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

MOTOMAN INSTRUCTIONS
MOTOMAN--□□□ INSTRUCTIONS
DX100 INSTRUCTIONS
DX100 OPERATOR’S MANUAL
DX100 MAINTENANCE MANUAL

The DX100 Operator’s manual above corresponds to specific usage.
Be sure to use the appropriate manual.
MANDATORY

- This manual explains the Speed Reducer's Life Diagnostic Function of DX100. Read this manual carefully and be sure to understand its contents before handling the DX100.
- General items related to safety are listed in Chapter 1: Safety of the DX100 Instructions. To ensure correct and safe operation, carefully read the DX100 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 DX100.

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.

**NOTE**
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 DX100 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.

*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*

- 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 DX100.
  - 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 the front door of the DX100 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 DX100 cabinet 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 DX100 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:

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Manual Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>DX100 controller</td>
<td>DX100</td>
</tr>
<tr>
<td>DX100 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, 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</td>
<td>The keys which have characters printed on them are denoted with [ ]. ex. [ENTER]</td>
</tr>
<tr>
<td>Symbol Keys</td>
<td>The keys which have a symbol printed on them are not denoted with [ ] but depicted with a small picture. ex. page key</td>
</tr>
<tr>
<td>Axis Keys</td>
<td>&quot;Axis Keys&quot; and &quot;Number Keys&quot; are generic names for the keys for axis operation and number input.</td>
</tr>
<tr>
<td>Number 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.
1 Speed reducer Life Diagnosis Function ..........................................................................................1-1
  1.1 Diagnosis Principle ............................................................................................................1-1
    1.1.1 Constant Speed Torque ........................................................................................1-1
    1.1.2 Speed Reducer Diagnosing Database ........................................................................1-1
    1.1.3 Diagnosing Methods ..................................................................................................1-2
  1.2 System Outline ...................................................................................................................1-3
    1.2.1 Torque Data Collecting Function ..........................................................................1-3
    1.2.2 Torque Data Transmitting Function ......................................................................1-3
    1.2.3 Updating/Analyzing Function of The Speed Reducer Diagnosis Data Base ........1-3
  1.3 Applicable Version .............................................................................................................1-4

2 The Settings of the Speed Reducer Life Diagnosis Function ..........................................................2-1
  2.1 The Speed Reducer Life Diagnosis Function Settings ......................................................2-1
  2.2 Ethernet Settings ...............................................................................................................2-2
  2.3 Creating Measuring Jobs ..................................................................................................2-3
    2.3.1 Relevant Instructions ............................................................................................2-3
      2.3.1.1 TRQCLS ..................................................................................................2-3
      2.3.1.2 MEASON TRQ ........................................................................................2-4
      2.3.1.3 MEASOF TRQ/TRQDB ...........................................................................2-5
    2.3.2 Control Group .......................................................................................................2-6
    2.3.3 Control Axis ..........................................................................................................2-7
      2.3.3.1 Robot/Base Axis ......................................................................................2-7
      2.3.3.2 Station Axis .............................................................................................2-7
      2.3.3.3 Without Control Group .............................................................................2-7
    2.3.4 Setting Confirmation of the Control Group and the Control Axis .........................2-8
    2.3.5 Job Examples .....................................................................................................2-10
  2.4 Measurement Condition Settings .....................................................................................2-12
    2.4.1 Procedure for the Measurement Condition Settings ............................................2-12
    2.4.2 Details of the Measurement Conditions ................................................................2-14
      2.4.2.1 TORQUE VARIATION ACCEPT RATE .................................................2-14
      2.4.2.2 REDUCER LIVE DIAG. ALERT OUTPUT ..............................................2-14
      2.4.2.3 CONST SPEED TORQUE NG OUTPUT ...............................................2-14
      2.4.2.4 CONSECUTIVE DAYS (ACCEPT NG) .....................................................2-14
      2.4.2.5 CALCULATION DAYS ...........................................................................2-15
      2.4.2.6 ELAPSED DAYS FROM CALC. START ..................................................2-15
      2.4.2.7 LATEST MEASURED DAYS ................................................................2-16
      2.4.2.8 ERROR DELETE FILTER .....................................................................2-16
      2.4.2.9 ACCELERATION EXAMINATION .........................................................2-17
      2.4.2.10 ALARM OUTPUT (TRQ MEASURE.) .....................................................2-17
3 Execution of The Speed Reducer Life Diagnosis Function................................................. 3-1
  3.1 Execution of the Measuring Jobs..................................................................................... 3-1
  3.2 Confirmation of The Result......................................................................................... 3-1
    3.2.1 Servo Monitor Window ...................................................................................... 3-1
    3.2.2 The Speed Reducer Life Diagnosis Window..................................................... 3-2
    3.2.3 Details of The Speed Reducer Life Diagnosis Window........................................ 3-3
      3.2.3.1 NG COUNT (IN A ROW)............................................................................. 3-3
      3.2.3.2 NG COUNT (ACCUM.) ........................................................................... 3-3
      3.2.3.3 MEASURED DATE .................................................................................. 3-3
      3.2.3.4 MEAS. .................................................................................................... 3-3
      3.2.3.5 AVE. ....................................................................................................... 3-3
      3.2.3.6 VARIATION (The Determining Value)......................................................... 3-3
      3.2.3.7 LATEST ................................................................................................. 3-3
    3.2.4 Acceleration Examination...................................................................................... 3-4
    3.2.5 Stop the Alarm Signal Output................................................................................ 3-4
    3.2.6 Replacement of the Speed Reducer ................................................................... 3-5

