JANOME SCARA/GANTRY ROBOT
JS/JSR4400N/JSG Series
JANOME DESKTOP ROBOT
JR2000N Series

Operation Manual
External Control II
(COM Communication)

Thank you for purchasing a Janome Robot.

- **Read this manual thoroughly in order to ensure proper use of this robot. Be sure to read "For Your Safety" before you use the robot. The information will help you protect yourself and others 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.**
- **This manual is written according to IEC 62079.**

JANOME

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.

Please follow these instructions

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

● Symbols Indicating the Degree of Potential Damage or Danger

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

Warning	The Warning symbol indicates the possibility of death or serious injury.
Caution	The Caution symbol indicates the possibility of accidental injury or damage to property.

● Symbols Indicating the Type of Danger and Preventive Measures

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

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

FOR YOUR SAFETY

JR2000N Series

⚠ Warning

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

Use the robot in a condensation-free environment between 0 and 40 degrees centigrade with a humidity level of 20 to 95 percent.
Failure to do so may result in malfunction.
IP Protection Rating: IP30 (IP40 for CE specification models)

Use the robot in an electric noise-free environment.
Failure to do so may result in malfunction or breakdown.

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

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 or overturn, thereby causing damage or injury.
Leave a space of at least 30cm between the back of the robot (the side with a cooling fan) and the wall. Insufficient space can lead to overheating or fire.

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

If your robot has the I/O-S circuit, be sure to install a safeguard such as an area sensor when installing the robot.
Without a safeguard, going near the robot while it is operating may cause injury.

Plug the power cord into the wall outlet firmly.
Failure to do so can cause the plug to heat up and may result in fire.

FOR YOUR SAFETY

JR2000N Series

⚠ Warning

Wipe the power plug with a clean, dry cloth periodically to eliminate dust.
Dust accumulation can undermine the electrical insulation and cause fire.

Ensure that the robot is properly grounded before use. Do not use without grounding.
Insufficient grounding can cause electric shock and/or fire.

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

Keep water and oil away from the robot and power cable.
Contact with water or oil can cause electric shock, fire, or unit malfunction.
IP Protection Rating: IP30 (IP40 for CE specification models)

If tools have been attached (such as the electric screwdriver), make sure they are properly connected.
Failure to do so may result in injury or breakdown.

During prolonged use, be sure to regularly check that the mounting screws are sufficiently tightened.
Loose screws may cause injury or breakdown.

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

FOR YOUR SAFETY

JR2000N Series

⚠ Warning

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

Be sure to check that there is no danger anywhere near the operator before starting the robot.
Careful attention will protect the operator from injury.

Do not attempt to disassemble or modify the unit.
Disassembly or modification may cause electric shock or malfunction.

Be sure to unplug the power cord from the wall outlet when examining or lubricating the machine.
Failure to do so may cause electric shock or injury.

If anything unusual (e.g. a burning smell or an abnormal sound) occurs, stop operation and unplug the cable immediately. Contact the dealer from whom 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 unit breakdown.

Do not leave the unit plugged in (power cord and connectors) when it is not in use for long periods of time. Accumulated dust can cause fire.
Be sure to shut off the power supply before removing the power cord.

Be sure to turn off the robot before inserting and removing all cables.
Failure to do so may result in electric shock, fire, data loss or unit malfunction.

Keep the emergency stop switch within reach of an operator while teaching or running the robot.
Failure to do so is dangerous since it may not be possible to stop the robot immediately and safely.

FOR YOUR SAFETY

JR2000N Series

⚠ Warning

Regularly check that the emergency stop switch works properly.
For models with I/O-S circuits, also check that they work properly.
Failure to do so is dangerous since it may not be possible to stop the robot immediately and safely.

FOR YOUR SAFETY

JSR4400N Series

⚠ Warning

Do not leave the unit plugged in (power cord and connectors) when it is not in use for long periods of time. Accumulated dust can cause 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 is dangerous since it may not be possible to stop the robot immediately and safely.

Regularly check that the emergency stop switch works properly.
For models with I/O-S circuits, also check that they work properly.
Failure to do so is dangerous since it may not be possible to stop the robot immediately and safely.

During prolonged use, check the mounting screws etc, regularly and ensure that they are firmly tightened.
Loose screws may cause injury or breakdown.

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

Keep water and oil away from the robot and power cable.
Contact with water or oil can cause electric shock, fire, or unit malfunction.
IP Protection Rating: IP20

Wipe the power plug with a clean, dry cloth periodically to eliminate dust.
Dust accumulation can undermine the electrical insulation and cause fire.

FOR YOUR SAFETY

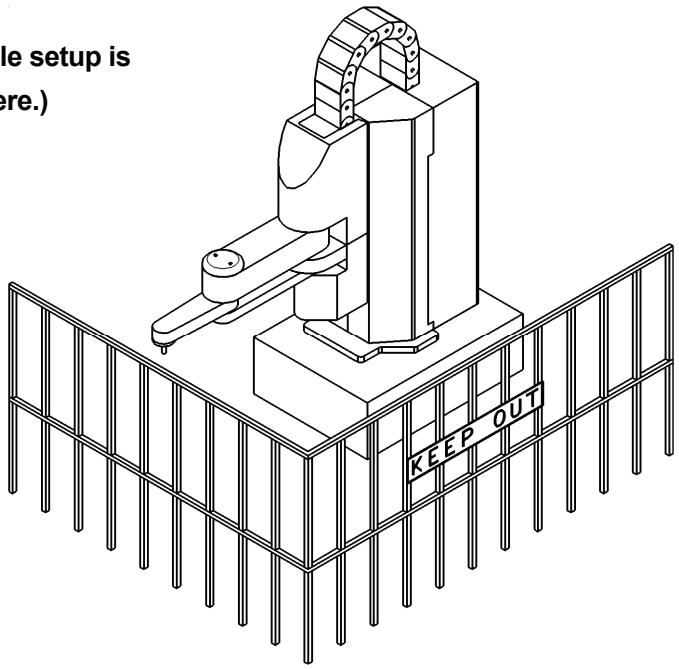
JSR4400N Series

INSTALLATION

⚠ Warning

Always set up a safety barrier.
Anyone entering the operating range of the robot may be injured.
Set up an emergency stop interlock system that is triggered when the entrance to the safety barrier is opened.
Use the I/O-S connector included in the 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 place.

(An example setup is pictured here.)



Make sure the safety barrier is strong enough to protect the operator from flying debris caused during robot operation.
Always wear protective gear (helmet, protective gloves, protective glasses, and protective footwear) when going inside the safety barrier.

If the object the robot is holding is in danger of flying off or falling, make sure **safety precautions adequate for the object's size, weight, temperature and chemical composition have been taken.**

FOR YOUR SAFETY

JSR4400N Series

INSTALLATION

⚠ Warning

Be sure to check grounding before using the unit.
Improper grounding can cause electric shock, fire, unit malfunction, or breakdown.

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 or overturn, and may cause injury or damage.

There is an air intake vent on the lower back of the robot (18mm above the ground). Do not block this vent, or overheating or fire may result.

Do not use the unit in the presence of flammable or corrosive gas.
Leaked gas accumulated around the unit can cause fire or explosion.

For the health and safety of the operator, place the unit in a well-ventilated area.

Use the robot in a condensation-free environment between 0 and 40 degrees centigrade with a humidity level of 20 to 90 percent.
Failure to do so may result in malfunction.
IP Protection Rating: IP20

Use the robot in an electric noise-free environment.
Failure to do so may result in malfunction or breakdown.

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

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

FOR YOUR SAFETY

JSR4400N Series

INSTALLATION

⚠ Warning

Do not attempt to disassemble or modify the unit.
Disassembly or modification may cause electric shock or malfunction.

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.
Doing so can cause breakdown.

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

If tools have been attached (such as the electric screwdriver), make sure they 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 while teaching or running the robot.
Failure to do so is dangerous since it may not be possible to stop the robot immediately and safely.

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

Be sure to turn off the robot before plugging it in.

FOR YOUR SAFETY

JSR4400N Series

INSTALLATION

⚠Warning	
	**Plug the power cord firmly into the wall outlet.** Incomplete insertion into the wall outlet causes the plug to heat up and may result in fire. Be sure to turn off the robot y before connecting the power cable.
	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 or dampness may lead to breakdown or malfunction. IP Protection Rating: IP20

FOR YOUR SAFETY

JSR4400N Series

DURING OPERATION

⚠ Warning

When lubricating or inspecting 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.

Put up a **"Do Not Operate"** sign on the start switch when people are entering the safety barrier.

Keep the emergency stop switch within reach of an operator while teaching or running the robot.
Failure to do so is dangerous since it may not be possible to stop the robot immediately and safely.

Make sure the safety barrier is strong enough to protect the operator from flying debris caused during robot operation.
Always wear protective gear (helmet, protective gloves, protective glasses, and protective footwear) when going inside the safety barrier.

Make sure 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

JSR4400N Series
DURING OPERATION

⚠ Warning

When entering the safety barrier, **do not enter the operating range of the robot.**

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

When activating the robot, check that **no one is inside the safety barrier and that no object will interfere with the robot's operation.**

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 an abnormal sound) occurs, stop operation and turn off the robot. Contact the dealer from whom 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 or running the robot.
Failure to do so is dangerous since it may not be possible to stop the robot immediately and safely.

FOR YOUR SAFETY

JS Series and JSG Series

⚠ Warning

When not in use for extended periods of time, unplug the power cord from the power source. Accumulated dust leads to fires.
When unplugging the cord, make sure the power is off.

Change the robot battery periodically (approximately every three years) to prevent unit malfunction or breakdown.

Keep the emergency stop switch within reach of an operator while teaching or running the robot.
Failure to do so is dangerous since the robot may not be able to be stopped immediately and safely.

