NetwoRC provider

DENSO Robot

Version 1.2.19

User's guide

October 13, 2015

【Remarks】

【Revision history】

Version	Date	Content
1.0.0	2006-05-11	First edition.
1.0.1	2006-07-17	@n, ROTATE pose option, ST_* commands were supported.
1.0.2	2006-08-31	SYSSTATE, Pose Data Type Transformation, Conveyer Tracking Commands were supported.
1.0.3	2006-09-13	POSEDATA type was supported.
1.0.4	2006-10-16	Trouble Shooting was added.
1.0.5	2006-12-09	A “Len” option of I/O variable was added
1.1.0	2007-07-12	Servo Log Commands were added, RC5 was supported.
1.1.1	2007-08-10	MyIP option was added.
1.1.2	2007-11-21	TORetry option was added.
1.2.0	2008-01-14	Extended-joints were supported.
1.2.1	2008-01-211	Error code table was added.
1.2.2	2008-06-18	An high path accuracy command was added.
1.2.3	2008-07-02	Minor upgrade.
1.2.4	2008-08-22	FIGAPRP, FIGAPRL were supported.
1.2.5	2008-09-30	Minor upgrade.
1.2.6	2008-11-21	Variable name with ‘*’ (ex. I[*]) and UDP local port option were added.
1.2.7	2009-06-12	Collision Detection Commands was supported.
1.2.8	2009-07-03	Tips were added.WDIn and WDOut were supported.
1.2.9	2009-07-07	Variable time stamp (Microsecond property) was supported.
1.2.10	2010-02-11	Mini I/O All-general was supported. Error code was added.
1.2.11	2010-05-21	CtrlChk option was added.
1.2.12	2010-11-17	Correct Execute command name.
1.2.13	2011-01-11	“Transferring PAC program” upgrade.
1.2.14	2011-02-01	“caoRobot” Commands upgrade.
1.2.15	2011-04-05	Correct Hardware version.
1.2.16	2011-04-21	Non-stop motion calculator option was added.
1.2.17	2011-05-16	@ERROR_CODE_HEX was added.
1.2.18	2011-05-26 2012-07-17	The Bundle connection limitation (max. 3) was abolished. Document versioning rules was changed
1.2.19	2015-10-13	@ERROR_LEVEL was added

【Hardware】

Model	Version	Notes
RC7	Ver2.330 or higher	“ORiN” option (1214) is required.
RC5	Ver1.998 or higher	“ORiN” option (1213) is required. See Appendix D for details.

【Attention】

The maximum number with which NetwoRC can be connected[1] at a time is 79.

[1] Connected Number = Number of instances of NetwoRC providers = Number of objects made with CaoWorkspace::AddController

Contents

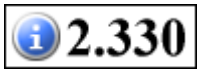
1. Introduction

This document describes external specifications of the CAO provider for NetwoRC controller (RC7) of the DENSO robot. In this document, CAO provider (CaoProvRoboTalk.dll) is called as NetwoRC provider. The NetwoRC provider implements all interfaces defined in the CAO provider specification.

This document describes the NetwoRC provider specifications on connection parameters, system variables, user variables, files and original enhancement.

The dependency of the NetwoRC controller's model and version is described in the next table used as Sign in this document.

Table 1-1 NetwoRC controller's model and version

Controller		Sign	Explanation
Model	Version		
RC7M	2.330 or more		If the controller version is 2.330 or more, it is valid.
-	-		"RobSlave.pac" program need to be executed commands.

All global variables (I, F, D, V, P, J, T, S) from [0] to [9] have been reserved with the system.
Please do not access these variables in the user's program.

1.1. Outline

The NetwoRC provider is CAO provider that absorbs RC7 dependant part and offers the function defined by the CAO provider interface specifications. The file format is DLL (Dynamic Link Library), and it is dynamically loaded from CAO engine when it is used. To use NetwoRC provider, registry need to be manually registered according to the table below.

Table 1-2 NetwoRC provider

File name	CaoProvNetwoRC.dll
ProgID	CaoProv.DENSO.NetwoRC
Registry registration[2]	regsvr32 CaoProvNetwoRC.dll
Remove registry registration	regsvr32 /u CaoProvNetwoRC.dll

A license key is required to use the CAO Engine module. Please refer to “License registeration” section of “ORiN2 SDK User’s Guide”.

NetwoRC provider communicates to the controller using RS232C or Ethernet, and the provider supports functions like controller variable read/write, PAC program invocation, and robot motion. ORiN supports various communications to connect to the robot controller, as shown in Figure 1-1. Thisprovider supports the communication method shown in the red frame.

[2]In case of installation from ORiN2 SDK, register and unregister operation is not required.

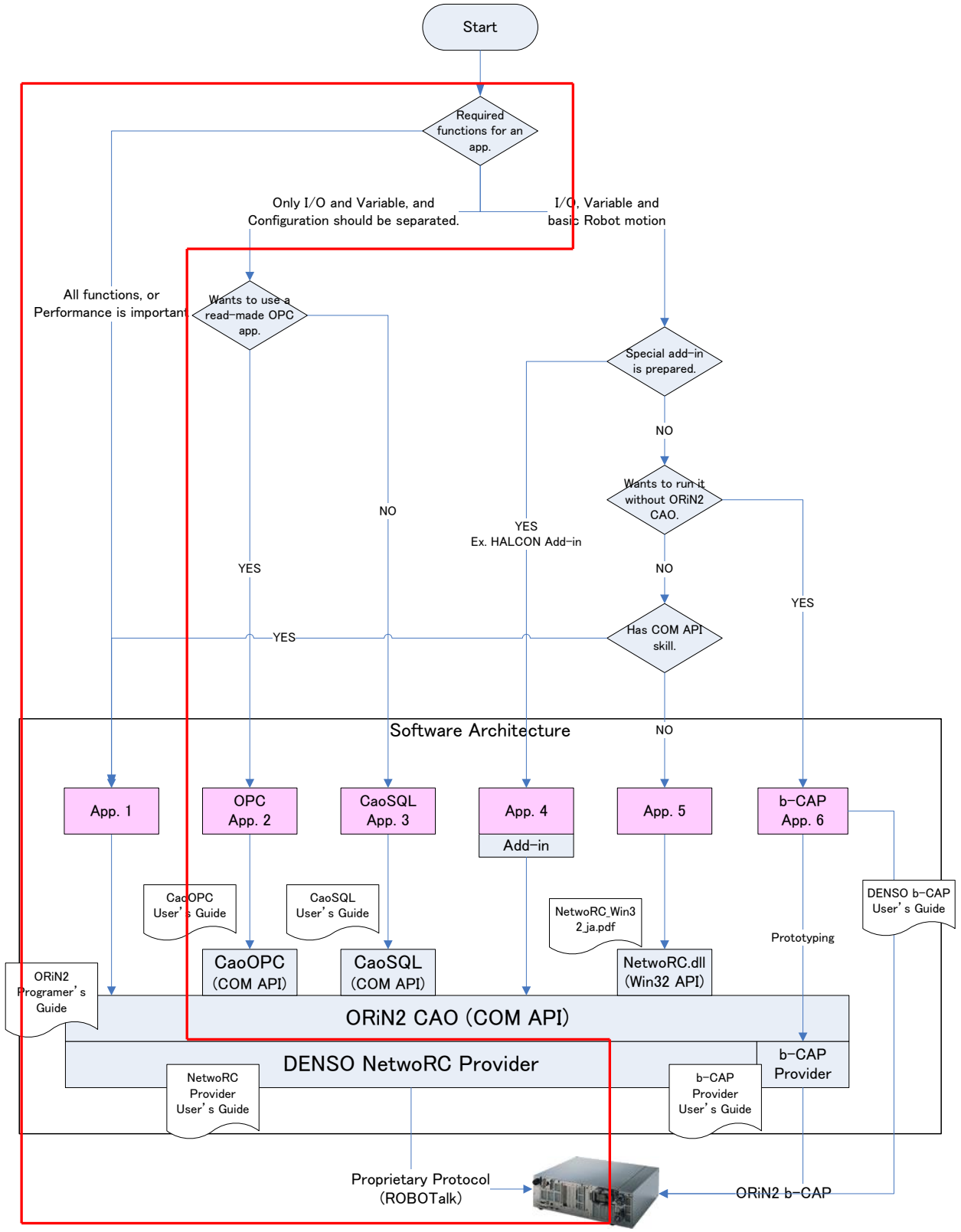


Figure 1-1 Robot connection

2. Setup

2.1. Emergency stop device position

A robot emergency stop switch should be prepared and set up near a robot operator before operating the robot, so that the switch can immediately stop the robot motion in an emergency situation.

The robot emergency stop switch should meet the following requirement.

(1) The emergency stop switch should be red-colored.

(2) After the emergency stop switch is activated, the switch should not return to normal (robot operating) position automatically or by other operator's careless action.

(3) A robot emergency stop switch should be set up separately from the power switch.

The emergency stop device shall be in accordance with IEC 60204-1:2005, 10.7 and ISO 13850.

2.2. Controller setup

A robot controller need to be setup before is controlled by the NetwoRC provider. A teach pendant or a mini pendant is needed for the robot controller setup. Following is the procedure to setup the controller.

2.2.1. Setup using a teach pendant

Setup a robot controller with a teach pendant according to the following procedure.

(1) Set the robot controller to the manual mode.

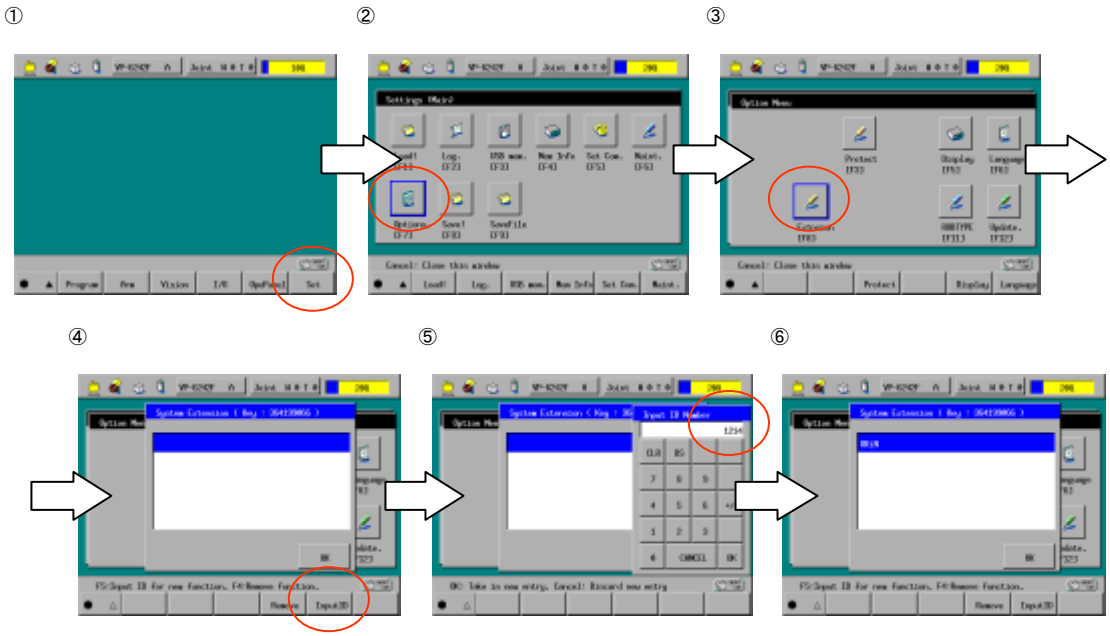


Figure 2-1 ORiN option activation

(2) Set controller's communication permission. When you use Ethernet, Set "Read/Write" in the menu "Communications setting menu" => "Permit." When you use RS-232C, set "Read/Write" in the same menu

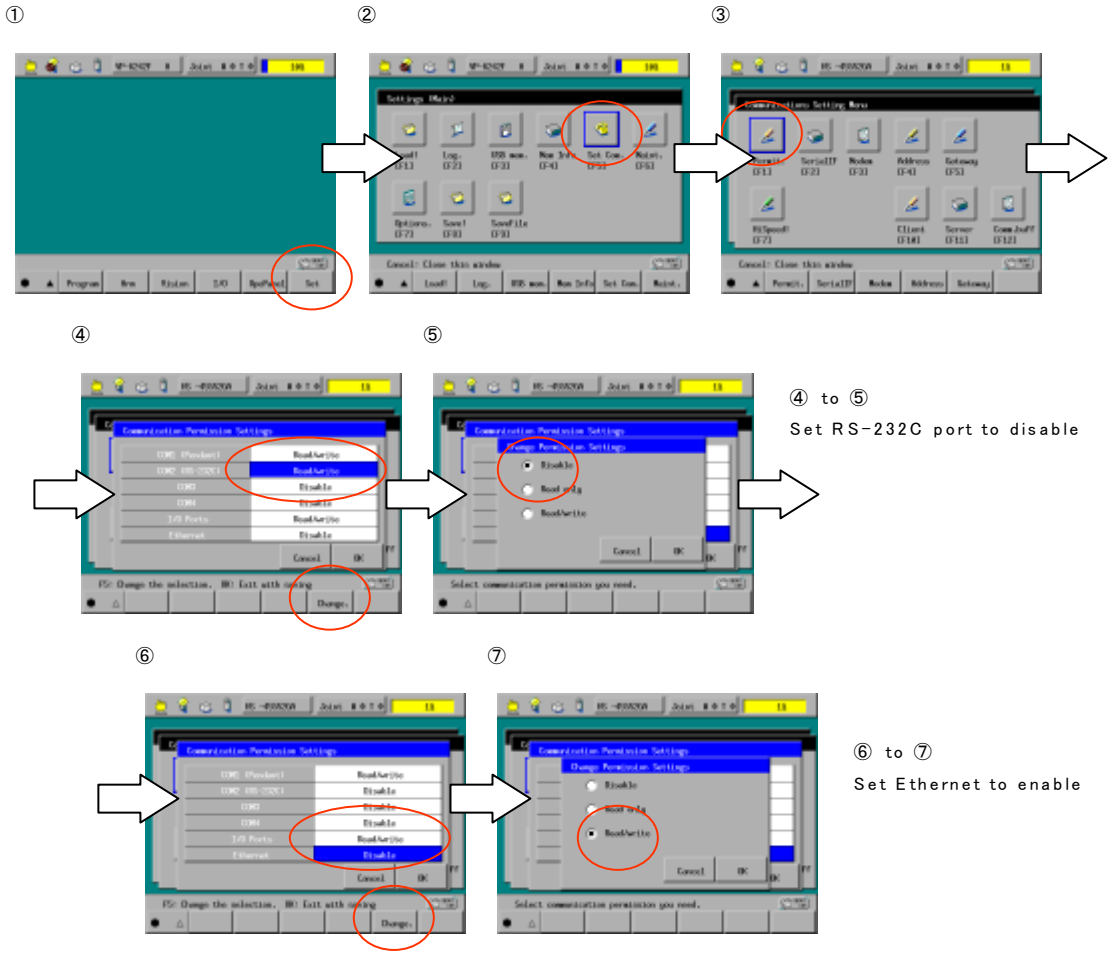


Figure 2-2 Setting of communication permission

(3) Activate ORiN option. Select "Option" => Input password "1214" in the function expansion menu to activate "ORiN" option. [3] Input "1213" if robot controller is RC5.

(4) To turn ON/OFF the motor of the robot, or to start programs from an ORiN application, it is necessary to set controller's executable token. Set the executable token to "Ethernet" by setting the "Communications setting menu" => "Ext.Run", and set IP address of client PC by "F4:IP set" menu afterwards when you use Ethernet as the connection method. Set the executable token to each COM port when you use RS232 C.

[3] By setting "ORiN" option, ORiN applications can freely access the variables and I/Os. Access the variables and I/Os after fully understanding the state and the content of the robot controller program etc. Especially, the changing the variables and I/Os might give the critical effect to the movement of the robot and the program.
In the internal automatic mode, when "ORiN" option is activated, the robot program stops if an error more than level 3 occurs. However, in external automatic mode, the robot program stops if an error more than error level 2 occurs. Therefore, when a robot is in external automatic mode, please be careful not to perform wrong operation or not to transmit a wrong command.

2.330

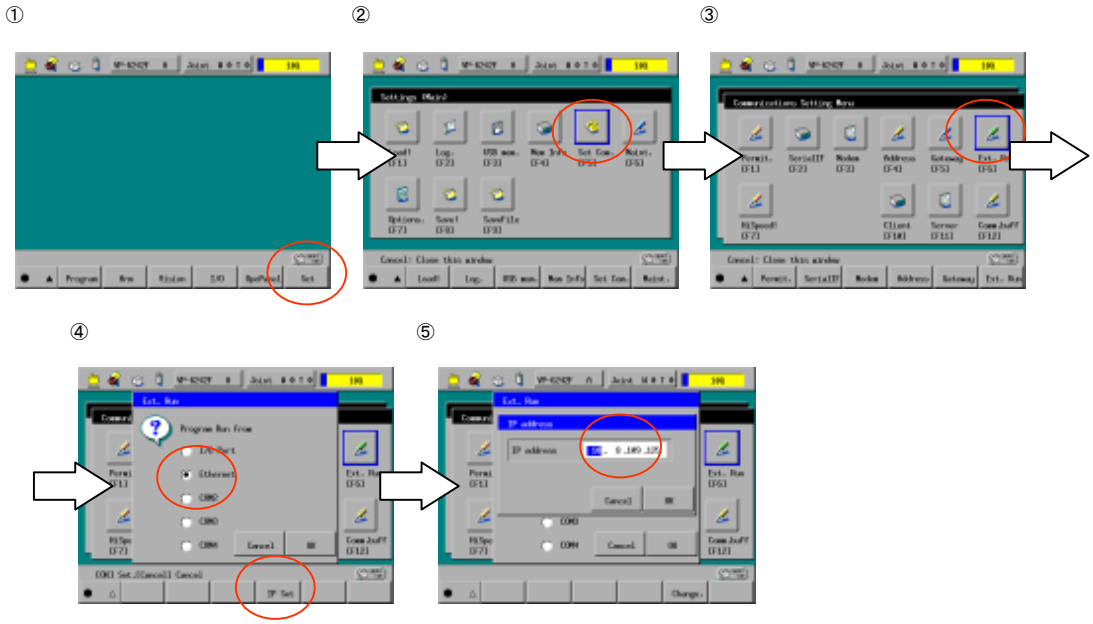


Figure 2-3 Settings of Executable token

2.2.2. Setup using the mini pendant

2.330

Setup a controller with a mini pendant according to the following procedure.

(1) Set a robot controller to the manual mode.

(2) Activate ORiN option. [Aux Function] => [Extension] => [Extension] => Input “1214” with Add and make “ORiN” effective. [3]

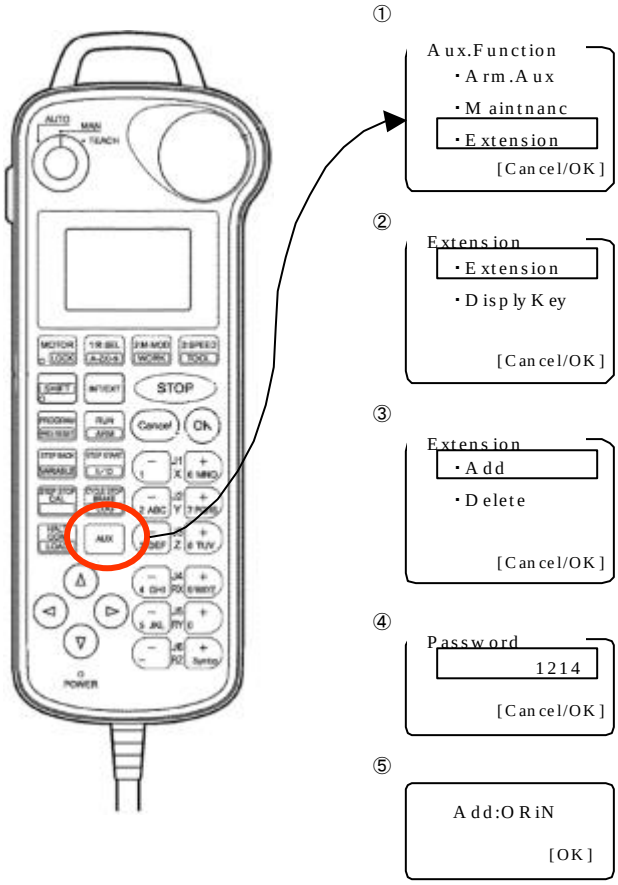


Figure 2-4 ORiN option activation

(3) Set robot controller's communication permission. When you use Ethernet, go to COM Setting of mini pendant => Set R/W to Ethernet with Permit. When you use RS232C, set R/W to appropriate COM port.

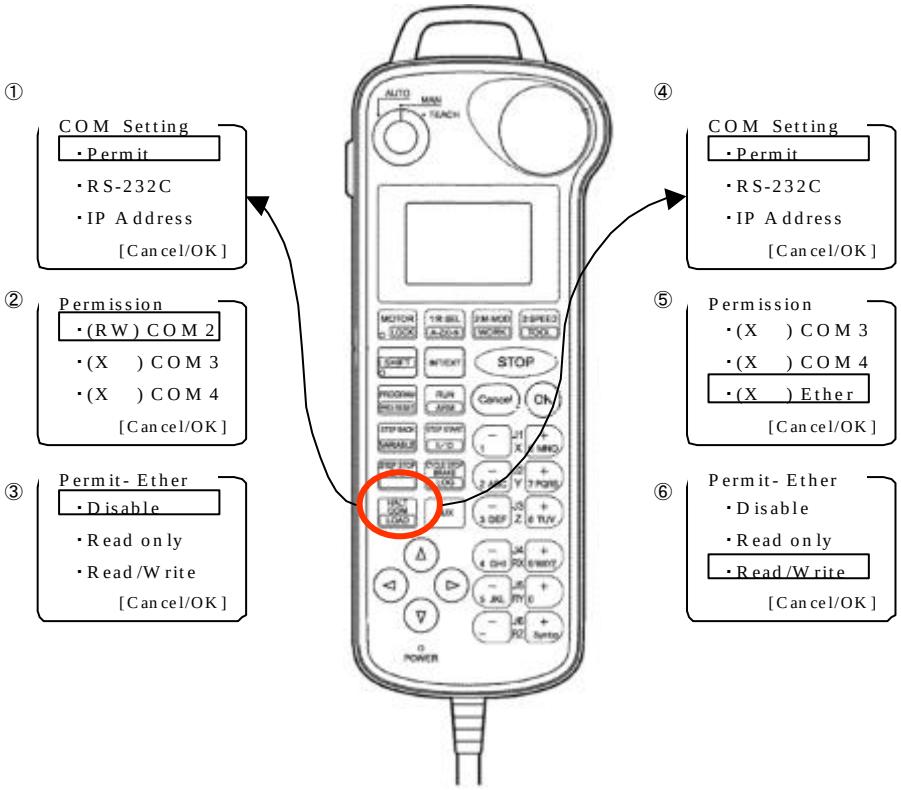


Figure 2-5 Setting of communication permission

(4) To turn ON/OFF the motor of the robot, or to start programs from an ORiN application, it is necessary to set controller's executable token. When Ethernet is used for communication, go to COM menu of mini pendant and set the executable token to Ethernet in [Ext Run], and also set IP address of client PC in [Client IP] menu. Set the executable token to appropriate COM port when you use RS232 C.

