 80 % → "0080"
10	Rotational speed (%)	0000 to 1000	Percentage of rated rotational speed. (x10) Example : 80 % → "0800"
11	Rated rotational speed (rpm)	0000 to 5000	Rated rotational speed / 10 Example : 21000 rpm → "2100"
21	Axis 1 unbalance monitor amount	0000 to 0999	Unbalance monitor value of magnetic bearing : Axis 1 Example : 3 % → "0003"
22	Axis 2 unbalance monitor amount	0000 to 0999	Unbalance monitor value of magnetic bearing : Axis 2 Example : 3 % → "0003"
26	MB sensor output X1	0000 to 0999	Sensor output monitor value of magnetic bearing : Axis X1 Example : 3 % → "0003"
27	MB sensor output Y1	0000 to 0999	Sensor output monitor value of magnetic bearing : Axis Y1 Example : 3 % → "0003"
28	MB sensor output X2	0000 to 0999	Sensor output monitor value of magnetic bearing : Axis X2 Example : 3 % → "0003"
29	MB sensor output Y2	0000 to 0999	Sensor output monitor value of magnetic bearing : Axis Y2 Example : 3 % → "0003"
30	MB sensor output Z	0000 to 0999	Sensor output monitor value of magnetic bearing : Axis Z Example : 3 % → "0003"

Table A-4 Table of Timer

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No.	Name	Range	Description and format
01	Run time	00000 to 99999	Integrating timer while the pump is rotating. (Can not be reset. Reset data is invalid) "00000" : 0 hour "99999" : 9999 hours
02	Last maintenance time	00000 to 99999	Timer of maintenance call timer. The maintenance call timer is a function that outputs warning if internal timer is equal to set-value. Set value of maintenance call is refer to No.06 in this table. "00000" : function is disable "12345" : 12345 hours
03	Power failure touch-down count	00000 to 00999	Number of occurrences of touchdown by power interruption. The levitating control is not done and supported the rotor by touchdown bearing, when the power interruption occurs below a predetermined rotational speed. This timer shows the number of occurrences of touchdown by power interruption. (Can be reset) "00000" : 0 time "00102" : 102 times
04	High-speed touch-down count	00000 to 00999	Number of occurrences of continuous touchdown at high-speed rotation. Touchdown caused by continuous vibration etc. makes the alarm related to magnet bearing occur. This timer show the number of occurrences of continuous touchdown at high-speed rotation. (Can be reset) "00000" : 0 time "00004" : 4 times
05	MB warning counter	00000 to 00999	Number of occurrences of instantaneous touchdown at high-speed rotation. Touchdown caused by instantaneous vibration etc. makes the warning related to magnet bearing occur. This timer show the number of occurrences of instantaneous touchdown at high-speed rotation. (Can be reset) "00000" : 0 time "00024" : 24 times
06	Maintenance call time	00000 to 99999	Set value of maintenance call timer. The maintenance call timer is a function that outputs warning if internal timer is equal to set-value. If use this function, this timer is needed to set. "00000" : function is disable "12345" : 12345 hours

