

## VFD FEEDBACK CONTROL FUNCTION MANUAL

**For the DX200**

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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 manuals above correspond to specific usage.  
Be sure to use the appropriate manual.

Part Number: 177330-1CD  
Revision: 2

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## MANDATORY

- This manual explains operation procedures of the VFD Feedback Control system. Read this manual carefully and be sure to understand its contents before using the VFD Feedback Control.
- General items relating to safety are in the 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.

We suggest that you obtain and review a copy of the ANSI/RIA National Safety Standard for Industrial Robots and Robot Systems (ANSI/RIA R15.06-2012). You can obtain this document from the Robotic Industries Association (RIA) at the following address:

Robotic Industries Association  
900 Victors Way  
P.O. Box 3724  
Ann Arbor, Michigan 48106  
TEL: (734) 994-6088  
FAX: (734) 994-3338  
[www.roboticsonline.com](http://www.roboticsonline.com)

Ultimately, well-trained personnel are the best safeguard against accidents and damage that can result from improper operation of the equipment. The customer is responsible for providing adequately trained personnel to operate, program, and maintain the equipment. **NEVER ALLOW UNTRAINED PERSONNEL TO OPERATE, PROGRAM, OR REPAIR THE EQUIPMENT!**

We recommend approved Yaskawa training courses for all personnel involved with the operation, programming, or repair of the equipment.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications.

## Notes for Safe Operation

Read this manual carefully before operating the VFD Feedback Control.

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.



**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.



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 when the EMERGENCY STOP buttons on the front door of the DX200 and programing pendant are pressed. When the servo power is turned off, the SERVO ON LED on the programing 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 properly.

*Fig. : [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.

*Fig. : Release of EMERGENCY STOP Button*



- **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 the P-point envelope.**
  - **Display a sign that 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.**
  - **Ensure that there is 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 everyone is in a safe location before:**
  - **Turning on the power for the DX200.**
  - **Moving the manipulator with the programing pendant.**
  - **Running the system in the check mode.**
  - **Performing automatic operations.**

Injury may result if anyone enters the working envelope of the manipulator during operation. Always press an EMERGENCY STOP button immediately if there are problems.

EMERGENCY STOP buttons are located on the right of the front door of the DX200 and programing 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 processes are performed.
  - Check for problems within the manipulator movement area.
  - Check for damage to insulation and sheathing of external wires.
- Always return the programming pendant to its specified position after use.

If the programming pendant is inadvertently left on the manipulator, on a fixture, or on the floor, the angularities of the floor may activate the Enable Switch, and the servo power could be turned ON as a consequence. Also, when the manipulator starts its operation, the manipulator or a tool could collide with the inadvertently left programming pendant during manipulator movement, possibly causing injury or equipment damage.

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

## Definition of Terms Used In this Manual

The MOTOMAN manipulator is the YASKAWA industrial robot product.

The MOTOMAN usually consists of a controller, 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

Descriptions of the programming pendant keys, 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 is an exception, and a picture is not shown.
	Axis Keys Numeric Keys	"Axis Keys" and "Numeric 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 key  +COORD key 
	Mode Key	Three kinds of modes that can be selected by the mode key are denoted as follows: REMOTE, PLAY, or TEACH
	Button	Three buttons on the upper side of the programming pendant are denoted as follows: HOLD button START button EMERGENCY STOP button
	Displays	The menu displayed in the programming pendant is denoted with { }. ex. {JOB}
PC Keyboard		The name of the key is denoted ex. Ctrl key on the keyboard

## **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 TM are omitted.

## Explanation of Warning Labels


DANGER

- **The label described below is attached to the manipulator.**

Observe the precautions on the warning labels.  
Failure to observe this caution may result in injury or damage to equipment.

*Fig. : Warning Labels*

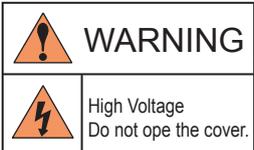


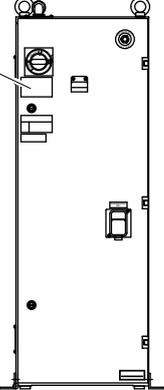


- **The following warning labels are attached to DX100.**

Observe the precautions on the warning labels.  
Failure to observe this warning may result in injury or damage to equipment.

