

Computer Controlled
AC Servo Nutrunner

SDNR

USER'S MANUAL

Revision History		
Date	Version No.	Revision (update) contents
2002.10.23	1.0-E	First issue
2003.08.11	1.2-E	Page 4-9,-10 Torque keep function was added. Table 5.1-2 was revised. Table 5.1-4 was revised. Page 5-8 Yield point detection level was revised. Page 5-9 Torque keep time was added. 7.2.7 MACHINE TROUBLE messages added. 8.4 TORQUE-TENSION CONTROL added. 8.5 YIELD POINT DETECTION CONTROL added. Table 11.1-2 was revised. Table 11.1-5 was revised.
2003.12.04	1.3-E	Table 5.1-2,-3,-4 was revised. Page 5-7,-10,-11,-12,-19,-20,-24,-25 Parameter set added. Table 6.1-1,-2,-3 was revised. Table 6.2-8.-9 was revised. Page 6-18-19,-20 data item was added. Table 7.2-2 NG message codes of the DRIVER was added Table 7.2-5,-6,-7,-8 was revised. 7.2.3 NG messages of the DRIVER was revised. 8.7 SLOPE 3 was added. ANGLE TRIGGER of SLOPE MONITOR was added. 8.8 MID. POINT JUDGEMENT was added. 11.1,2,3,4 were deleted. 11.5 was changed to 11.1.
2004.04.05	1.4-E	Chapter 7 MACHINE TROUBLE messages of the MULTI-CONTROLLER were revised because of being supported with new option boards.
2005.01.06	1.5-E	5.1, 5.2 RUNDOWN parameter was added. 6.2 RUNDOWN data was added. 7.2.1, 7.2.4 RUNDOWN trouble message was added. 8.3 TIGHTENING TIME MAXIMUM and TIGHTENING ANGLE MAXIMUM added to TROUBLE reference values. 8.9 RUNDOWN JUDGEMENT was added.
2005.02.03	1.5-EA	All page The font was changed for PDF.
2005.03.16	1.6-E	Chapter 8 End of cycle data print-out addition. The chapter number was advanced after Chapter 9.
2005.06.24	1.7-E	5.2 TORQUE CURVE DATA BUFFER SIZE addition. 7.2.5 OVER LOAD Explanatory note addition. Figure 11.5-1,-2 Dimensions of all spindle types were modified correctly.

Revision History		
Date	Version No.	Revision (update) contents
2005.08.08	1.8-E	1.3 Caution for use was added. 2.3 Serial No. was added. 8.2 The words of BCD-DATA were replaced to DATA. 10.2 Warning description was added. 10.3 Warning description was added. 11.3 The power supply voltage of the Multi Controller was modified. 11.3,11.4,11.5 Following environmental information of the Driver, the Multi Controller and the Spindle were added to the table of specifications. - Altitude - Vibration 11.4 Contents of the maximum rated current were added in the table 11.4-3.
2006.03.20	1.8-EA	5.1,5.2 The numbers of the parameters were modified.
2007.07.16	1.9-E	The description of PASSAGE DATA SAVE was added to Chapter 4.
2009.10.15	1.9-EA	10.2 Calibration was added.
2010.11.1	1.9-EB	1.1 Features Description of the TIMED TORQUE CONTROL METHOD was added. 4.2 Description of fastening program " PERIODICAL ANGLE MONITORING TORQUE CONTROL" changed to "ANGLE MONITORING TIMED TORQUE CONTROL ". 5.2 Description of fastening parameter set Chapter label of level3 was added. " PERIODICAL ANGLE MONITORING TORQUE CONTROL" changed to "ANGLE MONITORING TIMED TORQUE CONTROL ". 9.6 ANGLE MONITORING TIMED TORQUE CONTROL " PERIODICAL ANGLE MONITORING TORQUE CONTROL" changed to "ANGLE MONITORING TIMED TORQUE CONTROL ".

Revision History		
Date	Version No.	Revision (update) contents
2010.11.15	1.10-E	SDNR(T*1)-005 was added to Table 2.1-1, Table 2.2-1 and Table 2.2-2.. SDN-SP1-005S, SDN-SP3-1000S and SDN-SP3-1800S were added to Table 4.2-2. 4.2 Description of fastening program: "PERIODICAL ANGLE MONITORING TORQUE CONTROL" was chanded to "ANGLE MONITORING TIMED TORQUE CONTROL ". 4.3 Fastening parameter set: "PERIODICAL ANGLE MONITORING TORQUE CONTROL" was chanded to "ANGLE MONITORING TIMED TORQUE CONTROL ". 9.6 "PERIODICAL ANGLE MONITORING TORQUE CONTROL" was chanded to "ANGLE MONITORING TIMED TORQUE CONTROL ". SDNR(T*1)-005 was added to Table 10.2-2. SDNR(T*1)-005, SDNR(T*3)-1000 and SDNR(T*3)-1800 were added to Table 11.1-2. SDN-SP1-005S, SDN-SP3-1000S and SDN-SP3-1800S were added to Table 11.2-1. SDN-DR1-005, SDN-DR3-1000 and SDN-DR3-1800 were added to Table 11.4-2 and Table 11.4-3. SDN-SP1-005S, SDN-SP3-1000S and SDN-SP3-1800S were added to Figure 11.5-1 and Table 11.5-2.
2012.1.25	1.11-E	5.1 About the fastening parameter set RUN DOWN TORQUE JUDGEMENT MODE was added to Table 5.1-2 Fastening parameter set. 5.2 Description of fastening parameter set Parameter No.4 RUN DOWN TORQUE JUDGEMENT MODE was added. Description of the Momentary Mode was added to the Parameter No.4 END ANGLE OF RUN DOWN TRQ.MAXIMUM JUDGEMENT. 5.2.3 TROUBLE REFERENCE VALUE Description of the Momentary Mode was added to the Parameter No.105 RUN DOWN TORQUE MINIMUM. 6.2 Description Description of the Momentary Mode was added to the END OF CYCLE DATA No.39 RUN DOWN TORQUE MINIMUM JUDGEMENT ANGLE. 7.2.4 CONTROL TROUBLE messages of the DRIVER Description of the Momentary Mode was added to the CODE 56 RUN DOWN TORQUE MINIMUM TROUBLE.

Revision History		
Date	Version No.	Revision (update) contents
2012.1.25	1.11-E	9.9 RUN DOWN JUDGEMENT Figure 9.9-1~ Figure 9.9-3 were revised and added. 9.9.2 RUN DOWN TORQUE JUDGEMENT was split to 9.9.2.1 The Normal mode and 9.9.2.2 The Momentary mode.

Preface

This manual describes the mechanism, performance, specifications and operational methods of the model SDNR NUTRUNNER.

You are advised to carefully read this manual before the operation in order to make the best use of the performance of this NUTRUNNER.

Notice

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2. The contents of this manual may be revised in the future without any notice in advance
3. Please do not hesitate to contact us if you have any question or find any errors or omissions even though the best effort was made in making this manual.
4. Please understand that we cannot take any responsibility for the application result of this manual regardless of the above item No.3

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Contents

Chapter 1 General	1-1
1.1 Features	1-2
1.2 System block diagram	1-3
1.3 Caution for use	1-5
Chapter 2 Components	2-1
2.1 NUTRUNNER models and types	2-2
2.2 Component units	2-4
2.3 Serial No	2-6
Chapter 3 Components functions	3-1
3.1 SPINDLE ASSEMBLY	3-2
3.2 DRIVER	3-4
3.3 MULTI CONTROLLER	3-6
Chapter 4 Fastening program	4-1
4.1 About the fastening program	4-2
4.2 Description of fastening program	4-3
Chapter 5 Fastening parameter set	5-1
5.1 About the fastening parameter set	5-2
5.2 Description of fastening parameter set	5-6
5.2.1 CONTROL VALUE	5-6
5.2.2 NG REFERENCE VALUE	5-16
5.2.3 TROUBLE REFERENCE VALUE	5-23
Chapter 6 End of cycle data	6-1
6.1 About the End of Cycle Data	6-2
6.2 Description	6-4
Chapter 7 End of cycle status	7-1
7.1 About the End of Cycle status	7-2
7.2 NG/TROUBLE messages	7-3
7.2.1 The end of cycle status of the DRIVER	7-4
7.2.2 The end of cycle status of the MULTI CONTROLLER	7-7

Contents

7.2.3 NG messages of the DRIVER	7-13
7.2.4 CONTROL TROUBLE messages of the DRIVER.....	7-17
7.2.5 MACHINE TROUBLE messages of the DRIVER.....	7-23
7.2.6 Control trouble messages of the MULTI CONTROLLER	7-35
7.2.7 Machine trouble messages of the MULTI CONTROLLER	7-37
Chapter 8 End of cycle data print out	8-1
8.1 Specification of print-out.....	8-2
8.2 The contents of print-out	8-3
8.2.1 Print-out item.....	8-3
8.2.2 Print-out format	8-5
Chapter 9 Fastening methods	9-1
9.1 About the fastening methods.....	9-2
9.2 ANGLE MONITORING TORQUE CONTROL.....	9-3
9.3 TORQUE-TURN CONTROL	9-7
9.4 TORQUE-TENSION CONTROL	9-11
9.5 YIELD POINT DETECTION CONTROL	9-15
9.6 ANGLE MONITORING TIMED TORQUE CONTROL	9-19
9.7 SLOPE MONITORING	9-23
9.8 MID. POINT JUDGEMENT	9-28
9.9 RUN DOWN JUDGEMENT.....	9-31
9.9.1 RUN DOWN ANGLE JUDGEMENT	9-31
9.9.2 RUN DOWN TORQUE JUDGEMENT.....	9-33
Chapter 10 Maintenance check	10-1
10.1 Periodical check	10-2
10.2 Calibration	10-3
10.3 Repairs	10-4
Chapter 11 Specifications	11-1
11.1 System specifications.....	11-2
11.2 Typical operation cycle	11-4
11.3 MULTI CONTROLLER specifications	11-6
11.4 DRIVER specifications	11-7
11.5 SPINDLE ASSEMBLY specifications	11-10

Contents

Chapter 12 Appendix	12-1
12.1 Speed setting list	12-2

Contents

Chapter 1 General

The general outline of the model SDNR NUTRUNNER is described in this chapter. You are advised to read this chapter when the NUTRUNNER is used for the first time.

Chapter 1 General1-1

1.1 Features 1-2

1.2 System block diagram 1-3

1.3 Caution for use..... 1-5

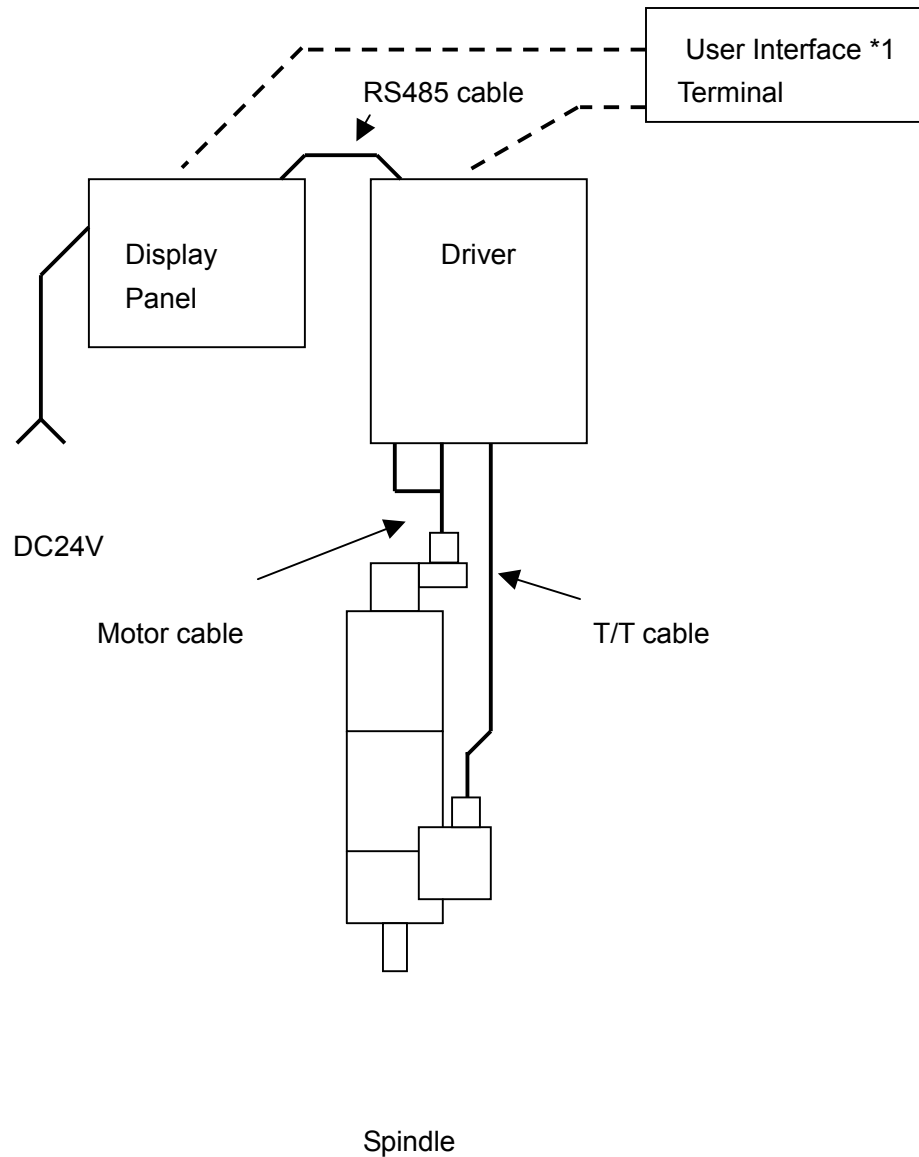
1.1 Features

The model SDNR NUTRUNNER is a high performance user-friendly fastening tool. This NUTRUNNER features high level multiple NUTRUNNER control, complex fastening operations and its small compact size. This NUTRUNNER has the following features.

- 1 The fastening accuracy is $\pm 2\%$ or less.
- 2 Not to mention the difference of fastening torque depending on the type of product, the difference of fastening methods as well as the difference between right-hand and left-hand thread screws can be successfully dealt with by this NUTRUNNER using the combination of 8 fastening programs and 32 parameter sets.
- 3 The fastening control can be selectable by ANGLE MONITORING TORQUE METHOD, TORQUE-TURN METHOD, TORQUE-TENSION METHOD, YIELD POINT METHOD or TIMED TORQUE CONTROL METHOD.
- 4 The nonvolatile memory (EEPROM), which does not need batteries, is used to back up the fastening program and parameter set.
- 5 A short system cycle time can be realized because of high fastening speed.
- 6 Fastening rotation is smooth by the application of sinusoidal wave controlled AC servo motor. Therefore, the computation of the rise rate of the torque can be done precisely with plastic zone fastening and others.
- 7 Simultaneous and sequential tightening operations are possible to do at each interlock position.
- 8 The AC servomotor is compact, high powered and has been specifically designed for high torque fastening operations.
- 9 The pre-amplification of the torque signal is built into the SPINDLE ASSEMBLY. Therefore, calibration adjustment is not required when spindle is replaced.
- 10 The DISPLAY PANEL displays the NUTRUNNER settings, End-Of-Cycle data display, history of NG, and torque curve of the NUTRUNNER in addition to other functions.
- 11 The USER INTERFACE TERMINAL provides the function of system configuration, fastening data acquisition, real time statistical reporting as well as torque curve acquisition and display.

1.2 System block diagram

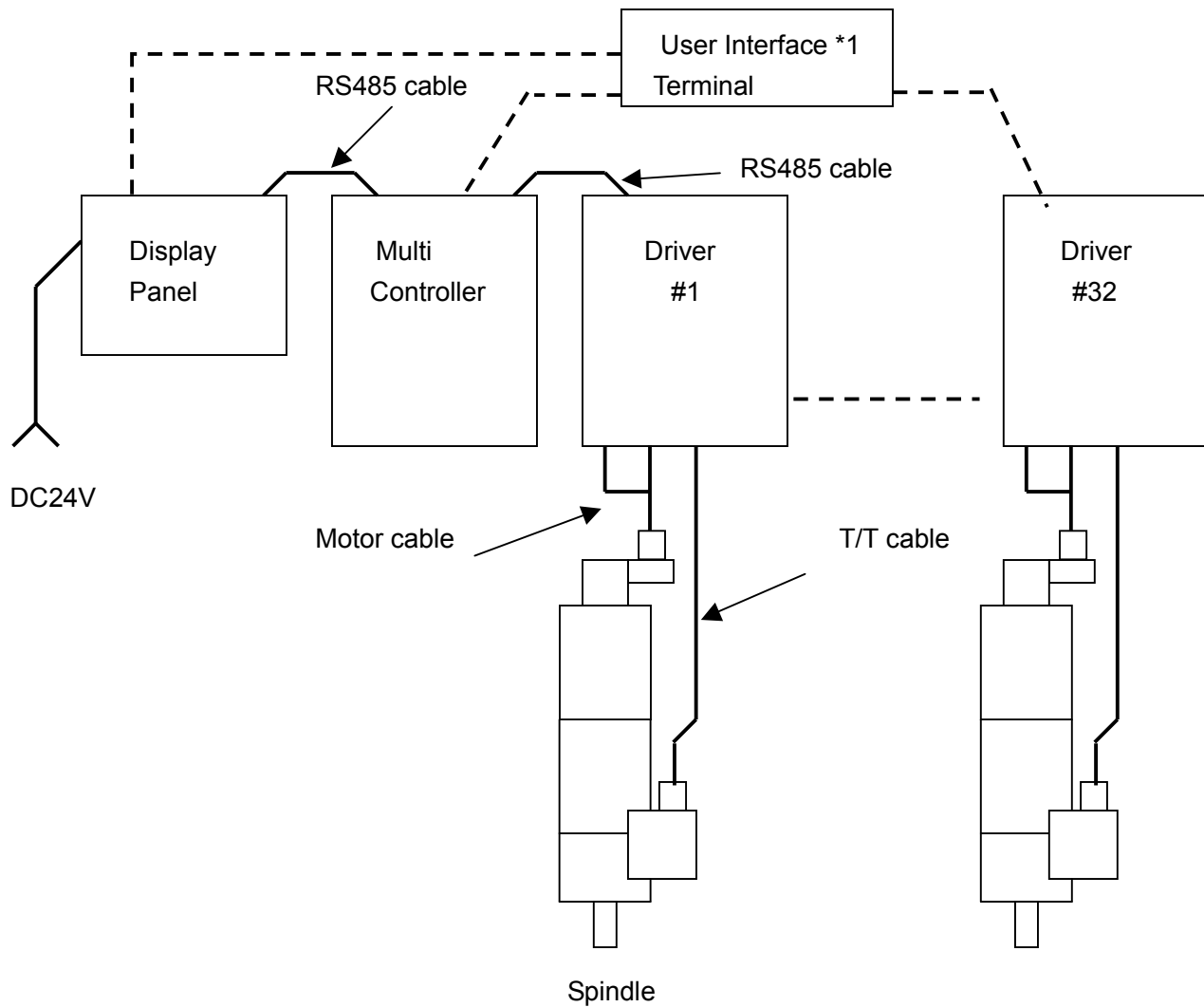
The system block diagram of the model SDNR NUTRUNNER type S is as shown below.



*1 Connect the User Interface Terminal to either DISPLAY PANEL or DRIVER using the provided RS485 cable.

Figure 1.2-1 System block diagram of model SDNR NUTRUNNER type S

The system block diagram of the model SDNR NUTRUNNER type M is as shown below.



*1 Connect the USER INTERFACE TERMINAL to either MULTI CONTROLLER, DISPLAY PANEL or DRIVER using the provided RS485 cable. It is also possible to connect the USER INTERFACE TERMINAL and the MULTI CONTROLLER using the UIT/PR connector with the RS232 cable.

Figure 1.2-2 System block diagram of model SDNR NUTRUNNER type M

1.3 Caution for use

Pay attention to below when using the model SDNR nut runner.

- 1 Read the INSTALLATION MANUAL well for installation of each units.
- 2 Care shall be taken in handling the part of being danger of electric shock, especially showing below mark.



- 3 The surface of the driver and spindle will often be hot. Therefore, care shall be taken in handling the surface of them, especially showing below mark.



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Chapter 2 Components

The components of the model SDNR NUTRUNNER are described in this chapter. The information regarding NUTRUNNER model and type, its component units and options will be provided.

Chapter 2 Components	2-1
2.1 NUTRUNNER models and types	2-2
2.2 Component units.....	2-4
2.3 Serial No.	2-6

2.1 NUTRUNNER models and types

: NUTRUNNER MODELS

MODEL		RATED TORQUE (N.m)	SPINDLE TYPE
TYPE S	TYPE M		
SDNR(TS1)-005S	SDNR(TM1)-005S	5.0	Straight
SDNR(TS1)-010SH	SDNR(TM1)-010SH	10.0	Straight
SDNR(TS1)-010FH	SDNR(TM1)-010FH		Offset
SDNR(TS1)-010S	SDNR(TM1)-010S		Straight
SDNR(TS1)-010F	SDNR(TM1)-010F		Offset
SDNR(TS1)-025S	SDNR(TM1)-025S	25.0	Straight
SDNR(TS1)-025F	SDNR(TM1)-025F		Offset
SDNR(TS2)-050S	SDNR(TM2)-050S	50.0	Straight
SDNR(TS2)-050F	SDNR(TM2)-050F		Offset
SDNR(TS2)-100S	SDNR(TM2)-100S	100	Straight
SDNR(TS2)-100F	SDNR(TM2)-100F		Offset
SDNR(TS3)-180S	SDNR(TM3)-180S	180	Straight
SDNR(TS3)-180F	SDNR(TM3)-180F		Offset
SDNR(TS3)-320S	SDNR(TM3)-320S	320	Straight
SDNR(TS3)-320F	SDNR(TM3)-320F		Offset
SDNR(TS3)-580S	SDNR(TM3)-580S	580	Straight
SDNR(TS3)-580F	SDNR(TM3)-580F		Offset
SDNR(TS3)-1000S	SDNR(TM3)-1000S	1000	Straight
SDNR(TS3)-1800S	SDNR(TM3)-1800S	1800	Straight

Table 2.1-1 SDNR NUTRUNNER models

: For CE Directive

The NUTRUNNER complied with the CE directive can be produced. Please ask us about details of them.
Please keep the contents written in the Chapter 10 of the Installation manual to comply with the CE directive.

: NUTRUNNER MODEL INFORMATION

SDNR (TS 2) - 100 S
 #1 #2 #3 #4 #5

[Example]

SDNR NUTRUNNER

Rated torque : 100 N.m

SPINDLE ASSEMBLY type : Straight

1 Model SDNR NUTRUNNER

2 SYSTEM SPECIFICATION

SYMBOL	SYSTEM SPECIFICATION
TS	TYPE S
TM	TYPE M

3 MOTOR

SYMBOL	MOTOR TYPE	DIAMETER (mm)
1	SDN-MO-40	φ42
2	SDN-MO-55	φ55
3	SDN-MO-75	φ75

4 RATED TORQUE

SYMBOL	RATED TORQUE (N.m)
005	5.0
010	10.0
025	25.0
050	50.0
100	100
180	180
320	320
580	580
1000	1000
1800	1800

5 SPINDLE ASSEMBLY

SYMBOL	TYPE
S	STRAIGHT
F	OFFSET

2.2 Component units

: TYPE S

NUTRUNNER MODEL	DRIVER MODEL	SPINDLE MODEL
SDNR(TS1)-005S	SDN-DR1-005	SDN-SP1-005S
SDNR(TS1)-010SH/FH	SDN-DR1-010	SDN-SP1-010SH/FH
SDNR(TS1)-010S/F		SDN-SP1-010S/F
SDNR(TS1)-025S/F	SDN-DR1-025	SDN-SP1-025S/F
SDNR(TS2)-050S/F	SDN-DR2-050	SDN-SP2-050S/F
SDNR(TS2)-100S/F	SDN-DR2-100	SDN-SP2-100S/F
SDNR(TS3)-180S/F	SDN-DR3-180	SDN-SP3-180S/F
SDNR(TS3)-320S/F	SDN-DR3-320	SDN-SP3-320S/F
SDNR(TS3)-580S/F	SDN-DR3-580	SDN-SP3-580S/F
SDNR(TS3)-1000S	SDN-DR3-1000	SDN-SP3-1000S
SDNR(TS3)-1800S	SDN-DR3-1800	SDN-SP3-1800S

Table 2.2-1 Component units (Type S)

: TYPE M

NUTRUNNER MODEL	MULTI CONTROLLER MODEL	DRIVER MODEL	SPINDLE MODEL
SDNR(TM1)-005S	SDNM-MC	SDN-DR1-005	SDN-SP1-005S/
SDNR(TM1)-010SH/FH		SDN-DR1-010	SDN-SP1-010SH/FH
SDNR(TM1)-010S/F			SDN-SP1-010S/F
SDNR(TM1)-025S/F		SDN-DR1-025	SDN-SP1-025S/F
SDNR(TM2)-050S/F		SDN-DR2-050	SDN-SP2-050S/F
SDNR(TM2)-100S/F		SDN-DR2-100	SDN-SP2-100S/F
SDNR(TM3)-180S/F		SDN-DR3-180	SDN-SP3-180S/F
SDNR(TM3)-320S/F		SDN-DR3-320	SDN-SP3-320S/F
SDNR(TM3)-580S/F		SDN-DR3-580	SDN-SP3-580S/F
SDNR(TM3)-1000S		SDN-DR3-1000	SDN-SP3-1000S
SDNR(TM3)-1800S		SDN-DR3-1800	SDN-SP3-1800S

Table 2.2-2 Component units (Type M)

CAUTION

The NUTRUNNER shall be used in one of the combination shown in the above table.

NOTE

To set the NUTRUNNER, the optional SDN*-DP DISPLAY PANEL or SDNR-UITW USER INTERFACE TERMINAL is required.

*1 Symbol * in [SDN*] indicates [S] in Type S, and [M] in Type M.

2.3 Serial No.

The indication sheet that shows the name, model, manufacturing number and serial number are put on the unit.

About detail of the serial number is shown in the following.

: Serial No. INFORMATION

For example, "0507001" is shown as a serial number.

<u>05</u>	<u>07</u>	<u>001</u>
#1	#2	#3

[Example]

#1 The year of manufacture 2005

#2 The month of manufacture July

#3 Serial number of the year and month indicated with #1 and #2 001

#1 The year of manufacture is shown.

#2 The month of manufacture is shown.

#3 Serial number of the year and month indicated with #1 and #2 is shown.

Chapter 3 Components functions

The functions of the SPINDLE ASSEMBLY, DRIVER and MULTI CONTROLLER are described in this chapter. The respective operating manuals shall be referred to for the DISPLAY PANEL, USER INTERFACE TERMINAL and other options.

Chapter 3 Components functions3-1

3.1 SPINDLE ASSEMBLY3-2

3.2 DRIVER3-4

3.3 MULTI CONTROLLER3-6

3.1 SPINDLE ASSEMBLY

Straight type

Offset Type

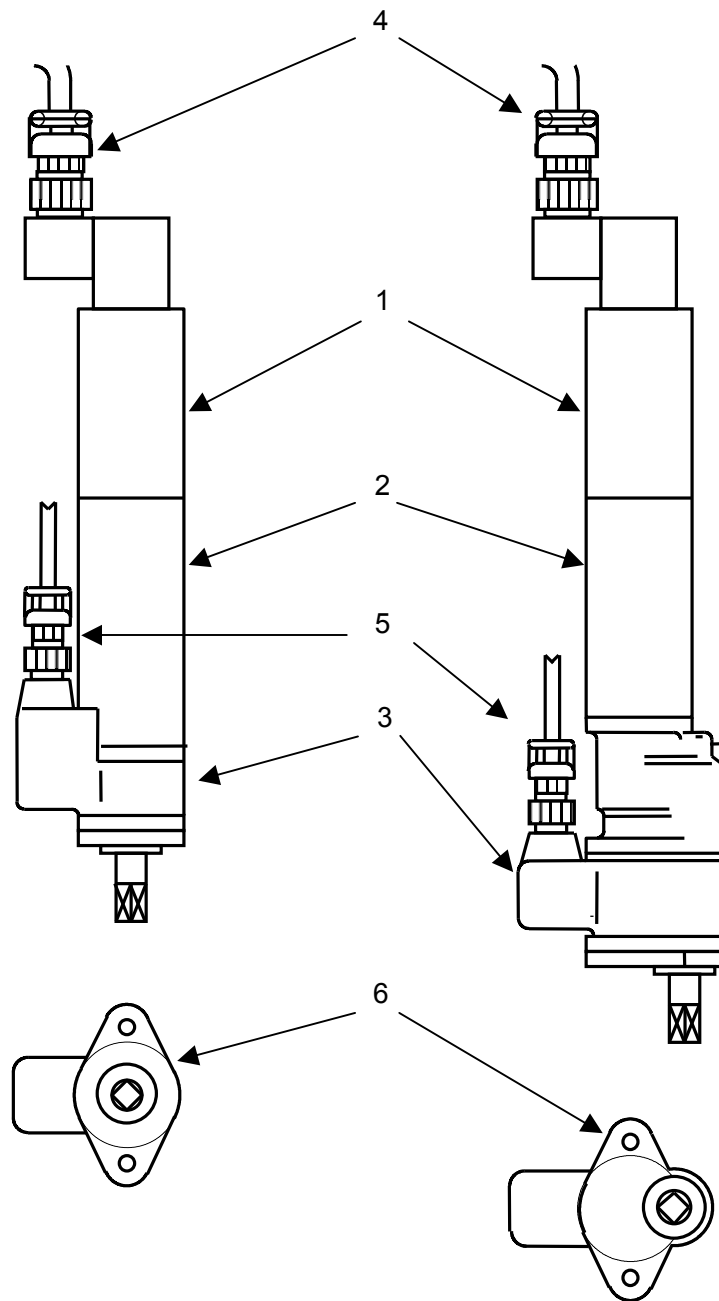


Figure 3.1-1 SPINDLE ASSEMBLY

No.	NAME	FUNCTION
1	Motor	AC Servo motor of compact size and high output power.
2	Reduction gear box	It is used to reduce the revolution of the motor to the speed suitable for fastening operation.
3	Torque transducer (T/T)	It is used to detect the torque. Provided with built-in pre-amplifier.
4	Motor connector	It is used to connect the motor cable.
5	Transducer connector	It is used to connect the transducer cable.
6	Mounting plate	It is used to mount the SPINDLE ASSEMBLY.

Table 3.1-1 SPINDLE ASSEMBLY and its functions

3.2 DRIVER

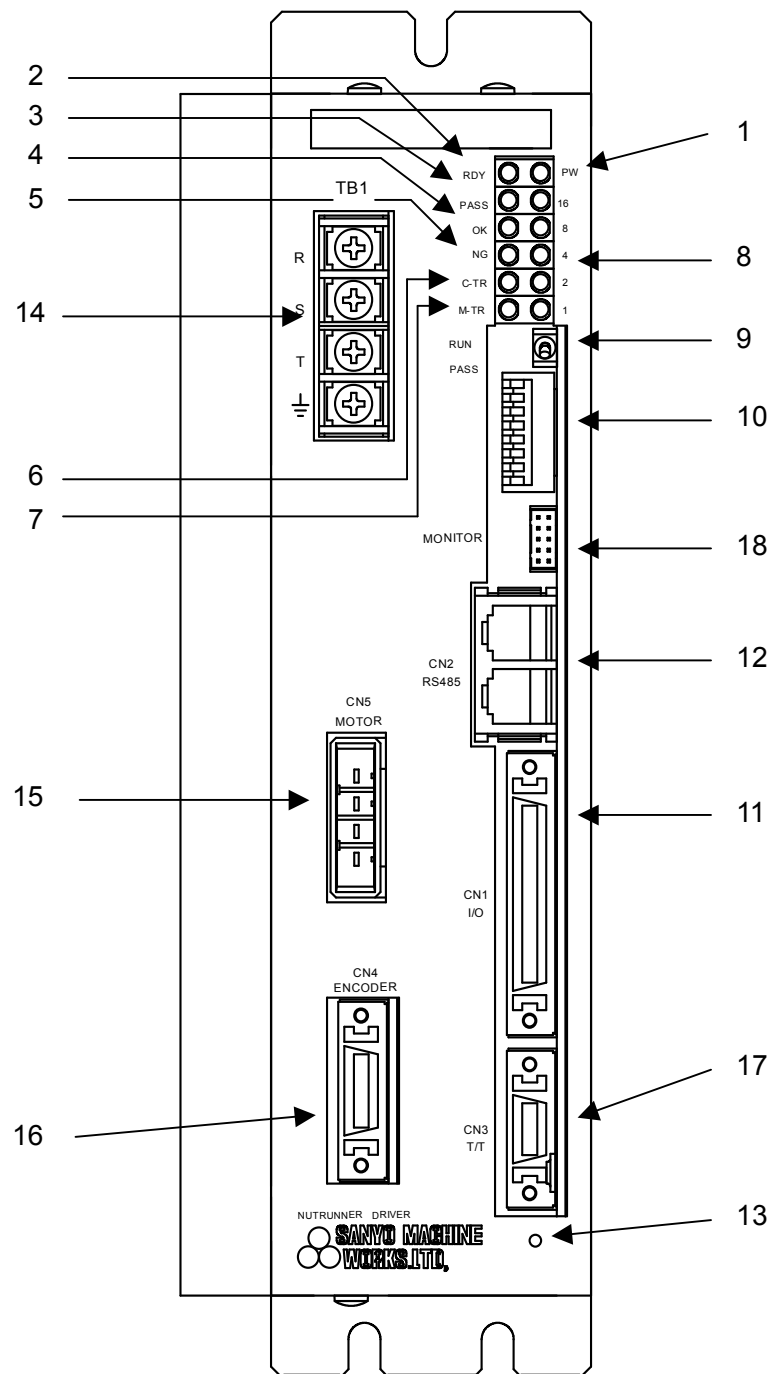


Figure 3.2-1 DRIVER (front panel)

No	NAME	FUNCTION
1	POWER lamp	It is lit when the power is on.
2	READY lamp	It is lit when the NUTRUNNER is ready to start operation.
3	PASS lamp (Bypass lamp)	It is lit when the NUTRUNNER is in the "PASS" mode, which does not allow the NUTRUNNER to run.
4	OK lamp	It is lit when all End of Cycle Data are accepted (OK)
5	NG lamp	It is lit when any of the End of Cycle Data is rejected (NG) or if an error occurs.
6	C-TRBL lamp (Control trouble lamp)	It is lit when the reference value specified for errors is exceeded.
7	M-TRBL lamp (Machine trouble lamp)	It is lit when an error occurs in the DRIVER.
8	INFO (1-16) lamp (Information lamp)	It indicates the kind of "NG" or "TROUBLE" that has occurred.
9	PASS switch	Whether the NUTRUNNER is operable or not is selected with this switch. Select RUN to allow the NUTRUNNER to restart operation.
10	DIP switch (DSW1)	It selects the SPINDLE ASSEMBLY type (straight or offset) and NUTRUNNER No.
11	I/O interface connector	It enables the external device to control the DRIVER via input and output signals.
12	RS485 connector	It allows the network communication with the DISPLAY PANEL, USER INTERFACE TERMINAL, MULTI CONTROLLER (Type M only).
13	Reset switch	It is used to reset the DRIVER.
14	AC power input terminal block	It supplies AC power (3 phases 180 - 242 V AC) to the DRIVER.
15	Motor connector	It is used to connect the motor cable.
16	Encoder connector	It is used to connect the motor cable.
17	Transducer connector	It is used to connect the transducer cable.
18	Monitor connector	It is used to connect the monitor cable.

Table 3.2-1 DRIVER and its functions

3.3 MULTI CONTROLLER

MULTI CONTROLLER (for Type M only).

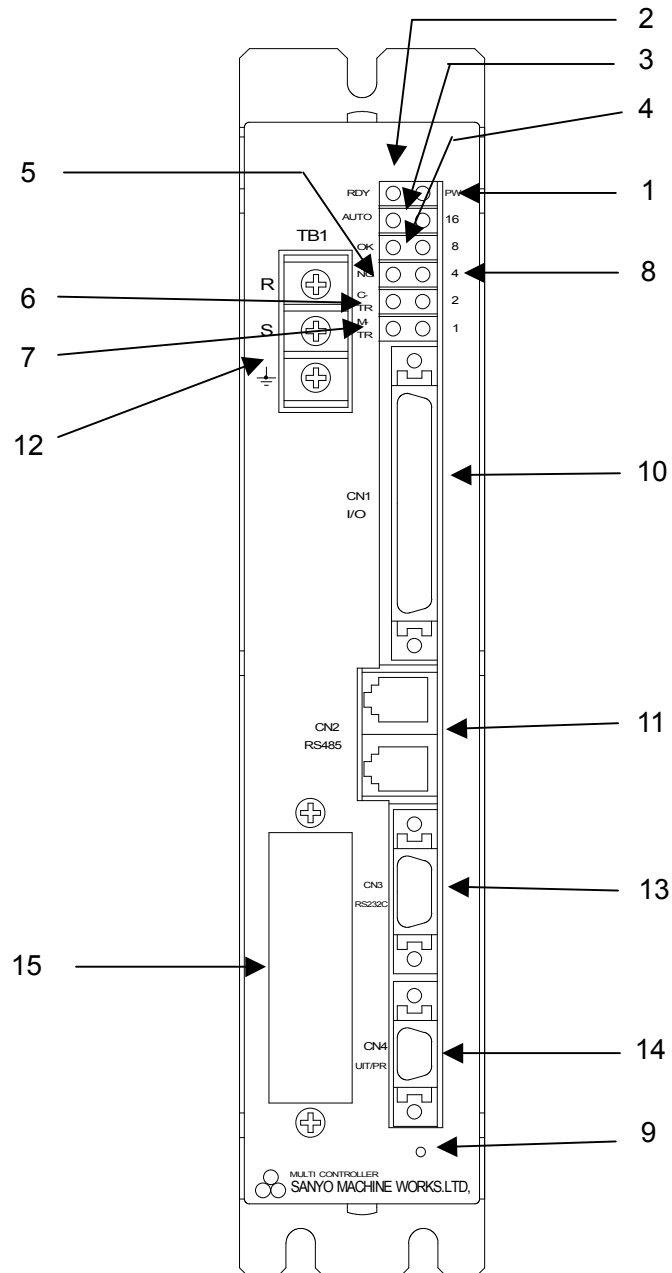


Figure 3.3-1 Multi controller (front panel)

No	NAME	FUNCTION
1	POWER lamp	It is lit when the power is on.
2	READY lamp	It is lit when the NUTRUNNER is ready to start operation.
3	AUTO lamp	It is lit when the NUTRUNNER is in the "AUTO" mode.
4	OK lamp	It is lit when all End of Cycle Data are accepted (OK)
5	NG lamp	It is lit when: - a trouble or error occurs - a trouble occurs in the reverse mode - a trouble occurs in the MULTI CONTROLLER
6	C-TRBL lamp (Control trouble lamp)	It is lit when: - the reference value specified for errors is exceeded - a control error occurs in the DRIVER or MULTI CONTROLLER
7	M-TRBL lamp (Machine trouble lamp)	It is lit when a machine error occurs in the MULTI CONTROLLER or DRIVER.
8	INFO (1-16) lamp (Information lamp)	It indicates the kind of trouble that has occurred in the MULTI CONTROLLER.
9	RESET switch	It is used to reset the MULTI CONTROLLER.
10	I/O interface connector	It enables the external device to control the DRIVER via input and output signals.
11	RS485 connector	It allows the network communication with the DRIVER, DISPLAY PANEL, USER INTERFACE TERMINAL.
12	AC power input terminal block	It supplies AC power (3 phases 180 - 242 V AC) to the MULTI CONTROLLER.
13	RS232C connector	It is used to communicate with external device
14	UIT/PR connector	It is used to connect the USER INTERFACE TERMINAL or printer.
15	Option connector	It is used to connect the OPTION BOARD.