4 Data Management............................................................................................................. 4-1
  4.1 External Memory........................................................................................................ 4-1
  4.2 Initializing the Data .................................................................................................... 4-2
  4.3 Transmission of the Torque Data ............................................................................... 4-4

5 Alarm................................................................................................................................. 5-1
  5.1 Signal Output............................................................................................................. 5-1
    5.1.1 Speed Reducer Life Alarm Output...................................................................... 5-1
    5.1.2 Constant Speed Torque Measurement NG Output ............................................ 5-1
  5.2 Alarms When Measuring ......................................................................................... 5-2
  5.3 Output by the Servo Monitor .................................................................................. 5-3
1 Speed Reducer Life Diagnosis Function

The Speed Reducer Life Diagnosis Function is a life span diagnosing function by analyzing the data from the database. When the manipulator’s motor of each axes is rotated at a constant speed, the running torque data is saved in the database.

This instruction manual explains the necessary settings and the relevant information of this function.

1.1 Diagnosis Principle

1.1.1 Constant Speed Torque

The torque waveforms when the manipulator is operated at each motor’s axes is called a constant speed torque.

Of these waveforms, the torque which shows the maximum value is called the maximum torque of the constant speed (hereforth referred as maximum torque), and the one which shows the minimum value within a fixed range with the maximum torque in the center is called the minimum torque of the constant speed (hereforth referred as minimum torque).

At this Speed Reducer Life Diagnosis Function, the absolute value of the difference between the maximum and minimum torque is regarded as the difference of the torque of the constant speed (hereforth referred as the torque differential) and it is recognized as a basic data for the life span diagnosis.

1.1.2 Speed Reducer Diagnosing Database

To conduct the life span diagnosis, it is necessary to recognize the torque differential by the periodical measurement of the constant speed torque under the same operating conditions. To do so, this function can save the daily measurement result in the database.

This database is called speed reducer diagnosing database.

This database saves the part of collected results as well as the measurement result. The data recorded in this database can be loaded/saved by using the external memory devices.
1.1.3 Diagnosing Methods

The life span curve shows the correlation between the torque differential and its operating time.

*Fig. 1-1: Life Span Curve*

As the state of the speed reducer changes ‘Break In’ → ‘Steady’ → ‘Deterioration’, the torque differential changes ‘Decrease’ → ‘Steady’ → ‘Increase’. This means, when the torque differential is increasing, the speed reducer can be diagnosed as in the deterioration period and about to fail.

The items to be checked to assume the tendency of the torque differential are shown below.

*Fig. 1-2: Detecting Principle*

The objective periods for the verification are defined as follows.

**Latest** : The past fixed period including the measurement day.

**Average** : The past fixed period before the nearest period, the measurement day as a reference.

Measure the average within above mentioned each data and calculate the respective latest and average values. The value calculate by the latest value - the average value is recognized as the determining value. When this value increases more than the fixed value, it alarms to notify that the speed reducer is going to fail soon.
1.2 System Outline

The Speed Reducer Life Diagnosis Function consists of software solitary and doesn’t need any special hardware.

The software itself consists of three sub functions shown below.

Fig. 1-3: Function Configuration

1.2.1 Torque Data Collecting Function

This function monitors the torque data of each axes, extracts the maximum and minimum torques, and saves them in the servo monitor data.

This function is shown as A in fig. 1-3 “Function Configuration” at page 1-3.

1.2.2 Torque Data Transmitting Function

This function transmits the maximum and minimum torques in the servo monitor data to the external PC. It is used when making an in-depth analysis by the external PC originally.

This function is shown as B in fig. 1-3 “Function Configuration” at page 1-3.

1.2.3 Updating/Analyzing Function of The Speed Reducer Diagnosis Data Base

This function updates the Speed Reducer Diagnosis database by the maximum and minimum torques in the servo monitor data. Furthermore, it can analyze its cumulative data. Also, it shows the result of the analysis on the programming pendant window or it outputs the signal as an alarm when diagnosed as the failure.