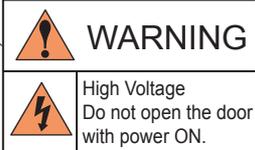
*Fig. : Location of Warning Labels*





Internal Breaker





## Safeguarding Tips

All operators, programmers, maintenance personnel, supervisors, and anyone working near the system must become familiar with the operation of this equipment. All personnel involved with the operation of the equipment must understand potential dangers of operation. General safeguarding tips are as follows:

- Improper operation can result in personal injury and/or damage to the equipment. Only trained personnel familiar with the operation of this equipment, the operator's manuals, the system equipment, and options and accessories should be permitted to operate this equipment.
- Improper connections can damage the equipment. All connections must be made within the standard voltage and current ratings of the equipment.
- The system must be placed in Emergency Stop (E-Stop) mode whenever it is not in use.
- In accordance with ANSI/RIA R15.06-2012, section 4.2.5, Sources of Energy, use lockout/tagout procedures during equipment maintenance. Refer also to Section 1910.147 (29CFR, Part 1910), Occupational Safety and Health Standards for General Industry (OSHA).

## Mechanical Safety Devices

The safe operation of this equipment is ultimately the users responsibility. The conditions under which the equipment will be operated safely should be reviewed by the user. The user must be aware of the various national codes, ANSI/RIA R15.06-2012 safety standards, and other local codes that may pertain to the installation and use of this equipment.

Additional safety measures for personnel and equipment may be required depending on system installation, operation, and/or location. The following safety equipment is provided as standard:

- Safety barriers
- Door interlocks
- Emergency stop palm buttons located on operator station

Check all safety equipment frequently for proper operation. Repair or replace any non-functioning safety equipment immediately.

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## Programming, Operation, and Maintenance Safety

All operators, programmers, maintenance personnel, supervisors, and anyone working near the system must become familiar with the operation of this equipment. Improper operation can result in personal injury and/or damage to the equipment. Only trained personnel familiar with the operation, manuals, electrical design, and equipment interconnections of this equipment should be permitted to program, or maintain the system. All personnel involved with the operation of the equipment must understand potential dangers of operation.

- Inspect the equipment to be sure no potentially hazardous conditions exist. Be sure the area is clean and free of water, oil, debris, etc.
- Be sure that all safeguards are in place. Check all safety equipment for proper operation. Repair or replace any non-functioning safety equipment immediately.
- Check the EMERGENCY STOP (E-STOP) button on the operator station for proper operation before programming. The equipment must be placed in Emergency Stop (E-Stop) mode whenever it is not in use.
- Back up all programs and jobs onto suitable media before program changes are made. To avoid loss of information, programs, or jobs, a backup must always be made before any service procedures are done and before any changes are made to options, accessories, or equipment.
- Any modifications to the controller unit can cause severe personal injury or death, as well as damage to the robot! Do not make any modifications to the controller unit. Making any changes without the written permission from YASKAWA will void the warranty.
- Some operations require standard passwords and some require special passwords.
- The equipment allows modifications of the software for maximum performance. Care must be taken when making these modifications. All modifications made to the software will change the way the equipment operates and can cause severe personal injury or death, as well as damage parts of the system. Double check all modifications under every mode of operation to ensure that the changes have not created hazards or dangerous situations.
- This equipment has multiple sources of electrical supply. Electrical interconnections are made between the controller and other equipment. Disconnect and lockout/tagout all electrical circuits before making any modifications or connections.
- Do not perform any type of operations before reading and understanding the proper procedures in the appropriate manual.
- Use proper replacement parts.
- Improper connections can damage the equipment. All connections must be made within the standard voltage and current ratings of the equipment.

## **Summary of Warning Information**

This manual is provided to help users establish safe conditions for operating the equipment. Specific considerations and precautions are also described in the manual, but appear in the form of Dangers, Warnings, Cautions, and Notes.

It is important that users operate the equipment in accordance with this instruction manual and any additional information which may be provided by YASKAWA. Address any questions regarding the safe and proper operation of the equipment to YASKAWA Customer Support.

## Customer Support Information

If you need assistance with any aspect of your VFD Feedback Control system, please contact YASKAWA Customer Support at the following 24-hour telephone number:

**(937) 847-3200**

For **routine** technical inquiries, you can also contact YASKAWA Customer Support at the following e-mail address:

[techsupport@motoman.com](mailto:techsupport@motoman.com)

When using e-mail to contact YASKAWA Customer Support, please provide a detailed description of your issue, along with complete contact information. Please allow approximately 24 to 36 hours for a response to your inquiry.



