

# DX200 OPTIONS INSTRUCTIONS

FOR T-AXIS SPEED CONTROL FUNCTION

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

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## MOTOMAN INSTRUCTIONS

MOTOMAN-□□□ INSTRUCTIONS  
DX200 INSTRUCTIONS  
DX200 OPERATOR'S MANUAL  
DX200 MAINTENANCE MANUAL

The DX200 operator's manual above corresponds to specific usage.  
Be sure to use the appropriate manual.

Part Number: 165635-1CD  
Revision: 0



## MANDATORY

- This manual explains the T-axis 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.

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## 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 “WARNING”, “CAUTION”, “MANDATORY”, or “PROHIBITED”.



### 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.



### MANDATORY

Always be sure to follow explicitly the items listed under this heading.



### PROHIBITED

Must never be performed.

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 “CAUTION” and “WARNING”.



## 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.

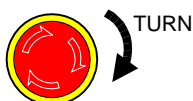
*Figure 1: Emergency Stop Button*



- 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*



- Observe the following precautions when performing teaching operations within the P-point maximum envelope of the manipulator:
  - 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.



## CAUTION

- Perform the following inspection procedures prior to conducting manipulator teaching. If problems are found, repair them immediately, and be sure that all other necessary processing has been performed.
  - Check for problems in manipulator movement.
  - Check for damage to insulation and sheathing of external wires.
- Always return the programming pendant to the hook on the cabinet of the DX200 after use.

The programming pendant can be damaged if it is left in the manipulator's work area, on the floor, or near fixtures.

- Read and understand the Explanation of Warning Labels in the DX200 Instructions before operating the manipulator:

## 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:


Equipment	Manual Designation
DX200 controller	DX200
DX200 programming pendant	Programming pendant
Cable between the manipulator and the controller	Manipulator cable

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## T-axis Speed Control

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Descriptions of the programming pendant, buttons, and displays are shown as follows:

Equipment		Manual Designation
Programming Pendant	Character Keys	The keys which have characters printed on them are denoted with [ ]. ex. [ENTER]
	Symbol Keys	The keys which have a symbol printed on them are not denoted with [ ] but depicted with a small picture.  ex. page key  The cursor key is an exception, and a picture is not shown.
	Axis Keys Number Keys	“Axis Keys” and “Number Keys” are generic names for the keys for axis operation and number input.
	Keys pressed simultaneously	When two keys are to be pressed simultaneously, the keys are shown with a “+” sign between them, ex. [SHIFT]+[COORD]
	Displays	The menu displayed in the programming pendant is denoted with { }. ex. {JOB}

## 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 brand names for each company or corporation. The indications of (R) and <sup>TM</sup> are omitted.

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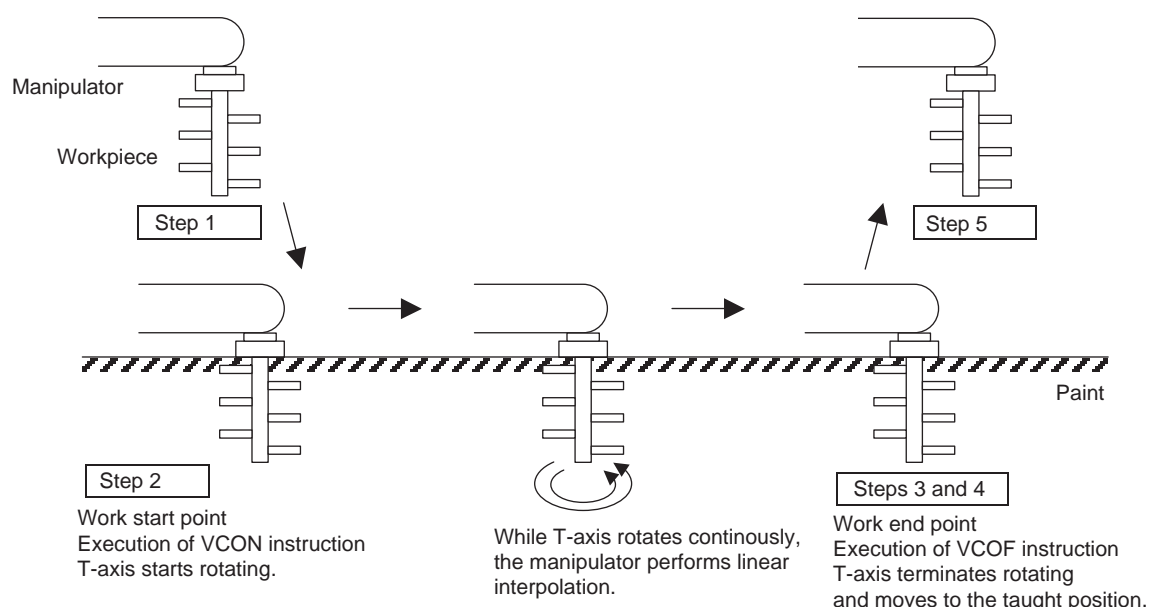
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## 1 Outline