Table 3.3-1 MULTI CONTROLLER and its functions

.

Chapter 4 Fastening program

The fastening program of the NUTRUNNER is described in this chapter.

Chapter 4 Fastening program	4-1
4.1 About the fastening program	4-2
4.2 Description of fastening program	4-3

4.1 About the fastening program

The fastening program consists of command sets to control the NUTRUNNER. It is possible to control the various types of operation by modifying the sequence and combination of these command sets. The specification of the fastening program is shown in the following. The result is the ability to construct a flexible program of which any desired result can be achieved.

ITEM	SPECIFICATION
Number of programs	8 programs
Number of steps	32 steps / program
Size of step	8 bytes / step
Type of commands	12 types
Command code	Hexadecimal code

Table 4.1-1 Fastening program specification

4.2 Description of fastening program

The NUTRUNNER COMMAND SET of the fastening program are shown as follows.

COMMAND CODES	COMMAND SIZE	CONTENTS
00h	1	NOP (NO OPERATION)
10h	7	SOFT START
20h	6	HIGH SPEED
30h	8	TIGHTEN
40h	1	BRAKE
50h	7	JOG
60h	4	INTERLOCK
70h	2	SWITCH PARAMETER SET
80h	6	SOCKET RELEASE
90h	1	END OF CYCLE
A0h	2	TIME DELAY
B0h	2	JUMP

Table 4.2-1 NUTRUNNER COMMAND SET

The respective command codes are described in the following pages.

00	NOP (NO OPERATION)
----	--------------------

- FUNCTION

Nothing is done except for progressing the program by one step.

- FORMAT

1	-	-	-	-	-	-	-
---	---	---	---	---	---	---	---

1) NOP command

command code	00h
-----------------	-----

- DESCRIPTION

The NOP command provides a convenient means for deleting unused or incorrect commands, or for providing command space within a program for future use.

- STEPPING CONDITION

None.

The NOP command will automatically step to the next command.

1 0	SOFT START
------------	------------

- **FUNCTION**

The revolution of NUTRUNNER is increased (or decreased) to the set speed. After reaching the set revolution, the speed is kept constant until the stepping time is reached.

- **FORMAT**

1	2	3	4	5	6	7	-
---	---	---	---	---	---	---	---

1) SOFT START command

command code	10h (An output shaft is rotated in the clockwise or reverse direction)
--------------	--

2) STEPPING CONDITION

The stepping condition for the SOFT START command is set.

CODE	STEPPING CONDITION
00h	The step progresses by the detection of seating torque or at a time out.*1
01h	The step progresses by the detection of seating torque or the external signal.*2

*1 Refer to settings for the STEPPING TIME

*2 Input signal I/O "IN7(Step)" of the DRIVER.

3) 4) SPEED

The target constant speed is set.

[# # # # h]

4)

3)

CODE	SPEED (rpm)
4000h	Maximum speed in the clockwise rotation.
0000h	0
C000h	Maximum speed in the reverse rotation.

The actual speed of the NUTRUNNER is calculated by the following formula. Refer to the section 11.5 of chapter 11 "SPEED SETTING LIST".

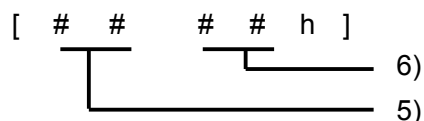
$$\text{ACTUAL SPEED (rpm)} = [\text{SET VALUE}] \times \frac{\text{MAXIMUM SPEED (rpm)}}{16384(4000h)}$$

SPINDLE ASSEMBLY MODEL	MAXIMUM SPEED (rpm)
SDN-SP1-005S	3150
SDN-SP1-010SH, SDN-SP1-010FH	1540
SDN-SP1-010S, SDN-SP1-010F	640
SDN-SP1-025S, SDN-SP1-025F	640
SDN-SP2-050S, SDN-SP2-050F	545
SDN-SP2-100S, SDN-SP2-100F	545
SDN-SP3-180S, SDN-SP3-180F	465
SDN-SP3-320S, SDN-SP3-320F	300
SDN-SP3-580S, SDN-SP3-580F	155
SDN-SP3-1000S	90
SDN-SP3-1800S	45

Table 4.2-2 MAXIMUM SPEED

5) 6) ACCELERATION (or DECELERATION)

The acceleration (or deceleration) rate used to reach the set speed.



CODE	ACCELERATION (DECELERATION) (rpm/second)
4000h 0001h	The maximum acceleration (deceleration) The minimum acceleration (deceleration)

The acceleration (or deceleration) rate of the NUTRUNNER is calculated by the following formula.

$$\text{ACCELERATION (or DECELERATION)} = [\text{SETTING VALUE}] \times \frac{{}^{*1} \text{ MAXIMUM SPEED (rpm)}}{13.1}$$

* 1 Refer to Table 4.2-2 "MAXIMUM SPEED".

recommended value	0020h
-------------------	-------

7) STEPPING TIME

The timeout time (0-25.5 seconds) of SOFT START command is set. This setting is valid only when the stepping condition 2) of "00h" is set.

$$\text{Timeout time (second)} = [\text{TIMEOUT}] \times 0.1 \text{ (second)}$$

CODE	TIMEOUT (second)
00h	0
FFh	25.5

- DESCRIPTION

The speed is increased (or decreased) by the ACCELERATION (or DECELERATION) till it reaches the constant rpm. The rotation is kept at the SPEED until the seating torque is detected or the stepping time is reached.

- STEPPING CONDITION

The stepping condition of the SOFT START command is fulfilled.

NOTE

This command shall be placed in the first step of the fastening program.

20	HIGH SPEED
----	------------

- FUNCTION

The high-speed rotation is kept until the seating torque is detected.

- FORMAT

1	2	3	4	5	6	-	-
---	---	---	---	---	---	---	---

1) HIGH SPEED command

Command code	20h (An output shaft is rotated in the clockwise or reverse direction)
-----------------	--

2) 00

The number of the second byte is not used. Enter "00h".

3) 4) CONSTANT SPEED

The target constant rotation speed is set.

(The same as in "SOFT START".)

5) 6) ACCELERATION (or DECELERATION)

The acceleration (or deceleration) rate used to reach the constant rotation is set.

(The same as in "SOFT START".)

- DESCRIPTION

The rotation is increased (or decreased) by the ACCELERATION (or DECELERATION) until it reaches the constant speed. The speed is kept constant until the seating torque is detected.

- STEPPING CONDITION

The seating torque is detected.

30	TIGHTEN
----	---------

- FUNCTION

The fastening operation is conducted according to the fastening method and fastening parameter.

- FORMAT

1	2	3	4	5	6	7	8
---	---	---	---	---	---	---	---

1) TIGHTENING command

command code	30h (An output shaft is rotated in the clockwise or reverse direction)
--------------	--

2) FASTENING METHOD

The target fastening method is set.

CODE	FASTENING METHOD
00h	ANGLE MONITORING TORQUE CONTROL
01h	TORQUE-TURN CONTROL
02h	TORQUE-TENSION CONTROL
03h	YIELD POINT DETECTION CONTROL
10h	ANGLE MONITORING TIMED TORQUE CONTROL
40h	ANGLE MONITORING TORQUE CONTROL with TORQUE KEEP
41h	TORQUE-TURN CONTROL with TORQUE KEEP

3) 4) SPEED (*Initial speed for the ANGLE MONITORING TIMED TORQUE CONTROL)

The target constant revolution is set.

(This function is the same as in "SOFT START".)

5) 6) ACCELERATION (or DECELERATION)

The acceleration (or deceleration) rate used to reach the constant rpm is set.

(This function is the same as in "SOFT START".)

7) 8) Maximum speed for the ANGLE MONITORING TIMED TORQUE CONTROL

The maximum speed for the ANGLE MONITORING TIMED TORQUE CONTROL is set.

Not applicable in other methods.

- DESCRIPTION

The rpm is increased (or decreased) by the ACCELERATION (or DECELERATION) until it reaches the set SPEED.

After reaching the set SPEED, the rotation is kept at the SPEED till the stepping condition according to the FASTENING METHOD is fulfilled.

- STEPPING CONDITION

The stepping condition varies depending on the selected fastening method.

The stepping conditions for each method are shown below.

FASTENING METHOD	STEP PROGRESS CONDITIONS
ANGLE MONITORING TORQUE CONTROL	When the tightening torque reaches the control torque.
TORQUE-TURN CONTROL	When the tightening angle from the snug-torque point reaches the control angle.
TORQUE-TENSION CONTROL	When the tightening angle from the theoretical seating point reaches the control angle.
YIELD POINT DETECTION CONTROL	When the torque rate reaches the set torque rate
ANGLE MONITORING TIMED TORQUE CONTROL	When the tightening torque reaches the control torque
ANGLE MONITORING TORQUE CONTROL with TORQUE KEEP	When the time reaches the torque keep time after the TORQUE CONTROL.
TORQUE-TURN CONTROL with TORQUE KEEP	When the time reaches the torque keep time after the TORQUE-TURN CONTROL.

CAUTION

- 1)The TORQUE KEEP function is enabled by the ROM Ver 1.5 or later of the DISPLAY PANEL and the Ver 1.4 or later of the DRIVER.
- 2)The TORQUE-TENSION CONTROL is enabled by the ROM Ver 1.5 or later of the DISPLAY PANEL and the Ver 1.5 or later of the DRIVER.
- 3)The YIELD CONTROL is enabled by the ROM Ver 1.5 or later of the DISPLAY PANEL and the Ver 1.5 or later of the DRIVER.

40	BRAKE
-----------	-------

- FUNCTION

The NUTRUNNER is stopped by a brake.

- FORMAT

1	-	-	-	-	-	-	-
---	---	---	---	---	---	---	---

1) BRAKE command

command code	40h
--------------	-----

- DESCRIPTION

It is used to reduce the speed of NUTRUNNER to 0 rpm in the shortest time.

- STEPPING CONDITION

None

50	JOG
-----------	-----

- **FUNCTION**

The jogging operation is conducted.

- **FORMAT**

1	2	3	4	5	6	7	-
---	---	---	---	---	---	---	---

1) JOG command

Command code	50h (An output shaft is rotated in the clockwise or reverse direction)
--------------	--

2) STEPPING CONDITION

The stepping conditions of the JOG command are set.

SETTING									STEPPING CONDITION
b7	b6	b5	b4	b3	b2	b1	b0	Weight	
							1	01h	When the torque reaches the JOG TORQUE.
						1		02h	When the time reaches the JOG TIME.
					1			04h	When the angle reaches the JOG ANGLE.
				1				08h	When the JOG signal through the I/O interface of DRIVER is inactivated.
			1					10h	When the torque is reduced to the JOG TORQUE.
		1						20h	When the JOG OFF signal is received from the MULTI CONTROLLER through RS485 (Only type M).

More than one stepping condition may be set.

Multiple stepping conditions can be set by adding the hexadecimal values in the weight column.

3) 4) SPEED

The target constant revolution speed is set.

(The function is the same as in "SOFT START".)

5) 6) ACCELERATION (or DECELERATION)

The acceleration (or deceleration) rate used to reach the constant rpm is set.

(The function is the same as in "SOFT START".)

External signal

7) JOG LEVEL

External signal JOG LEVEL (1~4) is set.

This setting is required when STEPPING CONDITION of 20h is selected (Stepping condition is fulfilled when the JOG OFF signal is received from the MULTI CONTROLLER through RS485. Only type M).

CODE	EXTERNAL SIGNAL JOG LEVEL
01h	1
02h	2
03h	3
04h	4

- DESCRIPTION

The rotation is kept at the SPEED and in the direction specified by the JOG command till the STEPPING CONDITION is reached.

- STEPPING CONDITION

The stepping condition set for the JOG command is fulfilled.

60	INTERLOCK
-----------	-----------

- FUNCTION

The interlock operation is conducted.

- FORMAT

1	2	3	4	-	-	-	-
---	---	---	---	---	---	---	---

1) INTERLOCK command

command code	60h
--------------	-----

2) INTERLOCK TYPE

The type of interlock is set.

CODE	INTERLOCK TYPE
00h	The interlock is not made. The [INTERLOCK] output signal of the DRIVER I/O interface is activated.
01h	The interlock is made. This interlocks the external device through the I/O interface of the DRIVER.
02h	The interlock is made. This interlocks the MULTI-CONTROLLER through RS485 interface. (Only type M)
03h	The interlock is not made. The [INTERLOCK] output signal of the DRIVER I/O interface is inactivated.

3) INTERLOCK OUT DATA

00h-FFh

This byte is effective when "OUTPUT DATA" is being set on "INTERLOCK COMMAND OUTPUT DATA" by "DATA SELECTION A-D". The setting data of the "external output data" is outputted in the output data A-H. (Refer to the chapter 4 of the "INSTALLATION MANUAL".)

4) INTERLOCK LEVEL

The level (1 - 4) of interlock is set.

CODE	INTERLOCK LEVEL
01h	1
02h	2
03h	3
04h	4

- DESCRIPTION

The interlock is made when the INTERLOCK LEVEL suitable for the type of interlock is selected.

- STEPPING CONDITION

Varies depending on the INTERLOCK LEVEL.

INTERLOCK TYPE (CODE)	STEPPING CONDITION
00h	None
01h	The interlock is released when the INTERLOCK input signal of the DRIVER I/O interface is activated.
02h	The interlock is released when the MULTI-CONTROLLER receives the INTERLOCK RELEASE command. (Only type M)
03h	None

70	SWITCH PARAMETER SET
-----------	----------------------

- **FUNCTION**

The fastening program switches its parameter set No.

- **FORMAT**

1	2	3	-	-	-	-	-
---	---	---	---	---	---	---	---

1) SWITCH PARAMETER SET command

command code	70h
--------------	-----

2) OFFSET

The offset value is set for the parameter set No.

CODE	OFFSET VALUE	CODE	OFFSET VALUE
1Fh	31	FFh	-1
01h	1	E1h	-31
00h	0		

3) PASSAGE DATA SAVE

The mode of Passage Data Save is set.

CODE	PASSAGE DATA SAVE
00h	OFF
01h	ON

The Passage Data is saved into four areas of the Driver in order of area 1, area 2, area 3 and area 4. If it performed five times or more, the passage data is over written to the older data area.

- **DESCRIPTION**

Before entering this step, the value of OFFSET is added to the value of the current parameter No. The new parameter No. is used until either the program ends or another Switch Parameter Set command is executed. The "FASTENING PARAMETER ERROR" will occur, when the result of adding OFFSET to the parameter set No. comes out of the range of (1-32).

- STEPPING CONDITION

None

CAUTION

If the Driver ROM version is Ver 2.0A or earlier, the Passage Data Save can perform one times only.

80	SOCKET RELEASE
-----------	----------------

- **FUNCTION**

The socket is released from the bolt.

- **FORMAT**

1	2	3	4	5	6	-	-
---	---	---	---	---	---	---	---

1) **SOCKET RELEASE command**

Command code	80h
--------------	-----

2) **SOCKET RELEASE TIME**

The reverse rotation time (0 - 2.55 second) to release the socket is set.

Operation time (second) = [SOCKET RELEASE TIME] x 0.01 (second)

CODE	SOCKET RELEASE TIME (SEC)
00h	0
FFh	2.55

3) 4) **SOCKET RELEASE SPEED**

The socket release rpm is set.

(The function is the same as the SPEED in the "SOFT START".)

5) 6) **ACCELERATION (or DECELERATION)**

The acceleration (or deceleration) rate used to reach the constant rpm is set.

(The function is the same as in "SOFT START".)

- **DESCRIPTION**

The spindle is rotated at the SOCKET RELEASE SPEED only for the SOCKET RELEASE TIME in the reverse direction of fastening rotation.

- **STEPPING CONDITION**

Step progress can be made after the SOCKET RELEASE TIME has elapsed.

NOTE

The "NEGATIVE TORQUE MAXIMUM TROUBLE" will occur, when the releasing torque becomes more than about 1/2 of the TIGHTENING PEAK TORQUE during this command.

90	END OF CYCLE
-----------	--------------

- **FUNCTION**

The fastening program is completed and the fastening result is evaluated.

- **FORMAT**

1	-	-	-	-	-	-	-
---	---	---	---	---	---	---	---

1) END OF CYCLE command

command code	90h
--------------	-----

- **DESCRIPTION**

If this command is found in the fastening program, the NUTRUNNER completes the program and the result of fastening is evaluated.

This command is required at the end of program without fail.

NOTE

The "PROGRAM ERROR" will occur, if the END OF CYCLE command is not included in the fastening program.

A0	TIME DELAY
-----------	------------

- **FUNCTION**

It is used to pause the program for a fixed time interval.

- **FORMAT**

1	2	-	-	-	-	-	-
---	---	---	---	---	---	---	---

1) TIME DELAY command

command code	A0h
--------------	-----

2) WAITING TIME

Program stop time (0 - 25.5 second) is set.

Pause time (second) = [WAITING TIME] x 0.1 (second)

CODE	WAITING TIME (seconds)
00h	0
FFh	25.5

- **DESCRIPTION**

The program stops only for the WAITING TIME.

This is used for the adjustment of fastening timing with other NUTRUNNERS.

- **STEPPING CONDITION**

The stepping becomes possible after the WAITING TIME has elapsed.

NOTE

The cycle time is counted during the TIME DELAY (waiting time).

B 0	JUMP
------------	------

- FUNCTION

This command evaluates the fastening data and jumps to designated step if the condition is fulfilled.

- FORMAT

1	2	-	-	-	-	-	-
---	---	---	---	---	---	---	---

1) JUMP command

The condition to jump is set.

Command code	JUMP CONDITION
B0h	Always jump
B1h	Jump when the condition is "OK". (OK JUMP)
B2h	Jump when the condition is "NG". (NG JUMP)

2) STEP NO.

Designated step No. (1 - 32) to jump is set.

CODE	STEP NO.
01h	1
20h	32

NOTE

The "PROGRAM JUMP ERROR" will occur, when the step No. to jump is set after END OF CYCLE command.

.

Chapter 5 Fastening parameter set

The fastening parameters of the NUTRUNNER are described in this chapter.

Chapter 5 Fastening parameter set	5-1
5.1 About the fastening parameter set.....	5-2
5.2 Description of fastening parameter set	5-6
5.2.1 CONTROL VALUE	5-6
5.2.2 NG REFERENCE VALUE	5-16
5.2.3 TROUBLE REFERENCE VALUE.....	5-23

5.1 About the fastening parameter set

The fastening parameter set is the parameter set to be referred when the NUTRUNNER does fastening operation. These parameters can be classified as in the following.

PARAMETER TYPE	DESCRIPTION
Control value	The value to control the NUTRUNNER
NG reference value	The reference value for the NG judgement
TROUBLE reference value	The reference value for the TROUBLE judgement
Correction value	The correction value of torque and angle.

Table 5.1-1 Type of fastening parameters

NOTE

The “model SDN*-DP DISPLAY PANEL” or the SDNR-UITW USER INTERFACE TERMINAL is required for the confirmation and editing of fastening parameters.

Symbol [*] indicates [S] in Type S and for [M] in Type M.

CAUTION

NG REFERENCE VALUE is evaluated after fastening is completed even if NG occurs on the fastening.

TROUBLE REFERENCE VALUE is evaluated when trouble occurs (fastening is halted).

- CONTROL VALUE

No.	ITEM NAME	SYMBOL	UNIT
1	DIRECTION OF ROTATION	-	-
2	AUTO CALIBRATION SW	-	-
3	SLOPE MONITOR TRIGGER	-	-
4	RUN DOWN TORQUE JUDGEMENT MODE	-	-
5	SEATING TORQUE	T_S	kgf.m/N.m/ft.lb
6	SNUG TORQUE	T_{SN}	kgf.m/N.m/ft.lb
7	CONTROL TORQUE	T_C	kgf.m/N.m/ft.lb
8	CONTROL ANGLE	θ_C	degree
9	TORQUE TENSION MEASURING ANGLE	θ_{TNSM}	degree
10	YIELD POINT DETECTION LEVEL	Y_P	-
11	SLOPE MONITOR SAMPLING ANGLE	θ_{SLP}	degree
12	THRESHOLD TORQUE	T_{SLP1}	kgf.m/N.m/ft.lb
13	CROSS OVER TORQUE	T_{SLP2}	kgf.m/N.m/ft.lb
14	JOG TORQUE	T_J	kgf.m/N.m/ft.lb
15	JOG TIME	t_J	second
16	JOG ANGLE	θ_J	degree
17	CONTROL TIME	t_C	second
18	TORQUE KEEP TIME	t_K	second
19	SLOPE MONITOR 3 START TORQUE	T_{SLP3}	kgf.m/N.m/ft.lb
20	SLOPE MONITOR 2 START ANGLE	θ_{SLP2}	degree
21	SLOPE MONITOR 3 START ANGLE	θ_{SLP3}	degree
22	MID POINT JUDGEMENT TORQUE	T_{MPS}	kgf.m/N.m/ft.lb
23	MID POINT JUDGEMENT ANGLE	θ_{MPS}	degree
24	START TORQUE OF RUN DOWN ANGLE	T_{RDAS}	kgf.m/N.m/ft.lb
25	START ANGLE OF RUN DOWN TRQ.MIN.JDG	θ_{RDAS}	turn
26	END ANGLE OF RUN DOWN TRQ.MAX.JDG.	θ_{RDAE}	turn
27	TORQUE GAIN CORRECTION	$T_{CV(a)}$	-
28	TORQUE OFFSET CORRECTION	$T_{CV(b)}$	kgf.m/N.m/ft.lb
29	ANGLE GAIN CORRECTION	$\theta_{CV(a)}$	-
30	ANGLE OFFSET CORRECTION	$\theta_{CV(b)}$	degree
31	TORQUE CURVE SAMPLING INTERVAL	t_{tc}	millisecond
32	TORQUE CURVE DATA BUFFER SIZE	-	-

Table 5.1-2 Fastening parameter set (control values)

- NG REFERENCE VALUE

No.	ITEM NAME	SYMBOL	UNIT
40	TIGHTENING PEAK TORQUE LOWER LIMIT	$T_{P(LOW)}$	kgf.m/N.m/ft.lb
41	TIGHTENING PEAK TORQUE UPPER LIMIT	$T_{P(UP)}$	kgf.m/N.m/ft.lb
42	FINAL TORQUE LOWER LIMIT	$T_{F(LOW)}$	kgf.m/N.m/ft.lb
43	FINAL TORQUE UPPER LIMIT	$T_{F(UP)}$	kgf.m/N.m/ft.lb
44	TIGHTENING TIME LOWER LIMIT	$t_{(LOW)}$	second
45	TIGHTENING TIME UPPER LIMIT	$t_{(UP)}$	second
46	TIGHTENING ANGLE LOWER LIMIT	$\theta_{(LOW)}$	degree
47	TIGHTENING ANGLE UPPER LIMIT	$\theta_{(UP)}$	degree
48	TIGHTENING CURRENT LOWER LIMIT	$C_{(LOW)}$	Ampere (A)
49	TIGHTENING CURRENT UPPER LIMIT	$C_{(UP)}$	Ampere (A)
50	SEATING TIME LOWER LIMIT	$t_{S(LOW)}$	second
51	SEATING TIME UPPER LIMIT	$t_{S(UP)}$	second
52	SEATING ANGLE LOWER LIMIT	$\theta_{S(LOW)}$	turn
53	SEATING ANGLE UPPER LIMIT	$\theta_{S(UP)}$	turn
54	SNUG TORQUE LOWER LIMIT	$T_{SN(MIN)}$	kgf.m/N.m/ft.lb
55	SNUG TORQUE UPPER LIMIT	$T_{SN(MAX)}$	kgf.m/N.m/ft.lb
56	MONITOR ANGLE LOWER LIMIT	$\theta_{M(LOW)}$	degree
57	MONITOR ANGLE UPPER LIMIT	$\theta_{M(UP)}$	degree
58	SLOPE 1 TORQUE LOWER LIMIT	$T_{SLP1(LOW)}$	kgf.m/N.m/ft.lb
59	SLOPE 1 TORQUE UPPER LIMIT	$T_{SLP1(UP)}$	kgf.m/N.m/ft.lb
60	SLOPE 2 TORQUE LOWER LIMIT	$T_{SLP2(LOW)}$	kgf.m/N.m/ft.lb
61	SLOPE 2 TORQUE UPPER LIMIT	$T_{SLP2(UP)}$	kgf.m/N.m/ft.lb
62	FINAL SLOPE TORQUE LOWER LIMIT	$T_{FSLP(LOW)}$	kgf.m/N.m/ft.lb
63	FINAL SLOPE TORQUE UPPER LIMIT	$T_{FSLP(UP)}$	kgf.m/N.m/ft.lb
64	FINAL SLOPE LEVEL LOWER LIMIT	$SLP_{(LOW)}$	-
65	FINAL SLOPE LEVEL UPPER LIMIT	$SLP_{(UP)}$	-
66	STRETCH ANGLE LOWER LIMIT	$\theta_{YLD(LOW)}$	degree
67	STRETCH ANGLE UPPER LIMIT	$\theta_{YLD(UP)}$	degree
68	SLOPE 3 TORQUE LOWER LIMIT	$T_{SLP3(LOW)}$	kgf.m/N.m/ft.lb
69	SLOPE 3 TORQUE UPPER LIMIT	$T_{SLP3(UP)}$	kgf.m/N.m/ft.lb
70	MID POINT TORQUE LOWER LIMIT	$T_{MP(LOW)}$	kgf.m/N.m/ft.lb
71	MID POINT TORQUE UPPER LIMIT	$T_{MP(UP)}$	kgf.m/N.m/ft.lb

Table 5.1-3 Fastening parameter set (NG reference values)

- TROUBLE REFERENCE VALUE

No.	ITEM NAME	SYMBOL	UNIT
80	TORQUE MAXIMUM	$T_{(MAX)}$	kgf.m/N.m/ft.lb
81	TIGHTENING TIME MAXIMUM	$T_{(MAX)}$	kgf.m/N.m/ft.lb
82	TIGHTENING ANGLE MAXIMUM	$\theta_{(MAX)}$	degree
83	CURRENT MAXIMUM	$C_{(MAX)}$	Ampere (A)
84	TIGHTENING CURRENT MAXIMUM	$C_{(UP)}$	Ampere (A)
85	CYCLE TIME MAXIMUM	$t_{CYC(MAX)}$	second
86	SEATING TIME MINIMUM	$t_{S(MIN)}$	second
87	SEATING TIME MAXIMUM	$t_{S(MAX)}$	second
88	SEATING ANGLE MINIMUM	$\theta_{S(MIN)}$	turn
89	SEATING ANGLE MAXIMUM	$\theta_{S(MAX)}$	turn
90	SNUG TORQUE MAXIMUM	$T_{SN(MAX)}$	kgf.m/N.m/ft.lb
91	SNUG TIME MINIMUM	$t_{SN(MIN)}$	second
92	SNUG TIME MAXIMUM	$t_{SN(MAX)}$	second
93	SNUG ANGLE MINIMUM	$\theta_{SN(MIN)}$	degree
94	SNUG ANGLE MAXIMUM	$\theta_{SN(MAX)}$	degree
95	SLOPE 1 TORQUE MINIMUM	$T_{SLP1(MIN)}$	kgf.m/N.m/ft.lb
96	SLOPE 1 TORQUE MAXIMUM	$T_{SLP1(MAX)}$	kgf.m/N.m/ft.lb
97	SLOPE 2 TORQUE MINIMUM	$T_{SLP2(MIN)}$	kgf.m/N.m/ft.lb
98	SLOPE 2 TORQUE MAXIMUM	$T_{SLP2(MAX)}$	kgf.m/N.m/ft.lb
99	SLOPE 3 TORQUE MINIMUM	$T_{SLP3(MIN)}$	kgf.m/N.m/ft.lb
100	SLOPE 3 TORQUE MAXIMUM	$T_{SLP3(MAX)}$	kgf.m/N.m/ft.lb
101	MID POINT TORQUE MINIMUM	$T_{MP(MIN)}$	kgf.m/N.m/ft.lb
102	MID POINT TORQUE MAXIMUM	$T_{MP(MAX)}$	kgf.m/N.m/ft.lb
103	RUN DOWN ANGLE MINIMUM	$\theta_{RD(MIN)}$	turn
104	RUN DOWN ANGLE MAXIMUM	$\theta_{RD(MAX)}$	turn
105	RUN DOWN TORQUE MINIMUM	$T_{RD(MIN)}$	kgf.m/N.m/ft.lb
106	RUN DOWN TORQUE MAXIMUM	$T_{RD(MAX)}$	kgf.m/N.m/ft.lb

Table 5.1-4 Fastening parameter set (TROUBLE reference value)

5.2 Description of fastening parameter set

5.2.1 CONTROL VALUE

Parameter No. 01	DIRECTION OF ROTATION
------------------	-----------------------

The direction of rotation for the SPINDLE ASSEMBLY'S output shaft is set.

SETTING	DIRECTION OF ROTATION
CW	Direction of rotation for right-handed screw
CCW	Direction of rotation for left-handed screw

Parameter No. 02	AUTO CALIBRATION SW
------------------	---------------------

Prior to the start of fastening, if the auto calibration switch is activated, the NUTRUNNER performs a calibration check of the system. The recommended setting for this parameter is “ON”, but can be set to “OFF” to prevent an error if the TORQUE TRANSDUCER is exposed to a load just prior to the start of fastening. The AUTO CALIBRATION SW can be set separately for each fastening program.

AUTO CALIBRATION SETTING	CONTENTS
ON	AUTO CALIBRATION check is performed.
OFF	AUTO CALIBRATION check is not performed.

Parameter No. 03	SLOPE MONITOR TRIGGER
------------------	-----------------------

The slope monitor 2 and 3 start trigger are set.

SETTING	DIRECTION OF ROTATION
TORQUE	The NUTRUNNER starts the slope monitor 1 - 3 when It detects the slope monitor start torque. The SLOPE MONITOR 2 START TORQUE and the SLOPE MONITOR 3 START TORQUE are enabled.
ANGLE	The SLOPE MONITOR 1 is started after the SLOPE MONITOR 1 START TORQUE was detected. The SLOPE MONITOR 2 and 3 are started after the slope monitor start angle. The SLOPE MONITOR 2 START ANGLE and the SLOPE MONITOR 3 START ANGLE are enabled.

CAUTION

The setting of the slope monitor trigger is functioned from the ROM Ver 1.6 of the driver.
This setting is always the TORQUE before than Ver 1.6.

Parameter No. 04	RUN DOWN TORQUE JUDGEMENT MODE
------------------	--------------------------------

The RUN DOWN TORQUE JUDGEMENT MODE is set.

The Normal mode or the Momentary mode can be selected.

SETTING	DIRECTION OF ROTATION
Std.	The RUN DOWN TORQUE JUDGEMENT MODE is set to the Normal mode.
Mot.	The RUN DOWN TORQUE JUDGEMENT MODE is set to the Momentary mode The START ANGLE OF RUN DOWN TRQ.MIN.JDG is disabled.

CAUTION

The setting is functioned from the ROM Ver 2.1 of the driver and the User Interface Terminal Ver 1.19.0.

Parameter No. 05	SEATING TORQUE
------------------	----------------

Seating torque is set.

The torque when the screw makes contact with the seat surface is set. When the seating torque is detected, program will step to the SOFT START and HIGH SPEED commands.

Parameter No. 06	SNUG TORQUE
------------------	-------------

Snug torque is set.

The snug torque is the starting point for the measurement of the following data:

- Monitoring time
- Monitoring angle
- The control angle in the TORQUE-TURN CONTROL
- The torque rate in the TORQUE-TENSION or YIELD POINT DETECTION CONTROL

Parameter No. 07	CONTROL TORQUE
------------------	----------------

The tightening torque (control torque) is set.

This setting is available only in the ANGLE MONITORING TORQUE CONTROL.

Parameter No. 08	CONTROL ANGLE
------------------	---------------

The tightening angle (control angle) is set.

This setting is available in the TORQUE-TURN or TORQUE-TENSION CONTROL.

Parameter No. 09	TORQUE-TENSION MEASURING ANGLE
------------------	--------------------------------

The angle to measure the torque rate in the TORQUE-TENSION CONTROL is set.

The torque rate is measured by turning the NUTRUNNER by this angle from the snug torque.

Parameter No. 10	YIELD POINT DETECTION LEVEL
------------------	-----------------------------

The yield point detection level, which is the target value in the YIELD POINT DETECTION CONTROL, is set. This setting can be selected from the values, which were calculated by dividing the maximum torque rate by 100.

Target torque rate = maximum torque rate X Setting value / 100(%)

Tightening is completed when torque rate goes down to half of the maximum torque rate if set value is 50%.

Parameter No. 11	SLOPE MONITOR SAMPLING ANGLE
------------------	------------------------------

Slope monitor sampling angle is set.

The slope monitor measures the increase of torque by referring this sampling angle as the datum.

Parameter No. 12	SLOPE MONITOR 1 START TORQUE
------------------	------------------------------

The torque to start the SLOPE MONITOR 1 is set.

If Slope 1 monitoring is not required, it can be disabled in the PARAMETER SW.

This setting is enabled when the SLOPE MONITOR TRIGGER is being set on the TORQUE.

Parameter No. 13	SLOPE MONITOR 2 START TORQUE
------------------	------------------------------

The torque to start the SLOPE MONITOR 2 is set.

If Slope 2 monitoring is not required, it can be disabled in the PARAMETER SW.

This setting is enabled when the SLOPE MONITOR TRIGGER is being set on the TORQUE.

CAUTION

SLOPE MONITOR 2 is started only after SLOPE MONITOR 1 is started.

Parameter No. 14	JOG TORQUE
------------------	------------

The jog torque is set. This setting is available when the STEPPING CONDITION for the jog of torque-up or torque-down is set according to the jog instruction. The NUTRUNNER keeps running till the torque increases or decreases to the set torque.

Parameter No. 15	JOG TIME
------------------	----------

The jog time is set.
This setting is available when the STEPPING CONDITION for time jog is set according to the instruction. The NUTRUNNER keeps running only for this set time.

Parameter No. 16	JOG ANGLE
------------------	-----------

The jog angle is set.
This setting is available when the STEPPING CONDITION for angle jog is set according to the jog instruction. The NUTRUNNER runs only for this set angle.

Parameter No. 17	CONTROL TIME
------------------	--------------

The target tightening time (control time) is set.
This setting is available in the ANGLE MONITORING TIMED TORQUE CONTROL.

Parameter No. 18	TORQUE KEEP TIME
------------------	------------------

The torque hold time is set.
This setting is available in the TORQUE HOLDING CONTROL.

CAUTION

The setting is functioned from the ROM Ver 1.4 of the driver.

Parameter No. 19	SLOPE MONITOR 3 START TORQUE
------------------	------------------------------

The torque to start the SLOPE MONITOR 3 is set.

If Slope 3 monitoring is not required, it can be disabled in the PARAMETER SW.

This setting is enabled when the SLOPE MONITOR TRIGGER is being set on the TORQUE.

CAUTION

SLOPE MONITOR 3 is started only after SLOPE MONITOR 2 is started.

Parameter No. 20	SLOPE MONITOR 2 START ANGLE
------------------	-----------------------------

The angle to start the SLOPE MONITOR 2 is set.

This setting value is from the SLOPE MONITOR 1 START TORQUE.

If Slope 3 monitoring is not required, it can be disabled in the PARAMETER SW.

This setting is enabled when the SLOPE MONITOR TRIGGER is being set on the ANGLE.

CAUTION

SLOPE MONITOR 2 is started only after SLOPE MONITOR 1 is started.

Parameter No. 21	SLOPE MONITOR 3 START ANGLE
------------------	-----------------------------

The angle to start the SLOPE MONITOR 3 is set.

This setting value is from the SLOPE MONITOR 1 START TORQUE.

If Slope 3 monitoring is not required, it can be disabled in the PARAMETER SW.

This setting is enabled when the SLOPE MONITOR TRIGGER is being set on the ANGLE.

CAUTION

SLOPE MONITOR 3 is started only after SLOPE MONITOR 2 is started.

Parameter No. 22

MID POINT JUDGEMENT TORQUE

This setting torque is basing point for the MID POINT JUDGEMENT.

The MID POINT JUDGEMENT is judgement of torque that rotated to the MID POINT ANGLE from the MID POINT JUDGEMENT TORQUE.

CAUTION

This setting have enabled by following version.

Driver ROM Ver 1.6. Display panel ROM Ver. 1.6

Parameter No. 23

MID POINT JUDGEMENT ANGLE

This setting angle is point for the MID POINT JUDGEMENT.

The MID POINT JUDGEMENT is judgement of torque that rotated to the MID POINT ANGLE from the MID POINT JUDGEMENT TORQUE.

CAUTION

This setting have enabled by following version.

Driver ROM Ver 1.6. Display panel ROM Ver. 1.6

Parameter No. 24

START TORQUE OF RUN DOWN ANGLE

This setting torque is start point for the RUN DOWN ANGLE.

RUN DOWN angle is a rotation angle until it detects seating torque after detecting the START TORQUE OF RUN DOWN ANGLE.

CAUTION

This setting have enabled by following version.

Driver ROM Ver 1.8. Display panel ROM Ver. 1.8

Parameter No. 25	START ANGLE OF RUN DOWN TRQ. MINIMUM JUDGEMENT
------------------	--

The case of Normal mode, this setting angle is point for the START ANGLE OF RUN DOWN TRQ. MINIMUM JUDGEMENT.

The START ANGLE OF RUN DOWN TRQ. MINIMUM JUDGEMENT is judgement of rotation angle (turns) back from seating point. This is minimum setting in revolutions needed between Start torque of RUNDOWN ANGLE JUDGEMENT and SEATING TORQUE.