This function is shown as C in fig. 1-3 “Function Configuration” at page 1-3.
1.3 Applicable Version

The Speed Reducer Diagnosis Function is applicable from version No. : DS1.20.00A(**)-00.

As for the application to other versions, contact your Yaskawa representative.
2 The Settings of the Speed Reducer Life Diagnosis Function

To utilize the Speed Reducer Life Diagnosis Function, please follow the setting methods shown in this section.

2.1 The Speed Reducer Life Diagnosis Function Settings

Validate the parameter of The Speed Reducer Life Diagnosis Function. (The customer is not allowed to change this parameter. As for its settings, contact your Yaskawa representative.)

After validating this parameter, initialize the instruction with the following procedures.

1. Change the security mode to the “Management Mode”.
2. Select {SETUP} under the main menu
   - The sub menu appears.
3. Select {TEACHING COND}.
   - The teaching condition window appears.
4. Select {DATA}.
   - The pull-down menu appears.
5. Select {RESET INSTRUCTION}.
   - The confirmation dialog box appears.
6. Select [YES].
   - Instruction is initialized.
2.2 Ethernet Settings

The constant speed torque data can be read from the external PC via ethernet.

When reading, the ethernet setting is required and the FTP function setting is required as the need arises.

For the details of these functions and settings, please refer “3 Ethernet Function Settings” in DX100 OPTIONS INSTRUCTIONS FOR ETHERNET FUNCTION (HW0485429) and DX100 OPTIONS INSTRUCTIONS FOR FTP FUNCTION (HW0485556).
2.3 Creating Measuring Jobs

To perform the life diagnosis, measurement of the maximum and minimum torques under the same operational conditions is necessary. For this operation, create jobs for the measurement.

2.3.1 Relevant Instructions

When measuring the maximum and minimum torques, follow the instructions below.

2.3.1.1 TRQCLS

“TRQCLS” instruction clears the past maximum and minimum torques which are saved in the servo monitor data. This instruction should be executed before starting the measurement.

<table>
<thead>
<tr>
<th>TRQCLS (Torque·Clear)</th>
<th>Function</th>
<th>Additional Item</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Clear the constant speed torque data in the servo monitor data.</td>
<td></td>
<td>TRQCLS</td>
</tr>
</tbody>
</table>
“MEASON TRQ” instruction starts the measurement of maximum and minimum torques.

In case of the cause of the stop occurs during the measurement such as emergency stop, hold or alarm, finish the measurement after setting NG data to the measured value in the servo monitor data.

When the revolution speed of the motor deviates from the basic speed condition, it saves the maximum and minimum torques value in the servo monitor data and completes it successfully.

<table>
<thead>
<tr>
<th>MEASON (MEASURE · ON)</th>
<th>Function</th>
<th>Start the measurement of maximum and minimum torques</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Additional Items</strong></td>
<td><strong>TRQ</strong> (Speed Reducer Life Diagnosis setting)</td>
<td>It is compulsory to use it for the speed reducer life diagnosis.</td>
</tr>
<tr>
<td>AXIS= (Objective axis setting)</td>
<td>Control axis setting (Refer “2.3.3 Control Axis”)</td>
<td></td>
</tr>
<tr>
<td>BASICV= (Basic speed)</td>
<td>BASICV: 1 to 100 % % to MAXPPS</td>
<td></td>
</tr>
<tr>
<td>BASICT= (Basic speed continuance time)</td>
<td>BASICT: Positive value (msec)</td>
<td></td>
</tr>
<tr>
<td>Sample</td>
<td>MEASON TRQ AXIS=1 BASICV=10 BASICT=10</td>
<td></td>
</tr>
</tbody>
</table>

**Fig. 2-1: MEASON TRQ**

![Diagram of MEASON TRQ measurement](image)
2.3.1.3 MEASOF TRQ/TRQDB

"MEASOF TRQ" instruction finishes the measurement of the constant speed torque and then, saves the maximum and minimum torques in the servo monitor data and to the speed reducer diagnosis database. Furthermore, if it is not an acceleration examination, it processes the data in the speed reducer diagnosis database to determine the life span. When operating this instruction, it overwrites the existing data of the day if any so that only one datum per day is accepted for the life diagnosis.

"MEASOF TRQDB" instruction is required only when conducting the acceleration examination.

"MEASOF TRQ" doesn't process the data of the speed reducer diagnosis database nor determine the life span when conducting an acceleration examination. Instead, "MEASOF TRQDB" dose it.

When operating this instruction, the result data is saved as the latest one at each time. (not the daily data but each data is accepted for the diagnosis). This instruction is valid only when it is an acceleration examination.

