FANUC Auto HMI/T

Motor Load Torque Monitor

OPERATOR'S MANUAL

B-66274EN-1/02

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Should you wish to export or re-export these products, please contact FANUC for advice.

In this manual we have tried as much as possible to describe all the various matters.
However, we cannot describe all the matters which must not be done, or which cannot be done, because there are so many possibilities.
Therefore, matters which are not especially described as possible in this manual should be regarded as "impossible".

DEFINITION OF WARNING, CAUTION, AND NOTE

This manual includes safety precautions for protecting the user and preventing damage to the machine. Precautions are classified into Warning and Caution according to their bearing on safety. Also, supplementary information is described as a Note. Read the Warning, Caution, and Note thoroughly before attempting to use the machine.

⚠ WARNING
Applied when there is a danger of the user being injured or when there is a damage of both the user being injured and the equipment being damaged if the approved procedure is not observed.

⚠ CAUTION
Applied when there is a danger of the equipment being damaged, if the approved procedure is not observed.

NOTE
The Note is used to indicate supplementary information other than Warning and Caution.

- Read this manual carefully, and store it in a safe place.

GENERAL WARNINGS FOR CNC APPLICATION DEVELOPMENT

⚠ WARNING

Be careful enough for the following warnings when you develop two or more applications or use networks.
If you neglect them, there is a danger of the user being injured or there is a danger of both the user being injured and the equipment being damaged.

1 Be careful enough if you write an identical NC data, an identical PMC data or a series of related data set by two or more above applications including network functions. Because they are executed based on each individual cycles (in other words, asynchronous cycles), there is a possibility that the data will be written in an unexpected order.

Therefore, do NOT write above data in the following cases.
- Applications and network functions
- Two or more applications
- Two or more network functions

Data, applications and network functions of interest are listed in below. However, all may not be listed completely because new features will be added in the future.

2 Be careful enough that you must prevent PMC signals in the same byte from being written by the following two or more applications including network functions. While an application reads and writes one byte of PMC signals, other applications may write the same byte.

3 Be careful enough if you process a PMC signal set that is related to a NC function by using the following two or more applications including network functions. Because they are executed based on each individual cycles (in other words, asynchronous cycles), there is a possibility that the NC may receive the PMC signal set in an unexpected order.

4 Generally, when multi-byte data are read or written at once among the following two or more applications including network functions, the coherency of the read multi-byte data (in other words, reading all latest data at once) is not guaranteed. To ensure the coherency of the multi-byte data, prepare flags to notify the completion of reading or writing process that is separated from the entity of the data and make the handshaking process to access the data by using the flags.

Data List Table

Category	Data
General data for NC	Parameter, Tool compensation value and related data, Macro variable, P-CODE variable, Program and related data, Tool management function data
PMC Data	PMC signal, PMC parameter

List Table of Applications and Network Functions

Category	Functions
Applications	PMC Ladder, Macro Executor, C Language Executor, FANUC PICTURE, FOCAS2
Network functions	FL-net, EtherNet/IP, PROFINET, Modbus/TCP, PROFIBUS-DP, DeviceNet, CC-Link

5 CNC has functions that read or write PMC signals in other than the G/F address. Be careful enough for confliction between PMC signals used by these functions and ones used by the above mentioned applications and network functions. If there is the confliction, applications or CNC functions may work in an unexpected manner.
As for the CNC functions of interest, refer to the connection manual (Function)(B-64483EN-1) “Appendix B. List of Functions Using PMC Signals Other Than G/F Address”.

GENERAL WARNINGS AND CAUTIONS

⚠ WARNING

1 Real-time screen operation is not guaranteed.
2 An unpredictable operation results when multiple touch panel positions are pressed simultaneously. If multiple points are pressed at the same time, the central point of them seems to be pressed.

TABLE OF CONTENTS

1 SCOPE

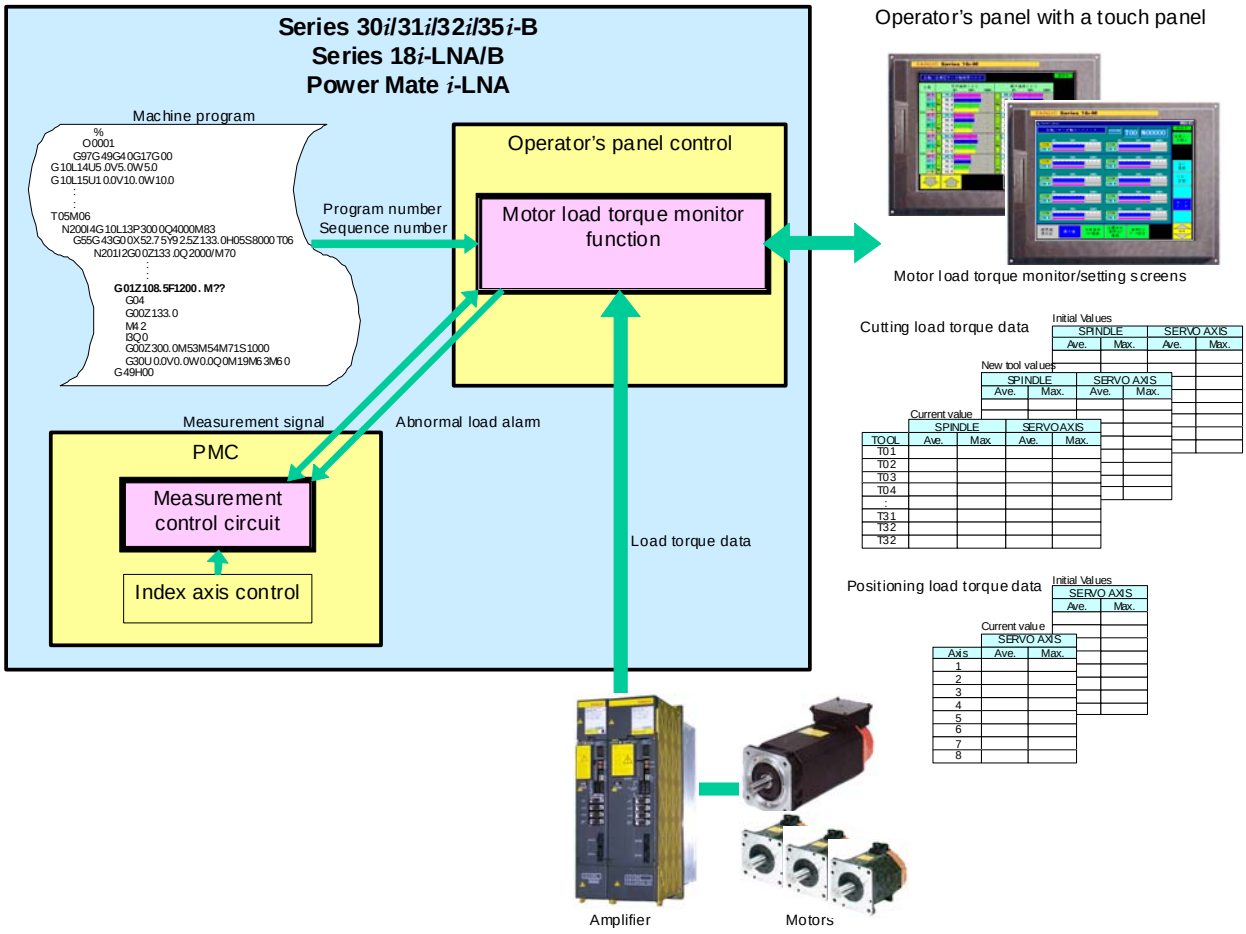
This manual explains how to use the motor load torque monitor function, which is incorporated in CNC using by FANUC Auto HMI/T.
The motor load torque monitor function can be incorporated in Series 18*i*-LNA/LNB, Power Mate *i*-LNA, and Series 30*i*/31*i*/32*i*/35*i*-B.

2 MOTOR LOAD TORQUE MONITOR FUNCTION

2.1 OVERVIEW

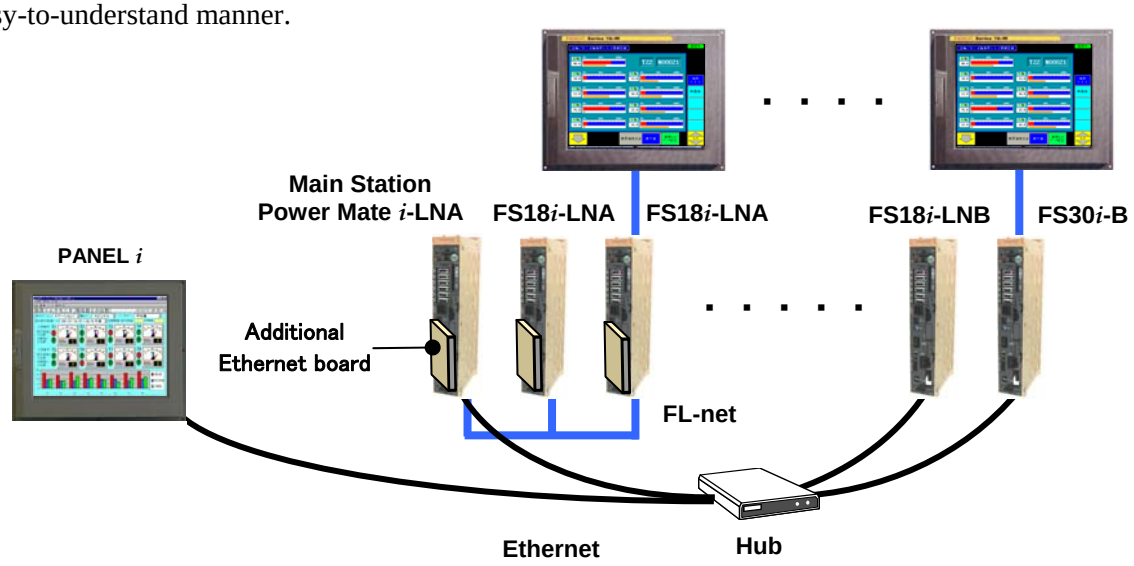
The motor load torque monitor function (called this function below) is incorporated in a CNC using FANUC Auto HMI/T. The screens required for using this function are also incorporated in the operator's panel with a touch panel and the functions of measuring load torque of motors are also incorporated in the CNC operator's panel control section.

According to commands in a program or sent a the PMC ladder, this function reads estimated load torque of spindle and servo motors at fixed sampling intervals, obtains the average and maximum values of the torque read during the specified period of time, and stores them in memory. This function can measure load torque values individually for up to 32 types (16 types for Series 18*i*-LNA/LNB, Power Mate *i*-LNA) of tools and display the load torque values for each tool on the screen.
This function updates the measured load torque data for each machining cycle and displays the newest load torque values.
You can set the limits of the load torque on each axis and output an alarm signal if a measurement value exceeds either of the limits.
A block diagram of this function is shown below.
To use this function, modify the PMC ladder and machining program for controlling this function.



This function has an interface for enabling measured load torque values to be read from an external unit via the Ethernet or FL-net. You can use this interface to store the load torque values measured during each machining cycle in an external computer, analyze the change in load torque with time, and use the result of analysis for more precise preventive maintenance.

The following figure shows an example of a measurement system using this interface.
This system stores load torque data measured at each facility on the hard disk of the PANEL *i* via the FL-net and Ethernet and displays the change in data with time and other items on the LCD display in an easy-to-understand manner.



NOTE

1 The motor load torque monitor function is a special function for TOYOTA MOTOR CORPORATION.
For Series 30*i*/31*i*/32*i*/35*i*-B, this function is available with FANUC Auto HMI/T Edition 09.0 or later. Moreover, the following CNC options are required.
- "Motor load torque monitor"
- "Unexpected Disturbance Torque Detection Function"
or "Function Suitable for Transfer Line"

For Series 18*i*-LNA/LNB and Power Mate *i*-LNA, this function is available with FANUC Auto HMI/T Edition 4.08 or later.

2 As for FANUC Auto HMI/T, see "FANUC Auto HMI/T Operator's Manual" (B-66254EN).

3 This function is mainly intended to monitor an abnormal load caused by a wear condition or fault in the machine. It is not suitable for detecting a slight change of load torque caused by an abnormal state such as a broken tool tip.

4 For Series 30*i*/31*i*/32*i*/35*i*-B, the transfer of the load torque data via FL-net is not supported.

2.2 OUTLINE

2.2.1 Load Torque Measurement Functions

This function provides the following load torque measurement, monitor, and display functions.

Load meter display

This function always reads estimated load torque of each servo motor and each spindle motor from the servo and spindle amplifiers and displays them on the operator's panel screen with load meters.

Cutting load torque measurement

When receiving a measurement command, this function obtains and saves the average and maximum values of the estimated load torque of the specified servo motor(s) and spindle motor(s) that is measured during the specified period. Then, the function displays the values on the SPINDLE/AXIS CUTTING LOAD TORQUE screen on the operator's panel. The average and maximum values of estimated load torque can be measured, saved, and displayed individually for up to 32 types (16 types for Series 18*i*-LNA/LNB, Power Mate *i*-LNA) of tools for each path.

Positioning load torque measurement

You can specify the measurement of load torque also for operation that is not involved with cutting, such as rapid traverse and peripheral axis operation. When the measurement of load torque for operation that is not involved with cutting is specified, this function measures and saves the average and maximum values of load torque only on servo axes, and displays them on the AXIS POSITIONING LOAD TORQUE screen on the operator's panel. This function does not measure the load torque on spindles.

Load torque monitor function

You can set the limit of each of the average and maximum values of estimated load torque of servo and spindle motors described above. If the average or maximum value exceeds its limit, this function outputs an alarm signal (limit alarm). Generally, use the limit alarm signal to execute the "return" command.
(For FANUC Auto HMI/T Edition 5.04 or later, push buttons for selecting action performed when a limit alarm occurs are added to the setting screen.)

2.2.2 Operator's Panel Screens

The following four types of screens are available for each path.

SPINDLE/AXIS LOAD METER screen

This screen displays the current estimated load torque on spindles and servo axes and the limit set for each of the spindles and servo axes.

SPINDLE/AXIS CUTTING LOAD TORQUE screen

This screen displays the maximum and average values of the cutting load torque on the spindles and servo axes corresponding to each used tool. The screen is updated each time measurement ends. In addition to the current measurement values, this screen displays new tool values and initial values. The new tool values are the load torque values measured immediately after a tool is replaced with a new one. When receiving the signal indicating the replacement of a tool, this function stores the measurement values at that time as new tool values in the operator's panel and displays them. As the initial values, this function stores the load torque values measured when the facility is new and displays them. When the "STORE INITIAL VALUE" button on the screen is pressed, the current values at that time are saved as initial values.

On this screen, you can also set the limits of the cutting load torque on each of the spindles and servo axes.

AXIS POSITIONING LOAD TORQUE screen

This screen displays the maximum and average values of the positioning load torque on each servo axis. In addition to the current measurement values, this screen displays the initial values. As the initial values, this screen stores the load torque values measured when the facility is new and displays them. When the “STORE INITIAL VALUE” button on the screen is pressed, the current values at that time are saved as initial values.
On this screen, you can also set the limits of the positioning load torque on each servo axis.

Setting screens

These screen are used to set items required for operation of this screen such as each tool number and its corresponding spindle and servo axes that are required for measuring cutting load torque.

2.2.3 Data Output Function

A function is available, which outputs measurement data saved in the CNC to an I/O area (R, D, or E area) on the PMC according to the setting. For a transfer machine system in which stations are connected to each other via the FL-net, load torque data output to the I/O area can be transferred to the main station via the FL-net, and then from the main station to the external host.
Load torque data saved in the CNC can be read to the external host using the FOCAS1/FOCAS2 function.

2.2.4 Servo Parameters

This function reads and monitors load torque detected on FANUC servo and spindle amplifiers. To obtain correct load torque, set and adjust the following servo and spindle parameters.

Servo parameters

	No.	Description	Setting
Parameters to be set	2015#5	TDOU (The estimated disturbance value is output.)	1
	2016#0	ABNT (The abnormal load detection function is enabled.)	1
	2200#2	IQOB	1
	2050	Observer gain	3559
	2051	Observer gain	3329
	2104	Abnormal load detection alarm level	32767
Parameters to be adjusted (*2)	2047	POA1 (observer parameter)	
	2087	Torque offset parameter(*1)	

NOTE
1 The torque offset parameter must be adjusted only for vertical axes.
2 For details of how to adjust parameters, refer to the section describing the "abnormal load detection function" in the parameter manuals for the relevant FANUC AC servo motors.

Spindle parameters

	No.	Description		Setting
Parameters to be set	4015#1	SPLDMT (The abnormal load detection function is enabled.)		1
	4247	Start-up time constant for magnetic flux	4012#7=0 (conventional control)	75
			4012#7=1 (HRV control)	0
	4249	Observer gain 1		500
	4250	Observer gain 2		500
	4341	Abnormal load detection alarm level for spindle		0
Parameters to be adjusted (*2)	4248	Torque constant (for high-speed characteristics)		
	4281	Torque constant (for low-speed characteristics)(*1)		

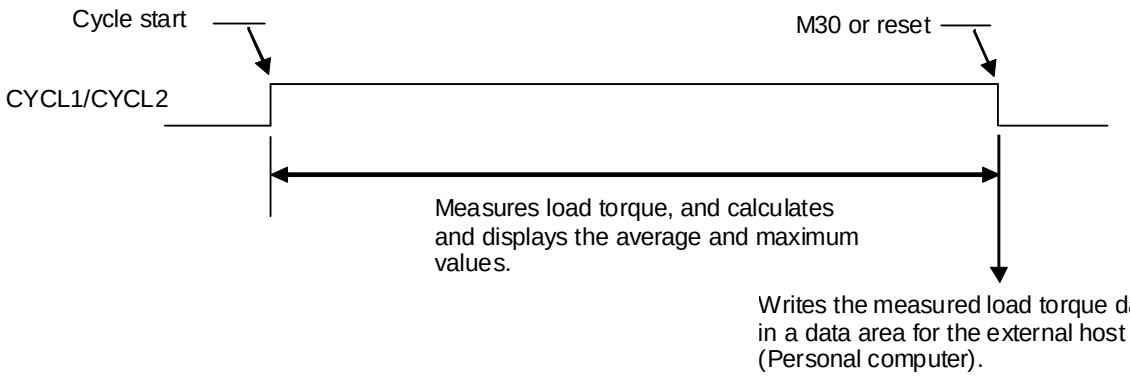
NOTE
1 Parameter 4281 must be adjusted only when the spindle motor winding is to be changed.
2 For details of how to adjust parameters, refer to the section describing the "abnormal load detection function" in the parameter manuals for the relevant FANUC AC spindle motors.

2.3 LOAD TORQUE MEASUREMENT

2.3.1 Load Torque Measurement Cycle

For this function, the period from the start of program operation to the end of the operation is assumed to be a load torque measurement cycle. This function measures load torque only during this load torque measurement cycle. This function checks the CYCL1/CYCL2 signal (N0289#0/N0295#0) to recognize the load torque measurement cycle. Set this signal to ON at the start of the cycle and to OFF at the end (normally, M30) of the machining cycle. When the CYCL1/CYCL2 signal is ON and this function receives one of the measurement commands described in the following subsections, this function measures the average and maximum values of the estimated load torque of the motors for the relevant axes according to the given command.
When a return program is executed or slide-in/out operation is performed, this function does not measure load torque even during a load torque measurement cycle.

The average and maximum values of the measured load torque are stored in the memory in the CNC and displayed on the operator's panel during a load torque measurement cycle. The load torque data stored in the memory in the CNC is copied into the output register at the end of the load torque measurement cycle. At this time, the 16-bit cycle counter is incremented by 1.



