Upon receipt of the product and prior to initial operation, read these instructions thoroughly and retain for future reference.

MOTOMAN INSTRUCTIONS
- MOTOMAN-□□□ INSTRUCTIONS
- DX200 INSTRUCTIONS
- DX200 OPERATOR’S MANUAL (for each purpose)
- DX200 MAINTENANCE MANUAL

The DX200 operator’s manuals above correspond to specific usage. Be sure to use the appropriate manual.
MANDATORY

• This manual explains the speed control function of the DX200 system. Read this manual carefully and be sure to understand its contents before handling the DX200.

• General items related to safety are listed in Chapter 1: Safety of the DX200 Instructions. To ensure correct and safe operation, carefully read the DX200 Instructions before reading this manual.

CAUTION

• Some drawings in this manual are shown with the protective covers or shields removed for clarity. Be sure all covers and shields are replaced before operating this product.

• The drawings and photos in this manual are representative examples and differences may exist between them and the delivered product.

• YASKAWA may modify this model without notice when necessary due to product improvements, modifications, or changes in specifications. If such modification is made, the manual number will also be revised.

• If your copy of the manual is damaged or lost, contact a YASKAWA representative to order a new copy. The representatives are listed on the back cover. Be sure to tell the representative the manual number listed on the front cover.

• YASKAWA is not responsible for incidents arising from unauthorized modification of its products. Unauthorized modification voids your product's warranty.
Notes for Safe Operation

Read this manual carefully before installation, operation, maintenance, or inspection of the DX200.

In this manual, the Notes for Safe Operation are classified as “DANGER”, “WARNING”, “CAUTION”, “MANDATORY”, or “PROHIBITED”.

- **DANGER**
  - Indicates an imminent hazardous situation which, if not avoided, could result in death or serious injury to personnel.

- **WARNING**
  - Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury to personnel.

- **CAUTION**
  - Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury to personnel and damage to equipment. It may also be used to alert against unsafe practices.
  - Always be sure to follow explicitly the items listed under this heading.

- **MANDATORY**
  - Must never be performed.

- **PROHIBITED**
  - Even items described as “CAUTION” may result in a serious accident in some situations.
  - At any rate, be sure to follow these important items.

To ensure safe and efficient operation at all times, be sure to follow all instructions, even if not designated as “DANGER”, “WARNING” and “CAUTION”. 
WARNING

• Before operating the manipulator, check that servo power is turned OFF pressing the emergency stop buttons on the front door of the DX200 and the programming pendant. When the servo power is turned OFF, the SERVO ON LED on the programming pendant is turned OFF.

Injury or damage to machinery may result if the emergency stop circuit cannot stop the manipulator during an emergency. The manipulator should not be used if the emergency stop buttons do not function.

Figure 1: Emergency Stop Button

• Once the emergency stop button is released, clear the cell of all items which could interfere with the operation of the manipulator. Then turn the servo power ON.

Injury may result from unintentional or unexpected manipulator motion.

Figure 2: Release of Emergency Stop

TURN

• Observe the following precautions when performing teaching operations within the P-point maximum envelope of the manipulator:
  – Be sure to use a lockout device to the safeguarding when going inside. Also, display the sign that the operation is being performed inside the safeguarding and make sure no one closes the safeguarding.
  – View the manipulator from the front whenever possible.
  – Always follow the predetermined operating procedure.
  – Keep in mind the emergency response measures against the manipulator’s unexpected motion toward you.
  – Ensure that you have a safe place to retreat in case of emergency.

Improper or unintended manipulator operation may result in injury.

• Confirm that no person is present in the P-point maximum envelope of the manipulator and that you are in a safe location before:
  – Turning ON the power for the DX200.
  – Moving the manipulator with the programming pendant.
  – Running the system in the check mode.
  – Performing automatic operations.

Injury may result if anyone enters the P-point maximum envelope of the manipulator during operation. Always press an emergency stop button immediately if there is a problem.

The emergency stop buttons are located on the right of front door of the DX200 and the programming pendant.
Definition of Terms Used Often in This Manual

The MOTOMAN is the YASKAWA industrial robot product.
The MOTOMAN usually consists of the manipulator, the controller, the programming pendant, and supply cables.