<table>
<thead>
<tr>
<th>MEASOF (MEASURE · OFF)</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Finish the torque measurement, save the result to the database and diagnose the life span.</td>
<td></td>
</tr>
<tr>
<td>Additional Item</td>
<td>TRQ(Speed Reducer Life diagnosis setting)</td>
<td>It is compulsory to use it for the speed reducer life diagnosis.</td>
</tr>
<tr>
<td></td>
<td>TRQDB(Acceleration examination setting for the Speed Reducer Life Diagnosis)</td>
<td></td>
</tr>
<tr>
<td>Example</td>
<td>MEASOF TRQ</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MEASOF TRQDB</td>
<td></td>
</tr>
</tbody>
</table>
2.3.2 Control Group

The DX100 regards singly or plurally organized operational object axis as "Control Group". And it is classified into "Robot", "Base" and "Station".

<table>
<thead>
<tr>
<th>Classification</th>
<th>Explanation</th>
<th>Designation for the DX100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Robot</td>
<td>Indicate the manipulator itself.</td>
<td>R1, R2, R3, R4, R5, R6, R7, R8</td>
</tr>
<tr>
<td>Base</td>
<td>The axis that move the manipulator. It corresponds to Servo truck etc. The robot and the base should be operated by the same numbers. (R1-B1, R2-B2, R3-B3, R4-B4)</td>
<td>B1, B2, B3, B4, B5, B6, B7, B8</td>
</tr>
<tr>
<td>Station</td>
<td>The axis other than for the robot and base, instead, in charge of operating and turning the jigs.</td>
<td>S1, S2, S3, S4, S5, S6, S7, S8, S9, S10, S11, S12, S13, ..., S24</td>
</tr>
</tbody>
</table>

When diagnosing the life of the speed reducer, the measurement should be carried out by either "Robot", "Robot +Base" or "Station" control group.
2 The Settings of the Speed Reducer Life Diagnosis Function

DX100

2.3 Creating Measuring Jobs

2.3.3 Control Axis

The “AXIS=“ tag of “MEASOF TRQ” enables to set which axes to be measured within the control group. As for the setting values, set the axis configuration values at each control group as a reference.

Those values are displayed in the CONNECTION window while it is in the maintenance mode. As for the Robot/Station axis, use the values as they are and when it is the base axis, plus 8 to the values as their values.

2.3.3.1 Robot/Base Axis

Set the following values to “AXIS=“ when the jobs for the control groups are “Robot” or “Robot +Base”.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Value to the AXIS=</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>S Axes</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>L Axes</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>U Axes</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>R Axes</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>B Axes</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>T Axes</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>C Axes</td>
<td>7</td>
<td>Normal robot doesn’t equip it.</td>
</tr>
<tr>
<td>W Axes</td>
<td>8</td>
<td>Normal robot doesn’t equip it.</td>
</tr>
<tr>
<td>Base 1st Axes</td>
<td>9</td>
<td>Option</td>
</tr>
<tr>
<td>Base 2nd Axes</td>
<td>10</td>
<td>Option</td>
</tr>
<tr>
<td>Base 3rd Axes</td>
<td>11</td>
<td>Option</td>
</tr>
</tbody>
</table>

2.3.3.2 Station Axis

Set the following values to the “AXIS=“ when the jobs for the control group is station axis.

<table>
<thead>
<tr>
<th>Axis</th>
<th>Value to the AXIS=</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Station 1st Axes</td>
<td>1</td>
<td>Option</td>
</tr>
<tr>
<td>Station 2nd Axes</td>
<td>2</td>
<td>Option</td>
</tr>
<tr>
<td>Station 3rd Axes</td>
<td>3</td>
<td>Option</td>
</tr>
<tr>
<td>Station 4th Axes</td>
<td>4</td>
<td>Option</td>
</tr>
<tr>
<td>Station 5th Axes</td>
<td>5</td>
<td>Option</td>
</tr>
<tr>
<td>Station 6th Axes</td>
<td>6</td>
<td>Option</td>
</tr>
<tr>
<td>Station 7th Axes</td>
<td>7</td>
<td>Option</td>
</tr>
<tr>
<td>Station 8th Axes</td>
<td>8</td>
<td>Option</td>
</tr>
</tbody>
</table>

2.3.3.3 Without Control Group

The job without control group cannot operate “MEASON TRQ” instruction.
2.3.4 Setting Confirmation of the Control Group and the Control Axis

The registered control groups at present can be confirmed by following procedures.

1. Turn ON the power supply while pressing [MAIN MENU].
   – Maintenance mode starts.
2. Select {SYSTEM} under the main menu.
   – The sub menu appears.
3. Select {SET UP}.
   – The SETUP window appears.
4. Select {CONTROL GROUP}.
   – The CONTROL GROUP window appears.
   – In this window, the setting status of the current control group is indicated. (R1 to R8, B1 to B8, S1 to S24)
5. Press [ENTER].