Please use e-mail for **routine** inquiries only. If you have an urgent or emergency need for service, replacement parts, or information, you must contact YASKAWA Customer Support at the telephone number shown above.

Please have the following information ready before you call Customer Support:

- |                            |  |
|----------------------------|--|
| • System                   | VFD Feedback Control   |
| • Robots                   | _____  |
| • Primary Application      | _____  |
| • Controller               | DX200  |
| • Software Version         | Access this information on the Programming Pendant's LCD display screen by selecting {MAIN MENU} - {SYSTEM INFO} - {VERSION} |
| • Robot Serial Number      | Located on the robot data plate  |
| • Robot Sales Order Number | Located on the DX200 controller data plate   |

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# 1 Introduction

## 1.1 About This Document

This manual is intended for personnel who has received operator training from YASKAWA and who are familiar with the operation of the VFD Feedback Control YASKAWA system. For more detailed information on any specific component or peripherals of the YASKAWA VFD Feedback Control function, please review the full documentation package that is included with the YASKAWA VFD Feedback Control function (refer to *section 1-2*).



This manual documents a standard YASKAWA VFD Feedback Control system. If your system is custom or modified, please use this manual in conjunction with the drawings, schematics, and parts listing (Bill of Material) for your specific system. The drawings, schematics, and parts listing are included in the documentation package supplied with your YASKAWA VFD Feedback Control system.

## 1.2 Function Overview

The VFD feedback option uses real time current feedback from a V1000 VFD motor controller to adjust the robot and tool speeds according to user defined current and speed set points. MotoPlus communicates with the VFD drive via Ethernet IP. Optionally, DeviceNet can also be used as the communications protocol if desired.

### 1.3 Typical Layout

The tool is installed as the robot end effector and the motor is controlled by the VFD. Four macros are utilized in the Inform jobs to control the required speed and define where and when to enable the control function.

Fig. 1-1: System Architecture (MotoPlus Application and DeviceNet/Internet IP Communication)

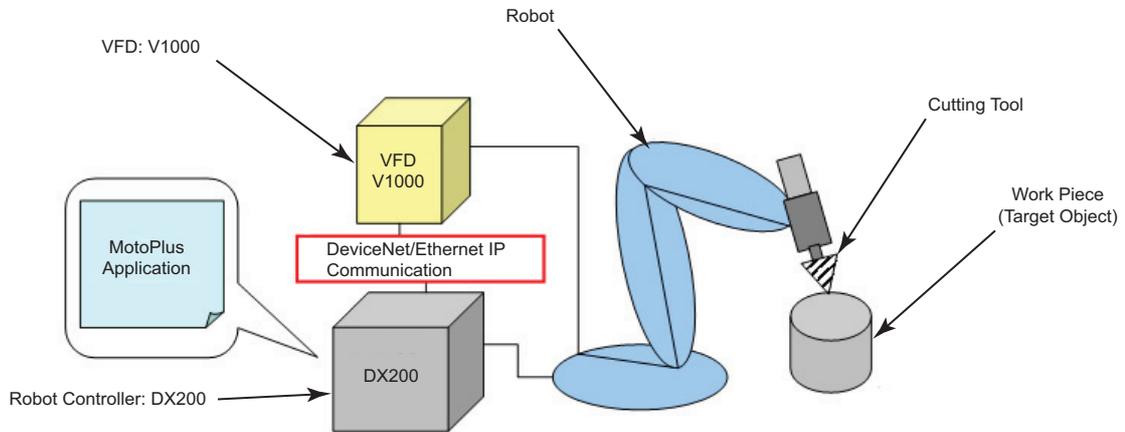
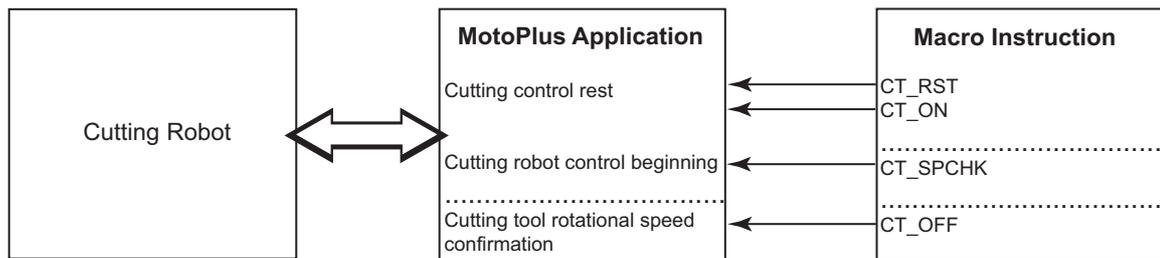


