DENSO ROBOT

SUPPLEMENT

Main System Software Version 2.0*

Preface

DENSO WAVE has updated main system software designed for DENSO robot series from Version 1.98* to Version 2.0*.

This book is a supplement to the DENSO robot manuals. It describes newly added and updated functions. Use this supplement together with other robot manuals.

Products covered by this manual

Robot series configured with RC5 robot controller Version 2.0* or later

Contents

1 Modification of Processing Time Exclusively Occupied by Supervisory Tasks

Refer to the SETTING-UP MANUAL, Chapter 3, Section 3.4.10 "Software PLC (Supervisory Task)."

This new feature allows you to modify the processing time exclusively occupied by supervisory tasks in a processing cycle (8 ms) to be applied when the supervisory tasks and user tasks (PAC programs) run concurrently (multitasking).

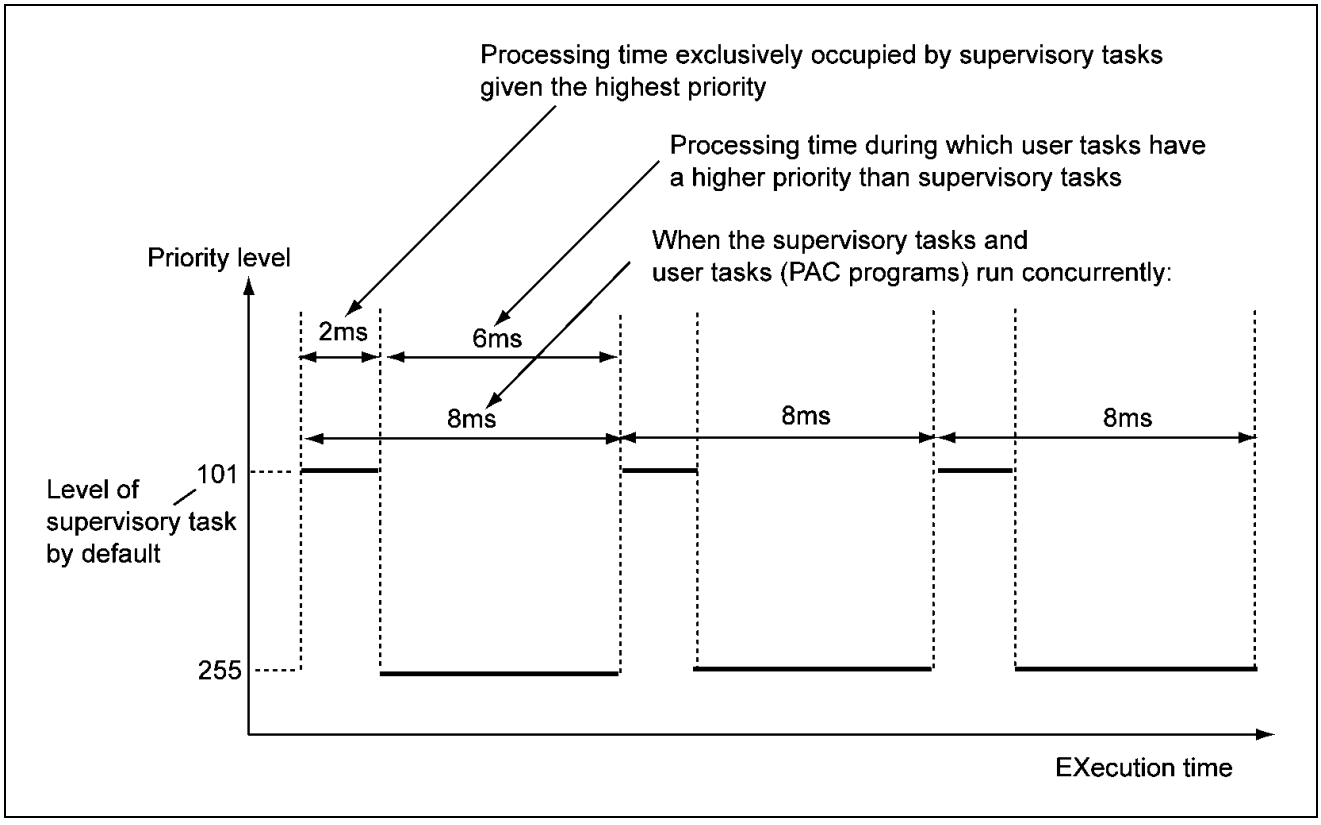
With this feature, you can switch the priority levels between supervisory tasks and user tasks at the desired timing. This makes it possible to assign higher priority to processing of supervisory tasks during particular operation or vice versa.

