LOCTITE®

EQUIPMENT OPERATION MANUAL

LOCTITE® SCARA-N ROBOT

S440N Series

External Control II

(COM Communication)

Thank you for purchasing the Loctite® SCARA-N Robot.

***Read this manual thoroughly in order to properly use this robot.**
Be sure to read "For Your Safety" before you use the robot. It will protect you from possible dangers during operation.

***After having read this manual, keep it in a handy place so that you or the operator can refer to it whenever necessary.**

FOR YOUR SAFETY

Safety Precautions

The precautions in this manual are provided for the customer to make the best use of this product safely, and to provide preventive measures against injury to the customer or damage to property.

・・・・・ **Be sure to follow the instructions**・・・・・

Various symbols are used in this manual. Please read the following explanations of what each symbol stands for.

- **Symbols Indicating the Degree of Damage or Danger**

  The following symbols indicate the degree of damage or danger which may be incurred if you neglect the safety notes.

Warnings	These “Warnings” indicate the possibility of death or serious injury.
Cautions	These “Cautions” indicate the possibility of accidental injury or damage to property.

- **Symbols Indicating Type of Danger and Preventive Measures**

  The following symbols indicate the type of safety measure that should be taken.

	Indicates the type of safety measure that should be taken.
	Take care. (General caution)
	Indicates prohibition.
	Never do this. (General prohibition)
	Do not disassemble, modify or repair.
	Do not touch. (Contact prohibition)
	Indicates necessity.
	Be sure to follow instructions.
	Be sure to unplug power cord from wall outlet.
	Be sure to check grounding.

FOR YOUR SAFETY

⚠ Warnings

Be sure to unplug the power cord from the wall outlet if the robot will remain unused for long periods of time. Gathered dust could lead to fire.
Be sure to shut off the power supply before removing the power cord.

Keep the emergency stop switch within reach of an operator while teaching or running the robot.
Failure to do so may cause danger since the robot cannot be stopped immediately and safely.

Regularly check that the I/O-S circuits and emergency stop switch work properly.
Failure to do so may cause danger since the robot cannot be stopped immediately and safely.

Check the mounting screws regularly so that they are always firmly tightened.
Loose screws may cause injury or breakdown.

Power the unit only with the rated voltage.
Excessive voltage can cause fire or malfunction of the unit.

Do not sprinkle water or oil on the robot, operation box, or power cord.
Contact with water or oil can cause electric shock, fire, or malfunction of the unit. IP Protection Rating is “IP20.”

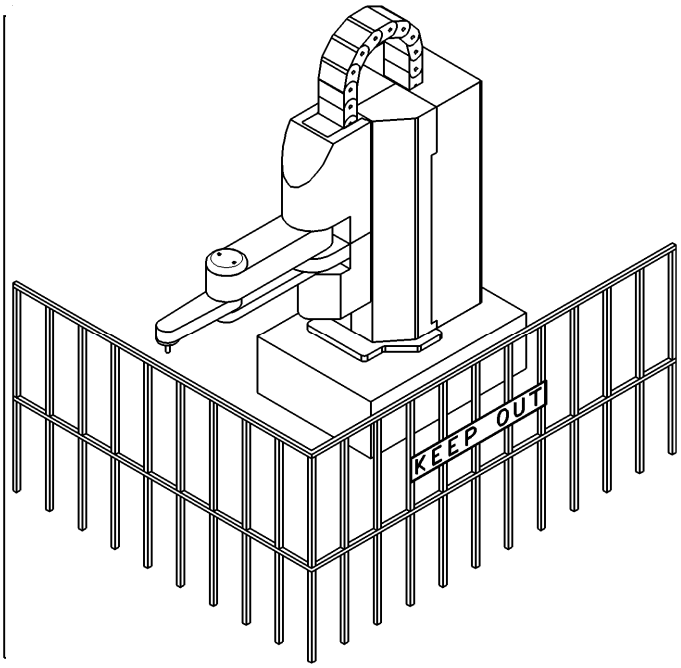
FOR YOUR SAFETY

■ INSTALLATION ■

⚠ Warnings

Always use a safety barrier.
A person entering the robot's maximum operating range may be injured. **Install an interlock that triggers an emergency stop when the gate is opened at the entry gate of the safety barrier, using the I/O-S connector included in package.** Ensure there is no other way of entering the restricted area. Furthermore, **put up a "No Entry" or "No Operating" warning sign** in a clearly visible position.

Example



Install a safety barrier of adequate strength so as to protect the operator from moving tools and flying objects.
Always use protective wear (helmet, protective gloves, protective glasses, and protective footwear) when going inside the safety barrier.

Take adequate precautions against objects the robot is gripping flying or falling off **taking into account the object's size, weight, temperature and chemical composition.**

FOR YOUR SAFETY

⚠ Warnings

Confirm that the robot is properly grounded before use.
Insufficient grounding can cause electric shock, fire, malfunction, or breakdown.

Plug the power cord into the wall outlet firmly.
Incomplete insertion into the wall outlet makes the plug hot and can cause fire.
Check that the plug is not covered with dust.
Be sure to shut off the power supply before connecting the power cord to the robot.

Install the robot in a place which can endure its weight and conditions while running.
Placing the unit in an insufficient or unstable surface may cause the unit to fall, overturn, or breakdown. This could result in operator injury.

Do not block the air intake on the lower part of the back of the robot (18mm above the floor.) This may cause overheating or fire.

Do not attempt to disassemble or modify the robot.
This may lead to electric shocks or fire.

Be sure to use within the voltage range indicated on the unit.
Failure to do so may cause electric shock or fire.

Do not use the unit where flammable or corrosive gas is present.
Leaked gas accumulated around the unit can cause fire or explosion.

Place the unit in a well-ventilated area for the health and safety of the operator.

Turn off the unit before inserting and removing cables.
Failure to do so may result in electric shock, fire, or malfunction of the unit.

FOR YOUR SAFETY

⚠ Warnings

Be sure to confirm that all the air tubes are connected correctly and firmly.

Use the robot in an environment between 0 to 40 degrees centigrade with a humidity of 20 to 90 percent without condensation.
Failure to do so may result in malfunction. IP Protection Rating is “IP20.”

Use the robot in an environment where no electric noise is present.
Electric noise may cause malfunction or breakdown.

Be sure to secure the movable parts of the robot before transportation.
Failure to do so may result in injury or breakdown.

Do not bump or jar the unit while it is being transported or installed.
This can cause breakdown.

Use the robot in an environment where it is not exposed to direct sunlight.
Direct sunlight may cause malfunction or breakdown.

Be sure to confirm that tools such as the electric screwdriver unit, etc. are properly connected.
Failure to do so may result in injury or breakdown.

Be sure to check the wiring to the main unit.
Improper wiring may result in malfunction or breakdown.

Keep the emergency stop switch within reach of an operator.
Failure to do so may cause danger since the robot cannot be stopped immediately and safely.

Be sure to shut off the power supply before plugging in the power cord.

FOR YOUR SAFETY

⚠ Cautions

Place the operation box on a flat surface more than 80 cm above the floor so that it is easier to operate it.

Use the unit in an environment that is not dusty or damp.
Dust and dampness may lead to breakdown or malfunction.
IP Protection Rating is “IP20.”

FOR YOUR SAFETY

■ WORKING ENVIRONMENT ■

⚠ Warnings

When you lubricate or inspect the unit, unplug the power cord from the robot.
Failure to do so may result in electric shock or injury.
Be sure to shut off the power supply before removing the power cord from the robot.

When going inside the safety barrier, **place a "Do Not Operate" sign** on the start switch.

Keep the emergency stop switch within reach of an operator while teaching and running the robot.
Failure to do so may cause danger since the robot cannot be stopped immediately and safely.

Install a safety barrier of adequate strength so as to protect the operator from moving tools and flying objects.
Always use protective wear (helmet, protective gloves, protective glasses, and protective footwear) when going inside the safety barrier.

Be sure to confirm that all the air tubes are connected correctly and firmly.

Always be aware of the robot's movement, even in the teaching mode.
Careful attention will protect the operator from injury.

FOR YOUR SAFETY

■ DURING OPERATION ■

⚠ Warnings

When operations are taking place within the safety barrier, **ensure no one enters the robot's maximum operating range.**

If you must go inside the safety barrier, be certain to **push the emergency stop switch** and **put a "Do Not Operate" sign** on the start switch.

When starting the robot, check that, **no one is within the safety barrier and no object will interfere with the robot operating.**

Under no circumstances should you go inside the safety barrier or place your hands or head inside the safety barrier while the robot is operating.

If anything unusual (e.g. a burning smell or abnormal sound) occurs, stop operation and unplug the cable immediately. Contact the dealer from which you purchased the robot or the office listed on the last page of this manual.
Continuous use without repair can cause electric shock, fire, or breakdown of the unit.

Keep the emergency stop switch within reach of an operator while teaching and running the robot.
Failure to do so may cause danger since the robot cannot be stopped immediately and safely.

PREFACE

This operation manual explains the protocols (transmission procedures and communication commands) for controlling the robot via the serial port (COM1.)
Note that this manual pertains to the communication between the robot and higher devices that control the robot. Lower devices, which are controlled by the robot, are not desribed in this manual.

This manual explains the protocols which convert data into hexadecimal ASCII characters to receive or send it. Put a code "$" at the head of the data and then convert it into the hexadecimal ASCII characters (HEXASCII.) Add a checksum to the data for error detection.
In the first chapter, the preparation process, such as cable and connector connection or baud rate setting, will be explained.
In the second chapter, the transmission methods of commands and data (hereinafter collectively called "text") will be explained.

In the following chapters, details of the following communication commands will be explained.

- Robot Information Request, Robot Status Request
- Robot Start, Program Number Change, Operation Control (e. g. temporary stop)
- I/O Status Request and Output Control
- Drive Control (PTP drive, linear drive, arc drive, JOG movement, CP continuous drive), Current Position Request
- Operation Information Request, Operation Report, Error Information Request
- Data Settings (e. g. point data setting, addition, deletion), Data Save

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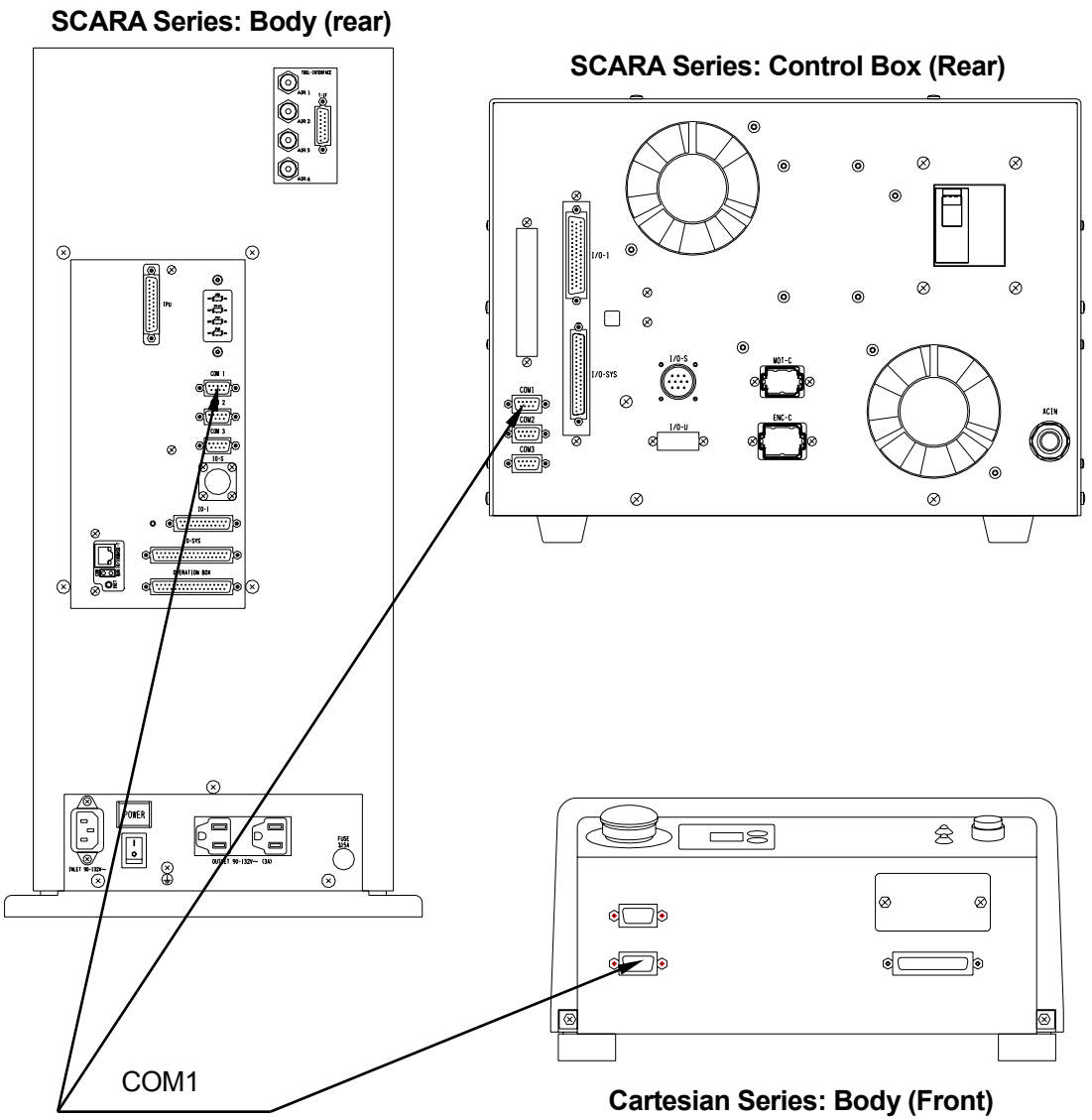
External Control II (COM Communication)

PREPARATION

■ Connector and Cable



Use a D-SUB 9 pin connector for the robot.

