YRC1000 OPTIONS
INSTRUCTIONS
FOR SPEED CONTROL FUNCTION

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

MOTOMAN INSTRUCTIONS

MOTOMAN-□□□ INSTRUCTIONS
YRC1000 INSTRUCTIONS
YRC1000 OPERATOR'S MANUAL (GENERAL) (SUBJECT SPECIFIC)
YRC1000 MAINTENANCE MANUAL
YRC1000 ALARM CODES (MAJOR ALARMS) (MINOR ALARMS)

The YRC1000 operator's manual above corresponds to specific usage. Be sure to use the appropriate manual.
The YRC1000 operator's manual above consists of "GENERAL" and "SUBJECT SPECIFIC".
The YRC1000 alarm codes above consists of "MAJOR ALARMS" and "MINOR ALARMS".

Please have the following information available when contacting Yaskawa Customer Support:
• System
• Primary Application
• Software Version (Located on Programming Pendant by selecting:
  {Main Menu} - {System Info} - {Version})
• Robot Serial Number (Located on robot data plate)
• Robot Sales Order Number (Located on controller data plate)

Part Number: 178682-1CD
Revision: 0
DANGER

• This manual explains the speed control function of the YRC1000 system. Read this manual carefully and be sure to understand its contents before handling the YRC1000. Any matter not described in this manual must be regarded as “prohibited” or “improper”.

• General information related to safety are described in “Chapter 1. Safety” of the YRC1000 INSTRUCTIONS. To ensure correct and safe operation, carefully read “Chapter 1. Safety” of the YRC1000 INSTRUCTIONS.

CAUTION

• In some drawings in this manual, the protective covers or shields are removed to show details. Make sure to install all the covers and shields in place before operating this product.

• YASKAWA is not responsible for incidents arising from unauthorized modification of its products. Unauthorized modification voids the product warranty.

NOTICE

• 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.
Notes for Safe Operation

Read this manual carefully before installation, operation, maintenance, or inspection of the YRC1000.

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

**DANGER** Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury. Safety Signs identified by the signal word DANGER should be used sparingly and only for those situations presenting the most serious hazards.

**WARNING** Indicates a potentially hazardous situation which, if not avoided, will result in death or serious injury. Hazards identified by the signal word WARNING present a lesser degree of risk of injury or death than those identified by the signal word DANGER.

**CAUTION** Indicates a hazardous situation, which if not avoided, could result in minor or moderate injury. It may also be used without the safety alert symbol as an alternative to “NOTICE”.

**NOTICE** NOTICE is the preferred signal word to address practices not related to personal injury. The safety alert symbol should not be used with this signal word. As an alternative to “NOTICE”, the word “CAUTION” without the safety alert symbol may be used to indicate a message not related to personal injury.

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

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

- Before operating the manipulator, make sure the servo power is turned OFF by performing the following operations. When the servo power is turned OFF, the SERVO ON LED on the programming pendant is turned OFF.
  - Press the emergency stop buttons on the front door of the YRC1000, on the programming pendant, on the external control device, etc.
  - Disconnect the safety plug of the safety fence.
    (when in the play mode or in the remote mode).

If operation of the manipulator cannot be stopped in an emergency, personal injury and/or equipment damage may result.

*Fig. : Emergency Stop Button*

- Before releasing the emergency stop, make sure to remove the obstacle or error caused the emergency stop, if any, and then turn the servo power ON.

Failure to observe this instruction may cause unintended movement of the manipulator, which may result in personal injury.

*Fig. : Release of Emergency Stop*

- Observe the following precautions when performing a teaching operation within the manipulator's operating range:
  - Be sure to perform lockout by putting a lockout device on the safety fence when going into the area enclosed by the safety fence. In addition, the operator of the teaching operation must display the sign that the operation is being performed so that no other person closes the safety fence.
  - View the manipulator from the front whenever possible.
  - Always follow the predetermined operating procedure.
  - Always keep in mind emergency response measures against the manipulator's unexpected movement toward a person.
  - Ensure a safe place to retreat in case of emergency.

Failure to observe this instruction may cause improper or unintended movement of the manipulator, which may result in personal injury.

- Confirm that no person is present in the manipulator's operating range and that the operator is in a safe location before:
  - Turning ON the YRC1000 power
  - Moving the manipulator by using the programming pendant
  - Running the system in the check mode
  - Performing automatic operations

Personal injury may result if a person enters the manipulator's operating range during operation. Immediately press an emergency stop button whenever there is a problem. The emergency stop buttons are located on the front panel of the YRC1000 and on the right of the programming pendant.

- Read and understand the Explanation of the Warning Labels 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.

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manual Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>YRC1000 controller</td>
<td>YRC1000</td>
</tr>
<tr>
<td>YRC1000 programming pendant</td>
<td>Programming pendant</td>
</tr>
<tr>
<td>Cable between the manipulator and</td>
<td>Manipulator cable</td>
</tr>
<tr>
<td>the controller</td>
<td></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</td>
<td></td>
</tr>
<tr>
<td>Character Keys /Symbol Keys</td>
<td>The keys which have characters or its symbol printed on them are denoted with [.]. ex. [ENTER]</td>
</tr>
<tr>
<td>Axis Keys /Numeric Keys</td>
<td>[Axis Key] and [Numeric Key] are generic names for the keys for axis operation and number input.</td>
</tr>
<tr>
<td>Keys pressed simultaneously</td>
<td>When two keys are to be pressed simultaneously, the keys are shown with a “+” 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 [SELECT] 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.
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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.

<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

![Speed control axis position diagram](image_url)
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)

NOTE
 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 speed control 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 speed control axis to or close to the position before rotation, it rotates 1 rotation.

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 speed control 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 speed control axis to or close to the position before rotation, it rotates 1 rotation.
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 5 or 6 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 11.
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 ③ or ④ and the axis specified in ③.
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 ③ or ④ and the axis specified in ③.
The speed control axis rotates for the specified amount.
Setting range: 0.1 to 100.0 (rotation)

- 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 Instruction
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="

NOTE
4 Registration of Instructions

4.1 VCON (Speed Control Start Instruction)

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}.
4. Registration of Instructions

4.1 VCON (Speed Control Start Instruction)

3. Select {VCON}.
   - The {VCON} instruction appears in the input buffer line.

![Image of screen showing VCON instruction in input buffer line]

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].

![Image of screen showing DETAIL EDIT display]

5. Press [ENTER].
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].
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 speed control axis rotation amount is changed into "0".
7 Restrictions

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 &quot;Resetting Rotation Amount&quot;). 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.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>⋅ 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.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>⋅ Don’t start the job which including control group under already operation by &quot;PSTART&quot; instruction.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>⋅ Set a manipulator axis (Robot=) of the active job control group to control the speed.</td>
</tr>
</tbody>
</table>
YRC1000 OPTIONS
INSTRUCTIONS
FOR SPEED CONTROL FUNCTION

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YASKAWA ELECTRIC CORPORATION

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