1.1 What is the processing time exclusively occupied by supervisory tasks?

As shown below, the task processing cycle of the robot controller is 8 ms that is shared by supervisory tasks and user tasks.

When supervisory tasks and user tasks are running concurrently, the processing time exclusively occupied by supervisory tasks is 2 ms by default (because the supervisory tasks are given the highest priority "101" by default).

During the remaining 6 ms, user tasks have higher priority than supervisory tasks (because user tasks are given higher priority than supervisory tasks by default).



Processing Time Exclusively Occupied by Supervisory Tasks in the Processing Cycle (by default)

1.2 Choice of processing time periods to be exclusively occupied by supervisory tasks

You can make a choice from the following five processing time periods:

0 ms, 2 ms, 4 ms, 6 ms and 8 ms in an 8 ms task processing cycle

Example: If you select "4 ms," the execution time required for supervisory tasks will be shorter and that for user tasks, longer than ones required by default (2 ms).

NOTE: If you select "0 ms," supervisory tasks will be processed only when no user tasks are being processed. If there is no free time, no supervisory tasks will be able to be processed.

NOTE: If you select "8 ms," no user tasks can be processed when any supervisory task is being processed. To process user tasks, you need to insert a process of DELAY or WAIT for getting an arm semaphore in the supervisory tasks.

1.3 Modifying the processing time exclusively occupied by supervisory tasks

You can modify the processing time to be exclusively occupied by supervisory tasks in PAC programs or with the teach pendant.

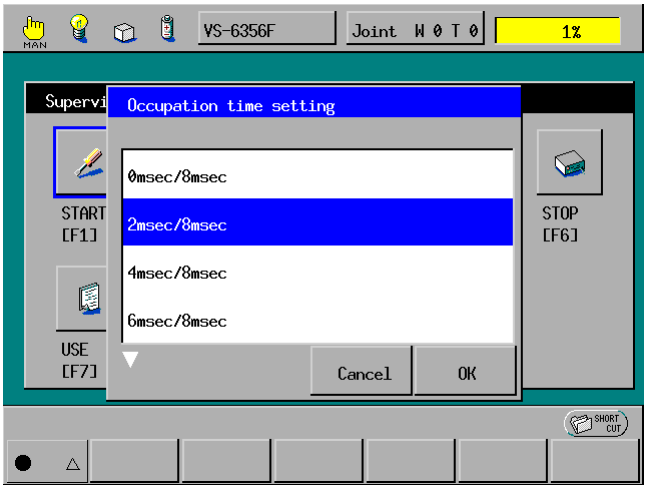
This modification can be made even if any supervisory task is executing and it will immediately take effect.

■ *From the teach pendant*

(1) Call up the processing time window (Occupation time setting).

Access: [F8 S-TASK]—[F10 Occupy]

(2) Select the desired processing time and press [OK].



■ *In PAC programs*

Use the `SETOCCUPATIONTIME` command. Refer to the next page for details.

Syntax `SETOCCUPATIONTIME <Processing time>`

Coding example
```
SETOCCUPATIONTIME 4      'Set 4 ms/8 ms
```

SETOCCUPATIONTIME (Statement)

Function

Reconfigures the processing time to be exclusively occupied by supervisory tasks. Refer to Section 1.1 for details.

Syntax

```
SETOCCUPATIONTIME <Processing time>
```

Description

When the supervisory task mode is enabled, SETOCCUPATIONTIME reconfigures the processing time to be exclusively occupied by supervisory tasks to <Processing time>.

<Processing time> 0, 2, 4, 6 or 8

0: 0 ms/8 ms
2: 2 ms/8 ms
4: 4 ms/8 ms
6: 6 ms/8 ms
8: 8 ms/8 ms

This statement can be placed in the execution of supervisory tasks. It immediately takes effect.