The output register and cycle counter form an interface which enables an external host (such as personal computer) to read load torque data measured by this function. The external host monitors the cycle counter, recognizes the end of a load torque measurement cycle, and reads the load torque values written in the output register. The contents of the output register remains unchanged until the end of the next measurement cycle. Accordingly, the external host can collect load torque data without stopping machining.
The output register are located in the SRAM in the CNC, and the external host generally reads the contents of the output register via the FOCAS1/Ethernet interface. A function which copies the contents of the output register into the R or D area of the PMC is also available so that data measured at each station can be transferred to the main station via the FL-net for a transfer machine system.
(If a load torque limit alarm occurs, the load torque values at that time must be reported to the external host and displayed on the screen. For this reason, the load torque values at that time are written in the output register.)

2.3.2 Load Torque Measurement Operations

When a measurement command is given during a load torque measurement cycle, this function performs the following basic load torque measurement operations.

Starting measurement

When the specified time (measurement start delay time = setting) has elapsed since a measurement command signal is turned ON or the pulse distribution starts for the axis selected by the measurement command, whichever occurs later, this function starts measurement. The measurement start delay time is required for avoiding the measurement of unstable load torque during motor acceleration. Set the measurement start delay time for each of cutting feed and rapid traverse operations based on the relevant acceleration/deceleration time constant.

Terminating measurement

When the pulse distribution ends, the measurement command signal is turned OFF, or a limit alarm occurs during measurement, this function terminates the measurement. When the pulse distribution ends or a limit alarm occurs, and this function terminates measurement, the function outputs the measurement end signal. According to this signal, turn the measurement command signal OFF. When the measurement command signal is turned OFF and this function terminates measurement, the function does not output the measurement end signal.

Measurement items

This function obtains the maximum and average values of load torque during the measurement period and displays them on the screen as current values. It updates the maximum value every moment and displays it on the screen. It calculates the average value at the end of measurement and displays it on the screen.

Monitoring the limits

This function compares each measured load torque value with the limit set for the maximum load torque during the measurement period. If the limit is exceeded, this function outputs the limit alarm signal for the maximum value. At the end of measurement, the function compares the average value of the measured load torque with the limit set for the average load torque. If the limit is exceeded, this function outputs the limit alarm signal for the average load torque. At the same time when the function outputs the limit alarm signal, the relevant limit alarm lamp lights red.
When this function detects a limit alarm, it terminates measurement at that time and outputs the measurement end signal.
If a limit alarm occurs, this function writes load torque data in the output register at the same time when outputting the signal. This operation enables the load torque values measured when a limit alarm occurs to be displayed on the screen of an external host (such as personal computer).

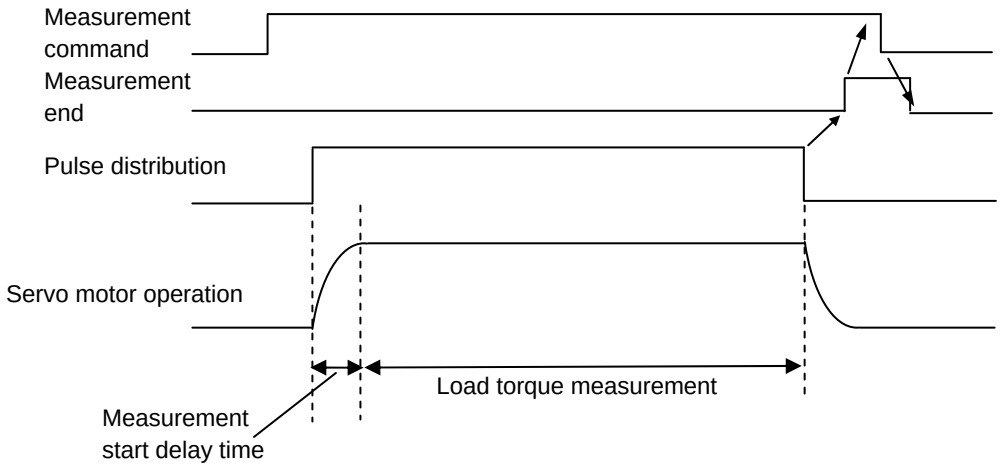
The limit alarm signal and lamp are kept in the alarm status until the limit alarm reset signal (ALMRST, N0293#5) is input.

Saving new tool values and initial values

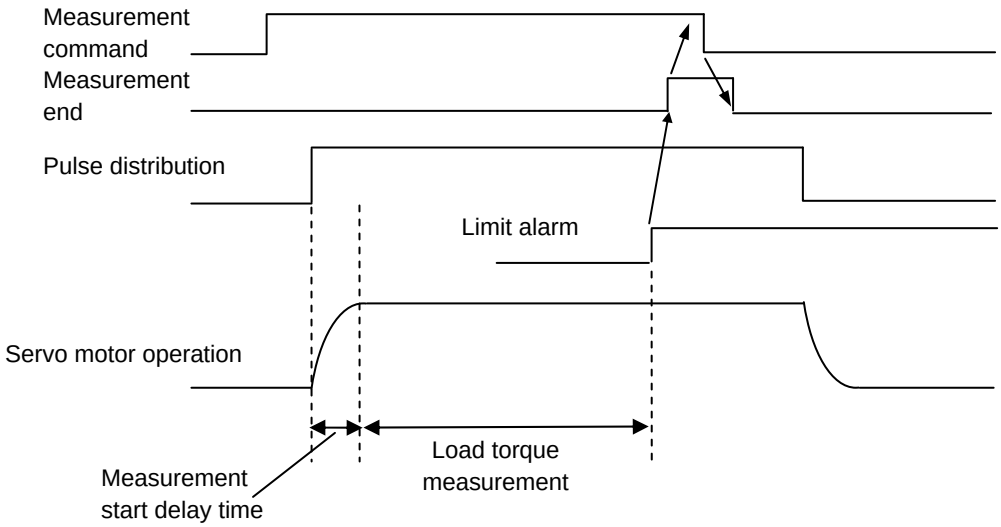
This function saves the cutting load torque measured when cutting is performed with a new tool as new tool values and displays it on the screen to compare them with the current cutting load torque. For this function, an interface for reporting the replacement of a tool is available. When this function is notified of the replacement of a tool via this interface, it stores cutting load torque data with the new tool as new tool values at the end of the load torque measurement cycle in the operator's panel and displays them on the screen.
This function also saves load torque data measured when the machine is new as initial values and displays it on the screen. Touching the "STORE INITIAL VALUE" button on each screen saves all load torque measurement values at that time as initial values.

On the following page, examples of various patterns of load torque measurement operations are shown.

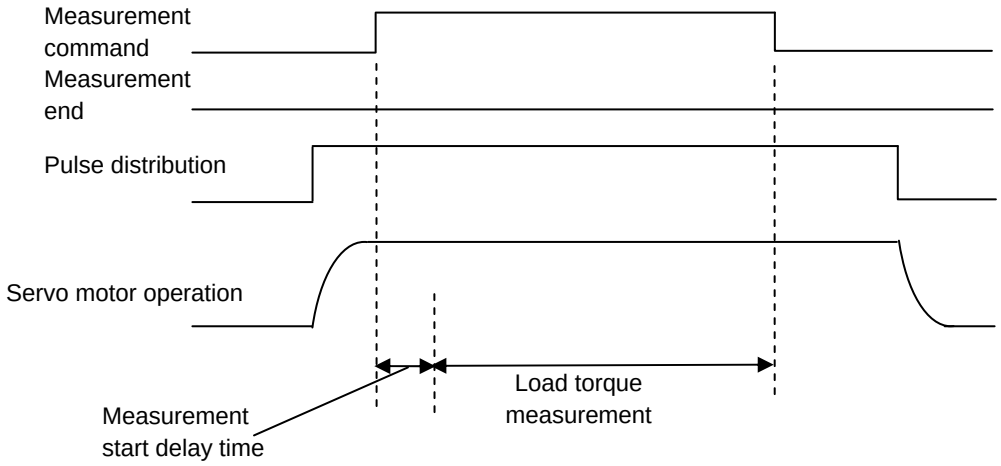
1) From the start to the end of pulse distribution



2) From the start of pulse distribution to a limit alarm

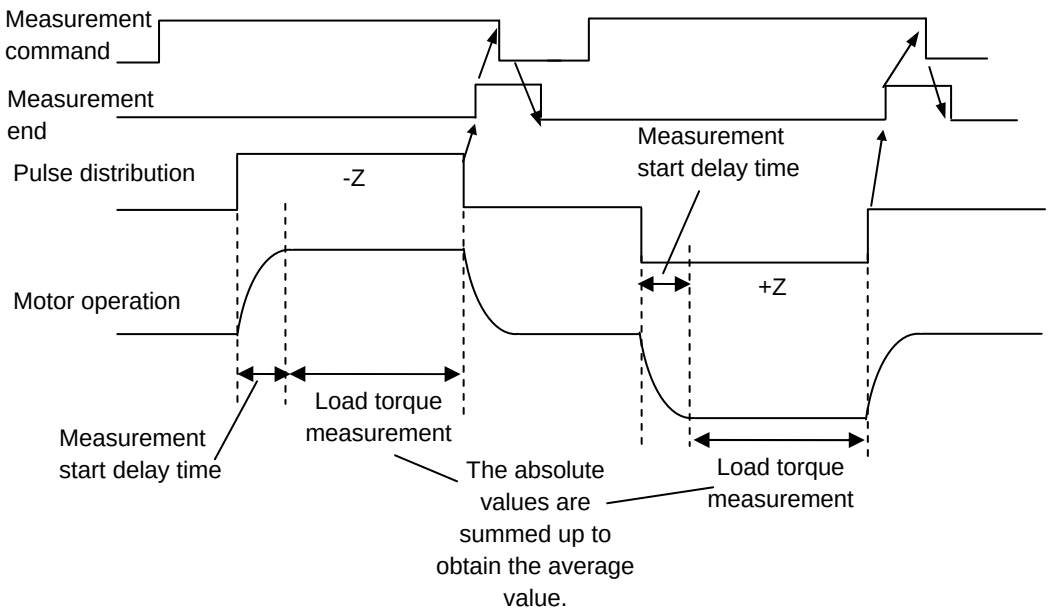


3) From measurement command ON to measurement command OFF



2.3.3 Repetition of Measurement

As described in the preceding subsections, this function measures load torque for one axis operation as a unit. At the end of the axis operation, the function obtains the maximum and average values of the load torque measured during the measurement period. One axis operation generally means the axis operation according to one block specified in a program for an NC axis or one index operation for an index axis. When measurement commands are specified continuously for multiple blocks or index commands, this function also terminates measurement for each axis operation. After the next pulse distribution starts, this function waits for the specified time, then restarts measurement. When cutting feed operations are continuously performed, this function also terminates measurement at the end of the pulse distribution for one block. When another measurement command is specified, after the next pulse distribution starts, this function waits for the specified time, then restarts measurement.
When the same type of load torque on the same axis is measured multiple times in a way as described above, this function extracts the maximum value and calculates the average value using all measurement data.
When measurement is specified for the same type of load torque (cutting or positioning) on the same axis during one measurement cycle multiple times, this function performs the same operation.



2.3.4 Cutting Load Torque and Positioning Load Torque

There are the following two types of load torque measurement modes: Cutting load torque measurement mode and positioning load torque measurement mode.

Cutting load torque measurement mode

In the cutting load torque measurement mode, this function measures the load torque on a spindle and a servo axis during cutting operation. In this mode, the function measures the load torque on one spindle and one servo axis at the same time. The spindle and servo axis on which to measure the load torque differ depending on the tool. For this reason, set the number of a tool for which to measure the load torque and the numbers of the spindle and servo axis corresponding to the tool on the "MONITOR PARAMETER SETTING" screen.
On the "MONITOR PARAMETER SETTING" screen, you can set the numbers of up to 32 types (16 types in case of FS18*i*-LNA/LNB, Power Mate *i*-LNA) of tools and the numbers of the spindle and servo axis corresponding to each tool for each path. (See Subsection 2.4.2, "Types of Load Torque Screens.")

When the measurement of cutting load torque is specified, this function reads the number of the tool used at that time via the PMC interface (N0291, N0297). Based on the tool number, the function references data set on the "MONITOR PARAMETER SETTING" screen, determines the spindle and servo axis on which to measure the load torque, and measures the load torque on the specified spindle and axis. The function displays the maximum and average values obtained using the measurement results on the line with the tool number on the "SPINDLE/AXIS CUTTING LOAD TORQUE" screen.

When no ATC is mounted and only one type of tool is used, input 00 to the PMC interface (N0291, N0297).
In this case, this function measures the load torque on the spindle and servo axis set for item 1 on the "MONITOR PARAMETER SETTING" screen. A number other than 00 must be set as the tool number for item 1 in advance.
In the cutting load torque measurement mode, this function measures the load torque only on NC axes.

Positioning load torque measurement mode

In the positioning load torque measurement mode, this function measures the load torque not on spindles, but on servo axes only. In this mode, the function measures the load torque on servo axes during positioning operation (G00 mode) and/or on index axes. It displays the measurement result for each axis on the "AXIS POSITIONING LOAD TORQUE" screen. In the positioning load torque measurement mode, you can measure the load torque on both NC controlled axes and index axes.

2.3.5 Units for Load Torque

The estimated load torque on spindles and servo axes that is measured by this function is normalized in the following unit and displayed on the screen.

Estimated load torque on a spindle	Relative value obtained when the maximum torque determined for each motor is assumed to be 100% The display unit is 0.1%.
Estimated load torque on a servo axis	Relative value obtained when the maximum output current determined for each servo amplifier is assumed to be 100%. The display unit is 0.1%.

2.3.6 Measurement Commands

There are the following four types of load torque measurement commands. Each command is detailed below.

No.	Type of measurement command	Specification method	Measurement mode	Target axis
1	Measurement command with an axis specification	Specified by the measurement command signal set for each axis	Positioning	NC axis Index axis
2	Measurement command with automatic axis selection	Specified by the measurement command signal common to all axes. The target axis is automatically selected.	Cutting/ positioning	NC axis
3	Measurement command with a sequence number specification	Specified to measure the load torque on the axes related to the block with the specified sequence number	Cutting/ Positioning	NC axis
4	G00 automatic measurement command	Specified to measure the load torque on the axes related to all G00 command blocks	Positioning	NC axis

2.3.6.1 Measurement command with an axis specification

According to the following measurement command signal set for each servo axis, the motor for which to measure the load torque is selected and measurement is specified.

	#7	#6	#5	#4	#3	#2	#1	#0	
N0290	MEAS18	MEAS17	MEAS16	MEAS15	MEAS14	MEAS13	MEAS12	MEAS11	For path 1
	8th axis	7th axis	6th axis	5th axis	4th axis	3rd axis	2nd axis	1st axis	
N0296	MEAS28	MEAS27	MEAS26	MEAS25	MEAS24	MEAS23	MEAS22	MEAS21	For path 2
	8th axis	7th axis	6th axis	5th axis	4th axis	3rd axis	2nd axis	1st axis	

MEAS1x Signal of the measurement command with an axis specification for path 1
MEAS2x Signal of the measurement command with an axis specification for path 2

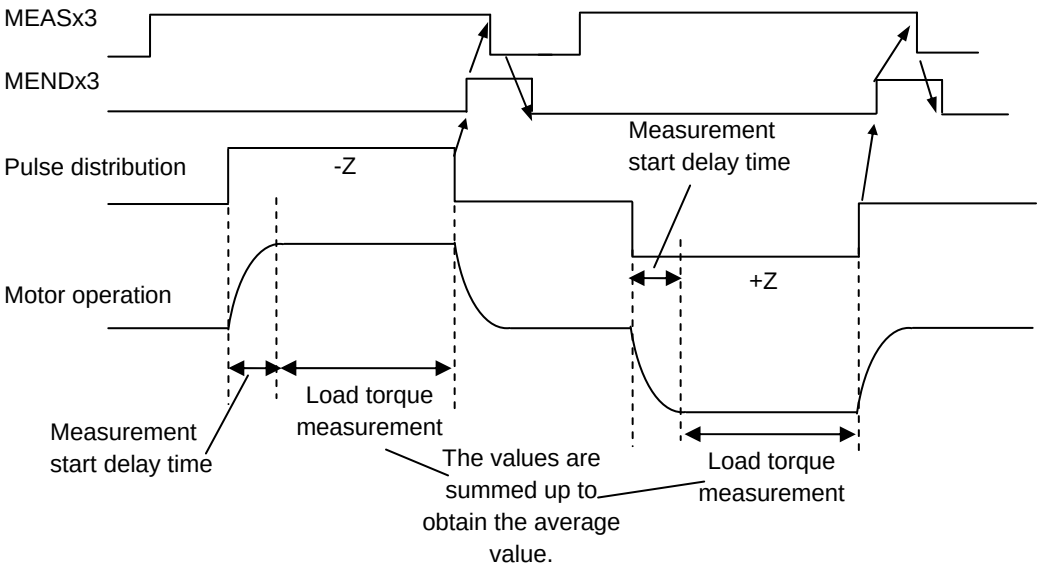
When the specified time has elapsed since this signal is turned ON or operation (pulse distribution) starts for the axis selected by this signal, whichever occurs later, this function starts measurement. When the pulse distribution ends or this signal is turned OFF, whichever occurs earlier, the functions ends the measurement. During the measurement period, the function reads and stores load torque data, and obtains the average and maximum values of the load torque measured during this period.

At the end of measurement, this function outputs the following measurement end signal for each axis. According to this signal, the measurement command signal should be turned OFF by the MTB ladder. The measurement command signal may remain ON after this function terminates measurement according to the termination of operation. In this case, when operation for the same axis restarts, the function measures load torque again after the specified time has elapsed. The function adds the measured load torque data to the previously measured values to obtain the average value. When a measurement command is issued again for the same axis, the function adds the measured load torque data to the previously measured values to obtain the average load torque in the same way.

	#7	#6	#5	#4	#3	#2	#1	#0	
M0297	MEND18	MEND17	MEND16	MEND15	MEND14	MEND13	MEND12	MEND11	For path 1
	8th axis	7th axis	6th axis	5th axis	4th axis	3rd axis	2nd axis	1st axis	
M0299	MEND28	MEND27	MEND26	MEND25	MEND24	MEND23	MEND22	MEND21	For path 2
	8th axis	7th axis	6th axis	5th axis	4th axis	3rd axis	2nd axis	1st axis	

MEND1x Measurement end signal for each axis for path 1
MEND2x Measurement end signal for each axis for path 2

With this type of command, only positioning load torque can be measured. Cutting load torque cannot be measured.
When load torque exceeds the limit for the maximum value during measurement, this function outputs the limit alarm signal, terminates the measurement for all axes, and outputs the measurement end signal. When the average value obtained at the end of measurement exceeds the limit for the average value, this function also outputs the limit alarm signal. The function does not output the measurement end signal, however, because in this case, the measurement has already been terminated.


MEASx3
MENDx3
Pulse distribution
-Z
Measurement
start delay time
+Z
Motor operation
Load torque
measurement
Measurement
start delay time
The values are
summed up to
obtain the average
value.
Load torque
measurement

2.3.6.2 Measurement command with automatic axis selection

The measurement command with automatic axis selection uses the following signals.