If the robot is cross-cabled as per the table on the next page, use a straight cable to connect the host (e.g. PC) and the robot.

When the D-SUB, 9 Pin is connected to the Host

COM1 (RS232C port)

Robot				Host (PC)		
PIN No.	Terminal	Function		PIN No.	Terminal	Function
3	RXD	Receive Data	←	3	TXD	Send Data
2	TXD	Send Data	→	2	RXD	Receive Data
8	RTS	Send Request	→	8	CTS	Send Ready
7	CTS	Send Ready	←	7	RTS	Send Request
5	GND	Ground	—	5	GND	Ground
Connector: D-SUB 9 Pin				Connector: D-SUB 9 Pin		

When the D-SUB, 25 Pin is connected to the Host

COM1 (RS232C port)

Robot				Host (PC)		
PIN No.	Terminal	Function		PIN No.	Terminal	Function
3	RXD	Receive Data	←	2	TXD	Send Data
2	TXD	Send Data	→	3	RXD	Receive Data
8	RTS	Send Request	→	5	CTS	Send Raedy
7	CTS	Send Ready	←	4	RTS	Send Request
5	GND	Ground	—	7	GND	Ground
Connector: D-SUB 9 Pin				Connector: D-SUB 25 Pin		

■ Baud Rate, etc.

The communication default settings are as follows.

Baud Rate	9600
Character Length	8 bit
Stop Bit	1 bit
Parity	None

All these settings are can be changed; but you may only need to change the baud rate to shorten the transmission time.

Set the robot to Administration mode. Select [COM Setting] from the [Administration Settings Mode] menu and then select [COM 1 Communication Setting.] The screen will display the current communication setting: Baud Rate, Character Length, Stop Bit, and Parity. You can change the settings as follows.

Baud Rate: 9600/19200/38400/57600/115200/230400/460800/921600
Character length: 8 bit/7 bit
Stop Bit: 1 bit/2 bit
Parity: None/Even Parity/Odd Parity

Note: This is [Baud Rate] selection menu in “LR C-Points” (optional) and “LR C-Points Limited Edition” software (included on the instruction manual CD-ROM.)

Baud Rate: 9600/19200/38400/115200

TRANSMISSION SUMMARY

■ Data Representation

In this protocol, data is transmitted in hexadecimal ASCII (HEXASCII) characters, not in binary. The data can be represented in 1 byte, 2 bytes, and 4 bytes. The following is an example of when 2 bytes of data “76” (decimal format) are converted.

2 bytes of “76” (decimal format) can be represented as “004C” in the hexadecimal format.

HEX	ASCII	Description
30	0	76 = 004C (hexadecimal)
30	0	
34	4	
43	C	

■ Transmission Method

The following is a transmission method example using a command to change the program number of the robot.

e. g. To change the program number to 76

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	52	R	Command Code
3	31	1	Subcommand Code (1: Program Number Change)
4	30	0	Program Number 76 = 004CH
5	30	0	
6	34	4	
7	43	C	
8	35	5	SUM 52H + 31H + 30H + 30H + 34H + 43H = 15AH
9	41	A	
10	0D		CR: Transmission End Code

Put “$” as a 1 byte transmission start code at the head of the command. Put “CR” as a transmission end code at the end of the command. The robot receives and handles the contents above, from the start code to the end code, as a command.

Put a letter “command code” (1 byte) just behind the “$” (transmission start) code. Use capital letters for transmission from the controller (e.g. PLC) to the robot and small letters for transmission from the robot to the controller (e.g. PLC.)

1 byte of “subcommand code” follows after the command code.

Use numbers and letters for the subcommand code.
The rest, data (parameter), is converted in hexadecimal characters.
In this example, the number can be changed (“76”) will be represented as “004C” in hexadecimal characters. 2 bytes of data will be represented in a 4-byte transmission code.

Note:

As in the example above, data larger than 2 bytes is transmitted from the upper layer to the lower layer.

Number of data is already fixed by a command (subcommand.) If the number is different, an operation error may be returned.

Put an error check code after the parameter alignments.

Put a return (CR) code at the end as a terminator.

■ Error Check Code

Use “SUM” as an error check code.
In this example, the “SUM” code is the sum total of the transmitted contents, from the command code to the end of data (the last 1 byte is retrieved), also converted in hexadecimal characters.

■ Communication Error

If the robot recognizes a communication error, an “e” message will be returned.
If a communication error is returned, no operation will be executed.

Communication Error Response (e.g. 2: Command Code Error)

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	65	e	Command Code
3	32	2	Subcommand Code (Communication Error Description) 0: Other communication error 1: Receive timeout 2: Command (subcommand) code error 4: Error check error
4	30	0	If an error check error (4) is returned, value of the check code (SUM) calculated by the robot will be displayed. Otherwise, “0” will be displayed.
5	30	0	
4	46	F	SUM 65H + 32H + 30H + 30H = F7H
5	37	7	
6	0D		CR: Transmission End Code

0: Other Communication Error

A subcommand code “0: Other Communication Error” will be returned if a “parity error”, “overrun error”, ”frame error”, or “receive buffer overflow” occurs. Check the parity, character length, and stop bit length settings.

1: Receive Timeout

When the robot receives commands, if there is more than a two-second delay between each character after receiving the start transmit code, a "1: Receive Timeout" error will be returned and the characters entered after it will be ignored.

Note that the "1: Receive Timeout" error will be returned if the return code (CR) is not transmitted.

While the robot is in operation, it does not wait for more than two seconds to receive the next character. Each character should be transmitted to the robot sequentially, without pause.

The transmission interval between characters may cause a "1: Receive Timeout" error and the characters entered after it will be ignored.

2: Command (Subcommand) Code Error

If the data, from the start transmit code to the return code (CR), is received successfully, the robot analyzes the received commands and subcommands. If the received command code is unable to be processed (the received data is not available), a "2: Command (Subcommand) Code Error" will be returned.

4: Error Check Error

For an "error check error", the SUM value calculated by the robot will be added to the end of the subcommand code as data. The "4: Error Check Error" will be returned if this SUM value does not coincide with the error check code attached to the received data.

Error Check Error

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	65	e	Command Code
3	34	4	Subcommand Code (4: Error Check Error)
4	35	5	Error Check Code calculated by the robot (SUM)
5	33	3	
6	30	0	SUM 65H + 34H + 35H + 33H = 101H
7	31	1	
8	0D		CR: Transmission End Code

You cannot make a request for the robot to resend the command even if the robot causes an "error check error." If an "error check error" occurs during information acquisition command response, you can resend the information request command.

ROBOT INFORMATION REQUEST/ ROBOT STATUS REQUEST

■ Robot Information Request (B0)

The host requests the robot to send the robot information. The “robot information” includes the model type (arm construction) and software version, etc.

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	42	B	Command Code
3	30	0	Subcommand Code
4	37	7	SUM
5	32	2	42H + 30H = 72H
6	0D		CR: Transmission End Code

When the robot receives the robot information request command (B0) from the host, the robot will return the system information (b0.)

e. g. SCARA (4-Axis), Ver. 1.00, Standard Specifications

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	62	b	Command Code
3	30	0	Subcommand Code
4	38	8	Hardware/Mechanical Composition Information
5	30	0	Refer to the following pages for details.
6	33	3	8031H
7	31	1	
8	30	0	Robot System Software Version Information
9	30	0	“100” stands for Ver. 1.00. 100: 0064H
10	36	6	
11	34	4	
12	30	0	Robot System Software Specifications
13	30	0	1: Standard
14	30	0	
15	31	1	
16	30	0	Reserved (Fixed to “0”)
17	30	0	
18	30	0	
19	30	0	
20	30	0	Robot Teaching Data Version Number
21	30	3	1000 = 3E8H
22	45	E	
23	3B	8	
24	30	0	Robot Teaching Data Sub 1 Version Number
25	30	0	1

26	30	0	
27	31	1	
28	30	0	Robot Teaching Data Sub 2 Version Number
29	30	0	1
30	30	0	
31	31	1	
32	30	0	SUM
33	42	B	62H + 30H + …… + 31H = 60BH
34	0D		CR: Transmission End Code

■ Hardware/Mechanical Composition Information

The hardware/mechanical composition information is represented in 16 bits, including model type (mechanical type or family type) and Axis presence.

bit		OFF	ON
00	Family Type I		
01	Family Type II		
02	Family Type III		
03	Family Type IV		
04	Z-Axis Presence	Absent	Present
05	R-Axis Presence	Absent	Present
06	Unused/Reserved	Reservation OFF Setting	
07	Unused/Reserved	Reservation OFF Setting	
08	Unused/Reserved	Reservation OFF Setting	
09	Unused/Reserved	Reservation OFF Setting	
10	Unused/Reserved	Reservation OFF Setting	
11	I/O Type	I/O-A	I/O-B
12	Unused/Reserved	Reservation OFF Setting	
13	Mechanical Type III		
14	Mechanical Type II		
15	Mechanical Type I		

The mechanical type is represented in the upper 3 bits in the hardware/mechanical composition information.

Mechanical Type III, II, I, bit 13, 14, 15

Model	III bit13	II bit14	I bit15	
Previous models	OFF	OFF	OFF	0
Servo SCARA-N Series	OFF	OFF	ON	4
SCARA-N Series	OFF	ON	OFF	2
Cartesian Series	OFF	ON	ON	6
Servo Gantry	ON	OFF	OFF	1
Unused/Reserved	ON	OFF	ON	5
Unused/Reserved	ON	ON	OFF	3
Unused/Reserved	ON	ON	ON	7

The family type is different from the mechanical type, classified by the Arm length (movable range.)

Servo SCARA Series, Family Type I, II, III, IV, bit 00, 01, 02, 03

Model	03	02	01	00
250	OFF	OFF	OFF	OFF
350	OFF	OFF	OFF	ON
450	OFF	OFF	ON	OFF
550	OFF	OFF	ON	ON
650	OFF	ON	OFF	OFF
750	OFF	ON	OFF	O N
880	OFF	ON	ON	OFF
1000	OFF	ON	ON	ON
350TH (Through hole)	ON	OFF	OFF	OFF
450TH (Through hole)	ON	OFF	OFF	O N
550TH (Through hole)	ON	OFF	ON	OFF

Servo Gantry (G Series), Family Type I, II, III, IV, bit 00, 01, 02, 03

Model	03	02	01	00
4030-150	OFF	OFF	OFF	OFF
6050-150	OFF	OFF	OFF	ON

SCARA-N (S440N Series), Family Type I, II, III, IV, bit 00, 01, 02, 03

Model	03	02	01	00
S440N	OFF	OFF	OFF	OFF

Desktop (Cartesian Series), Family Type I, II, III, IV, bit 00, 01, 02, 03

Model	03	02	01	00
98279A to 98286A	OFF	OFF	OFF	OFF
98287A to 98294A	OFF	OFF	OFF	ON
98295A to 98302A	OFF	OFF	ON	OFF
98602 to 98609	OFF	OFF	ON	ON

■ Robot Status Request (B1)

The host requests the robot to send the current robot status.

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	42	B	Command Code
3	31	1	Subcommand Code
4	37	7	SUM
5	33	3	42H + 31H = 73H
6	0D		CR: Transmission End Code

When the robot receives the robot status request command (B1) from the host, the robot returns the robot status response (b1.)

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	62	b	Command Code
3	31	1	Subcommand Code
4	30	0	Operation Mode 0: Teaching Mode 1: Reserved 2: Run Mode 3: Undefined 4: Test Run Mode 5: Point Run Mode 6: Administration Mode
5	32	2	
6	30	0	Teaching Sub Mode 0: Teaching (TP)
7	30	0	1: Teaching (PC)
8	30	0	Power Supply 0: I/O-SYS 1: COM1
9	30	0	2: User Definition
10	30	0	For extension (0)
11	30	0	
12	30	0	Currently selected program number
13	30	0	e. g. Program Number 12 = 0 CH
14	30	0	
15	43	C	
16	30	0	Robot Status
17	30	0	0004H Teaching Mode
18	30	0	000AH Run Mode, Power ON Standby
19	30	0	0088H Running Standby (Power ON, Start Ready)
20	30	0	0069H Running
21	30	0	00C8H Temporary Stop
22	38	8	05C8H Stop by Operation Error

23	38	8	0908H Stop by System Error 110AH Emergency Stop
24	30	0	Utilization Time (cumulative power-on time) [min] e. g. 1920125 min.: 001D4C7DH
25	30	0	
26	31	1	
27	44	D	
28	34	4	
29	43	C	
30	37	7	
31	44	D	
32	30	0	Running Time (cumulative running time) [min] e. g. 640042 min.: 0009C42AH
33	30	0	
34	30	0	
35	39	9	
36	43	C	
37	34	4	
38	32	2	
39	41	A	
40	32	2	SUM 72AH
41	41	A	
42	0D		CR: Transmission End Code

OPERATION CONTROL

■ Operation Control (R)

The host requests the robot to control operation (e.g. program start.)

R0 – R5 correspond to system input signals from the external I/O-SYS.