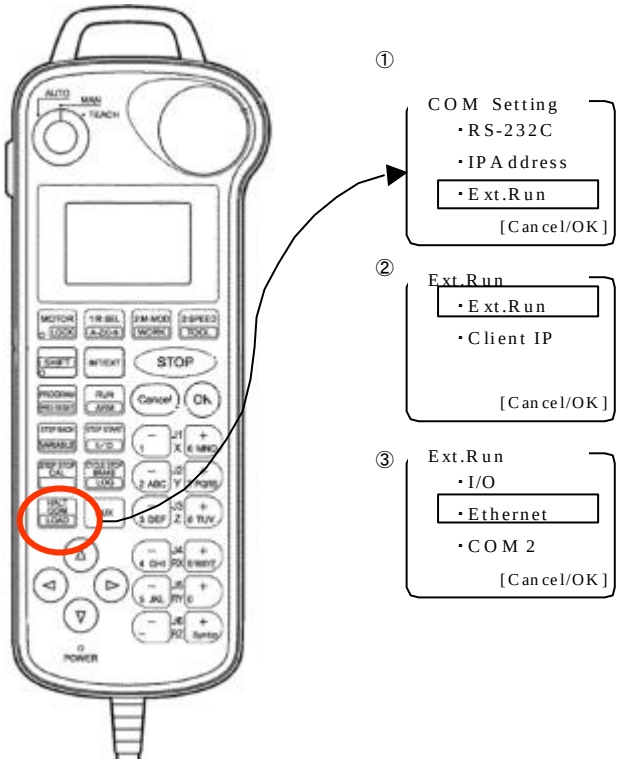


Figure 2-6 Setting of Executable token

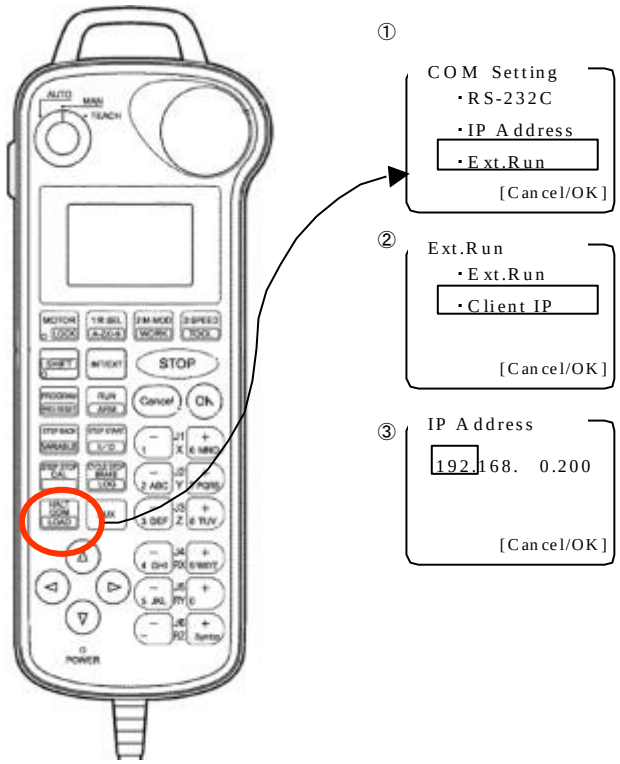


Figure 2-7 Input of IP address of client PC

2.3. Treatment of special I/O port

2.330

DENSO robot controller has a lot of system input signals.

To operate robot from PCs connected to the robot controller using ORiN, “Step stop (All tasks) signal” and “Instantaneous stop signal” need to be set to enable robot program execution.

Connector assignment and pin assignment of “Step stop (All tasks) signal” and “Instantaneous stop signal” are different depending on the robot controller configuration and I/O assignment. Please confirm the robot controller configuration to make correct I/O treatment to enable robot program execution.

[Note 1] The I/O treatment is not necessary for RC5, because these versions of software does not support running robot program using ORiN.

[Note 2] The I/O treatment is not necessary, if ORiN is used only to access variables or files, and if ORiN is NOT used to control robot motion or robot program (PAC).

2.3.1. I/O treatment for standard configuration controller (without I/O extension board)

Please close Mini I/O general purpose / system I/O connector CN5 – terminal No.11.

By closing the signal, Step stop (All tasks) signal (port number 0) becomes ON, and robot and program execution is enabled.

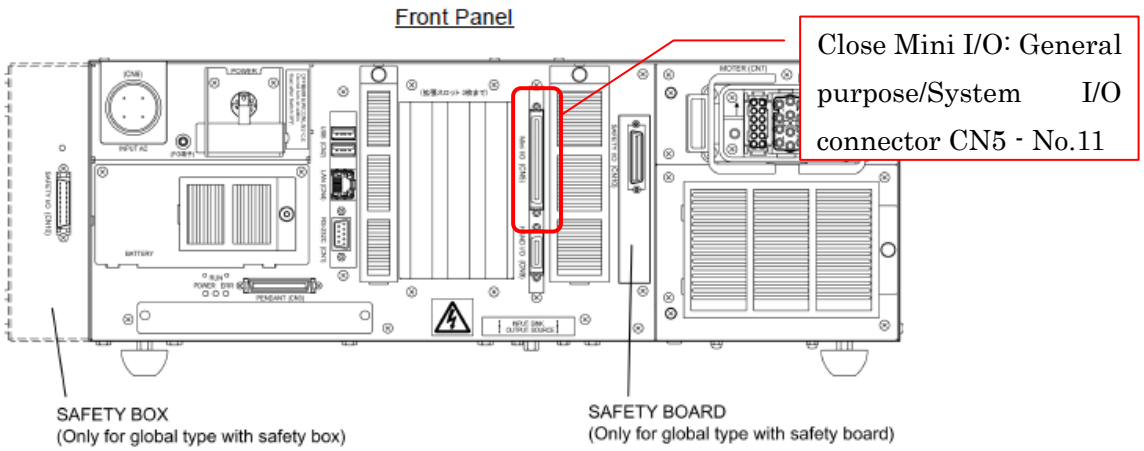


Figure 2-8 Step stop (All tasks) treatment

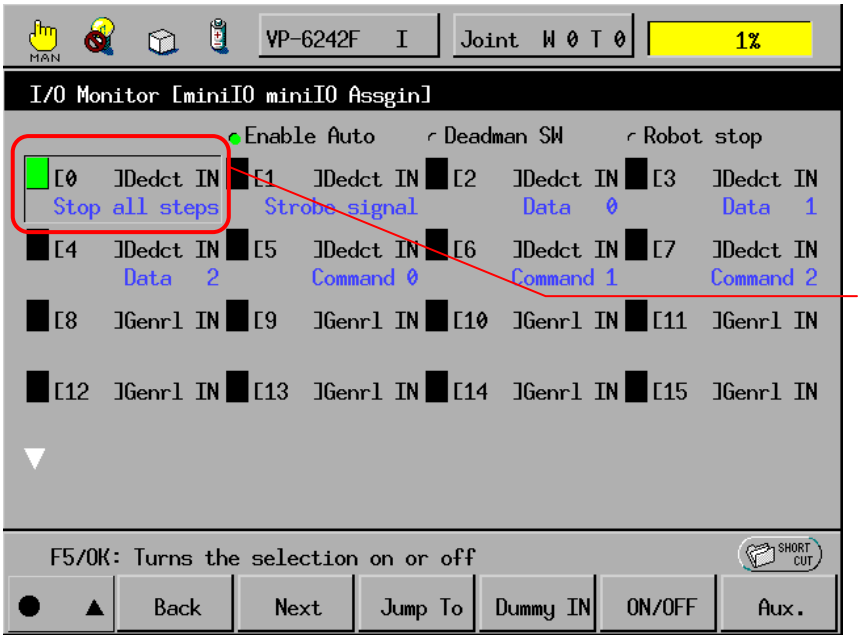


Figure 2-9 Signal confirmation after I/O treatment

This type of I/O does not have Instantaneous stop signal, so no treatment is necessary.

2.3.1.1. Mini I/O All general option

Mini I/O All-general option, available on Version 2.90 or later, is for robot system that does not require special I/O port assigned to mini I/O. By activating the option, all mini I/O ports are assigned as general I/O, and step stop signal wiring becomes not necessary.

To activate the option, setup a robot controller with a teach pendant according to the following procedure.

(1) Set a robot controller to the manual mode.

(2) To activate Mini I/O All-general option, select “Option” => “Function expansion” menu and input password “**6319**”.

(3) Turn off and restart a robot controller.

[Note 1] By activating mini I/O all-general option, a special I/O input assignment of step stop signal is nullified, and the robot cannot be step-stopped by the I/O input.

[Note 2] By activating mini I/O all-general option, step stop wiring becomes not necessary. However, wirings for auto enable input and emergency stop input are still necessary even if the option is activated.

2.3.2. I/O treatment for controllers with I/O extension board

If a robot controller is configures with extension I/O board (parallel I/O, DeviceNet, CC-Link, PROFIBUS, etc.), please refer “Installation and maintenance guide” and “Options Manual – Part2: RC7M I/O extension

board", and turn on "Step stop (All tasks) signal" and "Instantaneous stop signal".

2.4. Robot controller's Executable Token

2.330

2.4.1. Basic knowledge concerning robot controller's Executable Token

It is necessary to set the executable token for turning ON/OFF the motor or starting the program from the ORiN application. (Refer to 2.2.1and 2.2.2). For the safety reason and to meet with "Single point of control" requirement, only the selected equipment can control a robot controller from the outside. Moreover, the robot controller becomes executable only in the external automatic mode as for turning ON/OFF the motor and starting the task from the ORiN application.

The executable token changes as shown in the following figures.

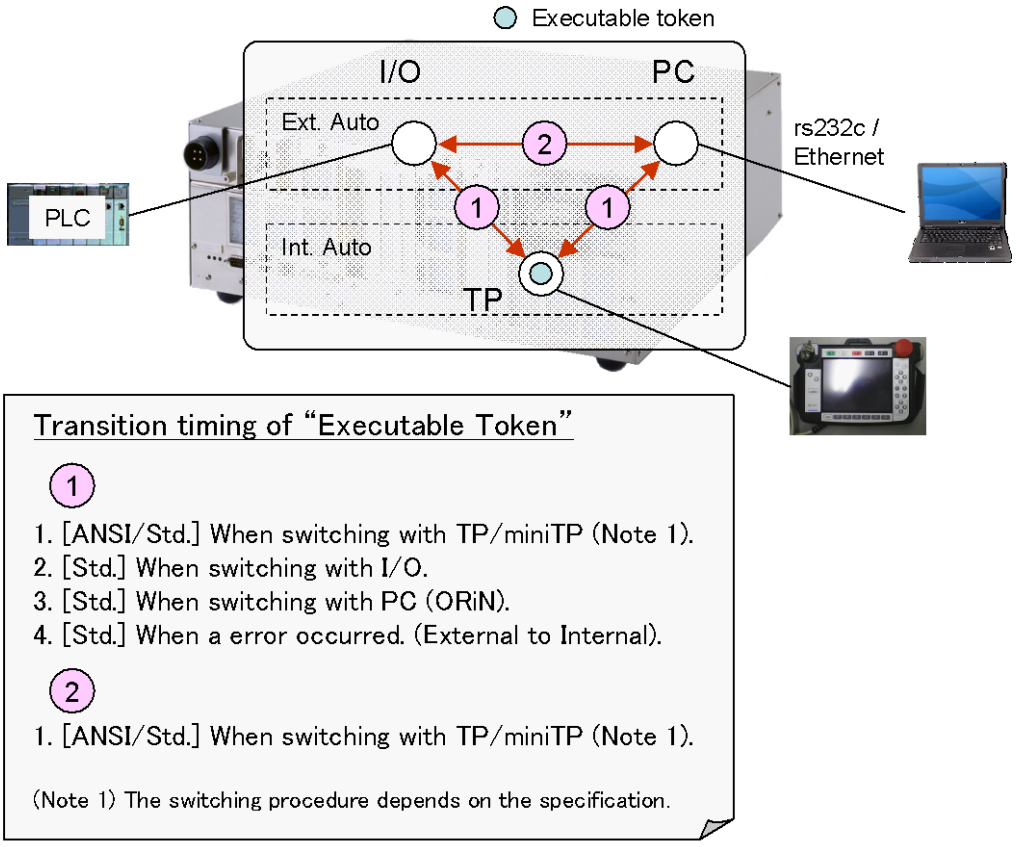


Figure 2-10 Transition of executable token

2.4.2. Notes in ANSI type robot controller

As previously stated, turning ON/OFF the motor and starting a program from the ORiN application is possible only if the controller is in the external automatic mode.

For the robot controller of the ANSI type, please note that you need to go to "I/O Auxiliary Function" – "single point of control" menu and select "External automatic operation" to change the robot controller to external automatic mode.

Following is the procedure to select external automatic mode in ANSI type controller. (Note: The ext button

on RobMaster does not work for ANSI type robot controllers.)

(4) Mode selection procedure using the teach pendant

After the following procedure is completed and robot is set to automatic mode, robot mode will be changed to the selected (internal or external) automatic mode.

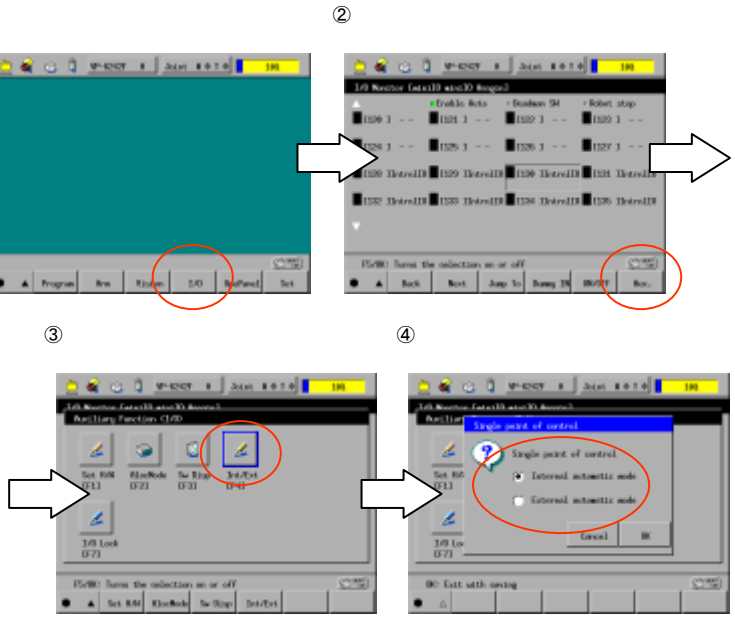


Figure 2-11 Internal/external automatic mode selection by teach pendant

(5) Mode selection procedure using the mini pendant

After the following procedure is completed and robot is set to automatic mode, robot mode will be changed to the selected (internal or external) automatic mode.

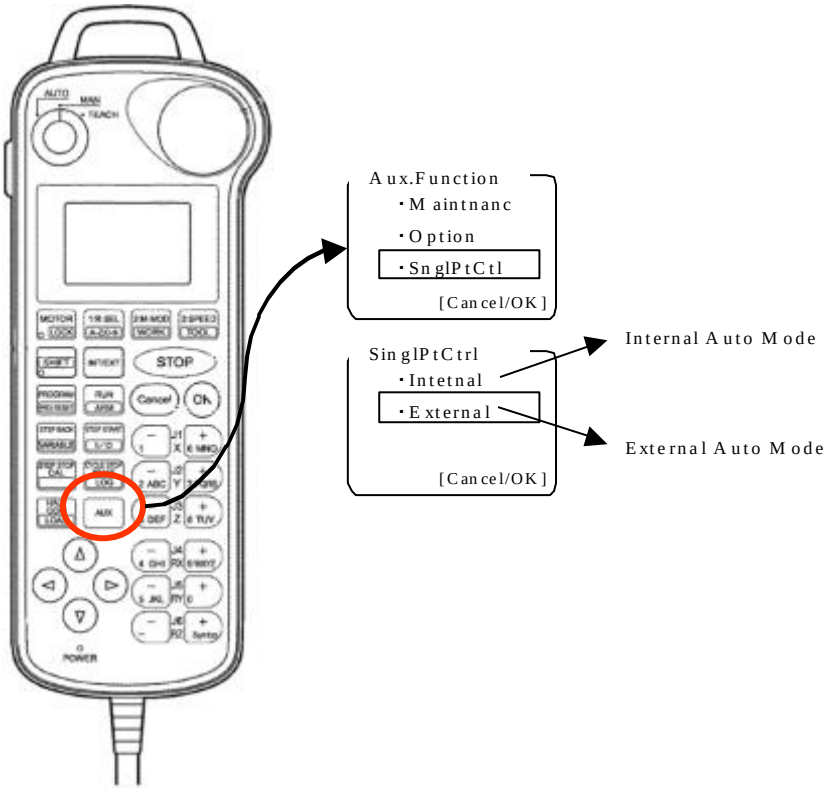


Figure 2-12 Internal/external automatic mode selection by mini pendant

2.5. Transferring PAC program

2.330

To execute robot motion commands (refer to Table 4-8) with NetwoRC provider, following PAC programs, RobSlave.pac, RobSlave.h and UserExtention.pac, need to be sent to the robot controller and need to be executed.

To transfer PAC program to a robot controller, Using RobMaster.exe tool included ORiN SDK.

Mini pendant (mini TP) or Teach pendant (TP) is necessary for these method.

RobMaster.exe[4] is a tool to show robot controller status and to control RobSlave task directly from PC, and the tool program is stored in NetwoRC provider installation folder.

<OriN2 installation folder>¥CAO¥ProviderLib¥DENSO¥NetwoRC¥Bin

Start RobMaster.exe and follow this procedure to setup the controller.

1. Start robot controller, and change to [manual] mode.
2. Start RobMaster.exe program.
   Start > All Programs > ORiN2 > CAO > ProviderLib > RobMaster
3. Press [Connect] button to connect the program to the robot controller.
4. Press [Setup] button of RobMaster.exe and follow the instructions to send necessary PAC programs to the robot controller.

2.6. Introduction of RobMaster

2.330

Bundled tool RobMaster is connected to a robot controller, and offers the following function.

1. Set up a robot controller to be used with ORiN.
2. Start and stop the controller's RobSlave task.
3. Turn on and off the motor power of the controller.
4. Display robot controller error status and clear error.
5. Display robot controller tatues.

Following is the introduction of RobMaster functions.

[4] <ORiN2 SDK install folder>¥CAO¥ProviderLib¥DENSO¥NetwoRC¥Bin¥RobMaster.exe

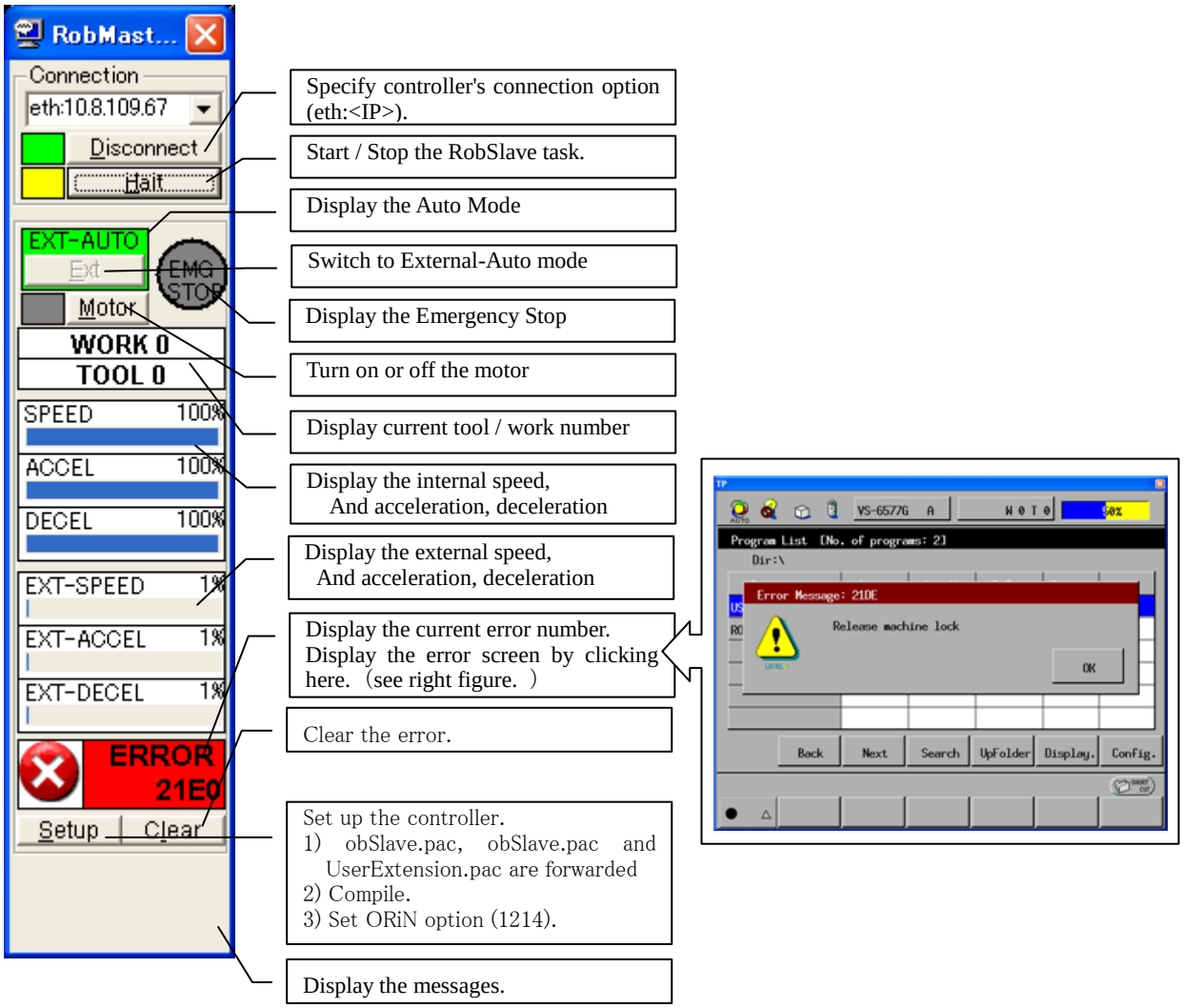


Figure 2-13 Function introduction of RobMaster

3. Programming with NetwoRC provider

3.1. Connection

To control robot with NetwoRC provider, communication between an ORiN installed PC and the robot controller should be established with RS232C or Ethernet. Some commands also require the robot controller setup. For details of setup, please refer chapter 2, and for details of commands, please refer chapter 4.