With the T-axis speed control function, the T-axis, the end tip axis of the manipulator, 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 T-axis is independently controlled. When operating the manipulator with the T-axis speed control function, the T-axis rotates at the specified speed disregarding teaching while other axes operate as taught.

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



Line	Step		
000		NOP	
001	001	MOVJ VJ=12.50	Moves to the waiting point.
002	002	MOVJ VJ=12.50	Moves to the work start point.
003		VCON RV=10	Starts rotation. Speed : 10 [min <sup>-1</sup> ]
004		TIMER T=0.50	Waits for rotation to start.
005	003	MOVL V=100	Moves to work end point by linear interpolation at 100.0 [mm/s].
006		VCOF	Terminates rotation.
007	004	MOVJ VJ=12.50	Moves T-axis to the taught position.
008	005	MOVJ VJ=12.50	Moves to the waiting point.
009		END	



## 2 Description of Function

### 2.1 Starting Rotation

The T-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 T-axis starts rotating, create a job using the TIMER instruction to wait for the T-axis to rotate at a constant speed before the next operation. The T-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 T-axis rotation, the manipulator moves to the aimed point while the T-axis keeps rotating. The T-axis soft limit check does not function during rotation.

The T-axis position that appears on the position display during rotating differs from its actual position.

### 2.2 Terminating Rotation

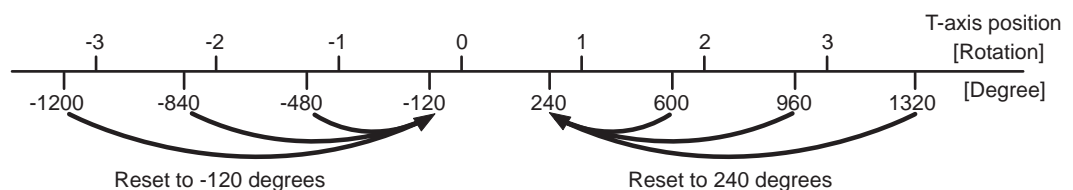
The T-axis terminates rotation with execution of the VCOF instruction. It takes approximately 0.5 seconds to stop rotation, and the execution of the job stops during the time. The position where the T-axis terminates rotation is not fixed but varies each time the job is executed. Register a move instruction to return the T-axis to the taught position after the T-axis terminates the rotation.