If it is disabled, this statement produces nothing.

Coding example

The following coding example contains three programs--supervisory task TSR1 and user programs PRO1 and PRO2. In ordinary operations, PRO1 and PRO2 are given higher priority during 6 ms, but in robot motions TSR1 is given higher priority during 4 ms even it sacrifices execution of PRO2 to some degree.

```
'Supervisory task TSR1 checks the robot motion range.
PROGRAM TSR1
 . . .
 . . .
END

PROGRAM PRO1
  TAKEARM
   . . .
  SETOCCUPATIONTIME 4    'Set 4 ms for supervisory tasks.
  MOVE P,P0              'Move the robot.
  SETOCCUPATIONTIME 2    'Restore the processing time to be occupied
                          'by supervisory tasks to the default (2 ms).
   . . .
END
PROGRAM PRO2
  DO WHILE 1
    . . .
  LOOP
END
```

Notes

If you select "0 ms," supervisory tasks will be processed only when no user tasks are being processed. If there is no free time, no supervisory tasks will be able to be processed.

If you select "8 ms," no user tasks can be processed when any supervisory task is being processed. To process user tasks, you need to insert a process of DELAY or WAIT for getting an arm semaphore in the supervisory tasks.

2 Screen Saver Newly Added

Refer to the SETTING-UP MANUAL, Chapter 5, Section 5.7, "Displaying the Option Menu."

A screen saver is newly added to the teach pendant. You can customize the screen saver.

Customizing the screen saver

(1) Call up the processing time window (Occupation time setting).

Access: [F6 Set]—[F7 Options.]—[F5 Display]

(2) Set the following items on the screen and press [OK].

Screen saver: 0: Disable (Not use), 1: Enable (Use)

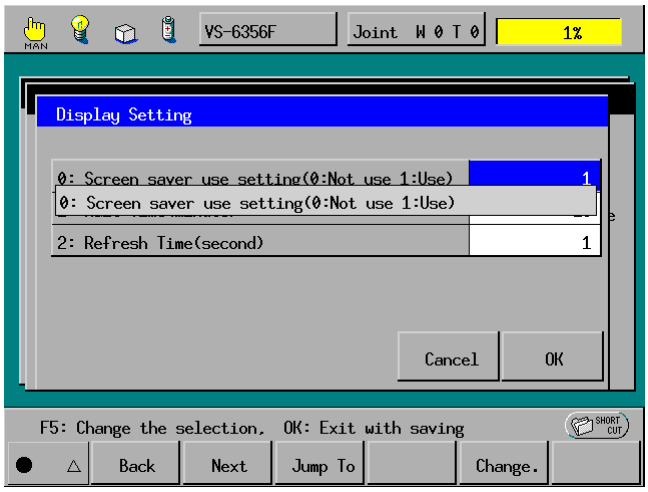
Waiting time: Entry range from 1 to 9999 (minutes)

If the touch panel is not accessed or no hardware button (such as MOTOR and F1) is pressed for the period specified by this waiting time, the screen saver will automatically run.

Refresh cycle: Entry range from 1 to 9 (seconds)

Once the screen saver runs, the screen switches to the monochrome mode where the black and white sections will reverse partially and sequentially at cycles specified by this refresh cycle.

Note: The refresh cycle may seem to be 1 to 4 times faster depending upon the display contents on the screen.



TIP: Persistence of vision on the LCD

Keeping the same pattern displayed on an LCD screen may yield persistence of vision.

Persistence of vision itself does not influence the robot operation, performance, function or safety.

Enabling the screen saver can prevent the screen from yielding persistence of vision.

When the screen saver is running, pressing the touch panel or any hardware button of the teach pendant will turn off the screen saver; however, the native function of the touch panel or hardware buttons will be ignored except the "Robot stop button," "Motor key (off)," "Mode switch (Manual, Auto)" and "STOP key." For example, if the screen saver has started running when any setting window was displayed, pressing the [F5 change.] will turn off the screen saver, but will not call up the numeric keypad.