Figure 3-1 Robot connection

The developed program uses NetwoRC provider to communicate with the robot controller, by generating NetwoRC proprietary communication (RoboTALK) packet. An special program called RobSlave runs on the controller for handshaking and operating robot. For details please refer chapter 5.

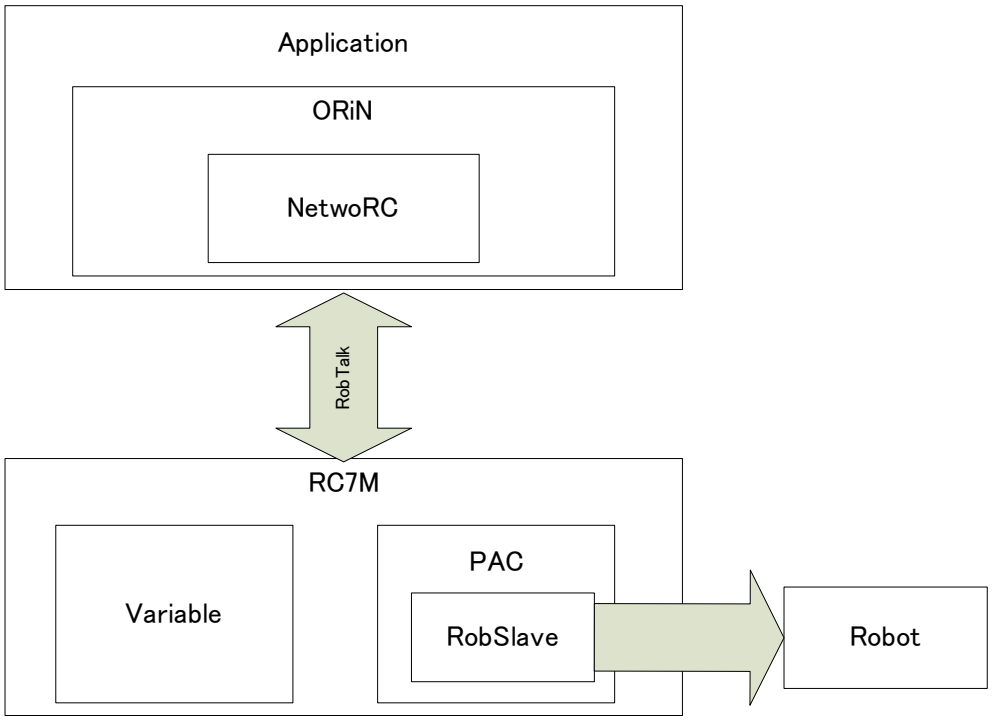


Figure 3-2 Outline of programing

NetwoRC provider establishes communication between the PC and the robot controller by the following procedure.

- Create CaoEngine
- Create CaoWorkspace
- Create CaoController

After the communication is established, variables in the controller will be access by creating CaoVariable object, and robot motions will be initiated by creating CaoRobot object. Examples in the following section explain the procedure of robot programming.

3.2. Variable Read/Write

Figure 3-3 shows the procedure to read and write variables.

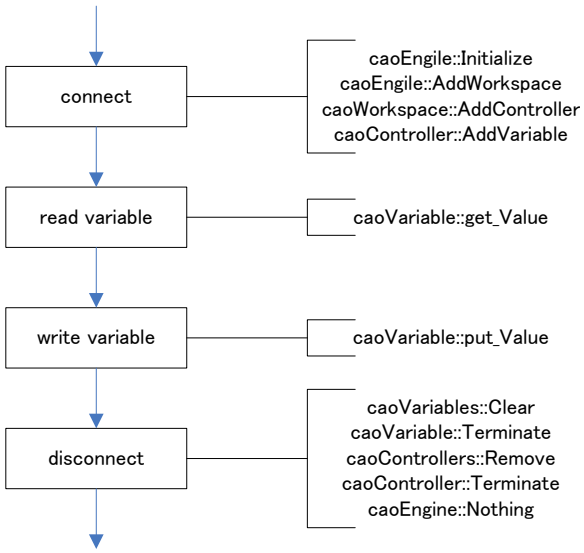


Figure 3-3 Read and write variable

3.2.1. Connection

Following is the procedure to establish connection to the robot controller.

(1) Create a variable to store object

CaoEngine object, CaoWorkspace object and CaoController object are required to establish communication to the robot controller. CaoWorkSpace need not prepare a variable if it is directory acquired from CaoWorkspaces. CaoVariable object is also necessary to access to variables. Following is a code example in VB6.

```
Dim g_eng as CaoEngine        ‘ CaoEngine object variable
Dim g_wrks as caoWorkspace    ‘ CaoWorkspace object variable
Dim g_ctrl as CaoController   ‘ CaoController object variable
Dim g_val as CaoVariable      ‘ CaoVariable object variable
```

(2) Create CaoEngine object

CaoEngine object is created with New keyword..

```
Set g_eng = New CaoEngine     ' CaoEngine object creation
```

(3) Acquire or create CaoWorkspace object

When created, CaoEngine object automatically creates one Caoworkspaces object and one Caoworkspace object. The next sample program uses the automatically created workspace. Following is a code example of creating new CaoWorkspace object.

```
g_wrks = g_ctrl.Addworkspace("NewWrks", "")
```

(4) Create CaoController object

To create a CaoController object, specify the provider name and its parameters. NetwoRC provider specifies destination controller IP address as an option. Following is an example code.

```
g_ctrl = g_wrks.AddController("RC", "CaoProv.DENSO.NetwoRC", "", "conn=eth:192.168.0.1")
```

(5) Create CaoVariable object

Create an object of CaoVariable for the accessed variable. Following is an example code of accessing the 10^{th} element of P type variable.

```
g_val = g_ctrl.AddVariable("P10", "")
```

3.2.2. Read/Write Variabl

To read and write the connected variable value, use Value property of CaoVariable object. To read and write value, another variable with the suitable type for the connected variable should be prepared. Following is an example code.

```
Dim vntPotision as Variant
vntPotision = g_val.Value                    ' Read value
g_val.Value = Array(50, 50, 50, 0, 0, 0, -1)    ' Write value
```

3.2.3. Disconnection

To disconnect from the controller, delete not only created object itself, but also delete the object from a collection class that manages the object. Following is an example code.

```
g_ctrl.Variables.Clear          ' Delete all objects from CaoVariables
Set g_val = Nothing             ' Delete CaoVariable
g_wrks.Controllers.Remove g_ctrl.Index  ' Delete CaoController from CaoControllers
Set g_ctrl = Nothing            ' Delete CaoCtonroller
g_eng.Workspaces.Remove g_wrks.Index ' Delete CaoWorkspace from CaoWorkspaces
Set g_wrks = Nothing            ' Delete CaoWorkspace
Set g_eng = Nothing             ' Delete CaoEngine
```

3.2.4. Sample program

Following is an example program written with VB6. IP and Port should be set to the value for the target controller. This sample program uses following value.

IP:192.168.0.1

Port:4112

List 3-1 Variable.frm

```
Dim g_eng As CaoEngine
Dim g_ctrl As CaoController
Dim g_val As CaoVariable

Private Sub Form_Load()
    Set g_eng = New CaoEngine

    ' connect RC : IP/Port setting depends on your RC setting.
    Set g_ctrl = g_eng.Workspaces(0).AddController("RC7", "caoProv.DENSO.NetwoRC", "",
"conn=eth:192.168.0.1:4112")

    ' variable name "IO150"
    Set g_val = g_ctrl.AddVariable("IO150", "")

End Sub

Private Sub Form_Unload(Cancel As Integer)
    ' destroy variable
    g_ctrl.Variables.Clear
    Set g_val = Nothing

    ' destroy contoroller
    g_eng.Workspaces(0).Controllers.Remove g_ctrl.Index
    Set g_ctrl = Nothing

    ' Destroy CaoEngine
    Set g_eng = Nothing
End Sub

Private Sub Command1_Click()
    ' read variable
    Text1.Text = g_val.Value
End Sub

Private Sub Command2_Click()
    ' write variable
    g_val.Value = Cbool(Text2.Text)
End Sub
```

3.3. Start and stop PAC program PAC

To start and stop PAC program, used the procedure described in Figure 3-4.The controller should be set to external auto mode to start PAC program. Also, the controller start right should be given to the IP address of the ORiN installed PC. For details, please refer chapter 2.4.

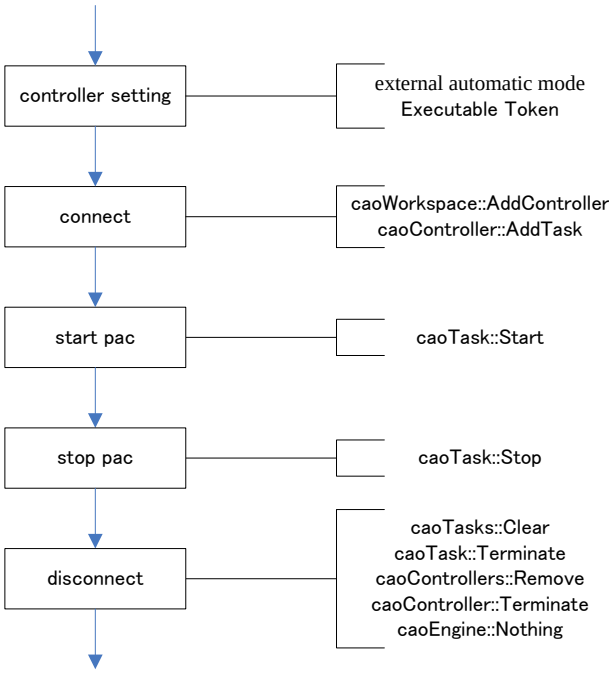


Figure 3-4 Start and stop pac program

3.3.1. Connection

Please refer 3.2.1 for the procedure of creating CaoController object. Create CaoTask object to start and stop PAC program. Following is an example code.

```
Dim g_task as CaoTask          ‘ A variable to store CaoTask
Set g_task = g_ctrl.AddTask(“PRO01”, “”)
```

3.3.2. Start/Stop PAC program

To start and stop PAC program, use Start method and Stop method of CaoTask object. Following is an example.

```
g_task.Start 2          ‘ Continuous execution
g_task.Stop  3          ‘ Cycle stop
```

3.3.3. Sample Program

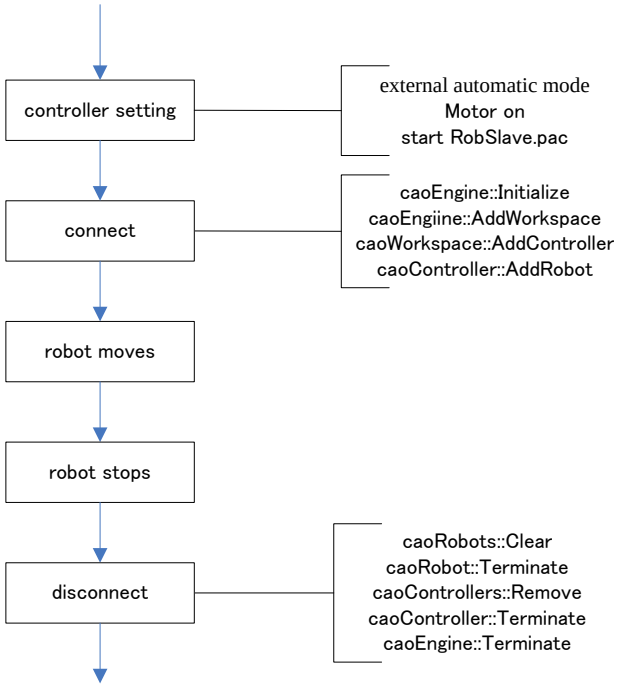
List 3-2 Task.frm

```
Dim g_eng As CaoEngine
Dim g_ctrl As CaoController
Dim g_task As CaoTask

Private Sub Command1_Click()
g_task.Start 2
End Sub
```

```
Private Sub Command2_Click()
    g_task.Stop 3
End Sub

Private Sub Form_Load()
    Set g_eng = New CaoEngine

    ' connect RC : IP/Port setting depends on your RC setting.
    Set g_ctrl = g_eng.Workspaces(0).AddController("RC7", "caoProv.DENSO.NetwoRC", "",
"conn=eth:192.168.0.1")

    ' Task Name "PRO1"
    Set g_task = g_ctrl.AddTask("PRO1", "")
End Sub

Private Sub Form_Unload(Cancel As Integer)
    g_ctrl.Tasks.Clear
    Set g_task = Nothing

    g_eng.Workspaces(0).Controllers.Remove g_ctrl.Index
    Set g_ctrl = Nothing

    Set g_eng = Nothing
End Sub
```

3.4. Robot motion

To move robot, the controller should be set auto mode and RobSlave program should be started on the contoller. For RobSlave, please refer to chapter 2.5. Motor power can be also controlledwith NetwoRC provider. For details, please refer to CaoTask:Execute motor command in 4.2.39.



3-5 Robot Moves

3.4.1. Connection

Please refer 3.2.1 for the procedure of creating CaoController object. To move robot, create CaoRobot object. Following is an example code.

```
Dim g_robot as CaoRobot        ‘  A variable to store CaoRobot object
Set g_ robot = g_ctrl.AddRobot(“Arm”, “”)
```

3.4.2. Move and stop robot

CaoRobot::Move method moves the robot. Please refer chapter 4.2.36. for the details of Move. By adding NEXT option to Move, CaoRobot:Halt method can stop the robot motion while it is moving.

List 3-3 Robot.frm

```
Dim g_eng As CaoEngine
Dim g_ctrl As CaoController
Dim g_robot As CaoRobot


‘ Stop Move
Private Sub Command2_Click()
    g_robot.Halt
End Sub

‘ Start Move
Private Sub Command1_Click()
    g_robot.Move 1, “@P P10”, “NEXT”
End Sub

Private Sub Form_Load()
    Set g_eng = New CaoEngine
    Set g_ctrl = g_eng.Workspaces(0).AddController(“RC7M”, “caoProv.DENSO.NetwoRC”, “”,
“conn=eth:10.6.235.60”)
    Set g_robot = g_ctrl.AddRobot(“Arm”)
End Sub

Private Sub Form_Unload(Cancel As Integer)
    g_ctrl.Robots.Clear
    Set g_robot = Nothing
    g_eng.Workspaces(0).Controllers.Remove g_ctrl.Index
    Set g_ctrl = Nothing
    Set g_eng = Nothing
End Sub
```

3.5. Another samples

Please refer to ORiN2¥CAO¥ProviderLib¥DENSO¥NetwoRC¥Sample and its subdirectories of ORiN2 SDK for other samples.

Table 3-1 Sample program list

Sample name	Division	Content
Variable	CaoVariable	Read/Write controller variable, I/O and CNF.
File	CaoFile	Read/Write file of controller.
Tree	CaoFile	Display folder list and get file in the controller.
Log	CaoFile	Get controller's error log and operation log.
Task	CaoTask	Display information and operate (start and stop) controller's task. [note] The task cannot start with RC5. 2.330
Robot	CaoRobot	Execute robot motion command, get robot current position, call user extension command. [note] RobSlave.pac, UserExtention.pac and RobSlave.h files stored at ORiN2¥CAO¥ProviderLib¥DENSO¥NetwoRC¥Bin are necessary. [note] Cannot use this with RC5. 2.330
Trans	CaoController CaoVariable CaoFile	Backup and restore Controller's all data.
Info	CaoController CaoVariable CaoRobot	Display information of controller.
Tracking	CaoRobot	Sample code for the Conveyer Tracking function. [note] Cannot use this with RC5. 2.330
SrvLog	CaoRobot	Single axis control log acquisition. [note] Cannot use Run and Motor command with RC5. 2.330

4. Outline of provider

4.1. List of method

Table 4-1 List of method

Category	Method/Property	Function	
caoWorkspace			
	Addcontroller	Connects communication to RC.	P. 34
caoController			
	AddCommand		P. 36
	AddFile	Connects to file or folder(PAC, system file).	P. 36
	AddRobot	Connects robot.	P. 37
	AddTask	Connects task.	P. 38
	AddVariable	Connects variable.	P. 38
	get_TaskNames	Get list of tasks.	P. 39
	get_VariableNames	Get list of variables.	P. 39
	Execute	Execute command of controller.	P. 39
	OnMessage	Event of OnMessage	P. 43
CaoCommand			
	Execute	Execute command.	P. 44
	get_Parameters	Get parameter of execution.	P. 44
	put_parammeters	Set parameter of execution.	P. 44
CaoFile			
	AddFile	Connect pac file or controller folder.	P. 44
	AddVariable	Connect system variable of files.	P. 45
	get_VariableNames	Get list of system variable name.	P. 45
	Copy	Copy file.	P. 45
	Delete	Delete file.	P. 45
	Move	Move file.	P. 45
	get_DateCreated	Get created date.	P. 45
	get_DateLastAccessed	Get accessed date.	P. 45
	get_DateLastModified	Get Modified date.	P. 45
	get_FileNames	Get list of files.	P. 45
	get_Attribute	Get attributes of file.	P. 45
	get_Path	Get path of file.	P. 46
	get_Size	Get size of file.	P. 46
	get_Type	Get extension of file.	P. 46
	get_Value	Get value of file.	P. 46
	put_Value	Set value of file.	P. 46
CaoRobot			

4.2. Method and Property

4.2.1. CaoWorkspace::AddController method

At AddController, NetwoRC provider refers communication connection parameters and connects communication.

Option specifies communication method, connection parameter and time-out time. Option and option are delimited by "," .

Syntax AddController(<bstrCtrlName:BSTR>,<bstrProvName:BSTR>,
<bstrPcName:BSTR > [,<bstrOption:BSTR>])

bstrCtrlName	:	[in]	Controller name
bstrProvName	:	[in]	Provider name (Fixed to "CaoProv.DENSO.NetwoRC")
bstrPcName	:	[in]	Provider execution machine name
bstrOption	:	[in]	Option character string = "<option1>, <option2>, …"

Following is a list of option string items.

Table 4-2 Option cstring of CaoWorkspace::AddController

Option	Explanation
Conn=< connected parameter >	Mandatory. Communication method and connection parameters are set. Refer 2.2.1.1 for details.
MyIP=[<local IP address>]:[local UDP port number]	Specify the IP address and UDP port number of the local machine. In case of multiple NICs, MyIP option is used to specify a NIC. If this option was omitted, the first NIC is selected automatically. If an invalid IP was set, an error occurs. If the UDP port number is not specified, the system assigns an appropriate port number automatically. In case of RS232c, this option is ignored.
Timeout =< Time-out time >	Communication time-out time. (default: 400) msec
TORetry=<Retry count>	Communication retry count. 1 – 7 (default:5) It is treated as 1 in case of 1 or less. It is treated as 7 in case of 7 or more.
CtrlChk=True/False	Connection check. (default: False)

In case of RS232C, only one CaoController object is creatable for one RS232C port.

4.2.1.1. Conn option

Following is communication parameter string for Comm option. Square blanket (“[]”) means the parameter can be omitted. Underline part shows the default value when the option is not specified.

- **RS232C device**

  “com:[<COM Port>[:<BaudRate>[:<Parity>:<DataBits>:<StopBits>]]]”

  <COM Port> : COM port number. ‘1’-COM1,‘2’-COM2,…
  <BaudRate> : Transmission rate. 4800,9600,19200,38400,57600,115200.
  <Parity> : Parity. ‘N’-NONE,‘E’-EVEN,‘O’-ODD.
  <DataBits> : Number of data bits. ‘7’-7bit,‘8’-8bit.
  <StopBits> : Number of stop bits. ‘1’-1bit,‘2’-2bit.

- **EtherNet device**

  “eth:<IP Address>[:<Port No>]”

  <IP Address> : Internet Protocol address.

Example:“127.0.0.1”,“192.168.0.1”

<Port No> : UDP connection port number. 4112,4113… any port number can be assigned.

4.2.2. CaoController::AddCommand method

The argument of the AddCommand method of the CaoController class specifies the command name (BSTR type).

4.2.3. CaoController::AddFile method

The argument of the AddFile method of the CaoController class specifies the file name (BSTR type). The specified “File name” is PAC program name or the system reserved file name.

An directory can be specified as an argument by designating only file path. If the path is not specified, files in the default directory “/rom/prj” are specified.

Following shows the argument specification of AddFile.

Syntax AddFile(<bstrName:BSTR > [,<bstrOption:BSTR>])

bstrName : [in] File name

bstrOption : [in] Option character string

The option uses the following character strings.

Table 4-3 Option character string of CaoController::AddFile

Option	Meaning
@Create[=<0 to 2>]	When the specified file does not exist, the file is created according to this option. 0:The file is not created. (default) 1:The file is made. 2:The directory is made. If the specified file exists, or the file name is the drive name, this option is ignored.

The table below shows the list of the file. Please refer to the file specification for a detailed format of the file.

Table 4-4 File implementation status list

	ORiN2 file name	Form	Explanation
1	*.PAC	text	PAC source
2	*.H	text	PAC header
3	*.NIC	bin	PAC execute form

4	*.MAP	text	Refer between PAC.
5	@VAR_INT	bin	I type variable
6	@VAR_SNG	bin	F type variable
7	@VAR_DBL	bin	D type variable
8	@VAR_VEC	bin	V type variable
9	@VAR_POS	bin	P type variable
10	@VAR_JNT	bin	J type variable
11	@VAR_TRN	bin	T type variable
12	@VAR_STR	bin	S type variable
13	@VAR_TOOL	bin	Tool coordinates definition
14	@VAR_WORK	bin	Work coordinates definition
15	@VAR_AREA	bin	Area definition
16	@LOG_ERROR	bin	Error log
17	@LOG_OPERATION	bin	Operation log
18	@LOG_CONTROL	bin	Control log
19	@CNF_ITP	bin	Interpreter environment setting
20	@CNF_PAC	bin	Program environment setting
21	@CNF_DIO	bin	I/O environment setting
22	@CNF_ARM	bin	Trajectory generation environment setting
23	@CNF_SRV	bin	Servo environment setting
24	@CNF_SPD	bin	Usage condition setting
25	@CNF_VIS	bin	Vision environment setting
26	@CNF_COM	bin	Communication environment setting

【 attention 】

CaoFile object does not support simultaneous access to a file.