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

FOR YOUR SAFETY

JS Series and JSG Series

⚠ Warning

During prolonged use, check the mounting screws etc, regularly and ensure that they are firmly tightened.
Loose screws may cause injury or breakdown.

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

Keep water or oil away from the robot, control box and power cable.
Contact with water or oil can cause electric shock, fire, or unit malfunction.
IP Protection Rating: IP40

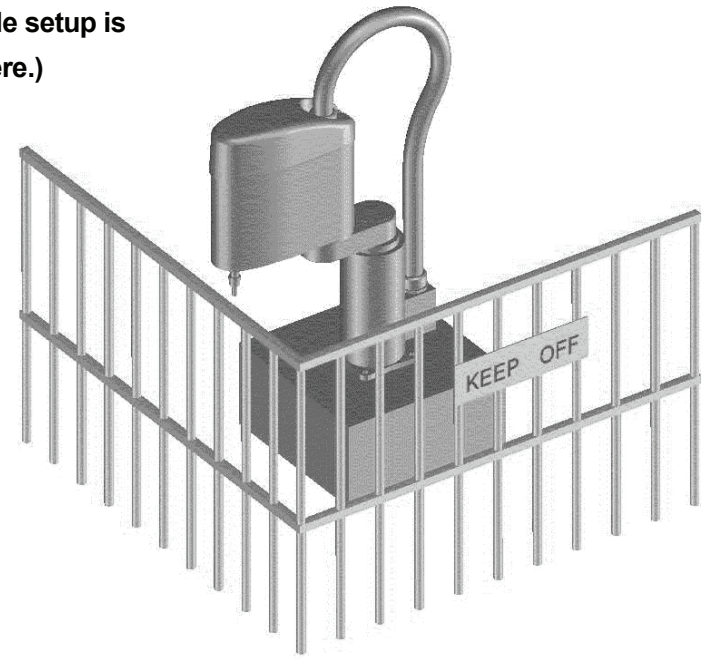
FOR YOUR SAFETY

JS Series and JSG Series
INSTALLATION

⚠ Warning

Always set up a safety barrier.
Anyone entering the operating range of the robot may be injured.
Set up an emergency stop interlock system that is triggered when the entrance to the safety barrier is opened.
Use the I/O-S connector included in the 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 place.

(An example setup is pictured here.)



Make sure the safety barrier is strong enough to protect the operator from flying debris caused during robot operation.
Always wear protective gear (helmet, protective gloves, protective glasses, and protective footwear) when going inside the safety barrier.

If the object the robot is holding is in danger of flying off or falling, make sure **safety precautions adequate for the object's size, weight, temperature and chemical composition have been taken.**

FOR YOUR SAFETY

JS Series and JSG Series
INSTALLATION

⚠ Warning

Be sure to check grounding before you use the unit.
Improper grounding can cause electric shock, fire, unit malfunction, or breakdown.

Plug the power cord firmly into the wall outlet and check for dust.
Incomplete insertion into the wall outlet causes the plug to heat up and may result in fire.
Be sure to shut off the power supply before connecting the power cable.

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 or overturn, thereby causing damage or injury.
Be sure to leave a space of at least 30cm between the back of the robot (the side with a cooling fan) and the wall. Insufficient space can lead to overheating or fire.

Do not attempt to disassemble or modify the unit.
Disassembly or modification may cause electric shock or malfunction.

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.

For the health and safety of the operator, place the unit in a well-ventilated area.

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

FOR YOUR SAFETY

JS Series and JSG Series

INSTALLATION

⚠ Warning

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

Use the robot in a condensation-free environment between 0 and 40 degrees centigrade with a humidity level of 20 to 90 percent.
Failure to do so may result in malfunction.
IP Protection Rating: IP40

Use the robot in an electric noise-free environment.
Failure to do so may result in 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.
Doing so can cause breakdown.

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

If tools have been attached (such as the electric screwdriver unit), make sure they are properly connected.
Failure to do so may result in injury or breakdown.

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 while teaching or running the robot.
Failure to do so is dangerous since it may not be possible to stop the robot immediately and safely.

FOR YOUR SAFETY

JS Series and JSG Series

INSTALLATION

⚠ Warning

Be sure to turn off both the robot and the power source before plugging in the power cable.

Be sure to remove the eyebolt after installing the robot.
If it is not removed, the Arm may bump into it, thereby causing damage or injury.

Place the control 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 or dampness may lead to breakdown or malfunction.
IP Protection Rating: IP40

Use the Clean Room type model in an environment of Clean Class 10* or less.
*: Federal Standard 209D (FED-STD209D)

FOR YOUR SAFETY

JS Series and JSG Series

DURING OPERATION

⚠ Warning

When lubricating or inspecting 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.

Put **a "Do Not Operate" sign** on the start switch when people are entering the safety barrier.

Keep the emergency stop switch within reach of an operator while teaching or running the robot.
Failure to do so is dangerous since it may not be possible to stop the robot immediately and safely.

Make sure the safety barrier is strong enough to protect the operator from flying debris caused during robot operation.
Always wear protective gear (helmet, protective gloves, protective glasses, and protective footwear) when going inside the safety barrier.

Make sure 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

JS Series and JSG Series
DURING OPERATION

⚠ Warning

When entering the safety barrier, **do not enter the operating range of the robot.**

If you must go inside the safety barrier, make sure you **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 that no object will interfere with the robot's operation.**

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

If anything unusual (e.g. a burning smell or an abnormal sound) occurs, stop operation and turn off the robot. Contact the dealer from whom 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 or running the robot.
Failure to do so is dangerous since it may not be possible to stop the robot 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 described in this manual.

In this protocol, data is transmitted in hexadecimal ASCII (HEXASCII) characters.
Put $ as a 1-byte transmission start code at the head of the command, convert the data sections in hexadecimal format, and then put a check sum code as an error check at the end of the data.

In the first chapter, the preparation process, such as cable and connector connection or baud rate settings, will be explained.

In the second chapter, the commands and data (hereinafter collectively referred to as *text* in this manual) transmission methods will be explained.

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

- Robot information and status request
- Operation control, such as start, program number change, and temporary stop
- IO control, such as IO status request and output control
- Drive control, such as PTP drive, linear motion, arc motion, JOG movement, CP drive, and current position request
- Operation information request, operation result report, and error information request
- Data settings, such as how to set, add, and delete point job data, and saving data

CONTENTS

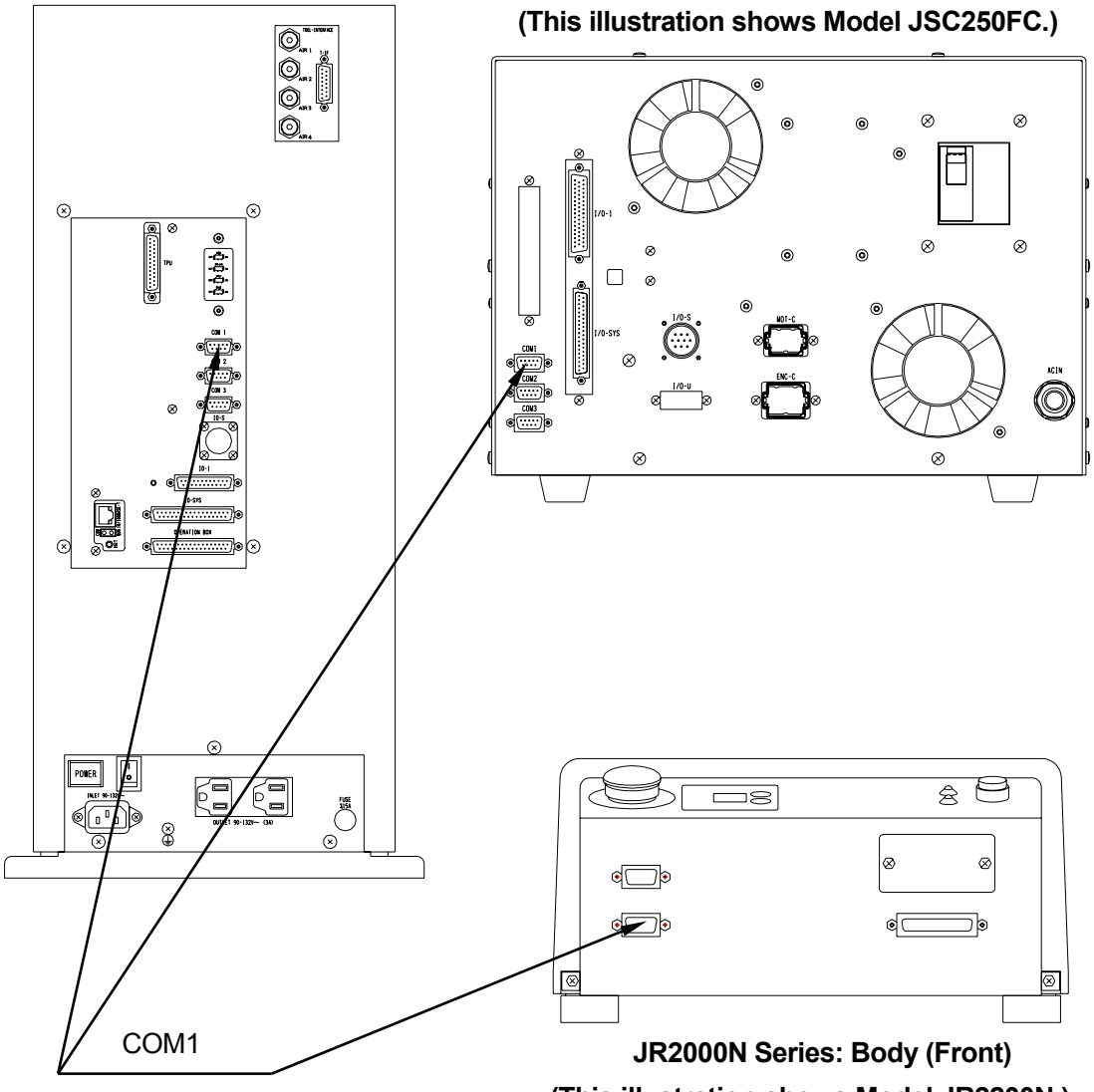
External Control II (COM Communication)

PREPARATION

■ Connector and Cable

JSR4400N Series: Body (Rear)

JS/JSG Series: Control Box (Rear)
(This illustration shows Model JSC250FC.)