Table A-5 Alarm History Data Format

No.	Item	Number of bytes	Data	Comments
1	History number	2	01 to 99	History number designated by the command.
2	Time	10	YYMMDDHHMM	Time when the failure occurred (stored as Greenwich Mean Time) YY : year, MM : month, DD : day, HH : hour, MM : minutes
3	Alarm number	2	00 to 99	Alarm number of the failure that occurred. Refer to "Table of Alarms" and "Table of Warnings" in the instruction manual of pump for details.
4	Run status	2	NS, NA, NN...	Run status when the failure occurred. Data is identical to CS command answer.
5	Rotational speed	4	0000 to 0100	Speed when the failure occurred. Format is identical to 09 in Table A-3.
6	Motor current	4	0000 to 0150	Motor current in the event of a fault. The format is the same as No.04 in Table A-3.
7	Pump temperature	2	00 to 99	Pump temperature in the event of a fault. The format is equivalent to the last two characters of No. 05 in Table A-3. (Valid only for a power supply with a temperature control function.)
8	Temperature control function	2	00, 01, 02, 03	Temperature control function when the failure occurred. Format is equivalent to last 2 characters of 07 in Table A-3.
9	Temperature control set temperature	2	55 to MAXTEMP	Temperature control set temperature when the failure occurred. Format is equivalent to last 2 characters of 08 in Table A-3. MAXTEMP depends on the pump model. (Refer to Instruction manual of the pump.) (Valid only for a power supply with a temperature control function.)
10	Axis 1 unbalance monitor amount	4	0000 to 0100	Unbalance monitor value of magnetic bearing when a fault occurs : Axis 1 Format is the same as No.21 in Table A-3.
11	Axis 2 unbalance monitor amount	4	0000 to 0100	Unbalance monitor value of magnetic bearing when a fault occurs : Axis 2 Format is the same as No.22 in Table A-3.
12	MB sensor output X1	4	0000 to 0100	Sensor output monitor value of magnetic bearing when a fault occurs : Axis X1 Format is the same as No.26 in Table A-3.
13	MB sensor output Y1	4	0000 to 0100	Sensor output monitor value of magnetic bearing when a fault occurs : Axis Y1 Format is the same as No.27 in Table A-3.
14	MB sensor output X2	4	0000 to 0100	Sensor output monitor value of magnetic bearing when a fault occurs : Axis X2 Format is the same as No.28 in Table A-3.
15	MB sensor output Y2	4	0000 to 0100	Sensor output monitor value of magnetic bearing when a fault occurs : Axis Y2 Format is the same as No.29 in Table A-3.
16	MB sensor output Z	4	0000 to 0100	Sensor output monitor value of magnetic bearing when a fault occurs : Axis Z Format is the same as No.30 in Table A-3.
17	Operation time	6	000000 to 099999	Operation time when a fault occurs. Format is the same as No.01 in Table A-4.

Table A-6 Table of Settings
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No.	Name	Range	Description and format
01	Temperature control on/off	0000 / 0001	Read or change the set values of temperature control function. "0000" : Temperature control function on "0001" : Temperature control function off (Valid only for a power supply with a temperature control function.)
03	Rotational speed	0000 / 0001	Variable speed operation setting. When set to "LOW SPEED" mode, rated rotational speed is changed to preset rotational speed value which set No.04 or No.08 in this table. "0000" : NORMAL "0001" : LOW SPEED
04	Low speed value	0025 to 0100	Values for variable speed operation. In "LOW SPEED" mode, rated rotational speed is set to this value. This value is same as No.08 in this table. "0025" : 25 % "0100" : 100 %
05	"ALARM" signal operation setting (Note 1)	0000 / 0001	Connection mode of "ALARM" signal in remote-control connector "0000" : SEMI-E74 ("POWER OFF" and "active alarm" are same logic) "0001" : EI-03 ("POWER OFF" and "no alarm" are same logic)
06	"REMOTE" signal operation setting (Note 1)	0000 / 0001	Connection mode of "REMOTE" signal in remote-control connector "0000" : SEMI-E74 ("POWER OFF" and "active alarm" are same logic) "0001" : EI-03 ("POWER OFF" and "no alarm" are same logic)
07	"STOP" signal operation setting (Note 1)	0000 / 0001	Connection mode of "STOP" signal in remote-control connector "0000" : REMOTE ONLY (only if operation mode is in "REMOTE" mode, accept "STOP" signal in remote-control connector) "0001" : REMOTE&RSXXX (if operation mode is not in "LOCAL" mode, always accept "STOP" signal in remote-control connector)
08	Low speed value	0250 to 1000	Values for variable speed operation. In "LOW SPEED" mode, rated rotational speed is set to this value. This value is same as No.04 in this table. "0250" : 25.0 % "0999" : 99.9 %
09	Temperature setting	0055 to MAXTEMP	Read or change the set values of the set temperature. MAXTEMP depends on the pump model. (Refer to Instruction manual of the pump.) "0055" : 55 degrees C. "0075" : 75 degrees C.
10	Warning output setting	0000 / 0001	Warning output setting. "0001" : ON (When warning occur, output signal is sent via remote-control connector and serial communication) "0000" : OFF (When warning occur, output signal is not sent via remote control connector and serial communication)
11	Power failure detection time	0000 / 0001	Detection time of the alarm "POWER FAILURE" "0000" : 2 seconds "0001" : 1 second