Be sure to implement exclusive file access control routine in the application.

4.2.4. CaoController::AddRobot method

The argument of the AddRobot method of the CaoController class specifies the robot name (BSTR type). “Robot name” specified here is an arbitrary string. For instance, specify like AddRobot(“ROBOTalk1”). A CaoRobot object is retrieved by calling the AddRobot method.

Syntax AddRobot(<bstrName:BSTR > [,<bstrOption:BSTR>])

bstrName	:	[in]	Robot name
bstrOption	:	[in]	Option character string (unused)

4.2.5. CaoController::AddTask method

The argument of the AddTask method of the CaoController class specifies the task name (BSTR type). “Task name” specified here specifies a PAC program name. For instance, the CaoTask object is retreieved in the expression like AddTask(“pro1”).

Syntax AddTask(<bstrName:BSTR > [,<bstrOption:BSTR>])

bstrName	:	[in]	Task name
bstrOption	:	[in]	Option character string (unused)

If “@ALL” is specified as a task name, a created CaoTask object provides CaoTask::Start method and CaoTask::Stop method for the all tasks.

4.2.6. CaoController::AddVariable method

The AddVariable method of this CaoController class is a method for the access to the variable. In the NetwoRC provider, both the user variable and the system variable can be specified for the variable name.

User variable supports following variables, i.e., controller variable (I,F,V,P,J,D,T,S), I/O, and system parameter (CNF). Following is the argument specification of AddVariable.

Syntax AddVariable(<bstrName:BSTR > [,<bstrOption:BSTR>])

bstrName	:	[in]	Variable name
bstrOption	:	[in]	Option character string

<Variable identifier>	:	I, F, V, P, J, D, T, S, IO, TOOL, WORK, AREA, _ ITP, _ PAC, _ DIO, _ ARM, _ SRV, _ SPD, _ VIS,_ COM, WDIn, WDOut The character is not case-sensitive (uppercase and lowercase has same meaning). System variable (CNF) begins with “_” (underscore).
< number >	:	Variable index or ‘*’ or ‘*_<Index>’ The number is specified by a decimal number. In case of ‘*’, the initial index is 0. The index can be retrieved and changed by ‘ID’ property.
< option >	:	“LEN=<bit length>” (valid only for I/O variables) <bit length>: 1 or 8 or 16. (default = 1)

“[” and ”]” ca be omitted.

(example 1)	“i0”, “I[0]”	・・・	specify the 0^{th} I type variables.
(example 2)	“IO128”, “io[128]”	・・・	specify the 128^{th} I/O variables.
(example 3)	“_ARM0”, “_arm[0]”	・・・	specify the 0^{th} element of ARMCNF. (The number of elements of ???CNF is stored

				in ???CNF[0].)
(example 4)	"_itp19",	"_itp[19]"	・・・	specify the 19th element of ITPCNF.
(example 5)	"tool10", "tool[10]"		・・・	specify the 10th element of Tool.
(example 6)	"I*", "_PAC[*]"		・・・	specify the index by ID property.
(example 7)	"I*_1", "I*_2", "I*_3"		・・・	create various I*

Please note that the number of CNF variable (_ITP,_PAC,_DIO,_ARM,_SRV,_SPD,_VIS,_COM) is not as same as the number displayed on NetwoRC teach pendant. The value shifts because the 0th number of elements is not displayed in the pendant. (in many cases, CNF variable = pendant display +1)

When a system variable is specified, "@" is applied at the beginning of the variable name. All variable names without "@" at the beginning is treated as an user variable.

Please refer 4.3Variable list about the system variable implemented in the NetwoRC provider.

4.2.7. CaoController::get_TaskNames property[5]

A list of the PAC program name that can be specified by the AddTask method is acquired.

4.2.8. CaoController::get_VariableNames property

A list of the variable identifier and the system variable identifier that can be specified by the AddVariable method is acquired.

4.2.9. CaoController::Execute method

The argument of the Execute method of the CaoController class specifies the command name (BSTR type).

The list of the command that can be specified is shown in Table 4-5.

Syntax [<vntRet:VARIANT> =] Execute(<bstrCmd:BSTR > [,<vntParam:VARIANT>])

bstrCmd	:	[in]	Command
vntParam	:	[in]	Parameter
vntRet	:	[out]	Return value

Example

```
Dim vRes as Variant
vRes = caoCtrl.Execute("GetAutoMode")
```

[5] = VT_ARRAY|VT_VARIANT (less than Ver1.1.0, VT_ARRAY|VT_BSTR)

Table 4-5 CaoController::Execute method implemented command list

Command	Parameter	Return value	Operation
GetAutoMode	None	<Mode:VT_I2> = 0:Unkown 1:Internal auto 2:External auto	Get auto mode
PutAutoMode	<Mode:VT_I2> = 1:Internal auto 2:External auto	None	Set auto mode
StartLog	None	None	Start log recording
StopLog	None	None	Stop log recording
ClearLog	None	None	Clear log data
SaveFile	None	None	Request to save file
GetFileTransMode	None	<Mode :VT_I4> := File transfer mode 0= normal transfer 0bit: Old procedure 1bit: ROM operation 2bit: Status notification (with OnMessage event.)	Get file transfer mode
PutFileTransMode <Mode>	<Mode :VT_I4> = File transfer mode 0=normal transfer 0bit: Old procedure 1bit: ROM operation 2bit: Status notification (With OnMessage event.)	None	Set file transfer mode

ChangeConfig <CnfID>	<CnfID:VT_I2> = 1 : COMCNF 2 : ARMCNF 3 : VISCNF 4 : PACCNF 5 : SRVCNF 6 : SPDCNF 7 : ITPCNF 8 : DIOCNF 9 : SYSCNF	None	Change notice of CNF
SetDummyIO <IO> <Value> [<Range>]	<IO:VT_I2> = I/O number <Value:VT_I2> = State 0: OFF 1:ON [<Range:VT_I2>] = Range(default: 1.) ex. 1 -> Only < IO > 8 -> From < IO > To < IO>+7	None	Set pseudo input All setting is cleared when < IO>=-1 (<Value> is ignored. Range must be omitted or specify 1)
GetDummyIO <IO> <Value>	<IO:VT_I2> = I/O number	<Value:VT_I2> = State 0: OFF 1:ON	Get pseudo input
LoadNIC <WaitForCompletion>	< WaitForCompletion :VT_BOOL> = Wait load completion. (True/False)	None	Load NIC file.
DoSignal <Mode> <Action>	< Mode :VT_I4>= mode < Action :VT_I4>= action	None	Notify the timing of process start to controller
GetVarSize <Type>	<Type of variable:VT_BSTR> “I”,”F” ,”D”,”V”,”P”,”J”,”T”,”S”	<Size:VT_I4>	Get the variable number.
Compile	None	None	Execute the compilation. 2.330

GetCompileState	None	<Mode:VT_I4> := 1 : Compiling. （ or Loading） 0 : Normal termination -1 : Abnormal termination （ Compile error） -2 : Abnormal termination（ Excluding the compile error）	Get the progress report of the compilation. 2.330
SetExtension	<Mode:VT_I2>= 1:Add,2:Remove <Key:VT_I4>	None	Add or remove robot controller extension.
ClearError	<Error No.:VT_I4>	<Res:VT_I2>= 0:OK, -1:NG	Clear robot controller error.
InitNonStopPathLib[6]	None	None	Initializate non-stop trajectory generation process

[6] 【Attention】Additional license for "Non-Stop Motion Calculator" is required to use this Command.

GenerateNonStopPath[7]	<Teaching Points: <Position> | VT_ARRAY>, <Area: <Area> | VT_ARRAY>, <Teaching Point Number: VT_I4>, <Total speed rate: VT_R4(0.0～1.0)>, < Convergence Coefficient: VT_R4(0.0～1.0)>, [<Adjustment Method: VT_I4> = 1 : Synchronous motion with Extended-Joint(default), 0 : Asynchronous motion with Extended-Joint]	<Motion Points: <Position> | VT_ARRAY>	Generate non-stop trajectory. The first <Teaching Point> is Start Point, and the Last point is End Point. For detailed information, refer to "6.1.3.Appendix F.Non-Stop Motion Calculator - Trajectory Generator Command for Non Stop Inspection "

4.2.10. CaoController::OnMessage event

The table below shows the implemented OnMessage event of the CaoController class.

Table 4-6 OnMessage event implementation list

Number	Data type	Content of notification	Meaning
1	VT_BSTR	Error message	The error occurs.
2	VT_BSTR	Error message	There is no response.
3	VT_I4	<LONG:RangeMax>	GetText: Start Progress status notification starts. Maximun range is <RangeMax>. The bit2 of Execute("Put_FileTransMode <Mode>") need to be set as 1.
4	VT_I4	<LONG:Range>	GetText: Progressing and returns status. The bit2 of Execute("Put_FileTransMode <Mode>") need to be set as 1.

[7] 【Attention】Additional license for "Non-Stop Motion Calculator" is required to use this Command.

5	VT_I4	< LONG:RangeMax > or -1(error)	GetText: Completed. Returns maximum range size if normally finished. Returns –1 if NG. The bit2 of Execute("Put_FileTransMode <Mode>") need to be set as 1.
6	VT_I4	<LONG:RangeMax>	PutText: Start Progress status notification starts. Maximun range is <RangeMax>. The bit2 of Execute("Put_FileTransMode <Mode>") need to be set as 1.
7	VT_I4	<LONG:Range>	PutText: Progressing and returns status. The bit2 of Execute("Put_FileTransMode <Mode>") need to be set as 1.
8	VT_I4	<LONG:RangeMax> or -1(error)	PutText: Completed. Returns maximum range size if normally finished. Returns –1 if NG. The bit2 of Execute("Put_FileTransMode <Mode>") need to be set as 1.

4.2.11. CaoCommand::Execute method

A command is executed.

Please refer to Table 4-5 for necessary parameters for command execution and returned result.

Parameters necessary to execute command need to be specified by PutParameters property beforehand.

4.2.12. CaoCommand::get_Parameters property

Get currently set execution parameters.

4.2.13. CaoCommand::put_Parameters property

Set command execution parameters.

Required parameters differ depending on the command to be executed. Please refer Table 4-5 for command name and parameters to be set.

Even if the content of the parameter doesn't match the specification of executed command, this property doesn't return an error. The error is returned when the command is executed.

4.2.14. CaoFile::AddFile method

Create an file object like in the same way as 4.2.3. The file path corresponding to the created CaoFile object is "<path of the parent object>/<fine name specified in AddFile>".

4.2.15. CaoFile::AddVariable method

The argument of the AddVariable method of the CaoFile class specifies the system variable name.

Please refer Table 4-14 for the list of implemented system variables.

4.2.16. CaoFile::get_VariableNames property

A list of the variable identifier and the system variable identifier that can be specified by the AddVariable method is acquired.

4.2.17. CaoFile::Copy method

Copy a file corresponding to the object to the specified place.

4.2.18. CaoFile::Delete method

Delete a file corresponding to the object. After de deletion of the file, object is not deleted. If the object is not necessary, client program need to delete the object.

4.2.19. CaoFile::Move method

Move a file corresponding to the object The placement of the corresponding file is changed, but object name is not changed.

4.2.20. CaoFile::get_DateCreated property

Get the file creation date of the file corresponding to the object.

4.2.21. CaoFile::get_DateLastAccessed property

Get the last file access date of the file corresponding to the object.

4.2.22. CaoFile::get_DateLastModified property

Get the last file modification date of the file corresponding to the object.

4.2.23. CaoFile::get_FileNames property [8]

Get a list of file in the directory.

Only executable when the path corresponding to the object is a directory.

4.2.24. CaoFile::get_Attribute property

Get the attribute of the file corresponding to the object.

[8] = VT_ARRAY|VT_VARIANT (less than Ver1.1.0, VT_ARRAY|VT_BSTR)

4.2.25. CaoFile::get_Path property

Get the path to the file corresponding to the object. The retrieved value does not include file name.

4.2.26. CaoFile::get_Size property

Get the size of the file corresponding to the object.

4.2.27. CaoFile::get_Type property

Get the extension of the file corresponding to the object.

4.2.28. CaoFile::get_Value property

Get the contents of the file corresponding to the object.

4.2.29. CaoFile::put_Value property

Set the contents of the file corresponding to the object.

4.2.30. CaoRobot::Accelerate method

Set the internal acceleration and deceleration ratio of the robot.

This method corresponds to ACCEL instruction of PAC language.

Following is the argument specifications of Accelerate.

Syntax Accelerate <lAxis:LONG >, <fAccel:FLOAT> [,<fDecel:FLOAT>]

lAxis	:	[in]	Axis number -1: Tool accel (ACCEL), 0: All axes (JACCEL)
fAccel	:	[in]	Acceleration (-1: keep current setting)
fDecel	:	[in]	Deceleration (-1: keep current setting)

Example 1. Accelerate 0, 50.0, -1 // acceleration =50%, deceleration = no change.

Example 2 Accelerate 0, -1, 60.0 // acceleration = no change, deceleration =60%

4.2.31. CaoRobot::AddVariable method

The argument of the AddVariable method of the CaoRobot class specifies the system variable name.

The list of the implemented system variable is shown on Table 4-12.

4.2.32. CaoRobot::get_VariableNames property

A list of the variable identifier and the system variable identifier that can be specified by the AddVariable method is acquired.

4.2.33. CaoRobot::Halt method

By adding “NEXT” option to a CaoRobot class motion method like Move, Drive or Rotate, the motion

method are executed asynchronously. While a robot moves with an asynchronously executed motion method, Halt method can stop the robot motion.

However, if two or more asynchronous motion methods are executed in succession, halt method cannot stop robot motion. In this case, before the preceding motion method execution is finished, next motion method goes into "wait" status. In this status, OnMessage event of CaoController class is periodically issued, and Halt method is not accepted. To stop robot motion in this status, one of following action is necessary.

(6) Stop the execution of "ROBSLAVE" task using Stop method of CaoTask class

(7) Input robot stop signal from dedicated I/O port.

Executing Halt method while robot is not moving has no effect on robot motion.

4.2.34. CaoRobot::Change method

RobSlave 2.330

Change the tool / user coordinate system of robot.

This method corresponds to CHANGETOOL and the CHANGEWORK instruction of PAC language.

Following is the argument specifications of Change method.

Syntax Change <bstrName:BSTR>

bstrName	:	[in]	for CHANETOOL= "Tool <number>"
			for CHANGEWORK= "Work <number>"
<number>	:		numerical value expressed by decimal number

4.2.35. CaoRobot::Drive method

2.330

This method is not supported directly in this provider.

Instead, please use "DriveEx" or "DriveAEx" command of CaoRobot::Execute that can operate two or more axes all at once.

4.2.36. CaoRobot::Move method

RobSlave 2.330

Robot moves to the specified coordinates.

This method corresponds to MOVE instruction PAC language.

Following is the Move argument specifications.

Syntax Move <lComp:LONG >, <vntPose:POSEDATA>, < bstrOpt:BSTR>

lComp	:	[in]	Interpolation 1:MOVE P,… , 2:MOVE L,… , 3:MOVE C,… , 4:MOVE S,…
vntPose		[in]	Pose data
bstrOpt		[in]	Motion option, "NEXT" =Asynchronus call

Please refer to "6.1.3.Appendix APOSEDATA type definition" for the POSEDATA type..

The form and the meaning when the character string is specified by the POSEDATA type are as follows.

In case of VT_BSTR

・ If Comp = 1, 2

"[<@pass motion beginning displacement>] < pose > [<extended-joints>]"

ex. "P1", "@P T100", "@E J520"

・ If Comp = 3

"<pose 1> [<extended-joints>], [<@ pass motion beginning displacement>] <pose 2> [<extended-joints>]"

- *** pose 1 and pose 2 need to be same variable type. ***

ex. "P1, @E P2", "T100, @P T101"

・ If Comp = 4

"[<@pass motion beginning displacement>] <free curve trajectory number> [<extended-joints>]"

ex. "1", "@P 20", "@E 5"

<free curve trajectory number> : a decimal number (1 to 20)

<pose> : "<variable type><variable number>" or
"[<variable type>](<element1>,<element2>,…)"

: <variable type> : One character either 'P', 'T' or 'J'
<variable number> : a decimal number
<element n> : an element of variable either 'P', 'T' or 'J'

P(<x>,<y>,<z>,<rx>,<ry>,<rz>,<fig>)
J(<j1>,<j2>,<j3>,<j4>,<j5>,<j6>,<j7>,<j8>)
T(<x>,<y>,<z>,<ox>,<oy>,<oz>,<ax>,<ay>,<az>,<fig>)

[Note] For 4-axis robot, T element of P type variable corresponds to <rz>. <rx> and <ry> are not used.

<@pass motion beginning displacement> : "@0", "@P", "@E", or "@<*value*>"

<extended-joints> : The syntax of an exteded-joints option is shown below.[9].
(Please specify the extended-joints option after the pose data and

[9] To use extended joint option, please define extended joint related settings (e.g. arm group definition) on the controller, and use TakeArm command to select arm group for controlled extended joint.

blank.)

"EX((<JointNumber1>, <RelativeDistance1>)[, (<JointNumber2>, <RelativeDistance2>)…])"
or
"EXA((<JointNumber1>, <AxisCoordinates1>)[, (<JointNumber2>, <AxisCoordinates2>)…])"

Example 1.	Move 1, "@P P1" ,"NEXT"	' MOVE P, @P P1, NEXT
Example 2	Move 3, "P1,@E P2"	' MOVE C, P1,@E P2
Example 3	Move 2, "@0 P(307.1856,-157.8244,107.0714,160,0,0,1)"	' MOVE L,@0 P(307.1856,-157.8244,107.0714,160,0,0,1)
Example 4	Move 4, "@E 2"	' MOVE S, @E 2
Example 5	Move 1, "@P P10 EX((7, 30.5))" ,"NEXT"	' MOVE P, @P P10 EX((7,30.5)), NEXT
Example 6	Move 2, "@E P20 EXA((7, 30.8), (8, 90.5))	'MOVE L, @E P20 EXA((7, 30.8), (8, 90.5))"

If <NEXT option> is added, the robot proceeds to the next no-movement instruction without waiting for movement to finish.

When two or more Move method is executed consecutively, the latter motion method is in "wait" status until the preceding motion method execution ends, and application seems to be not responding. In this wait state, OnMessage event #9 of CaoController class is periodically issued, so catch the event and pass the program control to application program if necessary.

The following table shows the PAC MOVE command supported by Move method.

Table 4-7 Move command list

Division	PAC command	Move method
MOVE P,…	MOVE P, P<*n1*>	Move 1, "P<*n1*>"
	MOVE P, @P P<*n1*>	Move 1, "@P P<*n1*>"
	MOVE P, @E P<*n1*>	Move 1, "@E P<*n1*>"
	MOVE P, T<*n1*>	Move 1, "T<*n1*>"
	MOVE P, @P T<*n1*>	Move 1, "@P T<*n1*>"
	MOVE P, @E T<*n1*>	Move 1, "@E T<*n1*>"
	MOVE P, J<*n1*>	Move 1, "J<*n1*>"

	MOVE P, @P J<*n1*>	Move 1, "@P J<*n1*>"
	MOVE P, @E J<*n1*>	Move 1, "@E J<*n1*>"
MOVE L,…	MOVE L, P<*n1*>	Move 2, "P<*n1*>"
	MOVE L, @P P<*n1*>	Move 2, "@P P<*n1*>"
	MOVE L, @E P<*n1*>	Move 2, "@E P<*n1*>"
	MOVE L, T<*n1*>	Move 2, "T<*n1*>"
	MOVE L, @P T<*n1*>	Move 2, "@P T<*n1*>"
	MOVE L, @E T<*n1*>	Move 2, "@E T<*n1*>"
	MOVE L, J<*n1*>	Move 2, "J<*n1*>"
	MOVE L, @P J<*n1*>	Move 2, "@P J<*n1*>"
	MOVE L, @E J<*n1*>	Move 2, "@E J<*n1*>"
MOVE C,…	MOVE C, P<*n1*>, P<*n2*>	Move 3, "P<*n1*>, P<*n2*>"
	MOVE C, P<*n1*>, @P P<*n2*>	Move 3, "P<*n1*>, @P P<*n2*>"
	MOVE C, P<*n1*>, @E P<*n2*>	Move 3, "P<*n1*>, @E P<*n2*>"
	MOVE C, T<*n1*>, T<*n2*>	Move 3, "T<*n1*>, T<*n2*>"
	MOVE C, T<*n1*>, @P T<*n2*>	Move 3, "T<*n1*>, @P T<*n2*>"
	MOVE C, T<*n1*>, @E T<*n2*>	Move 3, "T<*n1*>, @E T<*n2*>"
	MOVE C, J<*n1*>, J<*n2*>	Move 3, "J<*n1*>, J<*n2*>"
	MOVE C, J<*n1*>, @P J<*n2*>	Move 3, "J<*n1*>, @P J<*n2*>"
	MOVE C, J<*n1*>, @E J<*n2*>	Move 3, "J<*n1*>, @E J<*n2*>"
MOVE S,…	MOVE S, *n1*	Move 4, "*n1*"
	MOVE S, @P *n1*	Move 4, "@P *n1*"
	MOVE S, @E *n1*	Move 4, "@E *n1*"
Extended-joints	MOVE P, P<*n1*> EX((*j1*, *v1*))	Move 1, "P<*n1*> EX((*j1*,*v1*))"
	MOVE P, P<*n1*> EX((*j1*, *v1*),(*j2*, *v2*))	Move 1, "P<*n1*> EX((*j1*,*v1*),(*j2*, *v2*))"
	MOVE P, P<*n1*> EXA((*j1*, *v1*))	Move 1, "P<*n1*> EXA((*j1*,*v1*))"
	MOVE P, P<*n1*> EXA((*j1*, *v1*),(*j2*, *v2*))	Move 1, "P<*n1*> EXA((*j1*,*v1*),(*j2*, *v2*))"
Misc.	MOVE P, P<*n1*> + (*x*,*y*,*z*,*rx*,*ry*,*rz*)	Move 1, DEV("P<*n1*>", "P(*x*,*y*,*z*,*rx*,*ry*,*rz*)")
	MOVE P, P<*n1*> + (*x*,*y*,*z*,*rx*,*ry*,*rz*)H	Move 1, DEVH("P<*n1*>", "P(*x*,*y*,*z*,*rx*,*ry*,*rz*)")
		*Please refer to CaoRobot::Execute for DEV and DEVH.