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

After rotation is terminated, the value of the T-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 T-axis terminates rotation at -120 degrees of -3 to 3 rotations

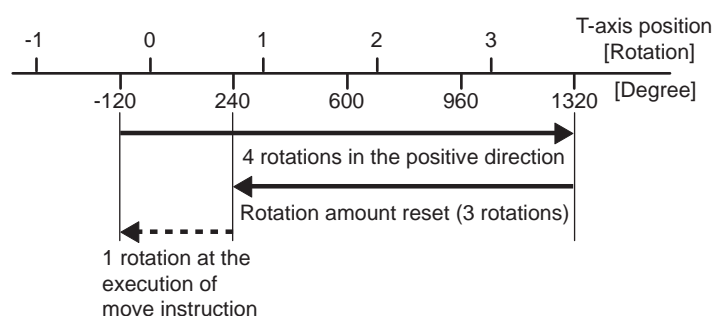


When rotating the T-axis in the positive direction, perform teaching so that it starts rotation at the position within 0 to 360 degrees. When rotating the T-axis in the negative direction, perform teaching so that it starts rotation at the position within -360 to 0 degrees.

If the T-axis rotates 2 or more rotations in the positive direction from the position within -360 to 0 degrees, or in the negative direction from the position within 0 to 360 degrees, the rotation amount and the reset rotation amount will differ by 1 rotation. Thus, note that when moving the T-axis to or close to the position before rotation, it rotates 1 rotation.



<Example> When the rotation amount is reset after 4 rotations in the positive direction from the position of -120 degrees



## 2.3 Suspending or Restarting Rotation

If the job execution is suspended during T-axis rotation by the following operations or in the following cases, the T-axis rotation is also suspended. When the job is restarted, the T-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 T-axis moves as it is taught without restarting rotation.

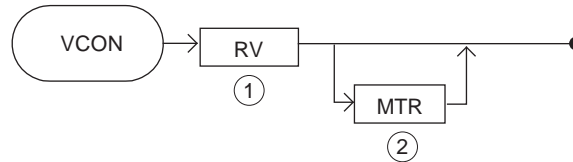
- Emergency stop or external emergency stop
- JOG operation
- Cursor moving operation
- Job selection
- Job editing operation
- Mode switching operation (Servo OFF)

## 3 Instruction

### 3.1 VCON (Speed Control Start Instruction)

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

The additional items to the VCON instruction are as follows.



#### ① RV

Setting range: -32768 to 32767

Unit:  $\text{min}^{-1}$  (revolutions per minute)

Sets the T-axis rotation speed.

If a positive value is set, the T-axis rotates in the positive direction; if a negative value is set, it rotates in the negative direction.

#### ② MTR

Setting range: 0.1 to 100.0

Sets the T-axis rotating amount.

T-axis rotates for the specified amount.

### 3.2 VCOF (Speed Control End Instruction)

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

The additional items to the VCOF instruction are as follows.



## 4 Registration of Instructions

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

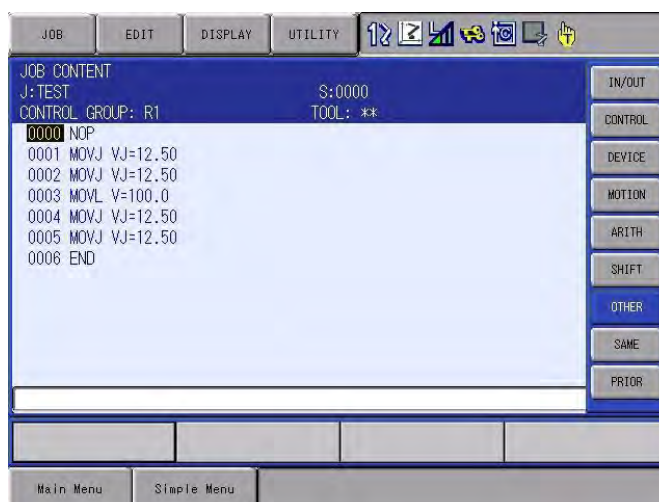
1. Select {JOB} under the main menu.
2. Select {JOB CONTENT}.
  - The JOB CONTENT display appears.