Fig. 1-2: System Communication



### 1.4 Corresponding Equipment

#### 1.4.1 Robot Controller Requirements

- Software version DX200 DN1.200.00A(\*)-00 or greater
- MotoPlus function
- Macro Function

#### 1.4.2 Inverter

Yaskawa inverter V1000 series (1000Hz specification)

- Ethernet IP Communication  
Necessary, optional unit: Unit SI-EN3/V for Ethernet IP communication
- DeviceNet Communication  
Necessary, optional DeviceNet option board for DX200 robot (Part#xxxxxxx)  
Necessary, optional unit: Unit SI-N3/V for DeviceNet communication

### 1.5 VFD Feedback Control Function

The VFD feedback control function prevents overloading of the tool by sensing the motor current and slowing the robot and/or tool. When the current rises above a specified threshold for a defined amount of time, the VFD feedback option slows the robot and/or tool to lower the load and allow the motor current to return to a level below the defined threshold.

The user sets the target current value, the detection time, the beginning and ending threshold levels as well as the desired slow down and recovery speeds of the robot and the tool.

Fig. 1-3: VFD Relationships

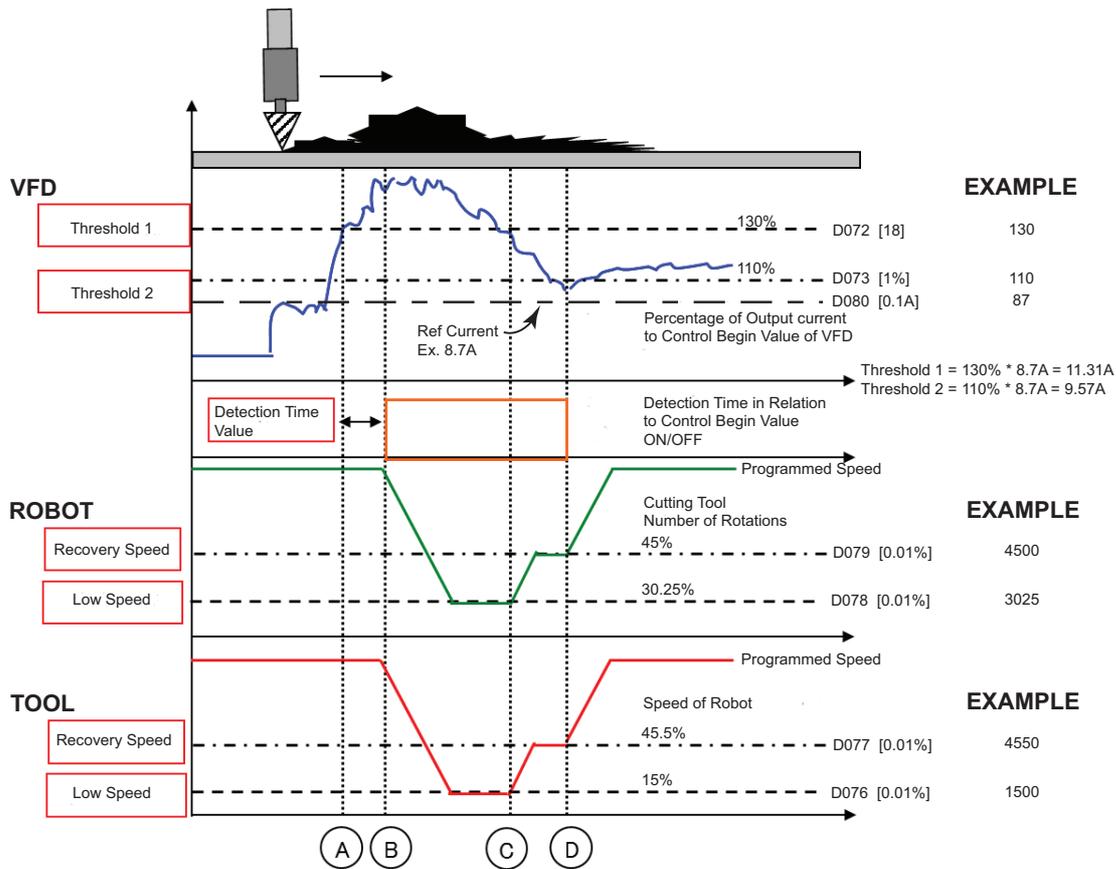


Table 1-1: VFD Relationships

	Condition	Movement of cutting tool and robot	Overcurrent Detection
A	Output current ≥ control beginning value and less than time of detection	Programmed speed of JOB	OFF
B	Output current ≥ passage of control beginning value and detection time	It decelerates to the low speed.	ON
C	Control beginning value ≥ output current ≥ control end value	It accelerates up to the recovery speed.	ON