< n1 > ,< n2>: integer 0-65535

Please refer to the sample of CAO robot class robot motion command coding supplied with ORiN2 SDK, which is stored at ORiN2¥CAO¥ProviderLib¥DENSO¥NetwoRC¥Sample¥Robot.

【 essential requisites 】

At the current implementation, “RobSlave.pac” program need to be executed beforehand on the robot controller to execute robot motion command of CaoRobot class (Table 4-8). RobSlave.pac is in ORiN2¥CAO¥ProviderLib¥DENSO¥NetwoRC¥Bin.

Robot controller’s T[0], T[1], and I[0] variable are used for the communication. DO NOT use these variables for other purposes.

Table 4-8 Motion Commands requiring “RobSlave.pac”

Method	Command name
CcaoProvRobot::Accelerate	
CcaoProvRobot::Change	
CcaoProvRobot::Halt	
CcaoProvRobot::Move	
CcaoProvRobot::Rotate	
CcaoProvRobot::Speed	
CcaoProvRobot::Execute	Approach, Depart, Draw, Motor, ClrSplinePoint, SetSplinePoint, GetSplinePoint, WaitSplinePoint, WaitMotionEnd, MotionSkip, MotionComp, DefTool, DefWork, DefArea, Interrupt, PosClr, Arrive, RotateH, DriveEx, DriveAEx, Delay, SYSSTATE, J2P, J2T, P2J, P2T, T2J, T2P, TINV, NORMTRN,TMUL, DEV, DEVH, FIGAPRP, FIGAPRL, TrackDataInitialize, TrackDataSet, TrackDataGet, TrackDataInfo, TrackDataNum, CurTrackPos, CurTrackSpd, WaitTrackMove, CalcWorkPos, CurTrackPosEx, WaitTrackMoveEx, SetTrackMove, ResetTrackMove, SetTrackStartArea, UserExt, ST_*, TakeArm, GiveArm,

【 attention 】

All global variables (I, F, D, V, P, J, T, S) from [0] to [9] have been reserved with the system.

Please do not access these variables in the user’s program.

4.2.37. CaoRobot::Rotate method

RobSlave 2.330

Robot rotates around the specified axis.

This method corresponds to ROTATE instruction PAC language.

Following is the Rotate argument specifications.

Syntax Rotate <vntRotSuf:POSEDATA >, <fDeg:FLOAT>, <vntPivot:POSEDATA>, <bsreOpt:BSTR>

vntRotSuf	:	[in]	rotation surface
fDeg	:	[in]	angle(deg)
vntPivot	:	[in]	rotation center
bstrOpt		[in]	motion option
			motion option, “@0”, “@P”, “@E” , “@<*value*>”
			or “pose=<n>”
			or “NEXT”

Please refer to “6.1.3.Appendix APOSEDATA type definition” for the POSEDATA type..

The form and the meaning when the character string is specified by the POSEDATA type are as follows.

In case of VT_BSTR

・ vntRotSuf: [in] rotation surface

“V < n1 >, V < n2 >, V < n3 > “ or “XY”,”YZ”,”ZX”,“XYH”,”YZH”,”ZXH”

or “V(<*x*>,<*y*>,<*z*>),V(…),V(…)”

ex. “V100,V101,V102”

・ vntPivot: [in] rotation center

“V < n4 >” or “V(<*x*>,<*y*>,<*z*>)”

ex. “V103”

Example 1. Rotate “V1,V2,V3”, 45.8, “V4”, “@E” ‘ ROTATE V1,V2,V3, @E 45.8, V4

Example 2. Rotate “V(0,0,1),V(0,1,0),V(0,0,0)”, 30.0, “V(0,0,0)”, “@E,pose=1,NEXT”

Example 3. Rotate “XY”, 90.0, “V(0,0,0)”, “@P”

Example 4. Rotate “XYH”, -45.0, “V(250,0,0)”, “@150”

Rotation surface is specified by three V type variables. The three points in base coordinate system defines the surfaces. Argument vntRotSuf specifies three V type variables in BSTR (string) type variable separated by comma, space or tab.

Rotation center point vntPivot is specified by a V type variable expressed in BSTR(string) type.

4.2.38. CaoRobot::Speed method

RobSlave 2.330

The internal movement speed of the robot is specified.

This method corresponds to SPEED and JSPEED instruction PAC language.

About the external movement speed of the robot, please use “ExtSpeed” command of CaoRobot::Execute.

Following is the Speed argument specifications

Syntax Speed <lAxis:LONG >, <fSpeed:FLOAT>

lAxis	:	[in]	axis number -1:effective to Tool axis(SPEED), 0:effective to all axis(JSPEED)
fSpeed	:	[in]	speed

4.2.39. CaoRobot::Execute method

2.330

The Execute method defines peculiar operation commands to the robot that isn't supported by the CaoRobot class, and offers the function to implement them.

Syntax [<vntRet:VARIANT> =] Execute(<bstrCmd:BSTR > [,<vntParam:VARIANT>])

bstrCmd	:	[in]	Commad
vntParam	:	[in]	Parameter
vntRet	:	[out]	Return value

The list shows available commands.

Table 4-9 List of implemented Execute command of CaoRobot class10

Command	Parameter	Return value	PAC command
UserExt	<command number:VT_I4> , <parameter 1:VT_R4>…	VT_R4 | VT_ARRAY	Execute extension method.
GetJntData	<data number:VT_I4>,<axis number:VT_I2>	VT_R4	GetJntData Gets the internal servo data of a specified joint.
GetSrvData	<data number:VT_I4>	VT_R4 | VT_ARRAY	GetSrvData Gets the internal servo data of robot joints.

[10] Please refer to "6.1.3.Appendix APOSEDATA type definition" for the POSEDATA type.

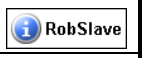
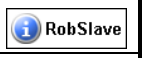
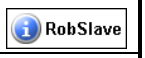
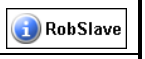
Approach	< Interpolation method:VT_I2 (=1:P, 2:L) > < base variable :POSEDATA-C0> < [pass] approach length : POSEDATA-C2> [,option :VT_BSTR "NEXT"]	None	APPROACH <Interpolation method>, <pose variable type><pose variable number>, <pass> <approach length>[, NEXT] Execute the absolute movement designated in the tool coordinate system. RobSlave
Depart	< Interpolation method:VT_I2 (=1:P, 2:L) > < [pass] approach length : POSEDATA-C2 > [,option :VT_BSTR "NEXT"]	None	DEPART <Interpolation method >, <pass> <approach length>[, NEXT] Executes the relative motion in the tool coordinate system. RobSlave
ExtSpeed	<external speed:VT_R4 (=0.1 to 100.0)> , <external acceleration:VT_R4 (=0.0001 to 100.0)>, < external deceleration:VT_R4 (=0.0001 to 100.0)>	None	ExtSpeed,ExtAcc,ExtDec Sets the external speed.
SetSplinePoint	<Free curve trajectory number:VT_I2(=1 to 20)>, <Viapoint : POSEDATA-C0(P,J) >	None	SETSPLINEPOINT <Free curve trajectory number> <Viapoint> Registers viapoints in the free curve motion. RobSlave
GetSplinePoint	<Free curve trajectory number:VT_I2>, <Viapoint number:VT_I4>	<P type : VT_R4|VT_ARRAY>	<Approach (P) point> = GETSPLINEPOINT (<Free curve trajectory number>, <Viapoint number>) Gets the viapoints for a registered free curve motion. RobSlave

ClrSplinePoint	<Free curve trajectory number:VT_I2 (=0 to 20)>	None	CLRSPLINEPOINT <Free curve trajectory number> Clears all viapoints for free curvemotion. RobSlave
WaitSplinePoint	<Viapoint number:VT_I4>, <Waiting condition:VT_I2 (=0: command value, Not 0: encoder value)>	None	xdWAITSPLINE <Viapoint number>, <Waiting condition> Waits for the free curve to pass the designated viapoint. RobSlave
WaitMotionEnd	None	None	Wait for robot motion end RobSlave
MotionSkip	None	None	MotionSkip Aborts running motion commands. RobSlave
MotionComp	None	VT_I2 0:running/1:done	MotionComp Judges whether execution of running motion commands is complete. RobSlave
Motor	VT_I2 1:ON/0:OFF	None	Motor ON/OFF RobSlave
DefTool	<no:VT_I2>,<P type: POSEDATA-C0>	None	For define tool in auto mode. RobSlave
DefWork	<no:VT_I2>,<P type: POSEDATA-C0> [,<0:Normal/1:Fixed>]	None	For define work in auto mode. RobSlave
DefArea	<no:VT_I2>, ,<P type: POSEDATA-C0>, ,<V type: POSEDATA-C1>, <io:VT_I4>,<pos:VT_I4>,<err:VT_I4>,<enable:VT_I2(0,1)>	None	For define area in auto mode. RobSlave

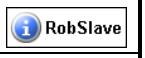
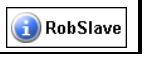
Draw	< Interpolation method:VT_I2 (=1:P, 2:L) > < [pass] vector : POSEDATA-C1> [,option :VT_BSTR "NEXT"]	None	DRAW <Interpolation method >, <pass> (<x>,<y>,<z>)[, NEXT] Executes the relative movement designated in the work coordinate system. RobSlave
DriveAEx	< [pass] (<Axis1 number >, <Axis1 coordinate>):POSEDATA-C3>, [(<Axis2 number>, <Axis2 coordinate>), … [(<Axis8 number>, <Axis8 coordinate>)]] [,option :VT_BSTR "NEXT"]	None	DRIVEA <Pass start displacement> (<Axis1 number>, <Axis1 Coordinate>), (<Axis2 number>, <Axis2 Coordinate>),…(<Axis8 number>, <Axis8 Coordinate>) [,NEXT] Executes the absolute motion of each axis. RobSlave
DriveEx	< [pass] (<Axis1 number >, <Axis1 coordinate>):POSEDATA-C3>, [(<Axis2 number>, <Axis2 coordinate>), … [(<Axis8 number>, <Axis8 coordinate>)]] [,option :VT_BSTR "NEXT"]	None	DRIVE <Pass start displacement> (<Axis1 number>, <Axis1 Coordinate>), (<Axis2 number>, <Axis2 Coordinate>),…(<Axis8 number>, <Axis8 Coordinate>) [,NEXT] Executes the relative motion of each axis. RobSlave

RotateH	< [pass] <Relative rotation angle around approach vector>:POSEDATA-C2>, [,option :VT_BSTR “NEXT”]	None	ROTATEH <Pass start displacement> <Relative rotation angle around approach vector> [,NEXT] Executes rotary motion by taking an approach vector as an axis. RobSlave
Arrive	<Motionratio:VT_R4>	None	ARRIVE <Motionratio> Defines the motion ratio relative to the programmed full travel distance to the target point in order to make the current program stand by to execute the next step until the robot reaches the defined motion ratio. RobSlave
PosClr	<JntNumber:VT_I2>	None	POSCLR <JntNumber> Forcibly restores the current position of a joint to 0 mm or 0 degree. RobSlave
Interrupt	<VT_I2:0:OFF 1:ON>	None	INTERRUPT ON/OFF Interrupts a robot motion. RobSlave
ST_aspACLD	<Mass of payload:VT_R4>, <Payload center of gravity coordinate X :VT_R4>, <Payload center of gravity coordinate Y:VT_R4>, <Payload center of gravity coordinate Z:VT_R4>	None	ST_aspACLD Changes the internal load condition values. RobSlave

ST_aspChange	<Mode:VT_I2>	None	ST_aspChange Selects the internal mode for proper control setting of motion optimization. RobSlave
ST_SetGravity	None	None	ST_SetGravity Compensates for the static load (gravity torque) applied to each joint and attains balance with gravity torque. RobSlave
ST_ResetGravity	None	None	ST_ResetGravity Disables the balance setting between the limited motor torque and gravity torque, which is made with ST_SetGravity. RobSlave
ST_SetGrvOffset	None	None	ST_SetGrvOffset Compensates the torque of each joint programmed with ST_SetGravity for gravity torque. RobSlave
ST_ResetGrvOffset	None	None	ST_ResetGrvOffset Disables the gravity offset function. RobSlave
ST_SetCurLmt	<AxisNumber:VT_I2>, <Value:VT_R4>	None	ST_SetCurLmt Sets the limit of motor current to be applied to the specified axis. RobSlave

ST_ResetCurLmt	<AxisNumber:VT_I2>	None	ST_ResetCurLmt Resets the motor current limit of the specified axis. 
ST_SetEralw	<AxisNumber:VT_I2>, <Value:VT_R4>	None	ST_SetEralw Modifies the allowable deviation of the specified axis. 
ST_ResetEralw	<AxisNumber:VT_I2>	None	ST_ResetEralw Resets the allowable deviation value of the specified axis to the initial value. 
ST_OnSrvLock	<specified axis:VT_I2>	None	ST_OnSrvLock Servo-locks a specified axis (exclusively designed for four-axis robots). 
ST_OffSrvLock	<specified axis:VT_I2>	None	ST_OffSrvLock Releases servo lock for the specified axis (exclusively designed for four-axis robots). 
ST_SetCompControl	None	None	ST_SetCompControl Enables the compliance function (exclusively designed for 6-axis robots). 
ST_SetCompFControl	None	None	ST_SetCompFControl Enables the compliance control function (exclusively designed for 6-axis robots). 

ST_ResetCompControl	None	None	ST_ResetCompControl Disables the compliance control function (exclusively designed for 6-axis robots). RobSlave
ST_SetFrcCoord	<Set value:VT_R4>	None	ST_SetFrcCoord Selects a force limiting coordinate system (exclusively designed for 6-axis robots). RobSlave
ST_SetFrcLimit	<Limiting rate along X:VT_R4>, <Limiting rate along Y:VT_R4>, <Limiting rate along Z:VT_R4>, <Limiting rate about X:VT_R4>, <Limiting rate about Y:VT_R4>, <Limiting rate about Z:VT_R4>	None	ST_SetFrcLimit Sets the force limiting rates (exclusively designed for 6-axis robots). RobSlave
ST_ResetFrcLimit	None	None	ST_ResetFrcLimit Initializes the force limiting rates (exclusively designed for 6-axis robots). RobSlave
ST_SetCompRate	<Compliance along X:VT_R4>, <Compliance along Y:VT_R4>, <Compliance along Z:VT_R4>, <Compliance about X:VT_R4>, <Compliance about Y:VT_R4>, <Compliance about Z:VT_R4>	None	ST_SetCompRate Sets the compliance rates under the compliance control (exclusively designed for 6-axis robots). RobSlave
ST_ResetCompRate	None	None	ST_ResetCompRate Initializes the compliance rates (exclusively designed for 6-axis robots). RobSlave

ST_SetFrcAssist	<Force assistance along X:VT_R4>, <Force assistance along Y:VT_R4>, <Force assistance along Z:VT_R4>, <Moment assistance about X:VT_R4>, <Moment assistance about Y:VT_R4>, <Moment assistance about Z:VT_R4>	None	ST_SetFrcAssist Sets the force assistance under the compliance control (special compliance control function statement) (exclusively designed for 6-axis robots). 
ST_ResetFrcAssist	None	None	ST_ResetFrcAssist Initializes the force assistance (special compliance control function statement) (exclusively designed for 6-axis robots). 
ST_SetCompJLimit	<J1 current limit :VT_R4>, <J2 current limit :VT_R4>, <J3 current limit :VT_R4>, <J4 current limit :VT_R4>, <J5 current limit :VT_R4>, <J6 current limit :VT_R4>	None	ST_SetCompJLimit Sets the current limit under the compliance control (special compliance control function statement) (exclusively designed for 6-axis robots). 
ST_ResetCompJLimit	None	None	ST_ResetCompJLimit aInitializes the current limit under the compliance control (special compliance control function statement) (exclusively designed for 6-axis robots). 

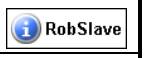
ST_SetCompVMode	None	None	ST_SetCompVMode Sets the velocity control mode under the compliance control (special compliance control function statement) (exclusively designed for 6-axis robots). RobSlave
ST_ResetCompVMode	None	None	ST_ResetCompVMode Disables the velocity control mode under the compliance control (special compliance control function statement) (exclusively designed for 6-axis robots). RobSlave
ST_SetCompEralw	<Allowable deviation X :VT_R4>, <Allowable deviation Y :VT_R4>, <Allowable deviation Z :VT_R4>, <Allowable deviation X :VT_R4>, <Allowable deviation Y :VT_R4>, <Allowable deviation Z :VT_R4>	None	ST_SetCompEralw Sets the allowable deviation values of the position and the posture of the tool tip under the compliance control (exclusively designed for 6-axis robots). RobSlave
ST_ResetCompEralw	None	None	ST_ResetCompEralw Initializes the allowable deviation values of the position and the posture of the tool end under the compliance control (exclusively designed for 6-axis robots). RobSlave

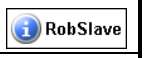
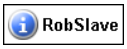
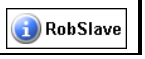
ST_SetDampRate	<DampRate along X:VT_R4>, <DampRate along Y:VT_R4>, <DampRate along Z:VT_R4>, <DampRate about X:VT_R4>, <DampRate about Y:VT_R4>, <DampRate about Z:VT_R4>	None	ST_SetDampRate Sets the damping rates under the compliance control (exclusively designed for 6-axis robots). RobSlave
ST_ResetDampRate	None	None	ST_ResetDampRate Initializes the damping rates under the compliance control (exclusively designed for 6-axis robots). RobSlave
ST_SetZBalance	None	None	ST_SetZBalance Sets the gravity compensation value of the Z and T axes (exclusively designed for 4-axis robots). RobSlave
ST_ResetZBalance	None	None	ST_ResetZBalance Disables the gravity compensation function (exclusively designed for 4-axis robots). RobSlave
DELAY	<value:VT_I2>	None	Msec Suspends program processing for a designated period time. RobSlave
SYSSTATE	None	None	SYSSTATE Gets the system status of the robot controller. RobSlave

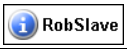
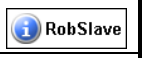
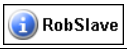
J2P	<J type:POSEDATA-C0>	<P type: VT_R4|VT_ARRAY>	J2P Transforms joint type data to position type data. RobSlave
J2T	<J type:POSEDATA-C0>	<T type : VT_R4|VT_ARRAY>	J2T Transforms joint type data to homogeneous transformation type data. RobSlave
P2J	<P type:POSEDATA-C0>	<J type: VT_R4|VT_ARRAY>	P2J Transforms position type data to joint type data. RobSlave
P2T	<P type:POSEDATA-C0>	<T type : VT_R4|VT_ARRAY>	P2T Transforms position type data to homogeneous transformation type data. RobSlave
T2J	<T type:POSEDATA-C0>	<J type: VT_R4|VT_ARRAY>	T2J Transforms homogeneous transformation type data to joint type data. RobSlave
T2P	<T type:POSEDATA-C0>	<P type: VT_R4|VT_ARRAY>	T2P Transforms homogeneous transformation type data to position type data. RobSlave
TINV	<T type:POSEDATA-C0>	<T type : VT_R4|VT_ARRAY>	TINV Calculates an inverse matrix of homogeneous transformation type data. RobSlave

NORMTRN	<T type:POSEDATA-C0>	<T type :VT_R4|VT_ARRAY>	NORMTRN Normalizes homogeneous-transformation data.
TMUL	<T type n1 :POSEDATA-C0>, <T type n2 :POSEDATA-C0>	<T type : VT_R4|VT_ARRAY>	=T<n1> * T<n2> Matrix operation for transformation type data. RobSlave

DEVH	<P type n1:POSEDATA-C0>,
	<P type n2:POSEDATA-C0>
		<P type:
		VT_R4|VT_ARRAY>
			Calculates destination coordinates based on tool coordinates.
			
			If n1>1 then
			=P<n1> + (P<n2>.x,
			P<n2>.y, P<n2>.z,
			P<n2>.rx, P<n2>.ry,
			P<n2>.rz)H
			
			If n1=0 then
			=DESTPOS + (P<n2>.x,
			P<n2>.y, P<n2>.z,
			P<n2>.rx, P<n2>.ry,
			P<n2>.rz)H
			
			If n1=-1 then
			=CURPOS + (P<n2>.x,
			P<n2>.y, P<n2>.z,
			P<n2>.rx, P<n2>.ry,
			P<n2>.rz)H
			RobSlave

DEV	<P type n1:POSEDATA-C0>,
	<P type n2:POSEDATA-C0>
		<P type:
		VT_R4|VT_ARRAY>
			Calculates destination coordinates based on base coordinates.
			
			If n1>1 then
			=P<n1> + (P<n2>.x,
			P<n2>.y, P<n2>.z,
			P<n2>.rx, P<n2>.ry,
			P<n2>.rz)
			
			If n1=0 then
			=DESTPOS + (P<n2>.x,
			P<n2>.y, P<n2>.z,
			P<n2>.rx, P<n2>.ry,
			P<n2>.rz)
			
			If n1=-1 then
			=CURPOS + (P<n2>.x,
			P<n2>.y, P<n2>.z,
			P<n2>.rx, P<n2>.ry,
			P<n2>.rz)
			 

TrackDataInitialize	<Initialization mode:VT_I2>	None	TRACKDATAINITIALIZE Initializes data within the conveyer tracking data buffer. 
TrackDataSet	<conveyer_number:VT_I2>,<number_of_recognized_workpieces:VT_I2>,<recognized_workpiece_position:POSEDATA-C0>	None	TRACKDATASET Saves data in the conveyer tracking buffer. 
TrackDataGet	<conveyer_number:VT_I2>,<data_number:VT_I2>	<number_of_remaining_data_items:VT_I2>, <recognized_workpiece_position: VT_R4|VT_ARRAY >	TRACKDATAGET Obtains data from the conveyer tracking buffer. 