(Note 1) Refer to instruction manual of pump for remote-control connector detail.

Table A-7 List of RS-485 Settings

No.	Name	Range	Description and Configuration
01	Network ID	0001 / 0032	Sets the Network ID "0001" : ID = 01 "0032" : ID = 32
02	Multidrop ON/OFF	0000 / 0001	Sets multidrop ON/OFF setting "0000" : ON "0001" : OFF

A5 COMMAND DESCRIPTION

A5.1 Operation Mode

Commands	LS	<p>Operation mode check</p> <p>Enables operation mode verification (LOCAL / REMOTE / RS-232C / RS-485)</p> <p>Action : returns an ANSWER showing present operation mode.</p>
	LN	<p>ON-LINE request</p> <p>If the current operation mode is REMOTE, the operation mode is shifted to RS-232C or RS-485. This command is ineffective in other operation modes.</p> <p>Action : returns an ANSWER showing the present operation mode.</p>
	LF	<p>OFF-LINE request</p> <p>If the current operation mode is RS-232C or RS-485, the operation mode is shifted to REMOTE. This command is ineffective in other operation modes.</p> <p>Action : returns an ANSWER showing the present operation mode.</p>
Answers	LL	<p>Operation mode LOCAL</p> <p>This answer is returned when the operation mode is LOCAL.</p> <p>The operation mode can also be shifted to LOCAL mode by the local switch.</p> <p>In this "LOCAL" mode, the operation of the pump is valid only by local switch.</p>
	LR	<p>Operation mode REMOTE</p> <p>This answer is returned when the operation mode is REMOTE.</p> <p>This operation mode can also be shifted to REMOTE mode by switching to "REMOTE" mode with a local switch and "OFF-LINE" is demanded from serial communications.</p> <p>In this "REMOTE" mode, the operation of the pump is valid only by signal from remote-control connector.</p>
	LC	<p>Operation mode RS-232C</p> <p>This answer is returned when the operation mode is RS-232C. The operation mode is shifted to RS-232C when the "ON-LINE" request command is sending via RS-232C in the remote operation mode.</p> <p>In this "RS-232C" mode, the operation of the pump is valid only by command via RS-232C.</p>
	LD	<p>Operation mode RS-485</p> <p>This answer is returned when the operation mode is RS-485. The operation mode is shifted to RS-485 when the "ON-LINE" request command is sending via RS-485 in the remote operation mode.</p> <p>In this "RS-485" mode, the operation of the pump is valid only by command via RS-485.</p>

A5.2 Operation

Commands	RT	START Operation The turbo molecular pump starts accelerating and sends the "Acceleration Start" answer.
	RP	STOP Operation The turbo molecular pump starts decelerating and sends the "Deceleration Start" answer.
	RR	RESET Operation This command is effective against failures. This command resets the ALARM. If the cause of the alarm is eliminated after resetting, the "Failure Elimination" answer will be returned.
Answers	RA	Acceleration Start This answer is returned after the acceleration is started on a START operation.
	RB	Deceleration Start This answer is returned after the deceleration is started on a STOP operation.
	RC	Failure elimination This answer is returned if the failure cause is removed and send RESET operation command.
	RF	Failure Occurrence This answer is returned if the failure cause is not removed and send RESET operation command. The alarm code of the failure that has not been eliminated is returned as a 2-character sub-command.
	RV	Operation invalid This answer is returned if the operation is invalid (START operation command sent during acceleration) or if the operation mode differs from the port that sent the command (operation mode is RS-485 but operation command was sent from the RS-232C port).