CAUTION

This setting have enabled by following version.
Driver ROM Ver 1.8. Display panel ROM Ver. 1.8

Parameter No. 26	END ANGLE OF RUN DOWN TRQ. MAXIMUM JUDGEMENT
------------------	--

This setting angle is point for the END ANGLE OF RUN DOWN TRQ. MAXIMUM JUDGEMENT.

The END ANGLE OF RUN DOWN TRQ. MAXIMUM JUDGEMENT is judgement of rotation angle (turns) back from seating point. This is maximum setting in revolutions needed between Start torque of RUNDOWN ANGLE JUDGEMENT and SEATING TORQUE.

In the case of Momentary mode, this setting angle is point for the END ANGLE OF RUN DOWN TRQ. MINIMUM JUDGEMENT.

CAUTION

This setting have enabled by following version.
Driver ROM Ver 1.8. Display panel ROM Ver. 1.8
The Momentary mode setting is functioned from the ROM Ver 2.1 of the driver and the User Interface Terminal Ver 1.19.0.

Parameter No. 27	TORQUE GAIN CORRECTION
------------------	------------------------

The gain for torque correction is set.

Parameter No. 28	TORQUE OFFSET CORRECTION
------------------	--------------------------

The offset for torque correction is set.

Parameter No. 29	ANGLE GAIN CORRECTION
------------------	-----------------------

The gain for angle correction is set.

Parameter No. 30	ANGLE OFFSET CORRECTION
------------------	-------------------------

The offset for angle correction is set.

Parameter No. 31	TORQUE CURVE SAMPLING INTERVAL
------------------	--------------------------------

The sampling time of torque curve is set.

The relation between the sampling time and the acquisition time of torque curve is shown in the following formula.

For DISPLAY PANEL

Acquisition time of torque curve (second)=Sampling time (millisecond) X 200 X 4092/10⁵

NOTE

The torque sampling interval has nothing to do with the sampling time used for the NUTRUNNER control.

Parameter No. 32	TORQUE CURVE DATA BUFFER SIZE
------------------	-------------------------------

The data buffer size of torque curve is set.

The size of samples can be chosen from 1K points to 4K points.

NOTE

This setting have enabled by following version.
Driver ROM Ver. 1.9. Display panel ROM Ver. 2.0

5.2.2 NG REFERENCE VALUE

Parameter No. 40	TIGHTENING PEAK TORQUE LOWER LIMIT
------------------	------------------------------------

The lower limit of NG reference value for tightening peak torque is set.
When the tightening peak torque is less than this set value, NG occurs.

Parameter No. 41	TIGHTENING PEAK TORQUE UPPER LIMIT
------------------	------------------------------------

The upper limit of NG reference value for tightening peak torque is set.
When the tightening peak torque is larger than this set value, NG occurs.

Parameter No. 42	FINAL TORQUE LOWER LIMIT
------------------	--------------------------

The lower limit of NG reference value for tightening peak torque is set.
When the tightening peak torque is less than this set value, NG occurs.

Parameter No. 43	FINAL TORQUE UPPER LIMIT
------------------	--------------------------

The upper limit of NG reference value for tightening peak torque is set.
When the tightening peak torque is larger than this set value, NG occurs.

Parameter No. 44	TIGHTENING TIME LOWER LIMIT
------------------	-----------------------------

The lower limit of NG reference value for tightening time is set.
When the tightening time (from the detection of seating torque to the end of fastening cycle)
is shorter than this set value, NG occurs.

Parameter No. 45	TIGHTENING TIME UPPER LIMIT
------------------	-----------------------------

The upper limit of NG reference value for tightening time is set.

When the tightening time (from the detection of seating torque to the end of fastening cycle) is longer than this set value, NG occurs.

Parameter No. 46	TIGHTENING ANGLE LOWER LIMIT
------------------	------------------------------

The lower limit of NG reference value for tightening angle is set.

When the tightening angle (used from the detection of seating torque to the end of fastening cycle) is smaller than this set value, NG occurs.

Parameter No. 47	TIGHTENING ANGLE UPPER LIMIT
------------------	------------------------------

The upper limit of NG reference value for tightening angle is set.

When the tightening angle (used from the detection of seating torque to the end of fastening cycle) is larger than this set value, NG occurs.

Parameter No. 48	TIGHTENING CURRENT LOWER LIMIT
------------------	--------------------------------

The lower limit of NG reference value for fastening current is set.

When the fastening current is less than this set value, NG occurs.

Parameter No. 49	TIGHTENING CURRENT UPPER LIMIT
------------------	--------------------------------

The upper limit of NG reference value for fastening current is set.

When the fastening current is more than this set value, NG occurs.

Parameter No. 50	SEATING TIME LOWER LIMIT
------------------	--------------------------

The lower limit of NG reference value for seating time is set.

When the seating time (from the start of fastening cycle to the detection of seating torque) is shorter than this set value, NG occurs.

Parameter No. 51	SEATING TIME UPPER LIMIT
------------------	--------------------------

The upper limit of NG reference value for seating time is set.

When the seating time (from the start of fastening cycle to the detection of seating torque) is longer than this set value, NG occurs.

Parameter No. 52	SEATING ANGLE LOWER LIMIT
------------------	---------------------------

The lower limit of NG reference value for seating angle is set.

When the seating angle (used from the start of fastening cycle to the detection of seating torque) is smaller than this set value, NG occurs.

Parameter No. 53	SEATING ANGLE UPPER LIMIT
------------------	---------------------------

The upper limit of NG reference value for seating angle is set.

When the seating angle (used from the start of fastening cycle to the detection of seating torque) is larger than this set value, NG occurs.

Parameter No. 54	SNUG TORQUE LOWER LIMIT
------------------	-------------------------

The lower limit of NG reference value for snug torque is set.

When the snug torque is smaller than this set value, NG occurs.

Parameter No. 55	SNUG TORQUE UPPER LIMIT
------------------	-------------------------

The upper limit of NG reference value for snug torque is set.
When the snug torque is larger than this set value, NG occurs.

Parameter No. 56	MONITOR ANGLE LOWER LIMIT
------------------	---------------------------

The lower limit of NG reference value for monitor angle is set.
When the monitor angle (used from the detection of snug torque to the end of fastening cycle) is smaller than this set value, NG occurs.

Parameter No. 57	MONITOR ANGLE UPPER LIMIT
------------------	---------------------------

The upper limit of NG reference value for monitor angle is set.
When the monitor angle (used from the detection of snug torque to the end of fastening cycle) is larger than this set value, NG occurs.

Parameter No. 58	SLOPE 1 TORQUE LOWER LIMIT
------------------	----------------------------

The lower limit of NG reference value for slope 1 torque is set.
When the slope 1 torque is smaller than this set value, NG occurs.

Parameter No. 59	SLOPE 1 TORQUE UPPER LIMIT
------------------	----------------------------

The upper limit of NG reference value for slope 1 torque is set.
When the slope 1 torque is larger than this set value, NG occurs.

Parameter No. 60	SLOPE 2 TORQUE LOWER LIMIT
------------------	----------------------------

The lower limit of NG reference value for slope 2 torque is set.
When the slope 2 torque is smaller than this set value, NG occurs.

Parameter No. 61	SLOPE 2 TORQUE UPPER LIMIT
------------------	----------------------------

The upper limit of NG reference value for slope 2 torque is set.
When the slope 2 torque is larger than the set value, NG occurs.

Parameter No. 62	FINAL SLOPE TORQUE LOWER LIMIT
------------------	--------------------------------

The lower limit of NG reference value for the final slope torque is set.
When the final slope is smaller than this set value, NG occurs.

Parameter No. 63	FINAL SLOPE TORQUE UPPER LIMIT
------------------	--------------------------------

The upper limit of NG reference value for the final slope torque is set.
When the final slope is larger than this set value, NG occurs.

Parameter No. 64	FINAL SLOPE LEVEL LOWER LIMIT
------------------	-------------------------------

The lower limit of NG reference value for the final slope level is set.
When the final slope is smaller than this set value, NG occurs.

Parameter No. 65	FINAL SLOPE LEVEL UPPER LIMIT
------------------	-------------------------------

The upper limit of NG reference value for the final slope level is set.
When the final slope is larger than this set value, NG occurs.

Parameter No. 66	STRETCH ANGLE LOWER LIMIT
------------------	---------------------------

The lower limit of NG reference value for the stretch angle is set.
When the stretch angle is smaller than this set value, NG occurs.

CAUTION

This setting have enabled by following version.
Driver ROM Ver 1.6. Display panel ROM Ver. 1.6

Parameter No. 67	STRETCH ANGLE UPPER LIMIT
------------------	---------------------------

The upper limit of NG reference value for the stretch angle is set.
When the stretch angle is larger than this set value, NG occurs.

CAUTION

This setting have enabled by following version.
Driver ROM Ver 1.6. Display panel ROM Ver. 1.6

Parameter No. 68	SLOPE 3 TORQUE LOWER LIMIT
------------------	----------------------------

The lower limit of NG reference value for slope 3 torque is set.
When the slope 3 torque is smaller than this set value, NG occurs.

CAUTION

This setting have enabled by following version.
Driver ROM Ver 1.6. Display panel ROM Ver. 1.6

Parameter No. 69	SLOPE 3 TORQUE UPPER LIMIT
------------------	----------------------------

The upper limit of NG reference value for slope 3 torque is set.
When the slope 3 torque is larger than this set value, NG occurs.

CAUTION

This setting have enabled by following version.
Driver ROM Ver 1.6. Display panel ROM Ver. 1.6

Parameter No. 70	MID POINT TORQUE LOWER LIMIT
------------------	------------------------------

The lower limit of NG reference value for the mid point torque is set.
When the mid point torque is smaller than this set value, NG occurs.

CAUTION

This setting have enabled by following version.
Driver ROM Ver 1.6. Display panel ROM Ver. 1.6

Parameter No. 71	MID POINT TORQUE UPPER LIMIT
------------------	------------------------------

The upper limit of NG reference value for the mid point torque is set.
When the mid point torque is larger than this set value, NG occurs.

CAUTION

This setting have enabled by following version.
Driver ROM Ver 1.6. Display panel ROM Ver. 1.6

5.2.3 TROUBLE REFERENCE VALUE

Parameter No. 80	TORQUE MAXIMUM
------------------	----------------

The upper limit of TROUBLE reference value for fastening torque is set.

When the fastening torque is larger than this set value, an error occurs to interrupt the fastening operation. It is effective also for negative torque.

Parameter No. 81	TIGHTENING TIME MAXIMUM
------------------	-------------------------

The upper limit of TROUBLE reference value for fastening time is set.

When the fastening time is longer than this set value, an error occurs to interrupt the fastening operation.

Parameter No. 82	TIGHTENING ANGLE MAXIMUM
------------------	--------------------------

The upper limit of TROUBLE reference value for fastening angle is set.

When the fastening angle is larger than this set value, an error occurs to interrupt the fastening operation.

Parameter No. 83	CURRENT MAXIMUM
------------------	-----------------

The upper limit of TROUBLE reference value for current is set.

When the peak current of the cycle is bigger than this set value, an error occurs to interrupt the fastening operation.

Parameter No. 84	TIGHTENING CURRENT MAXIMUM
------------------	----------------------------

The upper limit of TROUBLE reference value for fastening current is set.

When the current of the tightening step is bigger than this set value, an error occurs to interrupt the fastening operation.

Parameter No. 85	CYCLE TIME MAXIMUM
------------------	--------------------

The upper limit of TROUBLE reference value for cycle time is set.

When the cycle time is longer than this set value, an error occurs to interrupt the fastening operation.

Parameter No. 86	SEATING TIME MINIMUM
------------------	----------------------

The lower limit of TROUBLE reference value for seating time is set.

When the seating time (from the start of fastening cycle to the detection of seating torque) is shorter than this set value, an error occurs to interrupt the fastening operation.

Parameter No. 87	SEATING TIME MAXIMUM
------------------	----------------------

The upper limit of TROUBLE reference value for seating time is set.

When the seating time (from the start of fastening cycle to the detection of seating torque) is longer than this set value, an error occurs to interrupt the fastening operation.

Parameter No. 88	SEATING ANGLE MINIMUM
------------------	-----------------------

The lower limit of TROUBLE reference value for seating angle is set.

When the seating angle (used from the start of fastening cycle to the detection of seating torque) is smaller than this set value, an error occurs to interrupt the fastening operation.

Parameter No. 89	SEATING ANGLE MAXIMUM
------------------	-----------------------

The upper limit of TROUBLE reference value for seating angle is set.

When the seating angle (used from the start of fastening cycle to the detection of seating torque) is larger than this set value, an error occurs to interrupt the fastening operation.

Parameter No. 90	SNUG TORQUE MAXIMUM
------------------	---------------------

The upper limit of TROUBLE reference value for snug torque is set.

When the snug torque is larger than this set value, an error occurs to interrupt the fastening operation.

Parameter No. 91	SNUG TIME MINIMUM
------------------	-------------------

The lower limit of TROUBLE reference value for snug time is set.

When the snug time (from the detection of seating torque to the detection of snug torque) is shorter than this set value, an error occurs to interrupt the fastening operation.

Parameter No. 92	SNUG TIME MAXIMUM
------------------	-------------------

The upper limit of TROUBLE reference value for snug time is set.

When the snug time is longer than this set value, an error occurs to interrupt the fastening operation.

Parameter No. 93	SNUG ANGLE MINIMUM
------------------	--------------------

The lower limit of TROUBLE reference value for snug angle is set.

When the snug angle (from the detection of seating torque to the detection of snug torque) is smaller than this set value, an error occurs to interrupt the fastening operation.

Parameter No. 94	SNUG ANGLE MAXIMUM
------------------	--------------------

The upper limit of TROUBLE reference value for snug angle is set.
When the snug angle is larger than the set value, an error occurs to interrupt the fastening operation.

Parameter No. 95	SLOPE 1 TORQUE MINIMUM
------------------	------------------------

The lower limit of TROUBLE reference value for slope 1 torque is set.
When the slope 1 torque is smaller than this set value, an error occurs to interrupt the fastening operation.

Parameter No. 96	SLOPE 1 TORQUE MAXIMUM
------------------	------------------------

The upper limit of TROUBLE reference value for slope 1 torque is set.
When the slope 1 torque is larger than this set value, an error occurs to interrupt the fastening operation.

Parameter No. 97	SLOPE 2 TORQUE MINIMUM
------------------	------------------------

The lower limit of TROUBLE reference value for slope 2 torque is set.
When the slope 2 torque is smaller than this set value, an error occurs to interrupt the fastening operation.

Parameter No. 98	SLOPE 2 TORQUE MAXIMUM
------------------	------------------------

The upper limit of TROUBLE reference value for slope 2 torque is set.
When the slope 2 torque is larger than this set value, trouble occurs to interrupt the fastening operation.

Parameter No. 99	SLOPE 3 TORQUE MINIMUM
------------------	------------------------

The lower limit of TROUBLE reference value for slope 3 torque is set.

When the slope 3 torque is smaller than this set value, an error occurs to interrupt the fastening operation.

CAUTION

This setting have enabled by following version.
Driver ROM Ver 1.6. Display panel ROM Ver. 1.6

Parameter No. 100	SLOPE 3 TORQUE MAXIMUM
-------------------	------------------------

The upper limit of TROUBLE reference value for slope 2 torque is set.

When the slope 2 torque is larger than this set value, trouble occurs to interrupt the fastening operation.

CAUTION

This setting have enabled by following version.
Driver ROM Ver 1.6. Display panel ROM Ver. 1.6

Parameter No. 101	MID POINT TORQUE MINIMUM
-------------------	--------------------------

The lower limit of TROUBLE reference value for the mid point torque is set.

When the mid point torque is smaller than this set value, an error occurs to interrupt the fastening operation.

CAUTION

This setting have enabled by following version.
Driver ROM Ver 1.6. Display panel ROM Ver. 1.6

Parameter No. 102	MID POINT TORQUE MAXIMUM
-------------------	--------------------------

The upper limit of TROUBLE reference value for the mid point torque is set.

When the mid point torque is larger than this set value, trouble occurs to interrupt the fastening operation.

CAUTION

This setting have enabled by following version.

Driver ROM Ver 1.6. Display panel ROM Ver. 1.6

Parameter No. 103	RUN DOWN ANGLE MINIMUM
-------------------	------------------------

The lower limit of TROUBLE reference value for the RUN DOWN ANGLE is set.

When the RUN DOWN ANGLE is smaller than this set value, trouble occurs to interrupt the fastening operation.

CAUTION

This setting have enabled by following version.

Driver ROM Ver 1.8. Display panel ROM Ver. 1.8

Parameter No. 104	RUN DOWN ANGLE MAXIMUM
-------------------	------------------------

The upper limit of TROUBLE reference value for the RUN DOWN ANGLE is set.

When the RUN DOWN ANGLE is larger than this set value, trouble occurs to interrupt the fastening operation.

CAUTION

This setting have enabled by following version.

Driver ROM Ver 1.8. Display panel ROM Ver. 1.8

Parameter No. 105	RUN DOWN TORQUE MINIMUM
-------------------	-------------------------

The lower limit of TROUBLE reference value for the RUN DOWN TORQUE is set.

In the case of the Normal mode, when the RUN DOWN TORQUE is smaller than this set value between START ANGLE RUNDOWN TORQUE MINIMUM JUDGEMENT and seating point, trouble occurs to interrupt the fastening operation.

In the case of the Momentary mode, when the RUN DOWN TORQUE is always smaller than this set value between fastening start and END ANGLE RUNDOWN TORQUE MINIMUM JUDGEMENT, trouble occurs to interrupt the fastening operation.

CAUTION

This setting have enabled by following version.

Driver ROM Ver 1.8. Display panel ROM Ver. 1.8

The Momentary mode is functioned from the ROM Ver 2.1 of the driver.

Parameter No. 106	RUN DOWN TORQUE MAXIMUM
-------------------	-------------------------

The upper limit of TROUBLE reference value for the RUN DOWN TORQUE is set.

When the RUN DOWN TORQUE is larger than this set value, trouble occurs to interrupt the fastening operation.

CAUTION

This setting have enabled by following version.

Driver ROM Ver 1.8. Display panel ROM Ver. 1.8

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Chapter 6 End of cycle data

The end of cycle data of the NUTRUNNER is described in this chapter.

Chapter 6 End of cycle data 6-1

6.1 About the End of Cycle Data.....6-2

6.2 Description6-4

6.1 About the End of Cycle Data

The End of Cycle Data are the data acquired as the result of the fastening cycle with the NUTRUNNER.

Their analysis enables to check the progress and condition of each fastening operation performed by the NUTRUNNER.

The End of Cycle Data for one NUTRUNNER are shown in the following table.

No.	END OF CYCLE DATA ITEM		SYMBOL	UNIT
1	END OF CYCLE STATUS	CYCLE STATUS CODE	-	-
		NG/TROUBLE MESSAGE	-	-
2	UPPER NG BIT		-	-
3	LOWER NG BIT		-	-
4	STEP No.		-	-
5	CYCLE TIME		t_{CYC}	second
6	OFFSET TORQUE		T_{CFT}	kgf.m/N.m/ft.lb
7	CYCLE PEAK TORQUE (CW)		T_{CW}	kgf.m/N.m/ft.lb
8	CYCLE PEAK TORQUE (CCW)		T_{CCW}	kgf.m/N.m/ft.lb
9	TIGHTENING PEAK TORQUE		T_P	kgf.m/N.m/ft.lb
10	NEGATIVE PEAK TORQUE		T_N	kgf.m/N.m/ft.lb
11	CYCLE PEAK CURRENT		C_{CYC}	Ampere (A)
12	TIGHTENING PEAK CURRENT		C_P	Ampere (A)
13	FINAL TORQUE		T_F	kgf.m/N.m/ft.lb
14	TIGHTENING TIME		t	second
15	TIGHTENING ANGLE		θ	degree
16	FINAL CURRENT		C_F	Ampere (A)
17	SEATING TORQUE		T_S	kgf.m/N.m/ft.lb
18	SEATING TIME		t_S	second
19	SEATING ANGLE		θ_S	turn
20	SNUG TORQUE		T_{SN}	kgf.m/N.m/ft.lb
21	SNUG TIME		t_{SN}	second
22	SNUG ANGLE		θ_{SN}	degree
23	MONITOR ANGLE		θ_M	degree
24	MINIMUM VALUE OF SLOPE 1		$T_{SLP1(MIN)}$	kgf.m/N.m/ft.lb
25	MAXIMUM VALUE OF SLOPE 1		$T_{SLP1(MAX)}$	kgf.m/N.m/ft.lb
26	MINIMUM VALUE OF SLOPE 2		$T_{SLP2(MIN)}$	kgf.m/N.m/ft.lb
27	MAXIMUM VALUE OF SLOPE 2		$T_{SLP2(MAX)}$	kgf.m/N.m/ft.lb
28	FINAL SLOPE TORQUE		T_{SLPF}	kgf.m/N.m/ft.lb
29	YIELD POINT ANGLE		θ_{YLD}	degree
30	STRETCH ANGLE		θ_{ST}	degree

Table 6.1-1 End of Cycle Data list (1/2)

No.	END OF CYCLE DATA ITEM	SYMBOL	UNIT
31	SLOPE BASE VALUE	$T_{SI\ PR}$	kgf.m/N.m/ft.lb
32	SLOPE BASE VALUE ANGLE	θ_{SLPB}	degree
33	SLOPE BASE VALUE TORQUE	T_{SLPB}	kgf.m/N.m/ft.lb
34	MINIMUM VALUE OF SLOPE 3	$T_{SLP3(MIN)}$	kgf.m/N.m/ft.lb
35	MAXIMUM VALUE OF SLOPE 3	$T_{SLP3(MAX)}$	kgf.m/N.m/ft.lb
36	MID POINT JUDGEMENT TORQUE	T_{MP}	kgf.m/N.m/ft.lb
37	MID POINT JUDGEMENT FASTENING ANGLE	θ_{MP}	degree
38	RUN DOWN ANGLE	θ_{RD}	turn
39	RUN DOWN TORQUE MINIMUM JDG.ANGLE	$\theta_{RDT(MIN)}$	turn
40	RUN DOWN TORQUE MAXIMUM JDG.ANGLE	$\theta_{RDT(MAX)}$	turn
41	TORQUE GAIN CORRECTION	$T_{CV(a)}$	-
42	TORQUE OFFSET CORRECTION	$T_{CV(b)}$	kgf.m/N.m/ft.lb
43	ANGLE GAIN CORRECTION	$\theta_{CV(a)}$	-
44	ANGLE OFFSET CORRECTION	$\theta_{CV(b)}$	degree
45	PROGRAM No.	-	-
	PARAMETER SET No.	-	-

Table 6.1-1 End of Cycle Data list (2/2)

- Display of the End of Cycle Data

The following devices shall be used to display the fastening data.

DEVICE NAME	DESCRIPTION
Model SDN*-DP DISPLAY PANEL	All the End of Cycle Data can be displayed.
Model SDNR-UITW User Interface Terminal	All the End of Cycle Data can be displayed, printed out or saved on disc.

Table 6.1-2 Devices used to display the End of Cycle Data

Symbol [*] indicates [S] for TYPE S and [M] for TYPE M.

CAUTION

For details on the above devices, refer to their respective operating manuals.

6.2 Description

END OF CYCLE DATA No. 01	END OF CYCLE STATUS
--------------------------	---------------------

This is the End of Cycle Status of a NUTRUNNER. This cycle status consists of the CYCLE STATUS CODE (1 byte) and the NG/TROUBLE MESSAGE (1 byte).

- CYCLE STATUS CODE

The cycle status codes are shown as follows.

CYCLE STATUS CODE (HEX)	CONTENTS
00	No end of cycle status
01	OK
02	NG
06	CONTROL TROUBLE
0A	MACHINE TROUBLE
10	BYPASS

Table 6.2-1 CYCLE STATUS CODES

- NG/TROUBLE MESSAGE

Refer to chapter 7 about the NG/TROUBLE MESSAGE.

END OF CYCLE DATA No. 02	UPPER NG BIT
--------------------------	--------------

The contents of UPPER NG BIT are shown in the following table.

UPPER NG BIT																CONTENTS
b 15	b 14	B 13	b 12	b 11	b 10	b 9	b 8	b 7	b 6	b 5	b 4	b 3	b 2	b 1	b 0	
															1	PEAK TORQUE UPPER LIMIT NG
															1	FINAL TORQUE UPPER LIMIT NG
														1		TIGHTENING TIME UPPER LIMIT NG
												1				TIGHTENING ANGLE UPPER LIMIT NG
											1					TIGHTENING CURRENT UPPER LIMIT NG
										1						SEATING TIME UPPER LIMIT NG
									1							SEATING ANGLE UPPER LIMIT NG
								1								SNUG TORQUE UPPER LIMIT NG
							1									MONITOR ANGLE UPPER LIMIT NG
						1										SLOPE 1 TORQUE UPPER LIMIT NG
					1											SLOPE 2 TORQUE UPPER LIMIT NG
				1												FINAL SLOPE TORQUE UPPER LIMIT NG
			1													FINAL SLOPE LEVEL UPPER LIMIT NG
		1														STRETCH ANGLE UPPER LIMIT NG
	1															SLOPE 3 TORQUE UPPER LIMIT NG
1																MID POINT TORQUE UPPER LIMIT NG

Table 6.2-2 UPPER NG BIT

END OF CYCLE DATA No. 03 LOWER NG BIT

The contents of LOWER NG BIT are shown in the following table.

LOWER NG BIT																CONTENTS
b 15	b 14	b 13	b 12	b 11	b 10	b 9	b 8	b 7	b 6	b 5	b 4	b 3	b 2	b 1	b 0	
															1	PEAK TORQUE LOWER LIMIT NG
														1		FINAL TORQUE LOWER LIMIT NG
													1			TIGHTENING TIME LOWER LIMIT NG
												1				TIGHTENING ANGLE LOWER LIMIT NG
											1					TIGHTENING CURRENT LOWER LIMIT NG
										1						SEATING TIME LOWER LIMIT NG
									1							SEATING ANGLE LOWER LIMIT NG
								1								SNUG TORQUE LOWER LIMIT NG
							1									MONITOR ANGLE LOWER LIMIT NG
						1										SLOPE 1 TORQUE LOWER LIMIT NG
					1											SLOPE 2 TORQUE LOWER LIMIT NG
				1												FINAL SLOPE TORQUE LOWER LIMIT NG
			1													FINAL SLOPE LEVEL LOWER LIMIT NG
		1														STRETCH ANGLE LOWER LIMIT NG
	1															SLOPE 3 TORQUE LOWER LIMIT NG
1																MID POINT TORQUE LOWER LIMIT NG

Table 6.2-3 LOWER NG BIT

END OF CYCLE DATA No. 04	PROGRAM STEP No
--------------------------	-----------------

This is the final operation step No. of the fastening program.

When the fastening cycle stops due to an error, etc., it is possible to know the step No. that the fastening program last achieved.

END OF CYCLE DATA No. 05	CYCLE TIME
--------------------------	------------

This is the time from the start to the end of a fastening cycle.

END OF CYCLE DATA No. 06	OFFSET TORQUE
--------------------------	---------------

This is the offset value of the torque measured before the start of fastening cycle.

The relation between the tightening torque and the offset torque is shown by the following formula.

Tightening torque = Measured torque - Offset torque

END OF CYCLE DATA No. 07	CYCLE PEAK TORQUE (CW)
--------------------------	------------------------

This is the peak torque of clockwise direction in cycle operation.

END OF CYCLE DATA No. 08	CYCLE PEAK TORQUE (CCW)
--------------------------	-------------------------

This is the peak torque of reverse direction in cycle operation.

END OF CYCLE DATA No. 09	TIGHTENING PEAK TORQUE
--------------------------	------------------------

This is the peak torque in the TIGHTEN step.

END OF CYCLE DATA No. 10	NEGATIVE PEAK TORQUE
--------------------------	----------------------

This is the negative peak torque detected in the SOCKET RELEASE step.

END OF CYCLE DATA No. 11	CYCLE PEAK CURRENT
--------------------------	--------------------

This is the peak current in cycle operation.

END OF CYCLE DATA No. 12	TIGHTENING PEAK CURRENT
--------------------------	-------------------------

This is the peak current in the TIGHTEN step.

END OF CYCLE DATA No. 13	FINAL TORQUE
--------------------------	--------------

This is the final torque at the end of fastening cycle.

END OF CYCLE DATA No. 14	TIGHTENING TIME
--------------------------	-----------------

This is the time from the detection of seating torque to the end of fastening cycle.

END OF CYCLE DATA No. 15	TIGHTENING ANGLE
--------------------------	------------------

This is the peak angle from the detection of seating torque to the end of fastening cycle.

END OF CYCLE DATA No. 16	FINAL CURRENT
--------------------------	---------------

This is the current at the end of fastening cycle.

END OF CYCLE DATA No. 17	SEATING TORQUE
--------------------------	----------------

This is the seating torque detected at the SOFT START or at the HIGH SPEED step.

END OF CYCLE DATA No. 18	SEATING TIME
--------------------------	--------------

This is the time from the start of SOFT START or HIGH SPEED step to the detection of seating torque.

END OF CYCLE DATA No. 19	SEATING ANGLE
--------------------------	---------------

This is the number of revolutions from the start of SOFT START or HIGH SPEED step to the detection of seating torque.

END OF CYCLE DATA No. 20	SNUG TORQUE
--------------------------	-------------

This is the starting torque of monitor time, monitor angle and control angle.

END OF CYCLE DATA No. 21	SNUG TIME
--------------------------	-----------

This is the time from the detection of seating torque to the detection of snug torque in the TIGHTEN step.

END OF CYCLE DATA No. 22	SNUG ANGLE
--------------------------	------------

This is the angle from the seating torque to the snug torque.

END OF CYCLE DATA No. 23	MONITOR ANGLE
--------------------------	---------------

This is the peak angle from the detection of snug torque to the end of fastening cycle.

END OF CYCLE DATA No. 24	MINIMUM VALUE OF SLOPE 1 TORQUE
--------------------------	---------------------------------

This is the minimum torque increase value in the SLOPE MONITOR 1.

The minimum torque rate in the SLOPE MONITOR 1 can be calculated by the following formula.

$$\text{MINIMUM TORQUE RATE} = \frac{\text{MINIMUM VALUE OF SLOPE 1 TORQUE}}{\text{SLOPE MONITOR SAMPLING ANGLE}}$$

END OF CYCLE DATA No. 25	MAXIMUM VALUE OF SLOPE 1 TORQUE
--------------------------	---------------------------------

This is the maximum torque increase value in the SLOPE MONITOR 1.

The maximum torque rate in the SLOPE MONITOR 1 can be calculated by the following formula.

$$\text{MAXIMUM TORQUE RATE} = \frac{\text{MAXIMUM VALUE OF SLOPE 1 TORQUE}}{\text{SLOPE MONITOR SAMPLING ANGLE}}$$

END OF CYCLE DATA No. 26	MINIMUM VALUE OF SLOPE 2 TORQUE
--------------------------	---------------------------------

This is the minimum torque increase value in the SLOPE MONITOR 2.

The minimum torque rate in the SLOPE MONITOR 2 can be calculated by the following formula.

$$\text{MINIMUM TORQUE RATE} = \frac{\text{MINIMUM VALUE OF SLOPE 2 TORQUE}}{\text{SLOPE MONITOR SAMPLING ANGLE}}$$

END OF CYCLE DATA No. 27	MAXIMUM VALUE OF SLOPE 2 TORQUE
--------------------------	---------------------------------

This is the maximum torque increase value in the slope monitor 2.

The maximum torque rate in the slope monitor 2 can be calculated by the following formula.

$$\text{MAXIMUM TORQUE RATE} = \frac{\text{MAXIMUM VALUE OF SLOPE 2 TORQUE}}{\text{SLOPE MONITOR SAMPLING ANGLE}}$$

END OF CYCLE DATA No. 28	FINAL SLOPE TORQUE
--------------------------	--------------------

This is the torque increase value at the end of fastening cycle.

The final torque rate can be calculated by the following formula.

$$\text{FINAL TORQUE RATE} = \frac{\text{FINAL SLOPE TORQUE}}{\text{MONITOR SAMPLING ANGLE}}$$

END OF CYCLE DATA No. 29	YIELD POINT ANGLE
--------------------------	-------------------

This is the angle from the seating torque to the YIELD POINT ANGLE.

This angle is the theoretical tightening angle of the final torque by the torque rate of the elasticity area.

END OF CYCLE DATA No. 30	STRETCH ANGLE
--------------------------	---------------

This angle is a theoretical stretch angle of bolt.

END OF CYCLE DATA No. 31	SLOPE BASE VALUE
--------------------------	------------------

The reference value range calculates SLOPE BASE VALUE.
This is the max value range of a running average of the torque.

END OF CYCLE DATA No. 32	SLOPE BASE VALUE ANGLE
--------------------------	------------------------

This is the tightening angle of the SLOPE BASE VALUE ANGLE.

END OF CYCLE DATA No. 33	SLOPE BASE VALUE TORQUE
--------------------------	-------------------------

This is the tightening torque of the SLOPE BASE VALUE TORQUE.

END OF CYCLE DATA No. 34	MINIMUM VALUE OF SLOPE 3 TORQUE
--------------------------	---------------------------------

This is the minimum torque increase value in the SLOPE MONITOR 3.
The minimum torque rate in the SLOPE MONITOR 3 can be calculated by the following formula.

$$\text{MINIMUM TORQUE RATE} = \frac{\text{MINIMUM VALUE OF SLOPE 3 TORQUE}}{\text{SLOPE MONITOR SAMPLING ANGLE}}$$

END OF CYCLE DATA No. 35	MAXIMUM VALUE OF SLOPE 3 TORQUE
--------------------------	---------------------------------

This is the maximum torque increase value in the SLOPE MONITOR 3.
The maximum torque rate in the SLOPE MONITOR 3 can be calculated by the following formula.

$$\text{MAXIMUM TORQUE RATE} = \frac{\text{MAXIMUM VALUE OF SLOPE 3 TORQUE}}{\text{SLOPE MONITOR SAMPLING ANGLE}}$$

END OF CYCLE DATA No. 36	MID POINT JUDGEMENT TORQUE
--------------------------	----------------------------

This is the tightening torque of the MID POINT.

END OF CYCLE DATA No. 37	MID POINT JUDGEMENT FASTENING ANGLE
--------------------------	-------------------------------------

This is the tightening angle of the MID POINT.

END OF CYCLE DATA No. 38	RUN DOWN ANGLE
--------------------------	----------------

This is the rotation angle from the START TORQUE OF RUN DOWN ANGLE to seating torque.

END OF CYCLE DATA No. 39	RUN DOWN TORQUE MINIMUM JUDGEMENT ANGLE
--------------------------	---

In the case of the Normal mode, RUN DOWN TORQUE MINIMUM JUDGEMENT ANGLE shows the position near seating in the position which was less than the RUN DOWN torque minimum value.

In the case of the Momentary mode, RUN DOWN TORQUE MINIMUM JUDGEMENT ANGLE shows the most distant position from seating in the position having exceeded the RUN DOWN torque minimum value.

This angle shows the rotation angle from the above-mentioned position.

CAUTION

The Momentary mode is functioned from the ROM Ver 2.1 of the driver.

END OF CYCLE DATA No. 40	RUN DOWN TORQUE MAXIMUM JUDGEMENT ANGLE
--------------------------	---

RUN DOWN TORQUE MAXIMUM JUDGEMENT ANGLE shows the most distant position from seating in the position having exceeded the RUN DOWN torque maximum value.

This angle shows the rotation angle from the above-mentioned position to seating.

END OF CYCLE DATA No. 38	TORQUE GAIN CORRECTION
--------------------------	------------------------

This is the gain for the torque correction value.

END OF CYCLE DATA No. 39	TORQUE OFFSET CORRECTION
--------------------------	--------------------------

This is the offset for the torque correction value.

END OF CYCLE DATA No. 40	ANGLE GAIN CORRECTION
--------------------------	-----------------------

This is the gain for the angle correction value.

END OF CYCLE DATA No. 41	ANGLE OFFSET CORRECTION
--------------------------	-------------------------

This is the offset for the angle correction value.

END OF CYCLE DATA No. 42	PROGRAM No., PARAMETER SET No
--------------------------	-------------------------------

These are the program No. and the parameter set No. used when the fastening cycle was run.

Chapter 7 End of cycle status

The End of Cycle status of the NUTRUNNER is described in this chapter.

Chapter 7 End of cycle status	7-1
7.1 About the End of Cycle status	7-2
7.2 NG/TROUBLE messages	7-3
7.2.1 The end of cycle status of the DRIVER	7-4
7.2.2 The end of cycle status of the MULTI CONTROLLER	7-7
7.2.3 NG messages of the DRIVER	7-13
7.2.4 CONTROL TROUBLE messages of the DRIVER	7-17
7.2.5 MACHINE TROUBLE messages of the DRIVER	7-23
7.2.6 Control trouble messages of the MULTI CONTROLLER	7-35
7.2.7 Machine trouble messages of the MULTI CONTROLLER	7-37

7.1 About the End of Cycle status

The End of Cycle status of the NUTRUNNER can be classified as in the following.

STATUS	DESCRIPTION
NUTRUNNER STATUS	The End of Cycle status of all spindles is judged by the MULTI CONTROLLER. The MULTI CONTROLLER indicates the status using selected lamp and sends a message code via I/O interface.
SPINDLE STATUS	The End of Cycle status of each spindle is read by the DRIVER. The DRIVER indicates the status using selected lamp and sends a message code via I/O interface.

Table 7.1-1 NUTRUNNER CYCLE STATUS

NUTRUNNER CYCLE STATUS.

STATUS	DESCRIPTION
OK	The end of cycle status of the NUTRUNNER (excluding paused spindles) is OK (ACCEPT).
NG	Either of the end of cycle status of the NUTRUNNER is NG (REJECT).
TROUBLE	Either of the end of cycle status of the NUTRUNNER or is TROUBLE or an error occurred in the MULTI CONTROLLER.
BYPASS	Either of the end of cycle status is BYPASS.
NO END OF CYCLE STATUS	The fastening cycle was RESET or the NUTRUNNER completed reverse cycle.

Table 7.1-2 NUTRUNNER CYCLE STATUS

SPINDLE CYCLE STATUS.

SPINDLE CYCLE STATUS	DESCRIPTION
OK	The end of cycle status is OK (ACCEPT).
NG	The end of cycle status is NG (REJECT).
TROUBLE	The TROUBLE occurred in fastening or reverse cycle.
BYPASS	The fastening or reverse cycle is bypassed.
NO END OF CYCLE STATUS	The fastening cycle was RESET or the NUTRUNNER completed reverse cycle.

Table 7.1-3 SPINDLE CYCLE STATUS

7.2 NG/TROUBLE messages

The contents of the end of cycle status are shown by the message codes. The message codes can be classified as in the following.