	#7	#6	#5	#4	#3	#2	#1	#0	
N0289	MEAS1	SPMEAS1	SQNO1	G0AM1		INTLS1	MH1	CYCL1	For path 1
N0295	MEAS2	SPMEAS2	SQNO2	G0AM2		INTLS2	MH2	CYCL2	For path 2
M0296	MEND1								For path 1
M0298	MEND2								For path 2
N0291	CURTL_1 (2-digit BCD)								For path 1
N0297	CURTL_2 (2-digit BCD)								For path 2

Turning the above measurement command signal available for each path, MEAS1 (for path 1) or MEAS2 (for path 2), ON starts measurement. Whether this function performs the measurement in the cutting or positioning load torque measurement mode is determined whether cutting feed or rapid traverse (positioning) is specified in the block executed at that time.

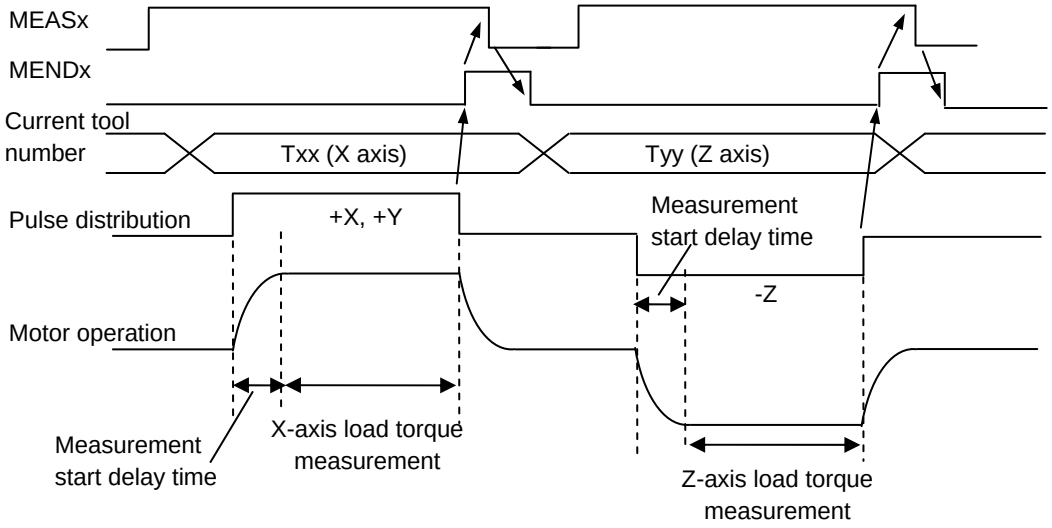
When the measurement command signal (MEAS1/MEAS2) is turned ON during cutting command (other than G00) operation, this function reads the tool number for each path reported via path 1 or 2 current tool number input interface (CURTL_1, CURTL_2). The function measures the cutting load torque on the servo axis and spindle corresponding to the tool number. Use the “MONITOR PARAMETER SETTING” screen to specify the servo axis and spindle corresponding to each tool number.

While the measurement command signal is ON during positioning (G00 command) operation, the function measures the positioning load torque on all servo axes for which motors are running. The function does not measure the load torque on any spindle.

Similarly to the measurement command with an axis specification, when the specified time has elapsed since the measurement command signal is turned ON or the pulse distribution starts for the selected axis, whichever occurs later, this function starts measurement. Until the pulse distribution ends or the measurement command signal is turned OFF, whichever occurs earlier, the function reads and stores load torque data, and obtains the average and maximum values of the load torque during this period. When the function terminates the measurement according to the end of the pulse distribution, it outputs the above measurement end signal (MEND1/MEND2). According to this signal, turn the measurement command signal OFF. When the measurement command signal is turned OFF and this function terminates measurement, the function does not output the measurement end signal.

The measurement command signal may remain ON after the pulse distribution ends and this function terminates measurement. In this case, when the pulse distribution restarts for the same axis, the function measures load torque again after the specified time has elapsed. The function adds the measured load torque data to the previously measured values to obtain the average value. When a measurement command is issued again for the same axis, the function adds the measured load torque data to the previously measured values to obtain the average load torque in the same way.

This measurement command is available only for NC controlled axes. With this measurement command, you cannot measure the load torque on any index axis.
When the maximum load torque exceeds the limit during measurement, this function outputs the limit alarm signal, terminates the measurement, and outputs the measurement end signal.



2.3.6.3 Measurement command with a sequence number specification

For the measurement command with a sequence number specification, unlike the command with an axis specification and measurement command with automatic axis selection, specify a block for which to measure load torque not with a signal, but with a sequence number. You can specify the sequence number of a specific block in a machining program on the "SEQUENCE NUMBER SETTING" screen to specify axis operation for which to measure load torque. When a cutting command (other than G00) is specified in the specified block, this function measures the cutting load torque on the servo axis and spindle corresponding to the current tool number (N0291/N0297) that is for the operation in that block. When the G00 command is specified in the specified block, the function measures the positioning load torque on all axes that is for the operation in that block.

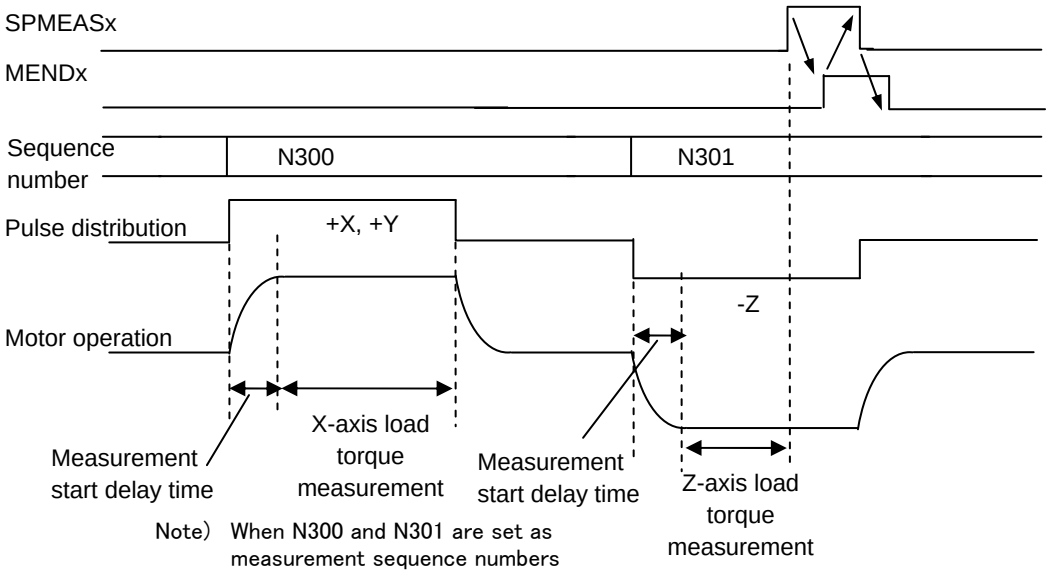
For cutting load torque measurement, this function measures the load torque on both the spindle and servo axis. During the period from when the specified time has elapsed since the pulse distribution starts for the block with the specified sequence number to when the pulse distribution ends, the function reads and stores load torque data, and obtains the average and maximum values. For positioning load torque measurement, the function measures the load torque only on servo axes during a period similar to that described above. When the function terminates the measurement differs depending on the axis, however.

The measurement command with a sequence number specification is valid when signal SQNO1/SQNO2 shown below is ON and "YES" is set for "SEQ NO. AUTO MEASUREMENT" on the SEQUENCE NUMBER SETTING screen. When YES is set for "G00 AUTO MEASUREMENT" described later, this function does not measure the positioning load torque according to the measurement command with a sequence number specification.

This measurement command is available only for NC controlled axes. With this measurement command, you cannot measure the load torque on any index axis.
When the maximum load torque exceeds the limit during measurement, this function outputs the limit alarm signal and terminates the measurement. (The function does not output the measurement end signal at this time.)

You can turn signal SPMEAS1/SPMEAS2 shown below ON to cancel the measurement in this measurement mode before the pulse distribution ends. In this case, this function outputs the measurement end signal (MEND1, MEND2) at the end of measurement for confirmation. According to this signal, turn the measurement suspend signal OFF. When the measurement suspend signal is turned OFF, the measurement end signal is also turned OFF.

	#7	#6	#5	#4	#3	#2	#1	#0	
N0289	MEAS1	SPMEAS1	SQNO1	G0AM1		INTLS1	MH1	CYCL1	For path 1
N0295	MEAS2	SPMEAS2	SQNO2	G0AM2		INTLS2	MH2	CYCL2	For path 2
M0296	MEND1								For path 1
M0298	MEND2								For path 2
N0291	CURTL_1 (2-digit BCD)								For path 1
N0297	CURTL_2 (2-digit BCD)								For path 2



For each path, set the sequence number of each block for which to measure load torque on the "SEQUENCE NUMBER SETTING" screen. You can set up to 50 sequence numbers for each path.
To use this measurement command, sequence numbers (Nxxxxx) must be specified in the machining program. A sequence number once specified is retained in the CNC until a new sequence number is specified. For this reason, multiple blocks may have the same sequence number, depending on the program specification method. Be careful about this point when assigning sequence numbers to blocks in the program and specifying measurement sequence numbers.

```
      :
T05M06
N200 I4G10L13P3000Q4000M83                    } The sequence numbers of
G55G43G00X52.75Y92.5Z133.0H05S8000T06/M52     } these 2 blocks are N200.
N201 I2G00Z133.0Q2000/M70

N202 G01Z108.5F1200.
N203 G04                                      }
G00Z133.0                                     } The sequence numbers of
M42                                           } these 4 blocks are N203.
I3Q0                                          }
N204 G00Z300.0M53M54M71S1000                  }
G30U0.0V0.0W0.0Q0M19M63M60                    } The sequence numbers of
G49H00                                        } these 3 blocks are N204.
      :
```

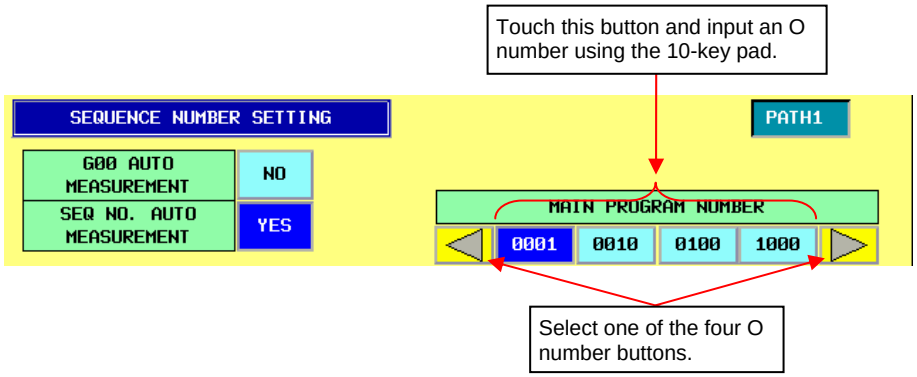
Extended function for the sequence number setting table

A function is added to FANUC Auto HMI/T Edition 5.04 (FANUC Auto HMI/T Assist Version 5.30) or later, which sets 50 sequence numbers for each of up to four main programs for each path.

Set the O number (numeric characters only) of a main program you want to register for one of the four buttons (program selection buttons) in the “MAIN PROGRAM NUMBER” section on the “SEQUENCE NUMBER SETTING” screen. You can register up to four main programs.

For a registered main program, to set sequence numbers for which to measure load torque, press the buttons on which the right or left arrow is displayed to select the desired O number. By this operation, the sequence number setting table for the program with the O number is selected. Set sequence numbers in the “SEQUENCE NUMBER SETTING” section on the screen.

This function searches the O numbers of the main programs being executed for the selected O number and uses the sequence numbers set for the O number to control measurement. If this function cannot find the O number, it does not perform measurement. This rule does not apply when 0 (zero) is set for the leftmost button in the “MAIN PROGRAM NUMBER” section, however. In this case, this function uses the sequence number table corresponding to the leftmost program selection button to control the measurement for all programs whose O number is not set for any program selection button.
Screen data created without using the extended function of the sequence number setting table may be upgraded. In this case, 0 (zero) is set for all four program selection buttons and the sequence numbers set on the old screen are inherited to the leftmost program selection button.



This extended function for the sequence number setting table is also available for the G00 automatic measurement command described in the following subsection.

2.3.6.4 G00 automatic measurement command

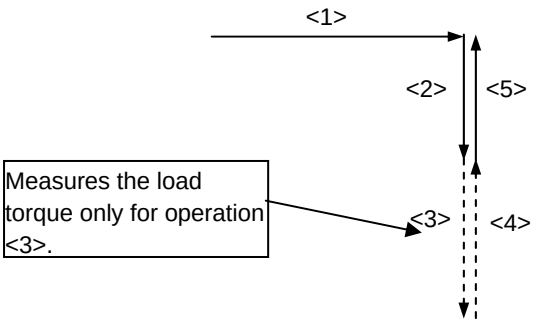
You can use the G00 automatic measurement command to measure the load torque on the axis operations performed by all G00 commands in a machining program without specifying each measurement target.
By turning signal G0AM1/G0AM2 ON and setting YES for “G00 AUTO MEASUREMENT” on the SEQUENCE NUMBER SETTING screen, the G00 automatic measurement command is enabled. When the command is enabled, the load torque is measured for all G00 command blocks in a machining program. Measurement starts when the specified time has elapsed since the pulse distribution starts for each G00 operation and ends when the pulse distribution ends. During this measurement period, this function reads and stores load torque data. The function also adds the load torque data to the values measured for the previous G00 blocks and obtains the average and maximum values of the positioning load torque on each axis throughout the machining program.
If you do not want to measure the load torque for a G00 command block for some reason, set the sequence number of the G00 command block on the SEQUENCE NUMBER SETTING screen. When the G00 automatic measurement command is executed, the function does not measure the load torque for the block having each sequence number set on the SEQUENCE NUMBER SETTING screen.
The G00 automatic measurement command is available only for NC controlled axes. The function can measure only positioning load torque and does not measure the load torque on any spindle.
When the maximum load torque exceeds the limit during measurement, this function outputs the limit alarm signal and terminates the measurement on all axes. At this time, the function does not output the measurement end signal.
For this command, like the measurement command with a sequence number specification, you can turn the measurement suspend signal (SPMEAS1, SPMEAS2) ON to cancel the measurement in this measurement mode before the pulse distribution ends. Similarly, this function outputs the measurement end signal (MEND1, MEND2).

2.3.7 Notes on Load Torque Measurement

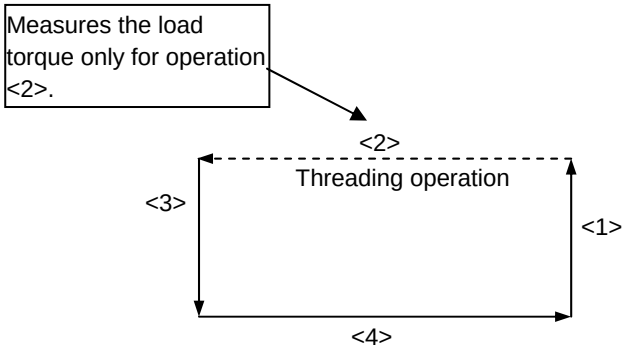
2.3.7.1 Measurement for a canned cycle

For a canned cycle such as a tapping cycle, the command in one block specifies multiple operations. When the load torque for such a command block is to be measured, this function measures the cutting load torque only for the following operations. The function does not measure positioning load torque.
The load torque only for G74, G84, and G94 can be measured. For other canned cycles, load torque cannot be measured.

G74 and G84 (tapping cycle)



G94 (threading cycle)



2.3.7.2 Measurement command for a block with no axis movement

This function does not measure load torque unless the pulse distribution is performed. For this reason, if a measurement command is executed for a command block with no axis movement (such as G04*, S0*, or I3Q0*), the command is ignored and the load torque is not measured.
In this case, the measurement end signal is not output. Be careful about this point when using the measurement command with an axis specification and measurement command with automatic axis selection. If load torque measurement is specified for a block with no axis movement using these measurement commands, the measurement command signal is not reset because the measurement end signal is not output. As a result, the load torque is to be also measured for the next block.
When the measurement command with a sequence number specification or G00 automatic measurement command is used to measure the load torque for a block with no axis movement, the measurement command is ignored and the load torque is not measured. You do not need to be careful about the above point because the measurement end signal is not used for these measurement commands.

2.3.7.3 G codes for which load torque can be measured

The following table lists the relationships between the load torque monitor function and each G code. The load torque on NC axes can basically be measured only in the block of each G code for which "Available" is written in the "Measurement" column in the table below.

Series 18*i*-LNB :
Series 30*i*/31*i*/32*i*/35*i*-B (When "Function suitable for machines in transfer line" option is selected) :

G code	Measurement	Remarks
G00	Available	Positioning load torque is measured.
G01, G02, G03, G32	Available	Cutting load torque is measured.
G74, G84	Available	Cutting load torque for the tapping operation is measured. In FS30*i*/31*i*/32*i*/35*i*-B, the load torque can be measured only in the rigid mode.
G94	Available	Cutting load torque for the threading operation is measured.
G48	Available	Cutting or positioning load torque is measured according to the modal G code (G00/G01).
G24, G25, G28, G29, G30	Available	Positioning load torque is measured only when G00 is specified as the modal G code.
G26, G34, G45, G46	Available	Cutting load torque is measured only when G00 is not specified as the modal G code.
G04, G27, G31 G75, G76, G77 G85, G86, G87 G750, G770, G780, G790	Unavailable	The load torque is not measured. Note that the measurement end signal is not output when the measurement command with an axis specification or with automatic axis selection is issued.
Others	Unavailable	

CNC operation	Measurement	Remarks
Positioning	Unavailable	(Movement from slide position to programmed position)
Return to flag point	Unavailable	(Movement to flag point after Return operation)
Return operation	Unavailable	(Execution of interrupt program)
Slide-out 1 operation	Unavailable	(Execution of interrupt program)
Slide-out 2 operation	Unavailable	(Execution of interrupt program)
Slide-in operation	Unavailable	(Execution of interrupt program)

Series 30*i*/31*i*/32*i*/35*i*-B (When "Function suitable for machines in transfer line" option is not selected) :

G code	Measurement	Remarks
G00	Available	Positioning load torque is measured.
G01, G02, G03	Available	Cutting load torque is measured.
G74, G84	Available	Cutting load torque for the tapping operation is measured. The load torque can be measured only in the rigid mode.
G81, G82	Available	Cutting load torque is measured.
Others	Unavailable	

⚠ CAUTION
1 When a measurement command is issued for the block of an unavailable G code, the measurement might not be executed correctly.
2 When the measurement command with an axis specification or with automatic axis selection is issued for the block of an unavailable G code, the measurement end signal might not be output.

2.3.7.4 Repetitive measurement

As described in Subsection 2.3.3, when the load torque on the same axis is repeatedly measured in the same mode, this function calculates the average value of all measurement data at the end of the measurement. It is generally considered that obtaining the average of load torque values measured under different conditions makes no sense. To measure load torque repeatedly, sections under the same cutting condition or at the same rapid traverse rate must be selected basically.

For positioning operation, normally, the rapid traverse rate set for each axis is used and the tool is always moved along each axis at the same traverse feedrate. In this case, the measurement command with an axis specification, with automatic axis selection, or with a sequence number specification can be used to measure the load torque for positioning operation along the same axis multiple times or the G00 automatic measurement command can be used. It is considered that the load torque for many positioning operations can be measured to calculate the average value to obtain more precise positioning load torque.

Care must be taken when you use the linear type positioning function, however. With the linear type positioning function, the feedrate used for positioning varies depending on the specified move direction, so the average value of all measured load torque does not mean the average load torque at the rapid traverse rate. For this reason, if you want to measure load torque to obtain the correct average value at the rapid traverse rate, consider how measurement commands are issued so that the load torque for any block containing positioning operation performed simultaneously along two or more axes is not to be measured.