A5.3 Run Status

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Command	CS	Run Status Check This command requests the current status of the turbo molecular pump.
Answers	NS	Stop For a normal status, "00" is returned as the sub-command. If a warning has occurred, the 2-character alarm code is returned as the sub-command.
	NA	Acceleration For a normal status, "00" is returned as the sub-command. If a warning has occurred, the 2-character alarm code is returned as the sub-command.
	NN	Normal rotation For a normal status, "00" is returned as the sub-command. If a warning has occurred, the 2-character alarm code is returned as the sub-command.
	NB	Deceleration For a normal status, "00" is returned as the sub-command. If a warning has occurred, the 2-character alarm code is returned as the sub-command.
	FS	Failure-Stop This answer is returned when the pump is stopped after a failure occurs. The 2-character alarm code is returned as the sub-command.
	FF	Failure-Free run This answer is returned when the pump is free-running (neither accelerating nor decelerating) after a failure occurs. The 2-character alarm code is returned as the sub-command.
	FR	Failure-Regenerative braking This answer is returned when the pump is regenerative braking after a failure occurs. The 2-character alarm code is returned as the sub-command.
	FB	Failure-Deceleration This answer is returned when the pump is decelerating after a failure occurs. The 2-character alarm code is returned as the sub-command.
Command	CF	Read alarm list Reads the alarm that occurred for a designated alarm list number. To check all the current failures, the sub-command alarm list number is increased sequentially from 01 until the answer CV is returned.
Answers	CA	Send alarm list Returns the alarm code corresponding to the requested alarm list number. The sub-command returns a 2-character alarm list number and a 2-character alarm code.
	CV	No alarm list This answer is returned if no alarm corresponds to the requested alarm list number. The sub-command returns a 2-character alarm list number.

A5.4 Parameters

Command	PR	Read parameter Reads the parameter value for a designated parameter number. Sends the 2-character parameter number as the sub-command. Refer to Table A-3 "Table of Parameters" for parameter number.
Answers	PA	Send parameter Returns the parameter value for the designated parameter number. The 2-character parameter number + 4-character parameter value is returned as the sub-command.
	PV	Invalid parameter number This answer is returned if the designated parameter number is invalid. Returns the 2-character parameter number as the sub-command.

A5.5 Timer

Commands	TR	Read timer Reads the timer value for a designated timer number. Sends the 2-character timer number as the sub-command. Refer to Table A-4 "Table of Timer" for timer number.
	TC	Clear timer Clears the timer value for a designated timer number. Sends the 2-character timer number as the sub-command.
	TW	Write timer Overwrites the set value for a maintenance call timer. Sends the 2-character settings number + 5-character set value data as the sub-command.
Answers	TA	Send timer value Returns the timer value for the designated timer number. The 2-character timer number + 5-character timer value is returned as the sub-command.
	TV	Invalid timer number This answer is returned if the designated timer number is invalid. Returns the 2-character timer number as the sub-command.

A5.6 History

Command	GA	Read alarm history Reads the alarm history for a designated alarm history number. Sends the 2-character alarm history number as the sub-command.
Answers	GB	Send alarm history Returns the alarm history for the designated alarm history number. The 64-character alarm history data is returned as the sub-command in the format shown in Table A-5 "Alarm History Data Format".
	GV	No history data This answer is returned if no alarm history data corresponds to the designated alarm history number. Returns the 2-character alarm history number as the sub-command.