TrackDataInfo	<conveyer_number:VT_I2>,<data_number:VT_I2>	<encoder_value_at_recognition:VT_I4>,<availability:VT_I2>,<recognized_workpiece_position:VT_R4|VT_ARRAY >	TRACKDATAINFO Obtains information within the conveyer tracking buffer. 
TrackDataNum	<conveyer_number:VT_I2>	<number_of_saved_data_items:VT_I2>	TRACKDATANUM Obtains the number of data items retained with TRACKDATASET. 
CurTrackPos	<conveyer_number:VT_I2>,<recognized_workpiece_position Ptype:POSEDATA-C0>,<mode:VT_I2>	<position:VT_R4|VT_ARRAY >	CURTRACKPOS Obtains the position of the workpiece subject to tracking as a P type. 
CurTrackPosEx	<conveyer_number:VT_I2>,<recognized_workpiece_position Ptype:POSEDATA-C0>,<mode:VT_I2>	<position:VT_R4|VT_ARRAY >	CURTRACKPOSEX Obtains a tracking-target workpiece position in the P-type form. 
WaitTrackMove	<conveyer_number:VT_I2>,<recognized_workpiece_position Ptype:POSEDATA-C0>,<timeout:VT_I2>	None	WAITTRACKMOVE Waits for tracking-target workpiece to enter into a tracking start area. 
WaitTrackMoveEx	<conveyer_number:VT_I2>,<recognized_workpiece_position Ptype:POSEDATA-C0>,<timeout:VT_I2>	<error_information:VT_I2>	WAITTRACKMOVEEX Waits for tracking-target workpiece to enter into a tracking start area. 
CurTrackSpd	<conveyer_number:VT_I2>	<conveyer_speed:VT_R4>	CURTRACKSPD Obtains the speed of the conveyer specified in <conveyer_number>. 

CalcWorkPos	<conveyer_number:VT_I2>,<workpiece_position_at_recognitin Ptype:POSEDATA-C0>,<encode_value_at_recognition:VT_I4>	<position: VT_R4|VT_ARRAY >	CALCWORKPOS Obtains the current position of the specified workpiece. RobSlave
SetTrackMove	<conveyer_number:VT_I2>	None	SETTRACKMOVE Starts the tracking operation for the specified conveyer. RobSlave
ResetTrackMove	None	None	RESETTRACKMOVE Switches from the tracking operation mode to the normal operation mode. RobSlave
SetTrackStartArea	<conveyer_number:VT_I2>,<conveyer_upstream_(-)side_tracking_start_position:VT_I2>,<conveyer_downstream_(+)side_tracking_start_position:VT_I2>	None	SETTRACKSTARTAREA Sets the tracking start range at the time of WAITTRACKMOVE. RobSlave
ClearSrvLog	None	None	Clearness of single axis control log ＝PAC:ClearSrvMonitor
StartSrvLog	None	None	Beginning of single axis control log =PAC:StartSrvMonitor
StopSrvLog	None	None	End of single axis control log =PAC:StopSrvMonitor
SetSrvLogCond	<Axis number : VT_I2>,<Data number 1 : VT_I2>,<Data number 2 : VT_I2>,<Sampling rate : VT_I2>	None	Condition setting of single axis control log =PAC:SetMonitorCond

GetSrvLogCond	None	<Axis number : VT_I2>,<Data number 1:VT_I2>,<Data number 2 : VT_I2>,<Sampling rate : VT_I2>,<Sampling counts:VT_I2>	Condition acquisition of single axis control log
GetSrvLog	None	<Servo data (Two dimension array):VT_R4 | VT_ARRAY>	Acquisition of single axis control log
TakeArm	<Arm group : VT_I4> [, <Keep option:VT_I4>]	None	TakeArm <Keep option>:= 0(default): 0: The tool coordinate and the work coordinate are returned to the origin, and the internal speed, the internal acceleration, and the internal deceleration are set to 100. 1: The tool coordinate, the work coordinate, the internal speed, the internal acceleration, and the internal deceleration are maintained to their current setting. Obtains visual process priority. RobSlave
GiveArm	None	None	GiveArm Releases robot control priority. RobSlave
SetHighPathAccuracy	None	None	High path accuracy mode ON
ResetHighPathAccuracy	None	None	High path accuracy mode OFF

SetSingularAvoid	<Mode：VT_I2 = 0:OFF, 1:ON>	None	Singular-point avoidance mode ON/OFF <Mode> = 0:OFF, 1:ON
FigAprp	<Reference position : POSEDATA-C0 (P type only)> , <Approach length : VT_R4>	<Fig:VT_I2>	FIGAPRP Calculates figures at an approach position and a standard position available to move in PTP motion. RobSlave
FigAprl	<Reference position : POSEDATA-C0 (P type only)> , <Approach length : VT_R4>	<Fig:VT_I2>	FIGAPRL Calculates figures at an approach position and a standard position available to move in CP motion. RobSlave
GetCollisionForce	None	<Max value: VT_R4|VT_ARRAY>	Get a maximum external force value.
ClearCollisionForce	None	None	Clear a maximum external force value.
ResetCollisionJnt	<Axis No: VT_I2>	None	Disable collision detection for the specified axis
SetCollisionJnt	<Axis No: VT_I2>	None	Enable collision detection for the specified axis.
SetCollisionLevel	<Axis No: VT_I2>, <Detection Level: VT_I4(1 ～ 500)>	None	Set collision detection level.
SetExtForceDetect	<Enable: VT_I2(0/1)>	None	Enable/Disable collision detection.
RPM	<Axis No: VT_I2>, <RPM value: VT_R4>	<SPEED value (%): VT_R4>	Convert the rotation speed of the specified joint, which is specified in rpm, to the percentage (%) of the maximum internal speed in PTP motion.

MPS	<MPS value: VT_R4>	<SPEED value (%): VT_R4>	Convert the speed value specified in mm/sec to the percentage (%) of the maximum internal speed in CP motion.

The argument of the Execute method of the CaoRobot class specifies command number + parameter by the VARIANT array.

Example:

```
Dim vRes as Variant
vRes=caoRobot.Execute("GetJntData",Array(1,6))  ' 6th joint motor current speed[rpm]
caoRobot.Execute("ExtSpeed",Array(50.0, 25.0, 25.0 ) )
'external speed =50%, acceleration =25%, deceleration =25%
caoRobot.Execute "APPROACH", Array(1, "P11", "@P 100", "NEXT")
'APPROACH P,P11,@P 100, NEXT
```

The user can enhance an original command by defining an additional command in the UserExtention program of the UserExtention.pac file, and describing the execution code corresponding to it. Following is an concrete code example when GETSRVDATA and the GETJNTDATA command are added

1. UserExtention.pac and RobSlave.h are acquired.

Refer to ORiN2¥CAO¥ProviderLib¥DENSO¥NetwoRC¥Bin¥ folder.

2. Define the corresponding command number into RobSlave.h.

Define the corresponding command number and add it into RobSlave.h.

The value of RBS_CMD_EXTENTION is 10000. It is defined by RobSlave.h.

```
'User Extention Commands Def.
'-----------------------------------------------------------
#define RBS_CMDEX_APPROACH_L                    (RBS_CMD_EXTENTION +1)
#define RBS_CMDEX_APPROACH_P                    (RBS_CMD_EXTENTION +2)
#define RBS_CMDEX_GETSRVDATA                    (RBS_CMD_EXTENTION +3)
#define RBS_CMDEX_GETJNTDATA                    (RBS_CMD_EXTENTION +4)
```

3. Describe the execution code to an additional command.

Pv.x (=T[RBS_IDX_COMMAND].X) stores execution command ID. Refer this value and branch to the actual execution code using SELECT-CASE statement. Command arguments are stored in pv.Y, pv.Z, ov.X, ov.Y, ov.Z, av.X, av.Y, and av.Z (= T[RBS_IDX_COMMAND]. Y and Z etc.).

```
' User Extention Commands Impl.
'-------------------------------------------------------------------------------
PROGRAM UserExtention(pv as VECTOR, ov as VECTOR, av as VECTOR)
    DEFSNG ret
    DEFINT index, path
    DEFINT vartype, varindex
    DEFSNG length
    DEFJNT jv

    select case POSX(pv)
        '-----------------------------------------------------------
```

```
        case RBS_CMDEX_GETJNTDATA             'GetJntData(<Index>, <JontNo>)
            '-------------------------------------------------------------
            LETX T[RBS_IDX_RESULT] = GetJntData ( POSY(pv), POSZ(pv) )
            I[RBS_IDX_STATE] = RBS_STA_RETVAL ' Return value
        case RBS_CMDEX_GETSRVDATA             'GetSrvData(<Index>)
            '-------------------------------------------------------------
            jv = GetSrvData ( POSY(pv) )
#ifdef __VERTICAL_ROBOT__
            T[RBS_IDX_RESULT] = ( JOINT(1,jv), JOINT(2,jv), JOINT(3,jv), JOINT(4,jv), JOINT(5,jv),
JOINT(6,jv), 0,0,0, -1 )
#else
            T[RBS_IDX_RESULT] = ( JOINT(1,jv), JOINT(2,jv), JOINT(3,jv), JOINT(4,jv), 0,0,0,0,0, -1 )
#endif
            I[RBS_IDX_STATE] = RBS_STA_RETVAL ' Return value
            '-------------------------------------------------------------
        case else
            I[RBS_IDX_STATE] = RBS_STA_ERR
        end select
```

If the call does not return value, set I[RBS_IDX_STATE] = RBS_STA_DONE.

When a value is returned, substitute the value in T[RBS_IDX_RESULT] and set I[RBS_IDX_STATE] = RBS_STA_RETVAL. In this case, Execute method of CaoRobot class will have return value of VARIANT array, and each elements of T[RBS_IDX_RESULT] is stored in the array.

4. Update CRC32 information of the UserExtention.pac file.

CRC32 information of UserExtension.pac is recorded in RobSlave.h.

```
,CRC code
#define RBS_SLVCRC_CODE11             &H62cb2dc4
#define RBS_EXTCRC_CODE               &H1e5d8368
```

Calculate CRC32 of UserExtension.pac and update the value of RBS_EXTCRC_CODE.

Otherwise, the error occurs when the operation command is executed.

The value of CRC32 can be acquired in the @CRC system variable of the CaoFile class.

5. Execute CaoRobot::Execute method with "UserExt" command.

Command="UserExt"

Parameter=<additional command >,<arg1>,<arg2>,… (array of VARIANT)

Example: vRes = CaoRobot.Execute("UserExt", Array(10004, 1, 6)) '= GetJntData(1,6)

【 essential requisites 】

At the current implementation, "RobSlave.pac" and "UserExtention.pac" programs need to be executed beforehand on the robot controller to execute Execute method of CaoRobot class. RobSlave.pac and UserExtention.pac are in ORiN2¥CAO¥ProviderLib¥DENSO¥NetwoRC¥Bin.

4.2.40. CaoTask::AddVariable method

The argument of the AddVariable method of the CaoTask class specifies the system variable name.

Please refer Table 4-13 for the list of implemented system variables.

[11] CRC32 of RobSlave.pac

4.2.41. CaoTask::get_VariableNames property

A list of the variable identifier and the system variable identifier that can be specified by the AddVariable method is acquired.

4.2.42. CaoTask::Start method

2.330

Start PAC program corresponding to the object.

This method has the following two arguments.

Syntax Start <lMode:LONG>, <bstrOpt:BSTR>

lMode	:	[in]	Start mode 1: One cycle execution, 2: Cyclic execution, 3: One step forward, ~~4: 1 Step backword,~~ 5: Resume all
bstrOpt	:	[in]	Option character string (unused)

If this method is called with mode 5 (Resume), then all suspeneded programs in the robot controller are resumed.

4.2.43. CaoTask::Stop method

Stop PAC program corresponding to the object. This method has the following two arguments.

Syntax Stop <lMode:LONG>, <bstrOpt:BSTR>

lMode	:	[in]	Stop mode 0: Default stop, 1: Instant stop, 2: Step stop, 3: Cycle stop, 4: Initialized stop, 5: Suspend all
bstrOpt	:	[in]	Option character string (unused)

"0: Default stop" is the same as "1: Instant stop".

If this method is called with mode 5 (Suspend), then all programs in the robot controller are suspeneded.

4.2.44. CaoVariable::get_Value property

Get the value of the variable that corresponds to the object.

Please refer 2.3 for implementation situation and supported data type.

4.2.45. CaoVariable::put_Value property

Set the value of the variable that corresponds to the object.

Please refer 2.3 for implementation situation and supported data type.

4.2.46. CaoVariable::put_ID property

Set the index of the varialbe that corresponds to the object.

This property can be used for the object created with '*'.

Example (VB):

```
Set objIO = caoCtrl.AddVariable( "IO[*]" )      ' Specify a wild card (*) for I/O.
objIO.ID = 128                                  ' Specify the index by ID property
boolValue = objIO.Value                         ' get IO[128] value
```

4.2.47. CaoVariable::get_ID property

Get the index of the varible that corresponds to the object.

4.2.48. CaoVariable::get_Microsecond property

Get time stamp of the variable corresponding to the object.

Time stamp counter is incremented by one on every 500 microsecond after controller boot, with counter value 0 at the controller startup.

As the counter value increases, the value goes around as following.

0,1,2→2147483647(0x7fffffff) ,-2147483648(0x80000000) ,-2147483647(0x80000001) →-2,-1,0

[Note] If the object does not support time stamp, the property returns 0.

4.2.49. CaoMessage::Clear method

Clear the occurring error status by using the Clear method of the CaoController class.

4.3. Variable list

4.3.1. Controller class

Table 4-10 Controller class user variable list

Variable identifier	Data type	Explanation	Attribute	
			get	put
I	VT_I4	I type variable. The variable number is specified behind the variable name.	√	√
F	VT_R4	F type variable. The variable number is specified behind the variable name.	√	√
D	VT_R8	D type variable. The variable number is specified behind the variable name.	√	√
V	VT_ARRAY | VT_R4	V type variable. The variable number is specified behind the variable name. The data type has three elements.	√	√
P	VT_ARRAY | VT_R4	P type variable. The variable number is specified behind the variable name. The data type has seven elements.	√	√
J	VT_ARRAY | VT_R4	J type variable. The variable number is specified behind the variable name. The data type has six elements.	√	√
T	VT_ARRAY | VT_R4	T type variable. The variable number is specified behind the variable name. The data type has ten elements.	√	√
S	VT_BSTR	S type variable. The variable number is specified behind the variable name.	√	√
IO	VT_BOOL	IO type variable. The variable number is specified behind the variable name.	√	√
TOOL	VT_ARRAY | VT_R4	TOOL. The variable number (0 or greater) is specified behind the variable name.	√	√
WORK	VT_ARRAY | VT_R4	WORK. The variable number (0 or greater) is specified behind the variable name.	√	√

AREA	VT_ARRAY | VT_R4	AREA. The variable number (0 or greater) is specified behind the variable name. (V[0],..,V[8],IO,Pos,Err,Enable) V[0]～V[8]: area IO : I/O port number Pos : position number Err : error flag Enable : function enable/disable	√	√
_ITP	VT_I4	ITPCNF . The variable number is specified behind the variable name.	√	√
_PAC	VT_I4	PACCNF . The variable number is specified behind the variable name.	√	√
_DIO	VT_I4	DIOCNF . The variable number is specified behind the variable name.	√	√
_ARM	VT_I4	ARMCNF . The variable number is specified behind the variable name.	√	√
_SRV	VT_I4	SRVCNF . The variable number is specified behind the variable name.	√	√
_SPD	VT_I4	SPDCNF . The variable number is specified behind the variable name.	√	√
_VIS	VT_I4	VISCNF . The variable number is specified behind the variable name.	√	√
_COM	VT_I4	COMCNF . The variable number is specified behind the variable name.	√	√

Table 4-11 Controller class system variable list

Variable identifier	Data type	Explanation	Attribute	
			get	put
@CURRENT_TIME	VT_DATE	Current time held in the controller	√	√
@FREE_USER_MEM	VT_I4	Free user memory size (byte)	√	×
@NORMAL_STATUS	VT_BOOL	true = normal, false = abnormal (an error is occurring.)	√	×
@AUTO_MODE	VT_BOOL	true = automatic mode, false = not in automatic mode	√	×

@MODE	VT_I2	1: manual, 2: teach check, 3: auto, 4: external auto	√	×
@BUSY_STATUS	VT_BOOL	true = program is executed. False = program is not executed.	√	×
@EMERGENCY_STOP	VT_BOOL	true = emergency stop is active. False = emergency stop is not active.	√	×
@ERROR_CODE	VT_I4	Currently occurring error code. Returns 0 if no error is occurring	√	×
@ERROR_CODE_HEX	VT_BSTR	Currently occurring error code by hexadecimal character string.	√	×
@ERROR_LEVEL	VT_I4	Currently occurring error level.	√	×
@ERROR_DESCRIPTION	VT_BSTR	Currently occurring error description.	√	×
@MAKER_NAME	VT_BSTR	“DENSO CORPORATION”	√	×
@TYPE	VT_BSTR	“NetwoRC Controller”	√	×
@VERSION	VT_BSTR	Controller’s version	√	×
@SERIAL_NO	VT_BSTR	Controller’s serial number	√	×

4.3.2. Robot class

Table 4-12 Robot class system variable list

Variable identifier	Data type	Explanation	Attribute	
			get	put
@CURRENT_POSITION	VT_ARRAY | VT_R4	Current robot position. The unit is arbitrary. P type variable.	√	×
@CURRENT_ANGLE	VT_ARRAY | VT_R4	Current robot position (each axis value). The unit is arbitrary. J type variable	√	×
@SERVO_ON	VT_BOOL	True = servo ON, false = servo OFF	√	×
@ZERO_RETURN_REQUIRED	VT_BOOL	True = zero return is necessary, false = zero return is not necessary.	√	×
@BUSY_STATUS	VT_BOOL	true=arm moving, false=arm stopping	√	×
@TYPE_NAME	VT_BSTR	Robot type name “VM-D”,”VS-D”,”VSS-D”,”DM-D”,”Unknown”	√	×
@TYPE	VT_I4	Robot type data	√	×
@CURRENT_TRANS	VT_ARRAY | VT_R4	Current robot position expressed in T type	√	×
@CURRENT_TOOL	VT_I2	Currently used tool number	√	×
@CURRENT_WORK	VT_I2	Currently used work number	√	×
@SPEED	VT_R4	Internal speed 2.330	√	×
@ACCEL	VT_R4	Internal acceleration 2.330	√	×
@DECEL	VT_R4	Internal deceleration 2.330	√	×
@JSPEED	VT_R4	Internal joint speed 2.330	√	×
@JACCEL	VT_R4	Internal joint acceleration 2.330	√	×
@JDECEL	VT_R4	Internal joint deceleration 2.330	√	×
@EXTSPEED	VT_R4	External speed	√	×
@EXTACCEL	VT_R4	External acceleration	√	×

@EXTDECEL	VT_R4	External deceleration	√	×
@HIGH_CURRENT_POSITION	VT_ARRAY | VT_R4	Current robot position. The unit is arbitrary. P type variable. The value is indefinite under machine-locked because it is retrieved from an encoder directly. 2.330 When the controller is not in machine-lock mode, the current encoder value is returned. (update resolution: 500 microsecond) When the controller is in machine-lock mode, the internal position target value is returned. (update resolution: 8 msec) The time stamp of data acquisition can be referred by Microsecond property of CaoVariable class. [Note] Controllers prior to Version 2.90 do not support time stamp. On machine-lock mode, current position is indefinite.	√	×
@HIGH_CURRENT_ANGLE	VT_ARRAY | VT_R4	Current robot position (each axis value). The unit is arbitrary. J type variable. 2.330 For function specification, please refer to @HIGH_CURRENT_POSITION.	√	×
@HIGH_CURRENT_TRANS	VT_ARRAY | VT_R4	Current robot position expressed in T type. 2.330 For function specification, please refer to @HIGH_CURRENT_POSITION.	√	×

4.3.3. Task class

Table 4-13 Task class system variable list

Variable identifier	Data type	Explanation	Attribute	
			get	put
@STATUS	VT_I4	State of task. 1: DORMANT 2: READY 3: RUN 4: WAIT 6: SUSPEND 0: NON_EXISTENT	√	×
@PRIORITY	VT_I4	Priority of task.	√	×
@LINE_NO	VT_I4	Line – number of currently executing main program.	√	×
@CYCLE_TIME	VT_I4	One cycle execution time of task.	√	×
@START	VT_I4	Start task. The meaning of the value is the same as the Mode argument of the CaoTask::Start method. The mode is 1: one cycle execution, 2: continuous executes, 3: 1 step forward, ~~4: 1 step backward.~~ , 5: resume all (Note) If the value is set to 5 (resume all), then all suspended programs in the controller are resumed. 2.330	×	√
@STOP	VT_I4	Stop task. The meaning of the value is the same as the Mode argument of the CaoTask::Stop method. The mode is 0: default stop, 1: Instant stop, 2: step stop, 3: Cycle stop, 4: Initialization stop, 5: Suspend all If an option is required, please use CaoTask::Stop method instead. Default stop (0) is the same as Instant stop (1). (Note) If the value is set to 5 (resume all), then all programs in the controller are suspended.	×	√

4.3.4. File class

Table 4-14 File class system variable list

Variable identifier	Data type	Explanation	Attribute	
			get	put
@ACTIVE	VT_I4	Active of file(compile flag). 2.330 0: Inactive 1: Active	√	√
@CRC	VT_I4	CRC32 2.330	√	×

5. Outline of robot operation command execution

2.330

The execution of the robot motion commands of the CaoRobot class (Move, GoHome, Accelerate, Change, Speed, and Execute method) has been achieved in the following way. NetwoRC provider communicate with a PAC program RobSlave (RobSlave.pac) running on the robot controller, and the PAC program executes specified PAC command. Controller global variables I[0], T[0] and T[1] are used for communication between NetwoRC provider and RobSlave. I[0] is uses to express the executing command status, e.g., running, completed, or error. T[0] is used to pass command and parameters from NetwoRC provider to RobSlave. T[1] is used to return value from RobSlave to NetwoRC provider.

Following diagram shows the execution procedure of robot motion command.