In this manual, the equipment is designated as follows:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manual Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>DX200 controller</td>
<td>DX200</td>
</tr>
<tr>
<td>DX200 programming pendant</td>
<td>Programming pendant</td>
</tr>
<tr>
<td>Cable between the manipulator and the controller</td>
<td>Manipulator cable</td>
</tr>
</tbody>
</table>
Descriptions of the programming pendant keys, buttons, and displays are shown as follows:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manual Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programming Pendant Keys</td>
<td>The keys which have characters printed on them are denoted with [ ]. ex. [ENTER]</td>
</tr>
<tr>
<td>Symbol Keys</td>
<td></td>
</tr>
<tr>
<td>Axis Keys</td>
<td>&quot;Axis Keys&quot; and &quot;Numeric Keys&quot; are generic names for the keys for axis operation and number input.</td>
</tr>
<tr>
<td>Numeric Keys</td>
<td></td>
</tr>
<tr>
<td>Keys pressed simultaneously</td>
<td>When two keys are to be pressed simultaneously, the keys are shown with a &quot;+&quot; sign between them, ex. [SHIFT]+[COORD]</td>
</tr>
<tr>
<td>Displays</td>
<td>The menu displayed in the programming pendant is denoted with { }. ex. {JOB}</td>
</tr>
</tbody>
</table>

**Description of the Operation Procedure**

In the explanation of the operation procedure, the expression "Select • • • " means that the cursor is moved to the object item and the SELECT key is pressed, or that the item is directly selected by touching the screen.

**Registered Trademark**

In this manual, names of companies, corporations, or products are trademarks, registered trademarks, or bland names for each company or corporation. The indications of (R) and ™ are omitted.
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With the speed control function, the T-axis, the end tip axis of the manipulator, or the external axis (hereinafter referred to as the speed control axis), can be continuously rotated according to the specified rotation speed.

This continuous rotating operation starts with execution of the speed control start instruction (VCON) and terminates with execution of the speed control end instruction (VCOF). During the continuous rotation, the rotation speed of the speed control axis is independently controlled. When operating the manipulator with the speed control function, the speed control axis rotates at the specified speed disregarding teaching while other axes operate as taught.

This function can be used for a feeder controlled by the external axis or such applications as the manipulator grasping a workpiece to put into the paint, rotating the workpiece continuously. Because the speed control axis working envelope is limited in the normal position-control method, the continuous rotating operation is disabled. Using this function, however, the speed control axis can continuously rotate without its working envelope being limited.

### INFORM Instruction Explanation

<table>
<thead>
<tr>
<th>Line</th>
<th>Step</th>
<th>INFORM Instruction</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0000</td>
<td></td>
<td>NOP</td>
<td></td>
</tr>
<tr>
<td>0001</td>
<td>0001</td>
<td>MOVJ VJ=12.50</td>
<td>Moves to the waiting point.</td>
</tr>
<tr>
<td>0002</td>
<td>0002</td>
<td>MOVJ VJ=12.50</td>
<td>Moves to the work start point.</td>
</tr>
<tr>
<td>0003</td>
<td></td>
<td>VCON ROBOT=1 JOINT=6 RPM=1000</td>
<td>Starts rotation of the T-axis of the manipulator 1. Rotation speed: 10.00 [rotation/min]</td>
</tr>
<tr>
<td>0004</td>
<td></td>
<td>TIMER T=0.50</td>
<td>Waits for rotation to start.</td>
</tr>
<tr>
<td>0005</td>
<td>0003</td>
<td>MOVL V=100</td>
<td>Moves to work end point by linear interpolation at 100.0 [mm/sec].</td>
</tr>
<tr>
<td>0006</td>
<td></td>
<td>VCOF ROBOT=1 JOINT=6</td>
<td>Terminates rotation.</td>
</tr>
<tr>
<td>0007</td>
<td>0004</td>
<td>MOVJ VJ=12.50</td>
<td>Moves T-axis to the taught position.</td>
</tr>
<tr>
<td>0008</td>
<td>0005</td>
<td>MOVJ VJ=12.50</td>
<td>Moves to the waiting point.</td>
</tr>
<tr>
<td>0009</td>
<td></td>
<td>END</td>
<td></td>
</tr>
</tbody>
</table>
2 Description of Function

2.1 Starting Rotation

The speed control axis starts rotating continuously with execution of the VCON instruction. Although it takes several hundred [ms] to start rotation, the job is continuously executed. Therefore, if the next operation needs to be performed after the speed control axis starts rotating, create a job using the TIMER instruction to wait for the speed control axis to rotate at a constant speed before the next operation. The speed control axis is continuously rotated even if no move instruction is executed (or during execution of TIMER or WAIT instruction). When a move instruction is executed during the speed control axis rotation, the manipulator moves to the aimed point while the speed control axis keeps rotating. The speed control axis soft limit check does not function during rotation.

The speed control axis position that appears on the position display during rotating differs from its actual position.