JR2000N Series: Body (Front)
(This illustration shows Model JR2200N.)

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

Use a straight cable when connecting the host (e.g. PC) to the robot.

■ **D-Sub 9 Pin on the Host Side**

COM1 (RS232C Port)

Robot				Host (PC)		
Pin No.	Terminal Name	Function		Pin No.	Terminal Name	Function
3	RxD	Receive Data	←	3	TxD	Transmit Data
2	TxD	Transmit Data	→	2	RxD	Receive Data
8	RTS	Request to Send	→	8	CTS	Clear to Send
7	CTS	Clear to Send	←	7	RTS	Request to Send
5	GND	Ground	—	5	GND	Ground
Connector: D-Sub 9 Pin				Connector: D-Sub 9 Pin		

■ **D-Sub 25 Pin on the Host Side**

COM (RS232C Port)

Robot				Host (PC)		
Pin No.	Terminal Name	Function		Pin No.	Terminal Name	Function
3	RxD	Receive Data	←	2	TxD	Transmit Data
2	TxD	Transmit Data	→	3	RxD	Receive Data
8	RTS	Request to Send	→	5	CTS	Clear to Send
7	CTS	Clear to Send	←	4	RTS	Request to Send
5	GND	Ground	—	7	GND	Ground
Connector: D-Sub 9 Pin				Connector: D-Sub 25 Pin		

■ Communication Settings

The default communication settings are as follows:

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

All these settings can be changed; but it will probably only be necessary to change the baud rate. Lower the baud rate if a long cable is being used to connect the robot to the controller. Increase the baud rate to shorten transmission time.

Switch to the Administration mode. Select [COM Setting] from the [Administration Settings Mode] menu and then select [COM 1 Communication Setting]. The current communication settings: Baud Rate, Character Length, Stop Bit, and Parity settings are displayed. Select from the following items.

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

TRANSMISSION SUMMARY

■ Data Representation

In this protocol, data is transmitted in hexadecimal ASCII (HEXASCII) characters, not in binary.
You can select the data capacity from 1 byte, 2 bytes, or 4 bytes.

The following example shows how to convert 2-byte data 76 (described in decimal):

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

■ Transmission Method

The following is an example of a transmission method using a command to change the program number:

e.g. To Change the Program Number to 6

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 return (CR) as a transmission end code at the end of the command. The robot receives and handles the contents above, between the start code and the end code, as a command.
Put a command code (Roman letter) behind the transmission start code. Basically, capital letters are used for transmission from the upper controller (e.g. PC or PLC) to the robot and small letters are used for transmission from the robot to the upper controller (e.g. PC or PLC).
Put a 1-byte subcommand code (Roman letter or Arabic numeral) behind the command code.
The rest is data sections (parameters) which are converted in hexadecimal format. In this example, the program number 76 will be represented as 004C in hex. 2-byte data will be represented in a 4-byte transmission code.

Note: Data larger than 2 bytes is transmitted from the upper layer to the lower layer.

The number of bytes of data is already fixed by a command (subcommand). If the number is different, an operation error may occur.

Put a check sum code at the end of the data.

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

■ Error Check Code

Put SUM as an error code.

In this example, the “SUM” code is the last byte of the sum total of the transmitted content (from the command code to the end of data) converted into hexadecimal format.

■ Communication Error

If the robot detects a communication error, an “e” command will be returned.

If a communication error is returned, no operation will be performed.

e. g. Communication Error Response (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: Check Sum Error
4	30	0	If a Check Sum error (4) has occurred, the value of the check code (SUM) calculated by the robot will be returned. Otherwise, 0 will be returned.
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

The subcommand code 0 (Other Communication Error) will be returned if a parity error, overrun error, frame error, or receive buffer overflow has occurred.

Check the [Parity], [Character Length], and [Stop Bit] settings in the [COM1 Communication Setting] menu.

1: Receive Timeout

If there is more than a two-second delay between each character after receiving the start transmit code while the robot is receiving commands, the subcommand code 1 (Receive Timeout error) will be returned and the characters entered after it will be ignored.

The subcommand code 1 (Receive Timeout error) will be returned if the return code (CR) is not transmitted.

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

The transmission interval between characters may cause the subcommand code 1 to be returned (Receive Timeout error), and any characters entered after it will be ignored.

2: Command (Subcommand) Code Error

If data, from the transmission start 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), the subcommand code 2 (Command (Subcommand) Code Error) will be returned.

4: Check Sum Error

For a “check sum error”, the SUM value calculated by the robot will be added to the end of the subcommand code as data. The “4: Check Sum Error” will be returned if this SUM value does not coincide with the check sum 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: Check Sum Error)
4	35	5	Check sum code calculated by the robot (SUM)
5	33	3	
6	30	0	SUM
7	31	1	65H+34H+35H+33H=101H
8	0D		CR: Transmission End Code

If a “check sum error” has occurred when receiving a command from the robot, you cannot send a re-transmission request command. However, if a “check sum error” has occurred when receiving a system information reply command, you can resend the system information request command.

ROBOT INFORMATION AND STATUS REQUEST

■ Robot Information Request (B0)

Send this command to request the robot information (e.g. model, Arm type, and version of software) data from the robot.

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

If the robot receives the robot information request command (B0), it will return the robot information transfer command (b0) as follows:

e.g. JS3504 (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	Ver. 1.00 is represented as 100. 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 (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 1
29	30	0	
30	30	0	
31	31	1	
32	30	0	SUM 62H+30H +……+31H=60BH
33	42	B	
34	0D		CR: Transmission End Code

■ Hardware and 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	With/Without Z-Axis	Without Z-Axis	With Z-Axis
05	With/Without R-Axis	Without R-Axis	With R-Axis
06	Unused/Reserved	Reservation OFF	
07	Unused/Reserved	Reservation OFF	
08	Unused/Reserved	Reservation OFF	
09	Unused/Reserved	Reservation OFF	
10	Unused/Reserved	Reservation OFF	
11	IO Type	IO-A	IO-B
12	Unused/Reserved	Reservation OFF	
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	
JR2000 and JSR4400 (previous models)	OFF	OFF	OFF	0
JS Series	OFF	OFF	ON	4
JSR4400N Series	OFF	ON	OFF	2
JR2000N Series	OFF	ON	ON	6
JSG Series	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 classified according to Arm lengths (movable ranges).

Servomotor SCARA Robot JS Series, Family Type I, II, III, IV, bit 00, 01, 02, 03

Model	03	02	01	00
JS250	OFF	OFF	OFF	OFF
JS350	OFF	OFF	OFF	ON
JS450	OFF	OFF	ON	OFF
JS550	OFF	OFF	ON	ON
JS650	OFF	ON	OFF	OFF
JS750	OFF	ON	OFF	ON
JS880	OFF	ON	ON	OFF
JS1000	OFF	ON	ON	ON
JS350TH (Through hole)	ON	OFF	OFF	OFF
JS450TH (Through hole)	ON	OFF	OFF	ON
JS550TH (Through hole)	ON	OFF	ON	OFF
JS550THL300	ON	OFF	ON	ON

Servomotor Gantry Robot JSG Series, Family Type I, II, III, IV, bit 00, 01, 02, 03

Model	03	02	01	00
JSG4030-150	OFF	OFF	OFF	OFF
JSG6050-150	OFF	OFF	OFF	ON

Pulse Motor SCARA Robot JSR4400N Series, Family Type I, II, III, IV, bit 00, 01, 02, 03

Model	03	02	01	00
JSR4400N	OFF	OFF	OFF	OFF

Desktop Robot JR2000N Series, Family Type I, II, III, IV, bit 00, 01, 02, 03

Model	03	02	01	00
JR2200N	OFF	OFF	OFF	OFF
JR2300N	OFF	OFF	OFF	ON
JR2400N	OFF	OFF	ON	OFF
JR2500N	OFF	OFF	ON	ON
JR2250N (Y250mm)	OFF	ON	OFF	OFF
JR2300N-Z50 (Z50mm)	OFF	ON	OFF	ON
JR2400N-Z50 (Z50mm)	OFF	ON	ON	OFF
JR2400N-Z100 (Z100mm)	OFF	ON	ON	ON
JR2400N-Y510 (Y510mm)	ON	OFF	OFF	OFF

■ Robot Status Request (B1)

Send this command to request the current robot status from the robot.