You can use communication to control operations (e.g. start running) instead of using the I/O-SYS.

e. g. Switching to Program Number 12

N	HEX	ASC	Description
1	24	$	S: Transmission Start Code
2	52	R	Command Code
3	31	1	Subcommand Code 0: Power ON (incl. Servomotor ON) 1: Program Number Change 2: Return to Work Home 3: Start 4: Temporary Stop 5: Last Work

			6: Reserved 7: End Program 8: Start Designated Program Number 9: Execute Single Point Job
4	30	0	Program Number (Point JobNumber) Only for “1: Program Number Change”, “8: Designated Program Number Start”, and “9: Single Point Job Execution” e. g. Program Number 12: 0 CH
5	30	0	
6	30	0	
7	43	C	
8	35	5	SUM 156H
9	36	6	
10	0D		CR: Transmission End Code

Usually, when the robot receives an operation control command from the host, it returns an operation control response (r) to the host, whether the command can be executed or not. When the robot receives a subcommand code, it returns the code with no change.

e. g. If the Start Fails

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	72	r	Command Code
3	33	3	Subcommand Code
4	46	F	Normal/Error Code 0: Normal, -1: Error The switched number will be displayed. If the program number change fails, “-1” will be displayed.
5	46	F	
6	46	F	
7	46	F	
8	42	B	SUM 1BDH
9	44	D	
10	0D		CR: Transmission End Code

However, if it takes a lot of time to execute commands (R0, R2, R3, R8, and R9), the robot returns a start response temporarily.

The start response (temporary) is used to indicate that the robot recognizes the command. The robot simply returns the received code (capital letter), with no parameters.

e.g. Start Response (Temporary)

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	52	R	Command Code
3	38	8	Subcommand Code 0: Power ON (incl. Servomotor ON) 2: Return to Work Home 3: Start (Program Start) 8: Start Designated Program Number 9: Execute Single Point Job
4	38	8	SUM
5	41	A	
6	0D		CR: Transmission End Code

After returning the start response (temporary), the robot executes actual operation. After completing the operation (whether normal or error), the robot returns a normal response.
However, if the robot recognizes these commands cannot meet conditions (e.g. the robot is not in the run mode), it returns an error response, instead of a start response (temporary.)

R0: Power ON (incl. Servomotor ON)

This command is for turning the power to the drive motor and all of the Axis servomotors ON. It is valid when the robot is standing by for start or has stopped and is waiting for start during running.
If the robot is not in the run mode, it returns an error code "-1: Error." If not, the robot returns a temporary start response (R0), and then turns the motor power and servomotor ON. If they are not turned ON successfully (due to emergency stop, for example), the robot returns the error code "-1."

R1: Program Number Change

This command is for changing program numbers. It is valid when the robot is waiting for a start signal. If the program number is changed successfully, the robot returns the new program number. If not, the robot returns an error code "-1: Error."

R2: Return to Work Home

When the robot receives this command, it shifts to the work home position in the currently selected program number. To drive the Arm, the power supply has to be set to "COM1."
If the robot is not in the run mode, or if the power supply is set to "COM1" even when the robot is in the run mode, it returns an error code "-1: Error." In other cases, the robot returns a temporary start response (R2) and starts shifting to the work home position. If it reaches the work home position successfully, it returns a normal code. If not, an error code is returned.

R3: Start

After receiving this command, the robot starts operation if it is standing by for start. If the robot stops temporarily (after an error occurs), the operation is restarted.
The power supply has to be set to "COM1."
If the robot is not stopped or is not standing by for start, it returns an error code "-1: Error." If the robot is not in the run mode (COM power supply), it also returns the error code "-1: Error." The same result is returned if the robot is in the emergency stop state or start inhibition state.
If the robot is standing by and is ready for start, it returns a temporary start response (R1) and starts operation. After completing the operation, the robot returns a normal response.
If the robot stops temporarily, it restarts operation and returns a normal response, not a temporary response.

R4: Temporary Stop

When the robot receives this command, it shifts to the breakpoint and stops temporarily. After stopping, the robot returns a response. This command is valid when the robot is running.

R5: Last Work

The robot returns a response soon after receiving this command.
If the robot receives this command during cycle operation, it returns to the work home position after the cycle operation (when the last point job is executed) and completes the program successfully.
This command is valid when the robot is running.

R7: Program End

When the robot receives this command while running, it shifts to a breakpoint and cancels the program. It enters a start standby state and does not return to the work home position. If you want the robot to return to the work home position, use the "2: Return to Work Home" after completing the program. This command is valid when the robot is running.

R8: Start Designated Program Number

When the robot receives this command during start standby (COM power supply), it returns a temporary response (R8) and starts operation if it is ready for start. After completing the operation, the robot returns a normal response.
If the robot is not ready for start, it returns an error response.

R9: Execute Single Point Job

After receiving this command, the robot executes the designated point job. This command is valid when the robot is in run mode and also stands by for start or restart (during temporary stop or after an error occurs.)
If the power supply is not set to "COM1", drive commands and a callProgram command are invalid and not executed. (It does not return an error.)

I/O CONTROL

In this chapter, Boolean variables (e.g. input/output, internal relay, and system flag) are represented by types and numbers to handle them collectively.
There are the folllowing types. Designate each type by “type specification values (0 – 11).”

Type	Symbol	Type Specification Value	Number
System I/O Input	#sysIn	0	1 – 15
General I/O Input	#genIn	1	1 – 18
Hand I/O Input	#handIn	2	1 – 4
System I/O Output	#sysOut	3	1 – 14
General I/O Output	#genOut	4	1 – 22
Hand I/O Output	#handOut	5	1 – 4
Internal Relay	#mv	6	1 – 99
Keep Relay	#mkv	7	1 – 99
System Flag	#sysFlag	8	1 – 999
Pallet Flag	#palletFlag	9	1 – 100
Sequencer Timer Flag	#seqT	10	1 – 100
Sequencer Counter Flag	#seqC	11	1 – 50

The following variations are available for both current status readout and current status output.

1. Designated Number Readout
2. set (Turn ON.)
3. reset (Turn OFF.)
4. delaySet (Turn ON in designated time.)
5. delayReset (Turn OFF in designated time.)
6. pulse (Turn ON and then turn OFF after outputting the designated pulse.)
7. invPulse (Turn OFF and then turn ON after outputting the designated pulse.)
8. delayPlusSet (Turn ON in the designated time and then turn OFF after outputting the designated pulse.)
9. delayinvPulseSet (Turn OFF in the designated time and then turn ON after outputting the designated pulse.)

■ I/O Readout (K0, K1)

To use a readout command (K0), designate a type. When the robot receives this command, it returns the status as a bit flag alignment. If the robot receives a designated number readout request (K1), it designates a type and number and reads out only the designated number status.

Readout Request (K0)

e.g. General I/O Input (#genIn)

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	4B	K	Command Code
3	30	0	Subcommand Code
4	30	0	Type Specification Value (0 – 11)
5	30	0	
6	30	0	
7	31	1	
8			SUM
9			
10	0D		CR: Transmission End Code

The robot returns the status to an IOM status read out request (K0.)

e.g. #genIn

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	6B	k	Command Code
3	30	0	Subcommand Code
4	30	0	Type Specification Value (The robot returns the value with the request command value attached.) (0 – 11)
5	30	0	
6	30	0	
7	30	0	
8	32	2	No. 1 – No. 8 status; bit0: No. 1 ... bit7: No. 8, ON: 1, OFF: 0
9	31	1	00100001: 21H
10	30	0	No.9 – No.16 status; bit0: No. 9 ... bit7: No. 16, ON: 1, OFF: 0
11	30	4	00000100: 04H
12	30	0	No. 17 – No. 18 status; bit0: No. 17 ... bit1: No. 18, ON: 1, OFF: 0
13	30	0	
14	30	0	Reserved (0)
15	30	0	
16			SUM
17			
18	0D		CR: Transmission End Code

Designated Number Readout Request (K1)

e.g. General I/O Input, No. 3 (#genIn3)

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	4B	K	Command Code
3	31	1	Subcommand Code
4	30	0	Type Specification Value (0 – 11)
5	30	0	
6	30	0	
7	31	1	
8	30	0	IOM Number
9	30	0	
10	30	0	
11	30	0	
12	30	0	
13	30	0	
14	30	0	
15	33	3	
16			SUM
17			
18	0D		CR: Transmission End Code

If the robot receives a designated number readout request, it returns a type specification number and IOM number with no change. Then, the robot returns the status.

Designated Number Readout Response (k1)

e.g. General I/O Input, No. 3 (#genIn3)

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	4B	K	Command Code
3	31	1	Subcommand Code
4	30	0	Type Specification Value (0 – 11)
5	30	0	
6	30	0	
7	31	1	
8	30	0	IOM Number
9	30	0	
10	30	0	
11	30	0	
12	30	0	
13	30	0	
14	30	0	
15	33	3	
16	30	0	Status 0: ON 1: OFF
17	30	0	
18	30	0	
19	30	0	
20	30	0	
21	30	0	
22	30	0	
23	31	1	

24			SUM
25			
26	0D		CR: Transmission End Code

■ I/O Output: set, reset (K2, K3)

These commands are used to set (ON) or reset (OFF) signals. The type specification values 0 – 2 are invalid since the System I/O Input, General I/O Input, and Hand I/O Input cannot be used for output. (It does not return an error but there is no response.)

e.g. set, #genOut2

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	4B	K	Command Code
3	32	2	Subcommand Code (2 or 3)
4	30	0	Type Specification Value (3 – 11)
5	30	0	
6	30	0	
7	30	4	
4	30	0	Number
5	30	0	
6	30	0	
7	30	0	
4	30	0	
5	30	0	
6	30	0	
7	32	2	
8			SUM
9			
10	0D		CR: Transmission End Code

The robot returns a normal or an error response. For the ION output, it does not return an error since there is no special treatment (e.g. parameter check.)

Response, e.g. set

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	4B	k	Command Code
3	32	2	Subcommand Code (2 or 3)
4	30	0	Normal/Error 0: Normal -1: Error
5	30	0	
6	30	0	
7	30	0	
8			SUM
9			
10	0D		CR: Transmission End Code

■ I/O Output: delaySet, delayReset (K4, K5)

These commands are used to set (ON) or reset (OFF) in the designated time. The delay time is designated in msec. The type specification values 0 – 2 are invalid since the System I/O Input, General I/O Input, and Hand I/O Input cannot be used for output. (It does not return an error but there is no response.) The response to this command is returned within the delay time.

e.g.

N	HEX	ASC	Description
1	24	$	$: Start Transmission Code
2	4B	K	Command Code
3	30	4	Subcommand Code (4 or 5)
4	30	0	Type Specification Value (3 – 11)
5	30	0	
6	30	0	
7	34	4	
8	30	0	Number
9	30	0	
10	30	0	
11	30	0	
12	30	0	
13	30	0	
14	30	0	
15	31	1	
16	30	0	Delay Time [msec] e.g. 100msec = 64H
17	30	0	
18	30	0	
19	30	0	
20	30	0	
21	30	0	
22	36	6	
23	34	4	
24			SUM
25			
26	0D		CR: Transmission End Code

The response parameters are the same as K2 and K3. A normal or an error response is returned.

■ I/O Output: pulse, invPulse (K6, K7)

These commands are used to output a plus or minus pulse. The plus pulse output is the same as outputting the delaySet after turning the signal ON. The minus pulse output is the same as outputting the delaySet after turning the signal OFF. The pulse width is designated in msec. The type specification values 0 – 2 are invalid since the System I/O Input, General I/O Input, and Hand I/O Input cannot be used for output. (It does not return an error but there is no response.) The response to this command is returned within the pulse output time.

e.g.

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	4B	K	Command Code
3	36	6	Subcommand Code (6 or 7)
4	30	0	Type Specification Value (3 – 11)
5	30	0	
6	30	0	
7	34	4	
8	30	0	Number
9	30	0	
10	30	0	
11	30	0	
12	30	0	
13	30	0	
14	30	0	
15	31	1	
16	30	0	Pulse Time Width [msec] e.g. 100msec = 64H
17	30	0	
18	30	0	
19	30	0	
20	30	0	
21	30	0	
22	36	6	
23	34	4	
24			SUM
25			
26	0D		CR: Transmission End Code

The response parameters are the same as K2 and K3. A normal or an error response is returned.

■ I/O Output: delayPulseSet, delayinvPulseSet (K8, K9)

These commands are used to output pulse or minus pulse in the designated delay time. The delay time and pulse width are designated in msec. The type specification values 0 – 2 are invalid since the System I/O Input, General I/O Input, and Hand I/O Input cannot be used for output. (It does not return an error but there is no response.) The response to this command is returned within the delay time and pulse output time.

e.g.

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	4B	K	Command Code
3	38	8	Subcommand Code (8 or 9)
4	30	0	Type Specification Value (3 – 11)
5	30	0	
6	30	0	
7	34	4	
8	30	0	Number
9	30	0	
10	30	0	
11	30	0	
12	30	0	
13	30	0	
14	30	0	
15	31	1	
16	30	0	Delay Time [msec] e.g. 100msec = 64H
17	30	0	
18	30	0	
19	30	0	
20	30	0	
21	30	0	
22	36	6	
23	34	4	
24	30	0	Pulse Time Width [msec] e.g. 100msec = 64H
25	30	0	
26	30	0	
27	30	0	
28	30	0	
29	30	0	
30	36	6	
31	34	4	
32			SUM
33			
34	0D		CR: Transmission End Code

The response parameters are the same as K2 and K3. A normal or an error response is returned.

DRIVE CONTROL

Drive control commands are valid when the robot is stopped in the external run (COM) mode.
These commands are not activated when the start is inhibited by the I/O-S or start inhibition signal. External I/O output control (turning “Ready for Start” and “Robot Stopping” signals OFF) is necessary for driving.

■ PTP Drive Control (M1)

Using this command, designate the destination and execute the PTP drive.