D	Output current < control end value	Returns to the programmed speed	OFF

## **1.6 About the Operation at HOLD and the Emergency Stop**

The operation of HOLD and EMERGENCY STOP (servo OFF) is as follows in the PLAY mode.

### **1.6.1 HOLD Request**

The robot stops operating (servo ON), and the VFD motor maintains its set speed.

### **1.6.2 Resume from HOLD**

The robot restarts operation, and the motor continues following INFORM commands.

### **1.6.3 Emergency Stop**

The robot stops operating (servo OFF) and the motor attached to the VFD stops.

### **1.6.4 Clear the Emergency Stop**

Correct all causes of the emergency stop to both the robot and VFD drive and reset the emergency stop. Please see Yaskawa inverter V1000 technical manual (sentence number SIJP C710606 16G) and V1000 optional unit Ethernet IP/DeviceNet communication technical manual (sentence number SIJP C730600 28A) for reset procedures of the VFD.

### **1.6.5 Restarting from Emergency Stop**

When pressing the [START] button in PLAY MODE the VFD motor starts immediately. The HOLD light momentarily flashes and the START light goes out. When the speed of the VFD motor reaches the set speed the START light turns on and the robot resumes operation. The motor will continue to operate following INFORM commands.

## **1.7 CUBE 64 Interlock**

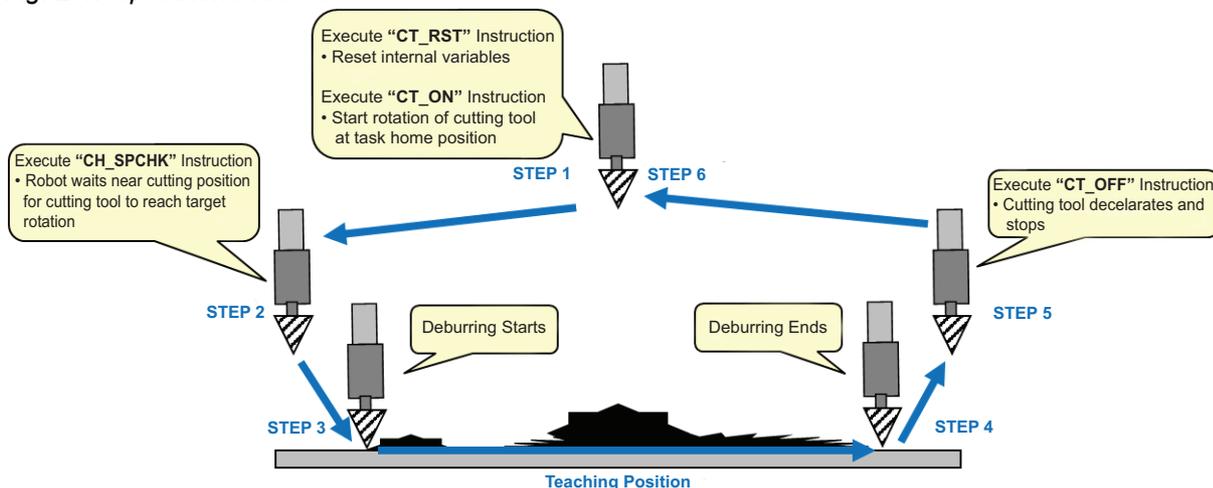
Create a CUBE 64 interference zone around the robot's normal start/restart position. This cube defines an area where there will be no attempt to do an emergency stop restart.