2.2 Terminating Rotation

The speed control axis terminates rotation with execution of the VCOF instruction. It takes approximately 500 [ms] to stop rotation, and the execution of the job stops during the time. The position where the speed control axis terminates rotation is not fixed but varies each time the job is executed. If matching the position in an operation after the speed control axis terminates rotation, register a move instruction to return the speed control axis to the taught position after it terminates the rotation.

When rotation is terminated, the speed control axis current value, the position display, and the speed control axis home positioning data are updated.

After rotation is terminated, the value of the speed control axis position will be within either of the two ranges shown below.

- When the rotation direction is positive: 0 to 360 degrees
- When the rotation direction is negative: -360 to 0 degrees

<Example> The reset position when the speed control axis terminates rotation at -120 degrees of -3 to 3 rotations

<table>
<thead>
<tr>
<th>Speed control axis position [Rotation]</th>
<th>Speed control axis position [Degree]</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>-1200</td>
</tr>
<tr>
<td>-2</td>
<td>-840</td>
</tr>
<tr>
<td>-1</td>
<td>-480</td>
</tr>
<tr>
<td>0</td>
<td>-120</td>
</tr>
<tr>
<td>1</td>
<td>240</td>
</tr>
<tr>
<td>2</td>
<td>600</td>
</tr>
<tr>
<td>3</td>
<td>960</td>
</tr>
<tr>
<td>4</td>
<td>1320</td>
</tr>
</tbody>
</table>

Reset to -120 degrees Reset to 240 degrees
2.3 Suspending or Restarting Rotation

If the job execution is suspended during the speed control axis rotation by the following operations or in the following cases, the speed control axis rotation is also suspended. When the job is restarted, the speed control axis rotation also restarts.

- HOLD or external HOLD
- When the operation cycle is changed into STEP

When the job execution is restarted by the following operations or in the following cases, the speed control axis moves as it is taught without restarting rotation.

- Emergency stop or external emergency stop
- JOG operation
- Cursor moving operation
- Job selection
- Job editing operation
- Mode switching operation (Servo OFF)
3  Instruction

3.1  VCON (Speed Control Start Instruction)

The VCON instruction is to start the speed control axis speed control.

The additional items to the VCON instruction are as follows.

1. **RV=**
   Sets the rotation speed of the speed control axis (mainly T-axis) included in the manipulator axis.
   If a positive value is set, the speed control axis rotates in the positive direction; if a negative value is set, it rotates in the negative direction.
   Setting range: -32768 to 32767
   Unit: RPM (revolutions per minute)

2. **MTR=**
   Sets the rotation amount of the speed control axis (mainly T-axis) included in the manipulator axis.
   The speed control axis rotates for the specified amount.
   Setting range: 0.1 to 100.0 (rotation)

3. **RVE=**
   Sets the rotation speed of the speed control axis included in the external axis.
   If a positive value is set, the speed control axis rotates in the positive direction; if a negative value is set, it rotates in the negative direction.
   Setting range: -32768 to 32767
   Unit: RPM (revolutions per minute)

4. **MTR=**
   Sets the rotation amount of the speed control axis included in the external axis.
   The speed control axis rotates for the specified amount.
   Setting range: 0.1 to 100.0 (rotation)

5. **ROBOT=**
   Sets its number of the manipulator including the speed control axis to start the speed control.
   Setting range: 1 to 8

6. **STATION=**
   Sets its number of the external axis including the speed control axis to start the speed control.
   Setting range: 1 to 24
3. Instruction
3.1 VCON (Speed Control Start Instruction)

7. **JOINT**=
   Sets its number of the speed control axis to start the speed control.
   Setting range: 1 to 8

8. **RPM**=
   Sets the rotation speed of the control group specified in 3 or 8 and the axis specified in 7.
   If a positive value is set, the speed control axis rotates in the positive direction; if a negative value is set, it rotates in the negative direction.
   Setting range: -2147483648 to 2147483647
   Unit: 0.01 RPM (revolutions per minute)
   *When the specified axis is a linear motion axis, the unit is 0.01mm per second.

9. **ROBOT**=
   Sets its number of the manipulator including the speed control axis to start the speed control.
   Setting range: 1 to 8

10. **STATION**=
    Sets its number of the external axis including the speed control axis to start the speed control.
    Setting range: 1 to 24

11. **JOINT**=
    Sets its number of the speed control axis to start the speed control.
    Setting range: 1 to 8

12. **RPM**=
    Sets the rotation speed of the control group specified in 9 or 10 and the axis specified in 7.
    If a positive value is set, the speed control axis rotates in the positive direction; if a negative value is set, it rotates in the negative direction.
    Setting range: -2147483648 to 2147483647
    Unit: 0.01 RPM (revolutions per minute)
    *When the specified axis is a linear motion axis, the unit is 0.01mm per second.