MESSAGE	DESCRIPTION
NG MESSAGE	The contents of NG are shown when the end of fastening cycle status is NG.
CONTROL TROUBLE MESSAGE	The contents of errors are shown when the TROUBLE occurs during the fastening cycle. Mainly the troubles as to the setting are shown.
MACHINE TROUBLE MESSAGE	The contents of errors are shown when the TROUBLE occurs in the NUTRUNNER. The errors are caused by the reasons other than the setting.

Table 7.2-1 NG/TROUBLE messages

NOTE

The message codes other than "NG" or "TROUBLE" are classified as "00 h".

7.2.1 The end of cycle status of the DRIVER

The message codes of the DRIVER are shown in the following.

STATUS	MESSAGE CODE (HEX)	CONTENTS
NG	01	PEAK TORQUE LOWER LIMIT NG
	02	FINAL TORQUE LOWER LIMIT NG
	03	TIGHTENING TIME LOWER LIMIT NG
	04	TIGHTENING ANGLE LOWER LIMIT NG
	05	TIGHTENING CURRENT LOWER LIMIT NG
	06	SEATING TIME LOWER LIMIT NG
	07	SEATING ANGLE LOWER LIMIT NG
	08	SNUG TORQUE LOWER LIMIT NG
	09	MONITOR ANGLE LOWER LIMIT NG
	0A	SLOPE 1 TORQUE LOWER LIMIT NG
	0B	SLOPE 2 TORQUE LOWER LIMIT NG
	0C	FINAL SLOPE TORQUE LOWER LIMIT NG
	0D	FINAL SLOPE LEVEL LOWER LIMIT NG
	0E	STRETCH ANGLE LOWER LIMIT NG
	0F	SLOPE 3 TORQUE LOWER LIMIT NG
	10	MID POINT TORQUE LOWER LIMIT NG
	21	PEAK TORQUE UPPER LIMIT NG
	22	FINAL TORQUE UPPER LIMIT NG
	23	TIGHTENING TIME UPPER LIMIT NG
	24	TIGHTENING ANGLE UPPER LIMIT NG
	25	TIGHTENING CURRENT UPPER LIMIT NG
	26	SEATING TIME UPPER LIMIT NG
	27	SEATING ANGLE UPPER LIMIT NG
	28	SNUG TORQUE UPPER LIMIT NG
	29	MONITOR ANGLE UPPER LIMIT NG
	2A	SLOPE 1 TORQUE UPPER LIMIT NG
	2B	SLOPE 2 TORQUE UPPER LIMIT NG
	2C	FINAL SLOPE TORQUE UPPER LIMIT NG
	2D	FINAL SLOPE LEVEL UPPER LIMIT NG
	2E	STRETCH ANGLE UPPER LIMIT NG
	2F	SLOPE 3 TORQUE UPPER LIMIT NG
	30	MID POINT TORQUE UPPER LIMIT NG

Table 7.2-2 NG message codes of the DRIVER (1/3)

STATUS	MESSAGE CODE (HEX)	CONTENTS
CONTROL TROUBLE	41	SEATING TIME MINIMUM TROUBLE
	42	SEATING ANGLE MINIMUM TROUBLE
	44	SNUG TIME MINIMUM TROUBLE
	45	SNUG ANGLE MINIMUM TROUBLE
	4B	SLOPE 1 TORQUE MINIMUM TROUBLE
	4C	SLOPE 2 TORQUE MINIMUM TROUBLE
	4F	SLOPE 3 TORQUE MINIMUM TROUBLE
	50	SLOPE CALCULATION ERROR (0)
	51	SLOPE CALCULATION ERROR (Over flow)
	52	TORQUE TENSION CALCULATION ERROR
	53	TORQUE TENSION ANGLE ERROR
	54	MID. POINT TORQUE MINIMUM TROUBLE
	55	RUN DOWN ANGLE MINIMUM TROUBLE
	56	RUN DOWN TORQUE MINIMUM TROUBLE
	61	SEATING TIME MAXIMUM TROUBLE
	62	SEATING ANGLE MAXIMUM TROUBLE
	63	SNUG TORQUE MAXIMUM TROUBLE
	64	SNUG TIME MAXIMUM TROUBLE
	65	SNUG ANGLE MAXIMUM TROUBLE
	66	TORQUE MAXIMUM TROUBLE
	67	TIGHTENING TIME MAXIMUM TROUBLE
	68	TIGHTENING ANGLE MAXIMUM TROUBLE
	69	CURRENT MAXIMUM TROUBLE
	6A	TIGHTENING CURRENT MAXIMUM TROUBLE
	6B	SLOPE 1 TORQUE MAXIMUM TROUBLE
	6C	SLOPE 2 TORQUE MAXIMUM TROUBLE
	6D	CYCLE TIME MAXIMUM TROUBLE
	6E	NEGATIVE TORQUE MAXIMUM TROUBLE
	6F	SLOPE 3 TORQUE MAXIMUM TROUBLE
	74	MID. POINT TORQUE MAXIMUM TROUBLE
	75	RUN DOWN ANGLE MAXIMUM TROUBLE
	76	RUN DOWN TORQUE MAXIMUM TROUBLE
	7F	EMERGENCY STOP

Table 7.2-3 TROUBLE message codes of the DRIVER (2/3)

STATUS	MESSAGE CODE (HEX)	CONTENTS
MACHINE TROUBLE	81	IPM TROUBLE
	82	PHASE DETECT FAULT
	83	ENCODER LOGIC ERROR
	84	ENCODER DIFFERENTIAL ERROR
	85	OVER LOAD TROUBLE
	86	OVER CURRENT TROUBLE
	87	OVER SPEED ERROR
	88	LOW VOLTAGE TROUBLE
	89	OVER VOLTAGE TROUBLE
	8A	HEAT SINK OVERHEAT
	8B	MOTOR RUNAWAY TROUBLE
	8C	MOTOR DRIVE TROUBLE
	91	RAM TROUBLE
	92	EEPROM TROUBLE
	93	CURRENT A/D TROUBLE
	94	TORQUE A/D TROUBLE
	95	T/T OFFSET TROUBLE
	96	T/T CALIBRATION ERROR
	A1	T/T TYPE ERROR
	A2	MOTOR TYPE ERROR
	A3	PROGRAM END ERROR
	A4	PROGRAM CODE ERROR
	A5	PROGRAM JUMP ERROR
	A6	PARAMETER SELECTION ERROR
	AD	SUM CHECK ERROR
	AE	CPU ALARM
	B1	FORMAT ERROR
	B2	DOUBLE ID ERROR
	B3	IC ERROR
	B4	COMMUNICATION RECEPTION ERROR
	B5	COMMUNICATION TROUBLE
	B6	RECONFIGURATION ERROR

Table 7.2-4 TROUBLE message codes of the DRIVER (3/3)

7.2.2 The end of cycle status of the MULTI CONTROLLER

The message codes of the MULTI CONTROLLER are shown in the following.

CONTROL TROUBLE message codes for the MULTI CONTROLLER

STATUS	MESSAGE CODE (HEX)	CONTENTS
CONTROL TROUBLE	81	CYCLE TIME MAXIMUM TROUBLE
	82	MULTIPLE AXIS CONTROL ERROR
	83	PROGRAM SELECTION ERROR
	84	PARAMETER SELECTION ERROR
	A1	SPINDLE ASSIGNMENT ERROR
	BF	MC EMERGENCY STOP

Table 7.2-5 Message codes for the MULTI CONTROLLER (1/5)

MACHINE TROUBLE message codes for the MULTI CONTROLLER

Judgement contents of OPTION BOARD (DeviceNet, PROFIBUS, CC-Link Board)

STATUS	MESSAGE CODE (HEX)	CONTENTS
MACHINE TROUBLE	C1	OPT START UP ERROR
	C2	OPT NO RESPONSE
	C3	OPT UNKNOWN FIELD BUS TYPE
	C4	OPT MISMATCH FIELD BUS TYPE
	C5	OPT TROUBLE
	C6	Reserved
	C7	Reserved
	C8	Reserved
	C9	Reserved
	CA	Reserved
	CB	Reserved
	CE	Reserved
	CF	Reserved
	D1	Reserved
	D2	Reserved
	D3	Reserved
	D4	Reserved
	D5	Reserved
	D6	Reserved
	D7	Reserved
	D8	Reserved
	D9	Reserved
	DA	Reserved
	DB	Reserved
	DC	Reserved
	DD	Reserved
	DE	Reserved
	DF	Reserved

Table 7.2-6 Message codes for the MULTI CONTROLLER (2/5)

CAUTION

Contents OF MACHINE TROUBLE message codes C1~DF vary depending on the OPTION BOARD.

MACHINE TROUBLE message codes for the MULTI CONTROLLER

Judgement contents of OPTION BOARD (DeviceNet UCS Board)

STATUS	MESSAGE CODE (HEX)	CONTENTS
MACHINE TROUBLE	C1	UCS HARDWARE TROUBLE
	C2	UCS CONFIGURATION MODE ERROR
	C3	UCS START UP ERROR
	C4	UCS ASSERT ERROR
	C5	UCS ABORT ERROR
	C6	UCS KERNEL ERROR
	C7	UCS W/DOG TIME OUT
	C8	UCS W/DOG ERROR
	C9	UCS STATUS ERROR
	CA	UCS NO CONNECTION
	CB	UCS NO OPERATION
	CE	UCS BUS ERROR
	CF	UCS INTERRUPT ERROR
	D1	UCS BUSY TIME OUT
	D2	UCS BUS SIGNAL ERROR
	D3	UCS ID BLOCK NONCONFORMITY
	D4	UCS CONTROL/STATUS BLOCK NONCONFORMITY
	D5	OPEN INTERFACE TIME OUT
	D6	HEART BEAT TIME OUT
	D7	UCS HEART BEAT TIME OUT
	D8	TRIGGER OUTPUT POINTER INVALID
	D9	TRIGGER INPUT POINTER INVALID
	DA	TRIGGER FULL
	DB	EVENT OUT POINTER INVALID
	DC	EVENT IN POINTER INVALID
	DD	TRIGGER ERROR
	DE	INVALID MESSAGE RECEIVED
	DF	INCORRECT MESSAGE RECEIVED

Table 7.2-7 Message codes for the MULTI CONTROLLER (3/5)

CAUTION

Contents OF MACHINE TROUBLE message codes C1~DF vary depending on the OPTION BOARD.

Judgement contents of LINK function (PLC LINK UNIT)

JUDGEMENT	MESSAGE CODE (HEX)	CONTENTS
MACHINE TROUBLE	C1	PLC LINK UNIT RECEIVE ERROR
	C2	PLC LINK UNIT NAK ERROR
	C3	PLC LINK UNIT COMMUNICATION ERROR
	C4	OMRON RUNNING MODE
	C5	OMRON FCS ERROR
	C6	OMRON FORMAT ERROR
	C7	OMRON DATA ERROR
	C8	OMRON FRAME LENGTH MAXIMUM ERROR
	C9	OMRON CPU ERROR
	CA	OMRON ABORT ERROR
	CB	OMRON OTHER ERROR
	CE	
	CF	
	D1	
	D2	
	D3	
	D4	
	D5	
	D6	
	D7	
	D8	
	D9	
	DA	
	DB	
	DC	
	DD	
	DE	
	DF	

Table 7.2-8 Message codes for the MULTI CONTROLLER (4/5)

MACHINE TROUBLE message codes for the MULTI CONTROLLER

JUDGEMENT	MESSAGE CODE (HEX)	CONTENTS
MACHINE TROUBLE	E1	RAM TROUBLE
	E2	EEPROM TROUBLE
	E6	INTERDRIVER COMMUNICATION ERROR
	E7	RECEIVED CODE NONCONFORMITY ERROR
	E8	TOKEN ERROR
	E9	FORMAT ERROR
	EA	RECONFIGURATION ERROR
	EB	DOUBLE ID ERROR
	EC	IC ERROR
	ED	COMMUNICATION RECEPTION ERROR
	EE	COMMUNICATION TROUBLE
	EF	RECEPTION TROUBLE
	F1	RS232C PORT ERROR
	F2	RS232C PORT TRANSMISSION ERROR
	F3	UIT/PR PORT ERROR
	F4	UIT/PR PORT TRANSMISSION ERROR
	F8	T/T TYPE ERROR
	F9	MOTOR TYPE ERROR
	FA	ID ERROR
	FB	DRIVER SUM CHECK ERROR
	FC	DRIVER ERROR
	FD	SUM CHECK ERROR
	FE	CPU ALARM
	FF	WDT ALARM

Table 7.2-9 Message codes for the MULTI CONTROLLER (5/5)

The message codes of cycle status are described in the following pages.

The index symbols are as in the following.

Message code

NG/TROUBLE message

CODE	MESSAGE AND DRIVER LAMP DISPLAY	DESCRIPTION
96	CALIBRATION ERROR	A CALIBRATION ERROR occurs, when the calibration value is not within $\pm 2\%$ of the rated value as the result of calibration check of torque transducer (T/T) of the SPINDLE ASSEMBLY.
	NG C-TR M-TR INFO ● ○ ○ 16 8 4 2 1 ○	

● indicates "lit". ○ indicates "turn off". ⊗ indicates "blink".

DRIVER lamp display

7.2.3 NG messages of the DRIVER

CODE	MESSAGE AND DRIVER LAMP DISPLAY	DESCRIPTION
01	PEAK TORQUE LOWER LIMIT NG	A PEAK TORQUE LOWER LIMIT NG occurs, when the tightening PEAK TORQUE is less than the TORQUE LOWER LIMIT.
	NG C-TR M-TR INFO ● ○ ○ 16○ 8○ 4○ 2○ 1●	
02	FINAL TORQUE LOWER LIMIT NG	A FINAL TORQUE LOWER LIMIT NG occurs, when the FINAL TORQUE at the end of fastening cycle is less than the TORQUE LOWER LIMIT.
	NG C-TR M-TR INFO ● ○ ○ 16○ 8○ 4○ 2● 1○	
03	TIGHTENING TIME LOWER LIMIT NG	A TIGHTENING TIME LOWER LIMIT NG occurs, when the time from the detection of SEATING TORQUE of tightening step to the end of fastening cycle is shorter than the TIGHTENING TIME LOWER LIMIT.
	NG C-TR M-TR INFO ● ○ ○ 16○ 8○ 4○ 2● 1●	
04	TIGHTENING ANGLE LOWER LIMIT NG	A TIGHTENING ANGLE LOWER LIMIT NG occurs, when the angle from the detection of SEATING TORQUE of tightening step to the end of fastening cycle is smaller than the TIGHTENING ANGLE LOWER LIMIT.
	NG C-TR M-TR INFO ● ○ ○ 16○ 8○ 4● 2○ 1○	
05	TIGHTENING CURRENT LOWER LIMIT NG	A TIGHTENING CURRENT LOWER LIMIT NG occurs, when the final current is less than the TIGHTENING CURRENT LOWER LIMIT.
	NG C-TR M-TR INFO ● ○ ○ 16○ 8○ 4● 2○ 1●	
06	SEATING TIME LOWER LIMIT NG	A SEATING TIME LOWER LIMIT NG occurs, when the SEATING TIME from the SOFT START or HIGH SPEED command to the detection of SEATING TORQUE is lower than the SEATING TIME LOWER LIMIT
	NG C-TR M-TR INFO ● ○ ○ 16○ 8○ 4● 2● 1○	
07	SEATING ANGLE LOWER LIMIT NG	A SEATING ANGLE LOWER LIMIT NG occurs, when the SEATING ANGLE from the SOFT START or HIGH SPEED command to the detection of SEATING TORQUE is lower than the SEATING ANGLE LOWER LIMIT.
	NG C-TR M-TR INFO ● ○ ○ 16○ 8○ 4● 2● 1●	
08	SNUG TORQUE LOWER LIMIT NG	A SNUG TORQUE LOWER LIMIT NG occurs, when the tightening step to the SNUG TORQUE is smaller than the SNUG TORQUE LOWER LIMIT.
	NG C-TR M-TR INFO ● ○ ○ 16○ 8● 4○ 2○ 1○	

CODE	MESSAGE AND DRIVER LAMP DISPLAY	DESCRIPTION
09	MONITOR ANGLE LOWER LIMIT NG	A MONITOR ANGLE LOWER LIMIT NG occurs, when the MONITOR ANGLE from the detection of SNUG TORQUE to the end of fastening cycle is smaller than the MONITOR ANGLE LOWER LIMIT.
	NG C-TR M-TR INFO ● ○ ○ 16○ 8● 4○ 2○ 1●	
0A	SLOPE 1 TORQUE LOWER LIMIT NG	A SLOPE 1 TORQUE LOWER LIMIT NG occurs, when the torque rate from the SLOPE MONITOR 1 START TORQUE to the SLOPE MONITOR 2 started or the end of fastening cycle is less than the SLOPE 1 TORQUE LOWER LIMIT.
	NG C-TR M-TR INFO ● ○ ○ 16○ 8● 4○ 2● 1○	
0B	SLOPE 2 TORQUE LOWER LIMIT NG	A SLOPE 2 TORQUE LOWER LIMIT NG occurs, when the torque rate from the SLOPE MONITOR 3 is started after that to start SLOPE MONITOR 2 or the end of fastening cycle is less than the SLOPE 2 TORQUE LOWER LIMIT.
	NG C-TR M-TR INFO ● ○ ○ 16○ 8● 4○ 2● 1●	
0C	FINAL SLOPE TORQUE LOWER LIMIT NG	A FINAL SLOPE TORQUE LOWER LIMIT NG occurs, when the torque rate from the point before the end of fastening cycle by a slope monitor sample angle to the end of fastening cycle is less than the FINAL SLOPE TORQUE LOWER LIMIT.
	NG C-TR M-TR INFO ● ○ ○ 16○ 8● 4● 2○ 1○	
0D	FINAL SLOPE LEVEL LOWER LIMIT NG	A FINAL SLOPE LEVEL LOWER LIMIT NG occurs, when the slope at the end of fastening cycle and ratio of the standard value is shown in the per cent is less than the FINAL SLOPE LEVEL LOWER LIMIT.
	NG C-TR M-TR INFO ● ○ ○ 16○ 8● 4● 2○ 1●	
0E	STRETCH ANGLE LOWER LIMIT NG	A STRETCH ANGLE LOWER LIMIT NG occurs, when the quantity of the bolt which grew is calculated quantitatively by SLOPE MONITOR and STRETCH ANGLE is smaller than STRETCH ANGLE LOWER LIMIT.
	NG C-TR M-TR INFO ● ○ ○ 16○ 8● 4● 2● 1○	
0F	SLOPE 3 TORQUE LOWER LIMIT NG	A SLOPE 3 TORQUE LOWER LIMIT NG occurs, when the torque rate from the SLOPE MONITOR 3 started to the end of fastening cycle is less than the SLOPE 3 TORQUE LOWER LIMIT.
	NG C-TR M-TR INFO ● ○ ○ 16○ 8● 4● 2● 1●	
10	MID POINT TORQUE LOWER LIMIT NG	MID POINT TORQUE LOWER LIMIT NG occurs,when the torque of the point which fastened MID POINT JUDGEMENT ANGLE from MID POINT JUDGEMENT TORQUE is smaller than MID POINT TORQUE LOWER LIMIT.
	NG C-TR M-TR INFO ● ○ ○ 16● 8○ 4○ 2○ 1○	

CODE	MESSAGE AND DRIVER LAMP DISPLAY	DESCRIPTION
21	PEAK TORQUE UPPER LIMIT NG	A PEAK TORQUE UPPER LIMIT NG occurs, when the tightening PEAK TORQUE is higher than the TORQUE UPPER LIMIT.
	NG C-TR M-TR INFO ● ○ ○ 16○ 8○ 4○ 2○ 1⊗	
22	FINAL TORQUE UPPER LIMIT NG	A FINAL TORQUE UPPER LIMIT NG occurs, when the FINAL TORQUE at the end of fastening cycle is higher than the TORQUE UPPER LIMIT.
	NG C-TR M-TR INFO ● ○ ○ 16○ 8○ 4○ 2⊗ 1○	
23	TIGHTENING TIME UPPER LIMIT NG	A TIGHTENING TIME UPPER LIMIT NG occurs, when The TIGHTENING TIME from the detection of SEATING TORQUE of fastening step to the end of fastening cycle is higher than the TIGHTENING TIME UPPER LIMIT.
	NG C-TR M-TR INFO ● ○ ○ 16○ 8○ 4○ 2⊗ 1⊗	
24	TIGHTENING ANGLE UPPER LIMIT NG	A TIGHTENING ANGLE UPPER LIMIT NG occurs, when the TIGHTENING ANGLE from the detection of SEATING TORQUE of fastening step to the end of fastening cycle is higher than the TIGHTENING ANGLE UPPER LIMIT
	NG C-TR M-TR INFO ● ○ ○ 16○ 8○ 4⊗ 2○ 1○	
25	TIGHTENING CURRENT UPPER LIMIT NG	A TIGHTENING CURRENT UPPER LIMIT NG occurs, when the FINAL CURRENT is higher than the TIGHTENING CURRENT LOWER LIMIT.
	NG C-TR M-TR INFO ● ○ ○ 16○ 8○ 4⊗ 2○ 1⊗	
26	SEATING TIME UPPER LIMIT NG	A SEATING TIME UPPER LIMIT NG occurs, when the SEATING TIME from the SOFT START or HIGH SPEED command to the detection of SEATING TORQUE is higher than the SEATING TIME UPPER LIMIT.
	NG C-TR M-TR INFO ● ○ ○ 16○ 8○ 4⊗ 2⊗ 1○	
27	SEATING ANGLE UPPER LIMIT NG	A SEATING ANGLE UPPER LIMIT NG occurs, when the SEATING ANGLE from the SOFT START or HIGH SPEED command to the detection of SEATING TORQUE is higher than the SEATING ANGLE UPPER LIMIT.
	NG C-TR M-TR INFO ● ○ ○ 16○ 8○ 4⊗ 2⊗ 1⊗	
28	SNUG TORQUE UPPER LIMIT NG	A SNUG TORQUE UPPER LIMIT NG occurs, when the tightening step to the SNUG TORQUE is larger than the SNUG TORQUE UPPER LIMIT.
	NG C-TR M-TR INFO ● ○ ○ 16○ 8⊗ 4○ 2○ 1○	

CODE	MESSAGE AND DRIVER LAMP DISPLAY	DESCRIPTION
29	MONITOR ANGLE UPPER LIMIT NG	A MONITOR ANGLE UPPER LIMIT NG occurs, when the MONITOR ANGLE from the detection of SNUG TORQUE to the end of fastening cycle is higher than the MONITOR ANGLE UPPER LIMIT.
	NG C-TR M-TR INFO ● ○ ○ 16○ 8 4○ 2○ 1○	
2A	SLOPE 1 TORQUE UPPER LIMIT NG	A SLOPE 1 TORQUE UPPER LIMIT NG occurs, when the torque rate from the SLOPE MONITOR 1 START TORQUE to the SLOPE MONITOR 2 started or the end of fastening cycle is higher than the SLOPE 1 TORQUE UPPER LIMIT.
	NG C-TR M-TR INFO ● ○ ○ 16○ 8 4○ 2 1○	
2B	SLOPE 2 TORQUE UPPER LIMIT NG	A SLOPE 2 TORQUE UPPER LIMIT NG occurs, when the torque rate from the SLOPE MONITOR 3 is started after that to start SLOPE MONITOR 2 or the end of fastening cycle is higher than the SLOPE 2 TORQUE UPPER LIMIT.
	NG C-TR M-TR INFO ● ○ ○ 16○ 8 4○ 2 1○	
2C	FINAL SLOPE TORQUE UPPER LIMIT NG	A FINAL SLOPE TORQUE UPPER LIMIT NG occurs, when the torque rate from the point before the end of fastening cycle by a slope monitor sample angle to the end of fastening cycle is larger than the FINAL SLOPE TORQUE UPPER LIMIT.
	NG C-TR M-TR INFO ● ○ ○ 16○ 8 4 2○ 1○	
2D	FINAL SLOPE LEVEL UPPER LIMIT NG	A FINAL SLOPE LEVEL UPPER LIMIT NG occurs, when the slope at the end of fastening cycle and ratio of the standard value is shown in the per cent is higher than the FINAL SLOPE LEVEL UPPER LIMIT.
	NG C-TR M-TR INFO ● ○ ○ 16○ 8 4 2○ 1○	
2E	STRETCH ANGLE UPPER LIMIT NG	A STRETCH ANGLE UPPER LIMIT NG occurs, when the quantity of the bolt which grew is calculated quantitatively by SLOPE MONITOR and STRETCH ANGLE is higher than STRETCH ANGLE UPPER LIMIT.
	NG C-TR M-TR INFO ● ○ ○ 16○ 8 4 2 1○	
2F	SLOPE 3 TORQUE UPPER LIMIT NG	A SLOPE 3 TORQUE UPPER LIMIT NG occurs, when the torque rate from the SLOPE MONITOR 3 started to the end of fastening cycle is higher than the SLOPE 3 TORQUE UPPER LIMIT.
	NG C-TR M-TR INFO ● ○ ○ 16○ 8 4 2 1○	
30	MID POINT TORQUE UPPER LIMIT NG	MID POINT TORQUE UPPER LIMIT NG occurs,when the torque of the point which fastened MID POINT JUDGEMENT ANGLE from MID POINT JUDGEMENT TORQUE is larger than MID POINT TORQUE UPPER LIMIT.
	NG C-TR M-TR INFO ● ○ ○ 16 8○ 4○ 2○ 1○	

7.2.4 CONTROL TROUBLE messages of the DRIVER

CODE	MESSAGE AND DRIVER LAMP DISPLAY	DESCRIPTION
41	SEATING TIME MINIMUM TROUBLE	A SEATING TIME MINIMUM TROUBLE occurs, when the SEATING TIME from the SOFT START or HIGH SPEED command to the detection of SEATING TORQUE is lower than the SEATING TIME MINIMUM.
	NG C-TR M-TR INFO ● ● ○ 16○ 8○ 4○ 2○ 1●	
42	SEATING ANGLE MINIMUM TROUBLE	A SEATING ANGLE MINIMUM TROUBLE occurs, when the SEATING ANGLE from the SOFT START or HIGH SPEED command to the detection of SEATING TORQUE is lower than the SEATING ANGLE MINIMUM.
	NG C-TR M-TR INFO ● ● ○ 16○ 8○ 4○ 2● 1○	
44	SNUG TIME MINIMUM TROUBLE	A SNUG TIME MINIMUM TROUBLE occurs, when the SNUG TIME from the detection of SEATING TORQUE of fastening step to the detection of SNUG TORQUE is lower than the SNUG TIME MINIMUM.
	NG C-TR M-TR INFO ● ● ○ 16○ 8○ 4● 2○ 1○	
45	SNUG ANGLE MINIMUM TROUBLE	A SNUG ANGLE MINIMUM TROUBLE occurs, when the SNUG ANGLE from the detection of SEATING TORQUE of fastening step to that of SNUG TORQUE is lower than the SNUG ANGLE MINIMUM.
	NG C-TR M-TR INFO ● ● ○ 16○ 8○ 4● 2○ 1●	
4B	SLOPE 1 TORQUE MINIMUM TROUBLE	A SLOPE 1 TORQUE MINIMUM TROUBLE occurs, when the torque rate from the SLOPE MONITOR 1 START TORQUE to the SLOPE MONITOR 2 started or the end of fastening cycle is less than the SLOPE 1 TORQUE MINIMUM.
	NG C-TR M-TR INFO ● ● ○ 16○ 8● 4○ 2● 1●	
4C	SLOPE 2 TORQUE MINIMUM TROUBLE	A SLOPE 2 TORQUE MINIMUM TROUBLE occurs, when the torque rate from the SLOPE MONITOR 3 is started after that to start SLOPE MONITOR 2 or the end of fastening cycle is less than the SLOPE 2 TORQUE MINIMUM.
	NG C-TR M-TR INFO ● ● ○ 16○ 8● 4● 2○ 1○	
4F	SLOPE 3 TORQUE MINIMUM TROUBLE	A SLOPE 3 TORQUE MINIMUM TROUBLE occurs, when the torque rate from the SLOPE MONITOR 3 started to the end of fastening cycle is less than the SLOPE 3 TORQUE MINIMUM.
	NG C-TR M-TR INFO ● ● ○ 16○ 8● 4● 2● 1●	

CODE	MESSAGE AND DRIVER LAMP DISPLAY	DESCRIPTION
50	SLOPE CALCULATION TROUBLE (0 divide)	The error which occurs when the calculation of SLOPE is calculated. It occurs when a denominator is 0 divide.
	NG C-TR M-TR INFO ● ● ○ 16● 8○ 4○ 2○ 1○	
51	SLOPE CALCULATION TROUBLE (Over flow)	The error which occurs when the calculation of SLOPE does over flow.
	NG C-TR M-TR INFO ● ● ○ 16● 8○ 4○ 2○ 1●	
52	TORQUE TENSION CALCULATION TROUBLE	The calculation error of the theoretical seating point.
	NG C-TR M-TR INFO ● ● ○ 16● 8○ 4○ 2● 1○	
FACTORS 1) The TORQUE TENSION MEASURING ANGLE is too small. 2) The SNUG TORQUE is too small. MEASURES 1) Change the TENSION MEASURING ANGLE to big value. 2) Change the SNUG TORQUE to big value.		
53	TORQUE TENSION ANGLE ERROR	A TORQUE TENSION ANGLE ERROR occurs, when the angle from the theoretical seating point to the TORQUE TENSION REFERENCE TORQUE in the TORQUE TENSION method is higher than the CONTROL ANGLE.
	NG C-TR M-TR INFO ● ● ○ 16● 8○ 4○ 2● 1●	
FACTORS 1) The TORQUE TENSION MEASURING ANGLE is too big. 2) The SNUG TORQUE is too big. MEASURES 1) Change the TENSION MEASURING ANGLE to big value. 2) Change the SNUG TORQUE to big value.		
54	MID. POINT TORQUE MINIMUM TROUBLE	MID. POINT TORQUE MINIMUM TROUBLE occurs, when the torque of the point which fastened MID POINT JUDGEMENT ANGLE from MID POINT JUDGEMENT TORQUE is smaller than MID POINT TORQUE MINIMUM.
	NG C-TR M-TR INFO ● ● ○ 16● 8○ 4● 2○ 1○	

CODE	MESSAGE AND DRIVER LAMP DISPLAY	DESCRIPTION
55	RUN DOWN ANGLE MINIMUM TROUBLE	RUN DOWN ANGLE MINIMUM TROUBLE occurs, when the RUN DOWN ANGLE from the START TORQUE OF RUN DOWN ANGLE to the detection of SEATING TORQUE is lower than the RUN DOWN ANGLE MINIMUM.
	NG C-TR M-TR INFO ● ● ○ 16● 8○ 4● 2○ 1●	
56	RUN DOWN TORQUE MINIMUM TROUBLE	In the case of the Normal mode, when the RUN DOWN TORQUE from the START ANGLE OF RUN DOWN TORQUE MINIMUM JUDGEMENT to the detection of SEATING TORQUE is lower than the RUN DOWN TORQUE MINIMUM, RUN DOWN TORQUE MINIMUM TROUBLE occurs. In the case of the Momentary mode, when the RUN DOWN TORQUE from the fastening start to the END ANGLE OF RUN DOWN TORQUE MAXIMUM JUDGEMENT is always lower than the RUN DOWN TORQUE MINIMUM, RUN DOWN TORQUE MINIMUM TROUBLE occurs.
	NG C-TR M-TR INFO ● ● ○ 16● 8○ 4● 2● 1○	

CAUTION

The Momentary mode is functioned from the ROM Ver 2.1 of the driver.

CODE	MESSAGE AND DRIVER LAMP DISPLAY	DESCRIPTION
61	SEATING TIME MAXIMUM TROUBLE	A SEATING TIME MAXIMUM TROUBLE occurs, when the SEATING TIME from the start of fastening cycle to the detection of SEATING TORQUE is higher than the SEATING TIME MAXIMUM.
	NG C-TR M-TR INFO ● ● ○ 16○ 8○ 4○ 2○ 1⊗	
62	SEATING ANGLE MAXIMUM TROUBLE	A SEATING ANGLE MAXIMUM TROUBLE occurs, when the SEATING ANGLE from the SOFT START or HIGH SPEED command to the detection of SEATING TORQUE is higher than the SEATING ANGLE MAXIMUM.
	NG C-TR M-TR INFO ● ● ○ 16○ 8○ 4○ 2⊗ 1○	
63	SNUG TORQUE MAXIMUM TROUBLE	A SNUG TORQUE MAXIMUM TROUBLE occurs, when the SNUG TORQUE is higher than the SNUG TORQUE MAXIMUM.
	NG C-TR M-TR INFO ● ● ○ 16○ 8○ 4○ 2⊗ 1⊗	
64	SNUG TIME MAXIMUM TROUBLE	A SNUG TIME MAXIMUM occurs, when the SNUG TIME from the detection of SEATING TORQUE of fastening step to that of SNUG TORQUE is higher than the SNUG TIME MAXIMUM.
	NG C-TR M-TR INFO ● ● ○ 16○ 8○ 4⊗ 2○ 1○	
65	SNUG ANGLE MAXIMUM TROUBLE	A SNUG ANGLE MAXIMUM TROUBLE occurs, when the SNUG ANGLE from the detection of SEATING TORQUE of fastening step to that of SNUG TORQUE is higher than the SNUG ANGLE MAXIMUM.
	NG C-TR M-TR INFO ● ● ○ 16○ 8○ 4⊗ 2○ 1⊗	
66	TORQUE MAXIMUM TROUBLE	A TORQUE MAXIMUM TROUBLE occurs, when the torque is higher than the TORQUE MAXIMUM.
	NG C-TR M-TR INFO ● ● ○ 16○ 8○ 4⊗ 2⊗ 1○	
67	TIGHTENING TIME MAXIMUM TROUBLE	A TIGHTENING TIME MAXIMUM TROUBLE occurs, when the TIGHTENING TIME from the detection of SEATING TORQUE of fastening step to the end of fastening cycle is higher than the TIGHTENING TIME MAXIMUM.
	NG C-TR M-TR INFO ● ● ○ 16○ 8○ 4⊗ 2⊗ 1⊗	

NOTE

A TORQUE MAXIMUM TROUBLE occurs, also when the negative torque is higher than TORQUE MAXIMUM or 110% of rated torque.
 A TORQUE MAXIMUM TROUBLE occurs in the reverse cycle, only when the torque is higher than 110% of rated torque.

CODE	MESSAGE AND DRIVER LAMP DISPLAY	DESCRIPTION
68	TIGHTENING ANGLE MAXIMUM TROUBLE	A TIGHTENING ANGLE MAXIMUM TROUBLE occurs, when the TIGHTENING ANGLE from the detection of SEATING TORQUE of fastening step to the end of fastening cycle is higher than the TIGHTENING ANGLE MAXIMUM.
	NG C-TR M-TR INFO ● ● ○ 16○ 8⊗ 4○ 2○ 1○	
69	CURRENT MAXIMUM TROUBLE	A CURRENT MAXIMUM TROUBLE occurs, when the TIGHTENING PEAK CURRENT is higher than the CURRENT MAXIMUM.
	NG C-TR M-TR INFO ● ● ○ 16○ 8⊗ 4○ 2○ 1⊗	
6A	TIGHTENING CURRENT MAXIMUM TROUBLE	TIGHTENING CURRENT MAXIMUM TROUBLE occurs, when the final current to complete tightening is higher than the CURRENT MAXIMUM.
	NG C-TR M-TR INFO ● ● ○ 16○ 8⊗ 4○ 2⊗ 1○	
6B	SLOPE 1 TORQUE MAXIMUM TROUBLE	A SLOPE 1 TORQUE MAXIMUM TROUBLE occurs, when the torque rate from the SLOPE MONITOR 1 START TORQUE to the SLOPE MONITOR 2 started or the end of fastening cycle is I higher than the SLOPE 1 TORQUE MAXIMUM.
	NG C-TR M-TR INFO ● ● ○ 16○ 8⊗ 4○ 2⊗ 1⊗	
6C	SLOPE 2 TORQUE MAXIMUM TROUBLE	A SLOPE 2 TORQUE MAXIMUM TROUBLE occurs, when the torque rate from the SLOPE MONITOR 3 is started after that to start SLOPE MONITOR 2 or the end of fastening cycle is higher than the SLOPE 2 TORQUE MAXIMUM.
	NG C-TR M-TR INFO ● ● ○ 16○ 8⊗ 4⊗ 2○ 1○	
6D	CYCLE TIME MAXIMUM TROUBLE	A CYCLE TIME MAXIMUM TROUBLE occurs, when the CYCLE TIME from the start to the end of fastening cycle is higher than the CYCLE TIME MAXIMUM.
	NG C-TR M-TR INFO ● ● ○ 16○ 8⊗ 4⊗ 2○ 1⊗	
6E	NEGATIVE TORQUE MAXIMUM TROUBLE	A NEGATIVE TORQUE MAXIMUM TROUBLE occurs, when the negative torque is higher than 1/2 of TIGHTENING PEAK TORQUE in the socket release operation after the end of fastening cycle.
	NG C-TR M-TR INFO ● ● ○ 16○ 8⊗ 4⊗ 2⊗ 1○	
	FACTORS 1) The socket release time is too long. 2) Brake has some trouble. MEASURES 1) Reduce the socket release time of SOCKET RELEASE command. 2) When it occurs in the brake step, please contact our company	

CODE	MESSAGE AND DRIVER LAMP DISPLAY	DESCRIPTION
6F	SLOPE 3 TORQUE MAXIMUM TROUBLE	A SLOPE 3 TORQUE MAXIMUM TROUBLE occurs, when the torque rate from the SLOPE MONITOR 3 started to the end of fastening cycle is higher than the SLOPE 3 TORQUE MAXIMUM.
	NG C-TR M-TR INFO ● ● ○ 16○ 8● 4● 2● 1●	
74	MID. POINT TORQUE MAXIMUM TROUBLE	MID. POINT TORQUE MAXIMUM TROUBLE occurs,when the torque of the point which fastened MID POINT JUDGEMENT ANGLE from MID POINT JUDGEMENT TORQUE is larger than MID POINT TORQUE MAXIMUM.
	NG C-TR M-TR INFO ● ● ○ 16● 8○ 4● 2○ 1○	
75	RUN DOWN ANGLE MAXIMUM TROUBLE	When the angle from START TORQUE OF RUN DOWN ANGLE to seating point is larger than RUN DOWN ANGLE MAXIMUM, it becomes RUN DOWN ANGLE MAXIMUM TROUBLE.
	NG C-TR M-TR INFO ● ● ○ 16● 8○ 4● 2○ 1●	
76	RUN DOWN TORQUE MAXIMUM TROUBLE	When the torque before the position which returned the setting angle of END ANGLE OF RUN DOWN TORQUE MAXIMUM JUDGEMENT from seating is larger than RUN DOWN TORQUE MAXIMUM, it becomes RUN DOWN TORQUE
	NG C-TR M-TR INFO ● ● ○ 16● 8○ 4● 2● 1○	
7F	EMERGENCY STOP	The EMERGENCY STOP input signal of the DRIVER I/O interface is activated.
	NG C-TR M-TR INFO ● ● ○ 16● 8● 4● 2● 1●	
	FACTORS The EMERGENCY STOP input signal of the DRIVER I/O interface is activated. MEASURES Inactivate the EMERGENCY STOP signal of the DRIVER I/O interface and then activate the RESET signal.	