- The CONNECT window appears.
- In this window, the defined control groups and the axis configuration of the control groups are displayed. The axis configurations of each control group are shown within the following frame.
2.3.5 Job Examples

As for the job examples for measurement, the followings are the ones when conducting acceleration examination with R1 (6 axis) + B1 (1 axes) + S1 (2 axis) system.

When it is not the acceleration examination, the measurement can be executed at both registered/not registered condition since "MEASOF TRQDB" doesn't process it. (The results don't change.)

Job “MASTER” (No Control Group)

<table>
<thead>
<tr>
<th>NOP</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRQCLS</td>
<td></td>
</tr>
<tr>
<td>'ROBO_BASE ------</td>
<td></td>
</tr>
<tr>
<td>CALL JOB: R1MEAS</td>
<td></td>
</tr>
<tr>
<td>'STATION ------</td>
<td></td>
</tr>
<tr>
<td>CALL JOB: S1MEAS</td>
<td></td>
</tr>
<tr>
<td>'CALC -------</td>
<td></td>
</tr>
<tr>
<td>MEASOF TRQDB</td>
<td></td>
</tr>
<tr>
<td>END</td>
<td></td>
</tr>
</tbody>
</table>

Constant speed torque data is cleared

Job “R1MEAS” (Control Group : R1+B1)

<table>
<thead>
<tr>
<th>NOP</th>
<th>Explanation</th>
</tr>
</thead>
</table>
| MOVJ VJ = 20.00 | Move to the home position
| TIMER T = 1.00 | |
| 'S ------- | |
| MEASON TRQ AXIS = 1 BASICV = 10 BASICT = 10 | Measurement start
| MOVJ VJ = 20.00 | Perform S Axes only
| TIMER T = 1.00 | |
| MEASOF TRQ | |
| MOVJ VJ = 20.00 | |
| TIMER T = 1.00 | Return to the home position

-------- S Axes --------

-------- L Axes --------

-------- T Axes --------

-------- Base 1st Axes --------

Move to the home position

Measurement start

Perform T Axes only

Measurement end

Return to the home position
Job “S1MEAS” (Control Group : S1) | Explanation
---|---
NOP | Move to the home position
MOVJ VJ = 20.00 | Measurement start
TIMER T = 1.00 | Perform Base 1st Axes only
STATION 1st Axis -------- | Measurement end
MEASON TRQ AXIS = 1 BASICV = 10 BASICT = 10 | Return to the home position
MOVJ VJ = 20.00 | ------- Station 1st Axes -------
TIMER T = 1.00 | Measurement start
MEASOF TRQ | Perform Base 2nd Axes only
MOVJ VJ = 20.00 | Measurement end
TIMER T = 1.00 | Return to the home position
END | ------- Station 2nd Axes -------
STATION 2nd Axis -------- | Measurement end
The Settings of the Speed Reducer Life Diagnosis Function

2.4 Measurement Condition Settings

The followings are the setting procedures for the measurement conditions.

2.4.1 Procedure for the Measurement Condition Settings

1. Change the security mode to the management mode.

2. Select {APPLICATION} under the main menu.
   - The sub menu appears. (Mentioned below is the example window for spot welding.)

3. Select {REDUCER DIAG}.
   - The Speed Reducer Life Diagnosis window appears.
2. The Settings of the Speed Reducer Life Diagnosis Function

DX100

2.4 Measurement Condition Settings

4. Select {DATA}.

  – The pull down menu appears.

5. Select {SETUP CONDITION}.

  – The SETUP CONDITION window appears.

  – Modify the data as needed.

6. Select {COMPLETE}.

  – Return to the Speed Reducer Life Diagnosis window.
2.4.2 Details of the Measurement Conditions

Each measurement condition has the following meanings.

2.4.2.1 TORQUE VARIATION ACCEPT RATE

When the determining value (the latest value - the average value) is the same or smaller than the value set here, it is regarded as accept OK. If it is bigger than the set value, it is accept NG.

The initial value here is 50.

Fig. 2-2: Torque Variation Accept Rate

2.4.2.2 REDUCER LIVE DIAG. ALERT OUTPUT

When the continuous number of days that are regarded as accept NG (the latest value - the average value > torque variation accept rate) exceeds the specified number of accept NG days, the general output signal is turned ON. Set 0 when not willing to output the signal.

The initial value here is 0.

2.4.2.3 CONST SPEED TORQUE NG OUTPUT

Turn on the general output signal which is set here when the constant speed torque measurement is failed. Set 0 when not willing to output the signal.

The initial value here is 0.

2.4.2.4 CONSECUTIVE DAYS (ACCEPT NG)

When the number of continuous accept NG (the latest value - the average value > torque variation accept rate) days exceeds the days set here, the life of the speed reducer is determined to end soon.