13. **ROBOT**=
    Sets its number of the manipulator including the speed control axis to start the speed control.
    Setting range: 1 to 8

14. **STATION**=
    Sets its number of the external axis including the speed control axis to start the speed control.
    Setting range: 1 to 24

15. **JOINT**=
    Sets its number of the speed control axis to start the speed control.
    Setting range: 1 to 8
3 Instruction
3.1 VCON (Speed Control Start Instruction)

16 **RPM** =
Sets the rotation speed of the control group specified in 15 or 16 and the axis specified in 17.
If a positive value is set, the speed control axis rotates in the positive direction; if a negative value is set, it rotates in the negative direction.
Setting range: -2147483648 to 2147483647
Unit: 0.01 RPM (revolutions per minute)
"When the specified axis is a linear motion axis, the unit is 0.01mm per second.

17 **MTR** =
Sets the rotation amount of the control group specified in 5 or 6 and the axis specified in 7.
The speed control axis rotates for the specified amount.
Setting range: 0.1 to 100.0 (rotation)

18 **ACC** =
Sets the acceleration ratio of the speed control axis.
Setting range: 20 to 100 (%)

19 **DEC** =
Sets the deceleration ratio of the speed control axis.
Setting range: 20 to 100 (%)

- If "RV=" and "RVE=" are set with a variable, the rotation speed of the motor is applied.
- If "RV=" and "RVE=" are set with a constant, the rotation speed of the motor is not applied, but that considering the deceleration ratio is applied.
- If "RV=" and "RVE=" are set, all the speed control axes included in the control group of the job having executed an instruction are subject to the speed control.
- The rotation speed set in "RPM=" is not that of the motor, but that considering the deceleration.
- In the following cases, an alarm occurs when an instruction is executed.
  - When a manipulator number which does not exist or which is different from the number of the control group where the VCON instruction was executed is set in "ROBOT="
  - When an external axis number which does not exist is set in "STATION="
  - When an axis number which does not exist is set in "JOINT="
  - When a value exceeding the maximum rotation speed of the motor is set in "RV="", "RVE=", or "RPM=""
3.2 VCOF (Speed Control End Instruction)

The VCOF instruction is to terminate the speed control axis speed control.

The additional items to the VCOF instruction are as follows.

1. **ROBOT=**
   - Sets its number of the manipulator including the speed control axis to terminate the speed control.
   - Setting range: 1 to 8

2. **STATION=**
   - Sets its number of the external axis including the speed control axis to terminate the speed control.
   - Setting range: 1 to 24

3. **JOINT=**
   - Sets its number of the speed control axis to terminate the speed control.
   - Setting range: 1 to 8

4. **ROBOT=**
   - Sets its number of the manipulator including the speed control axis to terminate the speed control.
   - Setting range: 1 to 8

5. **STATION=**
   - Sets its number of the external axis including the speed control axis to terminate the speed control.
   - Setting range: 1 to 24

6. **JOINT=**
   - Sets its number of the speed control axis to terminate the speed control.
   - Setting range: 1 to 8

7. **ROBOT=**
   - Sets its number of the manipulator including the speed control axis to terminate the speed control.
   - Setting range: 1 to 8

8. **STATION=**
   - Sets its number of the external axis including the speed control axis to terminate the speed control.
   - Setting range: 1 to 24

9. **JOINT=**
   - Sets its number of the speed control axis to terminate the speed control.
   - Setting range: 1 to 8

10. **DEC=**
    - Sets the deceleration ratio of the speed control axis.
    - Setting range: 20 to 100 (%)
3 Instruction

3.2 VCOF (Speed Control End Instruction)

- If there are no additional items to the VCOF instruction, the speed control to all the speed control axes included in the control group of the job having executed an instruction is terminated. However, any speed control axis other than the above mentioned axes is not terminated.

- In the following cases, an alarm occurs when an instruction is executed.
  - When a manipulator number which does not exist is set in "ROBOT=
  - When an external axis number which does not exist is set in "STATION=
  - When an axis number which does not exist is set in "JOINT="
4 Registration of Instructions

Register an instruction when the cursor is in the address area of the JOB CONTENT display in the teach mode.