7.2.5 MACHINE TROUBLE messages of the DRIVER

CODE	MESSAGE AND DRIVER LAMP DISPLAY	DESCRIPTION
81	IPM TROUBLE	The IPM TROUBLE occurs when the IPM of the DRIVER detects a problem.
	NG C-TR M-TR INFO ● ○ ● 16○ 8○ 4○ 2○ 1●	
	FACTORS 1) The load on the SPINDLE ASSEMBLY is too large. 2) A motor cable or its connection is wrong. 3) A foreign substance appears in the motor connector or some pins are short-circuited. 4) The SPINDLE ASSEMBLY or the DRIVER is defective. MEASURES 1) Do either of the following. Reduce the load of the SPINDLE ASSEMBLY. Slow down the HIGH SPEED and the TIGHTENING SPEED. Use a NUTRUNNER of a larger size. 2) Check the connection of the motor cable. Replace the cable if the trouble still occurs. 3) Confirm the inside of the connector. Remove a foreign substance if one is found. 4) Replace the SPINDLE ASSEMBLY or the DRIVER.	
82	PHASE DETECT FAULT	The PHASE DETECT FAULT occurs when fault is detected in power source.
	NG C-TR M-TR INFO ● ○ ● 16○ 8○ 4○ 2● 1○	
	FACTORS The power supply to the DRIVER or the power cable has a defect. MEASURES Confirm the power cable or its connection, and supply the power source as specified. NOTE Wait for about 5 seconds before each re-powering the system.	
83	ENCODER LOGIC ERROR	The ENCODER LOGIC ERROR occurs when the signal of each phase of the encoder is of an unacceptable combination.
	NG C-TR M-TR INFO ● ○ ● 16○ 8○ 4○ 2● 1●	
	FACTORS 1) A motor cable or its connection is wrong. 2) A foreign substance appears in the motor connector or some pins are short-circuited. 3) The SPINDLE ASSEMBLY or the DRIVER is defective. MEASURES 1) Check the connection of the motor cable. Replace the cable if the trouble still occurs. 2) Confirm the inside of the connector. Remove a foreign substance if one is found. 3) Replace the SPINDLE ASSEMBLY or the DRIVER. NOTE To recover from this error, a hardware reset must be performed (re-powering the system).	

CODE	MESSAGE AND DRIVER LAMP DISPLAY	DESCRIPTION
84	ENCODER DIFFERENTIAL ERROR	The error of ENCODER DIFFERENTIAL ERROR occurs when there is aberration in the logic at the input of the differential receiver.
	NG C-TR M-TR INFO ● ○ ● 16○ 8○ 4● 2○ 1○	
	FACTORS 1) A motor cable or its connection is wrong. 2) A foreign substance appears in the motor connector or some pins are short-circuited. 3) The SPINDLE ASSEMBLY or the DRIVER is defective. MEASURES 1) Check the connection of the motor cable. Replace the cable if the trouble occurs after confirming the connection. 2) Confirm the inside of the connector. Remove a foreign substance if one is found. 3) Replace the SPINDLE ASSEMBLY or the DRIVER. NOTE To recover from this error, a hardware reset must be performed (re-powering the system).	
85	OVER LOAD	AN OVER LOAD occurs, when the integrated amount of the current passed through the SPINDLE ASSEMBLY by a DRIVER comes up more than the specified load.
	NG C-TR M-TR INFO ● ○ ● 16○ 8○ 4● 2○ 1●	
	FACTORS 1) The load on the SPINDLE ASSEMBLY is too large. 2) The T/T cable or its connection is wrong. 3) The motor cable or its connection is wrong. 4) A use condition exceeds a rated fastening cycle. MEASURES 1) Do either of the following. Reduce the load of the SPINDLE ASSEMBLY. Slow down the HIGH SPEED. Use a NUTRUNNER of a larger size. 2) Check the connection of the T/T cable. Replace the cable if the trouble occurs after confirming the connection. 3) Check the connection of the motor cable. Replace the cable if the trouble occurs after confirming the connection. 4) Make the cycle time longer in order that the NUTRUNNER may run in the rated cycle. 5) Replace the SPINDLE ASSEMBLY or the DRIVER	

CODE	MESSAGE AND DRIVER LAMP DISPLAY	DESCRIPTION
86	OVER CURRENT	The trouble of OVER CURRENT occurs when the motor current exceeds allowable range
	NG C-TR M-TR INFO ● ○ ● 16○ 8○ 4● 2● 1○	
	FACTORS 1) The load on the SPINDLE ASSEMBLY is too large. 2) A T/T cable or its connection is wrong. 3) The SPINDLE ASSEMBLY or the DRIVER is defective. MEASURES 1) Do either of the following. Reduce the load on the SPINDLE ASSEMBLY. Slow down the HIGH SPEED and the TIGHTENING SPEED. Use a NUTRUNNER of a larger size. 2) Check the connection of the T/T cable. Replace the cable if the trouble occurs after confirming the connection. 3) Replace the SPINDLE ASSEMBLY or the DRIVER.	
87	OVER SPEED ERROR	The OVER SPEED ERROR occurs when the rotation speed of the NUTRUNNER exceeds 1.2 times the rated speed.
	NG C-TR M-TR INFO ● ○ ● 16○ 8○ 4● 2● 1●	
	FACTORS 1) A motor cable or its connection is wrong. 2) The DRIVER or the SPINDLE ASSEMBLY is defective. MEASURES 1) Check the connection of the motor cable. Replace the cable if the trouble occurs after confirming the connection. 2) Contact our company	
88	LOW VOLTAGE TROUBLE	A LOW VOLTAGE TROUBLE occurs, when the power supply voltage drops to 140 V or less.
	NG C-TR M-TR INFO ● ○ ● 16○ 8● 4○ 2○ 1○	
	FACTORS 1) Abnormal voltage of power supply source. 2) Poor capacity of the transformer. MEASURES 1) Supply the required power to the NUTRUNNER. 2) Replace the transformer with a larger one.	

CODE	MESSAGE AND DRIVER LAMP DISPLAY	DESCRIPTION
89	OVER VOLTAGE TROUBLE	The OVER VOLTAGE TROUBLE occurs, when the voltage of main circuit of DRIVER comes up to 400V DC or over.
	NG C-TR M-TR INFO ● ○ ● 16○ 8● 4○ 2○ 1●	
	FACTORS 1) Abnormal voltage of power source. 2) Load inertia is too big. MEASURES 1) Supply the required power to the NUTRUNNER. 2) Reduce inertia.	
8A	HEAT SINK OVERHEAT	The HEAT SINK OVERHEAT occurs, when the temperature of heat sink comes up to 85 degrees C or over by the abnormal heat generation from the power transistor of DRIVER.
	NG C-TR M-TR INFO ● ○ ● 16○ 8● 4○ 2● 1○	
	FACTORS 1) The fastening cycle is over the rated cycle. 3) The NUTRUNNER in the enclosure is not cooled enough. 4) Load inertia is too big. MEASURES 1) Make the cycle time longer in order that the NUTRUNNER may run in the rated cycle. 2) Cool the NUTRUNNER in the enclosure. 3) Reduce inertia.	
8B	MOTOR RUNAWAY TROUBLE	The MOTOR RUNAWAY TROUBLE occurs, when a motor does not move as commanded.
	NG C-TR M-TR INFO ● ○ ● 16○ 8● 4○ 2● 1●	
	FACTORS 1) A motor cable or its connection is wrong. 2) A foreign substance appears in the motor connector, some pins are short-circuited. 3) The DRIVER or the SPINDLE ASSEMBLY is defective. MEASURES 1) Check the connection of the motor cable. Replace the cable if the trouble occurs after confirming the connection. 2) Confirm the inside of the connector. Remove a foreign substance if one is found. 3) Contact our company	

CODE	MESSAGE AND DRIVER LAMP DISPLAY	DESCRIPTION
8C	MOTOR DRIVE TROUBLE	A MOTOR CABLE TROUBLE occurs when a fault in the motor cable is detected.
	NG C-TR M-TR INFO ● ○ ● 16○ 8● 4● 2○ 1○	
	FACTORS 1) A motor cable has a defect. 2) The acceleration of HIGH SPEED of fastening program is too fast. 3) Too large load at the time of the high-speed rotation. 4) Too large load at the time of the reverse rotation. MEASURES 1) Confirm the motor cable and its connection. 2) Reduce acceleration. 3) Reduce the acceleration of the high-speed rotation. 4) Reduce the acceleration in the reverse rotation.	

CODE	MESSAGE AND DRIVER LAMP DISPLAY	DESCRIPTION
91	RAM TROUBLE	The RAM TROUBLE occurs, when the DRIVER cannot correctly read and write from the RAM area.
	NG C-TR M-TR INFO ● ○ ● 16● 8○ 4○ 2○ 1●	
	FACTORS The DRIVER fails. MEASURES Replace the DRIVER with a spare one.	
92	EEPROM TROUBLE	The EEPROM TROUBLE occurs, when the DRIVER cannot correctly read and write from the EEPROM.
	NG C-TR M-TR INFO ● ○ ● 16● 8○ 4○ 2● 1○	
	FACTORS The DRIVER fails. MEASURES Replace the DRIVER with a spare one.	
93	CURRENT A/D TROUBLE	A CURRENT A/D TROUBLE occurs, when a trouble in the A/D converter of the DRIVER is detected.
	NG C-TR M-TR INFO ● ○ ● 16● 8○ 4○ 2● 1●	
	FACTORS The DRIVER fails. MEASURES Replace the DRIVER with a spare one.	
94	TORQUE A/D TROUBLE	A TORQUE A/D TROUBLE occurs, when a trouble in the TORQUE A/D is detected.
	NG C-TR M-TR INFO ● ○ ● 16● 8○ 4● 2○ 1○	
	FACTORS The DRIVER fails. MEASURES Replace the DRIVER with a spare one.	

CODE	MESSAGE AND DRIVER LAMP DISPLAY	DESCRIPTION
95	T/T OFFSET TROUBLE	A T/T OFFSET TROUBLE occurs, when the offset torque of torque transducer of the SPINDLE ASSEMBLY is larger than ±12.5% (changeable) of the rated torque.
	NG C-TR M-TR INFO ● ○ ● 16● 8○ 4● 2○ 1●	
	FACTORS 1) A T/T cable or its connection is wrong. 2) The SPINDLE ASSEMBLY has a load. 3) A big shock is exerted on the SPINDLE ASSEMBLY. 4) A torque transducer of the SPINDLE ASSEMBLY has a defect. MEASURES 1) Check the connection of the T/T cable. Replace the cable if the trouble occurs after confirming the connection. 2) Prevent a load exerted on the SPINDLE ASSEMBLY when fastening starts. 3) Prevent a shock exerted on the SPINDLE ASSEMBLY when fastening starts. Change the timing of the fastening start when you can't prevent a shock condition. 4) Replace the SPINDLE ASSEMBLY.	
96	T/T CALIBRATION ERROR	A CALIBRATON ERROR occurs, when the calibration value is not within ±2% (changeable) of the rated value as the result of calibration check of torque transducer (T/T) of the SPINDLE ASSEMBLY.
	NG C-TR M-TR INFO ● ○ ● 16● 8○ 4● 2● 1○	
	FACTORS 1) A T/T cable or its connection is wrong. 2) The SPINDLE ASSEMBLY has a load. 3) A big shock is exerted on the SPINDLE ASSEMBLY. 4) A torque transducer of the SPINDLE ASSEMBLY has a defect. MEASURES 1) Check the connection of the T/T cable. Replace the cable if the trouble occurs after confirming the connection. 2) Prevent a load exerted on the SPINDLE ASSEMBLY when fastening starts. 3) Prevent a shock exerted on the SPINDLE ASSEMBLY when fastening starts. Change the timing of the fastening start when you can't prevent a shock. 4) Replace the SPINDLE ASSEMBLY.	

NOTE

The calibration value for T/T and offset value is checked just before the start of fastening cycle.
 The calibration value can be confirmed by using the DISPLAY PANEL

CODE	MESSAGE AND DRIVER LAMP DISPLAY	DESCRIPTION
A1	T/T TYPE ERROR	A T/T TYPE ERROR occurs, when the NUTRUNNER model of DRIVER'S DIP switch does not conform with the model setting in the EEPROM.
	NG C-TR M-TR INFO ● ○ ● 16○ 8○ 4○ 2○ 1⊗	
	FACTORS System setting or a DIP switch (DSW2) is wrong. MEASURES Correct the NUTRUNNER model setting of the DRIVER'S DIP switch (DSW 2).	
A2	MOTOR TYPE ERROR	A MOTOR TYPE ERROR occurs, when the NUTRUNNER model of DRIVER'S DIP switch does not conform with the model setting in the EEPROM.
	NG C-TR M-TR INFO ● ○ ● 16○ 8○ 4○ 2⊗ 1○	
	FACTORS System setting or a DIP switch (DSW2) is wrong. MEASURES Correct the NUTRUNNER model setting of the DRIVER'S DIP switch (DSW 2).	
A3	PROGRAM END ERROR	A PROGRAM END ERROR occurs, when the fastening program doesn't have end of cycle command.
	NG C-TR M-TR INFO ● ○ ● 16○ 8○ 4○ 2⊗ 1⊗	
	FACTORS System setting is wrong. MEASURES Add an end of cycle command to the end of the fastening program.	
A4	PROGRAM CODE ERROR	A PROGRAM CODE ERROR occurs, when the unacceptable command of fastening code was entered.
	NG C-TR M-TR INFO ● ○ ● 16○ 8○ 4⊗ 2○ 1○	
	FACTORS System setting is wrong. MEASURES Confirm command code of fastening program.	

CODE	MESSAGE AND DRIVER LAMP DISPLAY	DESCRIPTION
A5	PROGRAM JUMP ERROR	A PROGRAM JUMP ERROR occurs, when the step number selected in the jump command is set after the end of cycle command.
	NG C-TR M-TR INFO ● ○ ● 16○ 8○ 4⊗ 2○ 1⊗	
	FACTORS System setting is wrong. MEASURES Confirm jump command of fastening program.	
A6	PARAMETER SELECTION ERROR	A PARAMETER SELECTION ERROR occurs, when an error in the selected fastening parameter is detected.
	NG C-TR M-TR INFO ● ○ ● 16○ 8○ 4⊗ 2⊗ 1○	
	FACTORS Parameter setting is wrong. MEASURES Set a correct parameter in selection command.	
AD	SUM CHECK ERROR	A SUM CHECK ERROR occurs, when the check sum of EEPROM, which keeps the setting value for the DRIVER, is not correct.
	NG C-TR M-TR INFO ● ○ ● 16○ 8⊗ 4⊗ 2○ 1⊗	
	FACTORS 1) Writing the NUTRUNNER setting was interrupted. 2) The NUTRUNNER setting was changed by noise etc. MEASURES Rewrite the settings to the NUTRUNNER. If the trouble still occurs after re-writing, contact our company to inform us about the environment (power noise or another noise source, etc) around the NUTRUNNER system. NOTE Sum check is usually conducted at the time of connection of power supply or just before the start of fastening cycle.	
AE	CPU ALARM	A CPU ALARM occurs, when an error in the CPU of the DRIVER is detected.
	NG C-TR M-TR INFO ● ○ ● 16○ 8⊗ 4⊗ 2⊗ 1○	
	FACTORS Noise condition affects the operation of the CPU. MEASURES Contact our company.	

CODE	MESSAGE AND DRIVER LAMP DISPLAY	DESCRIPTION
B1	FORMAT ERROR	The FORMAT ERROR occurs, when format aberration occurred in the communication condition of RS485 cable.
	NG C-TR M-TR INFO ● ○ ● 16 8 4 2 1	
	FACTORS 1) The aberration of the communication integrated circuit. 2) The aberration of the RS485 cable by noise etc. MEASURES Inform us about the environment (power noise or another noise source, etc) around the NUTRUNNER system.	
B2	DOUBLE ID ERROR	The DOUBLE ID ERROR occurs, when identical ID exists within one NUTRUNNER system.
	NG C-TR M-TR INFO ● ○ ● 16 8 4 2 1	
	FACTORS 1) DIP switch (DSW 1) setting is wrong. The driver of the same ID No. exists. 2) Two or more DISPLAY PANELS are connected. 3) An RS485 cable or its connection is wrong. 4) The aberration of the RS485 cable by noise etc. MEASURES 1) Correct the NUTRUNNER ID setting of the DRIVER'S DIP switch (DSW 1). 2) Check the connection of the DISPLAY PANEL. 3) Check the connection of the RS485 cables. Replace the cable if the trouble occurs after confirming the connection. 4) Inform us about the environment (power noise or another noise source, etc) around the NUTRUNNER system.	
B3	IC ERROR	The IC ERROR occurs, when integrated circuit aberration occurred in the communication condition of RS485 cable.
	NG C-TR M-TR INFO ● ○ ● 16 8 4 2 1	
	FACTORS 1) The aberration of the communication integrated circuit. 2) The aberration of the RS485 cable by noise etc. MEASURES 1) Check the connection of the RS485 cables. Replace the cable if the trouble occurs after confirming the connection. 2) Inform us about the environment (power noise or another noise source, etc) around the NUTRUNNER system.	

CODE	MESSAGE AND DRIVER LAMP DISPLAY	DESCRIPTION
B4	COMMUNICATION RECEPTION ERROR	A COMMUNICATION RECEPTION ERROR occurs, when the unprepared condition of the reception occurred in the communication condition of RS485 cable.
	NG C-TR M-TR INFO ● ○ ● 16 8 4 2 1	
	FACTORS 1) An RS485 cable or its connection is wrong. 2) The aberration of the RS485 cable by noise etc. MEASURES 1) Check the connection of the RS485 cables. Replace the cable if the trouble occurs after confirming the connection. 2) Inform us about the environment (power noise or another noise source, etc) around the NUTRUNNER system.	
B5	COMMUNICATION TROUBLE	A COMMUNICATION TROUBLE occurs, when aberration occurred in the communication in RS485 cable.
	NG C-TR M-TR INFO ● ○ ● 16 8 4 2 1	
	FACTORS 1) An RS485 cable or its connection is wrong. 2) The aberration of the RS485 cable by noise etc. MEASURES 1) Check the connection of the RS485 cables. Replace the cable if the trouble occurs after confirming the connection. 2) Inform us about the environment (power noise or another noise source, etc) around the NUTRUNNER system.	
B6	RECONFIGURATION ERROR	A RECONFIGURATION ERROR occurs, when the RECONFIGURATION ERROR occurred in the communication in RS485 cable.
	NG C-TR M-TR INFO ● ○ ● 16 8 4 2 1	
	FACTORS 1) The power of the DRIVER or the DISPLAY PANEL was interrupted. 2) An RS485 cable or its connection is wrong. 3) The aberration of the RS485 cable by noise etc. MEASURES 1) Check the power of the DRIVER and DISPLAY PANEL. 2) Check the connection of the RS485 cables. Replace the cable if the trouble occurs after confirming the connection. 3) Inform us about the environment (power noise or another noise source, etc) around the NUTRUNNER system.	

CODE	MESSAGE AND DRIVER LAMP DISPLAY	DESCRIPTION
B7	RESERVED	RESERVED
	NG C-TR M-TR INFO ● ○ ● 16 8 4 2 1	
	RESERVED	
B8	RESERVED	RESERVED
	NG C-TR M-TR INFO ● ○ ● 16 8 4 2 1	
	RESERVED	
B9	RESERVED	RESERVED
	NG C-TR M-TR INFO ● ○ ● 16 8 4 2 1	
	RESERVED	
BA	RESERVED	RESERVED
	NG C-TR M-TR INFO ● ○ ● 16 8 4 2 1	
	RESERVED	

7.2.6 Control trouble messages of the MULTI CONTROLLER

CODE	MESSAGE AND LAMP DISPLAY	DESCRIPTION
81	CYCLE TIME MAXIMUM TROUBLE	The CYCLE TIME MAXIMUM TROUBLE occurs, when the system cycle time on the MULTI CONTROLLER (from the start to the end of all fastening cycles) exceeds the regulated time.
	NG C-TR M-TR INFO ● ● ○ 16○ 8○ 4○ 2○ 1●	
	MEASURES Correct the CYCLE TIME setting of the fastening program. NOTE 1) System cycle time shall be set for each fastening program. 2) The cycle time is counted during the waiting for the INTERLOCK or JOG etc.	
82	MULTIPLE AXIS CONTROL ERROR	The MULTIPLE AXIS CONTROL ERROR occurs, when there is an error in the settings of the MULTIPLE AXIS CONTROL of the MULTI CONTROLLER.
	NG C-TR M-TR INFO ● ● ○ 16○ 8○ 4○ 2● 1○	
	FACTOR Incorrect setting. MEASURES Correct the settings in the DISPLAY PANEL or USER INTERFACE TERMINAL.	
83	PROGRAM SELECTION ERROR	The PROGRAM SELECTION ERROR occurs, when incorrect fastening program No. (other than No.1~8) was selected in the USER INTERFACE TERMINAL or DISPLAY PANEL at the start of manual operation.
	NG C-TR M-TR INFO ● ● ○ 16○ 8○ 4○ 2● 1●	
	FACTOR Incorrect program selection in the USER INTERFACE TERMINAL or DISPLAY PANEL. MEASURES Set a correct program in the USER INTERFACE TERMINAL or DISPLAY PANEL	
84	PARAMETER SELECTION ERROR	The PARAMETER SELECTION ERROR occurs, when incorrect fastening parameter No. (other than No.1~32) was selected in the USER INTERFACE TERMINAL or DISPLAY PANEL at the start of manual operation.
	NG C-TR M-TR INFO ● ● ○ 16○ 8○ 4● 2○ 1○	
	FACTOR Incorrect parameter selection in the USER INTERFACE TERMINAL or DISPLAY PANEL. MEASURES Set a correct parameter in the USER INTERFACE TERMINAL or DISPLAY PANEL	

CODE	MESSAGE AND LAMP DISPLAY	DESCRIPTION
A1	SPINDLE ASSIGNMENT ERROR	The SPINDLE ASSIGNMENT ERROR occurs, when an assigned spindle cannot be found.
	NG C-TR M-TR INFO ● ● ○ 16○ 8○ 4○ 2○ 1○	
FACTOR 1) Incorrect system settings. 2) RS485 cable or its connection is wrong. MEASURES 1) Correct the settings of "SPINDLE ASSIGNMENT". 2) Check the connection of the RS485 cables. Replace the cable if the trouble occurs after confirming the connection.		

CODE	MESSAGE AND LAMP DISPLAY	DESCRIPTION
BF	MC EMERGENCY STOP	The MC EMERGENCY STOP occurs, when the EMERGENCY STOP input signal (to the MULTI CONTROLLER) set up as normally open, is activated (ON). Or, when the EMERGENCY STOP input signal set up as normally close, is deactivated (OFF).
	NG C-TR M-TR INFO ● ● ○ 16 8 4 2 1	
	MEASURES Release the EMERGENCY STOP input signal of I/O interface of the MULTI CONTROLLER and reset the problem by activating the RESET input signal.	

7.2.7 Machine trouble messages of the MULTI CONTROLLER

Content "C1-DF" of the multi-controller message code is changed by the Multi-controller system.

The message codes of the MULTI CONTROLLER are shown in the following.

1) The message code of the Multi-controller that has the option board(DeviceNet, PROFIBUS or CC-Link) is shown in the following.

CODE	MESSAGE AND LAMP DISPLAY	DESCRIPTION
C1	OPT START UP ERROR	FACTOR Option board is defective. MEASURES Check the peripheral devices or option board.
	NG C-TR M-TR INFO ● ○ ● 16○ 8○ 4○ 2○ 1●	
C2	OPT NO RESPONSE	
	NG C-TR M-TR INFO ● ○ ● 16○ 8○ 4○ 2● 1○	
C3	OPT UNKNOWN FIELDBUS TYPE	
	NG C-TR M-TR INFO ● ○ ● 16○ 8○ 4○ 2● 1●	
C4	OPT MISMATCH FIELDBUS TYPE	
	NG C-TR M-TR INFO ● ○ ● 16○ 8○ 4● 2○ 1○	
C5	OPT TROUBLE	
	NG C-TR M-TR INFO ● ○ ● 16○ 8○ 4● 2○ 1●	

2) The message code of the Multi-controller that has the UCS card is shown in the following.

CODE	MESSAGE AND LAMP DISPLAY	DESCRIPTION
C1	UCS HARDWARE TROUBLE	FACTOR UCS card is defective. MEASURES Check the peripheral devices or UCS card.
	NG C-TR M-TR INFO ● ○ ● 16○ 8○ 4○ 2○ 1●	
C2	UCS CONFIGURATION MODE ERROR	
	NG C-TR M-TR INFO ● ○ ● 16○ 8○ 4○ 2● 1○	
C3	UCS START UP ERROR	
	NG C-TR M-TR INFO ● ○ ● 16○ 8○ 4○ 2● 1●	
C4	UCS ASSERT ERROR	
	NG C-TR M-TR INFO ● ○ ● 16○ 8○ 4● 2○ 1○	
C5	UCS ABORT ERROR	
	NG C-TR M-TR INFO ● ○ ● 16○ 8○ 4● 2○ 1●	
C6	UCS KERNEL PROBLEM	
	NG C-TR M-TR INFO ● ○ ● 16○ 8○ 4● 2● 1○	
C7	UCS W/DOG TIME OUT	
	NG C-TR M-TR INFO ● ○ ● 16○ 8○ 4● 2● 1●	
C8	UCS W/DOG ERROR	
	NG C-TR M-TR INFO ● ○ ● 16○ 8● 4○ 2○ 1○	

CODE	MESSAGE AND LAMP DISPLAY	DESCRIPTION
C9	UCS STATUS ERROR	FACTOR UCS card is defective. MEASURES Check the peripheral devices or UCS card.
	NG C-TR M-TR INFO ● ○ ● 16○ 8● 4○ 2○ 1●	
CA	UCS NO CONNECTION	
	NG C-TR M-TR INFO ● ○ ● 16○ 8● 4○ 2● 1○	
CB	UCS NO OPERATION	
	NG C-TR M-TR INFO ● ○ ● 16○ 8● 4○ 2● 1●	
CE	UCS BUS ERROR	
	NG C-TR M-TR INFO ● ○ ● 16○ 8● 4● 2● 1○	
CF	UCS INTERRUPT ERROR	
	NG C-TR M-TR INFO ● ○ ● 16○ 8● 4● 2● 1●	
D1	UCS BUSY TIME OUT	
	NG C-TR M-TR INFO ● ○ ● 16● 8○ 4○ 2○ 1●	
D2	UCS BUS SIGNAL ERROR	
	NG C-TR M-TR INFO ● ○ ● 16● 8○ 4○ 2● 1○	
D3	UCS ID BLOCK NONCONFORMITY	
	NG C-TR M-TR INFO ● ○ ● 16● 8○ 4○ 2● 1●	
D4	UCS CONTROL/STATUS BLOCK NONCONFORMITY	
	NG C-TR M-TR INFO ● ○ ● 16● 8○ 4● 2○ 1○	

CODE	MESSAGE AND LAMP DISPLAY	DESCRIPTION
D5	OPEN INTERFACE TIME OUT	FACTOR UCS card is defective. MEASURE Check the peripheral devices and UCS card.
	NG C-TR M-TR INFO ● ○ ● 16● 8○ 4● 2○ 1●	
D6	HEART BEAT TIME OUT	
	NG C-TR M-TR INFO ● ○ ● 16● 8○ 4● 2● 1○	
D7	UCS HEART BEAT TIME OUT	
	NG C-TR M-TR INFO ● ○ ● 16● 8○ 4● 2● 1●	
D8	TRIGGER OUTPUT POINTER INVALID	
	NG C-TR M-TR INFO ● ○ ● 16● 8● 4○ 2○ 1○	
D9	TRIGGER INPUT POINTER INVALID	
	NG C-TR M-TR INFO ● ○ ● 16● 8● 4○ 2○ 1●	
DA	TRIGGER FULL	
	NG C-TR M-TR INFO ● ○ ● 16● 8● 4○ 2● 1○	
DB	EVENT OUT POINTER INVALID	
	NG C-TR M-TR INFO ● ○ ● 16● 8● 4○ 2● 1●	
DC	EVENT IN POINTER INVALID	
	NG C-TR M-TR INFO ● ○ ● 16● 8● 4● 2○ 1○	
DD	TRIGGER ERROR	
	NG C-TR M-TR INFO ● ○ ● 16● 8● 4● 2○ 1●	

CODE	MESSAGE AND LAMP DISPLAY	DESCRIPTION
DE	INVALID MESSAGE RECEIVED	FACTOR UCS card is defective. MEASURE Check the peripheral devices and UCS card.
	NG C-TR M-TR INFO ● ○ ● 16● 8● 4● 2● 1○	
DF	INCORRECT MESSAGE RECEIVED	
	NG C-TR M-TR INFO ● ○ ● 16● 8● 4● 2● 1●	

3) The message code of the Multi-controller that used the PLC LINK function is shown in the following.

CODE	MESSAGE AND LAMP DISPLAY	DESCRIPTION
C1	PLC LINK UNIT RECEIVE ERROR	There is no response from PLC in the limit time.
	NG C-TR M-TR INFO ● ○ ● 16○ 8○ 4○ 2○ 1●	
	FACTOR 1) The MULTI CONTROLLER and PLC protocol are mismatches. 2) The aberration of the RS232C cable by noise etc. MEASURES 3) Check the connection of the communication cable. 4) Select a proper communication protocol.	
C2	PLC LINK UNIT NAK ERROR	The PLC transmit NAK.
	NG C-TR M-TR INFO ● ○ ● 16○ 8○ 4○ 2● 1○	
	FACTOR 1) The MULTI CONTROLLER and PLC protocol are mismatches. 2) The aberration of the RS232C cable by noise etc.. MEASURES 1) Select a proper communication protocol. 2) Inform us about the environment (power noise or another noise source, etc) around the NUTRUNNER system.	
C3	PLC LINK UNIT COMMUNICATION ERROR	There is no response from PLC.
	NG C-TR M-TR INFO ● ○ ● 16○ 8○ 4○ 2● 1●	
	FACTOR 1) RS232C cable or its connection is wrong. 2) The MULTI CONTROLLER and PLC protocol are mismatches. MEASURES 1) Check the connection of the RS232C cables. 2) Select a proper communication protocol.	

CODE	MESSAGE AND LAMP DISPLAY	DESCRIPTION
C4	OMRON RUNNING MODE	FACTOR The aberration of the communication unit. MEASURE See the instruction manual of OMRON.
	NG C-TR M-TR INFO ● ○ ● 16○ 8○ 4● 2○ 1○	
C5	OMRON FCS ERROR	
	NG C-TR M-TR INFO ● ○ ● 16○ 8○ 4● 2○ 1●	
C6	OMRON FORMAT ERROR	
	NG C-TR M-TR INFO ● ○ ● 16○ 8○ 4● 2● 1○	
C7	OMRON DATA ERROR	
	NG C-TR M-TR INFO ● ○ ● 16○ 8○ 4● 2● 1●	
C8	OMRON FRAME LENGTH MAXIMUM ERROR	
	NG C-TR M-TR INFO ● ○ ● 16○ 8● 4○ 2○ 1○	
C9	OMRON CPU ERROR	
	NG C-TR M-TR INFO ● ○ ● 16○ 8● 4○ 2○ 1●	
CA	OMRON ABORT ERROR	
	NG C-TR M-TR INFO ● ○ ● 16○ 8● 4○ 2● 1○	
CB	OMRON OTHER ERROR	
	NG C-TR M-TR INFO ● ○ ● 16○ 8● 4○ 2● 1●	

CODE	MESSAGE AND LAMP DISPLAY	DESCRIPTION
E1	RAM TROUBLE	The RAM TROUBLE occurs when the MULTI CONTROLLER cannot correctly read and write from the RAM area.
	NG C-TR M-TR INFO ● ○ ● 16○ 8○ 4○ 2○ 1⊗	
E2	EEPROM TROUBLE	The EEPROM TROUBLE occurs, when the MULTI CONTROLLER cannot correctly read and write from the EEPROM.
	NG C-TR M-TR INFO ● ○ ● 16○ 8○ 4○ 2⊗ 1○	
	FACTOR MULTI CONTROLLER or EEPROM is defective. MEASURES Replace the MULTI CONTROLLER.	
E6	INTERDRIVER COMMUNICATION ERROR	The INTERDRIVER COMMUNICATION ERROR occurs, when the communication between the MULTI CONTROLLER and DRIVER is not possible.
	NG C-TR M-TR INFO ● ○ ● 16○ 8○ 4⊗ 2⊗ 1○	
	FACTOR 1) RS485 cable or its connection is wrong. 2) MULTI CONTROLLER is defective. 3) DRIVER is defective. MEASURES 1) Check the connection of the RS485 cables. Replace the cable if the trouble occurs after confirming the connection. 2) Replace the MULTI CONTROLLER. 3) Replace the DRIVER	
E7	RECEIVED CODE NONCONFORMITY ERROR	The RECEIVED CODE NONCONFORMITY ERROR occurs when the communication between the MULTI CONTROLLER and DRIVER is abnormal.
	NG C-TR M-TR INFO ● ○ ● 16○ 8○ 4⊗ 2⊗ 1⊗	
	FACTOR Different ROM versions of MULTI CONTROLLER and DRIVER. MEASURES Check the ROM versions of the MULTI CONTROLLER and DRIVER.	

CODE	MESSAGE AND LAMP DISPLAY	DESCRIPTION
E8	TOKEN ERROR	The TOKEN ERROR occurs when TOKEN cannot be found in the communication between the MULTI CONTROLLER and DRIVER.
	NG C-TR M-TR INFO ● ○ ● 16○ 8⊗ 4○ 2○ 1○	
	FACTORS 1) RS485 cable or its connection is wrong. 2) The power is not supplied to the DRIVER. MEASURES 1) Check the connection of RS485 cables. Replace the cable if the trouble occurs after confirming the connection. 2) Supply the power to the DRIVER.	
E9	FORMAT ERROR	The FORMAT ERROR occurs when the communication module does not initialize correctly.
	NG C-TR M-TR INFO ● ○ ● 16○ 8⊗ 4○ 2○ 1⊗	
	FACTORS Format aberration of the MULTI CONTROLLER. MEASURES Replace the MULTI CONTROLLER.	
EA	RECONFIGURATION ERROR	The RECONFIGURATION ERROR occurs when network is reconfigured.
	NG C-TR M-TR INFO ● ○ ● 16○ 8⊗ 4○ 2⊗ 1○	
	FACTORS 1) The power to the DISPLAY PANEL or DRIVER was interrupted. 2) RS485 cable or its connection is wrong. 3) The aberration of the RS485 cable by noise etc. MEASURES 1) Check the power source of DRIVER and DISPLAY PANEL. 2) Check the connection of the RS485 cable. Replace the cable it the trouble still occurs. 3) Inform us about the environment around the NUTRUNNER (power noise or another noise source, etc.).	

CODE	MESSAGE AND LAMP DISPLAY	DESCRIPTION
EB	DOUBLE ID ERROR	The DOUBLE ID ERROR occurs, when identical ID exists within one NUTRUNNER.
	NG C-TR M-TR INFO ● ○ ● 16○ 8⊗ 4○ 2⊗ 1⊗	
	FACTORS 1) DIP switch (DSW1) is wrong. The DRIVER of the same spindle No. exists. 2) Two or more DISPLAY PANELS are connected. 3) RS485 cable or its connection is wrong. 4) The aberration of the RS485 cable by noise, etc. MEASURES 1) Correct the setting of the DRIVER's DIP switch (DSW1). 2) Check the connection of the DISPLAY PANEL. 3) Check the connection of the RS485 cable. Replace the cable if the trouble occurs after confirming the connection. 4) Inform us about the environment around the NUTRUNNER (power noise or another noise source, etc.).	
EC	IC ERROR	The IC ERROR occurs, when integrated circuit aberration occurred in the ARCNET communication.
	NG C-TR M-TR INFO ● ○ ● 16○ 8⊗ 4⊗ 2○ 1○	
	FACTORS 1) The aberration of the communication integrated circuit. 2) The aberration of the RS485 cable by noise etc. MEASURES 1) Replace the MULTI CONTROLLER. 2) Check the connection of the RS485 cables. Replace the cable if the trouble occurs after confirming the connection. 3) Inform us about the environment (power noise or another noise source, etc) around the NUTRUNNER system.	
ED	COMMUNICATION RECEPTION ERROR	The COMMUNICATION RECEPTION ERROR occurs, when the transmission unit is not ready for communication.
	NG C-TR M-TR INFO ● ○ ● 16○ 8⊗ 4⊗ 2○ 1⊗	
	FACTORS 1) The RS485 cable or its connection is wrong. 2) The aberration of the RS485 cable by noise etc. MEASURES 1) Check the connection of the RS485 cables. Replace the cable if the trouble occurs after confirming the connection. 2) Inform us about the environment (power noise or another noise source, etc) around the NUTRUNNER	

CODE	MESSAGE AND LAMP DISPLAY	DESCRIPTION
EE	COMMUNICATION TROUBLE	The COMMUNICATION TROUBLE occurs when there is no response to the command from the DRIVER.
	NG C-TR M-TR INFO ● ○ ● 16○ 8⊗ 4⊗ 2⊗ 1○	
	FACTORS 1) RS485 cable or its connection is wrong. 2) The aberration of the RS485 cable by noise etc. MEASURES 1) Check the connection of the RS485 cables. Replace the cable if the trouble occurs after confirming the connection. 2) Inform us about the environment (power noise or another noise source, etc.) around the NUTRUNNER.	
EF	RECEPTION TROUBLE	The RECEPTION TROUBLE occurs, when a response to the command comes from the wrong spindle of the DRIVER.
	NG C-TR M-TR INFO ● ○ ● 16○ 8⊗ 4⊗ 2⊗ 1⊗	
	FACTORS 1) RS485 cable or its connection is wrong. 2) The aberration of the RS485 cable by noise etc. MEASURES 1) Check the connection of the RS485 cables. Replace the cable if the trouble occurs after confirming the connection. 2) Inform us about the environment (power noise or another noise source, etc.) around the NUTRUNNER.	