A5.7 Settings

Commands	SR	Read settings Reads the set value for a designated settings number. Sends the 2-character settings number as the sub-command. Refer to Table A-6 "Table of Settings" for setting number.
	SW	Write settings Overwrites the set value for a designated settings number. Sends the 2-character settings number + 4-character set value data as the sub-command. Refer to Table A-6 "Table of Settings" for setting number and set value.
Answers	SA	Send settings value Returns the set value for the designated settings number. The 2-character settings number + 4-character set value is returned as the sub-command.
	SV	Invalid setting number This answer is returned if the designated settings number is invalid. Returns the 2-character settings number as the sub-command.
Commands	SU	Read user memo Reads the character string in the user memo.
	SX	Write user memo Overwrites the character string in the user memo. Sends the 20 characters to set in the user memo as the sub-command. If less than 20 characters are set, the remaining characters are filled with spaces. Be sure to always send 20 characters.
Answer	SF	Send user memo Returns as a sub-command the set user memo character string or the 20-character user memo character string overwritten by the SX command.
Command	SG	Default setting Restore default setting described in Table A-2 *17 This setting is reflected after power supply reclosing.
Answer	SH	Default setting execute After power supply reclosing, turbo molecular pump starts up by default setting.

A5.8 Shared Answer

Answer	AN	Invalid Command Answer returned by the power supply after it receives an invalid command.
--------	----	----------------------------------------------------------------------------------------------

A5.9 RS-485 Settings

Commands	DR	Reads RS-485 setting Reads the setting value for the specified setting number. As subcommand, sends 2-character setting number. For setting numbers, refer to Table A-7 "List of RS-485 Settings".
	DW (Note 1)	Writes RS-485 setting Writes the setting value for the specified setting number. As subcommand, sends 2-character setting number and 4-character setting value. For setting numbers and setting values, refer to Table A-7 "List of RS-485 Settings".
Answers	DA	Sends RS-485 setting Returns setting value for specified setting number. As subcommand, sends 2-character setting number and 4-character setting value.
	DV	Invalid RS-485 setting number Answer returned when specified setting number is invalid. As subcommand, sends 2-character setting number.
Command (Note 1)	DD	Sets RS-485 settings to default factory settings Default setting is described in Table A-2 *18 This function change the setting of communication. Therefore, note that there is possibility not to be able to communicate.
Answer	DB	Answer returned when finished restoring RS-485 settings to factory settings.

(Note 1)

- Communication between customer equipment and turbo molecular pump is needed one-to-one communication when use "RS-485 Multi-drop setting" command.
- In "RS-485 Multi-drop setting" command, Network ID is fixed "99".

Set up the RS-485 as described below when using a multi-drop connection.

(1) Turn on the Multi-drop Function

Command (from computer to turbo molecular pump) *1	Answer (from turbo molecular pump to computer) *1	Description
MJ99DW020000C6\ 	MJ99DA020000B0\ 	Multidrop OFF
MJ99DW020001C7\ 	MJ99DA020001B1\ 	Multidrop ON

*1: "\n" represents a carriage return code (0dH).

(2) Setting the Network ID

The network ID is set to designate which turbo molecular pump connected via the multi-drop connection the computer is sending commands to.

The network ID is set as a number between 01 and 32, and must be unique for turbo molecular pump connected to a computer. Refer to Section A5 "COMMAND DESCRIPTION" RS-485 settings for details about the setting method.

Command (from computer to turbo molecular pump) *1	Answer (from turbo molecular pump to computer) *1	Description
MJ99DW010001C6\ 	MJ99DA010001B0\ 	Network ID = 01
MJ99DW010032CA\ 	MJ99DA010032B4\ 	Network ID = 32

*1: "\n" represents a carriage return code (0dH).