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	4D	M	Command Code
3	31	1	Subcommand Code
4-27			XYZR Position Refer to “Position (24-Byte)” on Page 72.
28			SUM
29			
30	0D		CR: Transmission End Code

[PTP Condition], [Tool Data], and [Move Area Limit] are determined by the selected program data settings. If the selected program is not registered, the program data defaults are applied.

The robot returns a start response (temporary) to this command. The start response (temporary) is used to indicate that the robot recognizes the command. The robot returns only the received code (capital letter), with no parameters.

e.g. Start Response (Temporary)

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	4D	M	Command Code
3	31	1	Subcommand Code
4	37	7	SUM
5	45	E	
6	0D		CR: Transmission End Code

After returning the start response (temporary), the robot executes actual operation. After completing the operation (whether normal or error), the robot returns a normal response.
However, if the robot recognizes that it cannot start (e.g. the robot is not in the run mode), it returns an error response, instead of a start response (temporary.)

If the robot shifts in the PTP drive successfully, it returns a normal response after reaching the destination.

If not (e.g. the robot exceeds the move area limit), the robot returns an error response.

e.g. Error

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	6D	m	Command Code
3	31	1	Subcommand Code
4	46	F	Result Code Normal: 0 Error: -1
5	46	F	
6	46	F	
7	46	F	
8	42	B	SUM 1B6
9	36	6	
10	0D		CR: Transmission End Code

Possible error causes are as follows.

- The robot is not standing by for external start.
- The robot is stopped due to an overload error.
- The robot position is out of the moving range.

■ CP Linear Drive Control (M2)

Use this command to designate the CP speed and destination to execute the CP linear drive.

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	4D	M	Command Code
3	32	2	Subcommand Code
4	30	0	CP Speed in increments of 0.1 [mm/s] e.g. 15.5 [mm/s] (155): 9BH
5	30	0	
6	39	9	
7	42	B	
8-31			Destination, XYZR Position Refer to "Position (24-Byte)" on Page 72.
32			SUM
33			
34	0D		CR: Transmission End Code

[CP Condition] ([Rotate Speed Limit] and [Rotate Acceleration Limit]), [Tool Data] and [Move Area Limit] are determined by the selected program data settings. If the selected program is not registered, the program data defaults are applied.

The robot returns a start response (temporary) to this command. The start response (temporary) is used to indicate that the robot recognizes the command. The robot returns only the received code (capital letter), with no parameters.

e.g. Start Response (Temporary)

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	4D	M	Command Code
3	32	2	Subcommand Code
4	37	7	SUM
5	46	F	
6	0D		CR: Transmission End Code

After returning the start response (temporary), the robot executes actual operation. After completing the operation (whether normal or error), the robot returns a normal response.
However, if the robot recognizes that it cannot start (e.g. the robot is not in the run mode), it returns an error response, instead of a start response (temporary.)

If the robot shifts in the CP linear drive successfully, it returns a normal response after reaching the destination.

If not (e.g. the robot exceeds the move area limit), the robot returns an error response.

e.g. Error

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	6D	m	Command Code
3	32	2	Subcommand Code
4	46	F	Result Code Normal: 0 Error: -1
5	46	F	
6	46	F	
7	46	F	
8	42	B	SUM 1B7H
9	37	7	
10	0D		CR: Transmission End Code

Possible error causes are as follows.

- The robot is not standing by for external start.
- The robot is stopped due to an overload error.
- The robot position is out of the moving range.
- CP Speed Over
- CP Righty/Lefty Error

■ CP Arc Drive Control (M3)

Use this command to designate the CP arc point, destination, and each CP speed to execute the CP arc drive.

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	4D	M	Command Code
3	33	3	Subcommand Code
4	30	0	CP Speed in increments of 0.1[mm/s] Speed to CP Arc Position e.g. 20.0 [mm/s] (200): C8H
5	30	0	
6	43	C	
7	38	8	
8-31			Arc Point, XYZR Position Refer to “Position (24-Byte)” on Page 72.
32	30	0	CP Speed in increments of 0.1[mm/s] (e.g. 20.0 [mm/s]) Speed from CP Arc Position to Destination e.g. 20.0 [mm/s] (200): C8H
33	30	0	
34	43	C	
35	38	8	
36-59			Destination, XYZR Position Refer to “Position (24-Byte)” on Page 72.
60			SUM
61			
62	0D		CR: Transmission End Code

[CP Condition] ([Rotate Speed Limit] and [Rotate Acceleration Limit]), [Tool Data] and [Move Area Limit] are determined by the selected program data settings. If the selected program is not registered, the program data defaults are applied.

The robot returns a start response (temporary) to this command. The start response (temporary) is used to indicate that the robot recognizes the command. The robot returns only the received code (capital letter), with no parameters.

e.g. Start Response (Temporary)

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	4D	M	Command Code
3	32	3	Subcommand Code
4	38	8	SUM
5	30	0	
6	0D		CR: Transmission End Code

After returning the start response (temporary), the robot executes actual operation. After completing the operation (whether normal or error), the robot returns a normal response.

However, if the robot recognizes that it cannot start (e.g. the robot is not in the run mode), it returns an error response, instead of a start response (temporary.)

If the robot shifts in the CP linear drive successfully, it returns a normal response after reaching the destination.
If not (e.g. the robot exceeds the move area limit), the robot returns an error response.

e.g. Error

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	6D	m	Command Code
3	33	3	Subcommand Code
4	46	F	Result Code 0: Normal -1: Error
5	46	F	
6	46	F	
7	46	F	
8	42	B	SUM 1B8H
9	38	8	
10	0D		CR: Transmission End Code

Possible causes of error are as follows.

- The robot is not standing by for external start.
- The robot is stopped due to an overload error.
- The robot position is out of the moving range.
- CP Speed Over
- CP Righty/Lefty Error

■ JOG Movement (M4, M5, M6)

If you want to execute JOG movement, use the three commands; JOG Start (M4), JOG Moving (M5), and JOG End (M6.)
First, send the JOG Start command (M4) and designate the distance and tool data. The robot returns a JOG Start response (m4) and starts JOG movement.
After receiving the response, you need to send a JOG Moving command (M5) every 100 msec. The robot cancels the JOG movement if it does not receive a continuation command within 150 msec. This is for safety (to stop quickly) in case of connection or communication error.
The robot does not return an m5 response to a JOG Moving (M5) command.
Send a JOG End command (M6) to stop the robot. The robot returns a JOG End response (m6) to this command.

Use the following data in the robot when JOG movement is required.

- JOG Speed (set in the [Teaching Environments Setting])
- Move Area Limit (in the currently selected program; if it is not registered, default is applied.)

Attach tool data to a JOG Start command to designate the JOG movement.

JOG Start Request (M4)

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	4D	M	Command Code
3	34	4	Subcommand Code, 4: JOG Start
4			XY/J Designation 0: XY (orthogonal) 1: J1 – J2 Axis (only for non-orthogonal robot)
5			
6			Moving Axis Designation 0: X/J1 1: Y/J2 2: Z 3: R
7			
8			Shifting Direction Designation 0: Plus Direction 1: Minus Direction
9			
10			Speed Select Designation For the (JS) SCARA robot, select between the followings. 0: Low Speed 1: Medium Speed 2: High Speed
11			
12-39			Tool Data (28 bytes)
40			SUM
41			
42	0D		CR: Transmission End Code

When the robot receives a JOG Start request (M4), it returns a JOG Start response (m4.) If the robot cannot start the JOG movement (e.g. it is not in the JOG mode), it returns an error code (-1.)

JOG Start Response (m4)

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	6D	m	Command Code
3	34	4	Subcommand Code, 4: JOG Start Response
4	30	0	Normal/Error Code 0: Normal -1: Error (if the robot is not in the JOG mode)
5	30	0	
6	30	0	
7	30	0	
8	36	6	SUM 161H
9	31	1	
10	0D		CR: Transmission End Code

JOG Moving Request (M5)

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	4D	M	Command Code
3	35	5	Subcommand Code, 5: JOG Moving Request
4	3E	0	Speed Selection Designation (Invalid for the SCARA robot: fixed to “0”.)
5	32	0	
6	45	E	SUM E2H
7	32	2	
8	0D		CR: Transmission End Code

The robot does not respond to M5. However, if the robot receives M5 without receiving a JOG Start request (M4), it returns m5 as an error code.

Error on JOG Moving (m5)

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	6D	m	Command Code
3	35	5	Subcommand Code, 5: Error on JOG Moving
4	46	F	Error Code -1: Error (if the robot receives this command without receiving a start command)
5	46	F	
6	46	F	
7	46	F	
8	42	B	SUM 1BAH
9	41	A	
10	0D		CR: Transmission End Code

JOG End Request (M6)

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	4D	M	Command Code
3	36	6	Subcommand Code, 6: JOG End Request
4	38	8	SUM 83H
5	33	3	
6	0D		CR: Transmission End Code

JOG End Response (m6)

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	6D	m	Command Code
3	36	6	Subcommand Code, 6: JOG End Response
4	30	0	Normal/Error 0: Normal -1: Error (if the robot receives this command without receiving a start command)
5	30	0	
6	30	0	
7	30	0	
8	36	6	SUM 163H
9	33	3	
10	0D		CR: Transmission End Code

If the robot does not receive a JOG End request (M6), it may return a JOG End response (m6) when reaching the maximum moving area. This result is a normal end. If the robot receives M6 without receiving a JOG Start request (M4), it returns m6 as an error code.

■ CP Continuous Drive (M7)

Use this command to execute the continuous CP linear and arc drive.

You can use up to 250 points.

N	HEX	ASC	Description
1		$	$: Transmission Start Code
2		M	Command Code
3		7	Subcommand Code
4		0	Number of Points
5		0	
6		0	
7		6	
8		0	1 → 2, Line Speed in increments of 0.1 [mm/s] (e.g. 20.0 [mm/s])
9		0	
10		0	
11		0	
12		0	Second Point, Point Type 0: CP Passing Point 1: CP Arc Point 2: CP End Point
13		0	
14		0	
15		0	
16-39			Second Point, XYZR Direction Refer to “Position (24-Byte)” on Page 72.
8		0	2 → 3, Line Speed in increments of 0.1 [mm/s] (e.g. 20.0 [mm/s])
9		0	
10		0	
11		0	
12		0	Third Point, Point Type 0: CP Passing Point 1: CP Arc Point 2: CP End Point
13		0	
14		0	
15		0	
16-39			Third Point, XYZR Direction Refer to “Position (24-Byte)” on Page 72.
8		0	3 → 4, Line Speed in increments of 0.1 [mm/s] (e.g. 20.0 [mm/s])
9		0	
10		0	
11		0	
12		0	Forth Point, Point Type 0: CP Passing Point 1: CP Arc Point 2: CP End Point
13		0	
14		0	
15		0	
16-39			Forth Point, XYZR Direction Refer to “Position (24-Byte)” on Page 72.
8		0	4 → 5, Line Speed in increments of 0.1 [mm/s] (e.g. 20.0 [mm/s])
9		0	
10		0	
11		0	
12		0	Fifth Point, Point Type

13		0	0: CP Passing Point 1: CP Arc Point 2: CP End Point
14		0	
15		0	
16-39			Fifth Point, XYZR Direction Refer to “Position (24-Byte)” on Page 72.
8		0	5 → 6, Line Speed in increments of 0.1 [mm/s] (e.g. 20.0 [mm/s])
9		0	
10		0	
11		0	
12		0	Sixth Point, Point Type 0: CP Passing Point 1: CP Arc Point 2: CP End Point
13		0	
14		0	
15		0	
16-39			Sixth Point, XYZR Direction Refer to “Position (24-Byte)” on Page 72.
48	31	1	SUM 53H + 35H + …… + 30H = 911H
49	31	1	
50	0D		CR: Transmission End Code

This command is valid only when the robot is stopped in the external run (COM1) mode.
[CP Condition] ([Rotate Speed Limit] and [Rotate Acceleration Limit]), [Tool Data] and [Move Area Limit] are determined by the selected program data settings. If the selected program is not registered, the program data defaults are applied.
This command is not activated when start is inhibited by the I/O-S or start inhibition signal. External I/O output control (turnning “Ready for Start” and “Robot Stopping” signals OFF) is necessary for driving.

When the robot receives this command, it returns a (temporary) start response. The start response (temporary) is used to indicate that the robot recognizes the command. The robot returns only the received code (capital letter), with no parameters.

e. g. Start Response (Temporary)

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	4D	M	Command Code
3	32	3	Subcommand Code
4	38	8	SUM
5	30	0	
6	0D		CR: Transmission End Code

After returning the start response (temporary), the robot executes actual operation. After completing the operation (whether normal or error), the robot returns a normal response.
However, if the robot recognizes that it cannot start (e.g. the robot is not in the run mode), it returns an error response, instead of a start response (temporary.)

If the robot shifts in the CP drive successfully, it returns a normal response after reaching the destination.

If not (e.g. the robot exceeds the move area limit), the robot returns an error response.

e. g. Error: $m7FFFFC0

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	73	m	Command Code
3	37	7	Subcommand Code
4	46	F	Result Code 0: Normal -1: Error
5	46	F	
6	46	F	
7	46	F	
8			SUM
9			
10	0D		CR: Transmission End Code

Possible causes of error are as follows.

- The robot is not standing by for external start.
- The robot is stopped due to an overload error.
- The robot position is out of the moving range.
- CP Speed Over
- CP Righty/Lefty Error

POSITION INFORMATION REQUEST

■ Arm Position Request (N0), Tool Tip Position Request (N1)

Using these commands, the host requests the robot to send the current robot Arm position (N0) and tool tip position (N1.)
When the robot receives these commands, it returns the current robot position (Righty/Lefty, X coordinate value, Y coordinate value, Z coordinate value, and R coordinate value.)