2.3.7.5 Notes on tandem control, simple synchronization control, simple spindle synchronization

Tandem control

This function monitors the load torque on an axis for which tandem control is used at the master axis side. Set 0 for the tandem slave axis in the “Abbreviated name of spindles and axes” table of FANUC Auto HMI/T Assist.

Simple synchronization control

If you want to measure the load torque on the master and slave axes for which simple synchronization control is used, set appropriate names for both axes in the “Abbreviated name of spindles and axes” table of FANUC Auto HMI/T Assist. In this case, measurement is performed as follows:

<1> In the positioning load torque measurement mode, the load torque on both master and slave axes is measured simultaneously.
When the measurement command with an axis specification is used, the load torque only on the specified axis is measured.

<2> In the cutting load torque measurement mode, the load torque on the master or slave axis set for the tool number specified at that time is measured.

Simple spindle synchronization

When two spindles are synchronously driven by simple spindle synchronization, the spindle on which the load torque is to be measured depends on the setting on the “MONITOR PARAMETER SETTING” screen. In this case, for the spindles on which to measure load torque, appropriate names must also be set in the “Abbreviated name of spindles and axes” of FANUC Auto HMI/T Assist.

2.3.7.6 Others

(1) Load torque is not measured during the execution of a return program or during slide-in/out operation.
(2) When this function detects a limit error as the result of load torque measurement, it displays the error on the operator's panel screen and outputs a signal, but does not affect CNC operation. Use the PMC ladder to determine CNC operation to be performed after a limit error occurs.
(3) Do not change the enable/disable signal (PMC interface) or YES/NO setting (SEQUENCE NUMBER SETTING screen) for the measurement command with a sequence number specification or G00 automatic measurement command, during any load torque measurement cycle. Be sure to change the signal or setting when the load torque measurement cycle signal (CYCL1/2) is set to 0.
(4) If you change a sequence number setting during a load torque measurement cycle, the setting is not reflected for the measurement operation in the current measurement cycle. The new setting takes effect from the next measurement cycle.

2.3.7.7 Notes when no T codes are specified in a part program

When the machine has no ATC unit, you do not need to specify any T code for replacing tools in the part program. To measure cutting load torque, however, for such a machine, you need to set the current tool number (N291/N297). Assign a virtual tool number to each tool and input this tool number to the current tool number (N291/N297). For the tool number, also set the numbers of the spindle and servo axis on which to measure load torque. Examples are shown below.

When one spindle motor (first spindle) controls two tools (spindle head)

(1) Set 1 (T1) and 2 (T2) as the tool numbers of the two tools. (You can assign any numbers for the tools.)
(2) For T1 and T2, set the numbers of the spindle and servo axis on which to measure load torque on the "MONITOR PARAMETER SETTING" screen.

MONITOR PARAMETER SETTING PATH1

	1	2	3	4	5	6	7	8
TOOL NUMBER	01	02	00	00	00	00	00	00
SPINDLE NUMBER	1	1	0	0	0	0	0	0
AXIS NUMBER	3	3	0	0	0	0	0	0

(3) Insert a T or M code before the section for which to measure the load torque for T1 or T2 in the part program, decode this program with the ladder, and input the number (1 or 2) of the measurement target tool to the current tool number input (N291/N297). The following is the simplest method unless it causes any problem with other operations: Use a T code to directly connect the T code to output to the current tool number input, and immediately return TFIN with TF2.

When two spindle motors control one tool each

Similarly to step (1), assign numbers to the two tools and input the number (1 or 2) of the measurement target tool to the current tool number input (N291/N297). On the "MONITOR PARAMETER SETTING" screen, specify the spindle number corresponding to each tool.

MONITOR PARAMETER SETTING PATH1

	1	2	3	4	5	6	7	8
TOOL NUMBER	01	02	00	00	00	00	00	00
SPINDLE NUMBER	1	2	0	0	0	0	0	0
AXIS NUMBER	3	3	0	0	0	0	0	0

When one spindle motor and one tool are used and no ATC is mounted

In this case, **input 00 to the current tool number input (N291/N297)**. See the explanation of the cutting load torque measurement mode in Subsection 2.3.4 and the explanation of the current tool number in Subsection 2.5.1, “Interface Signals.”

2.3.7.8 Measuring the load torque of multiple spindle motors simultaneously

This function is basically designed to measure the load torque on one spindle and one servo axis for one cutting operation. When the relationships between the spindle motors and tool numbers are fixed, that is, when a function which changes the tool mounted on the spindle such as an ATC is not used and the relationships between the spindles and tool numbers are fixed, you can exceptionally measure the load torque of multiple spindle motors and one servo axis simultaneously using the following method. You can measure the load torque of up to four spindle motors simultaneously.
(The function of simultaneously measuring the load torque on multiple spindles is available with FANUC Auto HMI/T Edition 5.01 or later (FANUC Auto HMI/T Assist Version 5.20 or later).)

Measurement method

Measurement command:

Use the measurement command with automatic axis selection or with a sequence number specification.

Multiple spindle signal:

Set the MH1 or MH2 signal to 1 to indicate the operation mode for simultaneously measuring the load torque on multiple spindles. To measure load torque according to the movement of a servo axis for path 1, set MH1 to 1; to measure it according to the movement of a servo axis for path 2, set MH2 to 1. Set this signal to 1 when the load torque measurement cycle signal CYCL1/2 (N289#0, N295#0) 0. This function reads the signal at the rising edge of the load torque measurement cycle signal.

	#7	#6	#5	#4	#3	#2	#1	#0	
N0289	MEAS1	SPMEAS1	SQNO1	G0AM1		INTLS1	MH1	CYCL1	For path 1
N0295	MEAS2	SPMEAS2	SQNO2	G0AM2		INTLS2	MH2	CYCL2	For path 2

Tool number input:

The tool number input (N291, N297) is not used.

Setting:

Use items 1 to 4 on the “MONITOR PARAMETER SETTING” screen. Assign a tool number to each spindle you use and set the number in the “TOOL NUMBER” field from the left. Set the spindle number corresponding to each tool number in the “SPINDLE NUMBER” field. Set the number of the servo axis operating simultaneously with multiple spindles in the “AXIS NUMBER” field corresponding to each tool number.

Display:

When measurement is specified, this function measures the load torque on one servo axis and multiple spindles simultaneously. The function displays the load torque on the SPINDLE/AXIS CUTTING LOAD TORQUE screen at the end of the measurement. It displays load torque data corresponding to each tool number set on the “MONITOR PARAMETER SETTING” screen. For the servo axis, it displays the same data for multiple spindles (= tool numbers).

Limit:

Set the limit of the spindle load torque for each tool in the same way as for normal measurement. Set the limit for the servo axis for at least one of the set tool numbers. To display the limits on the SPINDLE/AXIS LOAD METER screen, set the limits for the tool number set for the rightmost item (item 1 to 4) used on the “MONITOR PARAMETER SETTING” screen. You may set limits for multiple tool numbers. In this case, set the same values for all tool numbers.

New tool processing:

Notify this function of the tool number corresponding to a replaced tool in the same way as at the replacement of a tool for normal measurement.

[Example]

A setting example is shown below. In this example, the axis configuration of the machine is as shown below and the load torque on the two spindles and Z-axis is to be measured simultaneously when two holes are machined simultaneously using the Z-axis (third axis) for path 1, first spindle for path 1, and first spindle for path 2.

Axis configuration of the machine

	Path 1	Path 2
Servo axes	First axis: X-axis Second axis: Y-axis Third axis: Z-axis	None
Spindle	First spindle (SP11)	First spindle (SP21)

FANUC Auto HMI/T Assist settings

Set 1 to measure the load torque on the spindle for path 2 though the screen

[Load torque screen 1/1]

Screen name: LODTRQ

CHECK NEED

Default name

Screens for the 2nd PATH.

Set if you create 2nd PATH screens.(0: No 2nd PATH screens, 1:Create 2nd PATH	1

Abreviated name of spindles and axes. (within 4 alpha-numeric characters)

Setting items	PATH 1	PATH 2
Existence and name of the 1st spindle (0: no existence)	SP11	SP21
Existence and name of the 2nd spindle	0	0
Existence and name of the 1st axis	X	0
Existence and name of the 2nd axis	Y	0
Existence and name of the 3rd axis	Z	0
Existence and name of the 4th axis	0	0
Existence and name of the 5th axis	0	0
Existence and name of the 6th axis	0	0
Existence and name of the 7th axis	0	0
Existence and name of the 8th axis	0	0

Spindle assignment for each PATH.

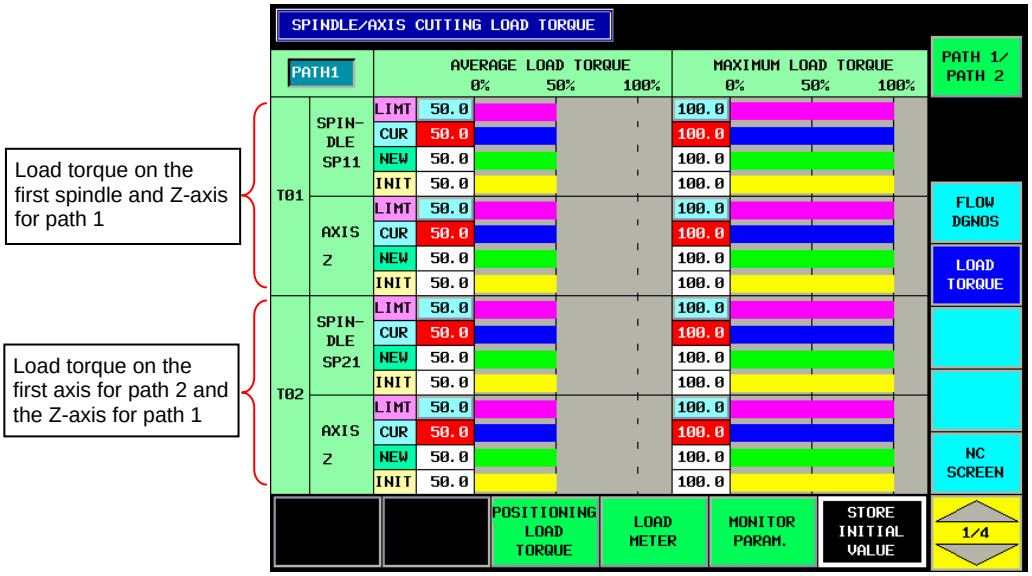
		Spindles controlled by PATH 1 controller		Spindles controlled by PATH 2 controller	
	Spindle numbe	1st spindle	2nd spindle	1st spindle	2nd spindle
		SP11		SP21	
Spindles used for the machining of PATH 1	1	1	0	0	0
	2	0	0	1	0
	3	0	0	0	0
	4	0	0	0	0
Spindles used for the machining of PATH 2	1	0	0	0	0
	2	0	0	0	0
	3	0	0	0	0
	4	0	0	0	0

Settings on the operator's panel screen

MONITOR PARAMETER SETTING PATH1

	1	2	3	4	5	6	7	8
TOOL NUMBER	01	02	00	00	00	00	00	00
SPINDLE NUMBER	1	2	0	0	0	0	0	0
AXIS NUMBER	3	3	0	0	0	0	0	0

By the above settings, on the “SPINDLE/AXIS CUTTING LOAD TORQUE” screen, the load torque on the first spindle and Z-axis for path 1 is displayed in the field for tool number T01 and the load torque on the first spindle for path 2 and the Z-axis for path 1 is displayed in the field for tool number T02.



2.3.7.9 Resetting the limit alarm

Once a limit alarm is detected, it is not released until it is reset by the ALMRST signal (N293#5). The limit alarm signal and alarm lamp on the screen do not turn off until the alarm is reset by the ALMRST signal.
If a limit alarm occurs, use the limit alarm signal to take appropriate action such as return or stop, and reset the limit alarm using the ALMRST signal (N293#5).

2.3.8 Processing Required When a Tool Is Replaced

As described in Subsection 2.3.2, “Load Torque Measurement Operations,” the load torque monitor function has a function of saving and displaying the load torque values measured when cutting is performed using a new tool as new tool values. To operate this function, the load torque monitor function needs to know when each tool is replaced. For this purpose, the following interfaces are provided.

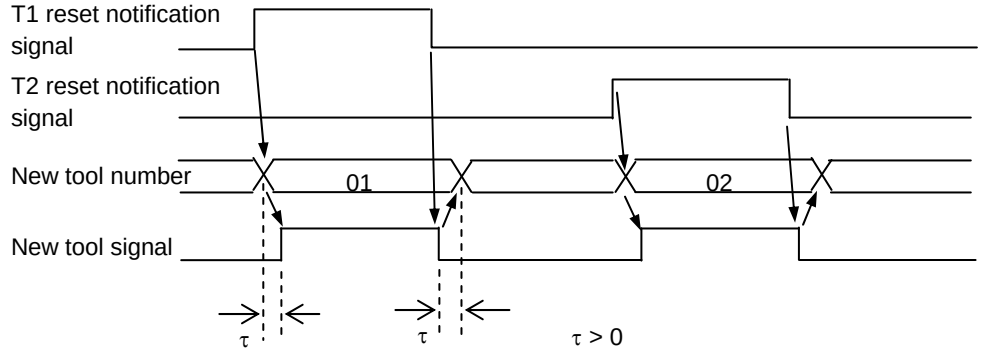
	#7	#6	#5	#4	#3	#2	#1	#0	
N0289	MEAS1	SPMEAS1	SQNO1	G0AM1		INTLS1	MH1	CYCL1	For path 1
N0295	MEAS2	SPMEAS2	SQNO2	G0AM2		INTLS2	MH2	CYCL2	For path 2

INTLS1/INTLS2 New tool signal (must be on for at least 100 ms.)

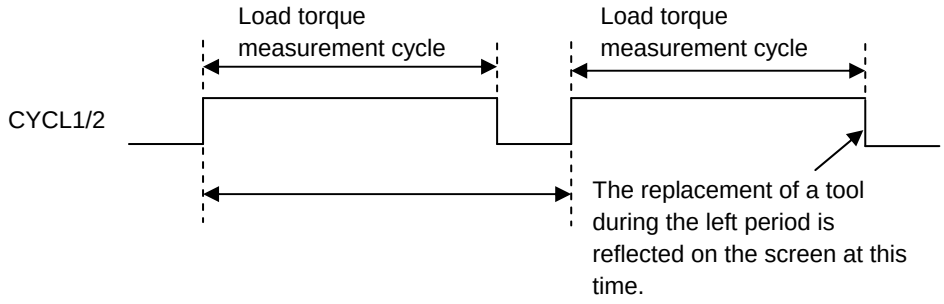
	#7	#6	#5	#4	#3	#2	#1	#0	
N0292	NWTLNO1 (2-digit BCD)								For path 1
N0298	NWTLNO2 (2-digit BCD)								For path 2

NWTLNO1/NWTLNO2 New tool number

When replacing a tool, select the replaced tool on the TOOL EXCHANGE COUNTER screen on the operator's panel to reset the counter. At this time, the reset notification signal set for each tool is output for approximately 500 ms from the operator's panel. Use this signal to create the new tool number (NWTLNO1/2) and new tool signal (INTLS1/2) as shown below. When replacing multiple tools at a time, input the new tool number and new tool signal each time resetting the relevant counter.



When the new tool signal is set to 1, the load torque monitor function reads the new tool number and stores the replacement of the tool having that number. After that, at the end of the next measurement cycle, the function saves load torque data measured during the measurement cycle that corresponds to the stored tool number as new tool values. At the same time, the function sets the new tool flag in the host interface that corresponds to the replaced tool. The new tool flag set to 1 returns to 0 at the end of the next measurement cycle.



2.4 LOAD TORQUE MONITOR SCREENS

2.4.1 Creating Load Torque Monitor Screens

To use the motor load torque monitor function, you need to make a machine operation screen where the load torque monitor screen is built in using FANUC Auto HMI/T.
In FANUC Auto HMI/T Assist, click the “Create” button on the [Setting of the entire system (1/4) Screen registration] sheet, and register the load torque screen.
When the load torque screen is registered, the following setting sheet is added.
When you perform “CONVERT” and “Make MEM” according to the usual screen creation procedure after setting required information in this sheet, the machine operation screen where the load torque monitor screen is built in is created.

NOTE
As for the method of making the machine operation screen using FANUC Auto HMI/T and FANUC Auto HMI/T Assist, see Section 6 “OPERATING FANUC Auto HMI/T Assist” and Section 7 “SCREEN CREATION USING FANUC Auto HMI/T Assist” of “FANUC Auto HMI/T Operator’s Manual” (B-66254EN).

[Load torque screen 1/1]

Screen name: LODTRQ

CHECK NEED — Default name

Screens for the 2nd PATH.

Set if you create 2nd PATH screens.(0: No 2nd PATH screens, 1:Create 2nd PATH screens)

Abreviated name of spindles and axes. (within 4 alpha-numeric characters)

Setting items	PATH 1	PATH 2
Existence and name of the 1st spindle (0: no existence)	SP1	SP3
Existence and name of the 2nd spindle	SP2	SP4
Existence and name of the 1st axis	AX1	AX9
Existence and name of the 2nd axis	AX2	AX10
Existence and name of the 3rd axis	AX3	AX11
Existence and name of the 4th axis	AX4	AX12
Existence and name of the 5th axis	AX5	AX13
Existence and name of the 6th axis	AX6	AX14
Existence and name of the 7th axis	AX7	AX15
Existence and name of the 8th axis	AX8	AX16

Spindle assignment for each PATH.

	Spindle numbe	Spindles controlled by PATH 1 controller: 1st spindle	Spindles controlled by PATH 1 controller: 2nd spindle	Spindles controlled by PATH 2 controller: 1st spindle	Spindles controlled by PATH 2 controller: 2nd spindle
		SP1	SP2	SP3	SP4
Spindles used for the machining of PATH 1	1	1	0	0	0
	2	0	0	1	0
	3	0	0	0	0
	4	0	0	0	0
Spindles used for the machining of PATH 2	1	0	0	1	0
	2	1	0	0	0
	3	0	0	0	0
	4	0	0	0	0

I/O addresses to store Load Torque data.

Setting items	PATH 1	PATH 2
Store Load Torque data in I/O area (1) or not (0).	0	0
Top address of data storage I/O area.(D or R area)		
Data size selection (0: 432 byte, 1: 696 byte)		

Set of action type at load torque failure

	Button name		Output signal
Type1	WAR-	NING	
Type2	CYCLE	STOP	
Type3	RETURN		
Type4	SBK	STOP	

(1) Screens for the 2nd PATH

When you use the load torque monitor screen for path 2, set 1.
When you use a single-path system, or when you do not measure the load torque on any axis of path 2 even if you use a two-path system, set 0.
However, when you want to measure the load torque on a spindle of path 2 together with the load torque on a servo axis of path 1, set 1 even if the screens for path 2 are not required.

(2) Abreviated name of spindles and axes (within 4 alpha-numeric characters)

Set existence or non-existence of each spindle or servo axis, and set its axis name. The name set here is used on the load torque monitor screens.
Set an axis name with up to four half-size characters or two full-size characters for the axis you use.
Set 0 for the axis you not use.
For Series 18*i*-LNA, you can specify up to 6 axes for path 1 and up to 4 axes for path 2.
For Series 18*i*-LNB, you can specify up to 8 axes for path 1 and up to 4 axes for path 2.
For Series 30*i*/31*i*/32*i*/35*i*-B, you can specify up to 8 axes for both path 1 and path 2.