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

If the robot receives the robot status request command (B1), it will return the robot status transfer command (b1) as follows:

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	62	b	Command Code
3	31	1	Subcommand Code
4	30	0	Operation Mode
5	32	2	0: Teaching Mode 1: Reserved 2: Run Mode 3: Undefined 4: Test Run Mode 5: Point Run Mode 6: Administration Mode
6	30	0	Teaching Sub Mode
7	30	0	0: Teaching (TP) 1: Teaching (PC)
8	30	0	Start Channel
9	30	0	0: IO-SYS 1: COM1 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	Running Time (cumulative power-on time) [min] e.g. 1920125min.: 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	Play Back Time (cumulative running time) [min] e.g. 640042min.: 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)

Send the R commands to control the robot operation (e.g. program start) from the host.
Commands R0 – R5 have the same functions as those of the external IO-SYS system input signals. Using these commands, the robot can be controlled without IO-SYS.

e.g. To Change the Program Number to 12

N	HEX	ASC	Description
1	24	$	$: 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: Program End 8: Start Designated Program Number 9: Execute Single Point Job
4	30	0	Program Number (Point Job Number) Necessary only for 1: Program Number Change, 8: Designated Program Number Start, and 9: Single Point Job Execution e.g. Program Number 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

Normally, the robot will return the operation control response (r) to indicate whether or not an operation control command has been successfully executed. The same subcommand code (0 – 5) as that sent from the host is returned.

e.g. If the Robot Cannot be Started

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 If the R1: Program number change command is executed successfully, the new program number will be returned. If not, -1 (error code) will be returned.
5	46	F	
6	46	F	
7	46	F	
8	42	B	SUM 1BDH
9	44	D	
10	0D		CR: Transmission End Code

If the robot receives commands which take some time to be executed (R0, R2, R3, R8, and R9), it will return a temporary start response. The temporary start response indicates that the received command has been interpreted and returns the same command code (Roman capital letter) as that sent from the host. No parameter is attached to a temporary response.

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 having returned the temporary response, the robot executes the operation according to the received command. It will send a response (normal or error) when the operation is completed.
However, if the robot recognizes that the command cannot be executed under current conditions (e.g. the robot is not in the Run mode), an error code will be returned instead of a temporary response.

R0: Power ON (incl. Servomotor ON)

Send this command to turn on the drive motor and the servomotors for each Axis. This command is valid when the robot is standing by for start, or is stopped and waiting for start during operation.
If the robot is not in the Run mode, the robot returns the error code -1 (Error). Otherwise, the robot returns a temporary start response (R0), and then turns on the drive motor and all the Axes servomotors. If they are not turned on, the robot returns 0 (Normal). Otherwise (e.g. when the emergency stop has been activated), the robot returns -1 (Error).

R1: Program Number Change

Send this command to change program numbers. This command 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 the error code -1.

R2: Return to Work Home

Send this command to move the robot Arm to the work home position in the currently selected program number. To move the Arm, the start channel has to be set to COM1.
If the robot is not in the Run mode, or if the start channel is not set to COM1 even when the robot is in the Run mode, the error code -1 is returned. Otherwise, the robot returns the temporary start response (R2) and the Arm starts shifting to the work home position. If it reaches the work home position successfully, the normal code 0 is returned. If not, the error code -1 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), it restarts operation from that point. The start channel has to be set to COM1.

If the robot is not standing by or stopped, it returns the error code -1. If the robot is not in the Run mode (the start channel is not set to COM1), it also returns -1. The error code -1 is also returned if the robot is stopped by the emergency stop or start inhibition command.

If the robot is standing by and ready for start, it returns the 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, the Arm shifts to a 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 operation ([1 Cycle Playback]), the Arm returns to the work home position after the cycle of operation (after running the last point) and the program completes successfully. This command is valid when the robot is running.

R7: Program End

When the robot receives this command during operation, the Arm shifts to a breakpoint and cancels the program. The robot enters a start standby state and the Arm does not return to the work home position. If you wish to return the Arm to the work home position, use the R2 (Return to Work Home) command. This command is valid when the robot is running.

R8: Start Designated Program Number

When the robot receives this command while standing by for start (the start channel has to be set to COM1), 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 the error code -1.

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 the Run mode and also standing by for start or restart (due to a temporary stop or error signal).

If the start channel is not set to COM1, the [Move] commands and *callProgram* command (see the *Features II* operation manual for details of the commands) are invalid and not executed. (No error is returned.)

IO 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 variable types. They are designated by the type values (0 – 11).

Type	Symbol	Type Value	Number
System IO Input	#sysIn	0	1 – 15
General IO Input	#genIn	1	1 – 18
Hand IO Input	#handIn	2	1 – 4
System IO Output	#sysOut	3	1 – 14
General IO Output	#genOut	4	1 – 22
Hand IO 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 IO control commands are available to read out the current IO status and output IO signals:

1. Designated Number Readout
2. set (Turn on.)
3. reset (Turn off.)
4. delaySet (Turn on after the designated time.)
5. delayReset (Turn off after the 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 after the designated time and then turn off after outputting the designated pulse.)
9. delayinvPulseSet (Turn off after the designated time and then turn on after outputting the designated pulse.)

■ IO Readout (K0, K1)

Type designation is necessary to use the readout request command (K0). When the robot receives this command, it returns its status as a bit flag alignment. If the robot receives a designated number readout request command (K1), it designates the requested type and number and reads out only the status of the designated IO number.

Readout Request (K0)

e.g. General IO 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 Value (0 – 11)
5	30	0	
6	30	0	
7	31	1	
8			SUM
9			
10	0D		CR: Transmission End Code

When the robot receives the K0 command, it will return the requested IO status.

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 Value (0 – 11) (The robot returns the value with the request command value attached.)
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 00100001: 21H
9	31	1	
10	30	0	No.9 – No.16 status; bit0: No. 9 ... bit7: No. 16; ON: 1, OFF: 0 00000100: 04H
11	30	4	
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 IO 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 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 the same type value and IOM* number as that sent from the host. Then, the status is returned.

Designated Number Readout Response (k1)

e.g. General IO 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 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

*: External IOs, internal relay, and keep relay are collectively referred to as *IOM* in this manual.

■ IO Output: set, reset (K2, K3)

Send these commands to set (turn on) and reset (turn off) the IO signals. If you designate the type values 0 (system IO input), 1 (general IO input), and 2 (hand IO input), they will be ignored because they cannot be used for output. (An error will not be returned.)

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 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 code or an error code. Actually, no error is returned since there is no special treatment (e.g. parameter check) for the IOM output.

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

■ IO Output: delaySet, delayReset (K4, K5)

Send these commands to set (turn on) and reset (turn off) the IO signals after the designated time. If you designate the type values 0 (system IO input), 1 (general IO input), and 2 (hand IO input), they will be ignored because they cannot be used for output. (An error will not be returned.)
Responses to these commands are 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 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 those for K2 and K3. A normal code or an error code is returned.

■ IO Output: pulse, invPulse (K6, K7)

Send these commands to output the pulse signals and inverting pulse signals. The pulse output is the same as sending the delaySet command after turning on the signal. The inverting pulse output is the same as sending the delaySet command after turning off the signal. The pulse width is designated in msec. If you designate the type values 0 (system IO input), 1 (general IO input), and 2 (hand IO input), they will be ignored because they cannot be used for output. (An error will not be returned.)
Responses to these commands are 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 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 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 those for K2 and K3. A normal code or an error code is returned.

■ IO Output: delayPulseSet, delayinvPulseSet (K8, K9)

Send these commands to output the pulse signals and inverting pulse signals after the designated delay time. The delay time and pulse width are designated in msec. If you designate the type values 0 (system IO input), 1 (general IO input), and 2 (hand IO input), they will be ignored because they cannot be used for output. (An error will not be returned.)

Responses to these commands are 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 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 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 those for K2 and K3. A normal code or an error code is returned.

DRIVE CONTROL

Drive control commands are valid when the robot is stopped in the External Run mode. (The start channel needs to be set to COM.)

These commands are not activated when the start is inhibited by the IO-S or start inhibition signal. To use the drive control commands, external IO output control (turning off the [Ready for Start] and [Robot Stopping] signals) is necessary.

■ PTP Drive Control (M1)

Use this command to designate the destination the Arm moves to in the PTP drive.

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	4D	M	Command Code
3	31	1	Subcommand Code
4 – 27			Destination: XYZR Positions Refer to “Position (24-Byte)” on Page 74.
28			SUM
29			
30	0D		CR: Transmission End Code

The Arm moves according to the [PTP Condition], [Tool Data], and [Move Area Limit] set under [Program Data Settings] in the selected program. If the selected program is not registered, the [Default Program Data] settings are applied.

The robot returns a temporary start response to this command. The temporary start response indicates that the received command has been interpreted and returns the same command code (Roman capital letter) as that sent from the host. No parameter is attached to a temporary response.

e.g. Temporary Start Response

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 having returned the temporary response, the robot executes the operation according to the received command. It will send a response (normal or error) when the operation is completed.

However, if the robot recognizes that the command cannot be executed under current conditions (e.g. the robot is not in the Run mode), an error code will be returned instead of a temporary response.

If the PTP drive is completed successfully, the robot returns a normal code after reaching the destination.

If not (e.g. the Arm 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 start in the External Run mode.
- The robot has stopped due to an overload error.
- The Arm has exceeded the move area limit. ([Position is out of range] error)

■ CP Line Drive Control (M2)

Use this command to designate the destination to which the Arm moves linearly, and the speed in the CP 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] (represented as 155): 9BH
5	30	0	
6	39	9	
7	42	B	
8 – 31			Destination: XYZR Positions Refer to “Position (24-Byte)” on Page 74.
32			SUM
33			
34	0D		CR: Transmission End Code

The Arm moves according to the [CP Condition] ([Limit Speed] and [Limit Acceleration] for each Axis), [Tool Data], and [Move Area Limit] set under [Program Data Settings] in the selected program. If the selected program is not registered, the [Default Program Data] settings are applied.

The robot returns a temporary start response to this command. The temporary start response indicates that the received command has been interpreted and returns the same command code (Roman capital letter) as that sent from the host. No parameter is attached to a temporary response.

e.g. Temporary Start Response

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 having returned a temporary response, the robot executes the operation according to the received command. It will send a response (normal or error) when the operation is completed.
However, if the robot recognizes that the command cannot be executed under current conditions (e.g. the robot is not in the Run mode), an error code will be returned instead of a temporary response.