Arm Position Request (N0), Tool Tip Position Request (N1)

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	4E	N	Command Code
3	31	1	Subcommand Code 0: Arm Position 1: Tool Tip Position
4	37	7	SUM 7FH
5	46	F	
6	0D		CR: Transmission End Code

When the robot receives the request command (N0, N1), it returns the current robot position (Righty/Lefty, X coordinate value, Y coordinate value, Z coordinate value, and R coordinate value.)

Arm Position Response (n0), Tool Tip Position Response (n1)

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	6E	n	Command Code
3	31	1	Subcommand Code 0: Arm Position 1: Tool Tip Position
4-27			XYZR Position Refer to “Position (24-Byte)” on Page 72.
28			SUM
29			
30	0D		CR: Transmission End Code

The robot refers to the tool data in the currently selected program to calculate the tool tip position coordinates. If the selected program is not registered, the robot refers to the default.
The Arm position is equal to the tool tip position when both [TCP-X] and [TCP-Y] are “0.”

■ Designated TCP Tool Tip Point Request (N2)

The host sends the TCP settings to the robot and requests to send the tool tip position.
When the robot receives this command, it returns the current robot position (Righty/Lefty, X coordinate value, Y coordinate value, Z coordinate value, and R coordinate value.)

Designated TCP Tool Tip Position Request (N2)

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	4E	N	Command Code
3	32	2	Subcommand Code
4-35			TCP (Tool Center Point) Refer to “TCP” on Page 70.
36			SUM
37			
38	0D		CR: Transmission End Code

When the robot receives the request command (N2), it returns the current robot position (Righty/Lefty, X coordinate value, Y coordinate value, Z coordinate value, and R coordinate value.)

Tool Tip Position Response (n2)

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	6E	n	Command Code
3	31	2	Subcommand Code
4-27			XYZR Position Refer to “Position (24-Byte)” on Page 72.
28			SUM
29			
30	0D		CR: Transmission End Code

The designated tool data (TCP) is used to calculate the tool tip position coordinates.

OPERATION INFORMATION REQUEST

■ Operation Information Request (I)

Using this command, the host requests the robot to send the operation information.
Some contents of the transferred data may be the same as the operation report (q.) The main difference between the operation information response and the operation report is that the robot sends the operation result spontaneously, with or without a request.

Execute Point Inforamtion Request

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	49	I	Command Code
3	38	0	Subcommand Code (0)
4	37	7	SUM
5	39	9	
6	0D		CR: Transmission End Code

e.g. I8: Counter Value of Pallet 12 Request

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	49	I	Command Code
3	38	8	Subcommand Code 6: Counter Value (1 – 50) 7: Timer Value (1 – 99) 8: Pallet Counter Value (1 – 100) 9: Workpiece Adjustment Amount (1 – 100)
4	30	0	Counter Number/Timenr Number/Pallet Number/ Work Adjustment Number
5	30	0	
6	30	0	
7	43	C	
8			SUM
9			
10	0D		CR: Transmission End Code

This “Operation Information” command can be activated in any mode or operating condition.

■ Execute Point Request (i0)

When the robot receives the operation information request (I0), the robot returns information about the point where the robot is running (program number, point number, and point type.) The contents are the same as the operation report (q2) except the command code.

e.g. Program Number 12, Point Number 1521, Point Type

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	69	i	Command Code
3	30	0	Subcommand Code
4	30	0	Program Number e.g. Number 12: 000CH
5	30	0	
6	30	0	
7	43	C	
8	30	0	Point Number e.g. 1521: 05F1H
9	30	0	
10	30	0	
11	30	0	
12	30	0	
13	35	5	
14	46	F	
15	31	1	
16			Point Type Code Refer to “Point Type Code” on Page 73.
17			
18			
19			
20			
21			
22			
23			
22	32	2	SUM 428H
23	38	8	
24	0D		CR: Transmission End Code

■ Counter Value (i6)

When the robot receives the operation information request (I6), it returns the counter (1 – 50) status and counter value.

If the designated counter number does not fall within the range of 1 – 50, the robot returns “0” (no number.)

e.g. Counter Number 12 is ON, Counter Value: 856

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	69	I	Command Code
3	36	6	Subcommand Code
4	30	0	Counter Number (1 – 50) e.g. 12: 0CH
5	30	0	
6	30	0	
7		C	
8	30	0	1: Number Available, 0: No Number Available If the counter number does not fall within the range, the robot returns 0 (no number) and the items following are represented as 0.
9	31	1	
10	30	0	Status ON: 1, OFF: 0
11	31	1	
12	30	0	Reserved (0)
13	30	0	
14	30	0	
15	30	0	
16	30	0	Counter Value e.g. 856: 0358H
17	30	0	
18	30	0	
19	30	0	
20	30	0	
21	33	3	
22	35	5	
23	38	8	
24			SUM
25			
26	0D		CR: Transmission End Code

■ Timer Value (i7)

When the robot receives the operation information request (I7), it returns the timer (1 – 99) status and timer value.

If the designated timer number does not fall within the range of 1 – 99, the robot returns “0” (no number.)

e.g. Timer Number 25 is OFF, Timer Value: 742

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	69	i	Command Code
3	37	7	Subcommand Code
4	30	0	Timer Number (1 – 99) e.g. 25: 19H
5	30	0	
6	31	1	
7	39	9	
8	30	0	1: Number Available, 0: No Number Available If the timer number does not fall within the range, the robot returns 0 (no number) and the items following are represented as 0.
9	31	1	
10	30	0	Status ON: 1, OFF: 0
11	30	0	
12	30	0	Reserved (0)
13	30	0	
14	30	0	
15	30	0	
16	30	0	Timer Value e.g. 742: 2E6H
17	30	0	
18	30	0	
19	30	0	
20	30	0	
21	32	2	
22	45	E	
23	36	6	
24	30	0	SUM 307H
25	37	7	
26	0D		CR: Transmission End Code

■ Pallet Counter Value (i8)

When the robot receives the operation information request (I8), it returns the pallet (1 – 100) status and the pallet counter value.

The robot also returns whether the designated pallet number is defined (1) or not (0.) If the pallet number does not fall within the range of 1 – 100, the robot returns “0” (undefined.)

e.g. Pallet Number 15, Plane Pallet, Reset State, First Row, Hundredth Column

(Total: 2 Rows, 123 Columns)

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	69	i	Command Code
3	38	8	Subcommand Code
4	30	0	Pallet Number e.g. 15: 0FH
5	30	0	
6	30	0	
7	46	F	
8	30	0	1: Defined, 0: Undefined
9	31	1	
10	30	0	Status 0: Reset (initial condition, now counting) 1: Set (The counter reached full and returned to 0.)
11	32	0	
12	30	0	Pallet Type 0: 1 Point repeat 1: Row 2: Plane Pallet 3: Cubic Pallet 4: Repeat by Camera 5: Circle Pallet
13	32	0	
14	30	0	
15	32	2	
16	30	0	Full Pallet Counter Value
17	30	0	
18	30	0	
19	32	2	
20	30	0	
21	30	0	
22	30	0	
23	31	1	
24	31	1	Current Pallet Counter Value
25	34	4	
26	30	0	
27	33	3	
28	30	0	
29	30	0	
30	36	6	
31	34	4	
32			SUM 78AH
33			
34	0D		CR: Transmission End Code

■ Workpiece Adjustment Amount (i9)

When the robot receives the operation information (I9), it returns the workpiece adjustment (1 – 100) amount.

The robot also returns whether the designated workpiece adjustment number is defined (1) or not (0.) If the workpiece adjustment number does not fall within the range of 1 – 100, the robot returns "0" (undefined.)

e.g. Workpiece Adjustment Number 15, Numeric Adjustment, X Adjustment: - 2.3 mm, Y Adjustment: -20.5 mm, Z Adjustment: + 2mm, R Adjustment: 0.5 deg., Rotate Adjustment: 0.001 deg.

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	69	i	Command Code
3	39	9	Subcommand Code
4	30	0	Work Adjustment Number e.g. 15: 0FH
5	30	0	
6	30	0	
7	46	F	
8	30	0	1: Defined, 0: Undefined
9	31	1	
10	30	0	Unused (0)
11	30	0	
12	30	0	Workpiece Adjustment Type 0: Numeric Adjustment 1: Camera Adjustment
13	30	0	
14	30	0	
15	30	0	
16	46	F	X Adjustment: in increments of 0.001 mm e.g. -2300: FFFFF704H
17	46	F	
18	46	F	
19	46	F	
20	46	F	
21	37	7	
22	30	0	
23	34	4	
24	46	F	Y Adjustment: in increments of 0.001 mm e.g. -20500: FFFFAFECH
25	46	F	
26	46	F	
27	46	F	
28	41	A	
29	46	F	
30	45	E	
31	43	C	
32	30	0	Z Adjustment: in increments of 0.001 mm Positive Numbers: Downward Direction Adjustment Negative Numbers: Upward Direction Adjustment e.g. 2000: 7D0H
33	30	0	
34	30	0	
35	30	0	
36	30	0	
37	37	7	
38	44	D	
39	30	0	

40	30	0	R Adjustment: in increments of 0.01 deg. e.g. 50: 32H
41	30	0	
42	30	0	
43	30	0	
44	30	0	
45	30	0	
46	33	3	
47	32	2	
48	30	0	Rotate Adjustment: in increments of 0.000001 deg. e.g. 1000: 3E8H
49	30	0	
50	30	0	
51	30	0	
52	30	0	
53	33	3	
54	45	E	
55	38	8	
56	30	0	Z Standard Data: in increments of 0.001 mm e.g. 1000: 3E8H
57	30	0	
58	30	0	
59	30	0	
60	30	0	
61	33	3	
62	46	E	
63	38	8	
64			SUM
65			
66	0D		CR: Transmission End Code

OPERATION REPORT

■ Operation Report Level Setting (Q0 – Q3)

The robot sends the operation report spontaneously as per the operation report level settings.
This is the main difference between the operation report and the other responses toward the operation control commands or information requests.

There are four levels from 0 to 3. Level 2 includes the Level 1 report. Level 3 includes both Levels 1 and 2 reports.

Level 0: No Report
Level 1: Returning to Work Home Position Complete, Operation Complete, Stop by Operation Error
Level 2: Execute Point Information Report
Level 3: Pallet Counter Control Report

Q1: Level 1 Setting

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	51	Q	Command Code
3	31	1	Subcommand Code
4	38	8	SUM 51H + 31H = 82H
5	32	2	
6	0D		CR: Transmission End Code

■ Operation Report Level Setting Response (q0)

When the robot receives the operation report level setting, it returns q0, regardless of the level.

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	71	q	Command Code
3	30	0	Subcommand Code
4	30	0	Result Code 0: Normal -1: Error
5	30	0	
6	30	0	
7	30	0	
8	36	6	SUM 161H
9	31	1	
10	0D		CR: Transmission End Code

■ Operation Report Level 1 (q1)

If the operation report level is set to 1, the robot sends the operation report after completing an operation or returning to the work home position. The robot also sends an operation report when an operation error occurs.
If the robot is stopped by an operation error, it returns an error code and error details.

e.g. "Stop by Operation Error" Occurs at Point Number 35.

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	71	q	Command Code
3	31	1	Subcommand Code
4	46	F	Normal/Error Code 1: Power ON, -1: Power On Error 2: Return to Work Home Complete, -2: Return to Work Home Error 3: Operation Complete, -3: Stop by Operation Error e.g. Stop by Operation Error (-3): FFFDH
5	46	F	
6	46	F	
7	44	D	
8	30	0	Error Details Code If the error code is "-3", the error details code is represented. (Refer to then "Error Code Table" under Specifications.)
9	30	0	
10	30	0	
11	36	6	
12	30	0	Error Point Number The robot returns the error point number. e.g. 35: 23H
13	30	0	
14	32	2	
15	33	3	
16	34	4	SUM 343H
17	33	3	
18	0D		CR: Transmission End Code

■ Operation Report Level 2 (q2)

If the operation report level is set to 2, the robot sends the execute point information (program number, point number, and point type code) in addition to the Level 1 report. The robot shifts to the execute point and sends the point information before executing operation.

Program Number 12, Point Number 1521, Condition Number 12

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	71	Q	Command Code
3	32	2	Subcommand Code
4	30	0	Program Number e.g. 12: 0CH
5	30	0	
6	30	0	
7	43	C	
8	30	0	Point Number e.g. 1521: 05F1H
9	30	0	
10	30	0	
11	30	0	
12	30	0	
13	35	5	
14	46	F	
15	31	1	
16			Point Type Code Refer to “Point Type Code” on Page 73.
17			
18			
19			
20			
21			
22			
23			
24			SUM
25			
26	0D		CR: Transmission End Code

The robot does not resend the q2 report.

If the host fails to receive the report and sends NAK, the robot does not respond to the request.