(3) Spindle assignment for each PATH

Set the correspondence of each spindle number 1 to 4, which is set on the "MONITOR PARAMETER SETTING" screen, to an actual spindle.
Set 1 only to the actual spindle that is assigned to one of spindle numbers 1 to 4. Assign the spindle number that is used for the machining of each path consecutively from 1.
When a spindle is shared between paths for a machine such as a two-path lathe, the load torque data on the same spindle can be displayed on the screen for both paths by using this setting table.

Example 1 :
For a two-spindle two-path lathe with facing tool posts, each path may have one spindle and the spindle may be shared between the paths. In this case, if you want to display the spindle for path 1 as the first spindle and the spindle for path 2 as the second spindle on the screens for path 1, and the spindle for path 2 as the first spindle and the spindle for path 1 as the second spindle on the screens for path 2, set data as follows:

Spindle assignment for each PATH.		Spindles controlled by PATH 1 controller		Spindles controlled by PATH 2 controller	
	Spindle numbe	1st spindle	2nd spindle	1st spindle	2nd spindle
		SP1	SP2	SP3	SP4
Spindles used for the machining of PATH 1	1	1	0	0	0
	2	0	0	1	0
	3	0	0	0	0
	4	0	0	0	0
Spindles used for the machining of PATH 2	1	0	0	1	0
	2	1	0	0	0
	3	0	0	0	0
	4	0	0	0	0

Example 2 :
For a facility in which the Z-axis for path 1 runs four spindles for path 1 and path 2 simultaneously, if you want to measure the load torque on the four spindles and Z-axis simultaneously, set data as follows:

Spindle assignment for each PATH.		Spindles controlled by PATH 1 controller		Spindles controlled by PATH 2 controller	
	Spindle numbe	1st spindle	2nd spindle	1st spindle	2nd spindle
		SP1	SP2	SP3	SP4
Spindles used for the machining of PATH 1	1	1	0	0	0
	2	0	1	0	0
	3	0	0	1	0
	4	0	0	0	1
Spindles used for the machining of PATH 2	1	0	0	0	0
	2	0	0	0	0
	3	0	0	0	0
	4	0	0	0	0

(4) I/O addresses to store Load Torque data

* For Series 30*i*/31*i*/32*i*/35*i*-B, this function is not available.

When you want to transfer the load torque data to the D or R area of PMC, set 1 to “Store Load Torque data in I/O area (1) or not (0).”.

Set a top address of the D or R area of PMC to which the load torque data is transferred, to “Top address of data storage I/O area. (D or R area)”.

Set a transfer size of the load torque data, to “Data size selection (0: 432 byte, 1: 696 byte)”.

0: 432 bytes
1: 696 bytes

This function is used to transfer the measured load torque data to the master station via FL-net.

As for the transfer of the load torque data via FL-net, see Subsection 2.6.2 “FL-net Connection”.

(5) Set of action type at load torque failure

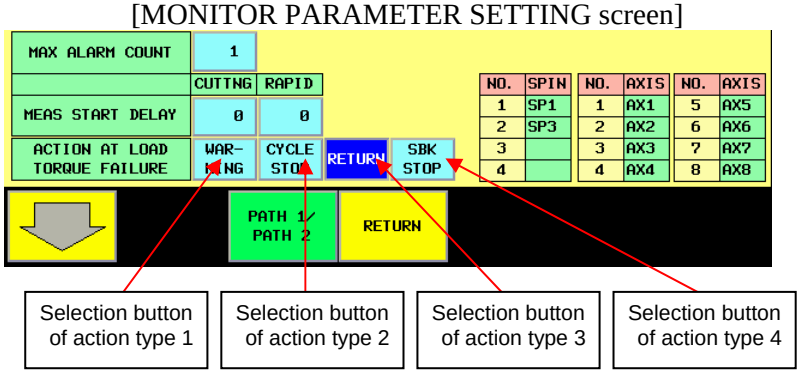
* This function is available with FANUC Auto HMI/T Edition 5.04 or later.

Set a name and an output signal for a selection button of action type on the “MONITOR PARAMETER SETTING” screen.

Set a character string that is displayed on the button with up to six half-size characters for two lines, to “Button name”.

Set a PMC signal that is output when the button was pushed, to “Output signal”.

[MONITOR PARAMETER SETTING screen]



The selection button of action type is a button to select the facility operation to be performed when a limit alarm for the load torque occurred.

The four buttons or less can be set. These buttons function as a selector switch and you can select one of the four buttons.

When a limit alarm signal for load torque (M0276 to M0295) was output, the PMC ladder performs appropriate action by referring to the state of the output signal assigned to these buttons.

Example of action type :

[Action type]	[Processing of PMC ladder]
<1> Warning	A warning lamp is lit.
<2> Cycle stop	Operation stops at end of a cycle.
<3> Return	A return program is executed.
<4> SBK stop	Single block stop

In the initial state, the most left button from among buttons to which the output signal has been assigned is selected.

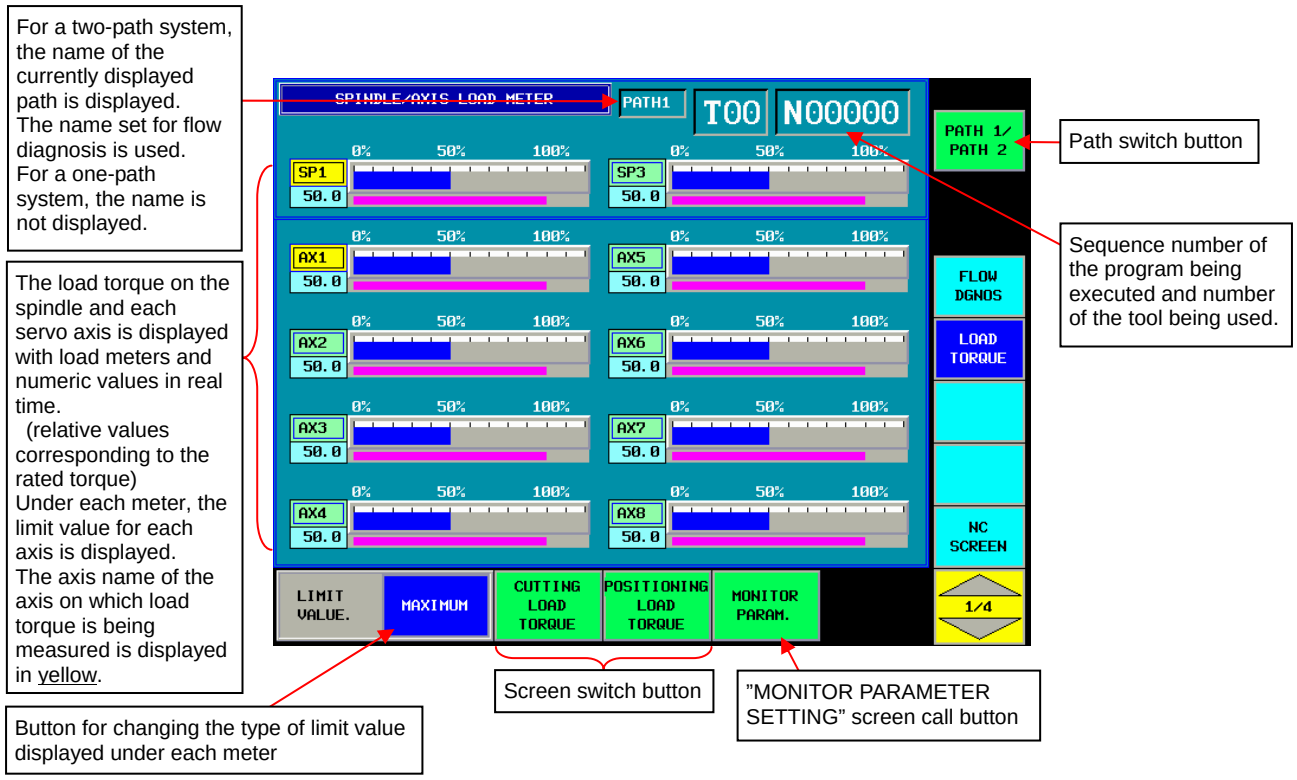
The selected state of buttons is kept even after the power is turned off. At power-on, the previously selected button becomes selected.

2.4.2 Types of Load Torque Screens

According to the setting made as described in the above subsection, the following screens are created. With this function, use the following screens to display the measurement result and set items required for measurement. The following screens are created for each path.

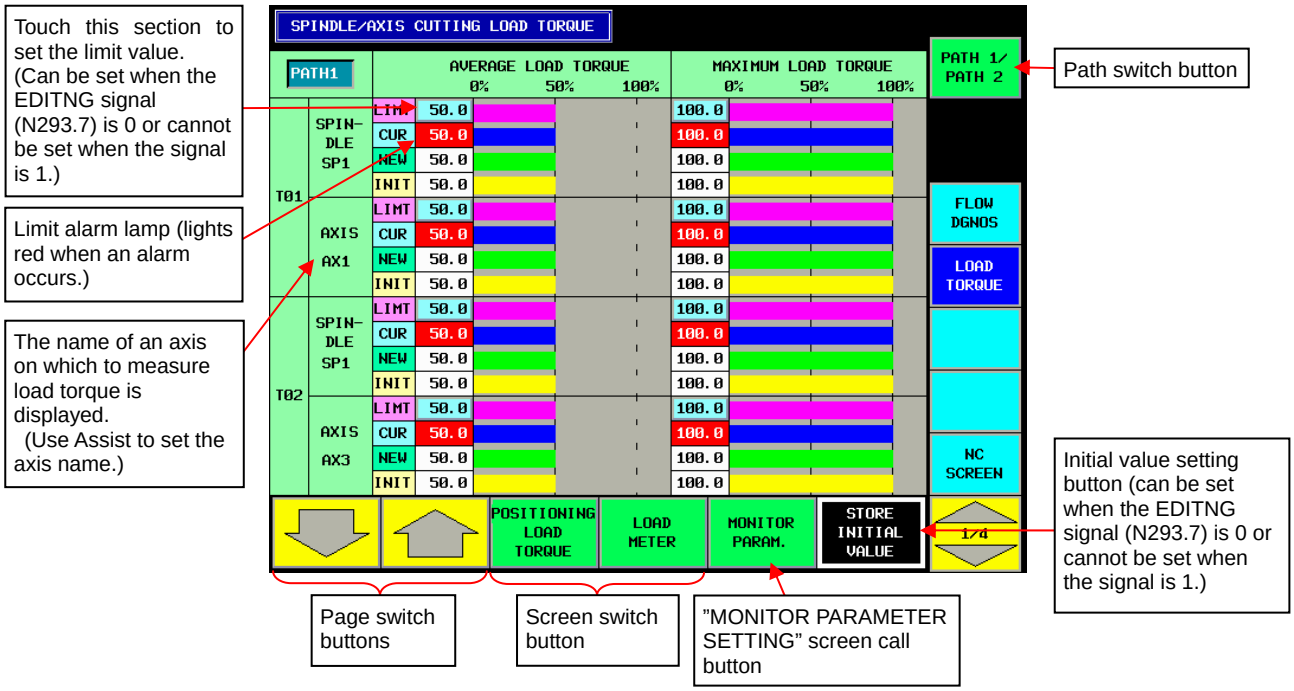
No.	Screen name	Description
1	SPINDLE/AXIS LOAD METER screen	This screen displays the operating load torque on the second spindle and each servo axis with numeric values and load meters. Each load torque is displayed with a relative value obtained when the maximum motor torque (for a spindle) or the maximum amplifier current (for a servo axis) is assumed to be 100%. Under the load meter for each axis, a bar chart indicating the limit set for the axis is displayed according to the load meter scale. You can use the corresponding button at the bottom of the screen to specify whether to display the limit of the maximum or average value. The displayed limit is normally for positioning load torque. During measurement of cutting load torque, the cutting load torque limit is displayed. The axis name of an axis on which load torque is currently being measured is displayed in yellow.
2	SPINDLE/AXIS CUTTING LOAD TORQUE screen	This screen displays the current average and maximum load torque values, new tool values, initial values, and limits for the spindle and servo axis during cutting operation for each of up to 32 tools (16 tools in case of FS18*i*-LNA/LNB, Power Mate *i*-LNA) with bar charts and numeric values. The numeric value display section of each limit is a touch switch. Touching this section displays a pop-up 10-key pad. Use this 10-key pad to set the limit. The numeric value display section of each current value is a lamp indicating a limit alarm. When a limit alarm occurs, this section lights red.
3	AXIS POSITIONING LOAD TORQUE screen	This screen displays the current average and maximum load torque values, initial values, and limits on each servo axis during positioning operation with bar charts and numeric values. The numeric value display section of each limit is a touch switch. Touching this section displays a pop-up 10-key pad. Use this 10-key pad to set the limit. The numeric value display section of each current value is a lamp indicating a limit alarm. When a limit alarm occurs, this section lights red.
4	MONITOR PARAMETER SETTING screen	Use this screen to set up to 32 sets (16 sets in case of FS18*i*-LNA/LNB, Power Mate *i*-LNA) of a measurement target tool number (T code), and the axis numbers of the corresponding spindle and servo axis. Also use this screen to set the measurement start delay time and continuous maximum value alarm count.
5	SEQUENCE NUMBER SETTING screen	If you want to use the measurement command with a sequence number specification, use this screen to set the sequence numbers of measurement target blocks. You can set up to 50 sequence numbers. Also use this screen to specify whether to enable or disable the measurement command with a sequence number specification and G00 automatic measurement command.
6	CUMULATIVE MAXIMUM LOAD TORQUE screen	The load torque for all operations is monitored regardless of whether the measurement command is issued and this screen displays the past maximum load torque. This value is cleared to zero by pressing the RESET VALUE button on the screen. The displayed value is not a relative value in 0.1% units, but a value read from the servo amplifier.

<1> SPINDLE/AXIS LOAD METER screen

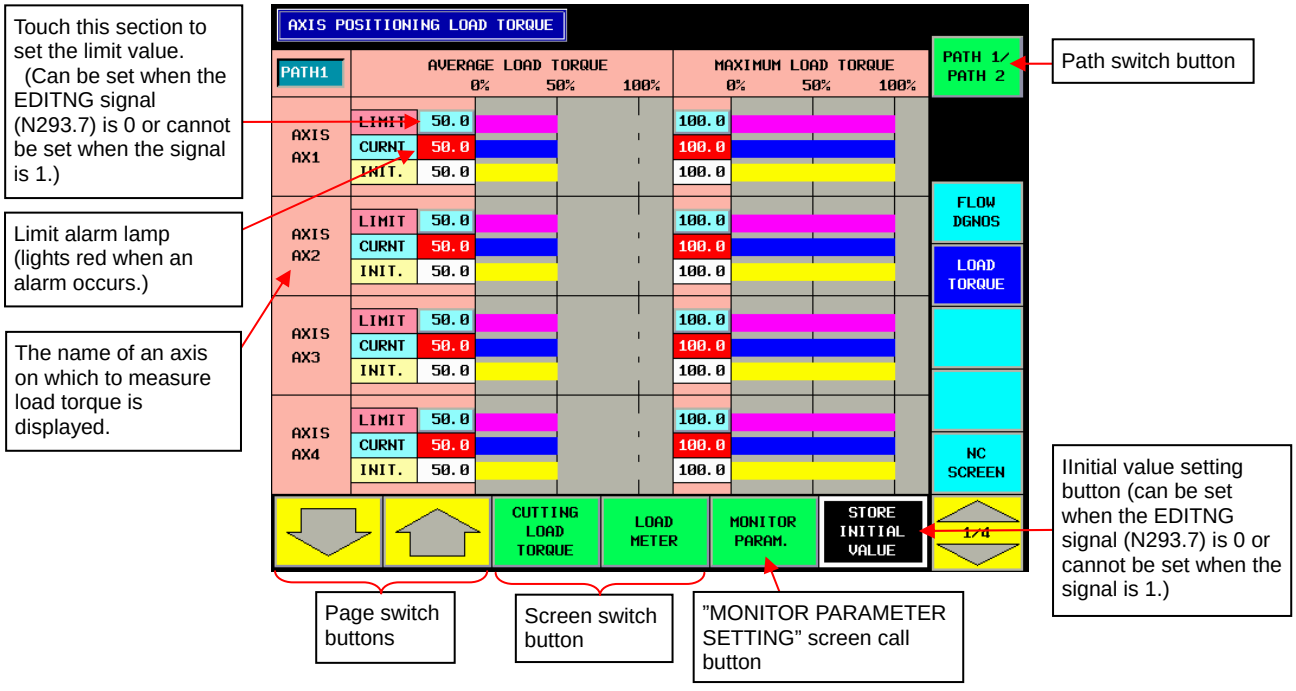


When three or more spindles are assigned in the “Spindle assignment for each PATH” item in the “LOAD TORQUE SCREEN 1/1” setting of FANUC Auto HMI/T Assist, the “SPINDLE/AXIS LOAD METER” screen for the path contains four spindle load meters as shown below. This screen has the functions identical to those the above screen has.

<2> SPINDLE/AXIS CUTTING LOAD TORQUE screen

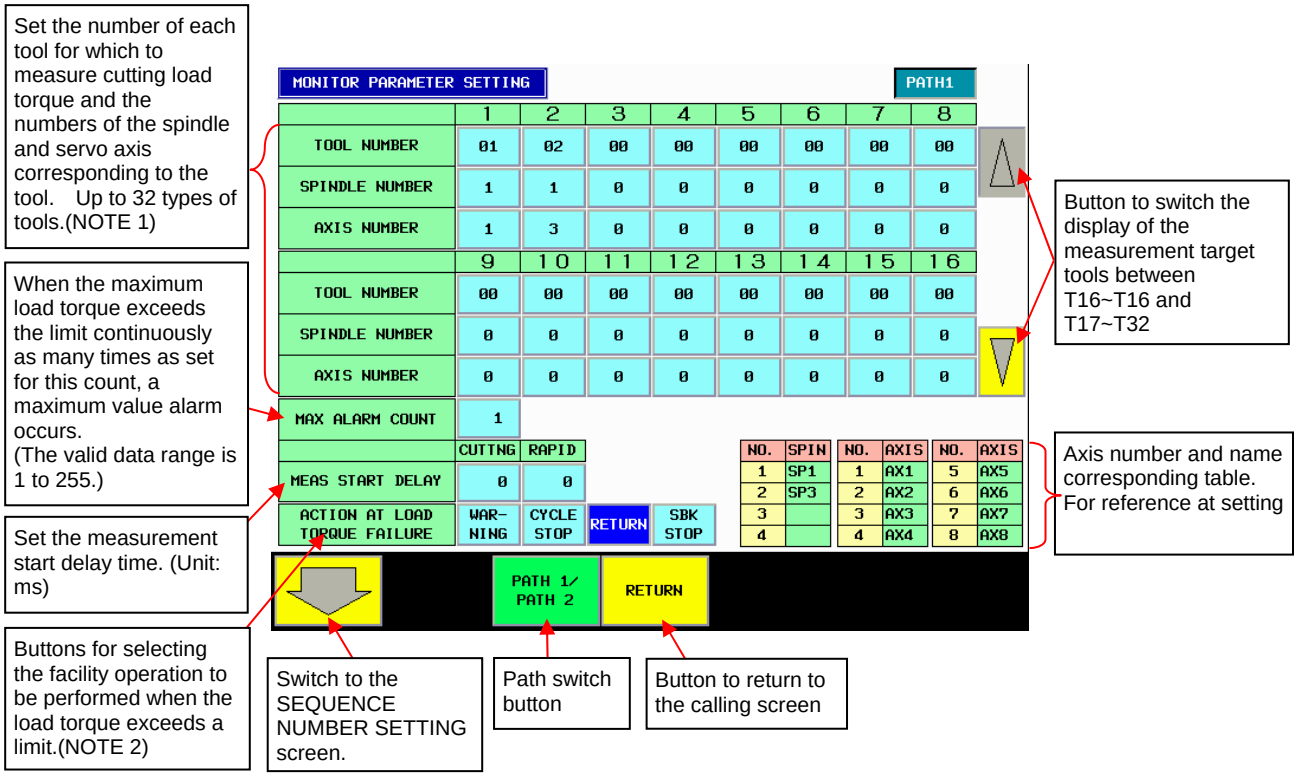


<3> AXIS POSITIONING LOAD TORQUE screen



<4> MONITOR PARAMETER SETTING screen

Each setting item on this screen can be changed only when the EDITNG signal (N293.7) is 0. When the signal is 1, the item cannot be changed.