The initial value here is 3 (days).
2.4.2.5 CALCULATION DAYS

Set the period to calculate the average value. The initial value here is 30 (days).

Fig. 2-3: Calculation Days

2.4.2.6 ELAPSED DAYS FROM CALC. START

Set the numbers of day commencing from the measurement day (today) in order to calculate the average value. The initial value here is 30 (days).

Fig. 2-4: Elapsed Days From CALC. Start
2.4.2.7 LATEST MEASURED DAYS

Set the number of days starting from the measurement day (today) to calculate the latest value. The initial value here is 5 (days).

Fig. 2-5: Latest Measured Days

2.4.2.8 ERROR DELETE FILTER

This filter is for deleting the error values when calculating the average value. The following measured values (torque differential) are eliminated from this calculation.

- When the average value of the previous day exists
  
  The the previous day's average value / Any measured values within average period x 100 > The set value of the deleting filter

  Any measured values within average period / The the previous day's average value x 100 > The set value of the deleting filter

- When the previous day's average value does not exist. (Before the period set by ELAPSED DAYS FROM CALC.START.)
  
  The latest value / Any measured values within the average period x 100 > The set value of the deleting filter

  Any measured values within average period / The latest value x 100 > The set value of the deleting filter

The initial value here is 200 (%).
2.4.2.9 ACCELERATION EXAMINATION

At normal settings, the existing data of the day is overwritten when the speed reducer diagnosis database is upgraded.

This enables us to try the measurement again when failing to it. On the other hand, some cases require to upgrade the speed reducer diagnosis database at each measurement.

In these cases, by setting this function “VALID” and executing “MEASOF TRQDB”, the database can be upgraded at each measurement time.

2.4.2.10 ALARM OUTPUT (TRQ MEASURE.)

When failed to measure the constant speed torque, the alarm output is possible to determine the cause of the failure.

On the other hand, it is also possible not to output the alarm to avoid other robots’ operations that are in motions.

Set this function “VALID” for alarm output and “INVALID” for no alarm output.
3 Execution of The Speed Reducer Life Diagnosis Function

The followings are the operational manuals of the Speed Reducer Life Diagnosis function.

3.1 Execution of the Measuring Jobs

Execute the measuring job for one cycle.

Determine the life span by saving the maximum and minimum torques to the servo monitor data and to the reducer diagnosis database. After the reducer life alarm output is set, the signal will be output when the left life span is short. Also, if the constant speed torque measurement finished abnormally when the constant speed torque measurement NG output is set, the alarm will be output.

NOTE
Execute the measuring job everyday so that the constant speed torque data enough for reducer diagnosis database is saved. If there is no enough data, the appropriate determination might not be conducted.

3.2 Confirmation of The Result

The measured result can be referred as follows.

3.2.1 Servo Monitor Window

The measured maximum and minimum torques are referred by the operations below.

1. Change the security mode to the management mode.
   – The sub menu appears.
2. Select {ROBOT} under the main menu.
3. Select {SERVO MONITOR}
   – The servo monitor window appears.
4. Select {DISPLAY}
   – The pull down menu appears.
5. Select {MONITOR ITEM1} or {MONITOR ITEM2}
   – The desired item appears.
6. Select {MAX TRQ (CONST)} or {MIN TRQ (CONST)}.
   – The {MAX TRQ (CONST)} or {MIN TRQ (CONST)} are set as an item in the monitor.

NOTE
The servo monitor data is cleared when turning OFF the DX100 power. In this case, conduct the measurement again and refer the servo monitor window after turning on the DX100 power.
3.2.2 The Speed Reducer Life Diagnosis Window

The torque differential or the diagnosis are referred by the following procedures.

1. Select {APPLICATION} under the main menu.
   - The sub menu appears.
     ( Mentioned below is the example window for spot welding. )

2. Select {REDUCER DIAG}.
   - The speed reducer life diagnosis window appears.

Press the page key if necessary.
Possible to refer the data of a certain date which corresponds to the number of times you press the page key.
3.2.3 Details of The Speed Reducer Life Diagnosis Window

The respective items appear in the window have the following meanings.

3.2.3.1 NG COUNT (IN A ROW)

This item means the number of the days that the determination value exceeds TORQUE VARIATION ACCEPT RATE continuously. When this number exceeds CONSECUTIVE DAYS (ACCEPT NG), the speed reducer life alarm is output.

3.2.3.2 NG COUNT (ACCUM.)

This item means the total number of days that the determination value exceeds TORQUE VARIATION ACCEPT RATE. When a day which doesn’t exceed TORQUE VARIATION ACCEPT RATE exists, the number of NG COUNT (IN A ROW) returns to 0, however the number of NG COUNT (ACCUM.) will not return to 0.

3.2.3.3 MEASURED DATE

This item means the date when these measurements mentioned on this page are conducted and the speed reducer diagnosis database is updated.