3. Move the cursor to the address area.

### 4.1 VCON (Speed Control Start Instruction)

1. Move the cursor to the address area.
2. Press the [INFORM LIST].
  - The instruction list dialog box appears.



3. Select {OTHER}.

## 4 Registration of Instructions

### 4.1 VCON (Speed Control Start Instruction)

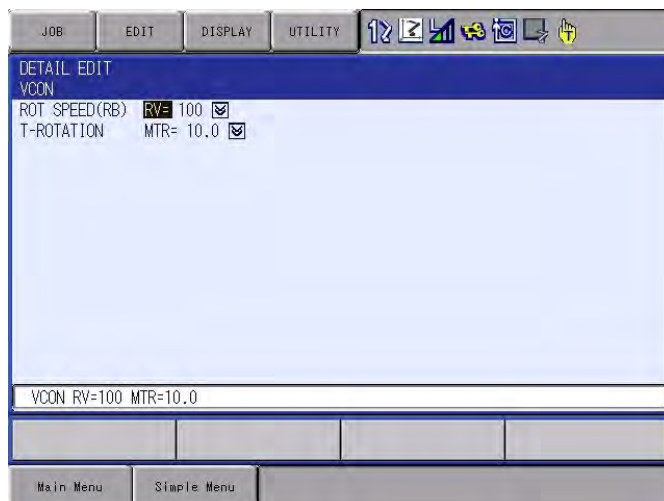
#### 4. Select {VCON}.

- The “VCON” instruction appears in the input buffer line.



#### 5. 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].



#### 6. Press [ENTER].

## 4.2 VCOF (Speed Control End Instruction)

1. Move the cursor to the address area.
2. Press the [INFORM LIST].
  - The instruction list dialog box appears.



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



5. Press [SELECT].
6. Press [ENTER].

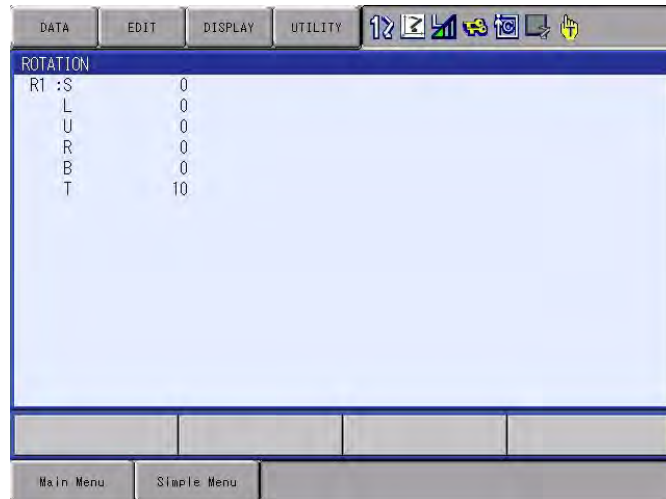
## 5 Display of Rotation Amount

The T-axis rotation amount can be viewed in the ROTATION display.

1. Select {ROBOT} under the main menu.

2. Select {ROTATION}.

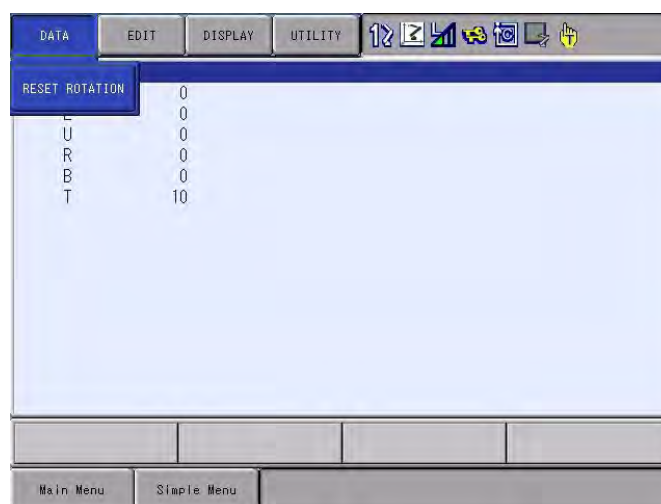
– The ROTATION display appears.