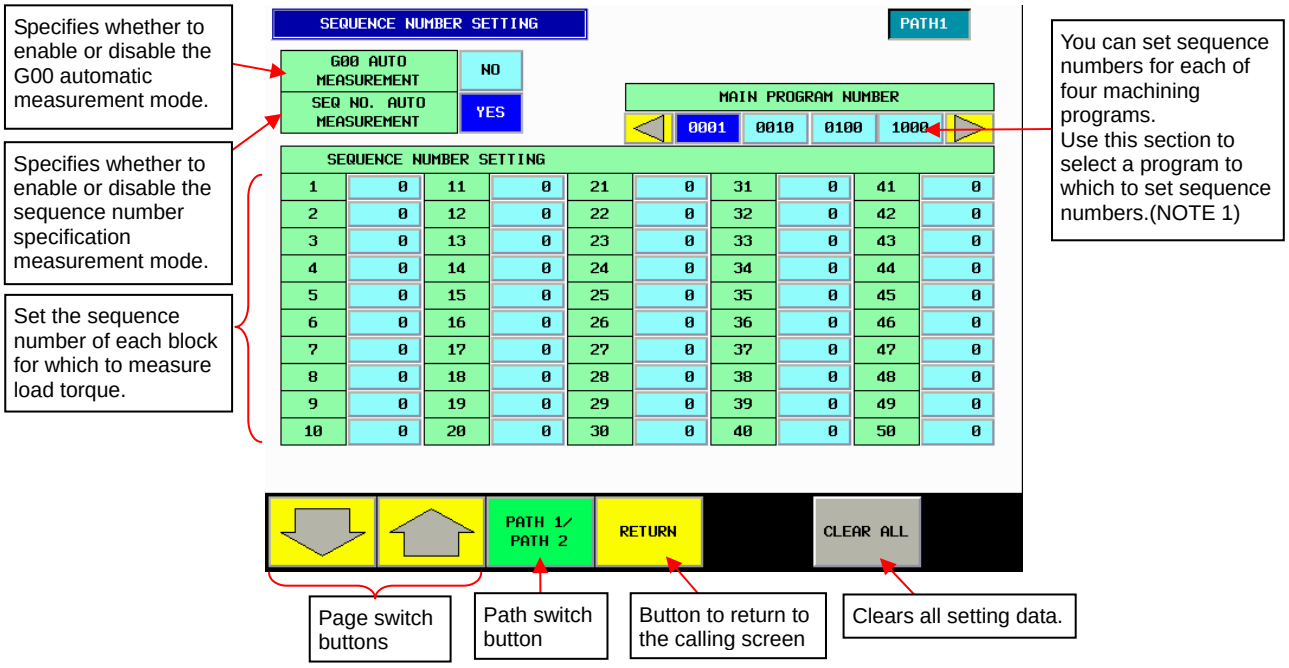
NOTE

1 In FS18*i*-LNA/LNB, Power Mate *i*-LNA, the types of tools is up to 16.

2 The “ACTION AT LOAD TORQUE FAILURE” buttons are available with FANUC Auto HMI/T **Edition 5.04** (FANUC Auto HMI/T Assist **Version 5.30**) or later.

<5> SEQUENCE NUMBER SETTING screen

Each setting item on this screen can be changed only when the EDITNG signal (N293.7) is 0. When the signal is 1, the item cannot be changed.



NOTE

The function which specifies sequence numbers for multiple programs is available with FANUC Auto HMI/T Edition 5.04 (FANUC Auto HMI/T Assist Version 5.30) or later.

2.5 PMC INTERFACE

2.5.1 Interface Signals

This subsection lists PMC interface signals used by this function. For details of each signal, see the relevant subsection(s).

(1) Input signals (PMC → CNC)

	#7	#6	#5	#4	#3	#2	#1	#0	
N0289	MEAS1	SPMEAS1	SQNO1	G0AM1		INTLS1	MH1	CYCL1	For path 1
N0295	MEAS2	SPMEAS2	SQNO2	G0AM2		INTLS2	MH2	CYCL2	For path 2

CYCL1/CYCL2 Load torque measurement cycle signal (See Subsection 2.3.1.)
MH1/MH2 Simultaneous multiple spindle measurement signal (See Subsection 2.3.7.8.)
INTLS1/INTLS2 New tool signal (must be on for at least 100 ms.)
G0AM1/G0AM2 Enables (1) or disables (0) the positioning (G00) block automatic measurement signal. (See Subsection 2.3.6.4.)
SQNO1/SQNO2 Enables (1) or disables (0) the measurement command with a sequence number specification. (See Subsection 2.3.6.3.)
SPMEAS1/SPMEAS2 Measurement suspend signal (See Subsections 2.3.6.3 and 2.3.6.4.)
MEAS1/MEAS2 Signal of the measurement command with automatic axis selection (See Subsection 2.3.6.2.)

	#7	#6	#5	#4	#3	#2	#1	#0	
N0290	MEAS18	MEAS17	MEAS16	MEAS15	MEAS14	MEAS13	MEAS12	MEAS11	For path 1
	8th axis	7th axis	6th axis	5th axis	4th axis	3rd axis	2nd axis	1st axis	
N0296	MEAS28	MEAS27	MEAS26	MEAS25	MEAS24	MEAS23	MEAS22	MEAS21	For path 2
	8th axis	7th axis	6th axis	5th axis	4th axis	3rd axis	2nd axis	1st axis	

MEAS1x/MEAS2x Signal of the measurement command with an axis specification (See Subsection 2.3.6.1.)

	#7	#6	#5	#4	#3	#2	#1	#0	
N0291	CURTL_1 (2-digit BCD)								For path 1
N0297	CURTL_2 (2-digit BCD)								For path 2

CURTL_1/CURTL_2 Current tool number
The number of the tool currently being used is reported with a 2-digit BCD number. (See Subsection 2.3.6.2.)
When no ATC is mounted and only one type of tool is used, input 00 to this interface signal. In this case, this function measures the cutting load torque according to the setting for item 1 on the "MONITOR PARAMETER SETTING" screen. A number other than 00 must be set as the tool number for item 1 in advance.

	#7	#6	#5	#4	#3	#2	#1	#0	
N0292	NWTLNO1 (2-digit BCD)								For path 1
N0298	NWTLNO2 (2-digit BCD)								For path 2

NWTLNO1/NWTLNO2 New tool number

After replacing a tool with a new one, set the number of the replaced tool with a 2-digit BCD number in this signal and output the INTLS1/2 signal described above. When you use only one type of tool and input 00 to the current tool number, also set the new tool number to 00. (See Subsection 2.3.8.)

	#7	#6	#5	#4	#3	#2	#1	#0
N0293	EDITNG		ALMRST					INISET

INISET Signal for copying load torque data in the initial value register

This signal is directly output from the operator's panel screen. The machine tool builder do not need to control this signal with the ladder.

ALMRST Limit alarm reset signal (on for at least 500 ms)

Setting this signal to 1 resets the limit alarm.

Once a limit alarm occurs, the alarm status is kept until the alarm is reset by this reset signal.

EDITNG Signal for disabling the setting of limits and other items

When this signal is 1, the setting is disabled. Control this signal using the "EDIT ENABLE" switch on the control panel. Input 1 to disable editing.

> ⚠ **CAUTION**
> When the EDITNG signal is 1, the edit of the each setting data of the cycle monitor function is disabled.

	#7	#6	#5	#4	#3	#2	#1	#0	
N0294	ALM18	ALM17	ALM16	ALM15	ASPMTR1	AMIST1	ALUB12	ALUB11	For path 1
N0299	ALM28	ALM27	ALM26	ALM25	ASPMTR2	AMIST2	ALUB22	ALUB21	For path 2

Use these signals to notify the external host of spindle unit lubrication errors, general-purpose spindle motor errors, and other errors together with load torque information. These signals are output to lubrication error data in the external host interface.

ALUB11/ALUB21 Lubrication error 1 (0 : Abnormal, 1 : Normal)

ALUB12/ALUB22 Lubrication error 1 (0 : Abnormal, 1 : Normal)

AMIST1/AMIST2 Oil filter error (0 : Abnormal, 1 : Normal)

ASPMTR1/ASPMTR2 General-purpose spindle motor error (0 : Abnormal, 1 : Normal)

ALM1x/ALM2x Can be used as a signal reporting an error other than the above. The setting on the external host is also required, however.

(2) Output signals (CNC → PMC)

	#7	#6	#5	#4	#3	#2	#1	#0	
M0276	ASPM18	ASPM17	ASPM16	ASPM15	ASPM14	ASPM13	ASPM12	ASPM11	For path 1
M0277	ASPM1G	ASPM1F	ASPM1E	ASPM1D	ASPM1C	ASPM1B	ASPM1A	ASPM19	
M0380	ASPM1O	ASPM1N	ASPM1M	ASPM1L	ASPM1K	ASPM1J	ASPM1I	ASPM1H	
M0381	ASPM1W	ASPM1V	ASPM1U	ASPM1T	ASPM1S	ASPM1R	ASPM1Q	ASPM1P	
M0286	ASPM28	ASPM27	ASPM26	ASPM25	ASPM24	ASPM23	ASPM22	ASPM21	For path 2
M0287	ASPM2G	ASPM2F	ASPM2E	ASPM2D	ASPM2C	ASPM2B	ASPM2A	ASPM29	
M0388	ASPM2O	ASPM2N	ASPM2M	ASPM2L	ASPM2K	ASPM2J	ASPM2I	ASPM2H	
M0389	ASPM2W	ASPM2V	ASPM2U	ASPM2T	ASPM2S	ASPM2R	ASPM2Q	ASPM2P	

ASPM1x/ASPM2x Limit alarm signal for the maximum load torque on the spindle during cutting load torque measurement (for each of 32 tools)

	#7	#6	#5	#4	#3	#2	#1	#0	
M0278	ASPA18	ASPA17	ASPA16	ASPA15	ASPA14	ASPA13	ASPA12	ASPA11	For path 1
M0279	ASPA1G	ASPA1F	ASPA1E	ASPA1D	ASPA1C	ASPA1B	ASPA1A	ASPA19	
M0382	ASPA1O	ASPA1N	ASPA1M	ASPA1L	ASPA1K	ASPA1J	ASPA1I	ASPA1H	
M0383	ASPA1W	ASPA1V	ASPA1U	ASPA1T	ASPA1S	ASPA1R	ASPA1Q	ASPA1P	
M0288	ASPA28	ASPA27	ASPA26	ASPA25	ASPA24	ASPA23	ASPA22	ASPA21	For path 2
M0289	ASPA2G	ASPA2F	ASPA2E	ASPA2D	ASPA2C	ASPA2B	ASPA2A	ASPA29	
M0390	ASPA2O	ASPA2N	ASPA2M	ASPA2L	ASPA2K	ASPA2J	ASPA2I	ASPA2H	
M0391	ASPA2W	ASPA2V	ASPA2U	ASPA2T	ASPA2S	ASPA2R	ASPA2Q	ASPA2P	

ASPA1x/ASPA2x Limit alarm signal for the average load torque on the spindle during cutting load torque measurement (for each of 32 tools)

	#7	#6	#5	#4	#3	#2	#1	#0	
M0280	ASVM18	ASVM17	ASVM16	ASVM15	ASVM14	ASVM13	ASVM12	ASVM11	For path 1
M0281	ASVM1G	ASVM1F	ASVM1E	ASVM1D	ASVM1C	ASVM1B	ASVM1A	ASVM19	
M0384	ASVM1O	ASVM1N	ASVM1M	ASVM1L	ASVM1K	ASVM1J	ASVM1I	ASVM1H	
M0385	ASVM1W	ASVM1V	ASVM1U	ASVM1T	ASVM1S	ASVM1R	ASVM1Q	ASVM1P	
M0290	ASVM28	ASVM27	ASVM26	ASVM25	ASVM24	ASVM23	ASVM22	ASVM21	For path 2
M0291	ASVM2G	ASVM2F	ASVM2E	ASVM2D	ASVM2C	ASVM2B	ASVM2A	ASVM29	
M0392	ASVM2O	ASVM2N	ASVM2M	ASVM2L	ASVM2K	ASVM2J	ASVM2I	ASVM2H	
M0393	ASVM2W	ASVM2V	ASVM2U	ASVM2T	ASVM2S	ASVM2R	ASVM2Q	ASVM2P	

ASVM1x/ASVM2x Limit alarm signal for the maximum load torque on the servo axis during cutting load torque measurement (for each of 32 tools)

	#7	#6	#5	#4	#3	#2	#1	#0	
M0282	ASVA18	ASVA17	ASVA16	ASVA15	ASVA14	ASVA13	ASVA12	ASVA11	For path 1
M0283	ASVA1G	ASVA1F	ASVA1E	ASVA1D	ASVA1C	ASVA1B	ASVA1A	ASVA19	
M0386	ASVA1O	ASVA1N	ASVA1M	ASVA1L	ASVA1K	ASVA1J	ASVA1I	ASVA1H	
M0387	ASVA1W	ASVA1V	ASVA1U	ASVA1T	ASVA1S	ASVA1R	ASVA1Q	ASVA1P	
M0292	ASVA28	ASVA27	ASVA26	ASVA25	ASVA24	ASVA23	ASVA22	ASVA21	For path 2
M0293	ASVA2G	ASVA2F	ASVA2E	ASVA2D	ASVA2C	ASVA2B	ASVA2A	ASVA29	
M0394	ASVA2O	ASVA2N	ASVA2M	ASVA2L	ASVA2K	ASVA2J	ASVA2I	ASVA2H	
M0395	ASVA2W	ASVA2V	ASVA2U	ASVA2T	ASVA2S	ASVA2R	ASVA2Q	ASVA2P	

ASVA1x/ASVA2x Limit alarm signal for the average load torque on the servo axis during cutting load torque measurement (for each of 32 tools)

	#7	#6	#5	#4	#3	#2	#1	#0	
M0284	APOSM18	APOSM17	APOSM16	APOSM15	APOSM14	APOSM13	APOSM12	APOSM11	For path 1
M0294	APOSM28	APOSM27	APOSM26	APOSM25	APOSM24	APOSM23	APOSM22	APOSM21	For path 2

APOSM1x/APOSM2x Limit alarm signal for the maximum load torque on the servo axis during positioning load torque measurement (for each axis)

	#7	#6	#5	#4	#3	#2	#1	#0	
M0285	APOSA18	APOSA17	APOSA16	APOSA15	APOSA14	APOSA13	APOSA12	APOSA11	For path 1
M0295	APOSA28	APOSA27	APOSA26	APOSA25	APOSA24	APOSA23	APOSA22	APOSA21	For path 2

APOSA1x/APOSA2x Limit alarm signal for the average load torque on the servo axis during positioning load torque measurement (for each axis)

	#7	#6	#5	#4	#3	#2	#1	#0	
M0296	MEND1								For path 1
M0298	MEND2								For path 2

MEND1/MEND2 Measurement end signal for the measurement command with automatic axis selection
The PMC ladder resets the measurement command signal (MEAS1, MEAS2) when receiving this signal.

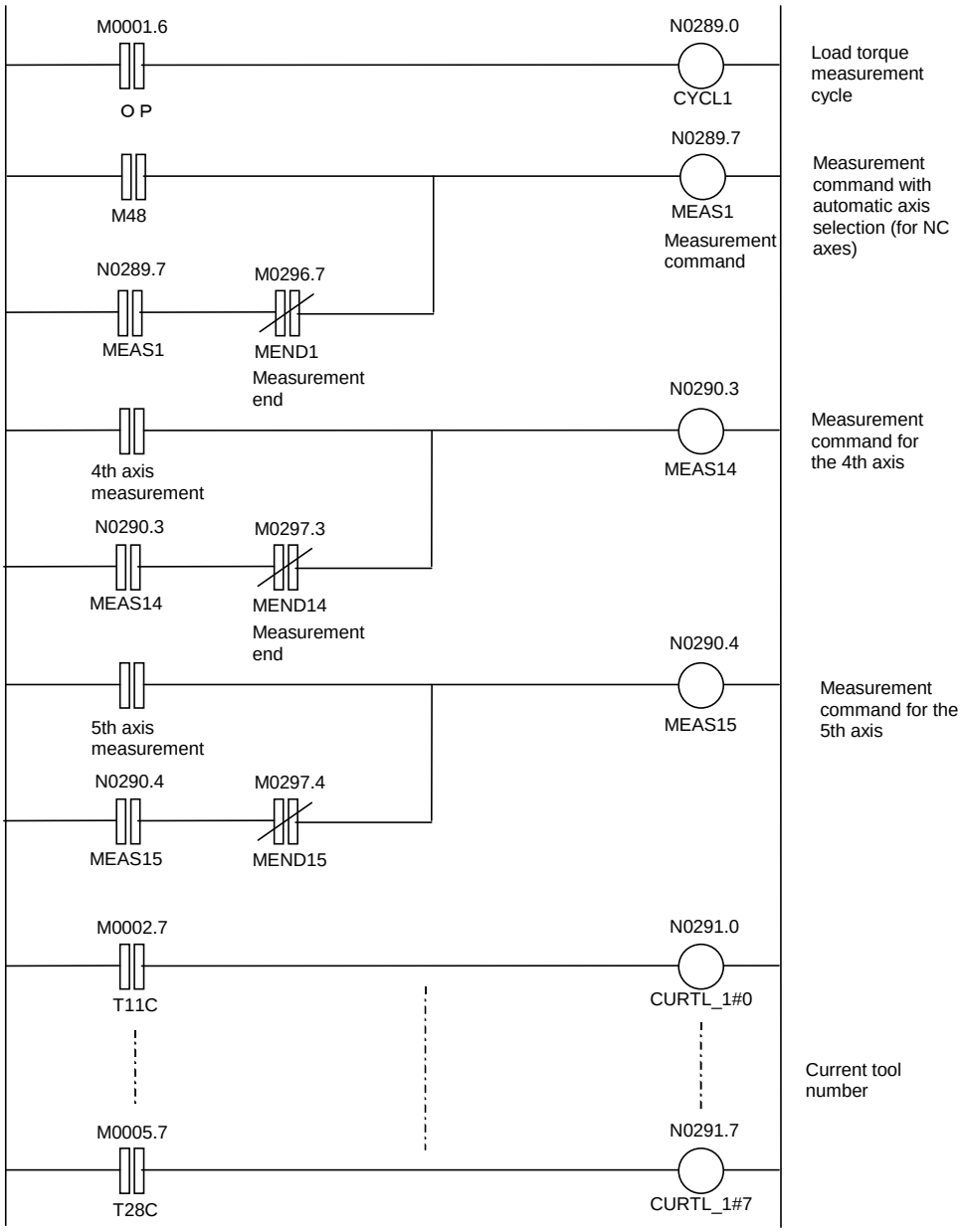
	#7	#6	#5	#4	#3	#2	#1	#0	
M0297	MEND18	MEND17	MEND16	MEND15	MEND14	MEND13	MEND12	MEND11	For path 1
	8th axis	7th axis	6th axis	5th axis	4th axis	3rd axis	2nd axis	1st axis	
M0299	MEND28	MEND27	MEND26	MEND25	MEND24	MEND23	MEND22	MEND21	For path 2
	8th axis	7th axis	6th axis	5th axis	4th axis	3rd axis	2nd axis	1st axis	

MEND1x/MEND2x Measurement end signal for the measurement command with an axis specification
The PMC ladder resets the measurement command signal (MEAS1x, MEAS2x) for each axis when receiving this signal.