3.2.3.4 MEAS.

This item means the torque differential (The absolute value of maximum torque - minimum torque) measured on the measurement day.

3.2.3.5 AVE.

This item means the arithmetical average value within the average period (A certain period of days before the calculating period, measurement day as a reference). However, the deleted value by ERROR DELETE FILTER is not included.

3.2.3.6 VARIATION (The Determining Value)

This item means the difference between the latest value and the average value. When this exceeds the value set by TORQUE VARIATION ACCEPT RATE, it is determined as accept NG.

3.2.3.7 LATEST

This item means the arithmetical average value within latest period (A past certain period of days including the measurement day).
3.2.4 Acceleration Examination

Conduct the measurement after validating the acceleration examination in the setup condition window of the speed reducer life diagnosis. The each result of "MEASOF TRQDB" is regarded as the latest one and saved in the speed reducer diagnosis database.

When disable the examination, only the last "MEASOF TRQDB" result of the day is saved in the speed reducer diagnosis database as its measured result.

3.2.5 Stop the Alarm Signal Output

Refer the following procedures to stop the output of speed reducer life diagnosis signal and constant speed torque measurement NG signal.

1. Change the security mode to the management mode.
2. Select {APPLICATION} under the main menu.
   – The sub menu appears.
3. Select {REDUCER DIAG}.
   – The Speed Reducer Life Diagnosis window appears.
4. Select {UTILITY}.
   – {RESET LIFE ERROR} appears in the pull down menu when speed reducer life alarm signal is output.
   – {RESET MEAS ERROR} appears when constant speed torque measurement NG signal is output.
5. Select {RESET LIFE ERROR} or {RESET MEAS ERROR}.
   – The selected signal output stops.
   – The stopped signal would not appear in the pull down menu even if {UTILITY} is selected.
3.2.6 Replacement of the Speed Reducer

When replacing the speed reducer, the previous reducer’s data causes the incorrect life diagnosis. To avoid this, the further use of the previous data can be avoided by setting the date of the speed reducer replacement. When setting the date, please refer the following procedures. Although the previous data is no longer needed for its diagnosis, it can be referred continuously.

1. Change the security mode to the management mode.
2. Select {APPLICATION} under the main menu.
   - The sub menu appears.
3. Select {REDUCER DIAG}.
   - The speed reducer life diagnosis window appears.
4. Select {DISPLAY}.
   - The pull down menu appears.

5. Select {EXCHANGED DATE}.
   - The speed reducer replacement date window appears.
6. Set the date of the speed reducer replacement.
   - Set the speed reducer replacing date with the numeric keys.
4 Data Management

4.1 External Memory

The speed reducer diagnosis database and its measuring conditions are loaded/saved by the external memory menu. Refer “7 External Memory Devices” in “DX100 OPERATOR’S MANUAL” for the details.

1. Select {FD/PC CARD} under the main menu.
   – The external memory menu appears
2. Select {LOAD} or {SAVE}.
   – The load or the save window appears.
3. Select {SYSTEM DATA}.
   – The system data selection window appears.
   (Mentioned below is the example window when save is selected.

4. Select the system data for loading or saving.
   – Select (REDUCER LIFE DIAG. FILE) in the speed reducer life diagnosis database. Select (REDUCER LIFE DIAG. COND) for the measuring conditions.
   – "*" is displayed to the selected system data.
5. Press [ENTER].
   – A confirmation dialog box appears.
6. Select {YES}.
   – The selected system data is saved.
4.2 Initializing the Data

The speed reducer diagnosis database and its measuring conditions can be initialized by the File menu in maintenance mode.

1. Turn ON the power supply while pressing [MAIN MENU].
   – Maintenance mode is executed.

2. Change the security mode.
   – Change the security mode to the “Management Mode”.

3. Select {FILE} under the main menu.
   – The file menu appears.

4. Select {INITIALIZE}.

5. Select the system data to be initialized.
   – Select {REDUCER LIFE DIAG. FILE} in the speed reducer life diagnosis database. Select {REDUCER LIFE DIAG. FILE} for the measuring conditions.
   – “*” is displayed to the selected system data.
4 Data Management
4.2 Initializing the Data

6. Press [ENTER].
   – A confirmation dialog box appears.

7. Select {YES}.
   – The selected data is initialized.
### 4.3 Transmission of the Torque Data

The torque data can be read from the external PC by using the data transmitting function.

In this case, it is read by “trqdat.dat” file. Followings are the formats of this file.

Refer “DX100 Data Transmission Function(RE-CKI-A456)” for details.