If the CP linear drive is completed successfully, the robot returns a normal code after reaching the destination.

If not (e.g. the Arm 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 start in the External Run mode.
- The robot has stopped due to an overload error.
- The Arm has exceeded the move area limit. ([Position is out of range] error)
- [CP Speed Over]
- [CP Righty/Lefty Error] (This error is returned if you change the directions in which the Arm turns during operation.)

■ CP Arc Drive Control (M3)

Use this command to designate [CP Arc Point] (the line curves at this point.), the destination to which the Arm moves in arc motion, and the speed at each point in the CP 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 0.1mm/s CP Speed to [CP Arc Point] e.g. 20.0mm/s (represented as 200): C8H
5	30	0	
6	43	C	
7	38	8	
8 – 31			CP Arc Point: XYZR Positions Refer to “Position (24-Byte)” on Page 74.
32	30	0	CP Speed: In increments of 0.1mm/s CP speed from [CP Arc Point] to the destination e.g. 20.0mm/s (represented as 200): C8H
33	30	0	
34	43	C	
35	38	8	
36 – 59			Destination: XYZR Positions Refer to “Position (24-Byte)” on Page 74.
60			SUM
61			
62	0D		CR: Transmission End Code

The Arm moves according to the [CP Condition] ([Limit Speed] and [Limit Acceleration] for each Axis), [Tool Data], and [Move Area Limit] set under [Program Data Settings] in the selected program. If the selected program is not registered, [Default Program Data] settings are applied.

The robot returns a temporary start response to this command. The temporary start response indicates that the received command has been interpreted and returns the same command code (Roman capital letter) as that sent from the host. No parameter is attached to a temporary response.

e.g. Temporary Start Response

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 having returned the temporary response, the robot executes the operation according to the received command. It will send a response (normal or error) when the operation is completed.
However, if the robot recognizes that the command cannot be executed under current conditions (e.g. the robot is not in the Run mode), an error code will be returned instead of a temporary response.

If the CP arc drive is completed successfully, the robot returns a normal code after reaching the destination.

If not (e.g. the Arm 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 error causes are as follows:

- The robot is not standing by for start in the External Run mode.
- The robot has stopped due to an overload error.
- The Arm has exceeded the move area limit. ([Position is out of range] error)
- [CP Speed Over]
- [CP Righty/Lefty Error] (This error is returned if you change the directions in which the Arm turns during operation.)

■ JOG Movement (M4, M5, M6)

Use the three commands; JOG Start (M4), JOG Moving (M5), and JOG End (M6) if you wish to move the Arm in the JOG mode.

First, send a JOG Start command (M4) and designate the distance and tool data. The robot returns a JOG Start response (m4) and starts the JOG movement.

After receiving the response, you need to send a JOG Moving command (M5) at 100msec intervals. For safety reasons (to stop quickly), the robot cancels the JOG movement if it does not receive the M5 command within 150msec, in case of connection or communication error.

The robot does not return a response (m5) to the 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 required for the JOG movement stored in the robot:

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

Attach tool data to a JOG Start command as below.

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: X-Y (for Cartesian coordinates robots) 1: J1-J2 Axis (for Non-Cartesian coordinates robots)
5			
6			Axis Designation 0: X or J1 1: Y or J2 2: Z 3: R
7			
8			Shifting Direction Designation 0: Plus Direction 1: Minus Direction
9			
10			Speed Designation For JS Series SCARA robots, select from the following: 0: Low Speed 1: Medium Speed 2: High Speed
11			
12 – 39			Tool Data (28-byte)
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 the 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 (e.g. 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 Designation (Invalid for SCARA robots: 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 an M5 command without receiving a JOG Start command (M4), it returns an m5 command as an error code.

JOG Moving Error Response (m5)

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	6D	m	Command Code
3	35	5	Subcommand Code: 5 (JOG Moving Error)
4	46	F	Error Code -1: Error (The robot receives this command without receiving an M4 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 (The robot receives this command without receiving the M4 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 it reaches the maximum moving limit. This is a normal end.
If the robot receives the M6 command without receiving the JOG Start request (M4), it returns the m6 command as an error code.

■ CP Continuous Drive (M7)

Use this command to repeat a linear or arc motion in the CP 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	Point 1 → Point 2, Line Speed: In increments of 0.1mm/s (e.g. 20.0mm/s)
9		0	
10		0	
11		0	
12		0	Point 2, Point Type 0: CP Passing Point 1: CP Arc Point 2: CP End Point
13		0	
14		0	
15		0	
16 – 39			Point 2, XYZR Positions Refer to “Position (24-Byte)” on Page 74.
8		0	Point 2 → Point 3, Line Speed: In increments of 0.1mm/s (e.g. 20.0mm/s)
9		0	
10		0	
11		0	
12		0	Point 3, Point Type 0: CP Passing Point 1: CP Arc Point 2: CP End Point
13		0	
14		0	
15		0	
16 – 39			Point 3, XYZR Positions Refer to “Position (24-Byte)” on Page 74.
8		0	Point 3 → Point 4, Line Speed: In increments of 0.1mm/s (e.g. 20.0mm/s)
9		0	
10		0	
11		0	
12		0	Point 4, Point Type 0: CP Passing Point 1: CP Arc Point 2: CP End Point
13		0	
14		0	
15		0	
16 – 39			Point 4, XYZR Positions Refer to “Position (24-Byte)” on Page 74.
8		0	Point 4 → Point 5, Line Speed: In increments of 0.1mm/s (e.g. 20.0mm/s)
9		0	
10		0	
11		0	
12		0	Point 5, Point Type 0: CP Passing Point 1: CP Arc Point 2: CP End Point
13		0	
14		0	
15		0	

16 – 39			Point 5, XYZR Positions Refer to “Position (24-Byte)” on Page 74.
8		0	Point 5 → Point 6, Line Speed: In increments of 0.1mm/s (e.g. 20.0mm/s)
9		0	
10		0	
11		0	
12		0	Point 6, Point Type 0: CP Passing Point 1: CP Arc Point 2: CP End Point
13		0	
14		0	
15		0	
16 – 39			Point 6, XYZR Positions Refer to “Position (24-Byte)” on Page 74.
48	31	1	SUM 53H+35H+……+30H=911H
49	31	1	
50	0D		CR: Transmission End Code

This command is valid when the robot is stopped in the External Run mode. (The start channel needs to be set to COM.)
The Arm moves according to the [CP Condition] ([Limit Speed] and [Limit Acceleration] for each Axis), [Tool Data], and [Move Area Limit] set under [Program Data Settings] in the selected program. If the selected program is not registered, the [Default Program Data] settings are applied.
This command is not activated when the start is inhibited by the IO-S or start inhibition signal. To use this command, external IO output control (turning off the [Ready for Start] and [Robot Stopping] signals) is necessary.

The robot returns a temporary start response to this command. The temporary start response indicates that the received command has been interpreted and returns the same command code (Roman capital letter) as that sent from the host. No parameter is attached to a temporary response.

e.g. Temporary Start Response

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 having returned the temporary response, the robot executes the operation according to the received command. It will send a response (normal or error) when the operation is completed.
However, if the robot recognizes that the command cannot be executed under current conditions (e.g. the robot is not in the Run mode), an error code will be returned instead of a temporary response.

If the CP drive is completed successfully, the robot returns a normal code after reaching the destination.

If not (e.g. the Arm 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 error causes are as follows:

- The robot is not standing by for start in the External Run mode.
- The robot has stopped due to an overload error.
- The Arm has exceeded the move area limit. ([Position is out of range] error)
- [CP Speed Over]
- [CP Righty/Lefty Error] (This error is returned if you change the directions in which the Arm turns during operation.)

POSITION INFORMATION REQUEST

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

Use these commands to request the robot to send the current robot Arm position (N0) and tool tip position (N1).

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 these commands (N0 and N1), it returns the current robot Arm position (Righty or Lefty) and tool tip position (each X-, Y-, Z-, 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 Positions Refer to “Position (24-Byte)” on Page 74.
28			SUM
29			
30	0D		CR: Transmission End Code

The robot refers to the tool data in the selected program to calculate the tool tip position coordinates.
If the selected program is not registered, the [Default Program Data] settings are applied.
The Arm position is equal to the tool tip position when both [TCP-X] and [TCP-Y] values are [0].

■ Designated Tool Center Position Request (N2)

Send the TCP (Tool Center Point) setting values to the robot and request to send the corresponding tool tip position.

Designated 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 setting values Refer to “TCP” on Page 73.
36			SUM
37			
38	0D		CR: Transmission End Code

When the robot receives this command (N2), it calculates the tool tip position coordinates using the received TCP setting values and returns the current robot Arm position (Righty or Lefty) and tool tip position (each X-, Y-, Z-, and R-coordinate value).

Designated 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 Positions Refer to “Position (24-Byte)” on Page 74.
28			SUM
29			
30	0D		CR: Transmission End Code

OPERATION INFORMATION REQUEST

■ Operation Information Request (I)

Send this command to request the robot to send the operation information.

Some contents of the transferred data may be the same as the operation report (q). The robot sends the operation report spontaneously, without a request.

Operation 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: Pallet No. 12 Counter Value 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/Timer 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 is activated in any operation mode or condition.

■ Job Point Response (i0)

When the robot receives the operation information request (I0), it returns the information (program number, point number, and point type) of the point where the robot is running. The contents are the same as the operation report (q2), with the exception of 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 75.
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: 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 this range, the robot returns 0 and the following items 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: 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 this range, the robot returns 0 and the following items 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 specifies and 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 (no number).

e.g. Pallet Number 15, Plane Pallet, Reset, 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 has 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 request (I9), it returns the workpiece adjustment amount (1 – 100).

The robot also specifies and 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 (no number).