CODE	MESSAGE AND LAMP DISPLAY	DESCRIPTION
F1	RS232C PORT ERROR	The RS232C PORT ERROR occurs, when either the overrun error, framing error or parity error happens.
	NG C-TR M-TR INFO ● ○ ● 16 8 4 2 1	
	FACTORS 1) Communication cable or its connection is wrong. 2) Communication protocol is incorrect. 3) Transmission timing is too early. MEASURES 1) Check the connection of the communication cable. Replace the cable if the trouble occurs after confirming the connection. 2) Select a proper communication protocol. 3) Delay the transmission time.	
F2	RS232C PORT TRANSMISSION ERROR	The RS232C PORT TRANSMISSION ERROR occurs when the transmission process exceeded the regulated time.
	NG C-TR M-TR INFO ● ○ ● 16 8 4 2 1	
	FACTORS 1) Communication cable or its connection is wrong. 2) Reception process is too slow. MEASURES 1) Check the connection of the communication cable. Replace the cable if the trouble occurs after confirming the connection. 2) Speed up the transmission process.	
F3	UIT/PR PORT ERROR	The UIT/PR PORT ERROR occurs when either the overrun error, framing error or parity error happens.
	NG C-TR M-TR INFO ● ○ ● 16 8 4 2 1	
	FACTORS 1) Communication cable or its connection is wrong. 2) Communication protocol is incorrect. 3) Transmission timing is too early. MEASURES 1) Check the connection of the communication cable. Replace the cable if the trouble occurs after confirming the connection. 2) Select a proper communication protocol. 3) Delay the transmission time.	

CODE	MESSAGE AND LAMP DISPLAY	DESCRIPTION
F4	UIT/PR PORT TRANSMISSION ERROR	The UIT/PR PORT TRANSMISSION ERROR occurs when the transmission process exceeded the regulated time.
	NG C-TR M-TR INFO ● ○ ● 16 8 4 2 1	
	FACTORS 1) Communication cable or its connection is wrong. 2) Communication protocol is incorrect. 3) Transmission timing is too early. MEASURES 1) Check the connection of the communication cable. Replace the cable if the trouble occurs after confirming the connection. 2) Select a proper communication protocol. 3) Delay the transmission time.	
F8	T/T TYPE ERROR	The T/T TYPE ERROR occurs when the T/T model of the DRIVER's DIP switch does not conform with the model setting in the EEPROM.
	NG C-TR M-TR INFO ● ○ ● 16 8 4 2 1	
	FACTORS System setting or a DIP switch (DSW2) is incorrect. MEASURES Correct the settings of the DRIVER's DIP switch (DSW2) or EEPROM.	
F9	MOTOR TYPE ERROR	The MOTOR TYPE ERROR occurs when the motor model of the DRIVER's DIP switch does not conform with the model setting in the EEPROM of the MULTI CONTROLLER.
	NG C-TR M-TR INFO ● ○ ● 16 8 4 2 1	
	FACTOR System setting or a DIP switch (DSW2) is incorrect. MEASURES Correct the settings of the DRIVER's DIP switch (DSW2) or EEPROM.	
FA	ID ERROR	The ID ERROR occurs, when the TYPE S or M model of the DRIVER's DIP switch does not conform with the model setting in the EEPROM of the MULTI CONTROLLER.
	NG C-TR M-TR INFO ● ○ ● 16 8 4 2 1	
	FACTOR System setting or a DIP switch (DSW2) is incorrect. MEASURES Correct the settings of the DRIVER's DIP switch (DSW2) or EEPROM.	

CODE	MESSAGE AND LAMP DISPLAY	DESCRIPTION
FB	DRIVER SUM CHECK ERROR	The DRIVER SUM CHECK ERROR occurs, when the check sum in the MULTI CONTROLLER settings is different from the check sum in the setting of the DRIVER.
	NG C-TR M-TR INFO ● ○ ● 16 8 4 2 1	
	FACTORS 1) A wrong DRIVER is connected. 2) A spindle No. of the DRIVER was changed. 3) EEPROM setting was changed by noise etc. MEASURES 1) Re-write the settings of the NUTRUNNER. 2) If the problem still occurs after re-writing, contact our company to inform about the environment (power noise or another noise source) around the NUTRUNNER.	
FC	DRIVER ERROR	The DRIVER ERROR occurs when an error in the assigned DRIVER is detected.
	NG C-TR M-TR INFO ● ○ ● 16 8 4 2 1	
	FACTORS The machine trouble occurred in the DRIVER. MEASURES Re-cycle the power to the NUTRUNNER after recovering from the problem. Replace the defected DRIVER if problem still occurs.	
FD	SUM CHECK ERROR	The SUM CHECK ERROR occurs when the check sum of EEPROM, which keeps the settings for the MULTI CONTROLLER, is not correct.
	NG C-TR M-TR INFO ● ○ ● 16 8 4 2 1	
	FACTORS 1) Writing the settings to the NUTRUNNER was interrupted. 2) EEPROM setting was changed by noise etc. MEASURES 1) Re-write the settings of the NUTRUNNER. 2) If the problem still occurs after re-writing, contact our company to inform about the environment (power noise or another noise source) around the NUTRUNNER.	

CODE	MESSAGE AND LAMP DISPLAY	DESCRIPTION
FE	CPU ALARM	The CPU ALARM occurs when an error in the CPU of the MULTI CONTROLLER is detected.
	NG C-TR M-TR INFO ● ○ ● 16 8 4 2 1	
	FACTORS Operation of CPU is affected by noise etc. MEASURES Contact our company.	
FF	WDT ALARM	The WDT ALARM occurs when a watch dog time error in the CPU of the MULTI CONTROLLER is detected.
	NG C-TR M-TR INFO ● ○ ● 16 8 4 2 1	
	FACTORS Operation of CPU is affected by noise etc. MEASURES Contact our company.	

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Chapter 8 End of cycle data print out

This chapter explains the print-out of the End of cycle data.

Chapter 8 End of cycle data print out	8-1
8.1 Specification of print-out	8-2
8.2 The contents of print-out.....	8-3
8.2.1 Print-out item.....	8-3
8.2.2 Print-out format	8-5

8.1 Specification of print-out

The signal of a printer is outputted from the UIT/PR port of a multi-controller. Therefore, only TypeM is possible for printing of fastening data. Print-out specification is shown below.

ITEM	SPECIFICATION
Application circuit	RS232C
Transmitting speed	4800 bps 9600 bps 14400 bps 19200 bps 28800 bps 31200 bps 38400 bps
Parity	Even/Odd/Non-parity (selectable)
Bit length	8 bit
Stop bit	1bit / 2bit (selectable)
Communication system	Full duplex communication system
Synchronization scheme	Synchronous system
Printer specification	ESC/P

Table 8.1-1 Print-out specification

The transmitting speed and parity shall be programmed at the DISPLAY PANEL or USER INTERFACE TERMINAL.

8.2 The contents of print-out

8.2.1 Print-out item

The End of cycle data print-out can print the following item.

Item	Symbol	Print-out	Contents
TOTAL CYCLE STATUS CODE	Total Judge	OK	Total judgement OK
		NG	Total judgement NG
		TRBL	Total judgement Trouble
		PASS	Bypass
		----	No judgement
NG/TROUBLE MESSAGE	Code	00 - FF	Total Judgement message code
CYCLE TIME	Cycle time	00.0 - 99.9	Cycle time (sec)
PROGRAM No.	Prg.No.	01 – 08	Start program number.
PARAMETER SET No.	Prm.No.	01 - 32	Start parameter set number.
Count		00000-99999	Cycle count
EACH SPINDLE CYCLE STATUS CODE	Judge	OK	OK
		NG	NG
		TRBL	Trouble
		PASS	Bypass
		----	No judgement
EACH SPINDLE NG/TROUBLE MESSAGE	Code	00 – FF	NG/TROUBLE MESSAGE
EACH SPINDLE DATA ITEM1	Reference Table 8.2-2	0000-9999	Item data chosen by the output item 1 of a DATA output item setting.
EACH SPINDLE DATA ITEM2			Item data chosen by the output item 2 of a DATA output item setting.
EACH SPINDLE DATA ITEM3			Item data chosen by the output item 3 of a DATA output item setting.
EACH SPINDLE DATA ITEM4			Item data chosen by the output item 4 of a DATA output item setting.

Table 8.2-1 Print-out item

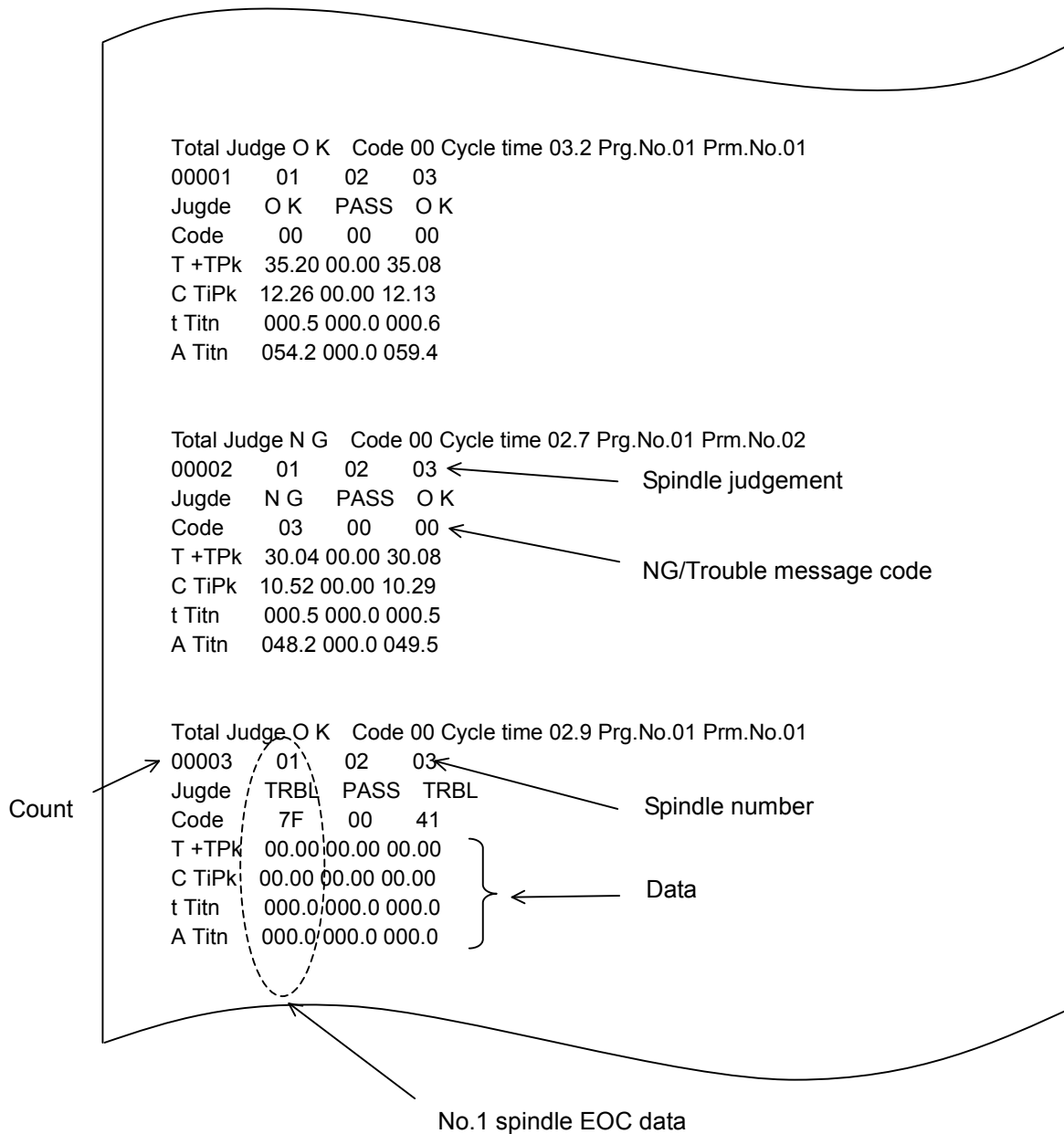
The item of each spindle data is expressed with the following symbols.

SYMBOL	DATA ITEM	SYMBOL	DATA ITEM
Jdg	JUDGEMENT	T SlpF	FINAL SLOPE TORQUE
Step	STEP No.	A Yld	YIELD POINT ANGLE
t Cycl	CYCLE TIME	A Y-F	STRETCH ANGLE
T Ofst	OFFSET TORQUE	T Slpx	SLOPE BASE VALUE
T +Pk	CYCLE PEAK TORQUE CW	A Slxp	SLOPE BASE ANGLE
T -Pk	CYCLE PEAK TORQUE CCW	T Slxp	SLOPE BASE TORQUE
T +TPk	TIGHTENING PEAK TORQUE	T SI3n	MINIMUM VALUE OF SLOPE 3
T -TPk	NEGATIVE PEAK TORQUE	T SI3x	MAXIMUM VALUE OF SLOPE 3
C Peak	CYCLE PEAK CURRENT	T Mp	MID.POINT JUDGEMENT TORQUE
C TiPk	TIGHTENING PEAK CURRENT	A Mp	MID.POINT JUDGEMENT TIGHTENING ANGLE
T Finl	FINAL TORQUE	A Rd	RUN DOWN ANGLE
t Titn	TIGHTENING TIME	A Rdn	RUN DOWN TORQUE MINIMUM JUDGEMENT ANGLE
A Titn	TIGHTENING ANGLE	A Rdx	RUN DOWN TORQUE MAXIMUM JUDGEMENT ANGLE
C Finl	FINAL CURRENT	T Gain	TORQUE GAIN CORRECTION
T Seat	SEATING TORQUE	T Ofst	TORQUE OFFSET CORRECTION
t Seat	SEATING TIME	A Gain	ANGLE GAIN CORRECTION
A Seat	SEATING ANGLE	A Ofst	ANGLE OFFSET CORRECTION
T Snug	SNUG TORQUE	PrgPrm	PROGRAM No. PARAMETER No.
t Snug	SNUG TIME		
A Snug	SNUG ANGLE		
A Mnt	MONITOR ANGLE		
T SI1n	MINIMUM VALUE OF SLOPE 1		
T SI1x	MAXIMUM VALUE OF SLOPE 1		
T SI2n	MINIMUM VALUE OF SLOPE 2		
T SI2x	MAXIMUM VALUE OF SLOPE 2		

Table 8.2-2 Data symbol

8.2.2 Print-out format

The print-out format of the END OF CYCLE DATA is shown below.



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Chapter 9 Fastening methods

This chapter explains the various types of fastening methods that can be run on the model SDNR NUTRUNNER.

Chapter 9 Fastening methods.....	9-1
9.1 About the fastening methods	9-2
9.2 ANGLE MONITORING TORQUE CONTROL	9-3
9.3 TORQUE-TURN CONTROL.....	9-7
9.4 TORQUE-TENSION CONTROL.....	9-11
9.5 YIELD POINT DETECTION CONTROL	9-15
9.6 ANGLE MONITORING TIMED TORQUE CONTROL	9-19
9.7 SLOPE MONITORING.....	9-23
9.8 MID. POINT JUDGEMENT	9-28
9.9 RUN DOWN JUDGEMENT	9-31
9.9.1 RUNDOWN ANGLE JUDGEMENT	9-31
9.9.2 RUNDOWN TORQUE JUDGEMENT	9-33

9.1 About the fastening methods

The NUTRUNNER is capable of running 5 different types of fastening methods. These are as follows:

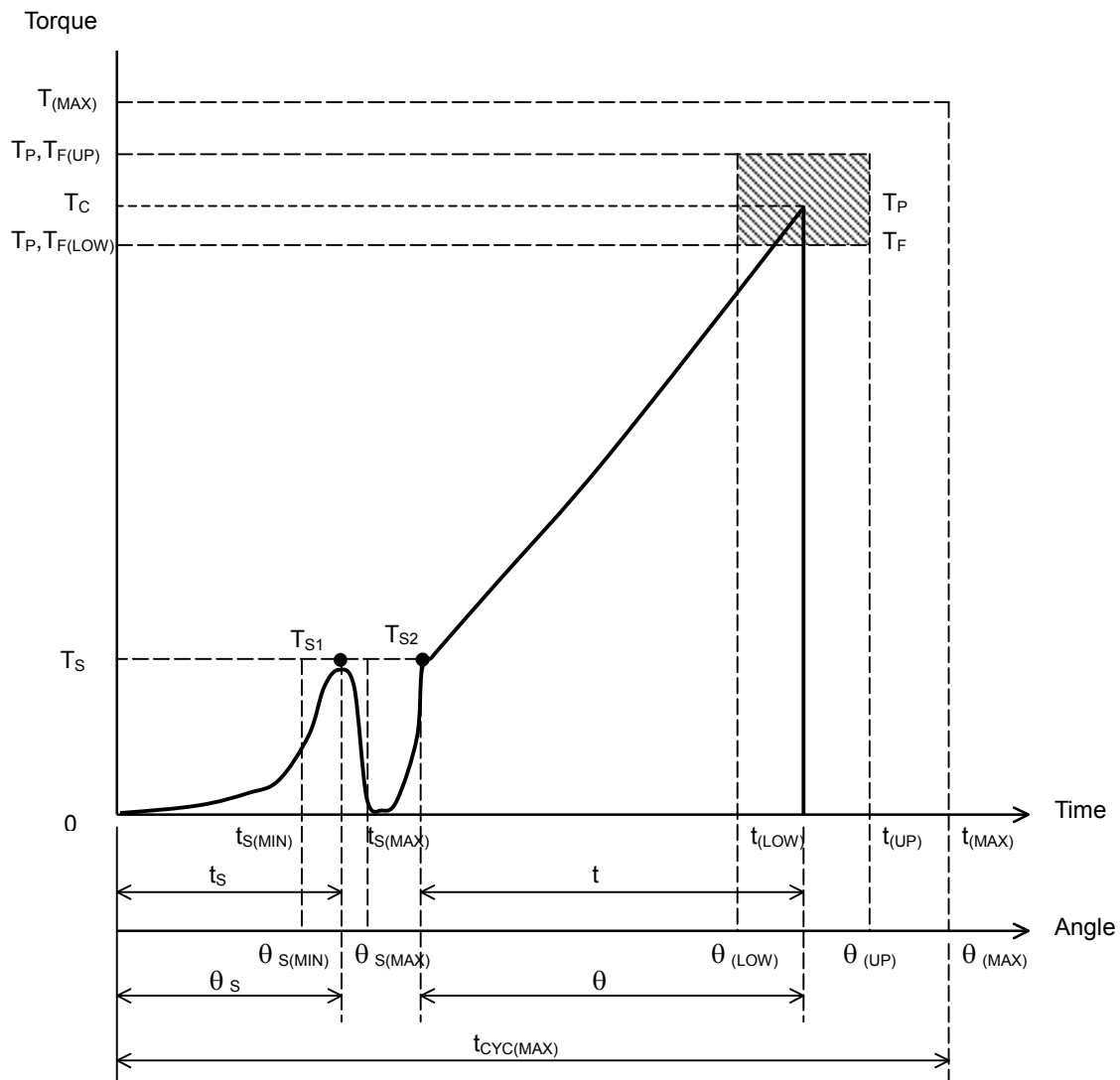
FASTENING METHOD	GUIDEPOST	FASTENING ZONE
ANGLE MONITORING TORQUE CONTROL	TORQUE	Elastic zone
TORQUE-TURN CONTROL	ANGLE	Elastic zone
		Plastic zone
TORQUE-TENSION CONTROL	ANGLE	Elastic zone
		Plastic zone
YIELD POINT DETECTION CONTROL	TORQUE RATE	Limit of elastic zone
ANGLE MONITORING TIMED TORQUE CONTROL	TORQUE, FASTENING TIME	Elastic zone

Table 9.1-1 Fastening methods

9.2 ANGLE MONITORING TORQUE CONTROL

The ANGLE MONITORING TORQUE CONTROL is the method for the control of a fastening cycle by monitoring the fastening angle from the specified torque having the fastening torque as its guidepost.

The ANGLE MONITORING TORQUE CONTROL is described in the following.



T_{S1} : The first seating torque detection point

T_{S2} : The second seating torque detection point

(The seating torque detection point in fastening step)

Figure 9.2-1 ANGLE MONITORING TORQUE CONTROL

- Control values

The control values, which are generally used in the ANGLE MONITORING TORQUE CONTROL, are shown in the following.

SYMBOL	DESIGNATION
-	DIRECTION OF ROTATION
-	AUTO CALIBRATION SW
T_c	CONTROL TORQUE
T_s	SEATING TORQUE

Table 9.2-1 Control values

- Fastening cycle description

- 1) The NUTRUNNER keeps rotating in high speed till it detects the SEATING TORQUE (T_{s1}).
- 2) It stops when it detects the SEATING TORQUE (T_{s1}).
- 3) It starts the tightening operation in low speed rotation.
- 4) The fastening operation is completed when the torque reaches the CONTROL TORQUE (T_c).

- NG reference values

The NG reference values, which are generally used in the ANGLE MONITORING TORQUE CONTROL are shown in the following.

SYMBOL	DESIGNATION
$T_{P(Low)}$	TIGHTENING PEAK TORQUE LOWER LIMIT
$T_{P(Up)}$	TIGHTENING PEAK TORQUE UPPER LIMIT
$T_{F(Low)}$	FINAL TORQUE LOWER LIMIT
$T_{F(Up)}$	FINAL TORQUE UPPER LIMIT
$t_{(Low)}$	TIGHTENING TIME LOWER LIMIT
$t_{(Up)}$	TIGHTENING TIME UPPER LIMIT
$\theta_{(Low)}$	TIGHTENING ANGLE LOWER LIMIT
$\theta_{(Up)}$	TIGHTENING ANGLE UPPER LIMIT

Table 9.2-2 NG reference values

- TROUBLE reference values

The TROUBLE reference values which are generally used in the ANGLE MONITORING TORQUE CONTROL are shown in the following.

SYMBOL	DESIGNATION
$t_{S(MIN)}$	SEATING TIME MINIMUM
$t_{S(MAX)}$	SEATING TIME MAXIMUM
$\theta_{S(MIN)}$	SEATING ANGLE MINIMUM
$\theta_{S(MAX)}$	SEATING ANGLE MAXIMUM
$T_{(MAX)}$	TORQUE MAXIMUM
$t_{(MAX)}$	TIGHTENING TIME MAXIMUM
$\theta_{(MAX)}$	TIGHTENING ANGLE MAXIMUM
$t_{CYC(MAX)}$	CYCLE TIME MAXIMUM

Table 9.2-3 TROUBLE reference values

- End of Cycle

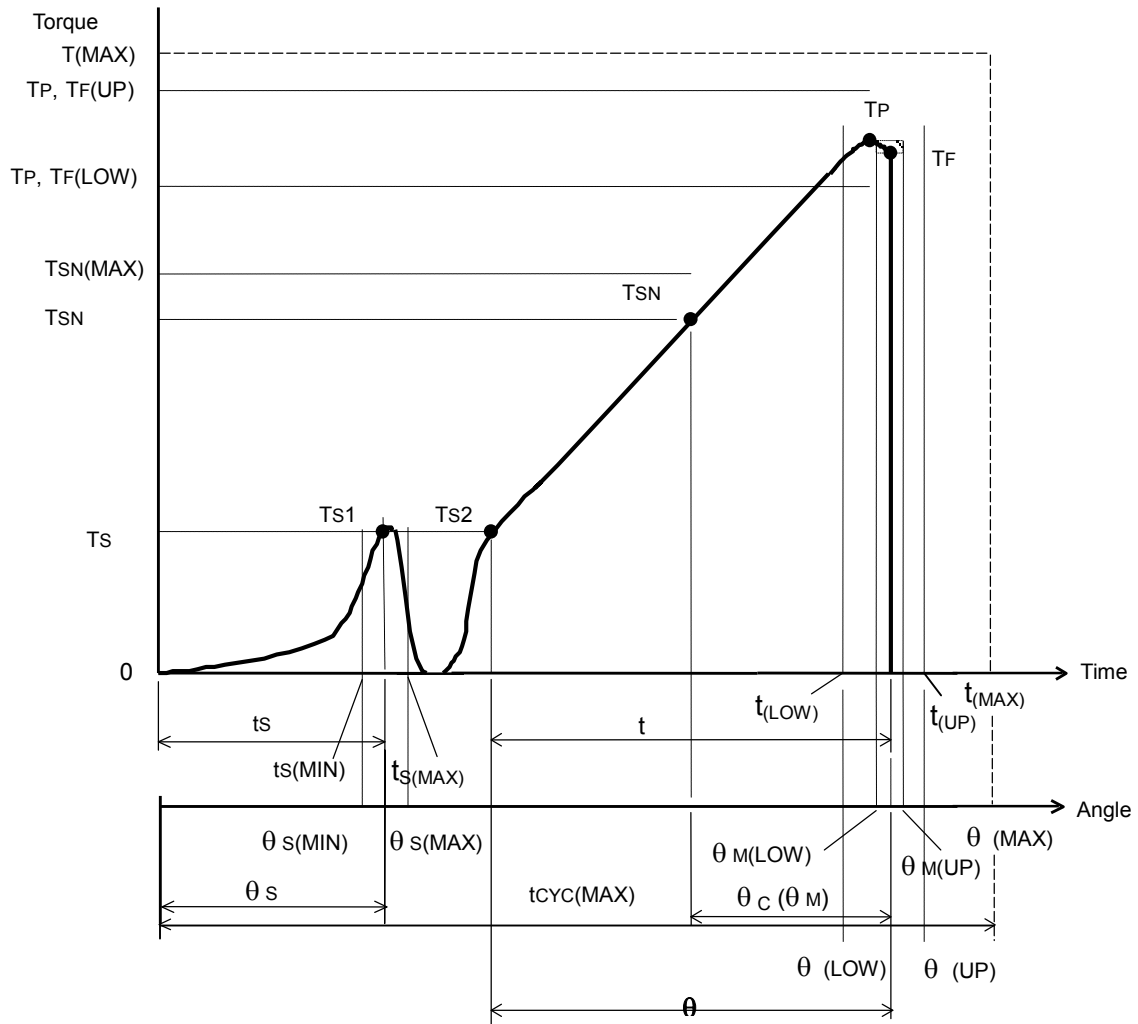
The End of Cycle data, which are generally used in the ANGLE MONITORING TORQUE CONTROL, are shown in the following.

SYMBOL	DESIGNATION
T_P	TIGHTENING PEAK TORQUE
T_F	FINAL TORQUE
t	TIGHTENING TIME
θ	TIGHTENING ANGLE
t_s	SEATING TIME
θ_s	SEATING ANGLE

Table 9.2-4 End of cycle data

9.3 TORQUE-TURN CONTROL

The TORQUE-TURN CONTROL is the fastening control method, which uses the angle as its guidepost.



T_{S1} : The first seating torque detection point

T_{S2} : The second seating torque detection point

(The seating torque detection point in fastening step)

Figure 9.3-1 TORQUE-TURN CONTROL

- Control values

The control values, which are generally used in the TORQUE-TURN CONTROL, are shown in the following.

SYMBOL	DESIGNATION
-	DIRECTION OF ROTATION
-	AUTO CALIBRATION SW
T_{SN}	SNUG TORQUE
T_S	SEATING TORQUE
θ_C	CONTROL ANGLE

Table 9.3-1 Control values

- Fastening cycle description

- 1) The NUTRUNNER keeps rotating in high speed till it detects the SEATING TORQUE (T_{S1}).
- 2) It stops when it detects the SEATING TORQUE (T_{S1}).
- 3) It starts the tightening operation in low speed rotation.
- 4) The fastening cycle is completed when the NUTRUNNER rotates only for the CONTROL ANGLE (θ_C) from the SNUG TORQUE (T_{SN}).

- NG reference values

The NG reference values, which are generally used in the TORQUE-TURN CONTROL, are shown in the following.

SYMBOL	DESIGNATION
$T_{P(LOW)}$	TIGHTENING PEAK TORQUE LOWER LIMIT
$T_{P(UP)}$	TIGHTENING PEAK TORQUE UPPER LIMIT
$T_{F(LOW)}$	FINAL TORQUE LOWER LIMIT
$T_{F(UP)}$	FINAL TORQUE UPPER LIMIT
$t_{(LOW)}$	TIGHTENING TIME LOWER LIMIT
$t_{(UP)}$	TIGHTENING TIME UPPER LIMIT
$\theta_{(LOW)}$	TIGHTENING ANGLE LOWER LIMIT
$\theta_{(UP)}$	TIGHTENING ANGLE UPPER LIMIT
T_{SN}	SNUG TORQUE LOWER LIMIT
$T_{SN(MAX)}$	SNUG TORQUE UPPER LIMIT
$\theta_{M(LOW)}$	MONITOR ANGLE LOWER LIMIT
$\theta_{M(UP)}$	MONITOR ANGLE UPPER LIMIT

Table 9.3-2 NG reference values

- TROUBLE reference values

The TROUBLE reference values, which are generally used in the TORQUE-TURN CONTROL, are shown in the following.

SYMBOL	DESIGNATION
$t_{S(MIN)}$	SEATING TIME MINIMUM
$t_{S(MAX)}$	SEATING TIME MAXIMUM
$\theta_{S(MIN)}$	SEATING ANGLE MINIMUM
$\theta_{S(MAX)}$	SEATING ANGLE MAXIMUM
$T_{(MAX)}$	TORQUE MAXIMUM
$t_{(MAX)}$	TIGHTENING TIME MAXIMUM
$\theta_{(MAX)}$	TIGHTENING ANGLE MAXIMUM
$t_{CYC(MAX)}$	CYCLE TIME MAXIMUM
$T_{SN(MAX)}$	SNUG TORQUE MAXIMUM

Table 9.3-3 TROUBLE reference values

- End of Cycle data

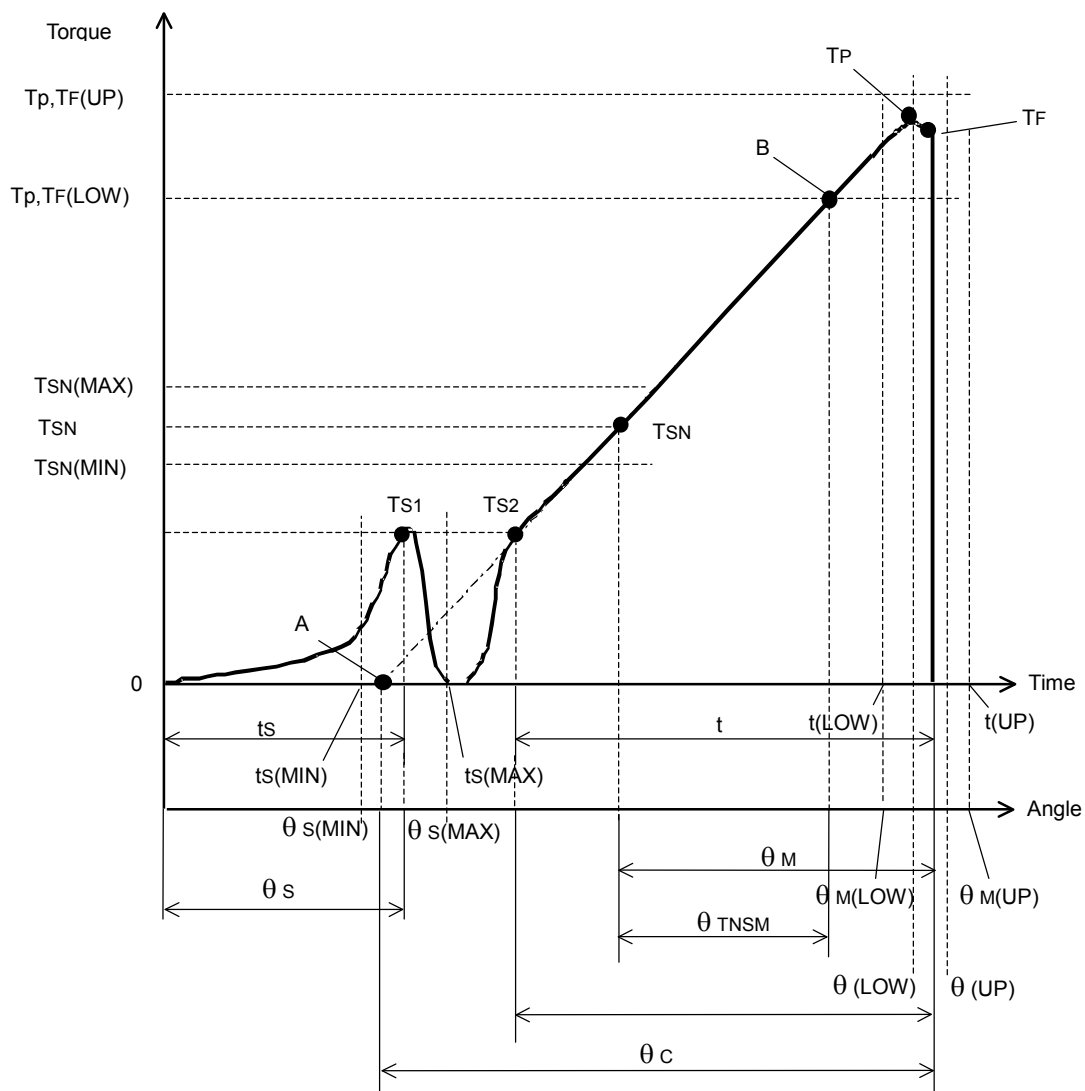
The End of Cycle data, which are generally used in the TORQUE-TURN CONTROL, are shown in the following.

SYMBOL	DESIGNATION
T_P	TIGHTENING PEAK TORQUE
T_F	FINAL TORQUE
T	TIGHTENING TIME
θ	TIGHTENING ANGLE
T_S	SEATING TIME
θ_S	SEATING ANGLE
θ_M	MONITOR ANGLE
T_{SN}	SNUG TORQUE

Table 9.3-4 End of Cycle data

9.4 TORQUE-TENSION CONTROL

The TORQUE-TENSION CONTROL is the fastening control method which uses the angle from the theoretical seating point (calculated using the torque rate in a zone) as a guidepost.



T_{s1} :The first seating torque detection point.

T_{s2} :The second seating torque detection point.(The seating torque detection point in fastening step)

A :The start point of the slope calculated from both the snug torque detection point and B point(The start point of control angle)

B :The completion point of torque rate measurement.(The point as the result of turning by θ_{TNSM} from the snug torque detection point)

Figure 9.4-1 TORQUE-TENSION CONTROL

- Control values

The control values, which are generally used in the TORQUE-TENSION CONTROL, are shown in the following.

SYMBOL	DESIGNATION
-	DIRECTION OF ROTATION
-	AUTO CALIBRATION SW
T_{SN}	SNUG TORQUE
θ_{TNSM}	TORQUE TENSION MEASURING ANGLE
θ_C	CONTROL ANGLE

Table 9.4-1 Control values

- Fastening cycle description

- 1) The NUTRUNNER keeps rotating in high speed till it detects the SEATING TORQUE (T_{S1}).
- 2) It stops when it detects the SEATING TORQUE (T_{S1}).
- 3) It starts the tightening operation in low speed rotation.
- 4) The theoretical seating point (A point) is calculated from the torque rate between the snug point and B point obtained as the result of fastening by TORQUE TENSION MEASURING ANGLE(θ_{TNSM}) from the SNUG TORQUE (T_{SN}).
- 5) The fastening cycle is completed by further tightening only for the shortage of control angle from B point to have A point as the start point for the CONTROL ANGLE(θ_C)

- NG reference values

The NG reference values, which are generally used in the TORQUE-TENSION CONTROL, are shown in the following.

SYMBOL	DESIGNATION
$T_{P(Low)}$	TIGHTENING PEAK TORQUE LOWER LIMIT
$T_{P(UP)}$	TIGHTENING PEAK TORQUE UPPER LIMIT
$T_{F(Low)}$	FINAL TORQUE LOWER LIMIT
$T_{F(UP)}$	FINAL TORQUE UPPER LIMIT
$t_{(Low)}$	TIGHTENING TIME LOWER LIMIT
$t_{(UP)}$	TIGHTENING TIME UPPER LIMIT
$\theta_{(Low)}$	TIGHTENING ANGLE LOWER LIMIT
$\theta_{(UP)}$	TIGHTENING ANGLE UPPER LIMIT
T	SNUG TORQUE LOWER LIMIT
$T_{SN(MAX)}$	SNUG TORQUE UPPER LIMIT
$\theta_{M(Low)}$	MONITOR ANGLE LOWER LIMIT
$\theta_{M(UP)}$	MONITOR ANGLE UPPER LIMIT

Table 9.4-2 NG reference values

- TROUBLE reference values

The TROUBLE reference values, which are generally used in the TORQUE-TENSION CONTROL, are shown in the following.

SYMBOL	DESIGNATION
$t_{S(MIN)}$	SEATING TIME MINIMUM
$t_{S(MAX)}$	SEATING TIME MAXIMUM
$\theta_{S(MIN)}$	SEATING ANGLE MINIMUM
$\theta_{S(MAX)}$	SEATING ANGLE MAXIMUM
$T_{(MAX)}$	TORQUE MAXIMUM
$t_{CYC(MAX)}$	CYCLE TIME MAXIMUM
$T_{SN(MAX)}$	SNUG TORQUE MAXIMUM

Table 9.4-3 TROUBLE reference values

- End of Cycle data

The End of Cycle data, which are generally used in the TORQUE-TENSION CONTROL, are shown in the following.

SYMBOL	DESIGNATION
T_P	TIGHTENING PEAK TORQUE
T_F	FINAL TORQUE
T	TIGHTENING TIME
θ	TIGHTENING ANGLE
T_S	SEATING TIME
θ_S	SEATING ANGLE
θ_M	MONITOR ANGLE
T_{SN}	SNUG TORQUE

Table 9.4-4 End of Cycle data

9.5 YIELD POINT DETECTION CONTROL

The YIELD POINT DETECTION CONTROL is the fastening control method which uses the slope change of fastening with the change of fastening turn angle as the guide post.