3 Commands Added

Refer to the PROGRAMMER'S MANUAL I, Chapter 19, Section 19.3, "Operation mode, SYSSTATE."

If you use the SYSSTATE command in the RC7 robot controller, the status data obtained will differ from one that can be obtained in the RC5 robot controller. This section describes the SYSSTATE command for the RC7 robot controller.

SYSSTATE (Statement)

Function Gets the system status of the robot controller.

Syntax SYSSTATE

Description This statement gets the system status of the robot controller. The status data differs depending upon the I/O line assignment. Listed below are data that can be obtained.

Bit	0	Robot-in-operation signal
	1	Robot failure signal
	2	Servo ON signal
	3	Robot initialization completed
	4	Auto mode signal
	5	External mode signal
	6	Dead battery warning signal
	7	Reserved.
	8	Continue start permitted signal
	9	SS mode signal
	10	Robot stop signal
	11	Enable Auto signal
	12 to 23	Reserved.
	24	Command processing complete signal
	25 to 31	Reserved.

Note for software version 2.00 or later

To get the "Operation preparation completed" status, AND Bit 2 "Servo ON" and Bit 5 "External mode" to use the result of the logical operation.

Coding example

```
PROGRAM TSR1
————————————
I1 = SYSSTATE              'Get the system status of robot controller.
IF (I1 AND &h0082) THEN    'If any failure occurs,
CLRERR                     'clear the error.
END IF
————————————
END
```

4 Error Code Tables Modified

Refer to the ERROR CODE TABLES.

4.1 Error level list modified

A new note (*4) has been added.

Error Level List

Error level		The robot controller			
		Outputs this error signal:	**Makes the program come to:**	**Switches the motion mode:**	**Turns the motor power:**
Level 1	*3	-	-	-	-
Level 2	Errors when using TP/MP/OP *1 *3	-	-	-	-
	Other errors	*Robot Warning* *4	Halt	-	-
Level 3	Errors when using TP/MP/OP *1 *3	-	-	-	-
	Other errors	*Robot Failure*	Halt	External → Internal	Off*2
Level 4		*Robot Failure*	Emergency stop	External → Internal	Off
Level 5		*Robot Failure*	Emergency stop	External → Internal	Off (Restart disabled)

*1 If caused during operation with the teach pendant, mini-pendant or operating panel, errors 6000s and run-time errors will be treated in the same way as for "Other errors" listed on the next line.

*2 If any of errors 6071 to 607B and 6671 to 667B (software motion limit over, out of motion space, or singular point), 607F (figure mismatch), 6081 to 6088 (Jx command speed limit over), and 6AF3 (Interference area detected by J1, J2, J3) occurs when the robot is in operation in Manual mode, then the robot controller will not cut off the motor power.

*3 External operation is accepted even when a level 1 error or a level 2 or 3 error in TP/MP/OP operation is displayed.

*4 The RC7 robot controller outputs the *Robot Failure* signal instead of the *Robot Warning* signal.

.

Definition of Terms Used in the Error Level List

Error level	Errors when using TP/MP/OP	Errors caused by misoperation of the teach pendant (TP), mini-pendant (MP) or operating panel (OP).
	Other errors	Errors caused during program execution, dedicated I/O input operation, or servo operation.
Outputs this error signal:	*Robot Warning* *4	The robot controller will output the *Robot Warning* signal to the external equipment (e.g., PLC) to tell the occurrence of an insignificant error (Level 2 error).
	Robot Failure	The robot controller will output the *Robot Failure* signal to the external equipment (e.g., PLC) to tell the occurrence of a fatal error (Level 3 error or higher one).
Makes the program come to:	Halt	The robot stops if Level 2 or 3 error occurs. When decelerating the motor speeds for this stop, the robot traces the same motion path as in the normal motion.
	Emergency stop	The robot stops in emergency if Level 4 or 5 error occurs. Each axis motor decelerates at the maximum rate for this stop, so the motion path may be different from that in the normal motion, particularly in CP motion.
Switches the motion mode:	External → Internal	If an error occurs in the external automatic mode, then the mode switches to the internal automatic mode.
Turns the motor power:	Off	If the motor power is ON when an error occurs, the controller will turn the motor power OFF.
	Off (Restart disabled)	If the motor power is ON when an error occurs, the controller will turn the motor power OFF. To restart, you need to turn the controller power OFF and ON. Without it, if you attempt to turn the motor power ON, then error 27A6 "Not executable due to fatal error" will result.