<table>
<thead>
<tr>
<th>trqdat.da</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Example of Control Group:R1 )</td>
<td>File identifier</td>
</tr>
<tr>
<td>//TRQDAT</td>
<td>Constituent element identifier</td>
</tr>
<tr>
<td>//NUM_ELEMENT</td>
<td>Maximum system component (R8,B8,S24)</td>
</tr>
<tr>
<td>8,8,24</td>
<td>Existing axis (at this line R1= 6 axis and no other axis)</td>
</tr>
<tr>
<td>6,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0</td>
<td>Torque data (%): S axis torque max. and min. value</td>
</tr>
<tr>
<td>13,1</td>
<td>Torque data (%): L axis torque max. and min. value</td>
</tr>
<tr>
<td>17,0</td>
<td>Torque data (%): U axis torque max. and min. value</td>
</tr>
<tr>
<td>24,2</td>
<td>Torque data (%): R axis torque max. and min. value</td>
</tr>
<tr>
<td>12,1</td>
<td>Torque data (%): B axis torque max. and min. value</td>
</tr>
<tr>
<td>12,1</td>
<td>Torque data (%): T axis torque max. and min. value</td>
</tr>
</tbody>
</table>
5 Alarm

5.1 Signal Output

5.1.1 Speed Reducer Life Alarm Output

When the left life span of the speed reducer is diagnosed as short, the specified general output signal can be turned ON.

Refer chapter 2.4 “Measurement Condition Settings” at page 2-12 for the detailed setting procedures for the general output signal.

And refer chapter 3.2.5 “Stop the Alarm Signal Output” at page 3-4 for the detailed procedures to stop the output signal.

5.1.2 Constant Speed Torque Measurement NG Output

When the constant speed torque measurement is not executed correctly, the specified universal output signal can be turned ON.

Refer chapter 2.4 “Measurement Condition Settings” at page 2-12 for the detailed setting procedures for the universal output signal.

And refer chapter 3.2.5 “Stop the Alarm Signal Output” at page 3-4 for the detailed procedures to stop the output signal.
## 5.2 Alarms When Measuring

<table>
<thead>
<tr>
<th>Alarm Number</th>
<th>Message</th>
<th>Cause</th>
<th>Remedy</th>
</tr>
</thead>
</table>
| 4650         | TRQ CLEAR ERROR                | Unexpected error occurred when executing TRQCLS. | (1) Turn the power OFF then back ON.  
(2) If the error occurs again, contact your YASKAWA representative. |
| 4652         | TRQ MEASURE MODE SET ERR(SV)   | Unexpected error occurred when executing MEASON TRQ. | (1) Turn the power OFF then back ON.  
(2) If the error occurs again, contact your YASKAWA representative. |
| 4653         | TRQ MEASURE MODE CANCEL ERR(SV)| Unexpected error occurred when executing MEASOF TRQ. | (1) Turn the power OFF then back ON.  
(2) If the error occurs again, contact your YASKAWA representative. |
| 4670         | INSUFFICIENT NUM OF SAMPLE DATA| The data for constant torque calculation is insufficient. | Longer the moving distance when measuring. |
| 4671         | SAMPLE BUFFER OVER FLOW        | The data for constant torque calculation is too enough to calculate. | Shorter the moving distance when measuring. |
| 4672         | BASIC SPEED UNREACHED          | Unable to reach the basic speed for the constant torque calculation. | Faster the moving speed when measuring.  
Slower the basic speed. |
| 4673         | MAX TRQ UNDETECTED             | Unable to detect the maximum torque for the constant speed torque calculation. | There is a possibility that acceleration/deceleration is included in the constant speed torque. Longer the basic speed continuance by correcting the job. |
5.3 Output by the Servo Monitor

The values that are output as the maximum and the minimum torques in the servo monitor data have the following meanings.

These values are the same as the “trqdat.dat” which can be obtained by data transmitting function.

<table>
<thead>
<tr>
<th>The value of the maximum/minimum torque</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>max. value (\geq) min. value (&gt;) 0</td>
<td>Measuring was correctly done. Each value is shown by%.</td>
</tr>
</tbody>
</table>
| max. value = min. value = 0 | The value of this axis is not measured. The followings are the expected causes.  
(1) The objective axis is not measured after the execution of “TRQCLS” instruction.  
(2) The max. torque was not detected. |
| max. value = min. value = -2147483648 | Failed to measure the value. The followings are the expected causes.  
(1) The servo was turned OFF during the measurement.  
(2) Didn’t reach the speed specified by “MEASON” instruction.  
(3) Failed to obtain the data which was more than 1.5 crank at both front and back sides.  
(4) The obtained amount of data exceeded the amount of the sampling buffer due to the long measuring period.  
(5) The data equivalent to 1.5 crank was not calculated. |
DX100 OPTIONS  
SPEED REDUCER LIFE DIAGNOSIS  
FUNCTION INSTRUCTIONS

Specifications are subject to change without notice for ongoing product modifications and improvements.