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

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 0.001mm 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 0.001mm 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 0.001mm 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 0.01deg 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 0.000001deg 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 0.001mm 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 Settings (Q0 – Q3)

The robot sends the operation report spontaneously according to the operation report level settings, without the corresponding request command.

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

Level 0: No Report
Level 1: Work Home Position Return Complete, Operation Complete, Stop due to Operation Error
Level 2: Job Point Information Report
Level 3: Pallet Counter Control Report

Q1: Level 1 Settings

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 Settings Response (q0)

When the robot receives the operation report level settings, 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 an 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. An 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 Code/Error Code 1: Power ON/-1: Power ON Error 2: Work Home Return Complete/-2: Work Home Return Error 3: Operation Complete/-3: Stop due to Operation Error e.g. Stop due to 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.
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 job point information (program number, point number, and point type code) in addition to the Level 1 report. The robot sends the point information before moving to the job point.

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 75.
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 a 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 in addition to Level 1 and 2 reports when the pallet routine is performed.

There are two types of pallet control functions for the pallet routine. One is [Auto Increment], which increases the count automatically. (The robot Arm shifts to the next point in the pallet at a time.) The other is [Increment by Point Job], which does not increase the count unless a point job data command (*incPallet*: Increment Pallet or *resPallet:* Reset Pallet) to renew the counter is set. (The robot Arm does not shift to the next point in the pallet.) These two functions can be switched.

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 a NAK, the robot does not respond to the request.

ERROR INFORMATION REQUEST

Send these commands to request the robot to send system error information and operation error information.

The robot stores 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, initialization error, incorrect teaching data 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 7FH
5	46	F	
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			An error function identifier is returned if a logic error (Error Code 100) has occurred.
65			SUM
66			
67	0D		CR: Transmission End Code

- For error handling, refer to “ERROR MESSAGE LIST” in the *Specifications* operation manual.

■ Operation Error Information Request (F2)

Operation errors include point job syntax error, CP speed over 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, operation 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) designated by point job command Pallet Number (Pal) or Label Number (Lab)
29			
30			
31			

32			SUM
33			
34	0D		CR: Transmission End Code

DATA SETTINGS

Send the data setting commands to request the numbers of points (S0), to rewrite the point data position (S1), to set point data (S2), to set workpiece adjustment data (S3, S4), to set TCP (S5, S6), to request program information (S7), or to request, add, insert, and delete point data (block) (SA, SB, SC, SD, and SE).

■ Number of Points Request (S0)

Send this command to request the robot to send the number of points in the designated program.

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

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. If the designated program is not registered, it returns 0 (no point available).

e.g. The number of Points in Program Number 12 is 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 e.g. 452: 1C4H
9	30	0	
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 Settings (S1)

Send this command to request the robot to set the point position according to the designated program number, point number, and position data.

e.g. Request to Set 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 Positions Refer to “Position (24-Byte)” on Page 74.
40			SUM
41			
42	0D		CR: Transmission End Code

When the robot receives the S1 command, it returns the result whether the settings are 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, an error is returned.
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 Settings (S2)

Send this command to request the robot to set the point data according to the designated program number, point number, and point data.

e.g. Request for Setting Point Data of 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 76 – 77.
112			SUM
113			
114	0D		CR: Transmission End Code

When the robot receives the S2 command, it returns the result whether the settings are complete or not.

e.g. Normal

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, an error is returned.
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 Settings (S3, S4)

Send these commands to request the robot to set the workpiece adjustment amount according to the designated workpiece adjustment number.
The S3 command is used only to set the Z (vertical direction) Adjustment.

The S4 command is used to set the X Adjustment, Y Adjustment, Z Adjustment, R Adjustment, and Rotate Adjustment represented as follows:

ΔX: X Adjustment
ΔY: Y Adjustment
ΔZ: Z Adjustment
ΔR: R Adjustment
Δθ: Rotate Adjustment

If additional function data [Workpiece Adjustment] is set to the registered point coordinates P (X, Y, Z, R), the robot runs on the coordinates P' (X', Y', Z', R') adjusted as calculated by the following formulas:

X' = X*cos (Δθ) - Y*sin (Δ) + ΔX
Y' = X*sin (Δθ) + Y*cos (Δθ) + ΔY
Z' = Z + ΔZ
R' = R + ΔR

The above formulas show the rotation (Δθ rotation) and translational (ΔX, ΔY, ΔZ, ΔR) transformations of the coordinates.
If you set only the Z Adjustment, X, Y, and R positions are not affected. It has the same effect as the S3 command.

e.g. Lowering Workpiece Adjustment Number 8 Point Position by 2mm. (Setting the +2mm-adjustment amount.)

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 0.001mm Positive Numbers: Downward Direction Adjustment Negative Numbers: Upward Direction Adjustment e.g. 2mm: 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. Setting Workpiece Adjustment Number 8 (X Adjustment: -2.3mm, Y Adjustment: -20.5mm, Z Adjustment: +2mm, R Adjustment: 0.5deg, Rotate Adjustment: 0.001deg)

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 0.001mm e.g. -2.3mm (-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 0.001mm e.g. -20.5mm (-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 0.001mm Positive Numbers: Downward Direction Adjustment Negative Numbers: Upward Direction Adjustment e.g. 2mm (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 0.01deg e.g. 0.5deg (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 0.000001deg e.g. 0.001deg (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 Settings Response (s3, s4)

When the robot receives an S3 or S4 command, it returns the result whether the settings are 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, an error is returned.
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 Settings (S5)

Send the S5 command to set the TCP (Tool Center Point) directly.

e.g. Request for Setting 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	Setting 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 0.001mm e.g. 2.000mm 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 0.001mm e.g. 1.950mm 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 0.01deg 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 the S5 command, it returns the result whether the settings are 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, an error is returned.
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 Settings (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 methods for designating the set position, program number, or tool number are the same as those for the S5 command.
The first and second point positions are represented as described in “Position (24-Byte)” on Page 74.

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 0.0005mm The least significant bit is the Arm type. 0: Righty, 1: Lefty e.g. Righty: X = 122.52mm = 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 0.0005mm The least significant bit: 0 e.g. Y = 139.68mm = 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 0.0005mm The least significant bit: 0 e.g. Z = 53.85mm = 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 0.005deg The least significant bit: 0 e.g. R = 0deg
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 0.0005mm The least significant bit is the Arm type. 0: Righty, 1: Lefty e.g. Righty, X = 163.49mm = 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 0.0005mm The least significant bit: 0 e.g. Y = 119.77mm = 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 0.0005mm The least significant bit: 0 e.g. Z = 54.82mm = 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 0.005deg The least significant bit: 0 e.g. R = 90deg = 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 Settings Response (s6)

When the robot receives the S6 command, it returns the result whether the settings are 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, an error is returned.
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 about 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)

Send these commands to create and delete the designated program. The created program contains no point (and program data is the default).

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 code or an error code.

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

For the S8 (program creation) command, the robot returns an error if the designated program number already exists. It also returns an error if there is not enough memory available to create a new program.

For the S9 (program deletion) command, an error is returned if the designated program does not exist.

■ Point Data Request (SA)

Send this command to request the point data of the designated point in the designated program.

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 designated 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 76 – 77.
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)

Send this command to add point data to the end of the designated 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 76 – 77.
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 point data.

■ Point Data Insertion (SC)

Send this command to insert point data behind the designated point in the designated program. Accordingly, the point numbers shift backward according to the numbers of the inserted point.

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 76 – 77.
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 or point does not exist or if there is not enough available memory to insert new point data.

■ Point Data Deletion (SD)

Send this command to delete the point data of the designated point in the designated program.

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)

Send this command to delete multiple point data (referred to as a *point data block* in the operation manuals), from the designated top point number (*block start number*) to the designated last point number (*block end number*), in the designated program.

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

■ Program Data Settings (SH)

Send this command to set the designated data in the designated program.

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	53	S	Command Code
3	48	H	Subcommand Code
4	30	0	Program Number e.g. 12: 0CH
5	30	0	
6	30	0	
7	43	C	
8	30	0	Data Type 0: Program Name 6: CP Condition 1: Work Home 7: Workpiece Weight 2: Cycle Mode 8: Position Data Type 3: PTP Condition 9: Job on Start of Cycle 4: Tool Data 10: PTP Condition Number for Home 5: Move Area Limit
9	30	0	
10	30	0	
11	33	3	
12	30	0	(Reserved: Sub data Type) 0
13	30	0	
14	30	0	
15	30	0	
			Data (Refer to “APPENDIX-A: COMMON DATA PARAMETER” on Pages 73 – 89.)
			SUM
	0D		CR: Transmission End Code

The robot returns a normal code or an error code.

e.g. Error Response

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	73	s	Command Code
3	48	H	Subcommand Code
4	46	F	Result Code Normal:0, Error: -1
5	46	F	
6	46	F	
7	46	F	
			SUM
	0D		CR: Transmission End Code

It returns an error if the designated program does not exist or the designated data type is wrong.

■ Program Data Request (SI)

Send this command to request the designated data in the designated program.

N	HEX	ASC	Description
1	24	$	$: Transmission Start Code
2	53	S	Command Code
3	49	I	Subcommand Code
4	30	0	Program Number e.g. 12: 0CH
5	30	0	
6	30	0	
7	43	C	
8	30	0	Data Type 0: Program Name 6: CP Condition 1: Work Home 7: Workpiece Weight 2: Cycle Mode 8: Position Data Type 3: PTP Condition 9: Job on Start of Cycle 4: Tool Data 10: PTP Condition Number for Home 5: Move Area Limit
9	30	0	
10	30	0	
11	33	3	
12	30	0	(Reserved: Sub data Type) 0
13	30	0	
14	30	0	
15	30	0	
16			SUM
17			
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	49	I	Subcommand Code
4	30	0	Result Code Normal:0, Error: -1
5	30	0	
6	30	0	
7	30	0	
			Data (Refer to “APPENDIX-A: COMMON DATA PARAMETER” on Pages 73 – 89.) No data is attached if the result code is -1 (Error).
			SUM
	0D		CR: Transmission End Code

It returns an error if the designated program does not exist or the designated data type is wrong.