A6 RS-232C COMMANDS / ANSWERS (SEND AND RECEIVE Examples)

Table A-8 RS-232C COMMANDS / ANSWERS (SEND AND RECEIVE Examples)

Type	Direction of data (Note 1)	Character string Sent/Receive (Note 2)	Description	Remarks
Operation Mode	→	MJ01LS97\	Operation Mode Check	
	←	MJ01LL90\	LOCAL	
		MJ01LR96\	REMOTE	
		MJ01LC87\	RS-232C	
		MJ01LD88\	RS-485	
	→	MJ01LN92\	ON-LINE Request	ON-LINE request from RS-232C communication port
	←	MJ01LC87\	Operation Mode Change	Operation mode changed to RS-232C ON-LINE
		MJ01LD88\	Invalid Request	When in RS-485 mode
		MJ01LL90\	Invalid Request	When in LOCAL mode
	→	MJ01LF8A\	OFF-LINE Request	OFF-LINE request from RS-232C communication port
	←	MJ01LR96\	Operation Mode Change	Operation mode changed to REMOTE
		MJ01LD88\	Invalid Request	When in RS-485 mode
MJ01LL90\		Invalid Request	When in LOCAL mode	
TMP Operation	→	MJ01RT9E\	START Operation	START operation from RS-232C communication port
	←	MJ01RA8B\	Acceleration Start	
		MJ01RVA0\	Ineffective Operation	When START operation is ineffective or operation mode is not RS-232C
	→	MJ01RP9A\	STOP Operation	STOP operation from RS-232C communication port
	←	MJ01RB8C\	Deceleration Start	
		MJ01RVA0\	Ineffective Operation	When STOP operation is ineffective or operation mode is not RS-232C
	→	MJ01RR9C\	RESET Operation	RESET operation from RS-232C communication port
	←	MJ01RF50F5\	Failure Occurrence	When the failure was not eliminated.
		MJ01RC8D\	Failure Eliminated	When the failure was eliminated.
MJ01RVA0\		Ineffective Operation	When RESET operation is ineffective or operation mode is not RS-232C	

Type	Direction of data (Note 1)	Character string Sent/Receive (Note 2)	Description	Remarks
Run Status	→	MJ01CS8E\	Run Status Check	
	←	MJ01NS00F9\	Stop	
		MJ01NA00E7\	Acceleration	
		MJ01NB00E8\	Deceleration	
		MJ01NN00F4\	Normal Rotation	
		MJ01FS1C05\	Failure Stop	
		MJ01FF32E9\	Failure Idle	
		MJ01FR15F6\	Failure Regeneration	
		MJ01FB60E6\	Failure Deceleration	
	→	MJ01CF01E2\	Read Alarm List	Confirm first alarm
←	MJ01CA011543\	Send Alarm List	Power failure occurred.	
Parameter	→	MJ01PR03FD\	Read Parameter	Parameter 03 (rotational speed)
	←	MJ01PA032700B5\	Send Parameter	Data = 2700 (27000 rpm)
	→	MJ01PR1500\	Read parameter	Parameter 10 (invalid number)
	←	MJ01PV1504\	Invalid parameter number	
Timer	→	MJ01TR01FF\	Read Timer	Timer 01 (Run time)
	←	MJ01TA0100135030405150000000000000B9\	Send Timer	Timer 01 = 135 (135 hours) ast update : 2003/4/5 15:00 Last reset : (invalid)
	→	MJ01TC03F2\	Clear Timer	Clear timer 03 (Number of power failure touch-downs.)
	←	MJ01TA030000003040515000304051500C4\	Send timer value	Sets timer number 03 = 0 to data/time cleared. Sets reset data/time to data/time when clear command was sent.
	→	MJ06TW060500003\	Write timer value	Sets timer number 03 to 5000 (time of maintenance call)
	←	MJ01TA060500003040515000304051500CC\	Send timer value	Sets timer number 06 = 5000 to data/time updated and reset data/time to data/time when write command was sent.