■ Operation Report Level 3 (q3)

If the operation report level is set to 3, the robot sends the pallet counter status when the pallet routine is executed in addition to Levels 1 and 2 reports.
The pallet routine consists of [Increment by Point Job] ([Reset Pallet Counter] and [Increment Pallet]) and [Auto Increment.]

e.g. Pallet Number 15, Increment, Reset State, Plane Pallet

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	71	q	Command Code
3	33	3	Subcommand Code
4	30	0	Pallet Number e.g. 15: 0FH
5	30	0	
6	30	0	
7	46	F	
8	30	0	Pallet Routine 0: Reset, 1: Increment
9	31	1	
10	30	0	Pallet State 0: Reset (initial state, now counting) 1: Set (The counter reached full and returned to 0.)
11	30	0	
12	30	0	Pallet Type 0: 1 Point Repeat 1: Row 2: Plane Pallet 3: Cubic Pallet 4: Repeat by Camera 5: Circle Pallet
13	30	0	
14	30	0	
15	32	2	
16	30	0	Full Pallet Counter Value e.g. 4 Rows, 5 Columns = 20 = 14H
17	30	0	
18	30	0	
19	32	0	
20	30	0	
21	30	0	
22	31	1	
23	34	4	
24	30	0	Current Pallet Counter Value e.g. 10 = 0AH
25	30	0	
26	30	0	
27	30	0	
28	30	0	
29	30	0	
30	30	0	
31	41	A	
32	31	1	SUM 613H
33	33	3	
34	0D		CR: Transmission End Code

The robot does not resend the q3 report.
If the host fails to receive the report and sends NAK, the robot does not respond to the request.

ERROR INFORMATION REQUEST

Using these commands, the host requests the robot to send system error information and operation error information.
The robot stores the error information if an error occurs while the teaching pendant is unconnected.
You can get the error information from the robot by sending the request commands via COM.

■ System Error Information Request (F1)

System errors include “hardware error”, “mechanical initialization error”, “teaching data incorrect error”, “logic error”, and “CPU trap error.”

System Error Information Request (F1)

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	4E	F	Command Code
3	31	1	Subcommand Code
4	37	7	SUM
5	46	F	7FH
6	0D		CR: Transmission End Code

System Error Information Response (f1)

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	4E	f	Command Code
3	31	1	Subcommand Code
4			System Error Code
5			
6			
7			
8-64			Error function identifier is returned if a logic error (Error Code 100) occurs.
65			SUM
66			
67	0D		CR: Transmission End Code

- For error handling, refer to “Error Code Table” under Specifications or Maintenance on the instruction manual CD-ROM.

■ Operation Error Information Request (F2)

Operation errors include “point job syntax error”, “CP speed error”, and “move area limit error.” The robot returns the error code and other error details (e.g. error program number, point number, point job number, command number, and pallet number.)

Operation Error Information Request (F2)

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	4E	F	Command Code
3	32	2	Subcommand Code
4	38	8	SUM
5	30	0	80H
6	0D		CR: Transmission End Code

Operation Error Information Response (f2)

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	4E	f	Command Code
3	32	2	Subcommand Code
4			Error Code
5			
6			
7			
8			Program Number
9			
10			
11			
12			0
13			
14			
15			
16			Point Number (Pn)
17			
18			
19			
20			Point Job Number (Job) or Condition Number (Cn)
21			
22			
23			
24			Point Job, Operation Number (Op)
25			
26			
27			

28			Next Operation Number (No) desiganated by a point job command Pallet Number (Pal) or Label Number (Lab)
29			
30			
31			
32			SUM
33			
34	0D		CR: Transmission End Code

DATA SETTING

Using the data setting commands, Number of Points Request (S0), Point Data Position Setting (S1), Point Data Setting (S2), Workpiece Adjustment Data Setting (S3, S4), TCP Setting (S5, S6) can be executed.
Program Presence Information Request (S7), Program Creation, Delete (S8, S9), Point Data Request, Addition, Insersion, Deletion, and Block Deletion (SA, SB, SC, SD, and SE) also can be executed.

■ Number of Points Request (S0)

Designate a program number to request the robot to send the number of points in the teaching data.

e.g. Requesting Number of Points in Program Number 12

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	53	S	Command Code
3	30	0	Subcommand Code
4	30	0	Program Number e.g. 12: 0CH
5	30	0	
6	30	0	
7	43	C	
8	35	5	SUM 156H
9	36	6	
10	0D		CR: Transmission End Code

When the robot receives an S0 command, it returns the number of points in the designated program number. If the designated program is not registered, it returns “0” (no point available.)

e.g. Number of Points in Program Number 12: 452

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	73	s	Command Code
3	30	0	Subcommand Code
4	30	0	Program Number e.g. 12: 0CH
5	30	0	
6	30	0	
7	43	C	
8	30	0	Number of Points

9	30	0	e.g. 452: 1C4H
10	30	0	
11	30	0	
12	30	0	
13	31	1	
14	43	C	
15	34	4	
16	30	0	SUM 30EH
17	45	E	
18	0D		CR: Transmission End Code

■ Point Data Position Setting (S1)

Designate a program number, point number, and position data to set the point position in teaching data.

e.g. Setting Position of Point Number 56 in Program Number 12

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	53	S	Command Code
3	31	1	Subcommand Code
4	30	0	Program Number e.g. 12: 0CH
5	30	0	
6	30	0	
7	43	C	
8	30	0	Point Number e.g. 56: 38H
9	30	0	
10	30	0	
11	30	0	
12	30	0	
13	30	0	
14	33	3	
15	38	8	
16-39			XYZR Position Refer to “Position (24-Byte)” on Page 72.
40			SUM
41			
42	0D		CR: Transmission End Code

When the robot receives an S1 command, it retuns the result whether the setting is complete or not.

e.g. Error

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	73	s	Command Code
3	31	1	Subcommand Code
4	46	F	Result Code 0: Normal, -1: Error If the designated point is not available, it returns an error.
5	46	F	
6	46	F	
7	46	F	
8	42	B	SUM 1BCH
9	43	C	
10	0D		CR: Transmission End Code

■ Point Data Setting (S2)

Designate a program number, point number, and point data to set a point in teaching data.

e.g. Setting Point Number 56 in Program Number 12

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	53	S	Command Code
3	32	2	Subcommand Code
4	30	0	Program Number e.g. 12: 0CH
5	30	0	
6	30	0	
7	43	C	
8	30	0	Point Number e.g. 56: 38H
9	30	0	
10	30	0	
11	30	0	
12	30	0	
13	30	0	
14	33	3	
15	38	8	
16-111			Point (96-byte) Refer to “Point” on Pages 73 – 74.
112			SUM
113			
114	0D		CR: Transmission End Code

When the robot receives an S2 command, it returns the result whether the setting is complete or not.

e.g. Error

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	73	s	Command Code
3	32	2	Subcommand Code
4	30	0	Result Code 0: Normal, -1: Error If the designated point is not available, it returns an error.
5	30	0	
6	30	0	
7	30	0	
8	36	6	SUM 165H
9	35	5	
10	0D		CR: Transmission End Code

■ Workpiece Adjustment Data Setting (S3, S4)

Designate a workpiece adjustment number and set a workpiece adjustment value.
The S3 command is used only to set the Z Adjustment. Use this command for vertical adjustment.
The S4 command is to set the X Adjustment, Y Adjustment, Z Adjustment, R Adjustment, and Rotate Adjustment.

Δ X: X Adjustment
Δ Y: Y Adjustment
Δ Z: Z Adjustment
Δ R: R Adjustment
Δ θ : Rotate Adjustment

If an additional function "Workpiece Adjustment" is set to the registered point coordinates P (X, Y, Z, R), the robot runs on the following adjusted coordinates P' (X', Y', Z', R'.)

X' = X*cos (Δ θ) – Y*sin (Δ) + Δ X
Y' = X*sin (Δ θ) + Y*cos (Δ θ) + Δ Y
Z' = Z + Δ Z
R' = R + Δ R

These are XY coordinates rotational (Δ θ rotation) and translational (Δ X, Δ Y, Δ Z, Δ R) transformations.
If you set only the Z Adjustment, X, Y, and R positions are not affected. Use the Z Adjustment for vertical adjustment.

Lower the Workpiece Adjustment Number 8 Point Position by 2 mm.
(Set an adjustment value of +2 mm.)

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	53	S	Command Code
3	33	3	Subcommand Code
4	30	0	Workpiece Adjustment Number
5	30	0	
6	30	0	
7	38	8	
8	30	0	Z Adjustment: in increments of 0.001 mm Positive Numbers: Downward Direction Adjustment Negative Numbers: Upward Direction Adjustment e.g. 2 mm: 07D0H
9	30	0	
10	30	0	
11	30	0	
12	30	0	
13	37	7	
14	44	D	
15	30	0	
16	45	E	SUM 2E9H
17	39	9	
18	0D		CR: Transmission End Code

e.g. Set Workpiece Adjustment Number 8 (X Adjustment: -2.3 mm, Y Adjustment: -20.5 mm, Z Adjustment: +2 mm, R Adjustment: 0.5 deg., Rotate Adjustment: 0.001 deg.)

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	53	S	Command Code
3	34	4	Subcommand Code
4	30	0	Workpiece Adjustment Number
5	30	0	
6	30	0	
7	38	8	
8	46	F	X Adjustment: in increments of 0.001 mm e.g. –2.3 mm (-2300): FFFFF704H
9	46	F	
10	46	F	
11	46	F	
12	46	F	
13	37	7	
14	30	0	
15	34	4	
16	46	F	Y Adjustment: in increments of 0.001 mm e.g. –20.5 mm (-20500): FFFFAFECH
17	46	F	
18	46	F	
19	46	F	
20	41	A	
21	46	F	
22	45	E	
23	43	C	
24	30	0	Z Adjustment: in increments of 0.001 mm Positive Numbers: Downward Direction Adjustment Negative Numbers: Upward Direction Adjustment e.g. 2 mm (2000): 7D0H
25	30	0	
26	30	0	
27	30	0	
28	30	0	
29	37	7	
30	44	D	
31	30	0	
32	30	0	R Adjustment: in increments of 0.01 deg. e.g. 0.5 deg. (50): 32H
33	30	0	
34	30	0	
35	30	0	
36	30	0	
37	30	0	
38	33	3	
39	32	2	
40	30	0	Rotate Adjustment: in increments of 0.000001 deg. e.g. 0.001 deg. (1000): 3E8H
41	30	0	
42	30	0	
43	30	0	
44	30	0	
45	33	3	
46	45	E	
47	38	8	

48	32	2	SUM A2FH
49	46	F	
50	0D		CR: Transmission End Code

■ Workpiece Adjustment Data Setting Response (s3, s4)

When the robot receives an S3 or S4 command, it returns the result whether the setting is complete or not.

e.g. s3, Normal

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	73	s	Command Code
3	33	3	Subcommand Code
4	30	0	Result Code 0: Normal, -1: Error If the designated workpiece adjustment number is not available, it returns an error.
5	30	0	
6	30	0	
7	30	0	
8	43	C	SUM 1C6H
9	36	6	
10	0D		CR: Transmission End Code

■ Direct TCP Setting (S5)

Use the S5 command to set the TCP directly.

e.g. Set TCP in Program Number 8.

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	53	S	Command Code
3	35	5	Subcommand Code
4	30	0	Set Position 0: Default Program Data 1: Program Data 2: Tool Data 3: All TCP
5	30	0	
6	30	0	
7	31	1	
8	30	0	Program Number or Tool Data Number If the [Default Program Data] or [All TCP] is selected, “0” is returned.
9	30	0	
10	30	0	
11	30	0	
12	30	0	
13	30	0	
14	30	0	
15	38	8	
16	30	0	TCP-X: in increments of 0.001 mm e.g. 2.000 mm 2000 = 7D0H
17	30	0	
18	30	0	

19	30	0	
20	30	0	
21	37	7	
22	44	D	
23	30	0	
24	30	0	TCP-Y: in increments of 0.001 mm e.g. 1.950 mm 1950 = 79EH
25	30	0	
26	30	0	
27	30	0	
28	30	0	
29	37	7	
30	39	9	
31	45	E	
32	30	0	TCP-deltaZ: in increments of 0.001 mm e.g. 0
33	30	0	
34	30	0	
35	30	0	
36	30	0	
37	30	0	
38	30	0	
39	30	0	
40	30	0	TCP-deltaR: in increments of 0.01 deg. e.g. 0
41	30	0	
42	30	0	
43	30	0	
44	30	0	
45	30	0	
46	30	0	
47	30	0	
48	31	1	SUM 53H + 35H + …… + 30H = 911H
49	31	1	
50	0D		CR: Transmission End Code

■ Direct TCP Setting Response (s5)

When the robot receives an S5 command, it returns the result whether the setting is complete or not.

e.g. Error

$s5FFFFC0

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	73	s	Command Code
3	35	5	Subcommand Code
4	46	F	Result Code 0: Normal, -1: Error If the designated program or tool data is not available, it returns an error.
5	46	F	
6	46	F	
7	46	F	
8	43	C	SUM
9	30	0	
10	0D		CR: Transmission End Code

■ 2-Points TCP Setting (4-Axis Specifications) (S6)

Set the TCP according to the two position coordinates designated by pointing at the same point from the two different R-Axis positions. (This method is available only for 4-Axis specifications models.)
The method for designating the set position, program number, or tool number is the same as for the S5 command.
Positions of the first and second points are the same as described in “Position (24-Byte)” on Page 72.

e.g. TCP Setting in Program Number 8

$S600010000000803BD3004434001A4B400000004FD4403A7B401AC48004650E0

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	53	S	Command Code
3	36	6	Subcommand Code
4	30	0	Set Position 0: Default Program Data 1: Program Data 2: Tool Data 3: All TCP
5	30	0	
6	30	0	
7	31	1	
8	30	0	Program Number or Tool Data Number If the [Default Program Data] or [All TCP] is selected, “0” is returned.
9	30	0	
10	30	0	
11	30	0	
12	30	0	
13	30	0	
14	30	0	
15	38	8	
16	30	0	First point, X-coordinate: in increments of 0.0005 mm The least significant bit; 0: Righty, 1: Lefty e.g. Righty, X = 122.52 mm = 245040 = 03BD30H
17	33	3	
18	42	B	
19	44	D	
20	33	3	
21	30	0	
22	30	0	First point, Y-coordinate: in increments of 0.0005 mm The least significant bit: 0 e.g. Y = 139.68 mm = 279360 = 044340H
23	34	4	
24	34	4	
25	33	3	
26	34	4	
27	30	0	
28	30	0	First point, Z-coordinate: in increments of 0.0005 mm The least significant bit: 0 e.g. Z = 53.85 mm = 107700 = 01A4B4H
29	31	1	
30	41	A	
31	34	4	
32	42	B	
33	34	4	
34	30	0	First point, R-coordinate: in increments of 0.005 deg. The least significant bit: 0 e.g. R = 0 deg.
35	30	0	
36	30	0	
37	30	0	
38	30	0	
39	30	0	