> ⚠ **CAUTION**
> A limit alarm is not released until it is reset by the ALMRST signal (N293#5). The limit alarm signal and alarm lamp on the screen do not turn off until the alarm is reset by the ALMRST signal.

2.5.2 Sample Interface Circuit

A sample PMC ladder circuit is shown below. This circuit is designed to use the measurement command with automatic axis selection for NC axes (X-, Y-, and Z-axes) and the measurement command with an axis specification for peripheral axes (4th and 5th axes).
In the following sample, an miscellaneous function [M48] is used to specify the measurement on the NC axes and it is assumed that the T code specified in the program matches the number of the tool currently being used.
In addition to the following circuit, a circuit to report tool replacement and a circuit to take appropriate action such as return when a load torque limit alarm is received are required.



2.6 HOST INTERFACE

An interface is available for reading load torque and related data collected using this function to an external host (such as personal computer). You can use this interface to monitor the status of the entire machining line on the display on the host.
To connect the external host, use the Ethernet connection or Ethernet connection + FL-net connection. (For Series 30*i*/31*i*/32*i*/35*i*-B, the FL-net connection is not supported.)
With an Ethernet connection, the external host uses the FOCAS1/FOCAS2 function to reference the output register in the memory managed by the operator's panel.
With an FL-net connection, the external host communicates with the main station, which is installed among facilities connected via the FL-net, via Ethernet. Data at each station (substation) other than the main station is transferred to the external host via the main station using the data exchange function with FL-net common memory area 2. For the data exchange, data must be stored in the PMC D or R area. To store data in the area, a function is available, which transfers data in the output register in the memory in the operator's panel to the PMC D or R area. Set the transfer destination PMC address using FANUC Auto HMI/T Assist.
Data in memory in the operator's panel or in the PMC D or R area that is to be transferred to the external host is updated at the completion of a machining cycle and remains unchanged until the completion of the next machining cycle.

2.6.1 Ethernet Connection

For Series 18*i*-LNA/LNB and Power Mate *i*-LNA, as the host interface for an Ethernet connection, the host references data of the output register located at addresses 9032 to 10,429 (decimal) in the SRAM area. To access the data, use the function for reading the SRAM area of the FOCAS1/Ethernet interface, cnc_rdcexesram().
For Series 30*i*/31*i*/32*i*/35*i*-B, each data of the output register are acquired by using the FOCAS2 function, cnc_rdtrqmonitor(), to read the information of load torque.

2.6.1.1 Output register

The following figure shows the data arrangement of the output register.

offset		OUTPUT REGISTER	size
PATH1	PATH2		
0	700	Data Validity Flag	1 byte
1	701	(reserve)	1 byte
2	702	Load meter data	20 bytes
22	722	Cycle counter	2 bytes
24	724	New tool flag T1-T16	2 bytes
26	726	Lubrication error	1 byte
27	727	(reserve)	1 byte
28	728	Limit alarm signal for cutting load torque T1-T16	8 bytes
36	736	Limit alarm signal for positioning load torque	2 bytes
38	738	Monitor parameter (Tool number) T1-T16	16 bytes
54	754	Max alarm count	1 byte
55	755	Current tool number	1 byte
56	756	Cutting load torque data (Current value) T1-T8	64 bytes
120	820	Cutting load torque data (New tool value) T1-T8	64 bytes
184	884	Cutting load torque data (Initial value) T1-T8	64 bytes
248	948	Cutting load torque data (Limit value) T1-T8	64 bytes
312	1012	Positioning load torque data (Current value) T1-T8	32 bytes
344	1044	Positioning load torque data (Initial value) T1-T8	32 bytes
376	1076	Positioning load torque data (Limit value) T1-T8	32 bytes
408	1108	(reserve)	2 bytes
410	1110	Monitor parameter (Servo axis number) T1-T16	16 bytes
426	1126	Monitor parameter (Spindle number) T1-T16	16 bytes
442	1142	Cutting load torque data (Current value) T9-T16	64 bytes
506	1206	Cutting load torque data (New tool value) T9-T16	64 bytes
570	1270	Cutting load torque data (Initial value) T9-T16	64 bytes
634	1334	Cutting load torque data (Limit value) T9-T16	64 bytes
698	1398	(reserve)	2 bytes
1400	2000	New tool flag T1-T8	2 bytes
1402	2002	Limit alarm signal for cutting load torque T17-T32	8 bytes
1410	2010	Monitor parameter (Tool number) T17-T32	16 bytes
1426	2026	Monitor parameter (Servo axis number) T17-T32	16 bytes
1442	2042	Monitor parameter (Spindle number) T17-T32	16 bytes
1458	2058	Cutting load torque data (Current value) T17-T32	128 bytes
1586	2186	Cutting load torque data (New tool value) T17-T32	128 bytes
1714	2314	Cutting load torque data (Initial value) T17-T32	128 bytes
1842	2442	Cutting load torque data (Limit value) T17-T32	128 bytes
1970	2570	(reserve)	30 bytes

NOTE
Output registers (offset 1400 to 1999, offset 2000 to 2599) are available only for Series 30*i*/31*i*/32*i*/35*i*-B.

Output register data is explained below.

(1) Data validity flag

These flags are used to indicate the data validity to the external host.

offset		data							
PATH1	PATH2	#7	#6	#5	#4	#3	#2	#1	#0
0	700							VLIDn2	VLIDn1

PATH1: n=1, PATH2: n=2

VLID11 is the flag indicating the validity of the load meter data at offsets 2 to 21 (for path 1) and VLID21 is the flag indicating that of the load meter data at offsets 702 to 721 (for path 2). Make the external host read the flags and data at a time. Also make the host determine the data to be valid when VLID11/21 is 1 or determine the data to be invalid and discard the data when VLID11/21 is 0.

VLID12 is the flag indicating the validity of the cutting and positioning load torque data at offsets 56 and after (for path 1) and VLID22 is the flag indicating that of the cutting and positioning load torque data at offsets 756 and after (for path 2). Make the external host read the flags and data at a time. Also make the host determine the data to be valid when VLID12/22 is 1 or determine the data to be invalid and discard the data when VLID12/22 is 0.

(2) Load meter data

The current load torque on the spindle and each servo axis is stored. The data is the same as that displayed on the "SPINDLE/AXIS LOAD METER" screen. The data is updated at intervals of approximately 0.1 seconds.
This data is represented with a relative value obtained when the maximum motor torque for a spindle or the maximum amplifier current for a servo axis is assumed to be 100%. The data is an unsigned binary absolute value. The unit is 0.1%.

offset		data	size
PATH1	PATH2		
2	702	Load meter of 1st spindle	2 bytes
4	704	Load meter of 2nd spindle	2 bytes
6	706	Load meter of 1st servo axis	2 bytes
:	:	:	
20	720	Load meter of 8th servo axis	2 bytes

(3) Cycle counter

These counters are incremented by 1 at the end of each machining cycle. For each path, an independent counter is provided. At the rising edge of the CYCL1/2 signal of the PMC interface, the cycle counter for each path is incremented by 1. The external host checks the value of this counter to determine whether output register data is updated (is data for a new machining cycle).

offset		data	size
PATH1	PATH2		
22	722	Cycle counter	2 bytes

(4) New tool flag

These flags are used to notify the external host that new tool data is updated. This function copies the load torque data corresponding to the replaced tool in the new tool value register and set the flag corresponding to the replaced tool to 1 at the end of the machining cycle following the machining cycle in which a tool is replaced with a new one. This flag returns to 0 at the end of the machining cycle after next. The external host can reference the value of this flag to recognize the number of the replaced tool and read the new tool value data for the tool.

offset		data							
PATH1	PATH2	#7	#6	#5	#4	#3	#2	#1	#0
24	724	T8 new	T7 new	T6 new	T5 new	T4 new	T3 new	T2 new	T1 new
25	725	T16 new	T15 new	T14 new	T13 new	T12 new	T11 new	T10 new	T9 new

1400	2000	T24 new	T23 new	T22 new	T21 new	T20 new	T19 new	T18 new	T17 new
1401	2001	T32 new	T31 new	T30 new	T29 new	T28 new	T27 new	T26 new	T25 new

(5) Lubrication error

This interface is used to notify the external host of general-purpose spindle motor errors and spindle unit lubrication errors. The signals input to the PMC interface (N0294/N0299) are copied into the areas at offsets 26 and 726 without modifications. The four low-order bits in this area are assigned to lubrication unit errors, oil filter unit error, and general-purpose spindle motor error as shown below. You can use the four high-order bits as general-purpose alarm signals because they are not assigned to specific purposes. For the explanation of the signals, see Section 2.5, “PMC INTERFACE.”
This data is updated at intervals of approximately 0.1 seconds.

offset		data							
PATH1	PATH2	#7	#6	#5	#4	#3	#2	#1	#0
26	726	ALMn8	ALMn7	ALMn6	ALMn5	ASPMTRn	AMISTn	ALUBn2	ALUBn1

PATH1: n=1, PATH2: n=2

(6) Limit alarm signal

The status of the limit alarm signals (M0276 to M0285 and M0286 to M0295) described in Section 2.5, “PMC INTERFACE,” is set in this area at intervals of approximately 0.1 seconds.

- Limit alarm signal for cutting load torque

offset		data							
PATH1	PATH2	#7	#6	#5	#4	#3	#2	#1	#0
28	728	ASPMn8	ASPMn7	ASPMn6	ASPMn5	ASPMn4	ASPMn3	ASPMn2	ASPMn1
29	729	ASPMnG	ASPMnF	ASPMnE	ASPMnD	ASPMnC	ASPMnB	ASPMnA	ASPMn9
30	730	ASPAn8	ASPAn7	ASPAn6	ASPAn5	ASPAn4	ASPAn3	ASPAn2	ASPAn1
31	731	ASPAnG	ASPAnF	ASPAnE	ASPAnD	ASPAnC	ASPAnB	ASPAnA	ASPAn9
32	732	ASVMn8	ASVMn7	ASVMn6	ASVMn5	ASVMn4	ASVMn3	ASVMn2	ASVMn1
33	733	ASVMnG	ASVMnF	ASVMnE	ASVMnD	ASVMnC	ASVMnB	ASVMnA	ASVMn9
34	734	ASVAn8	ASVAn7	ASVAn6	ASVAn5	ASVAn4	ASVAn3	ASVAn2	ASVAn1
35	735	ASVAnG	ASVAnF	ASVAnE	ASVAnD	ASVAnC	ASVAnB	ASVAnA	ASVAn9

1402	2002	ASPMnO	ASPMnN	ASPMnM	ASPMnL	ASPMnK	ASPMnJ	ASPMnI	ASPMnH
1403	2003	ASPMnW	ASPMnV	ASPMnU	ASPMnT	ASPMnS	ASPMnR	ASPMnQ	ASPMnP
1404	2004	ASPAnO	ASPAnN	ASPAnM	ASPAnL	ASPAnK	ASPAnJ	ASPAnI	ASPAnH
1405	2005	ASPAnW	ASPAnV	ASPAnU	ASPAnT	ASPAnS	ASPAnR	ASPAnQ	ASPAnP
1406	2006	ASVMnO	ASVMnN	ASVMnM	ASVMnL	ASVMnK	ASVMnJ	ASVMnI	ASVMnH
1407	2007	ASVMnW	ASVMnV	ASVMnU	ASVMnT	ASVMnS	ASVMnR	ASVMnQ	ASVMnP
1408	2008	ASVAnO	ASVAnN	ASVAnM	ASVAnL	ASVAnK	ASVAnJ	ASVAnI	ASVAnH
1409	2009	ASVAnW	ASVAnV	ASVAnU	ASVAnT	ASVAnS	ASVAnR	ASVAnQ	ASVAnP

PATH1: n=1, PATH2: n=2

NOTE
Limit alarm signals for cutting load torque (offset 1402 to 1409, offset 2002 to 2009) are available only for Series 30*i*/31*i*/32*i*/35*i*-B.

- Limit alarm signal for positioning load torque

offset		data							
PATH1	PATH2	#7	#6	#5	#4	#3	#2	#1	#0
36	736	APOSMn8	APOSMn7	APOSMn6	APOSMn5	APOSMn4	APOSMn3	APOSMn2	APOSMn1
37	737	APOSAn8	APOSAn7	APOSAn6	APOSAn5	APOSAn4	APOSAn3	APOSAn2	APOSAn1

PATH1: n=1, PATH2: n=2

(7) Monitor parameter (Tool number)

These interfaces are used to notify the external host of the T code numbers of tools for which to measure cutting load torque. The T code numbers set for items 1 to 16 on the "MONITOR PARAMETER SETTING" screen for each path are set in the area at offsets 38 to 53 or at offsets 738 to 754 with binary values. A change to a setting made on the "MONITOR PARAMETER SETTING" screen is immediately reflected to this data.

offset		data	size
PATH1	PATH2		
38	738	T1 Tool number	1 byte
:	:	:	
53	753	T16 Tool number	1 byte

1410	2010	T17 Tool number	1 byte
:	:	:	
1425	2025	T32 Tool number	1 byte

NOTE
T17-T32 Tool numbers (offset 1410 to 1425, offset 2010 to 2025) are available only for Series 30*i*/31*i*/32*i*/35*i*-B.

(8) Continuous maximum value alarm count

The external host is notified of the continuous alarm counts for the maximum values set on the "MONITOR PARAMETER SETTING" screen on the operator's panel. (When the maximum load torque continuously exceeds the limit as many times as the number set on the screen, a maximum value alarm occurs. The valid setting range is 1 to 255.) A change to this setting is immediately reflected to this data.

offset		data	size
PATH1	PATH2		
54	754	Continuous maximum value alarm count	1 byte

(9) Current tool number

The number of the tool currently being used for machining for each path that is reported via the PMC interface (N0291 or N0297) is stored with a binary value.

offset		data	size
PATH1	PATH2		
55	755	Current tool number	1 byte

(10) Cutting load torque data (Current value, New tool value, Initial value, Limit value)

The current values, new tool values, initial values of load torque measured according to the setting on the "MONITOR PARAMETER SETTING" screen and the limits set on the "SPINDLE/AXIS CUTTING LOAD TORQUE" screen are stored.

Data for one tool consists of the following four data items: Maximum and average values of the spindle load torque and the maximum and average values of the servo axis load torque. The size of the each data item is 2 bytes and the total data size is 64 bytes.

- Current value

offset		data	size
PATH1	PATH2		
56	756	T1 Spindle maximum value	2 bytes
58	758	T1 Spindle average value	2 bytes
60	760	T1 Servo maximum value	2 bytes
62	762	T1 Servo average value	2 bytes
:	:	:	
112	812	T8 Spindle maximum value	2 bytes
114	814	T8 Spindle average value	2 bytes
116	816	T8 Servo maximum value	2 bytes
118	818	T8 Servo average value	2 bytes
442	1142	T9 Spindle maximum value	2 bytes
444	1144	T9 Spindle average value	2 bytes
446	1146	T9 Servo maximum value	2 bytes
448	1148	T9 Servo average value	2 bytes
:	:	:	
498	1198	T16 Spindle maximum value	2 bytes
500	1200	T16 Spindle average value	2 bytes
502	1202	T16 Servo maximum value	2 bytes
504	1204	T16 Servo average value	2 bytes
1458	2058	T17 Spindle maximum value	2 bytes
1460	2060	T17 Spindle average value	2 bytes
1462	2062	T17 Servo maximum value	2 bytes
1466	2064	T17 Servo average value	2 bytes
:	:	:	
1578	2178	T32 Spindle maximum value	2 bytes
1580	2180	T32 Spindle average value	2 bytes
1582	2182	T32 Servo maximum value	2 bytes
1584	2184	T32 Servo average value	2 bytes

NOTE

T17-T32 Spindle maximum values, Spindle average values, Servo maximum values, and Servo average values (offset 1458 to 1585, offset 2058 to 2185) are available only for Series 30*i*/31*i*/32*i*/35*i*-B.

- New tool value

offset		data	size
PATH1	PATH2		
120	820	T1 Spindle maximum value	2 bytes
122	822	T1 Spindle average value	2 bytes
124	824	T1 Servo maximum value	2 bytes
126	826	T1 Servo average value	2 bytes
:	:	:	
176	876	T8 Spindle maximum value	2 bytes
178	878	T8 Spindle average value	2 bytes
180	880	T8 Servo maximum value	2 bytes
182	882	T8 Servo average value	2 bytes

506	1206	T9 Spindle maximum value	2 bytes
508	1208	T9 Spindle average value	2 bytes
510	1210	T9 Servo maximum value	2 bytes
512	1212	T9 Servo average value	2 bytes
:	:	:	
562	1262	T16 Spindle maximum value	2 bytes
564	1264	T16 Spindle average value	2 bytes
566	1266	T16 Servo maximum value	2 bytes
568	1268	T16 Servo average value	2 bytes

1586	2186	T17 Spindle maximum value	2 bytes
1588	2188	T17 Spindle average value	2 bytes
1590	2190	T17 Servo maximum value	2 bytes
1592	2192	T17 Servo average value	2 bytes
:	:	:	
1706	2306	T32 Spindle maximum value	2 bytes
1708	2308	T32 Spindle average value	2 bytes
1710	2310	T32 Servo maximum value	2 bytes
1712	2312	T32 Servo average value	2 bytes

NOTE

T17-T32 Spindle maximum values, Spindle average values, Servo maximum values, and Servo average values (offset 1586 to 1713, offset 2186 to 2313) are available only for Series 30*i*/31*i*/32*i*/35*i*-B.

- Initial value

offset		data	size
PATH1	PATH2		
184	884	T1 Spindle maximum value	2 bytes
186	886	T1 Spindle average value	2 bytes
188	888	T1 Servo maximum value	2 bytes
190	890	T1 Servo average value	2 bytes
:	:	:	
240	940	T8 Spindle maximum value	2 bytes
242	942	T8 Spindle average value	2 bytes
244	944	T8 Servo maximum value	2 bytes
246	946	T8 Servo average value	2 bytes
570	1270	T9 Spindle maximum value	2 bytes
572	1272	T9 Spindle average value	2 bytes
574	1274	T9 Servo maximum value	2 bytes
576	1276	T9 Servo average value	2 bytes
:	:	:	
626	1326	T16 Spindle maximum value	2 bytes
628	1328	T16 Spindle average value	2 bytes
630	1330	T16 Servo maximum value	2 bytes
632	1332	T16 Servo average value	2 bytes
1714	2314	T17 Spindle maximum value	2 bytes
1716	2316	T17 Spindle average value	2 bytes
1718	2318	T17 Servo maximum value	2 bytes
1720	2320	T17 Servo average value	2 bytes
:	:	:	
1834	2434	T32 Spindle maximum value	2 bytes
1836	2436	T32 Spindle average value	2 bytes
1838	2438	T32 Servo maximum value	2 bytes
1840	2440	T32 Servo average value	2 bytes

NOTE

T17-T32 Spindle maximum values, Spindle average values, Servo maximum values, and Servo average values (offset 1714 to 1841, offset 2314 to 2441) are available only for Series 30*i*/31*i*/32*i*/35*i*-B.