*4 The RC7 robot controller outputs the *Robot Failure* signal instead of the *Robot Warning* signal.

4.2 Error codes added or modified in version 2.0*

Code	Message	Level	Description	Remedy
203C	CPU overheated	4	The internal temperature inside the CPU has exceeded the predetermined value.	Wait for the internal temperature to decrease.
2106	Backup battery low voltage	4	The voltage level of the backup battery for the memory containing manager files has dropped below the specified level. Therefore, those manager files may be defective. It is impossible to turn the motor on or start programs until any recovery process is followed.	Contact your local Denso Wave representative.
2107	Backup memory failure	4	An error has occurred in the backup memory containing manager files. Therefore, those manager files may be defective. It is impossible to turn the motor on or start programs until any recovery process is followed.	Contact your local Denso Wave representative.
2280	Maximum connection of USB was exceeded	1	Connecting a USB device to the robot controller has exceeded the maximum number of USB device connection times allowed with the controller power turned on.	To access the USB device, reboot the robot controller and then connect the USB device again.
2281	USB cannot be recognized	1	The robot controller cannot find the USB device since the USB device has been removed without being released.	To access the USB device, reboot the robot controller and then connect the USB device again.
2282	USB cannot be connected at the same time	1	You attempted to connect such a USB device that cannot share the controller with one previously connected.	Do not connect more than one data storage USB device such as a USB FDD to the controller.

Code	Message	Level	Description	Remedy
2283	USB was detached without release	1	The USB device has been disconnected without being released. The controller cannot access any USB device until you reboot the controller. (You should release the USB device first and then disconnect it.)	To access the USB device, reboot the robot controller and then connect the USB device again.
6039	Watchdog error	5	A delay has occurred in an interrupt processing.	Reboot the robot controller and perform the operation again.
6101	Watchdog error	5	An interrupt processing has abnormally stopped.	Reboot the robot controller and perform the operation again. If the error persists, you need to investigate or repair the controller.
6102	Power failure	5	The AC power supply is faulty. If this error message appears when you turn the controller off, it means no problem.	1. Check that the voltage level of the AC power supply is within the specified range. 2. Check that each lead of the AC power cable is securely connected. Do not connect or disconnect the cable with the controller power on. Be sure to turn off the controller power switch. 3. If the error persists after rebooting the controller, you need to investigate or repair the controller.
6104	Power failure	5	1. The +24V output source is short-circuited. 2. The power voltage in the controller has been dropped. 3. The counterelectromotive force of the servomotor is abnormal. 4. The power supply board is faulty. If this error message appears when you turn the controller off, it means no problem.	1. At the wiring end of the controller I/O cable, check for a short between the +24V and 0V leads or between the +24V lead and output terminal. 2. Check that the hand specifications (including workpieces) do not exceed the robot capacity. 3. If the error persists after rebooting the controller, you need to investigate or repair the controller.
6105	Power failure	5	1. The DB relay has been melted. 2. The power supply board is faulty.	If the error persists after rebooting the controller, you need to investigate or repair the controller.

Code	Message	Level	Description	Recovery
6119	J1 overcurrent	4	An overcurrent error has occurred in the V-phase of the J1 motor.	1. Check each joint (including hand and workpieces) for no interference with surrounding devices, piping or wiring. 2. If the joint interferes with any mechanical end so as to cause this error, change the software limit or check that the CALSET operation has been correctly performed. 3. Check that the hand specifications (including workpieces) do not exceed the robot capacity. 4. Check that the robot controller cable is securely connected to the robot unit and controller. 5. Check that the FG terminals of the robot unit and controller are grounded.
611A	J2 overcurrent	4	An overcurrent error has occurred in the V-phase of the J2 motor.	Same as above.
611B	J3 overcurrent	4	An overcurrent error has occurred in the V-phase of the J3 motor.	Same as above.
611C	J4 overcurrent	4	An overcurrent error has occurred in the V-phase of the J4 motor.	Same as above.
611D	J5 overcurrent	4	An overcurrent error has occurred in the V-phase of the J5 motor.	Same as above.
611E	J6 overcurrent	4	An overcurrent error has occurred in the V-phase of the J6 motor.	Same as above.
611F	J7 overcurrent	4	An overcurrent error has occurred in the V-phase of the J7 motor.	Same as above.
6120	J8 overcurrent	4	An overcurrent error has occurred in the V-phase of the J8 motor.	Same as above.