1. Select {JOB} under the main menu.
2. Select {JOB CONTENT}.
   - The JOB CONTENT display appears.

3. Move the cursor to the address area.

4.1 VCON (Speed Control Start Instruction)

1. Press the [INFORM LIST].
   - The instruction list dialog box appears.

2. Select {OTHER}.
3. Select {VCON}.
   - The “VCON” instruction appears in the input buffer line.

![Diagram of VCON instruction setup]

4. Press [SELECT] and set each item in the DETAIL EDIT display.
   - The DETAIL EDIT display appears. Move the cursor to the item to be set, and press [SELECT]. Use the number keys to input each setting item and press [ENTER].

![Diagram of DETAIL EDIT display]

5. Press [ENTER].
4. Registration of Instructions

4.2 VCOF (Speed Control End Instruction)

1. Press the [INFORM LIST].
   - The instruction list dialog box appears.

2. Select {OTHER}.
3. Select {VCOF}.
   - The “VCOF” instruction appears in the input buffer line.

4. Press [SELECT].
5. Press [ENTER].
5 Display of Rotation Amount

The speed control axis rotation amount can be viewed in the ROTATION display.

1. Select {ROBOT} under the main menu.
2. Select {ROTATION}.
   - The ROTATION display appears.
6  Resetting Rotation Amount

The speed control axis rotation amount can be reset in the ROTATION display.

1. Select {ROBOT} under the main menu.
2. Select {ROTATION}.
3. Select {DATA} in the menu area.
   - The pull-down menu appears.
4. Select {RESET ROTATION}.
   - The displayed the speed control axis rotation amount is changed into “0”.

![Diagram](image_url)
7 Restrictions

7.1 Rotation Speed

The following describes the restrictions of the speed control function.

7.1 Rotation Speed

The rotation speed varies in the following cases:

- If operating the B-axis and the R-axis while performing the speed control, regarding the T-axis of the manipulator as the speed control axis.
- If operated in the teach mode

7.2 Maximum Rotation Amount

The maximum rotation amount differs depending on the manipulator model. The rotation amount in one speed control section cannot exceed the maximum rotation amount.

7.3 Specifying NWAIT

When a move instruction with NWAIT is executed, the instructions that have been registered before the next move instruction are executed in order. However, only the VCOF instruction is not executed at this time, but executed after completion of the move instruction.

7.4 Turning OFF Power Supply During the Speed Control

When the control power supply is turned OFF and then ON during the speed control, be sure to reset the rotation amount in the ROTATION display.

7.5 Resetting Rotation Amount

The rotation amount is automatically reset when the servo power supply is turned ON. When restarting after an emergency stop, the operation starts with the rotation amount reset.
## 8 Alarm List

<table>
<thead>
<tr>
<th>Alarm Number</th>
<th>Alarm Name/ Message</th>
<th>Contents</th>
<th>Sub Code</th>
<th>Meaning of sub code</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>4908</td>
<td>SPEED CONTROL ERROR</td>
<td>An error occurred at speed control execution.</td>
<td>1</td>
<td>Control group designation error.</td>
<td>Check the settings for the specified control group number.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>Speed control axis designation error.</td>
<td>Check the settings for the specified speed control axis number.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>Maximum rotation speed over.</td>
<td>Set the rotation speed that does not exceed the maximum rotation speed.</td>
</tr>
<tr>
<td>4353</td>
<td>DEFECTIVE TAUGHT POINT(ENDLESS)</td>
<td>This alarm occurs if the feedback pulse count of endless operation axis exceeds the allowable maximum pulse count (±536, 870, 912).</td>
<td>axis</td>
<td>The axis causing the alarm.</td>
<td>Reset the rotation amount. (Refer to chapter 6 “Resetting Rotation Amount”.) Recheck the setting so that the feedback pulse does not exceed the maximum number of pulses in one speed control section.</td>
</tr>
<tr>
<td>4474</td>
<td>WRONG CONTROL GROUP AXIS</td>
<td>The CALL/JUMP/ PSTART destination job could not be executed. An attempt was made to call or jump to a job whose control group cannot be controlled. An attempt was made to start the control group job that could not be operated. An axis of a different manipulator (Robot=) from the active job control group was set and an attempt was made to control its speed.</td>
<td>control-group</td>
<td>The related control-group.</td>
<td>Check the following settings. · Make the setting in advance so that the control group of the CALL/JUMP designation job is included in that of the CALL/JUMP source job. · Don't start the job which including control group under already operation by “PSTART” instruction. · Set a manipulator axis (Robot=) of the active job control group to control the speed.</td>
</tr>
</tbody>
</table>
Specifications are subject to change without notice for ongoing product modifications and improvements.