DATA SAVE

■ Data Save (T0), Data Readout (T1)

Send the T0 command to request the robot to save teaching data.

If you rewrite teaching data using the S (data settings) commands, the data is stored in the RAM temporarily and it is automatically deleted if the robot is turned off. Using the T0 data save command saves all data in the permanent memory.

Send the T1 command 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 84H
5	34	4	
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 85H
5	35	5	
6	0D		CR: Transmission End Code

The robot returns the result whether the data save or readout is complete (Normal) or not (Error).

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 0: Normal, -1: Error
5	46	F	
6	46	F	
7	46	F	
8	42	B	SUM 1BCH
9	43	C	
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 0.001mm
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 0.001mm
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 0.001mm
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 0.01deg
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 0, 1, 2… The actual tool weight differs from model to model. Selection numbers such as 0, 1, 2 are sent instead of the weight values.
2	30	0	
3	36	0	
4	30	0	
5	30	0	TCP-X or L1 In increments of 0.001mm
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 0.001mm
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 0.001mm
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 0.0005mm The least significant bit is the Arm type. 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 0.0005mm 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 0.0005mm 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 0.005deg 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 (Refer to “Point Type Code” on Page 75.) e.g. CP Start Point: 22H
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 74.
33	30	0	Line speed: In increments of 0.1mm/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	10-byte additional function data for extension (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	

■ Program Name (SH-0)

SN	HEX	ASC	Description
1	35	5	Program Name
2	34	4	
3	36	6	e.g. TestProg = 54H,65H,73H,74H,50H,72H,6FH,67H
4	35	5	
5	37	7	
6	33	3	
7	37	7	
8	34	4	
9	35	5	
10	30	0	
11	37	7	
12	32	2	
13	36	6	
14	46	F	
15	36	6	
16	37	7	
17	30	0	
18	30	0	
19	30	0	
20	30	0	
21	30	0	
…			
237	30	0	
238	30	0	
239	30	0	
240	30	0	

■ Work Home (SH-1)

SN	HEX	ASC	Description
1	30	0	Point Type Code (Refer to “Point Type Code” on Page 75.) e.g. CP Start Point: 22H
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 74.
33	30	0	Line speed: In increments of 0.1mm/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	10-byte additional function data for extension (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	

■ Cycle Mode (SH-2)

SN	HEX	ASC	Description
1	30	0	Cycle Mode 0: 1 Cycle Playback 1: Continuous Playback
2	30	0	
3	30	0	
4	30	0	
5	30	0	
6	30	0	
7	30	0	
8	31	1	

■ PTP Condition (SH-3)

SN	HEX	ASC	Description
1	30	0	X (J1) Limit Speed: In increments of 0.01%
2	30	0	
3	30	0	e.g. 100% = 10000 = 2710H
4	30	0	
5	32	2	
6	37	7	
7	31	1	
8	30	0	
9	30	0	X (J1) Limit Acceleration: In increments of 0.01%
10	30	0	
11	30	0	e.g. 100% = 10000 = 2710H
12	30	0	
13	32	2	
14	37	7	
15	31	1	
16	30	0	
17	30	0	Y (J2) Limit Speed: In increments of 0.01%
18	30	0	
19	30	0	e.g. 100% = 10000 = 2710H
20	30	0	
21	32	2	
22	37	7	
23	31	1	
24	30	0	
25	30	0	Y (J2) Limit Acceleration: In increments of 0.01%
26	30	0	
27	30	0	e.g. 100% = 10000 = 2710H
28	30	0	
29	32	2	
30	37	7	
31	31	1	
32	30	0	
33	30	0	Z (J3) Limit Speed: In increments of 0.01%
34	30	0	
35	30	0	e.g. 100% = 10000 = 2710H
36	30	0	
37	32	2	
38	37	7	
39	31	1	
40	30	0	
41	30	0	Z (J3) Limit Acceleration: In increments of 0.01%
42	30	0	
43	30	0	e.g. 100% = 10000 = 2710H
44	30	0	
45	32	2	
46	37	7	
47	31	1	
48	30	0	

49	30	0	R (J4) Limit Speed: In increments of 0.01% e.g. 100% = 10000 = 2710H
50	30	0	
51	30	0	
52	30	0	
53	32	2	
54	37	7	
55	31	1	
56	30	0	
57	30	0	R (J4) Limit Acceleration: In increments of 0.01% e.g. 100% = 10000 = 2710H
58	30	0	
59	30	0	
60	30	0	
61	32	2	
62	37	7	
63	31	1	
64	30	0	
65	30	0	Arc Motion 0: Relative Mode 1: Absolute Mode
66	30	0	
67	30	0	
68	30	0	
69	30	0	
70	30	0	
71	30	0	
72	30	0	
73	30	0	Z Move Height (from 0mm): In increments of 0.001mm e.g. 50mm = 50000 = C350H
74	30	0	
75	30	0	
76	30	0	
77	43	C	
78	33	3	
79	35	5	
80	30	0	
81	30	0	Z Up Distance: In increments of 0.001mm e.g. 20mm = 20000 = 4E20H
82	30	0	
83	30	0	
84	30	0	
85	34	4	
86	45	E	
87	32	2	
88	30	0	
89	30	0	Z Down Distance: In increments of 0.001mm e.g. 20mm = 20000 = 4E20H
90	30	0	
91	30	0	
92	30	0	
93	34	4	
94	45	E	
95	32	2	
96	30	0	

97	30	0	Horizontal Move Position: In increments of 0.001mm
98	30	0	
99	30	0	
100	30	0	
101	30	0	
102	30	0	
103	30	0	
104	30	0	
105	30	0	Start Horizontal: In increments of 0.001mm
106	30	0	
107	30	0	
108	30	0	
109	30	0	
110	30	0	
111	30	0	
112	30	0	
113	30	0	Start Down Position: In increments of 0.001mm
114	30	0	
115	30	0	
116	30	0	
117	30	0	
118	30	0	
119	30	0	
120	30	0	
121	30	0	Finish Mode 0: Driver Signal 1: Area 3 2: Area 2 3: Area 1 4: Pulse Output
122	30	0	
123	30	0	
124	30	0	
125	30	0	
126	30	0	
127	30	0	
128	30	0	
129	30	0	Reserved (0)
130	30	0	
131	30	0	
132	30	0	
133	30	0	
134	30	0	
135	30	0	
136	30	0	
137	30	0	Reserved (0)
138	30	0	
139	30	0	
140	30	0	
141	30	0	
142	30	0	
143	30	0	
144	30	0	

145	30	0	Acceleration Mode 0: S-Form 1: Constant
146	30	0	
147	30	0	
148	30	0	
149	30	0	
150	30	0	
151	30	0	
152	30	0	

■ Tool Data (SH-4)

SN	HEX	ASC	Description
1	30	0	Tool Weight 0 – 4 (depending on the models)
2	30	0	
3	30	0	
4	30	0	
5	30	0	
6	30	0	
7	30	0	
8	30	0	
9	30	0	TCP-X or L1: In increments of 0.001mm e.g. 1.150mm = 1150 = 47EH
10	30	0	
11	30	0	
12	30	0	
13	30	0	
14	34	4	
15	37	7	
16	45	E	
17	30	0	TCP-Y or L2: In increments of 0.001mm e.g. 2.500mm = 2500 = 9C4H
18	30	0	
19	30	0	
20	30	0	
21	30	0	
22	39	9	
23	43	C	
24	34	4	
25	30	0	deltaZ: In increments of 0.001mm
26	30	0	
27	30	0	
28	30	0	
29	30	0	
30	30	0	
31	30	0	
32	30	0	
33	30	0	deltaR: In increments of 0.01deg
34	30	0	
35	30	0	
36	30	0	
37	30	0	
38	30	0	
39	30	0	
40	30	0	

■ Move Area Limit (SH-5)

SN	HEX	ASC	Description
1	30	0	J1 Upper Limit: In increments of 0.01deg or X Upper Limit: In increments of 0.001mm e.g. 300mm = 300000 = 493E0H
2	30	0	
3	30	0	
4	34	4	
5	39	9	
6	33	3	
7	45	E	
8	30	0	
9	30	0	J1 Lower Limit: In increments of 0.01deg or X Lower Limit: In increments of 0.001mm
10	30	0	
11	30	0	
12	30	0	
13	30	0	
14	30	0	
15	30	0	
16	30	0	
17	30	0	J2 Upper Limit: In increments of 0.01deg or Y Upper Limit: In increments of 0.001mm e.g. 320mm = 320000 = 4E200H
18	30	0	
19	30	0	
20	34	4	
21	45	E	
22	32	2	
23	30	0	
24	30	0	
25	30	0	J2 Lower Limit: In increments of 0.01deg or Y Lower Limit: In increments of 0.001mm
26	30	0	
27	30	0	
28	30	0	
29	30	0	
30	30	0	
31	30	0	
32	30	0	
33	30	0	Z Upper Limit: In increments of 0.001mm e.g. 100mm = 100000 = 186A0H
34	30	0	
35	30	0	
36	31	1	
37	38	8	
38	36	6	
39	41	A	
40	30	0	
41	30	0	R Upper Limit: In increments of 0.01deg e.g. 360deg = 36000 = 8CA0H
42	30	0	
43	30	0	
44	30	0	
45	38	8	
46	43	C	
47	41	A	
48	30	0	