40	30	0	Second point, X coordinate: in increments of 0.0005 mm The least significant bit; 0: Righty, 1: Lefty e.g. Righty, X = 163.49 mm = 326980 = 04FD44H
41	34	4	
42	46	F	
43	44	D	
44	34	4	
45	34	4	
46	30	0	Second point, Y coordinate: in increments of 0.0005 mm The least significant bit: 0 e.g. Y = 119.77 mm = 239540 = 03A7B4H
47	33	3	
48	41	A	
49	37	7	
50	42	B	
51	34	4	
52	30	0	Second point, Z coordinate: in increments of 0.0005 mm The least significant bit: 0 e.g. Z = 54.82 mm = 109640 = 01AC48H
53	31	1	
54	41	A	
55	43	C	
56	34	4	
57	38	8	
58	30	0	Second point, R coordinate: in increments of 0.005 deg. The least significant bit: 0 e.g. R = 90 deg. = 18000 = 004650H
59	30	0	
60	34	4	
61	36	6	
62	35	5	
63	30	0	
64	45	E	SUM CE0H
65	30	0	
66	0D		CR: Transmission End Code

■ 2-Points TCP Setting Response (s6)

When the robot receives an S6 command, it returns the result whether the setting is complete or not.

e.g. Normal

$s6000069

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	73	s	Command Code
3	36	6	Subcommand Code
4	30	0	Result Code 0: Normal, -1: Error If the designated program or tool data is not available, it returns an error.
5	30	0	
6	30	0	
7	30	0	
8	36	6	SUM
9	39	9	
10	0D		CR: Transmission End Code

■ Program Presence Information Request (S7)

Use this command to get information regarding the presence of programs.

Program Presence Information Request (S7)

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	53	S	Command Code
3	37	7	Subcommand Code
4	30	0	Reserved (0)
5	30	0	
6	30	0	
7	30	0	
8	34	4	SUM 14AH
9	41	A	
10	0D		CR: Transmission End Code

Program Presence Information Response (s7)

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	73	s	Command Code
3	37	7	Subcommand Code
4	30	0	Reserved (0)
5	30	0	
6	30	0	
7	30	0	
8	32	2	Presence of Program No. 1 – No. 8; bit0: No. 1…...bit7: No. 8 Present: 1, Absent: 0 00100001: 21H
9	31	1	
10	30	0	Status of Program No. 9 – No. 16; bit0: No. 9…...bit7: No.16 Present: 1, Absent: 0 00000100: 04H
11	30	4	
12	30	0	Status of Program No. 17 – No. 24; bit0: No. 17…...bit7: No. 24 Present: 1, Absent: 0
13	30	0	
			……
70	30	0	Status of Program No. 249 – No. 256; bit0: No. 249…...bit7: No.256 Present: 1, Absent: 0
71	30	0	
72	41	A	SUM
73	31	1	
74	0D		CR: Transmission End Code

■ Program Creation, Deletion (S8, S9)

Designate a number and create/delete a program. Create a program that contains no point (default program data.)

e.g. Program Creation

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	53	S	Command Code
3	38	8	Subcommand Code (8 or 9)
4	30	0	Program Number
5	30	0	
6	30	0	
7	30	4	
8	34	4	SUM
9	46	F	
10	0D		CR: Transmission End Code

The robot returns a normal response or an error response.

e.g. Normal Response

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	73	s	Command Code
3	38	8	Subcommand Code (8 or 9)
4	30	0	Normal/Error 0: Normal -1: Error
5	30	0	
6	30	0	
7	30	0	
8	36	6	SUM
9	42	B	
10	0D		CR: Transmission End Code

When creating a program, an error is returned if the designated program number is already available. It also returns an error if there is not enough memory available for creating a new program.
When deleting a program, it returns an error if the program designated does not exist.

■ Point Data Request (SA)

Designate a program number and a point number to get point data.

e.g. Point Data Request

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	53	S	Command Code
3	41	A	Subcommand Code
4	30	0	Program Number
5	30	0	
6	30	0	
7	34	4	
8	30	0	Point Number
9	30	0	
10	30	0	
11	30	0	
12	30	0	
13	30	0	
14	30	0	
15	36	6	
16	44	D	SUM
17	45	E	
18	0D		CR: Transmission End Code

The robot returns the point data after sending a normal code or an error code.

e.g. Normal Response

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	73	s	Command Code
3	41	A	Subcommand Code
4	30	0	Normal/Error 0: Normal -1: Error
5	30	0	
6	30	0	
7	30	0	
8-103			Point (96-byte) Refer to “Point” on Pages 73 – 74.
104			SUM
105			
106	0D		CR: Transmission End Code

If the designated program or point does not exist, it returns an error.

■ Point Data Addition (SB)

Designate a program number and add point data to the end of program.

e.g. Point Data Addition

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	53	S	Command Code
3	42	B	Subcommand Code
4	30	0	Program Number
5	30	0	
6	30	0	
7	30	4	
8-103			Point (96-byte) Refer to “Point” on Pages 73 – 74.
104			SUM
105			
106	0D		CR: Transmission End Code

The robot returns a normal code or an error code.

e.g. Normal Response

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	73	s	Command Code
3	42	B	Subcommand Code
4	30	0	Normal/Error 0: Normal -1: Error
5	30	0	
6	30	0	
7	30	0	
8	37	7	SUM
9	35	5	
10	0D		CR: Transmission End Code

It returns an error if the designated program does not exist or if there is not enough available memory to add new data.

■ Point Data Insertion (SC)

Designate a program number and point number to insert point data. The inserted data replaces the designated point data and the succeeding point numbers shift backward.

e.g. Point Data Insertion

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	53	S	Command Code
3	43	C	Subcommand Code
4	30	0	Program Number
5	30	0	
6	30	0	
7	34	4	
8	30	0	Point Number
9	30	0	
10	30	0	
11	30	0	
12	30	0	
13	30	0	
14	30	0	
15	34	6	
16-111			Point (96-byte) Refer to “Point” on Pages 73 – 74.
112			SUM
113			
114	0D		CR: Transmission End Code

The robot returns a normal code or an error code.

e.g. Normal Response

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	73	s	Command Code
3	43	C	Subcommand Code
4	30	0	Normal/Error 0: Normal -1: Error
5	30	0	
6	30	0	
7	30	0	
8	37	7	SUM
9	36	6	
10	0D		CR: Transmission End Code

It returns an error if the designated program does not exist or if there is not enough memory available to insert a new point.

■ Point Data Deletion (SD)

Designate a program number and a point number to delete point data.

e.g. Point Data Deletion, Program Number 4, Point Number 6

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	53	S	Command Code
3	44	D	Subcommand Code
4	30	0	Program Number
5	30	0	
6	30	0	
7	34	4	
8	30	0	Point Number
9	30	0	
10	30	0	
11	30	0	
12	30	0	
13	30	0	
14	30	0	
15	36	6	
16	45	E	SUM
17	31	1	
18	0D		CR: Transmission End Code

The robot returns a normal code or an error code.

e.g. Normal Response

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	73	s	Command Code
3	44	D	Subcommand Code
4	30	0	Normal/Error 0: Normal -1: Error
5	30	0	
6	30	0	
7	30	0	
8	37	7	SUM
9	37	7	
10	0D		CR: Transmission End Code

It returns an error if the designated program or point does not exist.

■ Point Data Block Deletion (SE)

Delete multiple point data (point data block) by designating a program number, top point number (block start number), and last point number (block end number.)

e.g. Point Data Block Deletion, Program Number 4, Points 1 – 14

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	53	S	Command Code
3	45	E	Subcommand Code
4	30	0	Program Number
5	30	0	
6	30	0	
7	34	4	
8	30	0	Block Start Number
9	30	0	
10	30	0	
11	30	0	
12	30	0	
13	30	0	
14	30	0	
15	31	1	
16	30	0	Block End Number
17	30	0	
18	30	0	
19	30	0	
20	30	0	
21	30	0	
22	30	0	
23	45	E	
24	37	7	SUM
25	32	2	
26	0D		CR: Transmission End Code

The robot returns a normal code or an error code.

e.g. Normal Response

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	73	s	Command Code
3	45	E	Subcommand Code
4	30	0	Normal/Error 0: Normal -1: Error
5	30	0	
6	30	0	
7	30	0	
8	37	7	SUM
9	38	8	
10	0D		CR: Transmission End Code

DATA SAVE

■ Data Save (T0), Data Readout (T1)

Using the T0 command, the host requests the robot to save teaching data.
If you use the setting command (S) to save data, the data is stored in the RAM temporarily. However, it is automatically deleted if the power to the robot is turned off. Use the data save command (T0) to save data in the permanent memory. All data is saved by this command.
Use the data readout command (T1) to read out the saved data.

Data Save (T0)

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	54	T	Command Code
3	30	0	Subcommand Code
4	38	8	SUM
5	34	4	84H
6	0D		CR: Transmission End Code

Data Readout (T1)

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	54	T	Command Code
3	31	1	Subcommand Code
4	38	8	SUM
5	35	5	85H
6	0D		CR: Transmission End Code

The robot returns the result whether the data save/data readout is complete or not.

e.g. Data Save Error

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	74	t	Command Code
3	30	0	Subcommand Code
4	46	F	Result Code
5	46	F	0: Normal, -1: Error
6	46	F	
7	46	F	
8	42	B	SUM
9	43	C	1BCH
10	0D		CR: Transmission End Code

APPENDIX-A: COMMON DATA PARAMETER

This chapter explains the data parameters commonly used in drive control commands and data setting commands.

■ TCP (Tool Center Point)

SN	HEX	ASC	Description
1	30	0	TCP-X or L1 In increments of 0.001 mm
2	30	0	
3	36	0	
4	30	0	
5	30	0	
6	30	0	
7	37	7	
8	32	2	
9	30	0	TCP-Y or L2 In increments of 0.001 mm
10	30	0	
11	33	3	
12	30	0	
13	30	0	
14	35	5	
15	30	0	
16	30	0	
17	30	0	TCP-deltaZ In increments of 0.001 mm
18	30	0	
19	30	0	
20	30	0	
21	30	0	
22	30	0	
23	30	0	
24	30	0	
25	30	0	TCP-deltaR In increments of 0.01 deg.
26	30	0	
27	30	0	
28	30	0	
29	30	0	
30	30	0	
31	30	0	
32	30	0	

■ Tool Data (28-Byte)

SN	HEX	ASC	Description
1	30	0	Tool weight selection and switching 0/1/2・・・ The actual tool weight differs depending on models. Values such as Selection number 0/1/2 are sent instead of weight values.
2	30	0	
3	36	0	
4	30	0	
5	30	0	TCP-X or L1 In increments of 0.001 [mm]
6	30	0	
7	36	0	
8	30	0	
9	30	0	
10	30	0	
11	37	7	
12	32	2	
13	30	0	TCP-Y or L2 In increments of 0.001 [mm]
14	30	0	
15	33	3	
16	30	0	
17	30	0	
18	35	5	
19	30	0	
20	30	0	
21	30	0	TCP-deltaZ In increments of 0.001 [mm]
22	30	0	
23	30	0	
24	30	0	
25	30	0	
26	30	0	
27	30	0	
28	30	0	

■ Position (24-Byte)

SN	HEX	ASC	Description
1	30	0	X-coordinate: in increments of 0.0005 mm The least significant bit; 0: Righty, 1: Lefty e.g. Righty, X = 12.345: 6072H
2	30	0	
3	36	6	
4	30	0	
5	37	7	
6	32	2	
7	30	0	Y-coordinate: in increments of 0.0005 mm The least significant bit: 0 e.g. Y = 400.00: C3500H
8	43	C	
9	33	3	
10	35	5	
11	30	0	
12	30	0	
13	30	0	Z-coordinate: in increments of 0.0005 mm The least significant bit: 0 e.g. Z = 45.500: 16378H
14	31	1	
15	36	6	
16	33	3	
17	37	7	
18	38	8	
19	46	F	R-coordinate: in increments of 0.005 deg. The least significant bit: 0 e.g. R = -5.1: FFEC04H
20	46	F	
21	45	E	
22	43	C	
23	30	0	
24	34	4	

Follow the procedures below to convert the XYZR coordinates into the formats described above.

- Multiply the X-coordinate value by 1000, make the result an integer, and then double it. If the Arm position is Lefty, set the least significant bit to 1.
- Multiply the Y-coordinate by 1000, make the result an integer, and then double it.
- Multiply the Z-coordinate by 1000, make the result an integer, and then double it.
- Multiply the R-coordinate by 100, make the result an integer, and then double it.

Follow the procedures below to change the above converted data format back to real number data. (If the least significant bit of the X-coordinate is 0, the Arm position is Righty. If it is 1, the Arm position is Lefty.)

- Divide each X-, Y-, or Z-coordinate by 2000.
- Divide the R-coordinate by 200.