## 2 Example of Using VFD

### 2.1 Operation and Example of Job

The following example demonstrates a simple sequence using a grinder running at 15,000 RPM.

Fig. 2-1: Operation Process



- ① Reset instruction clears any previous settings
- ② Move to the work starting position.
- ③ The CT\_ON instruction starts the cutting tool with a speed of 15,000 rpm.
- ④ The robot moves to pre work position.
- ⑤ The CT\_SPCHK instruction waits until the motor speed reaches its requested speed.
- ⑥ The robot moves to the process beginning position.
- ⑦ The robot moves to the process end position.

- 
- ⑧ The robot moves to a clear position away from work.
  - ⑨ The CT\_OFF instruction causes the tool to decelerate to a stop.
  - ⑩ The robot moves back to the work start position.

VFD Feedback Control	3	Setup
	3.1	Robot Controller Settings

## 3 Setup

### 3.1 Robot Controller Settings

#### 3.1.1 Parameter Settings

Table 3-1: Parameter Setting

Parameter	Description	Value
S2C701	Enable Speed Override Function	1
S3D257	SKILLSND SLID = Robot 1	16
S3D346	SKILLSND Robot = Robot 1	16

#### 3.1.2 Setting the “D” Variable

Table 3-2: “D” Variable Settings

D Variable	Content	Unit	Setting Range
D070	Starting address of general-purpose input for communication (IN#) - The general-purpose starting address of the input I/O block # Please use the universal I/O number, not the logical I/O number (Ex 49 not 00070)	-	1 ~ 4025
D071	Starting address of general-purpose output for communication (OUT#) - The general-purpose starting address of the output I/O block # Please use the universal I/O number, not the logical I/O number (Ex 49 not 10070)	-	1 ~ 4025
D072	Ratio of Threshold 1 to reference current value	1 = 1%	0 ~ 200
D073	Ratio of Threshold 2 to reference current value	1 = 1%	0 ~ 200
D074	Overcurrent detection delay time	1 = 1 ms	0 ~ 60000
D075	VFD motor speed (rpm)	1 = 1rpm	-24000 ~ 24000
D076	Ratio of VFD low speed to VFD programmed speed	1 = 0.01%	0 ~ 10000
D077	Ratio of VFD recovery speed to VFD programmed speed	1 = 0.01%	0 ~ 10000
D078	Ratio of robot low speed to robot programmed speed	1 = 0.01%	0 ~ 15000
D079	Ratio of robot recovery speed to robot programmed speed	1 = 0.01%	0 ~ 15000
D080	VFD reference current. Normally FLA but not restricted.	1 = 0.1A	0 ~ 1000
D081	Communications type. 0 = EIP, 1 = DeviceNet	-	0 or 1
D082	Number of motor poles (default = 4)	-	2 ~ 24



To disable the slow down feature on the VFD, set both D076 and D077 to 100% = 10,000

### 3.2 V1000 Inverter Parameter Settings

Please see Yaskawa inverter V1000 technical manual (SIJP C710606 XXX) and V1000 optional unit Ethernet IP communication technical manual (SIEP YAICOM 15A) for details on setting parameters.

Table 3-3: Settings when using Ethernet IP Communications

Parameter	Content	Set Value	Factory Default	Description
b1-01	Frequency Instruction Selection 1	3	0	Instruction from optional unit
b1-02	Driving instruction selection 1	3	0	Instruction from optional unit
F6-01	Communications Error Operation Selection	0	1	Ramp to a stop
F6-02	Detection condition of external abnormality (EF0)	0	0	Detection always
F6-03	External Fault from Comm. Option Operation Selection	0	1	Ramp to a stop
F6-07	NetRef/ComRef select function	0	0	Multistep velocity instruction disabled
F6-08	Reset communication parameters	0	0	Neither F6 nor the F7 parameter are initialized by A1-03.
F7-01	IP Address 1	192 <sup>a)</sup>	192	Most significant octet of the static IP address
F7-02	IP Address 2	168 <sup>a)</sup>	168	Second most significant octet of the static IP address
F7-03	IP Address 3	255 <sup>a)</sup>	1	Third most significant octet of the static IP address
F7-04	IP Address 4	31 <sup>a)</sup>	20	Fourth most significant octet of the static IP address
F7-05	Subnet Mask 1	255	255	Most significant octet of the subnet mask
F7-05	Subnet Mask 2	255	255	Second most significant octet of the subnet mask
F7-05	Subnet Mask 3	255	255	Third most significant octet of the subnet mask
F7-05	Subnet Mask 4	0	0	Fourth most significant octet of the subnet mask