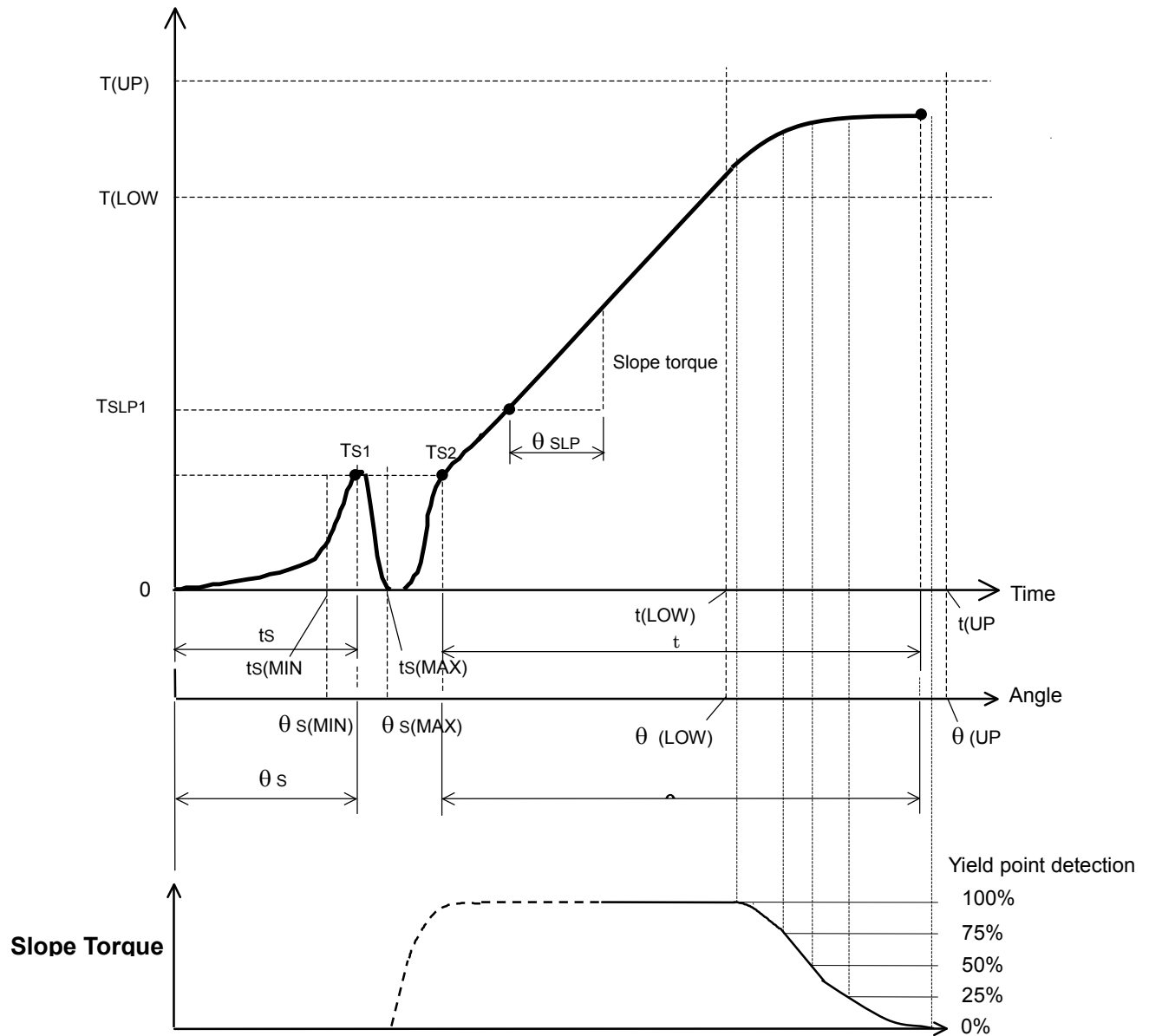


Figure 9.5-1 YIELD POINT DETECTION CONTROL

- Control values

The control values, which are generally used in the YIELD POINT DETECTION CONTROL, are shown in the following.

SYMBOL	DESIGNATION
-	DIRECTION OF ROTATION
-	AUTO CALIBRATION SW
T _s	SEATING TORQUE
θ_{SLP}	SLOPE MONITOR SAMPLING ANGLE
T _{SLP1}	SLOPE 1 START TORQUE
Y _P	YIELD CONTROL ANGLE

Table 9.5-1 Control values

- Fastening cycle description

- 1) The NUTRUNNER keeps rotating in high speed till it detects the SEATING TORQUE (T_{st}).
- 2) It stops when it detects the SEATING TORQUE (T_{st}).
- 3) It starts the tightening operation in low speed rotation.
- 4) The NUTRUNNER starts the SLOPE MONITOR 1 when it detects the SLOPE 1 START TORQUE (T_{SLP1}).
- 5) It reads the torque with the angle input signal
- 6) It starts to calculate the slope torque after rotation of the SLOPE MONITORING ANGLE (θ_{SLP}) from the SLOPE 1 START TORQUE (T_{SLP1}).

The SLOPE TORQUE is calculated as follows.

- T_{SLP} : Slope torque
- θ_{SLP} : Slope sampling angle
- T₁ : Current torque
- θ_1 : Current angle
- T₀ : Torque at the current angle that precedes the slope sampling angle.

$$T_{SLP} = T_1 - T_0$$

- 7) The slope torque is detected with angle input signal, and its maximum and minimum value as well as the comparative trouble reference values are memorized in the NUTRUNNER.
- 8) The Fastening cycle is completed at the time when the slope torque decreases by some rate from the maximum slope torque. The slope torque by which the fastening cycle is completed is calculated by the following formula.

Final slope torque = maximum slope torque / 100 X YIELD POINT DETECTION LEVEL

- NG reference values

The NG reference values, which are generally used in the YIELD POINT DETECTION CONTROL, are shown in the following.

SYMBOL	DESIGNATION
$T_{P(Low)}$	TIGHTENING PEAK TORQUE LOWER LIMIT
$T_{P(UP)}$	TIGHTENING PEAK TORQUE UPPER LIMIT
$T_{F(Low)}$	FINAL TORQUE LOWER LIMIT
$T_{F(UP)}$	FINAL TORQUE UPPER LIMIT
$t_{(Low)}$	TIGHTENING TIME LOWER LIMIT
$t_{(UP)}$	TIGHTENING TIME UPPER LIMIT
$\theta_{(Low)}$	TIGHTENING ANGLE LOWER LIMIT
$\theta_{(UP)}$	TIGHTENING ANGLE UPPER LIMIT

Table 9.5-2 NG reference values

- TROUBLE reference values

The TROUBLE reference values, which are generally used in the TORQUE-TENSION CONTROL, are shown in the following.

SYMBOL	DESIGNATION
$t_{S(MIN)}$	SEATING TIME MINIMUM
$t_{S(MAX)}$	SEATING TIME MAXIMUM
$\theta_{S(MIN)}$	SEATING ANGLE MINIMUM
$\theta_{S(MAX)}$	SEATING ANGLE MAXIMUM
$T_{(MAX)}$	TORQUE MAXIMUM
$\theta_{(MAX)}$	TIGHTENING ANGLE MAXIMUM
$t_{CYC(MAX)}$	CYCLE TIME MAXIMUM

Table 9.5-3 TROUBLE reference values

- End of Cycle data

The End of Cycle data, which are generally used in the YIELD POINT DETECTION CONTROL, are shown in the following.

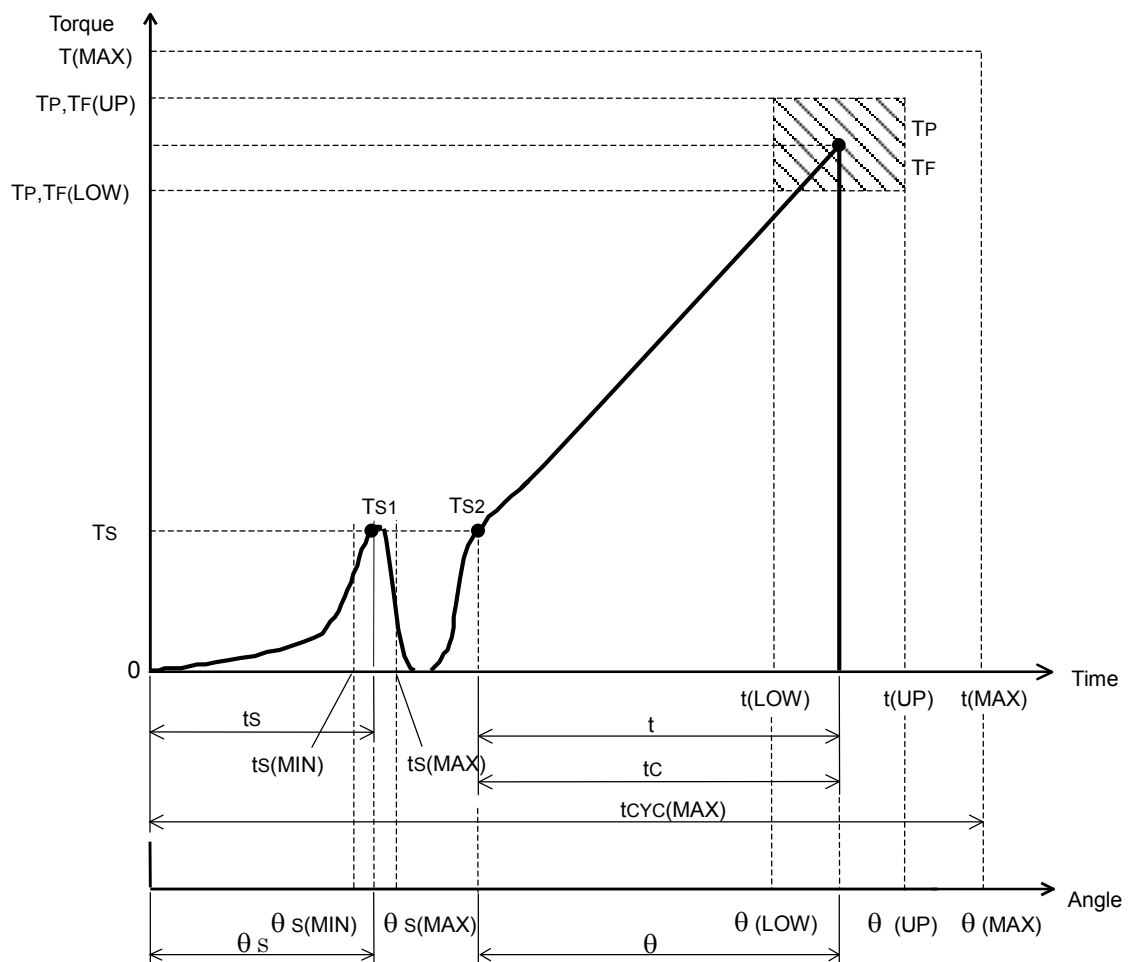
SYMBOL	DESIGNATION
T_P	TIGHTENING PEAK TORQUE
T_F	FINAL TORQUE
T	TIGHTENING TIME
θ	TIGHTENING ANGLE
T_S	SEATING TIME
θ_S	SEATING ANGLE
$T_{SLP1(MIN)}$	MINIMUM VALUE OF SLOPE1
$T_{SLP1(MAX)}$	MAXIMUM VALUE OF SLOPE1
$T_{SLP2(MIN)}$	MINIMUM VALUE OF SLOPE2
$T_{SLP2(MAX)}$	MAXIMUM VALUE OF SLOPE2
T_{SLPF}	FINAL SLOPE TORQUE

Table 9.5-4 End of Cycle data

9.6 ANGLE MONITORING TIMED TORQUE CONTROL

The ANGLE MONITORING TIMED TORQUE CONTROL is the method for the control of a fastening cycle by monitoring the fastening angle from the specified torque having the fastening torque and fastening time as its guideposts.

The ANGLE MONITORING TIMED TORQUE CONTROL is described in the following.



T_{S1} : The first seating torque detection point

T_{S2} : The second seating torque detection point

(The seating torque detection point in fastening step)

Figure 9.6-1 ANGLE MONITORING TIMED TORQUE CONTROL

- Control values

The control values, which are generally used in the ANGLE MONITORING TIMED TORQUE CONTROL, are shown in the following.

SYMBOL	DESIGNATION
-	DIRECTION OF ROTATION
-	AUTO CALIBRATOIN SW
T_c	CONTROL TORQUE
T_c	CONTROL TIME
T_s	SEATING TORQUE

Table 9.6-1 Control values

- Fastening cycle description

- 1) The NUTRUNNER keeps rotating in high speed till it detects the SEATING TORQUE (T_{s1}).
- 2) It stops when it detects the SEATING TORQUE (T_{s1}).
- 3) It starts the tightening operation in low speed rotation.
- 4) The fastening operation is completed when the torque reaches the CONTROL TORQUE (T_c). To complete the fastening operation in a set time (control time T_c), the fastening speed is regulated automatically within the range between the initial and high speed selected in the fastening program, and the minimum speed specified in the system settings.

- NG reference values

The NG reference values, which are generally used in the ANGLE MONITORING TIMED TORQUE CONTROL, are shown in the following.

SYMBOL	DESIGNATION
$T_{P(Low)}$	TIGHTENING PEAK TORQUE LOWER LIMIT
$T_{P(UP)}$	TIGHTENING PEAK TORQUE UPPER LIMIT
$T_{F(Low)}$	FINAL TORQUE LOWER LIMIT
$T_{F(UP)}$	FINAL TORQUE UPPER LIMIT
$t_{(Low)}$	TIGHTENING TIME LOWER LIMIT
$t_{(UP)}$	TIGHTENING TIME UPPER LIMIT
$\theta_{(Low)}$	TIGHTENING ANGLE LOWER LIMIT
$\theta_{(UP)}$	TIGHTENING ANGLE UPPER LIMIT

Table 9.6-2 NG reference values

- TROUBLE reference values

The TROUBLE reference values, which are generally used in the ANGLE MONITORING TIMED TORQUE CONTROL, are shown in the following.

SYMBOL	DESIGNATION
$T_{S(MIN)}$	SEATING TIME MINIMUM
$T_{S(MAX)}$	SEATING TIME MAXIMUM
$\theta_{S(MIN)}$	SEATING ANGLE MINIMUM
$\theta_{S(MAX)}$	SEATING ANGLE MAXIMUM
$T_{(MAX)}$	TORQUE MAXIMUM
$T_{(MAX)}$	TIGHTENING TIME MAXIMUM
$\theta_{(MAX)}$	TIGHTENING ANGLE MAXIMUM
$t_{CYC(MAX)}$	CYCLE TIME MAXIMUM

Table 9.6-3 TROUBLE reference values

- End of Cycle

The End of Cycle data, which are generally used in the ANGLE MONITORING TIMED TORQUE CONTROL, are shown in the following.

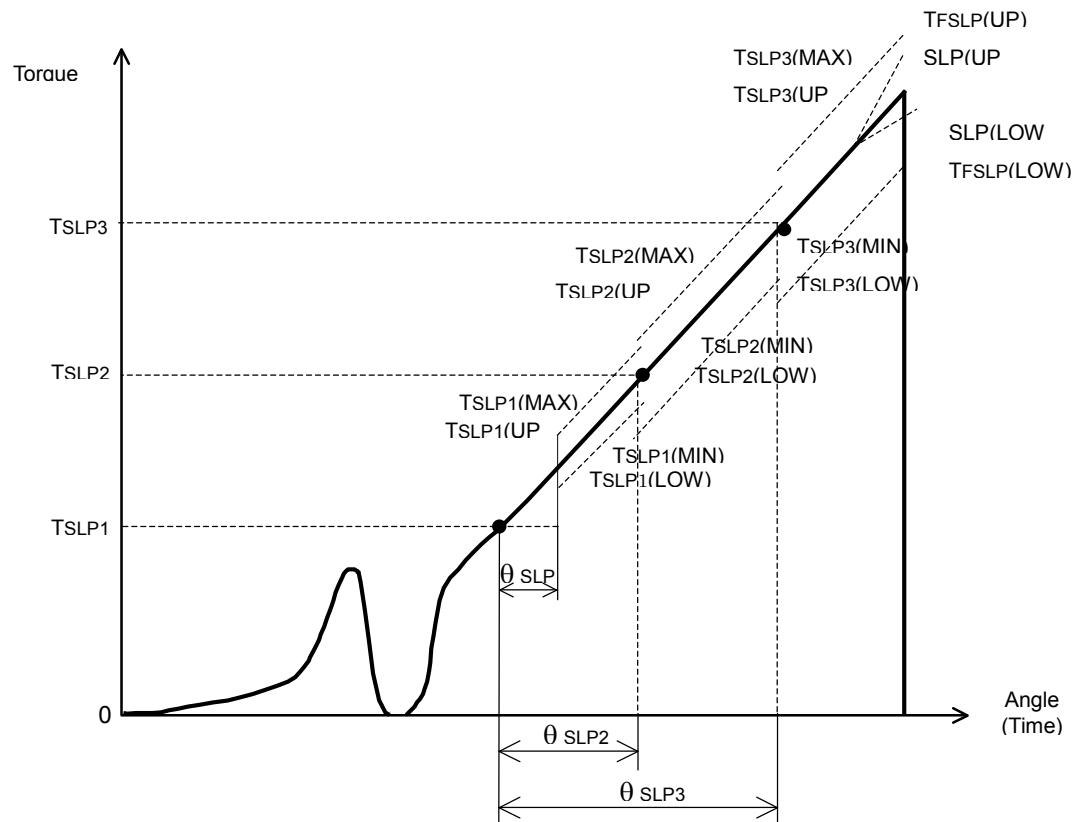
SYMBOL	DESIGNATION
T_P	TIGHTENING PEAK TORQUE
T_F	FINAL TORQUE
T	TIGHTENING TIME
θ	TIGHTENING ANGLE
T_S	SEATING TIME
θ_S	SEATING ANGLE

Table 9.6-4 End of cycle data

9.7 SLOPE MONITORING

The SLOPE MONITORING CONTROL is the control that is effective in all fastening methods.

The SLOPE MONITORING is described in the following.



- T_{SLP1} : Slope 1 Start Torque detection point
- T_{SLP2} : Slope 2 Start Torque detection point
- T_{SLP3} : Slope 3 Start Torque detection point
- θ_{SLP2} : Slope 2 Start Angle from T_{SLP1}
- θ_{SLP3} : Slope 3 Start Angle from T_{SLP1}
- θ_{SLP} : Slope sampling angle

Figure 9.7-1 SLOPE MONITOR

- Control values

The control values, which are generally used in the SLOPE MONITOR, are shown in the following.

SYMBOL	DESIGNATION
-	SLOPE MONITOR TRIGGER
θ_{SLP}	SLOPE MONITOR SAMPLING ANGLE
T_{SLP1}	SLOPE 1 START TORQUE
T_{SLP2}	SLOPE 2 START TORQUE
T_{SLP3}	SLOPE 3 START TORQUE
θ_{SLP2}	SLOPE 2 START ANGLE
θ_{SLP3}	SLOPE 3 START ANGLE

Table 9.7-1 Control values

The SLOPE 2 and SLOPE 3 START TORQUE are valid when the SLOPE MONITOR TRIGGER is set to TRQ.

The SLOPE 2 and SLOPE 3 START ANGLE are valid when the SLOPE MONITOR TRIGGER is set to ANG.

- Fastening cycle description

- 1) The NUTRUNNER starts the SLOPE MONITOR 1 when it detects the SLOPE 1 START TORQUE (T_{SLP1}).
- 2) It reads the torque with the angle input signal.
- 3) It starts to calculate the slope torque after rotation of the SLOPE MONITORING ANGLE (θ_{SLP}) from the SLOPE 1 START TORQUE (T_{SLP1}).

The SLOPE TORQUE is calculated as follows.

- T_{SLP} : Slope torque
- θ_{SLP} : Slope sampling angle
- T_1 : Current torque
- θ_1 : Current angle
- T_0 : Torque at the current angle that precedes the slope sampling angle.

$$T_{SLP} = T_1 - T_0$$

- 4) The slope torque is detected with angle input signal, and its maximum and minimum value as well as the comparative trouble reference values are memorized in the NUTRUNNER
- 5) The SLOPE MONITOR 1 stops and the SLOPE MONITOR 2 starts when the following condition is satisfied.
 - a) When the SLOPE MONITOR TRIGGER is set to TRQ
The SLOPE MONITOR 1 stops and the SLOPE MONITOR 2 starts when the SLOPE 2 START TORQUE (T_{SLP2}) is detected.
 - b) When the SLOPE MONITOR TRIGGER is set to ANG
The SLOPE MONITOR 1 stops and the SLOPE MONITOR 2 starts when the NUTRUNNER rotates the value of the SLOPE 2 ANGLE from starting the SLOPE MONITOR 1.
- 6) The SLOPE MONITOR 2 stops and the SLOPE MONITOR 3 starts when the following condition is satisfied.
 - a) When the SLOPE MONITOR TRIGGER is set to TRQ
The SLOPE MONITOR 2 stops and the SLOPE MONITOR 3 starts when the SLOPE 3 START TORQUE (T_{SLP3}) is detected.
 - b) When the SLOPE MONITOR TRIGGER is set to ANG
The SLOPE MONITOR 2 stops and the SLOPE MONITOR 3 starts when the NUTRUNNER rotates the value of the SLOPE 3 ANGLE from starting the SLOPE MONITOR 1.
- 7) A FINAL SLOPE(T_{SLPF}) is memorized when the fastening cycle is completed.
- 8) A maximum value of the SLOPE is memorized as the SLOPE BASE VALUE(T_{SLPR}). The tightening angle of the point of the SLOPE BASE VALUE is memorized as the SLOPE BASE ANGLE. The torque of the point of it is memorized as the SLOPE BASE TORQUE.
- 9) The rate of the final slope by maximum slope is compared with the FINAL SLOPE LOWER LIMIT and FINAL SLOPE UPPER LIMIT.

- NG reference values

The NG reference values, which are generally used in the SLOPE MONITOR, are shown in the following.

SYMBOL	DESIGNATION
$T_{SLP1(LOW)}$	SLOPE 1 TORQUE LOWER LIMIT
$T_{SLP1(UP)}$	SLOPE 1 TORQUE UPPER LIMIT
$T_{SLP2(LOW)}$	SLOPE 2 TORQUE LOWER LIMIT
$T_{SLP2(UP)}$	SLOPE 2 TORQUE UPPER LIMIT
$T_{SLP3(LOW)}$	SLOPE 3 TORQUE LOWER LIMIT
$T_{SLP3(UP)}$	SLOPE 3 TORQUE UPPER LIMIT
$T_{FSLP(LOW)}$	FINAL SLOPE TORQUE LOWER LIMIT
$T_{FSLP(UP)}$	FINAL SLOPE TORQUE UPPER LIMIT
$SLP_{(LOW)}$	FINAL SLOPE LEVEL LOWER LIMIT
$SLP_{(UP)}$	FINAL SLOPE LEVEL UPPER LIMIT

Table 9.7-2 NG reference values

- TROUBLE reference values

The TROUBLE reference values, which are generally used in the SLOPE MONITOR, are shown in the following.

SYMBOL	DESIGNATION
$T_{SLP1(MIN)}$	SLOPE 1 TORQUE MINIMUM
$T_{SLP1(MAX)}$	SLOPE 1 TORQUE MAXIMUM
$T_{SLP2(MIN)}$	SLOPE 2 TORQUE MINIMUM
$T_{SLP2(MAX)}$	SLOPE 2 TORQUE MAXIMUM
$T_{SLP3(MIN)}$	SLOPE 3 TORQUE MINIMUM
$T_{SLP3(MAX)}$	SLOPE 3 TORQUE MAXIMUM

Table 9.7-3 TROUBLE reference values

- End of Cycle data

The End of Cycle data, which are generally used in the SLOPE MONITOR, are shown in the following.

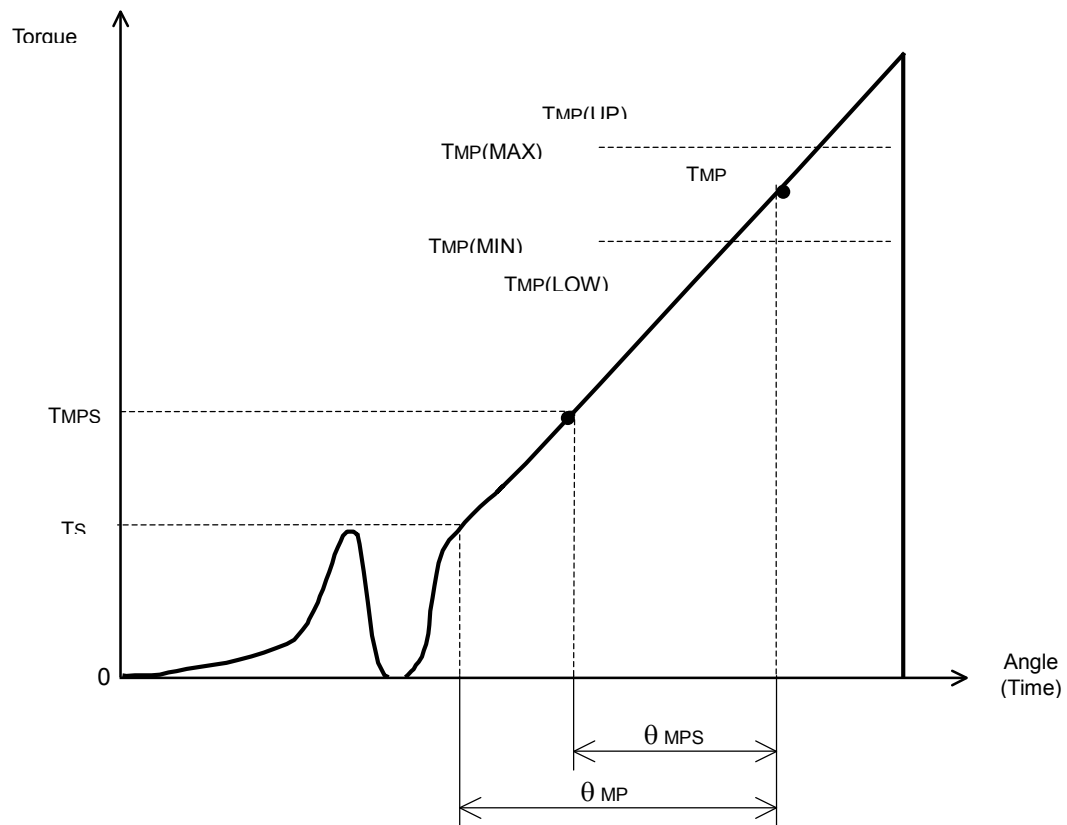
SYMBOL	DESIGNATION
$T_{SLP1(MIN)}$	MINIMUM VALUE OF SLOPE 1
$T_{SLP1(MAX)}$	MAXIMUM VALUE OF SLOPE 1
$T_{SLP2(MIN)}$	MINIMUM VALUE OF SLOPE 2
$T_{SLP2(MAX)}$	MAXIMUM VALUE OF SLOPE 2
$T_{SLP3(MIN)}$	MINIMUM VALUE OF SLOPE 3
$T_{SLP3(MAX)}$	MAXIMUM VALUE OF SLOPE 3
T_{SLPF}	FINAL SLOPE TORQUE
T_{SLPR}	SLOPE BASE VALUE
θ_{SLPB}	SLOPE BASE ANGLE
T_{SLPB}	SLOPE BASE TORQUE

Table 9.7-4 End of Cycle data

9.8 MID. POINT JUDGEMENT

The MID. POINT JUDGEMENT is the monitoring item that is effective in all fastening methods.

The MID. POINT JUDGEMENT is described in the following.



- T_{MPS} : Mid. Point starting torque
- θ_{MPS} : Mid. Point angle
- T_{MP} : Mid. Point judgement torque
- θ_{SLP3} : Mid. Point fastening angle

Figure 9.8-1 MID. POINT JUDGEMENT

- Control values

The control values, which are generally used in the MID. POINT JUDGEMENT, are shown in the following.

SYMBOL	DESIGNATION
T_{MPS}	MID. POINT START TORQUE
θ_{MPS}	MID. POINT ANGLE

Table 9.8-1 Control values

- Fastening cycle description

- 1) The NUTRUNNER starts the count of the angle for MID. POINT JUDGEMENT when it detects the MID. POINT START TORQUE (T_{MPS}).
- 2) The MID. POINT JUDGEMENT TORQUE(T_{MP}) is the torque that the NUTRUNNER rotate the MID. POINT ANGLE(θ_{MPS}) from detecting the MID. POINT START TORQUE(T_{MPS}). The MID. POINT FASTENING ANGLE is the fastening angle from the SEATING TORQUE to the MID. POINT JUDGEMENT TORQUE.
- 3) The MID. POINT JUDGEMENT TORQUE is compared with the TROUBLE reference values of the MID. POINT JUDGEMENT TORQUE LOWER LIMIT and the MID. POINT JUDGEMENT TORQUE UPPER LIMIT.
- 4) When the fastening cycle is completed, the MID. POINT JUDGEMENT TORQUE is compared with the NG reference values of the MID POINT JUDGEMENT TORQUE LOWER LIMIT and the MID. POINT JUDGEMENT TORQUE UPPER LIMIT.

- NG reference values

The NG reference values, which are generally used in the MID. POINT JUDGEMENT, are shown in the following.

SYMBOL	DESIGNATION
$T_{MP(LOW)}$	MID. POINT JUDGEMENT TORQUE LOWER LIMIT
$T_{MP(UP)}$	MID. POINT JUDGEMENT TORQUE UPPER LIMIT

Table 9.8-2 NG reference values

- TROUBLE reference values

The TROUBLE reference values, which are generally used in the MID. POINT JUDGEMENT, are shown in the following.

SYMBOL	DESIGNATION
$T_{MP(MIN)}$	MID. POINT JUDGEMENT TORQUE MINIMUM
$T_{MP(MAX)}$	MID. POINT JUDGEMENT TORQUE MAXIMUM

Table 9.8-3 TROUBLE reference values

- End of Cycle data

The End of Cycle data, which are generally used in the MID. POINT JUDGEMENT, are shown in the following.

SYMBOL	DESIGNATION
θ_{MP}	MID. POINT FASTENING ANGLE
T_{MP}	MID. POINT JUDGEMENT TORQUE

Table 9.8-4 End of Cycle data

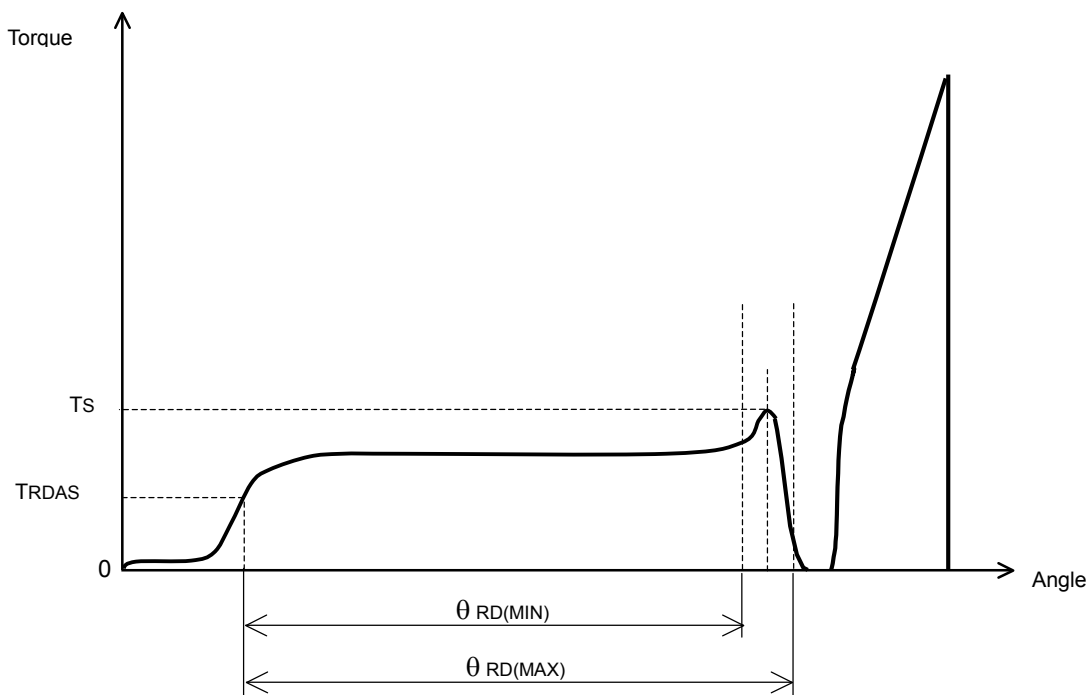
9.9 RUN DOWN JUDGEMENT

The RUN DOWN JUDGEMENT is the monitoring item that is effective in all fastening methods.

The RUN DOWN JUDGEMENT is described in the following.

9.9.1 RUN DOWN ANGLE JUDGEMENT

RUN DOWN ANGLE JUDGEMENT is the judgement function of a rotation angle until it detects seating torque from Start torque of RUN DOWN ANGLE.



- T_s : Seating torque
- T_{RDAS} : Start torque of RUN DOWN angle judgement
- $\theta_{RD(MAX)}$: RUN DOWN angle maximum
- $\theta_{RD(MIN)}$: RUN DOWN angle minimum

Figure 9.9-1 RUN DOWN ANGLE JUDGEMENT

Control values

The control values, which are generally used in the RUN DOWN ANGLE JUDGEMENT, are shown in the following.

SYMBOL	DESIGNATION
T_{RDAS}	Start torque of RUN DOWN angle judgement

Table 9.9-1 Control values

- Fastening cycle description

1) Once the Start torque of angle judgement(T_{RDAS}) is detected, the angle counter starts counting for RUN DOWN Angle judgement. This count angle value is RUN DOWN angle (θ_{RD}).

2) System stops counting once seating torque is detected (T_S)

3) Exceeding the Rundown angle maximum ($\theta_{RD(MAX)}$) prior to detecting the seating torque, will stop the system and result in an NR trouble judgement. Not reaching the RUN DOWN angle minimum ($\theta_{RD(MIN)}$) when system detects the seating torque, will also stop system and result in NR trouble judgement.

- TROUBLE reference values

The TROUBLE reference values, which are generally used in RUN DOWN ANGLE JUDGEMENT, are shown in the following.

SYMBOL	DESIGNATION
$\theta_{RD(MIN)}$	RUN DOWN ANGLE MINIMUM
$\theta_{RD(MAX)}$	RUN DOWN ANGLE MAXIMUM

Table 9.9-2 TROUBLE reference values

- End of Cycle data

The End of Cycle data, which are generally used in the RUN DOWN ANGLE JUDGEMENT, are shown in the following.

SYMBOL	DESIGNATION
θ_{RD}	RUNDOWN ANGLE

Table 9.9-3 End of Cycle data

9.9.2 RUN DOWN TORQUE JUDGEMENT

RUN DOWN TORQUE JUDGEMENT is a function of detecting upper/lower torque judgements before reaching seating point. The judging angle areas can be set anywhere back from when seating torque is detected.

Judgement modes, Normal mode and Momentary mode can be selected.

CAUTION

The Momentary mode is functioned from the ROM Ver 2.1 of the driver and the User Interface Terminal Ver 1.19.0.

9.9.2.1 The Normal mode

The shaded areas in Fig. 9.9-2 shows trouble zones.

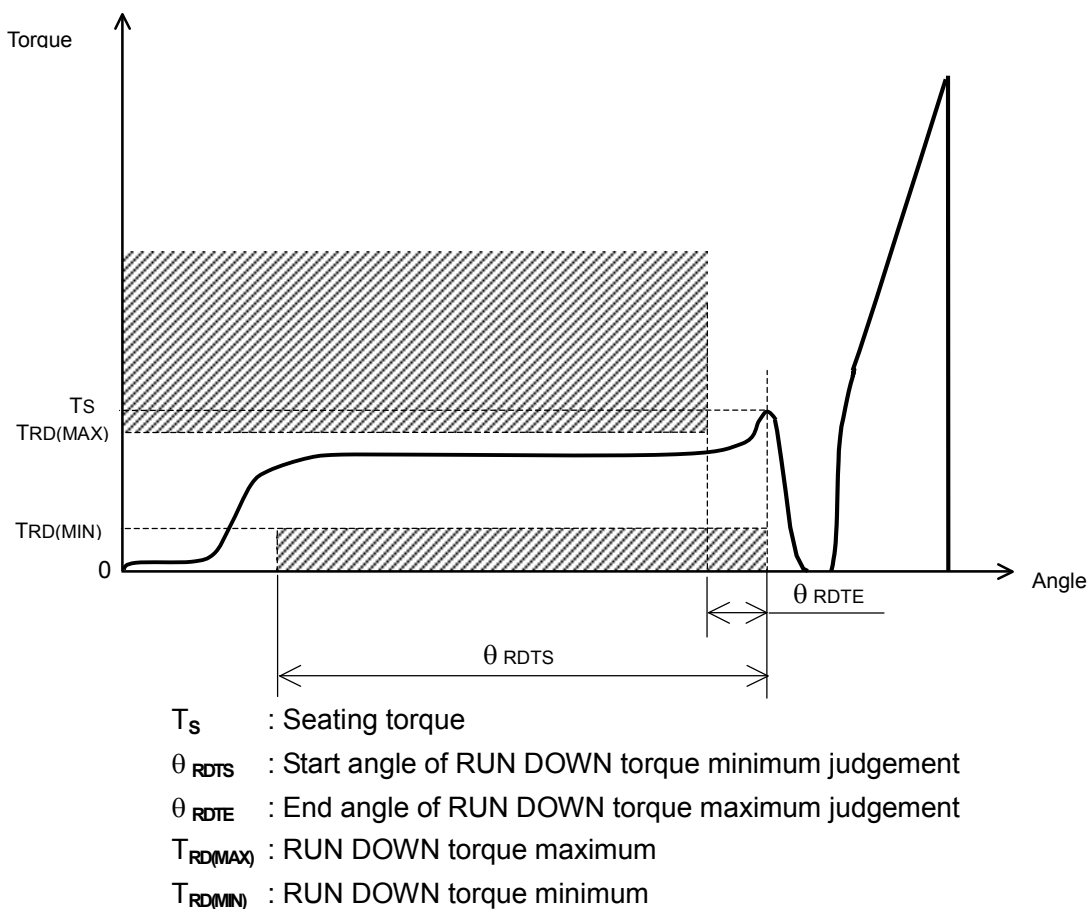


Figure 9.9-2 RUN DOWN TORQUE JUDGEMENT (Normal Mode)

- Control values

The control values, which are generally used in the RUN DOWN TORQUE JUDGEMENT, are shown in the following.

This angle unit shows revolution number. Not degree unit.

SYMBOL	DESIGNATION
-	RUN DOWN Torque Judgement Mode
θ_{RDTS}	Start angle of RUN DOWN torque minimum judgement
θ_{RDTE}	End angle of RUN DOWN torque maximum judgement

Table 9.9-4 Control values

- Fastening cycle description

- 1) Once SEATING TORQUE (T_s) is detected, the system calculates the START ANGLE OF RUN DOWN TORQUE MINIMUM JUDGEMENT (θ_{RDTS}) back from seating point.
- 2) If torque becomes lower than the RUN DOWN TORQUE MINIMUM ($T_{RD(MIN)}$) between START ANGLE RUN DOWN TORQUE MINIMUM JUDGEMENT (θ_{RDTS}) and seating point, the system will stop and a Rundown torque lower trouble judgement will occur.
- 3) Detecting the SEATING TORQUE (T_s), system also calculates END ANGLE OF RUN DOWN TORQUE MAXIMUM JUDGEMENT (θ_{RDTE}) back from seating point simultaneously.
- 4) If torque becomes higher than RUNDOWN TORQUE MAXIMUM ($T_{RD(MAX)}$) between fastening start and END ANGLE OF RUN DOWN TORQUE MAXIMUM JUDGEMENT (θ_{RDTE}), the system will stop and a RUN DOWN torque upper trouble judgement will occur.
- 5) If torque becomes lower than RUNDOWN TORQUE MINIMUM ($T_{RD(MIN)}$) between fastening start and seating point, the system will calculate and remember angle closest to seating as point for turn of RUNDOWN TORQUE MINIMUM JUDGEMENT ($\theta_{RD(MIN)}$) which is number of turns back from seating point.
- 6) If torque becomes higher than RUN DOWN TORQUE MAXIMUM ($T_{RD(MAX)}$) between fastening start and seating point, the system will calculate and remember the first angle point as turn of RUN DOWN TORQUE MAXIMUM JUDGEMENT ($\theta_{RD(MAX)}$) which is number of turns back from seating point.