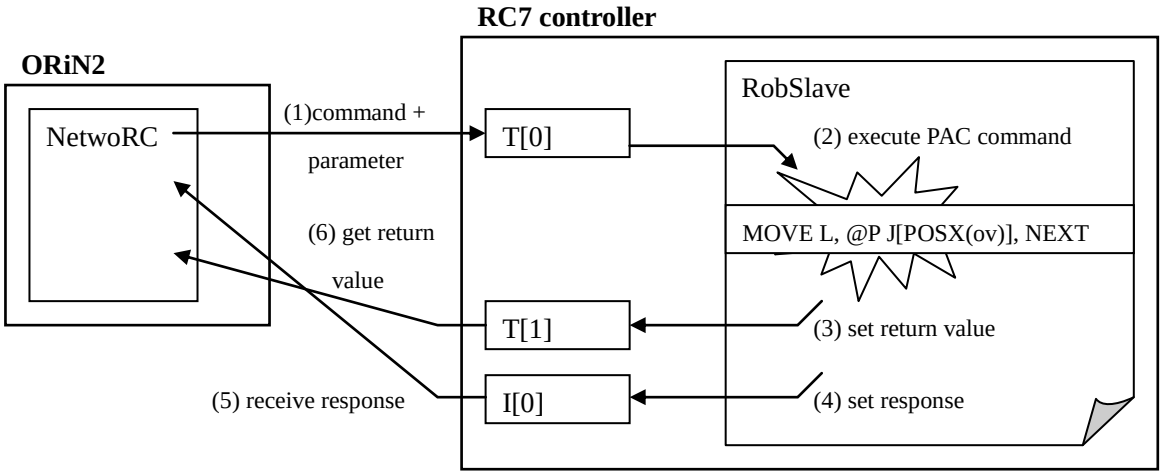


Figure 5-1 Execution procedure of robot motion command

【 attention 】

All global variables (I,F,D,V,P,J,T,S) from [0] to [9] have been reserved with the system.
Please do not access these variables in the user's program.

6. Tips

6.1. How to write data in an error state

NetwoRC controller rejects all writing data request (ex. Variable, I/O) when an error occurred because of safety reason. By using a suprevisory task (PAC) in the controller, the limitation can be solved.

The suprevisory tasks (TSR1, TSR2, ...) can write data during an error state, and those can be invoked at the startup of the controller. The procedure is as follows.

(1) Enable a suprevisory task
(2) Make a suprevisory task program which writes data when got notification from an external PC, and invoke the program.
(3) Notify to the suprevisory task from the PC.

The following figure shows an outline of the system using a suprevisory task and NetwoRC provider simultaneously.

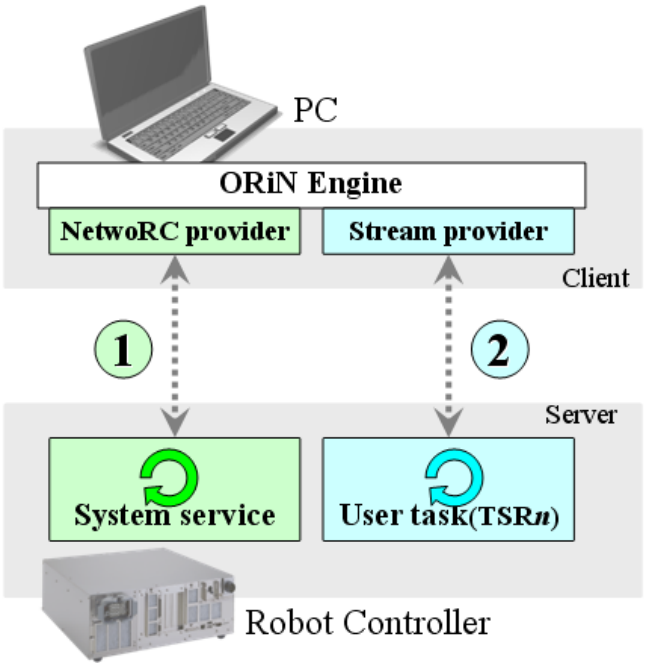


Figure 6-1 Expanded system using a suprevisory task (PAC)

By combining Stream provider[12] and a suprevisory task, it becomes possible to write data (ex. Variable, I/O) while an error occurred.

NetwoRC provider is much faster than this way, but it is useful for the manufacturing system recovery and so on(Table 6-1).

[12] Regarding Stream provider, please refer "Stream provider user's guide" in the ORiN2 SDK.

Table 6-1 A comparison of communication methods

Method	Speed	Supervisory Task	Write data in an error state
1. NetwoRC provider (ROBOTalk/UDP/IP)	**Fast**	**Not required** (System + RobSlave)	**Impossible**
2. Stream provider (TCP/IP)	**Slow**	**Required** (PAC program)	**Possible**

For the details of a supervisory task, please refer the following manual.

DENSO ROBOT SETTING-UP MANUAL

Chapter 3 General Introduction to Operation Modes and Additional Functions

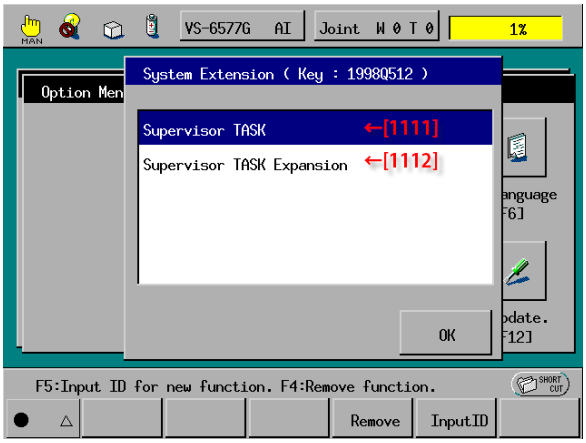
Supervisory Task (Software PLC)

6.1.1. Enable a supervisory task

To enable a supervisory task, the following steps are required.

(1) Add [1111] and [1112] options.

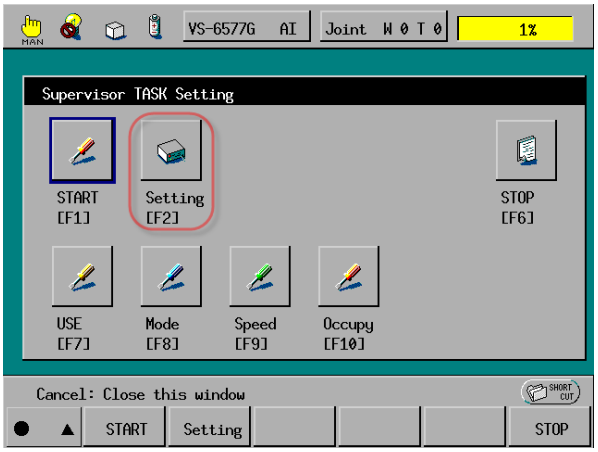
Top screen -> Set[F6] -> Options[F7] -> Extension[F8]



(2) Restart the controller.

(3) Enable a supervisory task.

Top screen -> SHIFT -> S-TASK[F2] -> Setting[F2]



(4) Restart the controller again.

6.1.2. Make a supervisory task

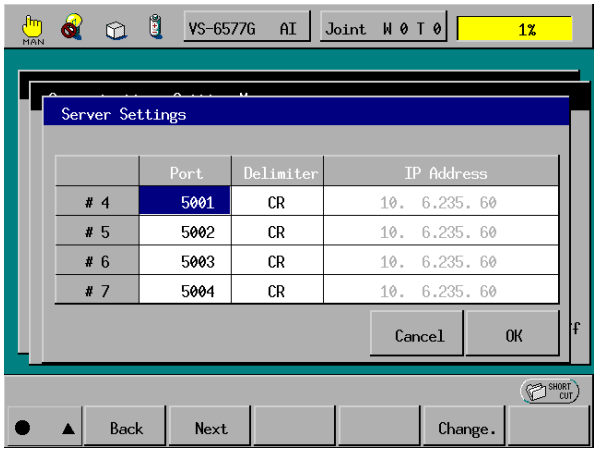
The following sample program writes I/O when it gets notification from an external PC. The controller is set as a server, and its input port number is #4, and its TCP port number is 5001.

List 6-1 TSR1.pac

```
PROGRAM TSR1
    Defint lval
    Defstr sval

    Do   ' Wait for a TCP connection
        com_state #4, lval
        If lval <> -1 Then Exit Do
        Delay 100
    Loop

    Do   ' Wait for a command
        Input #4, sval  ' #4 = TCP 5001 port
        lval = Val(sval)          ' Covert character string to a number
        If lval>0 Then
            Set IO[lval]          '"128" -> IO[128] = ON
            Print #4, sval; " ON"
        Else
            Reset IO[-lval]       '"-128" -> IO[128] = OFF
            Print #4, sval; " OFF"
        End If
    Loop
END
```

[Controller setting]

Top screen -> Set[F6] -> Set Com.[F5] -> Server[F11]



6.1.3. Notify to a supervisory task from a PC

The following sample program using Stream provider notifies to a supervisory task. from a PC. The IP address and the port number should be changed according as set above.

List 6-2 Client.frm

```
Private eng As CaoEngine
Private WithEvents ctrl As CaoController

Private Sub Form_Load()

    Set eng = New CaoEngine

    ' Connect to NetwoRC controller as a client
    Set ctrl = eng.Workspaces(0).AddController("Client", _
                                               "CaoProv.DNWA.STREAM", _
                                               "" _
                                               , _
                                               "Conn=eth:192.168.0.1:5001")
End Sub

Private Sub Command1_Click()

    ' Send data
    ctrl.Execute "Send", text1.Text        ' Ex. "128" -> IO128=ON

End Sub

' Receive data
Private Sub ctrl_OnMessage(ppCaoMess As CAOLib.ICaoMessage)

    ' get data
    text2.Text = ppCaoMess.Value

End Sub
```

Appendix A. POSEDATA type definition

In the NetwoRC provider, “POSEDATA” is defined so that the pose data type data and the vector type data of DENSO robot by VARIANT variable.

POSEDATA type (VARIANT)

- VT_BSTR[13] "[<Pass>] [<Variable type>]<Index> [<ExJnt>]" or "[<Pass>] [<Variable type>](<Element 1>,<Element 2>,...) [<ExJnt>]"
- VT_R4|VT_ARRAY[14] <Raw value> = (<Element 1:VT_R4>,<Element 2:VT_R4>,...)[15]
- VT_VARIANT|VT_ARRAY (<0:Value>[,<1:Variable type>[,<2:Path>[, <3:ExJnt>]]])
  - <Value> <Index:VT_R4> or <Raw value:VT_R4|VT_ARRAY>
  - <Variable type> P, T, J, V type (default＝P)
  - <Pass> @P, @E, @0, @<value> (default＝@0)
  - <ExJnt> <Extended-joints option:VT_VARIANT|VT_ARRAY> (default＝None)

<Pass> : @P, @E, @0, @<value>

Mark	@P	@E	@0	@<数値:n>	None
VT_BSTR	"@P"	"@E"	"@0"	"@*n*"	""
VT_I4	-1	-2	0	*n*	0

<Variable type> : P type, T type, J type, V type

Mark	P	T	J	V	None
VT_BSTR	"P"	"T"	"J"	"V"	""
VT_I4	0	1	2	3	-1

<Index> : <value:VT_R4>

<Element *n*> : <value:VT_R4>

<Extended-joints : (<EX or EXA>, (<Joint1:VT_I4>, <Value1:VT_R8>)[,

[13] In case of VT_BSTR, more than one POSEDATA type separated by commas can be specified.
[14] Because <Variable type> and <Pass> cannot be specified, variable type is treated as P type and pass type is treated as @0 by default.
[15] Cannot specify the extended-joints option.

<option> (<Joint2>,<Value2>)...])

表記	EX	EXA	なし
VT_BSTR	"EX"	"EXA"	""
VT_I4	1	2	0

The following formats of PAC language can be indicated by POSEDATA type.

[<Pass start displacement >] <Pose:P,T,J type> [<ExJnt>] (**C0**-format)

[<Pass start displacement >] <Vector:V type> (**C1**-format)

[<Pass start displacement >] <Value> [<ExJnt>] (**C2**-format)

[<Pass start displacement >] (<Element1>,< Element 2>,...) [<ExJnt>] (**C3**-format)

Appendix A.1. Examples

[<Pass start displacement >] <Pose:P,T,J type> [<ExJnt>] (C0-format)

ex1. T200

String	"T200"
VARIANT type array (variable type specified by string)	Array(200,"T")[16]
VARIANT type array (variable type specified by value)	Array(200,1)

ex2. @P J100

String	"@P J100"
VARIANT type array (variable type and pass type specified by string)	Array(100,"J","@P")
VARIANT type array (variable type and pass type specified by number)	Array(100,2,-1)

ex3. @E P(10.0, 10.5, 34.6, 0.0, 90.0, 0.0, -1.0)

String	"@E P(10.0, 10.5, 34.6, 0.0, 90.0, 0.0, -1.0)"
VARIANT type array (immediate value, with	Dim p(6) as Single Dim vP as Variant p(0) = 10.0 : p(1) = 10.5 : p(2) = 34.6 : p(3) = 0.0

[16] Array(…) is a function to return an array composed of the argument to the function.（Array function of VB6）

variable type and pass type specified by string)	p(4) = 90.0 : p(5) = 0.0 : p(6) = -1.0 vP = p() Array(vP, "P", "@E")
VARIANT type array (immediate value, with variable name and pass type specified by number)	Dim p(6) as Single Dim vP as Variant p(0) = 10.0 : p(1) = 10.5 : p(2) = 34.6 : p(3) = 0.0 p(4) = 90.0 : p(5) = 0.0 : p(6) = -1.0 vP = p() Array(vP, 0, -2)

ex4. @P J100 EXA((7, 30.5), (8, 90.5))

String	"@P J100 EXA((7, 30.5), (8, 90.5))"
VARIANT type array (variable type, pass type and aux. axis specified by string)	Array(100,"J","@P", Array("EXA",Array(7,30.5), Array(8,90.5)))
VARIANT type array (variable type, pass type and aux. axis specified by number)	Array(100,2,-1, Array(2, Array(7,30.5), Array(8,90.5)))

[<Pass start displacement >] <Vector:V type> (C1-format)

ex1. @P V20

String	"@P V20"
VARIANT type array (variable type and pass type specified by string)	Array(20,"V","@P")
VARIANT type array (variable type and pass type specified by number)	Array(20,3,-1)

ex2. @E V(0.0, 125.5, 50.0)

String	"@E V(0.0, 125.5, 50.0)"
VARIANT type array (immediate value, with variable type and pass type specified by string)	Dim v(2) as Single Dim vV as Variant v(0) = 0.0 : v(1) = 125.5 : v(2) = 50.0 vV = v() Array(vV, "V", "@E")
VARIANT type array (immediate value, with variable type and pass type specified by number)	Dim v(2) as Single Dim vV as Variant v(0) = 0.0 : v(1) = 125.5 : v(2) = 50.0 vV = v() ' = VT_R4 | VT_ARRAY Array(vV, 3, -2)

[<Pass start displacement >] <Value> [<ExJnt>] (C2-format)

ex1. @P 1

String	"@P 1"
VARIANT type array (variable type and pass type specified by string)	Array(1, "", "@P")
VARIANT type array (variable type and pass type specified by number)	Array(1,-1,-1)

ex2. @P 1.56

String	"@P 1.56"
VARIANT type array (variable type and pass type specified by string)	Array(1.56,"","@P")
VARIANT type array (variable type and pass type specified by number)	Array(1.56,-1,-1)

[<Pass start displacement >] (<Element1>,< Element 2>,...) [<ExJnt>] (C3-format)

ex1. @P (1, 30.0)

String	"@P (1, 30.0)"
VARIANT type array (variable type and pass type specified by string)	Dim v(1) as Single v(0) = 1 : v(1) = 30.0 Dim vV as Variant vV = v() Array(vV, "", "@P")
VARIANT type array (variable type and pass type specified by number)	Dim v(1) as Single v(0) = 1 : v(1) = 30.0 Dim vV as Variant vV = v() Array(vV, -1, -1)

Other examples

ex1. V1,V2,V3

(Rotation plane for CaoRobot::Rotate())

String	"V1,V2,V3"
String array	Array("V1","V2","V3")
VARIANT array	Array(Array(1,"V"),Array(2,"V"),Array(3,"V"))

(variable type specified by string)	
VARIANT array (variable type specified by number)	Array(Array(1,3),Array(2,3),Array(3,3))

ex2. APPROACH P,P70, 60, NEXT

(Approach command for CaoRobot::Execute(), without pass specification)

2nd argument : string 3rd argument : string	.Execute "APPROACH", Array(1, "P70", "60", "NEXT")
2nd argument : VARIANT array 3rd argument: VARIANT array	.Execute "APPROACH", Array(1, Array(70, "P"), _ Array(60, "", ""), "NEXT")

ex3. APPROACH L,J(60.5,30.3,400,90),@100 70, NEXT

(Approach command for CaoRobot::Execute(), without pass specification)

2nd argument : string 3rd argument : string	.Execute "APPROACH", Array(2, "J(60.5,30.3,400,90)", "@100 70", "NEXT")
2nd argument : VARIANT array (immediate value, with variable type specified by string) 3rd argument : VARIANT array (immediate value, with variable type specified by string)	Dim j(3) as Single Dim vJ as Variant j(0) = 60.5 : j(1) = 30.3 : j(2) = 400 : j(3) = 90 vJ = j() ' = VT_R4 | VT_ARRAY .Execute "APPROACH", Array(2, Array(vJ, "J"), _ Array(70,"","@100"), "NEXT")
2nd argument : VARIANT array (immediate value, with variable type specified by string) 3rd argument : VARIANT array (immediate value, with variable type specified by number)	Dim j(3) as Single Dim vJ as Variant j(0) = 60.5 : j(1) = 30.3 : j(2) = 400 : j(3) = 90 vJ = j() ' = VT_R4 | VT_ARRAY .Execute "APPROACH", Array(2, Array(vJ, "J"), _ Array(70, -1, 100), "NEXT")

【 attention 】

When the value is immediately specified directly by POSEDATA type by VT_R4|VT_ARRAY form, it becomes P type and @0 by default. Therefore, data other than P type cannot be specified directly by the VT_R4|VT_ARRAY form. In this case, please specify the variable type of the data by the VT_VARIANT|VT_ARRAY form or VT_BSTR form.

Please note that the following codes do not make sense.

‘[PAC] MOVE P, J100

```
Dim vJ as Variant
vJ=CaoCtrl.Variables(“J100”).Value   ‘VT_R4|VT_ARRAY
Robot.Move 1, vJ                      ‘= MOVE P, P(<j1>,<j2>,<j3>,…) NG!!
```

The correct code is as follows.

```
Robot.Move 1, Array(vJ,”J”)           ‘=MOVE P, J(<j1>,<j2>,<j3>,…) OK
```

Appendix B. PAC Commands supported by NetwoRC provider

2.330

Table 6-2 List of PAC Commands

Group	Commands	Availability
Motion Control		
	APPROACH	√
	DEPART	√
	DRAW	√
	DRIVE	√
	DRIVEA	√
	HOME	×
	GOHOME	×
	MOVE	√
	ROTATE	√
	ROTATEH	√
	CURJNT	√
	CURPOS	√
	CURTRN	√
	CUREXJ	×
	DESTJNT	×
	DESTPOS	×
	DESTTRN	×
	DESTEXJ	×
	ARRIVE	√
	POSCLR	√
	SETSPLINEPOINT	√
	CLRSPLINEPOINT	√
	GETSPLINEPOINT	√
	FIGAPRL	√
	FIGAPRP	√
Stop Control		
	HOLD	×
	HALT	×
	INTERRUPT ON/OFF	√
Speed Control		
	SPEED	√
	JSPEED	√
	ACCEL	√
	JACCEL	√
	DECEL	√
	JDECEL	√
	CURACC	√
	CURJACC	√
	CURDEC	√
	CURJDEC	√
	CURJSPD	√
	CURSPD	√
	CUREXTACC	√
	CUREXTDEC	√
	CUREXTSPD	√
	EXTSPEED	√
	CHANGETOOL	√
	CHANGEWORK	√
	CURTOOL	√
	CURWORK	√
Interference Check		
	SETAREA	√
	RESETAREA	√
Internal Servo Data		
	GetSrvData	√
	GetJntData	√

	GetSrvState	√
Motor Power		
	MOTOR {ON|OFF}	√
Particular Control		
	ST_aspACLD	√
	ST_aspChange	√
	ST_SetGravity	√
	ST_ResetGravity	√
	ST_SetGrvOffset	√
	ST_ResetGrvOffset	√
	ST_SetCurLmt	√
	ST_ResetCurLmt	√
	ST_SetEralw	√
	ST_ResetEralw	√
	ST_OnSrvLock	√
	ST_OffSrvLoc	√
	ST_SetCompControl	√
	ST_SetCompFControl	√
	ST_ResetCompControl	√
	ST_SetFrcCoord	√
	ST_SetFrcLimit	√
	ST_ResetFrcLimit	√
	ST_SetCompRate	√
	ST_ResetCompRate	√
	ST_SetFrcAssist	√
	ST_ResetFrcAssist	√
	ST_SetCompJLimit	√
	ST_ResetCompJLimit	√
	ST_SetCompVMode	√
	ST_ResetCompVMode	√
	ST_SetCompEralw	√
	ST_ResetCompEralw	√
	ST_SetDampRate	√
	ST_ResetDampRate	√
	ST_SetZBalance	√

	ST_ResetZBalance	√
Pose Data Type Transformation		
	J2P	√
	J2T	√
	P2J	√
	P2T	√
	T2J	√
	T2P	√
	TINV	√
	NORMTRN	√
Conveyer Tracking		
	TRACKDATAINITIALIZE	√
	TRACKDATASET	√
	TRACKDATAGET	√
	TRACKDATAINFO	√
	TRACKDATANUM	√
	CURTRACKPOS	√
	CURTRACKSPD	√
	WAITTRACKMOVE	√
	CALCWORKPOS	√
	CURTRACKPOSEX	√
	WAITTRACKMOVEEX	√
	SETTRACKMOVE	√
	RESETTRACKMOVE	√
	CONVCAL	×
	CALCCAMCALPOS	×
	CALCIOTEACHPOS	×
	SetTrackStartArea	√
	CalcConvPos	×
	SetConvLowVelErr	×
	CalcConvVec	×
	SortTrackData	×
	SortTrackAllData	×
Other		
	MotionSkip	√

	MotionComp	√
	XdWaitSpline	√
	DELAY	√
	SYSSTATE	√
	ClearSrvMonitor	√
	StartSrvMonitor	√
	StopSrvMonitor	√

Appendix C. Trouble-Shooting

Appendix C.1. I cannot connect with a robot controller...