<sup>a</sup> This is the recommended Ethernet IP address but the most important consideration is that the address is on the same subnet as the robot

VFD Feedback Control      3    Setup  
    3.2 V1000 Inverter Parameter Settings

See Yaskawa inverter V1000 technical manual (SIJP C710606 XXX) and V1000 optional unit DeviceNet communication technical manual (SIEP C730600 43B) for details on setting parameters.

Table 3-4: Settings when using DeviceNet Communications

Parameter	Content	Set Value	Factory Default	Description
b1-01	Frequency Instruction Selection 1	3	0	Instruction from optional unit
b1-02	Driving instruction selection 1	3	0	Instruction from optional unit
F6-01	Operation selection when BUS error is detected	0	1	Deceleration stop
F6-02	Detection condition of external abnormality (EF0)	0	0	Detection always
F6-03	Operation selection when (EF0) is detected external and abnormally	0	1	Deceleration stop
F6-07	NetRef/ComRef select function	0	0	Multistep velocity instruction invalidity
F6-08	Parameter in communication tools reset	0	0	Neither F6 nor the F7 parameter are initialized by A1-03.
F6-50	MAC ID	1*	0	Do not overlap with ID=1 * another. Match it to the setting of DX200.
F6-51	Transmission rate	2	0	500 kbps
F6-52	PCA setting	101	21	(Yaskawa original specification assembly)Standard control
F6-53	PPA setting	151	71	(Yaskawa original specification assembly)Standard control 1
F6-54	Abnormal detection selection at idol mode	0	0	Abnormality is not detected at the idol mode.
o1-03	Unit of frequency instruction setting/display	0	0	Every 0.01Hz

### 3.3 Drive Output Assembly (Drive Consumes) - 101

Table 3-5: Speed/Torque Control Output - 101 (0x65)

Output Instance	Word	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit1	Bit 0
101	0	0		Multi-Function Input 7	Multi-Function Input 6	Multi-Function Input 5	Multi-Function Input 4	Multi-Function Input 3	Run Rev	Run Fwd
		1	Multi-Function Photo coupler 2	Multi-Function Photo coupler 1	Multi-Function Digital Output	-	-	-	Fault Reset	External Fault
1	2	Speed Reference (Low Byte)								
		Speed Reference (High Byte)								
2	4	Torque Reference (Low Byte), not supported								
		Torque Reference (High Byte), not supported								
3	6	Torque Compensation (Low Byte), not supported								
		Torque Compensation (High Byte), not supported								

### 3.4 Drive Input Assembly (Drive Produces) - 151

Table 3-6: Speed/Torque Status Input - 151 (0x97)

Output Instance	Word	Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit1	Bit 0
151	0	0	Faulted	Alarm	Ready	Speed Agree	Reset	REV Running	ZSP	Running
		1			Multi-Function Photo-coupler 2	Multi-Function Photo-coupler 1	Multi Function Digital Output	LOCAL/ REMOTE	Uv	oPE
1	2	Output Frequency (Low Byte)								
		Output Frequency (High Byte)								
2	4	Torque Actual (Low Byte), not supported								
		Torque Actual (High Byte), not supported								
3	6	Current Actual (Low Byte)								
		Current Actual (High Byte)								

---

### 3.5 Manual Operation

The VFD can be operated manually using a general-purpose output with the robot in TEACH mode and servos on.