■ Point Type Code

Type	HEX	DEC
PTP Point	21	33
CP Start Point	22	34
CP Passing Point	24	36
CP Stop Point	26	38
CP Arc Point	16	22
CP End Point	23	35
PTP Evasion Point	11	17

■ Point

SN	HEX	ASC	Description
1	30	0	Point Type Code e.g. CP Start Point: 22H Refer to the above “Point Type Code.”
2	30	0	
3	30	0	
4	30	0	
5	30	0	
6	30	0	
7	32	2	
8	32	2	
9-32			XYZR position coordinates Refer to “Position (24-Byte)” on Page 72.
33	30	0	Line speed: in increments of 0.1 mm/sec e.g. Line speed 10 mm/sec (100): 64H
34	30	0	
35	30	0	
36	30	0	
37	30	0	
38	30	0	
39	36	6	
40	34	4	
41	30	0	Job before Moving
42	30	0	
43	30	0	Job while Moving
44	30	0	
45	30	0	Point Job Number
46	30	0	
47	30	0	Job while CP Moving
48	30	0	
49	30	0	PTP Condition Number
50	30	0	
51	30	0	CP Condition Number
52	30	0	

53	30	0	Tool Number
54	30	0	
55	30	0	Pallet Routine Number
56	30	0	
57	30	0	Execute Condition Number
58	30	0	
59	30	0	Work Adjustment Number
60	30	0	
61	30	0	Tag Code
62	30	0	
63-72	30	0	Additional function for extension 10 byte (0)
73	30	0	Condition Number
74	30	0	
75	30	0	
76	30	0	
77	30	0	Setting Variable 1
78	30	0	
79	30	0	
80	30	0	
81	30	0	Setting Variable 2
82	30	0	
83	30	0	
84	30	0	
85	30	0	Setting Variable 3
86	30	0	
87	30	0	
88	30	0	
89	30	0	Setting Variable 4
90	30	0	
91	30	0	
92	30	0	
93	30	0	Setting Variable 5
94	30	0	
95	30	0	
96	30	0	

APPENDIX-B: COMMAND SAMPLES

In Alphabetical Order

	Feature	Send/Receive Example
B0	Robot Information	$B072 $b0803100780001000003EA0001000119
B1	Robot Status	$B173 $b1020000000001000000080000024B0000B6
F1	System Error	$F177 $f1000000000000000000000000000000000000000000000000000000000000D7
F2	Operation Error	$F278 $f20000000000000000000000000000D8
I0	Execute Point Information	$I079 $i00001000000020000002 15F Prog=1 Pn=2 PTP Point
I6	Counter Value	$I6000140 $i60001010000000000000061 No.1,OFF,Count=0
I7	Timer Value	$I7000343 $i70003010000000000000064 No.3,OFF,Timer=0
I8	Pallet Counter Value	$I8000344 $i800030100000200000020000000007F0 No.3,Plane,OFF,7/32
I9	Work Adjustment Amount	$I9000143 $i900010100000000003E8000007D0FFFFF448000001900098968000001770DE No.1, X=1 Y=2 Z=-3 R=4 Rotate=10 SZ=6
K0	I/O Readout	$K000013C #genIn $k00001010C0000F0 1,11,12 ON
K1	Designated I/O Number Readout	$K1000100000003C0 #genIn3 $k1000100000030000000161 ON
K2	I/O Output: set	$K2000400000005C6 set #genOut5 $k200005D
K3	I/O Output: reset	$K3000400000006C8 reset #genOut6 $k300005E
K4	I/O Output: delaySet	$K4000400000005000003E868 delaySet #genOut5 1000 $k400005F
K5	I/O Output: delayReset	$K5000400000005000003E869 delayReset #genOut5 1000 $k5000060
K6	I/O Output: pulse	$K6000400000005000003E86A pulse #genOut5 1000 $k6000061
K7	I/O Output: invPulse	$K7000400000005000003E86B invPulse #genOut5 1000 $k7000062
K8	I/O Output: delayPulseSet	$K8000400000005000003E8000007D007 delayPulse #genOut5 1000, 2000 $k8000063
K9	I/O Output:	$K9000400000005000003E8000003E80D invDelayPulse #genOut5

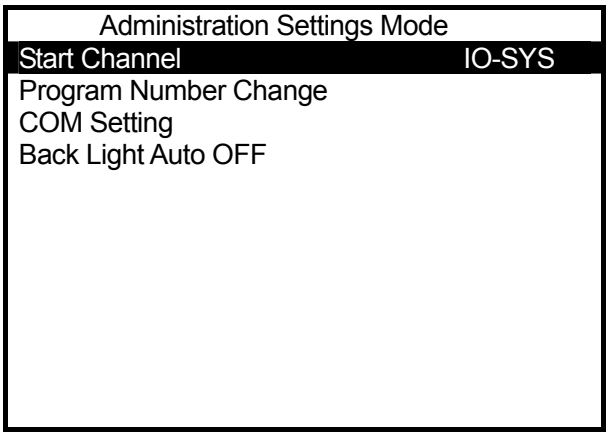
	delayinvPulseSet	1000,1000 $k9000064
M1	PTP Drive Control	$M1FE795F061A8000EA60000000A0 X=-50,Y=200,Z=30,R=0 $M17E $m100005E
M2	CP Linear Drive Control	$M200C8027101057E4000EA6000000036 20mm/s,X=80,Y=180,Z=30,R=0 $M27F $m200005F
M3	CP Arc Drive Control	40mm/s,X=130,Y=230,Z=30,R=0,40mm/s,X=80,Y=280,X=30,R=0 $M3019003F7A10704E000EA60000000190027101088B8000EA60000000F3 $M380 $m3000060
M4 M5 M6	JOG Movement	$M40000000200000000000000000000000000043 $m4000061 $M500E2 · · · · · $M683 $m6000063
M7	CP Continuous Drive	$M7000601F40000FFFFFE061A8100EA6100000001900000FFFFFE07A12100EA61000000012C00010186A2061A8100EA6100000000C80000FFFFFE0493E100EA6100000000640002FB6C1E0493E100EA6100000003A $M784 $m7000064
N0	Arm Position Lefty/Right	$N07E $n0FE7962061A7C00EA62000000C1
N1	Tool Tip Position Available TCP	$N17F $n102BF20057E4000EA600000009C
N2	Designated TCP Tool Tip Position	$N20000271000004E2000004E2000000000C0 $n2030D4005A55000EA6000000087
Q0	Operation Report Level 0: No Report	$Q081 $q0000061
Q1	Operation Report Level 1: Operation Complete Error Report	$Q182 $q0000061 $q1000300000000E5: Operation Complete $q1000200000000E4: Work Home Position
Q2	Operation Report Level 2: Execute Point	$Q283 $q0000061 $q20004000000002100000A Prog=4, Pn=0, PTP $q20004000100002100000B Prog=4, Pn=1, PTP
Q3	Operation Report Level 3: Pallet Count	$Q384 $q0000061 $q300040100000200000020000000006F3 No.4 inc 2:Plane 6/32
R0	Power ON	$R082 $R082 $r0000062
R1	Program Number Change	$R1000C56 $r1000C76
R2	Return to Work Home	$R284 $R284 $r2000064
R3	Start	$R385 $R385 $r3000065
R4	Temporary Stop	$R486 $r4000066
R5	Last Work	$R587 $r5000067
R7	Program End	$R789 $r7000069
R8	Start	$R800054F

	(Designatied Program Number)	$R88A $r800006A
R9	Execute Single Point Job	$R9000550 $R98B $r900006B
S0	Number of Points Request	$S0000447 $s0000400000019F1 Prog=4, Num of Points = 25
S1	Point Data Position Setting	Prog=6 Pn=1 X=90 Y=180 Z=30 R=0 $S100060000000102BF20057E4000EA60000000C8 $s1000064
S2	Point Data Setting	Prog=1 Pn=2 X=90 Y=180 Z=30 R=0 PTP Job=1 Tag=3 $S2000100000002000002102BF20057E4000EA600000000000000000 00010000000000000030000000000000000000000000000000004C $s2000065
S3	Workpiece Z Adjustment Amount Setting	$S30008000007D0E9 No.8 Z=2mm $s3000066
S4	Workpiece Adjustment Data Setting	No.8 X=-2.3 Y=-20.5 Z=2 R=0.5 rot=0.001 $S40008FFFFF704FFFFAFEC000007D000000032000003E82F $s4000067
S5	Direct TCP Setting	All X=2, Y=3 $S5000300000000000007D000000BB8000000000000000012 $s5000068
S6	2-Points TCP Setting	$S6000300000000FE795F061A8000EA60000000FEC77F061A8000EA6 00046502B $s6000069
S7	Program Presence Information	$S700004A $s70000390000010000000000000000000000000000000000000000000000 000000000000077 No.1,4,5,6,25
S8	Program Creation	$S8001A5D No.26 $s800006B
S9	Program Creation	$S9000551 No.5 $s900006C
SA	Point Data Request	$SA000100000001D6 Prog=1, Pn=1 $sA000000000021FE796007A1200186A00000000000000000000010000 00000400000000000000000000000000000000000000F8 PTP X=-50,Y=250,Z=50,R=0,Job=1,Pal=4
SB	Point Data Addition	Prog=1 PTP X=0,Y=200,Z=30,Job=5,Pal=4 $SB000100000021000000061A8000EA60000000000000000000050000 00000400000000000000000000000000000000000000AE $sB000075
SC	Point Data Insertion	Prog=1 Pn=3 CP X=25,Y=200,Z=30 Speed=50 $SC000100000003000000220 0C350061A8000EA60000000000001F400 00000000000000000000000000000000000000000000000000060 $sC000076
SD	Point Data Deletion	$SD000100000005DD Prog=1 Pn=5 $sD000077
SE	Point Data Block Deletion	$SE000100000020000000863 Prog=1 Pn=2-8 $sE000078
T0	Data Save	$T084 $t0000064
T1	Data Readout	$T185 $t1000065

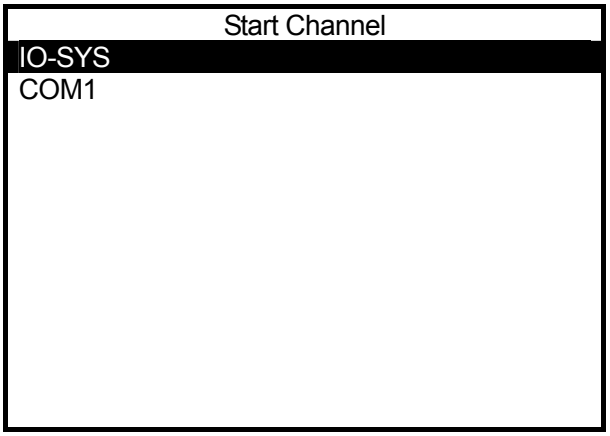
APPENDIX-C: OPERATION START CHANNEL

When using commands to move the Arm, such as Drive Control (M), Return to Work Home (R2), and Start (R3), set [Start Channel] to [COM1.]
The following explains how to set the start channel using the teaching pendant.

Select [Administration Settings Mode] from the Administration menu to display the following screen.。



Select [Start Channel] to display the following selection screen. Select [COM1.]



The Drive Control (M), Return to Work Home (R2), and Start (R3) commands are valid only when the start channel is COM1 and the robot is in the run mode.

Warranty

Henkel Corporation warrants, to the original Buyer for a period of one (1) year from date of delivery, that the Loctite® Equipment or System sold by it is free from defects in material and workmanship. Henkel will, at its option, replace or repair said defective parts. This warranty is subject to the following exceptions and limitations.

1. Purchaser Responsibilities – The Purchaser shall be responsible for:
   -Maintenance of the equipment as outlined in the Equipment Manual for the product.
   - Inventory of recommended maintenance parts established by Henkel;
   -Notification to Henkel within 6-8 hours of downtime.
   -Any cost of travel or transportation connected with warranty repair.
   -All cost associated with investigating or correcting any failure caused by the purchaser's misuse, neglect or unauthorized alteration or repair.
   -All costs attributed to accident or other factors beyond Henkel's control.

2. A thirty (30) day warranty will be extended on any items subject to normal wear, such as:
   -Pump Seals -Tubing -Wear Surfaces of Wiping Rollers
   -O-Rings -Hoses

Purchased items used in Loctite® dispensing equipment are covered under warranties of their respective manufacturers and are excluded from coverage under this warranty. Typical purchased items are:

-Solenoids -Electrical Relays -Refrigeration Units
-Timers -Fluid Power Cylinders -Electrical Motors

3. No warranty is extended to perishable items, such as:
   -Fuses -Dispensing Needles -Dispensing Nozzles
   -Light Bulbs -Lamps -Product Barrels

Henkel reserves the right to make changes in design and/or improvements to its equipment without obligation to include these changes in any equipment previously manufactured.

Henkel's warranty herein is in lieu of and excludes all other warranties of Henkel and its affiliated and related companies (hereinafter the "seller companies"), express, implied, statutory, or otherwise created under applicable law including, but not limited to, any warranty or merchantability and/or fitness for a particular purpose of use. In no event shall the seller and/or the seller companies be liable for any direct, indirect, special, incidental or consequential damages, including, but not limited to, loss of profits. In addition, this warranty shall not apply to any products, which have been subjected to abuse, misuse, improper installation, improper maintenance or operation, electrical failure or abnormal conditions; and to products, which have been tampered with, altered, modified, repaired or reworked by anyone not approved by seller. Buyer's sole and exclusive remedy under this warranty shall be limited to, at seller's discretion, the replacement or repair of any defective product or part thereof, or a refund of the purchase price paid by for the product in exchange for buyer's return of the product to seller, free and clear of any and all liens and encumbrances of any nature.

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