Check	Action
■ Robot controller side	
□ Is the NetwoRC ROM version higher than V2.330?	If version is below v.2330, please update controller ROM Image to v2.330 or above.
□ Is the cable, RS232C or Ethernet cable connected properly?	Ensure that the cable is not loose on the connector.
□ Is the type of cable such as Straight and Cross correct?	Check the cable.
□ In case of Ethernet, is the address correctly set?	Chech the address settings.
□ In case of the ethernet connection over the segment, is the default gateway correctly set?	Make sure that the Controller IP address in the COM settings is the same between the application and the controller. Make sure that the IP address of the client PC and the IP address of the ext. run on the controller are the same.
□ In case of RS232c, is the communication parameter correctly set?	Check the parameters of RS232c.
□ Is the communication permission on the communication menu correctly set?	Check the communication permission. (see 2.2.1)
□ Is the ORiN extension set?	Add the ORiN option. (see 2.2.1)
■ PC side	
□ Is the Windows version correct? (Windows 2000, Windwos XP)	Check the version.
□ In case of RS232c, is another application program such as HyperTerminal running?	Terminate the application.
□ Does RobMaster work properly?	Execute RobMaster.exe. The RobMaster application should be running on Windows.
□ Are the parameters of the AddController() function correctly set?	Check the arguments of the AddController function. (see 4.2.1)
□ Is the version of ORiN up to v.2.0.3?	Verify ORiN2 version by executing CAOConfig. Select Help and then select Version.

Appendix C.2. I cannot access variables of a robot controller...

Check	Action
■ Robot controller side	
□ Is the communication permission correctly set? ("Read/Write" or "Read-only")	Check the communication settings. (see 2.2.1)
□ Is any edit dialogue displayed in the teach pendant?	Close the dialogue.
□ Is any error message displayed in the teach pendant?	Clear the error.
■ PC side	
□ Is the variable name correctly set?	Check the variable name.
□ In case of writing, is not the variable read-only?	Check the variable and I/O attribute.
□ Is the range of index correctly specified?	Check the range.
□ Do the written value and type meet the specification of the variable?	Check the specifications.

Appendix C.3. I cannot move a robot...

Check	Action
■ Robot controller side	
□ Is the "Executable token" for a robot correctly set? (ANSI: Single point of control)	Check the settings. (see 2.4.2 for ANSI type)
□ Is the "RobSlave" program running?	Run the “RobSlave” program. (see 2.6)
□ Is the robot in the executable state?	Check the condition. (see 2.2.1)
□ Does RobSlave.pac match the version of "NetwoRC Provider"?	Use the modules included in the same ORiN Package.
■ PC side	
□ Are the command names and parameters correctly specified?	Check the command (funtion) specification.

Appendix D. Controllers supported by NetwoRC provider

Table 6-3 List of supported Controllers

Class	Property, Method, Event		R/W	RC5		RC7		Description
				Less than 1.998	1.998 or higher	Less than 2.330	2.330 or higher	
CaoController	Attribute	P	R	-	√	-	√	
	CommandNames	P	R	-	√	-	√	
	Commands	P	R	-	√	-	√	
	ExtensionNames	P	R	-	√	-	√	
	Extensions	P	R	-	√	-	√	
	FileNames	P	R	-	√	-	√	
	Files	P	R	-	√	-	√	
	Help	P	R	-	√	-	√	
	ID	P	R/W	-	√	-	√	
	Index	P	R	-	√	-	√	
	Name	P	R	-	√	-	√	
	RobotNames	P	R	-	√	-	√	
	Robots	P	R	-	√	-	√	
	Tag	P	R/W	-	√	-	√	
	TaskNames	P	R	-	√	-	√	
	Tasks	P	R	-	√	-	√	
	VariableNames	P	R	-	√	-	√	
	Variables	P	R	-	√	-	√	
	AddCommand	M	S	-	√	-	√	
	AddExtension	M	S	-	√	-	√	
	AddFile	M	S	-	√	-	√	
	AddRobot	M	S	-	√	-	√	
	AddTask	M	S	-	√	-	√	
	AddVariable	M	S	-	√	-	√	
	Execute	M	S	-	√	-	√	
	GetMessage	M	R	-	√	-	√	
	OnMessage	E	R	-	√	-	√	

						-		
CaoVariable	Attribute	P	R	-	√	-	√	
	DateTime	P	R	-	√	-	√	
	Help	P	R	-	√	-	√	
	ID	P	R/W	-	√	-	√	
	Index	P	R	-	√	-	√	
	Microsecond	P	R	-	√	-	√	
	Name	P	R	-	√	-	√	
	Tag	P	R/W	-	√	-	√	
	Value	P	R/W	-	√	-	√	
CaoFile	Attribute	P	R	-	√	-	√	
	DateCreated	P	R	-	√	-	√	
	DateLastAccessed	P	R	-	√	-	√	
	DateLastModified	P	R	-	√	-	√	
	FileNames	P	R	-	√	-	√	
	Files	P	R	-	√	-	√	
	Help	P	R	-	√	-	√	
	ID	P	R/W	-	√	-	√	
	Index	P	R	-	√	-	√	
	Name	P	R	-	√	-	√	
	Path	P	R	-	√	-	√	
	Size	P	R	-	√	-	√	
	Tag	P	R/W	-	√	-	√	
	Type	P	R	-	√	-	√	
	Value	P	R/W	-	√	-	√	
	VariableNames	P	R	-	√	-	√	
	Variables	P	R	-	√	-	√	
	AddFile	M	S	-	√	-	√	
	AddVariable	M	S	-	√	-	√	
	Copy	M	W	-	√	-	√	
	Delete	M	W	-	√	-	√	
	Execute	M	S	-	√	-	√	
	Move	M	W	-	√	-	√	
	Run	M	W	-	-	-	-	

CaoTask	Attribute	P	R	-	√	-	√	
	FileName	P	R	-	√	-	√	
	Help	P	R	-	√	-	√	
	ID	P	R/W	-	√	-	√	
	Index	P	R	-	√	-	√	
	Name	P	R	-	√	-	√	
	Tag	P	R/W	-	√	-	√	
	VariableNames	P	R	-	√	-	√	
	Variables	P	R	-	√	-	√	
	AddVariable	M	S	-	√	-	√	
	Delete	M	W	-	√	-	√	
	Execute	M	S	-	√	-	√	
	Start	M	W	-	-	-	√	
	Stop	M	W	-	√	-	√	
CaoRobot	Attribute	P	R	-	√	-	√	
	Help	P	R	-	√	-	√	
	ID	P	R/W	-	√	-	√	
	Index	P	R	-	√	-	√	
	Name	P	R	-	√	-	√	
	Tag	P	R/W	-	√	-	√	
	VariableNames	P	R	-	√	-	√	
	Variables	P	R	-	√	-	√	
	Accelerate	M	W	-	-	-	√	
	AddVariable	M	S	-	√	-	√	
	Change	M	W	-	-	-	√	
	Chuck	M	W	-	-	-	-	
	Drive	M	W	-	-	-	-	See “Execute”
	Execute	M	S	-	-	-	√	
	GoHome	M	W	-	-	-	-	
	Hold	M	W	-	-	-	√	
	Halt	M	W	-	-	-	√	
	Move	M	W	-	-	-	√	

	Rotate	M	W	-	-	-	√	
	Speed	M	W	-	-	-	√	
	Unchuck	M	W	-	-	-	-	
	Unhold	M	W	-	-	-	-	
CaoCommand	Attribute	P	R	-	√	-	√	
	Help	P	R	-	√	-	√	
	ID	P	R/W	-	√	-	√	
	Index	P	R	-	√	-	√	
	Name	P	R	-	√	-	√	
	Parameters	P	R/W	-	√	-	√	
	Result	P	R	-	√	-	√	
	State	P	R	-	√	-	√	
	Tag	P	R/W	-	√	-	√	
	Timeout	P	R/W	-	√	-	√	
	Cancel	M	S	-	√	-	√	
	Execute	M	S	-	√	-	√	
CaoExtension	Attribute	P	R	-	√	-	√	
	Help	P	R	-	√	-	√	
	ID	P	R/W	-	√	-	√	
	Index	P	R	-	√	-	√	
	Name	P	R	-	√	-	√	
	Tag	P	R/W	-	√	-	√	
	VariableNames	P	R	-	√	-	√	
	Variables	P	R	-	√	-	√	
	AddVariable	M	S	-	√	-	√	
	Execute	M	S	-	√	-	√	
CaoMessage	DateTime	P	R	-	√	-	√	
	Description	P	R	-	√	-	√	
	Destination	P	R	-	√	-	√	
	Number	P	R	-	√	-	√	
	SerialNumber	P	R	-	√	-	√	
	Source	P	R	-	√	-	√	

	Value	P	R	-	√	-	√	
	Clear	M	W	-	√	-	√	
	Reply	M	W	-	√	-	√	
Meaning of sign	M : Method P : Property E : Event		R : Read W : Write S : Specification					

Appendix E. Error code of NetwoRC provider

The structure of the NetwoRC provider error code is HRESULT fromat. Please refer to the following URL for the HRESULT structure.

<http://msdn2.microsoft.com/en-us/library/bb401631.aspx>

There are two kinds of error codes in the provider. One is "Standard error codes" defined by Microsoft Windows, and the other is "Custom error codes" defined by NetwoRC provider. The standard error is the global error defined in Winerror.h. The custom error is the local error defined in the NetwoRC provider. The table of the error codes is shown as follows.

Table 6-4 Error code of NetwoRC provider

Number	Macro name	Description
Standard Error (excerpt)		
0x00000000	S_OK	No error occurred
0x00000001	S_FALSE	No error occurred, but the command was not finished properly.
0x8000FFFF	E_UNEXPECTED	Catastrophic failure
0x80004001	E_NOTIMPL	Not implemented
0x8007000E	E_OUTOFMEMORY	Ran out of memory
0x80070057	E_INVALIDARG	One or more arguments are invalid
0x80004005	E_FAIL	Unspecified error
Custom Error		
0x80000801	E_CAOP_NO_ROBSLAVE	RobSlave program does not exist in the robot controller.
0x80000802	E_CAOP_ROBSLAVE_NOT_READY	RobSlave program in the robot controller is not running.
0x80000803	E_CAOP_ROBSLAVE_CRC_ERROR	RobSlave program CRC error.
0x80000804	E_CAOP_ILLEGAL_CTRLVER	Illegal robot controller version.
0x80000805	E_CAOP_NO_EXECTOKEN	No executable token.
0x80000806	E_CAOP_ILLEGAL_ROBSLAVE	Illegal RobSlave version.
0x80000807	E_CAOP_NO_LICENSE	The count of connections is over the possible number. Please purchase an additional license.
0x80000900	E_TIMEOUT	Timeout occurred
0x80010900	E_SEND_NAK	NAK occurred

0x80010902	E_REJECTED	Reject occurred
0x80010903	E_ABNORMAL_R_PACKET	Receive packet broken
0x80010904	E_ABNORMAL_S_PACKET	Send packet broken

Appendix F. Non-Stop Motion Calculator - Trajectory Generator Command for Non Stop Inspection

Appendix F.1. Parameter

Following is details of <Position > parameter and <Area> parameter of GenerateNonStopPath command.

<Position: VT_VARIANT | VT_ARRAY> =
<X : VT_R4>,
<Y : VT_R4>,
< Z : VT_R4>,
< RX : VT_R4>,
< RY : VT_R4>,
< RZ : VT_R4>,
< Fig : VT_I4>,
< J7 : VT_R4>,
< J8 : VT_R4>,
<Motion Velocity : VT_R4>=(0.0～1.0),
<Motion Pattern: VT_I4> = (0: @P, 1: @0, 2: @E),
< Tool Number: VT_I4>

<Area: VT_R4 | VT_ARRAY > =
<Area Size X: VT_R4>,
<Area Size Y: VT_R4>,
< Area Size Z: VT_R4>,
< Area Angle: VT_R4>,
< Area Size J7: VT_R4>,
< Area Size J8: VT_R4>

Appendix F.2. Error Codes

The following table shows error codes of GenerateNonStopPath Command, which is defined in the provider.

Error No.	Macro Name	Meaning
0x800120**	ERR_ORG_P2J_CONV	Conversion Error from Position to Joint

		(Teaching Data)
0x800121**	ERR_ORG_SOFT_LIMIT	Software limit Error (Teaching Data)
0x800122**	ERR_ECH_SPD_RATE	Out of Speed Rate Range
0x800123**	ERR_GEN_P2J_CONV	Conversion Error from Position to Joint (Revised Data)
0x800124**	ERR_GEN_SOFT_LIMIT	Software limit Error (Revised Data)
0x800125**	ERR_GEN_IMPOSSIBLE	Revision operation convergence is impossible
0x800126**	ERR_TOO_NEAR_POINT	Too near teaching points (Position and Posture)
0x800127**	ERR_SPEED_ZERO	Zero Speed definition
0x800128**	ERR_INVALID_AREA_INFO	Invalid Area Data (Teaching Data)
0x80012A0*	ERR_INVALID_JOINTFLG	Joint Flag must be set as “limited rotation”.
0x80012F00	ERR_SPEED_RATE	Out of total speed rate range
0x80012F01	ERR_GEN_COEF	Out of Coefficients Range
0x80012F02	ERR_PASS_GEN	Trajectory Pass Generation fail
0x80012F03	ERR_MEMORY_TOO_SMALL	Low Memory
0x80012F04	ERR_ARMDNTLL_LOAD_FAIL	ArmNT.dll Load fail
0x80012F05	ERR_DIVISION_BY_ZERO	Division by Zero
0x80012F06	ERR_UNESTB_ARMCNF	ArmCnf is unsetted
0x80012F07	ERR_UNESTB_SPDCNF	SpdCnf is unsetted
0x80012F08	ERR_UNESTB_SRVCNF	SrvCnf is unsetted
0x80012F09	ERR_MEMORY_LEAK	Memory Leak
0x80012F0A	ERR_OUT_OF_DATA_NUM	Out of Data Number
0x80012F10	ERR_IVALID_TOOL_DATA	Invalid Tool Data

0x80012F50	ERR_OUT_OF_TOOL_NUM	Out of Tool Number

Error Code:0x**8001**2000～0x**8001**2800

The symbol of "**" indicates the error occurred position number. The value is "the error occurred position number + 1".

Error Code:0x80012A0*

The symbol of "*" indicates the number of the axis which is set as "unlimited rotation".

Appendix F.3. Restrictions

Restrictions of GenerateNonStopPath Command are as follows:

- Max. Number of Teaching Points = 200
- Available for 6-axis robot only
- Area size for additional axis should be assigned in [degree] (for rotational axis) or [mm] (for linear axis) according to the axis setting.
- Unavailable for Unlimited rotation of the extra-joint
- Unavailable when Auto Speed and Auto Acceleration mode is used
- Payload setting is restricted to the unit of 1,000g.

Appendix F.4. Sample Program

The following sample program is described in CaoScript. The following sample teaching data is for VS-6577G-BA robot. Assign appropriate IP Address for the target controller. This sample assumes the target controller IP addres is 10.6.235.72.

Sample NonStopPath.vbs

```
' Generate NonStopPath
Const RC_ADDRESS = "10.6.235.72"

Sub Main
    Dim rc
    Dim vntTeachPos()
    Dim vntAreaInfo()
    Dim vntMovePos
    Dim vntParam
    Dim lIndex

    dbg.ClearLog

    set rc = cao.AddController("RC", "CaoProv.DENSO.NetwoRC", "", "conn = eth:" & RC_ADDRESS)
    ' ---------------------------------------
    ' Initialize NonStopPath Library
    ' ---------------------------------------
    call rc.Execute("InitNonStopPathLib")

    ' GenerateNonStopPath Command Parameter (Pos, Area, Size, SpdRate, Coef)
    ' Pos : TeachPoint Data (x, y, z, rx, ry, rz, fig, J7, J8, SpdRate, attr, ToolNum)
```

```
    redim vntTeachPos(7)

    vntTeachPos(0) = Array(300.0, 100.0, 600.0, 180.0, 0.0, 180.0, 5, 0.0, 0.0, 100 * 0.01, 1, 0)
    vntTeachPos(1) = Array(300.0, 91.0, 600.0, 180.0, 0.0, -180.0, 5, 0.0, 0.0, 100 * 0.01, 0, 0)
    vntTeachPos(2) = Array(310.0, 30.0, 600.0, 180.0, 0.0, -180.0, 5, 0.0, 0.0, 100 * 0.01, 1, 0)
    vntTeachPos(3) = Array(315.5, 24.5, 600.0, 180.0, 0.0, -180.0, 5, 0.0, 0.0, 100 * 0.01, 0, 0)
    vntTeachPos(4) = Array(300.0, 10.0, 600.0, 180.0, 0.0, 173.0, 5, 0.0, 0.0, 100 * 0.01, 1, 0)
    vntTeachPos(5) = Array(300.0, 10.0, 600.0, 180.0, 0.0, 176.0, 5, 0.0, 0.0, 100 * 0.01, 0, 0)
    vntTeachPos(6) = Array(300.0, 10.0, 600.0, 180.0, 0.0, 171.0, 5, 0.0, 0.0, 100 * 0.01, 0, 0)
    vntTeachPos(7) = Array(300.0, 10.0, 600.0, 180.0, 0.0, -180.0, 5, 0.0, 0.0, 100 * 0.01, 1, 0)

    ' Area : Area Info (x, y, z, angle, J7, J8)
    redim vntAreaInfo(7)

    vntAreaInfo(0) = Array(4,4,4,4,0,0)
    vntAreaInfo(1) = Array(4,4,4,4,0,0)
    vntAreaInfo(2) = Array(4,4,4,4,0,0)
    vntAreaInfo(3) = Array(4,4,4,4,0,0)
    vntAreaInfo(4) = Array(4,4,4,4,0,0)
    vntAreaInfo(5) = Array(4,4,4,4,0,0)
    vntAreaInfo(6) = Array(4,4,4,4,0,0)
    vntAreaInfo(7) = Array(4,4,4,4,0,0)

    dbg.Output "Teach Points"
    for lIndex = 0 to Ubound(vntTeachPos)
      dbg.Output lIndex & ":" & dat.BstrFromVariant(vntTeachPos(lIndex))
    next

    ' ---------------------------------------
    ' Generate NonStopPath
    ' ---------------------------------------
    vntMovePos = rc.Execute("GenerateNonStopPath", Array(vntTeachPos, vntAreaInfo,
Ubound(vntTeachPos) + 1, 100.0 * 0.01, 0.7, 1))

    dbg.Output "Move Points"
    for lIndex = 0 to Ubound(vntMovePos)
        dbg.Output lIndex & ":" & dat.BstrFromVariant(vntMovePos(lIndex))
    next
  End Sub
```

Appendix F.5. Workaround at the time of the Adjustment Failure (Error Code:0x800123xx)

The GenerateNonStopPath command fails when the revised angle is out of maximum adjustment angle range. If the failure occurs and error code 0x800123xx (xx represents teaching position number) is shown, change the teaching position, or adjust parameters for the selected Adjustment Method as shown in below.

- In case of Synchronous motion with Extended-Joint (default)

Adjust the following parameters in cOrbitGenSync.ini (in Bin folder of NetwoRC Provider)

Parameter	Oultime	Input Limitation
FIGCHECK.MAX_DISPLACEMENT_dJ1	Offset of Maximum Adjustment Angle for 1st axis (deg)	-180.0 ～ 180.0

FIGCHECK.MAX_DISPLACEMENT_dJ2	Offset of Maximum Adjustment Angle for 2nd axis (deg)	-180.0 ～ 180.0
FIGCHECK.MAX_DISPLACEMENT_dJ3	Offset of Maximum Adjustment Angle for 3rd axis (deg)	-180.0 ～ 180.0
FIGCHECK.MAX_DISPLACEMENT_dJ4	Offset of Maximum Adjustment Angle for 4th axis (deg)	-180.0 ～ 180.0
FIGCHECK.MAX_DISPLACEMENT_dJ5	Offset of Maximum Adjustment Angle for 5th axis (deg)	-180.0 ～ 180.0
FIGCHECK.MAX_DISPLACEMENT_dJ6	Offset of Maximum Adjustment Angle for 6th axis (deg)	-180.0 ～ 180.0
FIGCHECK.MAX_DISPLACEMENT_J7	Offset of Maximum Adjustment Angle for 7th axis (deg)	0.0 ～ 180.0
FIGCHECK.MAX_DISPLACEMENT_J8	Offset of Maximum Adjustment Angle for 8th axis (deg)	0.0 ～ 180.0
FIGCHECK.ERROR_DISTANCE	Maximum Adjustment Length (mm)	

Adjustment Angle for each axis is shown in MaxDispJoint.csv file. To save the MaxDispJoint.csv file, set DEBUG.FILEOUT parameter in cOrbitGenSync.ini as 1, and the file is saved in the folder set by DEBUG.FILEPATH.

The maximum adjusted angle for each joint is defined as a sum of “the angle calculated from the maximum adjustment length” and “the offset of maximum adjustment angle (MAX_DISPLACEMENT_dJ*)” for each joint.

DEBUG.FILEOUT	1
DEBUG.FILEPATH	Output Folder

[Remarks] While the DEBUG.FILEOUT parameter is set to 1, the .csv file is created each time when InitNonStopPathLib or GenerateNonStopPath command is executed. Therefore, reset the DEBUG.FILEOUT parameter to 0, after the offset parameters are adjusted.

- In case of Asynchronous motion with Extended-Joint

Adjust the following parameters in cOrbitGen.ini (in Bin folder of NetwoRC Provider)

Parameter	Outline	Input Limitation
FIGCHECK.MAX_DISPLACEMENT_dJ1	Maximum Adjustment Angle for 1st Axis (deg)	0.0 ～ 180.0

FIGCHECK.MAX_DISPLACEMENT_dJ2	Maximum Adjustment Angle for 2nd Axis (deg)	0.0 ～ 180.0
FIGCHECK.MAX_DISPLACEMENT_dJ3	Maximum Adjustment Angle for 3rd Axis (deg)	0.0 ～ 180.0
FIGCHECK.MAX_DISPLACEMENT_dJ4	Maximum Adjustment Angle for 4th Axis (deg)	0.0 ～ 180.0
FIGCHECK.MAX_DISPLACEMENT_dJ5	Maximum Adjustment Angle for 5th Axis (deg)	0.0 ～ 180.0
FIGCHECK.MAX_DISPLACEMENT_dJ6	Maximum Adjustment Angle for 6th Axis (deg)	0.0 ～ 180.0
FIGCHECK.MAX_DISPLACEMENT_J7	Maximum Adjustment Angle for 7th Axis (deg)	0.0 ～ 180.0
FIGCHECK.MAX_DISPLACEMENT_J8	Maximum Adjustment Angle for 8th Axis (deg)	0.0 ～ 180.0