49	46	F	R Lower Limit: In increments of 0.01deg
50	46	F	
51	46	F	e.g. -360deg = -36000 = FFFF7360H
52	46	F	
53	37	7	
54	33	3	
55	36	6	
56	30	0	

■ CP Condition (SH-6)

SN	HEX	ASC	Description
1	30	0	CP Acceleration: In increments of 0.01%
2	30	0	
3	30	0	e.g. 100% = 10000 = 2710H
4	30	0	
5	32	2	
6	37	7	
7	31	1	
8	30	0	
9	30	0	CP Limit Rotate Speed: In increments of 0.01%
10	30	0	
11	30	0	e.g. 100% = 10000 = 2710H
12	30	0	
13	32	2	
14	37	7	
15	31	1	
16	30	0	
17	30	0	CP Limit Rotate Acceleration: In increments of 0.01%
18	30	0	
19	30	0	e.g. 100% = 10000 = 2710H
20	30	0	
21	32	2	
22	37	7	
23	31	1	
24	30	0	

■ Workpiece Weight (SH-7)

SN	HEX	ASC	Description
1	30	0	Workpiece Weight 0 – 4 (depending on the models)
2	30	0	
3	36	0	
4	30	0	
5	30	0	
6	30	0	
7	30	0	
8	30	0	

■ Position Data Type (SH-8)

SN	HEX	ASC	Description
1	30	0	Position Data Type 0: Absolute 1: Relative 2: Moving Amount
2	30	0	
3	30	0	
4	30	0	
5	30	0	
6	30	0	
7	30	0	
8	30	0	

■ Job on Start of Cycle (SH-9)

SN	HEX	ASC	Description
1	30	0	Job on Start of Cycle (0 – 200) e.g. 24 = 18H
2	30	0	
3	30	0	
4	30	0	
5	30	0	
6	30	0	
7	32	2	
8	38	8	

■ PTP Condition Number for Home (SH-10)

SN	HEX	ASC	Description
1	30	0	PTP Condition Number for Home (0 – 100) e.g. 36 = 24H
2	30	0	
3	30	0	
4	30	0	
5	30	0	
6	30	0	
7	32	2	
8	34	4	

APPENDIX-B: COMMAND SAMPLES

(In Alphabetical Order)

	Function	Transmission Example
B0	Robot Information	$B072 $b0803100780001000003EA0001000119
B1	Robot Status	$B173 $b10200000000010000000800000024B0000B6
F1	System Error	$F177 $f1000000000000000000000000000000000000000000000000000000000000000000D7
F2	Operation Error	$F278 $f2000000000000000000000000000D8
I0	Job 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	Workpiece Adjustment Amount	$I9000143 $i900010100000000003E8000007D0FFFFF4480000019000989680000 01770DE No.1, X=1 Y=2 Z=-3 R=4 Rotate=10 SZ=6
K0	IO Readout	$K000013C #genIn $k00001010C0000F0 1,11,12 ON
K1	Designated IO Number Readout	$K1000100000003C0 #genIn3 $k10001000000030000000161 ON
K2	IO Output: set	$K2000400000005C6 set #genOut5 $k200005D
K3	IO Output: reset	$K3000400000006C8 reset #genOut6 $k300005E
K4	IO Output: delaySet	$K4000400000005000003E868 delaySet #genOut5 1000 $k400005F
K5	IO Output: delayReset	$K5000400000005000003E869 delayReset #genOut5 1000 $k5000060
K6	IO Output: pulse	$K6000400000005000003E86A pulse #genOut5 1000 $k6000061
K7	IO Output: invPulse	$K7000400000005000003E86B invPulse #genOut5 1000 $k7000062
K8	IO Output: delayPulseSet	$K8000400000005000003E8000007D007 delayPulse #genOut5 1000, 2000 $k8000063
K9	IO Output: delayinvPulseSet	$K9000400000005000003E8000003E80D invDelayPulse #genOut5 1000,1000 $k9000064
M1	PTP Drive Control	$M1FE795F061A8000EA60000000A0 X=-50,Y=200,Z=30,R=0 $M17E $m100005E

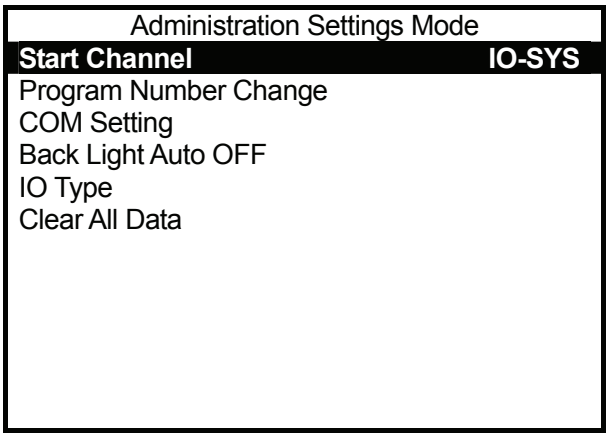
M2	CP Line Drive Control	$M200C8027101057E4000EA6000000036 20mm/s,X=80,Y=180,Z=30,R=0 $M27F $m200005F
M3	CP Arc Drive Control	40mm/s,X=130,Y=230,Z=30,R=0,40mm/s,X=80,Y=280,X=30,R=0 $M3019003F7A10704E000EA60000000190027101088B8000EA60000000F3 $M380 $m3000060
M4 M5 M6	JOG Movement	$M40000002000000000000000000000000000043 $m4000061 $M500E2 …… $M683 $m6000063
M7	CP Continuous Drive	$M7000601F40000FFFFFE061A8100EA6100000001900000FFFFFE07A12100EA61000000012C00010186A2061A8100EA6100000000C80000FFFFFE0493E100EA6100000000640002FB6C1E0493E100EA6100000003A $M784 $m7000064
N0	Arm Position X-Y Expression	$N07E $n0FE7962061A7C00EA62000000C1
N1	Available Tool Tip Position	$N17F $n102BF20057E4000EA600000009C
N2	Designated Tool Center 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: Job Point	$Q283 $q0000061 $q20004000000002100000A Prog=4, Pn=0, PTP $q20004000100002100000B Prog=4, Pn=1, PTP
Q3	Operation Report Level 3: Pallet Count	$Q384 $q0000061 $q3000401000002000000200000000006F3 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 Designated Program Number	$R800054F $R88A $r800006A
R9	Execute Single Point Job	$R9000550 $R98B $r900006B
S0	Numbers of Point Request	$S0000447 $s0000400000019F1 Prog=4, Num of Points = 25

S1	Point Data Position Settings	Prog=6 Pn=1 X=90 Y=180 Z=30 R=0 $S100060000000102BF20057E4000EA60000000C8 $s1000064
S2	Point Data Settings	Prog=1 Pn=2 X=90 Y=180 Z=30 R=0 PTP Job=1 Tag=3 $S2000100000002000000 2102BF20057E4000EA600000000000000000 0001000000000000000300000000000000000000000000000000004C $s2000065
S3	Workpiece Z Adjustment Amount Settings	$S30008000007D0E9 No.8 Z=2mm $s3000066
S4	Workpiece Adjustment Data Settings	No.8 X=-2.3 Y=-20.5 Z=2 R=0.5 rot=0.001 $S40008FFFFF704FFFFAFEC000007D000000032000003E82F $s4000067
S5	Direct TCP Settings	All X=2, Y=3 $S5000300000000000007D000000BB800000000000000000012 $s5000068
S6	2-Points TCP Settings	$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 Deletion	$S9000551 No.5 $s900006C
SA	Point Data Request	$SA000100000001D6 Prog=1, Pn=1 $sA000000000021FE796007A1200186A0000000000000000000010000 0000040000000000000000000000000000000000000000F8 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 $SB000100000021000000061A8000EA60000000000000000000000050000 0000040000000000000000000000000000000000000000AE $sB000075
SC	Point Data Insertion	Prog=1 Pn=3 CP X=25,Y=200,Z=30 Speed=50 $SC000100000030000002200C350061A8000EA60000000000001F400 0000000000000000000000000000000000000000000000000060 $sC000076
SD	Point Data Deletion	$SD000100000005DD Prog=1 Pn=5 $sD000077
SE	Point Data Block Deletion	$SE0001000000020000000863 Prog=1 Pn=2-8 $sE000078
T0	Data Save	$T084 $t0000064
T1	Data Readout	$T185 $t1000065

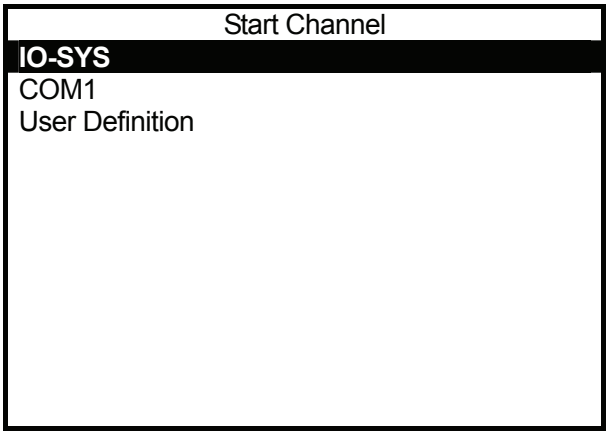
APPENDIX-C: OPERATION START CHANNEL

When using commands to move the Arm, such as M (drive control) commands or R2 (Return to Work Home) and R3 (Start) commands, set [Start Channel] to [COM1] and switch to the Run mode (to the External Run mode for the JR2000N and JSR4400N Series).
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].



Commands to move the Arm, such as M (drive control) commands or R2 (Return to Work Home) and R3 (Start) commands, are activated only when [Start Channel] is set to [COM1] and the Run mode (the External Run mode for the JR2000N and JSR4400N Series) is selected.

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