A6 RS-232C COMMANDS / ANSWERS (SEND AND RECEIVE Examples)

A

Type	Direction of data (Note 1)	Character string Sent/Receive (Note 2)	Description	Remarks
History	→	MJ01GA01E1\	Read Alarm History	History 01
	←	MJ01GB01030401120 015NN0100001000027 500040006000300030 005000500020012009 8\	Send Alarm History	History : 01 Data & time : 2003/04/01 12:00 Alarm : power failure Status : normal rotation Rotational speed : 100 % Motor current : 1.0 A Reserved bytes : 0075 (not significant) Unbalance monitor Axis1 : 4 %, Axis2 : 6 % MB sensor output X1 : 3 %, Y1 : 3 %, X2 : 5 %, Y2 : 5 %, Z : 2 % Runtime : 1200 hours
	→	MJ01GA10E1\	Read Alarm History	History 10
	←	MJ01GV10F6\	No History Data	Less than 10 alarm data
Setting	→	MJ01SR0300\	Read Settings	Settings number 03
	←	MJ01SA030000AF\	Send Settings Value	Settings number 03 = 0 Rotational speed = NORMAL
	→	MJ01SW030001C6\	Write Settings	Overwrite settings number 03 = 1
	←	MJ01SA030001B0\	Send Settings Value	Settings number 03 = 1 Rotational speed = LOW SPEED
Others	→	MJ01AA7A\	Undefined Command	When undefined command is received
	←	MJ01AN87\	Invalid Command	
	→	MJ01LS20\	Operation Mode Check	When command is correct, but checksum is not.
	←	MJ01AN87\	Invalid Command	

(Note 1) → From computer to turbo molecular pump.

← From turbo molecular pump to computer.

(Note 2) "\ " represents a carriage return code (0dH).

A7 RELATION OF LOCAL MODE TO REMOTE MODE OPERATIONS

- (1) Input of Control panel switch is only effective when POWER lamp is in "LOCAL" mode. (POWER lamp is FLASH.)
- (2) When the POWER lamp is in "REMOTE" mode (POWER lamp is ON), "REMOTE" input signal only is effective under initial status.
- (3) When the POWER lamp is in "REMOTE" mode (POWER lamp is ON),
 - a. The operation mode is shifted to RS-232C ON-LINE in response to ON LINE request of operation mode command from RS-232C communication port, only operation by the operation request command from computer is effective.
 - b. The operation mode is shifted to RS-485 ON-LINE in response to ON LINE request of operation mode command from RS-485 communication port, only operation by the operation request command from computer is effective.
- (4) RESET button input and "RESET" signals are all-time effective.
- (5) When the mode is shifted to "LOCAL" under ON-LINE operation mode, the operation mode is force-shifted to LOCAL.
- (6) Commands other than operation commands are all-time effective, and the power supply unit sends back an answer message to computer. In addition, event commands are all-time sent against event occurrence.

A8 TROUBLESHOOTING

A8.1 No Message can Transmit and Receive

- (1) Start the pump in LOCAL mode and check if the event command of Rotation start can be received in the timing at which ROTATION lamp lights.
 - a. Could be received >> check if command from connected computer can be received or not, using another computer, etc.
 - b. A nonsensical character string was received >> Go to Section A8.2.
 - c. Not receivable >> (2)
- (2) Check the connection of RS-232C cable in reference to instruction manual of the pump. Check the polarity of RS-485 interface, because there is the case that polarity is reverse.
- (3) Check the transmission specification of RS-232C at computer side.

A8.2 Sending and Receiving are Done, But Receivable Messages are Invalid

- (1) Check the transmission rate of the computer.

A8.3 Characters Get Disordered from Time to Time, Then Resulting in CHECKSUM Error

- (1) Remove the cable from equipment as noise source if it runs near it.
- (2) When the cable in use is not a shield cable, replace it with the latter cable. When shield cable is used, be sure to check that it is connected to the frame gland of the connected computer. Use twisted pair cable when RS-485 is used.
- (3) When 10 m or longer cable is used, replace it with another cable as short as possible.

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