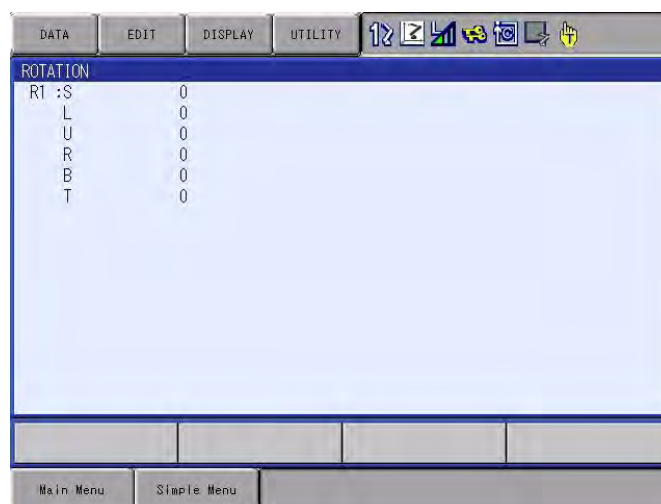
## 6 Resetting Rotation Amount

The T-axis rotation amount can be reset in the ROTATION display.

1. Select {ROBOT} under the main menu.
2. Select {ROTATION}.
3. Select {DATA} of the menu.
  - The pull-down menu appears.



4. Select {RESET ROTATION}.
  - The displayed T-axis rotation amount is changed into "0".





## 7 Restrictions

The following describes the restrictions of the T-axis speed control function.

### 7.1 Rotation Speed

The rotation speed varies in the following cases:

- When either the B-axis or R-axis operates.
- When the setting of the rotation speed exceeds the motor's maximum rotation speed, it is limited to the maximum rotation speed.

### 7.2 Maximum Rotation Amount

The maximum rotation amount is calculated as follows. The result differs depending on the manipulator model.

$$\text{Maximum rotation amount} = \pm 536870912 \text{ [pulse]}/\text{resolutions [pulse}/\text{min}^{-1}]$$

Do not set the rotation amount in one speed control section greater than the maximum rotation amount.

### 7.3 T-Axis Speed Control with Two Manipulators

The speed control start instruction (VCON) and end instruction (VCOF) cannot be set in a job with multiple control groups. To perform the speed control for each manipulator in a system using two manipulators, create the following job. Thus, make the control group call each job from the job R1+R2 to start and end the speed control for each manipulator.

- Example where R1 job is called

JOB: Work  
Control group: R1+R2

Line	Step	
000		NOP
001	001	MOVJ +MOVJ
002	002	MOVJ +MOVJ
003		CALL JOB:VCON-R1
004		TIMER T=0.50
005	003	MOVL +MOVL
006		CALL JOB:VCOF-R1
007	004	MOVJ +MOVJ

JOB: VCON-R1  
Control group: R1

Line	Step	
000		NOP
002		VCON
003		END

JOB: VCOF-R1  
Control group: R1

Line	Step	
000		NOP
002		VCOF
003		END

## **7.4 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.

## **7.5 After Turning OFF Power Supply During T-Axis Speed Control**

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

## **7.6 Turning ON Servo Power Supply**

In a system where the T-axis speed control is enabled, it takes longer to turn ON the servo power supply than ordinary operations. Keep pressing the servo ON button until you confirm that the servo power supply is turned ON.

## **7.7 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.

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## 8 Alarm List

Alarm No.	Message	Cause	Remedy
4353	DEFECTIVE TAUGHT POINT (ENDLESS)	Feedback pulse for speed- controlled axis exceeds $\pm 536870912$ pulses.	Reset the rotation amount. (Refer to <i>Chapter 6 Resetting Rotation Amount on page 6-1.</i> ) Recheck the setting so that the feedback pulse does not exceed the maximum number of pulses in one speed control section.

# DX200 OPTIONS INSTRUCTIONS

FOR T-AXIS SPEED CONTROL FUNCTION

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