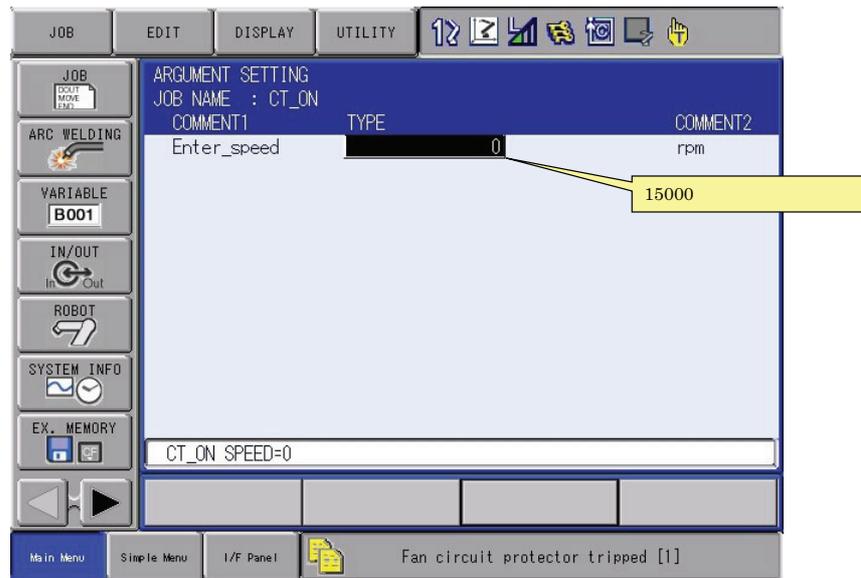
- Enable servos in TEACH mode.
- Energize the first bit of the general-purpose output address specified D071
- The VFD will start the motor with the speed specified in D075
- The VFD stops when the bit is de-energized or when servos are de-energized

**Example:** D071 = 49. D075 = 6000. The robot is in teach mode, servos are enabled and the dead man switch is depressed, general-purpose output #49 is energized. The VFD motor starts and runs at 6000 RPM until the dead man switch is released, or I/O #49 is de-energized, or the robot is switched to play mode.

## 4 Macro Instructions

### 4.1 CT\_ON: Begin Rotation

This instruction starts the VFD connected motor at the specified RPM. It waits for a 'READY' confirmation signal from the VFD. This instruction can be used to change speeds during a move as well as start the motor operation.



#### Content of Macro Instruction

```
0000 NOP
0001 GETARG LD000 IARG#(1)
0002 SET D075 LD000
0003 SET LD001 D070
0004 ADD LD001 5
0005 WAIT IN#(LD001) = ON 0006 SKILLSND ATTR = 3 "cutting_tool_on"
0007 END
```

- The VFD motor speed is set via an argument of CT\_ON which loads the requested speed into local variable LD000 by way of the GETARG instruction.
- The value of LD000 is transferred to D075.
- The option interface card starting address located in D070 is loaded into local variable LD001.
- Five is added to the value of LD001. This is the address of the inverter ready bit.
- The robot waits until the LD001 address bit is turned on.
- The VFD control 'tool on' is sent to MotoPlus via the SKILLSND instruction.

## 4.2 CT\_OFF Tool Stop

The tool stop command causes the VFD drive to initiate a ramp to stop operation.

Content of macro instruction

```
0000 NOP 0001 SKILLSND ATTR = 3 "cutting_tool_off"
0002 END
```

- The tool stop request is sent to MotoPlus via a SKILLSND instruction.

## 4.3 CT\_SPCHK: Cutting Tool Rotational Speed Confirmation

The robot waits until the actual speed of the motor reaches the requested speed set by the argument of the CT\_ON instruction.

Content of Macro instruction

```
0000 NOP
0001 SET LD000 D070
0002 ADD LD000 4
0003 WAIT IN#(LD000) = ON
0004 END
```

- Four is added to the value of LD000. This is the address of the inverter "speed agree" bit.
- The option interface card starting address located in D070 is loaded into local variable LD000.
- The robot waits until the speed agree bit turns on.

#### 4.4 CT\_RST: Cutting Control Reset

When this instruction is executed, the VFD control process is reset. This command should be executed immediately after the return to the starting point.

Content of macro instruction

```
0000 NOP
0001 SKILLSND ATTR = 3 "reset_home_position"
0002 END
```

VFD control reset is sent to MotoPlus by the SKILLSND instruction. It is possible to notify without stopping the robot operation by setting the ATTR to three.

ATTR	Description
1	After executing the command, does not stop the look ahead process.
2	After executing the command, continues the JOB without waiting for a response from the MotoPlus application.
3	Enables both of the two above
Other than above	Afer executing the command, stops the look-ahead processing and waits for the response of the MotoPlus application.

# VFD FEEDBACK CONTROL FUNCTION MANUAL

## For the DX200

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