Code	Message	Level	Description	Remedy
6121	J1 overcurrent	4	An overcurrent error has occurred in the U-phase of the J1 motor.	1. Check each joint (including hand and workpieces) for no interference with surrounding devices, piping or wiring. 2. If the joint interferes with any mechanical end so as to cause this error, change the software limit or check that the CALSET operation has been correctly performed. 3. Check that the hand specifications (including workpieces) do not exceed the robot capacity. 4. Check that the robot controller cable is securely connected to the robot unit and controller. 5. Check that the FG terminals of the robot unit and controller are grounded.
6122	J2 overcurrent	4	An overcurrent error has occurred in the U-phase of the J2 motor.	Same as above.
6123	J3 overcurrent	4	An overcurrent error has occurred in the U-phase of the J3 motor.	Same as above.
6124	J4 overcurrent	4	An overcurrent error has occurred in the U-phase of the J4 motor.	Same as above.
6125	J5 overcurrent	4	An overcurrent error has occurred in the U-phase of the J5 motor.	Same as above.
6126	J6 overcurrent	4	An overcurrent error has occurred in the U-phase of the J6 motor.	Same as above.
6127	J7 overcurrent	4	An overcurrent error has occurred in the U-phase of the J7 motor.	Same as above.
6128	J8 overcurrent	4	An overcurrent error has occurred in the U-phase of the J8 motor.	Same as above.

Code	Message	Level	Description	Remedy
6139	Power module overheated	4	The temperature inside the robot controller has arisen abnormally.	1. Check the ambient temperature 2. Check that there is no obstruction to ventilation maintained by the fans inside the controller. Once this error occurs, the motor will not be able to be turned on until the inside temperature drops below the specified level. Wait for at least one minute.
613A	Power module overheated	4	The temperature inside the robot controller has risen abnormally.	Same as above.
6149	J1 power module capacity failure	5	The J1 power module does not match the motor parameter values.	1. Check the matching between the power module capacity and the connected motor output. 2. Check the matching between the arm file being in use and the robot model. 3. When the joint is used as an extended-joint, check that the extended-joint path parameters are correctly set.
614A	J2 power module capacity failure	5	The J2 power module does not match the motor parameter values.	Same as above.
614B	J3 power module capacity failure	5	The J3 power module does not match the motor parameter values.	Same as above.
614C	J4 power module capacity failure	5	The J4 power module does not match the motor parameter values.	Same as above.
614D	J5 power module capacity failure	5	The J5 power module does not match the motor parameter values.	Same as above.
614E	J6 power module capacity failure	5	The J6 power module does not match the motor parameter values.	Same as above.

Code	Message	Level	Description	Remedy
614F	J7 power module capacity failure	5	The J7 power module does not match the motor parameter values.	Same as above.
6150	J8 power module capacity failure	5	The J8 power module does not match the motor parameter values.	Same as above.
6607	Servo parameter error	5	An error has occurred in the servo parameter.	Reboot the robot controller and perform the operation again.
6608	Host parameter error	5	An error has occurred in operation parameters.	Same as above.
6609	System timer delay	5	A delay has occurred in the internal clock.	Same as above.

SUPPLEMENT

Main System Software Version 2.0*

First Edition January 2004

DENSO WAVE INCORPORATED

xxxxx

The purpose of this manual is to provide accurate information in the handling and operating of the robot. Please feel free to send your comments regarding any errors or omissions you may have found, or any suggestions you may have for generally improving the manual.

In no event will DENSO WAVE INCORPORATED be liable for any direct or indirect damages resulting from the application of the information in this manual.