- Limit value

offset		data	size
PATH1	PATH2		
248	948	T1 Spindle maximum value	2 bytes
250	950	T1 Spindle average value	2 bytes
252	952	T1 Servo maximum value	2 bytes
254	954	T1 Servo average value	2 bytes
:	:	:	
304	1004	T8 Spindle maximum value	2 bytes
306	1006	T8 Spindle average value	2 bytes
308	1008	T8 Servo maximum value	2 bytes
310	1010	T8 Servo average value	2 bytes

634	1334	T9 Spindle maximum value	2 bytes
636	1336	T9 Spindle average value	2 bytes
638	1338	T9 Servo maximum value	2 bytes
640	1340	T9 Servo average value	2 bytes
:	:	:	
690	1390	T16 Spindle maximum value	2 bytes
692	1392	T16 Spindle average value	2 bytes
694	1394	T16 Servo maximum value	2 bytes
696	1396	T16 Servo average value	2 bytes

1842	2442	T17 Spindle maximum value	2 bytes
1844	2444	T17 Spindle average value	2 bytes
1846	2446	T17 Servo maximum value	2 bytes
1848	2448	T17 Servo average value	2 bytes
:	:	:	
1962	2562	T32 Spindle maximum value	2 bytes
1964	2564	T32 Spindle average value	2 bytes
1966	2566	T32 Servo maximum value	2 bytes
1968	2568	T32 Servo average value	2 bytes

NOTE
T17-T32 Spindle maximum values, Spindle average values, Servo maximum values, and Servo average values (offset 1842 to 1969, offset 2442 to 2569) are available only for Series 30*i*/31*i*/32*i*/35*i*-B.

The current values and new tool values are updated at the end of a machining cycle or when a limit alarm occurs. The initial values are updated when the “STORE INITIAL VALUE” button on the operator’s panel.

(11) Positioning load torque data (Current value, Initial value, Limit value)

These areas are used to report positioning load torque data. Data for up to eight axes is stored for path 1 and data for up to six axes is stored for path 2. Data for one axis consists of the following two data items: Maximum and average values of the servo axis load torque. Each data item is 2 bytes long and the total data size is 4 bytes.

- Current value

offset		data	size
PATH1	PATH2		
312	1012	1st servo axis maximum value	2 bytes
314	1014	1st servo axis average value	2 bytes
:	:	:	
340	1040	8th servo axis maximum value	2 bytes
342	1042	8th servo axis average value	2 bytes

- Initial value

offset		data	size
PATH1	PATH2		
344	1044	1st servo axis maximum value	2 bytes
346	1046	1st servo axis average value	2 bytes
:	:	:	
372	1072	8th servo axis maximum value	2 bytes
374	1074	8th servo axis average value	2 bytes

- Limit value

offset		data	size
PATH1	PATH2		
376	1076	1st servo axis maximum value	2 bytes
378	1078	1st servo axis average value	2 bytes
:	:	:	
404	1104	8th servo axis maximum value	2 bytes
406	1106	8th servo axis average value	2 bytes

The current values are updated at the end of a machining cycle or when a limit alarm occurs. The initial values are updated when the STORE INITIAL VALUE button on the screen is pressed.

(12) Monitor parameter (Servo axis number, Spindle number)

On the "MONITOR PARAMETER SETTING" screen on the operator's panel, the numbers of the spindle and servo axis on which to measure cutting load torque is set for each tool. The number of a tool for which to measure cutting load torque is stored in the area described in (7), "Monitor parameter (Tool number)". The numbers of the spindle and servo axis are stored in this area. Data is a binary integer value.

- Servo axis number

offset		data	size
PATH1			
410	1110	T1 Servo axis number	1 byte
:	:	:	
425	1125	T16 Servo axis number	1 byte

1426	2026	T17 Servo axis number	1 byte
:	:	:	
1441	2041	T32 Servo axis number	1 byte

NOTE
T17-T32 Servo axis numbers (offset 1426 to 1441, offset 2026 to 2041) are available only for Series 30*i*/31*i*/32*i*/35*i*-B.

- Spindle number

offset		data	size
PATH1	PATH2		
426	1126	T1 Spindle number	1 byte
:	:	:	
441	1141	T16 Spindle number	1 byte

1442	2042	T17 Spindle number	1 byte
:	:	:	
1457	2057	T32 Spindle number	1 byte

NOTE
T17-T32 Spindle numbers (offset 1442 to 1457, offset 2042 to 2057) are available only for Series 30*i*/31*i*/32*i*/35*i*-B.

2.6.1.2 Read function of the load torque information : cnc_rdtrqmonitor()

In Series 30*i*/31*i*/32*i*/35*i*-B, the output register are acquired by using the following FOCAS2 function, cnc_rdtrqmonitor().

Function name	cnc_rdtrqmonitor
Declaration	#include “fwlib32.h” FWLIBAPI short WINAPI cnc_rdtrqmonitor(unsigned short FlibHndl, long offset, void *data, long *length);
Description	Reads the load torque information of the motor load torque monitor function.
Arguments	FlibHndl[in] Specify the library handle. offset[in] Specify the start address of the output register. The top of the output register is indicated by ‘0’. data[out] Pointer to the storage area of the output register to be read. length[in/out] Pointer to the data length of the output register to be read. Actual data length to be read is stored after this function is called.
Return	EW_OK is returned on successful completion, otherwise any value except EW_OK is returned. The major error codes are as follows. EW_FUNC(1) Unavailable. The motor load torque monitor function is not built into CNC.. EW_LENGTH(2) The specification of ‘length’ is wrong. The value of 0 or less was specified for ‘length’. EW_NUMBER(3) The specification of ‘offset’ is wrong. The negative value was specified for ‘offset’. The value that exceeded the maximum value was specified for ‘offset’. EW_NOOPT(6) No option. FANUC PICTURE executor is necessary.

2.6.2 FL-net Connection

NOTE
For Series 30*i*/31*i*/32*i*/35*i*-B, this function is not available.

In a transfer machine system in which stations are connected to each other via the FL-net, data at each substation is transferred to the main station via the FL-net and the external host connected to the main station via the Ethernet reads the data. To transfer data via the FL-net, data at each station must be stored in the PMC D or R area.
On the "LOAD TORQUE SCREEN" setting sheet of FANUC Auto HMI/T Assist, select whether to transfer data for the FL-net, the data amount, and the starting address of the transfer destination PMC I/O area for each path. The following table lists each data amount setting and the amount of data to be transferred according to the setting. Data exchange with FL-net common memory area 2 is performed with data for paths 1 and 2 as a unit. For this reason, set the data transfer destination addresses so that data for path 1 and data for path 2 are stored in contiguous areas.
The size of data which can be transferred using the data exchange function with FL-net common memory area 2 is limited. Be careful not to transfer unnecessary data. For details, refer to the FL-net manual.

Setting items on the "LOAD TORQUE SCREEN" of FANUC Auto HMI/T Assist

I/O addresses to store Load Torque data.

Setting items	PATH 1	PATH 2
Store Load Torque data in I/O area (1) or not (0).		
Top address of data storage I/O area.(D or R area)		
Data size selection (0: 432 byte, 1: 696 byte)		

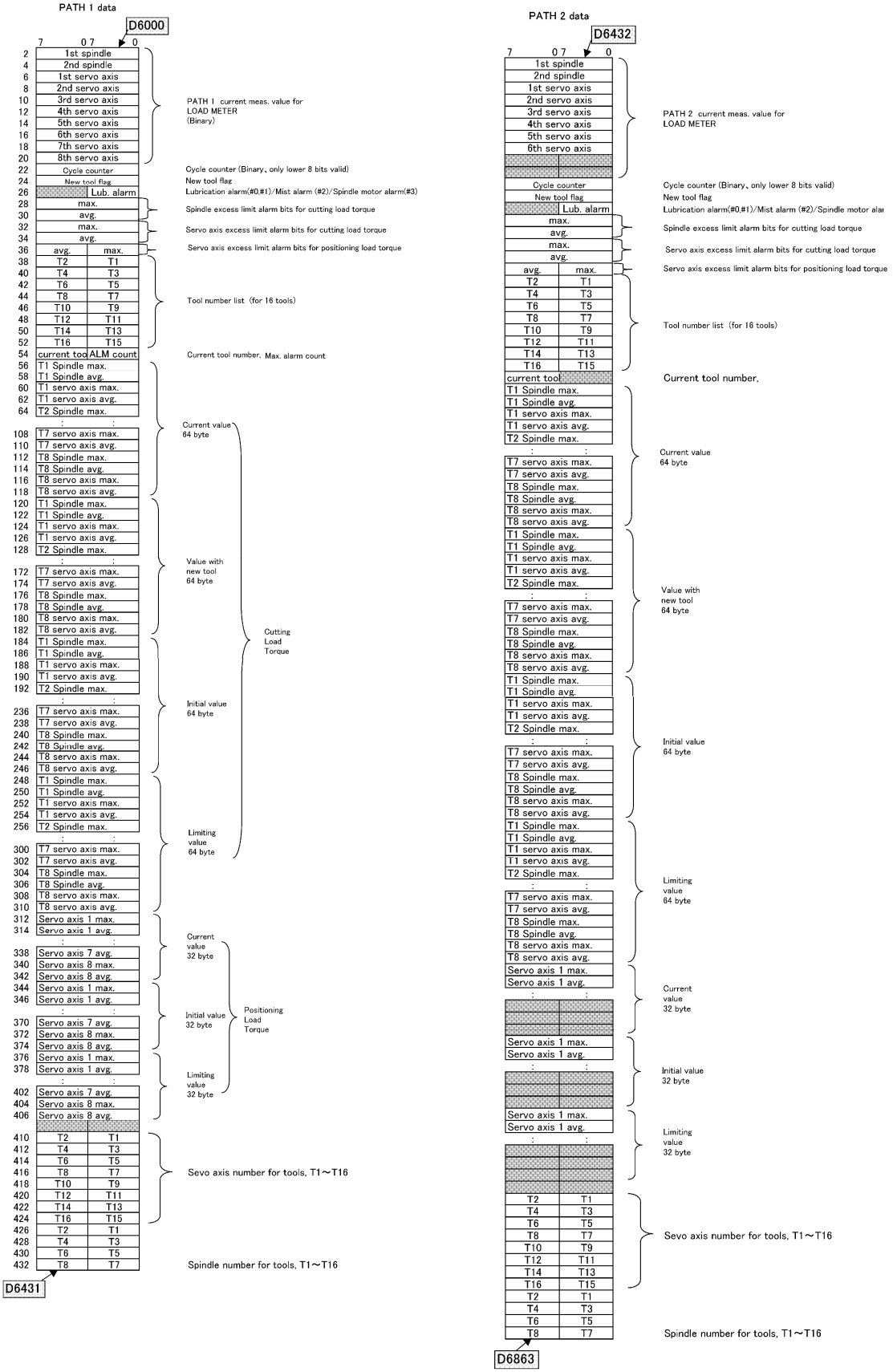
Transfer data amount setting and corresponding amount of data to be transferred

No.	Transfer data amount setting	Range of data to be transferred (offsets)		Amount of data transferred	Remarks
		Path 1	Path 2		
1	0	2 to 433	702 to 1133	432 bytes	For eight tools
2	1	2 to 697	702 to 1397	696 bytes	For 16 tools

The arrangement of data transferred to the PMC area by this function is the same as the data arrangement for an Ethernet connection. The first 2 bytes of the output register for an Ethernet connection are not transferred because they are unnecessary.
An example of arrangement of data transferred to the PMC data area when 432-byte data is transferred for each path of a two-path system with the following settings is shown on the following page.

I/O addresses to store Load Torque data.

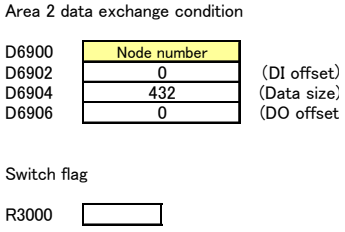
Setting items	PATH 1	PATH 2
Store Load Torque data in I/O area (1) or not (0).	1	1
Top address of data storage I/O area.(D or R area)	D6000	D6432
Data size selection (0: 432 byte, 1: 696 byte)	0	0


PATH 1 data
D6000
7 0 7 0
1st spindle
2nd spindle
1st servo axis
2nd servo axis
3rd servo axis
4th servo axis
5th servo axis
6th servo axis
7th servo axis
8th servo axis
PATH 1 current meas. value for LOAD METER (Binary)
Cycle counter
Cycle counter (Binary、only lower 8 bits valid)
New tool flag
New tool flag
Lub. alarm
Lubrication alarm(#0,#1)/Mist alarm (#2)/Spindle motor alarm(#3)
max.
Spindle excess limit alarm bits for cutting load torque
avg.
max.
Servo axis excess limit alarm bits for cutting load torque
avg.
avg. max.
Servo axis excess limit alarm bits for positioning load torque
T2 T1
T4 T3
T6 T5
T8 T7
T10 T9
T12 T11
T14 T13
T16 T15
Tool number list (for 16 tools)
current tool ALM count
Current tool number. Max. alarm count
T1 Spindle max.
T1 Spindle avg.
T1 servo axis max.
T1 servo axis avg.
T2 Spindle max.
T7 servo axis max.
T7 servo axis avg.
T8 Spindle max.
T8 Spindle avg.
T8 servo axis max.
T8 servo axis avg.
Current value 64 byte
Value with new tool 64 byte
Initial value 64 byte
Limiting value 64 byte
Cutting Load Torque
Servo axis 1 max.
Servo axis 1 avg.
Servo axis 7 avg.
Servo axis 8 max.
Servo axis 8 avg.
Current value 32 byte
Initial value 32 byte
Limiting value 32 byte
Positioning Load Torque
Sevo axis number for tools, T1～T16
Spindle number for tools, T1～T16
D6431
PATH 2 data
D6432
PATH 2 current meas. value for LOAD METER
Cycle counter (Binary、only lower 8 bits valid)
New tool flag
Lub. alarm
Lubrication alarm(#0,#1)/Mist alarm (#2)/Spindle motor alar
Spindle excess limit alarm bits for cutting load torque
Servo axis excess limit alarm bits for cutting load torque
Servo axis excess limit alarm bits for positioning load torque
Tool number list (for 16 tools)
current tool
Current tool number,
Current value 64 byte
Value with new tool 64 byte
Initial value 64 byte
Limiting value 64 byte
Current value 32 byte
Initial value 32 byte
Limiting value 32 byte
Sevo axis number for tools, T1～T16
Spindle number for tools, T1～T16
D6863

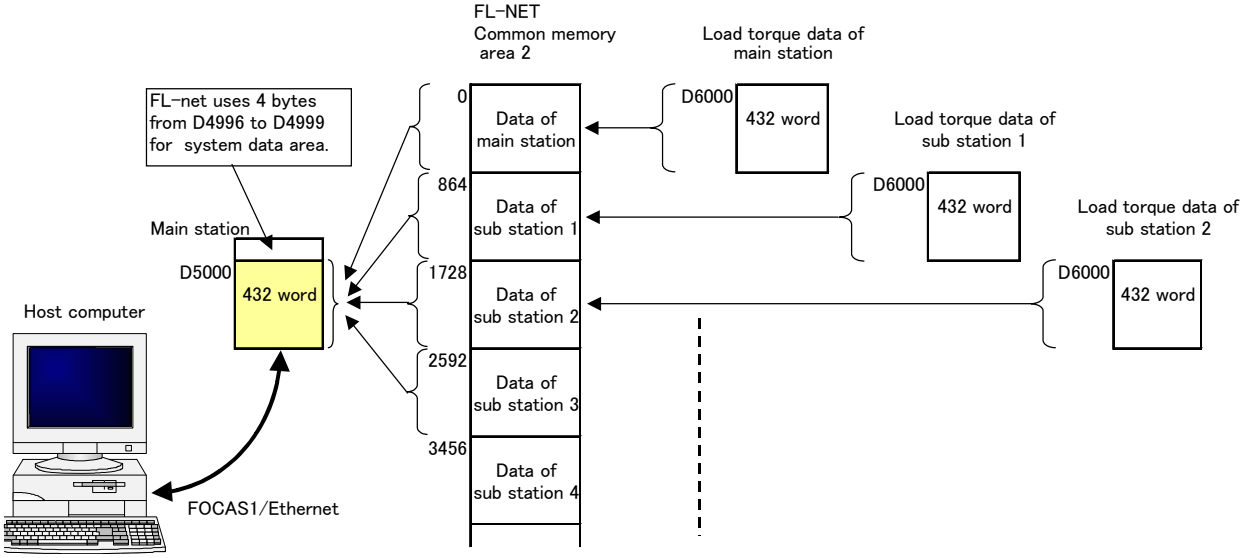
[Example of data transfer to the PMC data area]

An example of FL-net setting for transferring data on the previous page via the FL-net is shown below.

FL－NET parameters		Index	Main	Sub
Parameter name	Screen symbol	number	station	station
Basic parameters				
IP address	IP ADDRESS	Pa 10	x.x.x.1	x.x.x.n
Node name	NODE NAME	Pa 17		
Start address of area 1 transmit data	AREA1 ADDR	Pa 11		
Area 1 transmit data size	AREA1 SIZE	Pa 12		
Start address of area 2 transmit data	AREA2 ADDR	Pa 13	0	432 x n
Area 2 transmit data size	AREA2 SIZE	Pa 14	432	432
Token monitoring time	TOKEN WATCH	Pa 15		
Allowable minimum frame interval	MIN FRAME	Pa 16	20	20
State monitoring parameters				
Local node information address	OWN STATUS	Pa 20		
Participating node information address	ENTRY NODE	Pa 21		
Area 1 allocation parameters	AREA1 DO/DI			
Allocation address	ALLOCATION	Pa 30		
Area 1 address	ADDRESS	Pa 31		
Data size	SIZE	Pa 32		
Area 2 allocation parameters	AREA2 DO			
Allocation address (for DO)	ALLOCATION	Pa 40	D6000	D6000
Data size (for DO)	SIZE	Pa 41	432	432
	AREA2 DI			
Allocation address (for DI)	ALLOCATION	Pa 42	D4996	−1
Area 2 data exchange condition allocation address	ALLOC PTR	Pa 43	D6900	−1
Switch flag allocation address	CHANGE FLG	Pa 44	R3000	−1
Static allocation address (for DI)	AREA2 ADDR	Pa 45		
Static data size (for DI)	AREA2 SIZE	Pa 46	0	0



From the external host, a node number is set in the first 2 bytes (D6900 and D6901) of the area 2 data exchange condition area at the main station via the FOCAS1/Ethernet interface. By this operation, the load torque data on the set node is read into the DI area (D5000 to D5863 in this example) at the main station. Data in this area can be read via the FOCAS1/Ethernet interface to read the load torque data at a desired station (node) to the external host. (See the figure below.)
The switch flag (R3000 in this example) is used for handshaking when a node number is set and data is read. For details, refer to the FL-net manual.
To use the data exchange function with common memory area 2 for transferring load torque data, the setting of FL-net basic parameter MIN FRAME (refer to Section 1.2, “PARAMETER SETTING,” (on page 74) in Part III, “OPERATION,” in “VM16 Operator’s Manual”) may be required to be changed because the amount of transfer data is large.



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