- TROUBLE reference values

The TROUBLE reference values, which are generally used in RUN DOWN ANGLE JUDGEMENT, are shown in the following.

SYMBOL	DESIGNATION
$T_{RD(MIN)}$	RUN DOWN TORQUE MINIMUM
$T_{RD(MAX)}$	RUN DOWN TORQUE MAXIMUM

Table 9.9-5 TROUBLE reference values

- End of Cycle data

The End of Cycle data, which are generally used in the RUN DOWN ANGLE JUDGEMENT, are shown in the following.

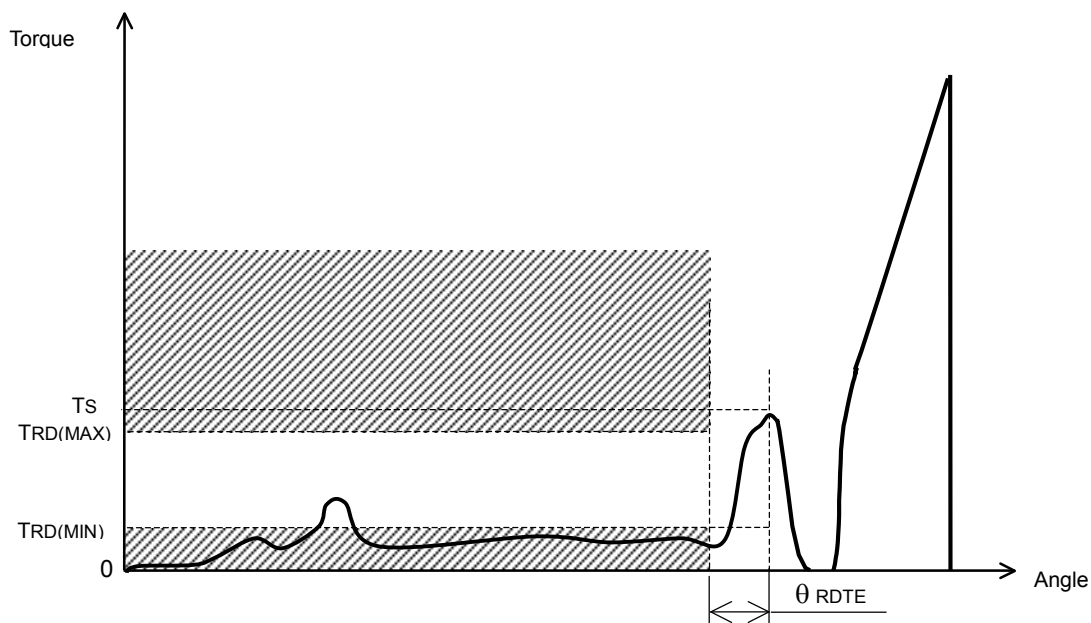
SYMBOL	DESIGNATION
$\theta_{RDT(MIN)}$	RUN DOWN TORQUE MINIMUM JUDGEMENT ANGLE
$\theta_{RDT(MAX)}$	RUN DOWN TORQUE MAXIMUM JUDGEMENT ANGLE

Table 9.9-6 End of Cycle data

9.9.2.2 The Momentary mode

If torque is always lower than the RUN DOWN TORQUE MINIMUM between fastening start and END ANGLE RUN DOWN TORQUE MAXIMUM JUDGEMENT, RUN DOWN torque lower trouble judgement will occur.

RUN DOWN TORQUE MAXIMUM JUDGEMENT is same as Normal mode.



T_S : Seating torque

θ_{RDTE} : End angle of RUN DOWN torque maximum judgement

$T_{RD(MAX)}$: RUN DOWN torque maximum

$T_{RD(MIN)}$: RUN DOWN torque minimum

Figure 9.9-3 RUN DOWN TORQUE JUDGEMENT (Momentary mode)

- Control values

The control values, which are generally used in the RUN DOWN TORQUE JUDGEMENT, are shown in the following.

This angle unit shows revolution number. Not degree unit.

SYMBOL	DESIGNATION
-	RUN DOWN Torque Judgement Mode
θ_{RDTE}	End angle of RUN DOWN torque maximum judgement

Table 9.9-7 Control values

- Fastening cycle description

- 1) Once SEATING TORQUE (T_s) is detected, the system calculates the END ANGLE OF RUN DOWN TORQUE MAXIMUM JUDGEMENT (θ_{RDTE}) back from seating point.
- 2) If torque is always lower than the RUNDOWN TORQUE MINIMUM ($T_{RD(MIN)}$) between fastening start and END ANGLE RUN DOWN TORQUE MAXIMUM JUDGEMENT (θ_{RDTE}), the system will stop and a Rundown torque lower trouble judgement will occur.
- 3) If torque becomes higher than the RUN DOWN TORQUE MAXIMUM ($T_{RD(MAX)}$) between fastening start and END ANGLE RUN DOWN TORQUE MINIMUM JUDGEMENT (θ_{RDTS}), the system will stop and a Rundown torque higher trouble judgement will occur.
- 4) If torque becomes higher than RUN DOWN TORQUE MINIMUM ($T_{RD(MIN)}$) between fastening start and seating point, the system will calculate and remember the first angle point as turn of RUN DOWN TORQUE MINIMUM JUDGEMENT ($\theta_{RDT(MIN)}$) which is number of turns back from seating point.
- 5) If torque becomes higher than RUN DOWN TORQUE MAXIMUM ($T_{RD(MAX)}$) between fastening start and seating point, the system will calculate and remember the first angle point as turn of RUN DOWN TORQUE MAXIMUM JUDGEMENT ($\theta_{RDT(MAX)}$) which is number of turns back from seating point.

- TROUBLE reference values

The TROUBLE reference values, which are generally used in RUN DOWN ANGLE JUDGEMENT, are shown in the following.

SYMBOL	DESIGNATION
$T_{RD(MIN)}$	RUN DOWN TORQUE MINIMUM
$T_{RD(MAX)}$	RUN DOWN TORQUE MAXIMUM

Table 9.9-8 TROUBLE reference values

- End of Cycle data

The End of Cycle data, which are generally used in the RUN DOWN ANGLE JUDGEMENT, are shown in the following.

SYMBOL	DESIGNATION
$\theta_{RDT(MIN)}$	RUN DOWN TORQUE MINIMUM JUDGEMENT ANGLE
$\theta_{RDT(MAX)}$	RUN DOWN TORQUE MAXIMUM JUDGEMENT ANGLE

Table 9.9-9 End of Cycle data

CAUTION

The Momentary mode is functioned from the ROM Ver 2.1 of the driver and the User Interface Terminal Ver 1.19.0.

Chapter 10 Maintenance check

The maintenance check of the NUTRUNNER is described in this chapter.

Chapter 10 Maintenance check.....	10-1
10.1 Periodical check.....	10-2
10.2 Calibration.....	10-3
10.3 Repairs.....	10-4

10.1 Periodical check

Although our company's NUTRUNNER is maintenance free, it is recommended to conduct the periodic checks for keeping its high performance over a long period.

The check and adjustments should only be made by qualified personnel.

The maintenance check items, intervals and methods are described as follows:

CHECK ITEM	CHECK INTERVAL	CHECK METHOD
Check of torque transducer ¹	Prior to the start of operation	Calibration check
Overhaul of spindle assembly ²	Every 10,000 hours	Spindle assembly shall be sent to our company.
Oil stuck to spindle assembly & driver (especially around connector)	At your own discretion	Oil shall be removed as it often causes break-downs
T/T & motor cables for moving parts	At your own discretion	Both continuity test and appearance check shall periodically be conducted as the precaution.
Connection of spindle assembly	At your own discretion	The connections shall periodically be tightened.
Connection of connector	At your own discretion	Care shall be taken of the screw connectors for looseness

Table 10.1-1 Maintenance check items

NOTE

1. The model SDNR DISPLAY PANEL is required for calibration check.
2. The overhaul of SPINDLE ASSEMBLY shall be performed by our company.
Please understand that we cannot take responsibility for actions or results for overhauls not conducted by our company.

10.2 Calibration

Calibration should be performed at least once a year to ensure high accuracy and efficiency of the NUTRUNNER. When calibrating, the use of SANYO torque calibrating device "PEAK TORQUE MASTER model SPPT" or other calibrating device which has enough accuracy.

The specifications of SANYO torque calibrating device "PEAK TOTQUE MASTER model SPPT" is described as follows:

<PTM INDICATOR>

MODEL	DESCRIPTION
SPPT-SIA	Both torque and angle are digitally measured and displayed. This is used in the combination with PTM TRANSDUCER.

Table 10.2-1 PTM Indicator

<PTM TRANSDUCER>

MODEL	RANGE OF TORQUE (N.m)	PULSE ENCODER RESOLUTION (P/R)	COMPATIBLE NUTRUNNER
SCPT-T-2.5	4.90~29.40	360	SDNR(T*1)-005 SDNR(T*1)-010 SDNR(T*1)-025
SCPT-T-5	9.80~58.80	360	SDNR(T*1)-025 SDNR(T*2)-050
SCPT-T-10	39.20~117.60	450	SDNR(T*2)-050 SDNR(T*2)-100
SCPT-T-20	78.0~235.0	450	SDNR(T*2)-100 SDNR(T*3)-180
SCPT-T-40	156.0~470.0	600	SDNR(T*3)-180 SDNR(T*3)-320
SCPT-T-80	314.0~941.0	750	SDNR(T*3)-580
SCPT-T-1000	400~1200	1440	SDNR(T*3)-1000
SCPT-T-2000	800~2400	1760	SDNR(T*3)-1800

Table 10.2-2 PTM Transducer

NOTE

The "model SPPT PEAK TORQUE MASTER OPERATING MANUAL" shall be referred to for the certification test method.

10.3 Repairs

Any breakdown, which occurs within one year after the customer's procurement and for which our company is clearly responsible, will be repaired by us free of charge.

Please understand that the customer is requested to pay for other repairs, overhaul, and certification tests.

Please do not take the units to pieces by the customer. Excessive adjustment could lead to a hazardous state of the units.

Chapter 11 Specifications

The specifications of the model SDNR NUTRUNNER are described in this chapter.

CHAPTER 11 SPECIFICATIONS 11-1

11.1 System specifications 11-2

11.2 Typical operation cycle..... 11-4

11.3 MULTI CONTROLLER specifications 11-6

11.4 DRIVER specifications..... 11-7

11.5 SPINDLE ASSEMBLY specifications 11-10

11.1 System specifications

ITEM	SPECIFICATIONS
Torque detection method	Strain gage
Fastening accuracy	$\pm 2\%$ (3σ / Rated torque)
Rated torque and torque range	Shown in Table 11.1-2.
Allowable minimum torque	25% of rated torque
Allowable maximum torque	110% of rated torque
Torque correction	Gain and offset changeable
Units of torque	kgf.m / N.m / ft.lb (selectable)
Angle detection method	Optical encoder
Minimum resolution and guaranteed accuracy of angle	Shown in Table 11.1-3.

Table 11.1-1 System Specifications

NUTRUNNER MODEL	RATED TORQUE (N.m)	TORQUE RANGE (N.m)
SDNR(T*1)-005	5.0	1.5 - 5.0
SDNR(T*1)-010	10.0	3.0 - 10.0
SDNR(T*1)-025	25.0	7.5 - 25.0
SDNR(T*2)-050	50.0	15.0 - 50.0
SDNR(T*2)-100	100	30.0 - 100
SDNR(T*3)-180	180	54.0 - 180
SDNR(T*3)-320	320	96.0 - 320
SDNR(T*3)-580	580	174 - 580
SDNR(T*3)-1000	1000	300 - 1000
SDNR(T*3)-1800	1800	540 - 1800

Table 11.1-2 Rated torque and torque range

Symbol [*] indicates [S] in Type S and [M] in Type M.

CAUTION

The fastening accuracy is not guaranteed by the fastening torque outside of the torque range.

DETECTION METHOD	RESOLUTION ABILITY	GUARANTEED ACCURACY
Encoder	500ppr	±1.0°

Table 11.1-3 Minimum resolution of angle

11.2 Typical operation cycle

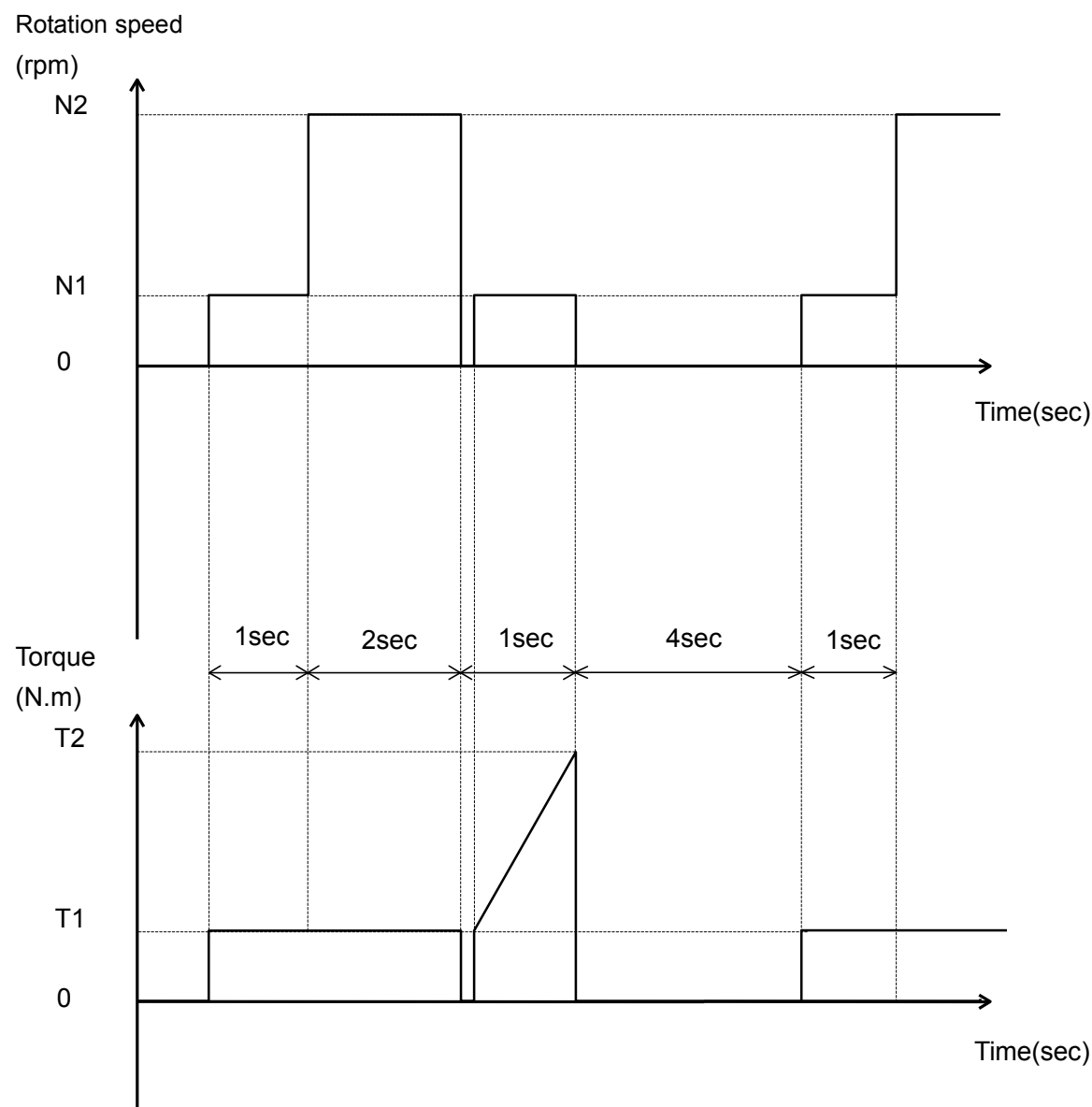


Figure 11.2-1 TYPICAL OPERATION CYCLE

NUTRUNNER MODEL	N1 (rpm)	N2 (rpm)	T1 (N.m)	T2 (N.m)
SDNR(T*)-005S	20 ~ 420	3150	0.5	Rated Torque
SDNR(T*)-010SH/FH	10 ~ 200	1540	1.0	
SDNR(T*)-010S/F	4 ~ 85	640	1.0	
SDNR(T*)-025S/F			2.0	
SDNR(T*)-050S/F	4 ~ 72	545	5.0	
SDNR(T*)-100S/F			10.0	
SDNR(T*)-180S/F	3 ~ 62	465	20.0	
SDNR(T*)-320S/F	2 ~ 40	300	30.0	
SDNR(T*)-580S/F	1 ~ 20	150	50.0	
SDNR(T*)-1000S	1 ~ 12	90	100.0	
SDNR(T*)-1800S	1 ~ 7	50	180.0	

Table 11.2-1 TYPICAL OPERATION CYCLE

Symbol [*] indicates [S] in Type S and [M] in Type M.

11.3 MULTI CONTROLLER specifications

ITEM	SPECIFICATIONS
Model	SDNM-MC
Dimensions (mm)	(W)50×(D)140×(H)220
Weight	1.3kg
Power supply	180V ~ 242V AC, 1 phase, 50/60 Hz
Maximum consumption of electric power	7W
Maximum output current	Shown in Table 11.3-3.
Maximum numbers of spindles	32 spindle assemblies
Interface	I/O interface RS485 interface RS232C interface Option Board Interface
Display	LED display (the end of fastening cycle status, state of the MULTI CONTROLLER, etc.)
Environmental conditions for operation	
Ambient temperature	0 to +50 degrees C
Storage temperature	-10 to +65 degrees C
Humidity	20 to 90% RH (non-condensing)
Altitude	Maximum 1000m (3280ft) above sea level
Vibration	5.9(m/s ²) or less
	19.4(ft/s ²) or less
Airborne dust	If not excessive
Corrosive gas	Not any
Others	1 Option Board can be installed

Table 11.3-1 MULTI CONTROLLER specifications

11.4 DRIVER specifications

ITEM	SPECIFICATIONS
Model	SDN-DR * - * * *
Dimensions (mm)	SDN-DR1 (W)52×(D)140×(H)220 SDN-DR2 (W)64×(D)140×(H)220 SDN-DR3 (W)78×(D)140×(H)220
Weight	Shown in Table 11.4-2.
Average consumption of electric power	Shown in Table 11.4-2.
Maximum consumption of electric power	Shown in Table 11.4-2.
Maximum output current	Shown in Table 11.4-3.
Control spindle Assembly number	1 spindle assembly
Interface	I/O interface RS485 interface
Display	LED lamp display (the end of fastening cycle status, state of the DRIVE, etc.)
Power supply	180V ~ 242V AC, 3 phases, 50/60 Hz
Environmental conditions for operation	
Ambient temperature	0 to +50 degrees C
Storage temperature	-10 to +65 degrees C
Humidity	20 to 90% RH (non-condensing)
Altitude	Maximum 1000m (3280ft) above sea level
Vibration	5.9(m/s ²) or less
	19.4(ft/s ²) or less
Airborne dust	If not excessive
Corrosive gas	Not any

Table 11.4-1 DRIVER specifications

DRIVER MODEL	AVERAGE CONSUMPTION POWER (W)	PEAK POWER CONSUMPTION (W)	WEIGHT (Kg)
SDN-DR1-005	70	500	1.1
SDN-DR1-010			
SDN-DR1-025			
SDN-DR2-050	250	1900	1.7
SDN-DR2-100			
SDN-DR3-180	390	2500	2.0
SDN-DR3-320			
SDN-DR3-580			
SDN-DR3-1000			
SDN-DR3-1800			

Table 11.4-2 AVERAGE and PEAK POWER CONSUMPTION of the DRIVER

NOTE

Average power consumption is based on the typical operation cycle shown in Figure 11.4-2.

DRIVER MODEL	MAXIMUM OUTPUT CURRENT (A)	MAXIMUM RATED CURRENT (A)
SDN-DR1-010	40.0	25.0
SDN-DR1-010		25.0
SDN-DR1-025		25.0
SDN-DR2-050	65.0	20.0
SDN-DR2-100		40.0
SDN-DR3-180	80.0	50.0
SDN-DR3-320		60.0
SDN-DR3-580		55.0
SDN-DR3-1000		55.0
SDN-DR3-1800		55.0

Table 11.4-3 Maximum output current of the DRIVER

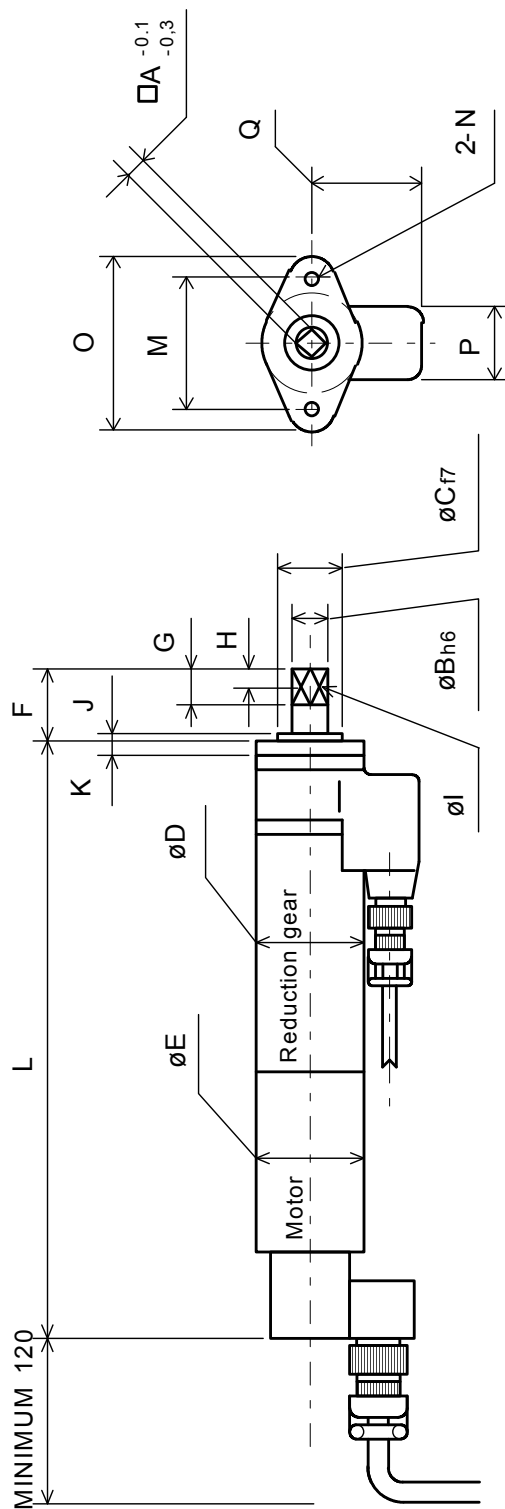
NOTE

The current value has $\pm 10\sim 20\%$ variation. An upper table is for reference value range.

11.5 SPINDLE ASSEMBLY specifications

ITEM	SPECIFICATIONS
Model	SDN-SP * - * * *
Dimensions (mm)	Shown in Figure 11.5-1 and Figure 11.5-2.
Weight	Shown in Table 11.5-2
Rated torque	Shown in Table 11.5-2
Maximum free speed	Shown in Table 11.5-2
Gear reduction ratio	Shown in Table 11.5-2
Type of motor	DC brushless motor
Encoder for output spindle assembly	Optical encoder
Type of spindle assembly	Straight / Offset
Environmental conditions for operation	
Ambient temperature	0 to 50 degrees C
Storage temperature	-10 to 65 degrees C
Humidity	20 to 90% RH (non-condensing)
Altitude	Maximum 1000m (3280ft) above sea level
Vibration	49(m/s ²) or less
	161(ft/s ²) or less
Airborne dust	If not excessive
Corrosive gas	Not any

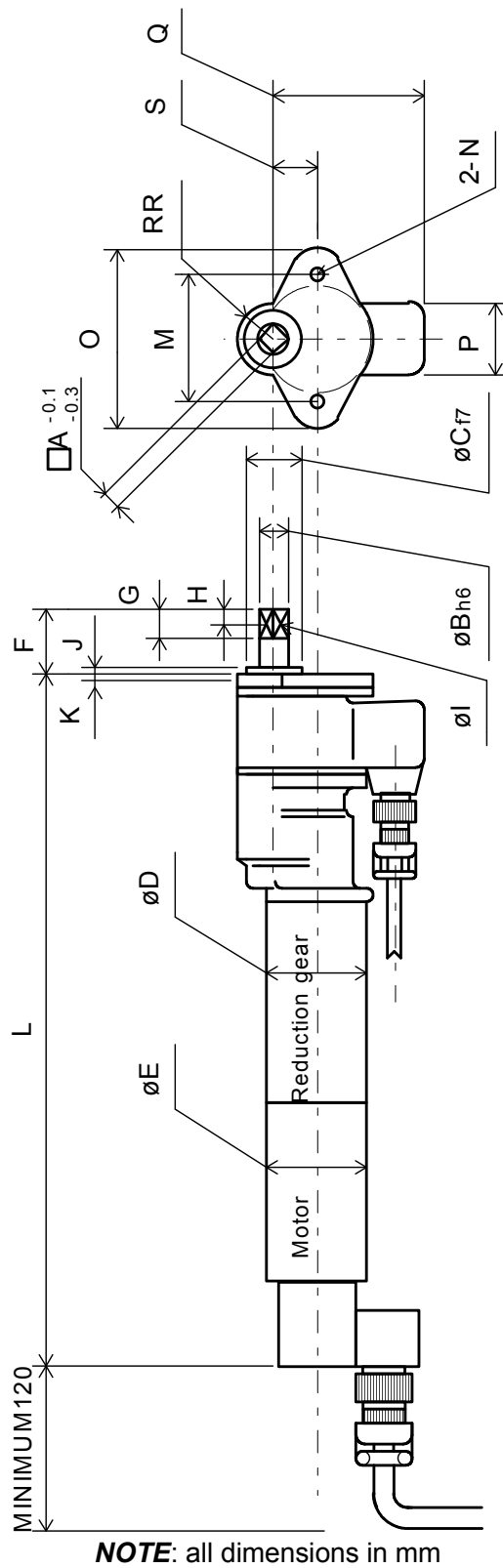
Table 11.5-1 SPINDLE ASSEMBLY specifications



NOTE: all dimensions in mm

Figure 11.5-1 STRAIGHT SPINDLE ASSEMBLY dimensions

MODEL	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
SDN-SP1-005S	9.52	12	22	42	42	25	12	5.5	3.0	3	7	258	54	M6	66	28	50
SDN-SP1-010SHB	9.52	12	22	42	42	25	12	5.5	3.0	3	7	283	54	M6	66	28	50
SDN-SP1-010SB	9.52	12	22	42	42	25	12	5.5	3.0	3	7	283	54	M6	66	28	50
SDN-SP1-025SB	9.52	12	22	42	42	25	12	5.5	3.0	3	7	283	54	M6	66	28	50
SDN-SP2-050SB	12.7	15	28	55	55	32	15	7.0	4.0	3	9	385	70	M8	88	28	56.5
SDN-SP2-100SB	15.88	20	33	55	55	42	21	10.0	5.5	3	9	385	70	M8	88	28	56.5
SDN-SP3-180SB	15.88	20	35	75	75	42	21	10.0	5.5	3	10	396	96	M10	115	28	66.5
SDN-SP3-320SB	19.05	25	40	75	75	50	25	12.0	6.5	3	12	411	96	M10	115	28	66.5
SDN-SP3-580SB	25.4	32	50	103	75	60	33	16.0	6.5	3	16	466	128	M12	150	28	80.5
SDN-SP3-1000S	31.75	40	64	128	75	65	41	20.0	6.5	3	16	508	128	M12	150	30	94
SDN-SP3-1800S	38.1	50	75	150	75	75	50	26.0	8.5	5	16	533	128	M12	150	30	105



MODEL	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
SDN-SP1-010FHB	9.52	12	22	42	42	25	12	5.5	3.0	3	7	316	54	M6	66	28	67	13	17.0
SDN-SP1-010FB												341							
SDN-SP1-025FB	9.52	12	22	42	42	25	12	5.5	3.0	3	7	341	54	M6	66	28	67	13	17.0
SDN-SP2-050FB	12.7	15	28	55	55	32	15	7.0	4.0	3	9	467	70	M8	88	28	82.9	19	26.4
SDN-SP2-100FB	15.88	20	33	55	55	42	21	10.0	5.5	3	9	467	70	M8	88	28	82.9	19	26.4
SDN-SP3-180FB	15.88	20	35	75	75	42	21	10.0	5.5	3	10	485	96	M10	115	28	98.9	23	32.4
SDN-SP3-320FB	19.05	25	40	75	75	50	25	12.0	6.5	3	12	523	96	M10	115	28	104.7	27	38.2
SDN-SP3-580FB	25.4	32	50	103	75	60	33	16.0	6.5	3	16	557	128	M12	150	28	121.5	30	41.0

Figure 11.5-2 OFFSET SPINDLE ASSEMBLY dimensions

SPINDLE ASSEMBLY MODEL	RATED TORQUE (N.m)	MAXIMUM FREE SPEED (rpm)	GEAR REDUCTION RATIO	PULSE RESOLUTION OF ENCODER (ppr)	WEIGHT (kg)
SDN-SP1-005S	5.0	3150	1:4.76	500	1.5
SDN-SP1-010SH	10.0	1540	1:9.8		1.7
SDN-SP1-010FH					2.1
SDN-SP1-010S	10.0	640	1:23.4		1.8
SDN-SP1-010F					2.2
SDN-SP1-025S	25.0	640	1:23.4		1.8
SDN-SP1-025F					2.2
SDN-SP2-050S	50.0	545	1:27.6		4.5
SDN-SP2-050F					5.8
SDN-SP2-100S	100	545	1:27.6		4.5
SDN-SP2-100F					5.8
SDN-SP3-180S	180	465	1:32.2		8.1
SDN-SP3-180F					10.3
SDN-SP3-320S	320	300	1:49.8		8.8
SDN-SP3-320F					11.0
SDN-SP3-580S	580	155	1:98.3		16.0
SDN-SP3-580F					22.0
SDN-SP3-1000S	1000	90	1:165.0		
SDN-SP3-1800S	1800	50	1:300.2		34.0

Table 11.5-2 SPINDLE ASSEMBLY specifications

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Chapter 12 Appendix

The appendix of the model SDNR NUTRUNNER is described in this chapter.

Chapter 12 Appendix12-1
12.1 Speed setting list.....12-2

12.1 Speed setting list

SDN-SP1-010SH-FH
SPEED SETTING LIST
(Positive rotation)

MODERATING RATIO : 1/9.8
POSITIVE ROTATION
MAXIMUM SPEED 1540 rpm

SET VALUE	ACTUAL SPEED (rpm)	SET VALUE	ACTUAL SPEED (rpm)	SET VALUE	ACTUAL SPEED (rpm)	SET VALUE	ACTUAL SPEED (rpm)
0076	11	1076	396	2076	781	3076	1166
00EB	22	10EB	407	20EB	792	30EB	1177
0160	33	1160	418	2160	803	3160	1188
01D5	44	11D5	429	21D5	814	31D5	1199
024A	55	124A	440	224A	825	324A	1210
02BF	66	12BF	451	22BF	836	32BF	1221
0334	77	1334	462	2334	847	3334	1232
03A9	88	13A9	473	23A9	858	33A9	1243
041E	99	141E	484	241E	869	341E	1254
0493	110	1493	495	2493	880	3493	1265
0508	121	1508	506	2508	891	3508	1276
057D	132	157D	517	257D	902	357D	1287
05F2	143	15F2	528	25F2	913	35F2	1298
0667	154	1667	539	2667	924	3667	1309
06DC	165	16DC	550	26DC	935	36DC	1320
0751	176	1751	561	2751	946	3751	1331
07C6	187	17C6	572	27C6	957	37C6	1342
083B	198	183B	583	283B	968	383B	1353
08B0	209	18B0	594	28B0	979	38B0	1364
0925	220	1925	605	2925	990	3925	1375
099A	231	199A	616	299A	1001	399A	1386
0A0F	242	1A0F	627	2A0F	1012	3A0F	1397
0A84	253	1A84	638	2A84	1023	3A84	1408
0AF9	264	1AF9	649	2AF9	1034	3AF9	1419
0B6E	275	1B6E	660	2B6E	1045	3B6E	1430
0BE3	286	1BE3	671	2BE3	1056	3BE3	1441
0C58	297	1C58	682	2C58	1067	3C58	1452
0CCD	308	1CCD	693	2CCD	1078	3CCD	1463
0D42	319	1D42	704	2D42	1089	3D42	1474
0DB7	330	1DB7	715	2DB7	1100	3DB7	1485
0E2C	341	1E2C	726	2E2C	1111	3E2C	1496
0EA1	352	1EA1	737	2EA1	1122	3EA1	1507
0F16	363	1F16	748	2F16	1133	3F16	1518
0F8B	374	1F8B	759	2F8B	1144	3F8B	1529
1000	385	2000	770	3000	1155	4000	1540

SDN-SP1-010SH-FH
SPEED SETTING LIST
(Reverse rotation)

MODERATING RATIO : 1/9.8
REVERSE ROTATION : -1540 rpm
MAXIMUM SPEED

SET VALUE	ACTUAL SPEED (rpm)	SET VALUE	ACTUAL SPEED (rpm)	SET VALUE	ACTUAL SPEED (rpm)	SET VALUE	ACTUAL SPEED (rpm)
FF8A	-11	EF8A	-396	DF8A	-781	CF8A	-1166
FF15	-22	EF15	-407	DF15	-792	CF15	-1177
FEA0	-33	EEA0	-418	DEA0	-803	CEA0	-1188
FE2B	-44	EE2B	-429	DE2B	-814	CE2B	-1199
FDB6	-55	EDB6	-440	DDB6	-825	CDB6	-1210
FD41	-66	ED41	-451	DD41	-836	CD41	-1221
FCCC	-77	ECCC	-462	DCCC	-847	CCCC	-1232
FC57	-88	EC57	-473	DC57	-858	CC57	-1243
FBE2	-99	EBE2	-484	DBE2	-869	CBE2	-1254
FB6D	-110	EB6D	-495	DB6D	-880	CB6D	-1265
FAF8	-121	EAF8	-506	DAF8	-891	CAF8	-1276
FA83	-132	EA83	-517	DA83	-902	CA83	-1287
FA0E	-143	EA0E	-528	DA0E	-913	CA0E	-1298
F999	-154	E999	-539	D999	-924	C999	-1309
F924	-165	E924	-550	D924	-935	C924	-1320
F8AF	-176	E8AF	-561	D8AF	-946	C8AF	-1331
F83A	-187	E83A	-572	D83A	-957	C83A	-1342
F7C5	-198	E7C5	-583	D7C5	-968	C7C5	-1353
F750	-209	E750	-594	D750	-979	C750	-1364
F6DB	-220	E6DB	-605	D6DB	-990	C6DB	-1375
F666	-231	E666	-616	D666	-1001	C666	-1386
F5F1	-242	E5F1	-627	D5F1	-1012	C5F1	-1397
F57C	-253	E57C	-638	D57C	-1023	C57C	-1408
F507	-264	E507	-649	D507	-1034	C507	-1419
F492	-275	E492	-660	D492	-1045	C492	-1430
F41D	-286	E41D	-671	D41D	-1056	C41D	-1441
F3A8	-297	E3A8	-682	D3A8	-1067	C3A8	-1452
F333	-308	E333	-693	D333	-1078	C333	-1463
F2BE	-319	E2BE	-704	D2BE	-1089	C2BE	-1474
F249	-330	E249	-715	D249	-1100	C249	-1485
F1D4	-341	E1D4	-726	D1D4	-1111	C1D4	-1496
F15F	-352	E15F	-737	D15F	-1122	C15F	-1507
F0EA	-363	E0EA	-748	D0EA	-1133	C0EA	-1518
F075	-374	E075	-759	D075	-1144	C075	-1529
F000	-385	E000	-770	D000	-1155	C000	-1540

SDN-SP1-010-025S-F
SPEED SETTING LIST
(Positive rotation)

MODERATING RATIO : 1/23.4
POSITIVE ROTATION
MAXIMUM SPEED 640 rpm

SET VALUE	ACTUAL SPEED (rpm)	SET VALUE	ACTUAL SPEED (rpm)	SET VALUE	ACTUAL SPEED (rpm)	SET VALUE	ACTUAL SPEED (rpm)
0076	5	1076	165	2076	325	3076	485
00EB	9	10EB	169	20EB	329	30EB	489
0160	14	1160	174	2160	334	3160	494
01D5	18	11D5	178	21D5	338	31D5	498
024A	23	124A	183	224A	343	324A	503
02BF	27	12BF	187	22BF	347	32BF	507
0334	32	1334	192	2334	352	3334	512
03A9	37	13A9	197	23A9	357	33A9	517
041E	41	141E	201	241E	361	341E	521
0493	46	1493	206	2493	366	3493	526
0508	50	1508	210	2508	370	3508	530
057D	55	157D	215	257D	375	357D	535
05F2	59	15F2	219	25F2	379	35F2	539
0667	64	1667	224	2667	384	3667	544
06DC	69	16DC	229	26DC	389	36DC	549
0751	73	1751	233	2751	393	3751	553
07C6	78	17C6	238	27C6	398	37C6	558
083B	82	183B	242	283B	402	383B	562
08B0	87	18B0	247	28B0	407	38B0	567
0925	91	1925	251	2925	411	3925	571
099A	96	199A	256	299A	416	399A	576
0A0F	101	1A0F	261	2A0F	421	3A0F	581
0A84	105	1A84	265	2A84	425	3A84	585
0AF9	110	1AF9	270	2AF9	430	3AF9	590
0B6E	114	1B6E	274	2B6E	434	3B6E	594
0BE3	119	1BE3	279	2BE3	439	3BE3	599
0C58	123	1C58	283	2C58	443	3C58	603
0CCD	128	1CCD	288	2CCD	448	3CCD	608
0D42	133	1D42	293	2D42	453	3D42	613
0DB7	137	1DB7	297	2DB7	457	3DB7	617
0E2C	142	1E2C	302	2E2C	462	3E2C	622
0EA1	146	1EA1	306	2EA1	466	3EA1	626
0F16	151	1F16	311	2F16	471	3F16	631
0F8B	155	1F8B	315	2F8B	475	3F8B	635
1000	160	2000	320	3000	480	4000	640

SDN-SP1-010 · 025S-F
SPEED SETTING LIST
(Reverse rotation)

MODERATING RATIO : 1/23.4
REVERSE ROTATION
MAXIMUM SPEED -640 rpm

SET VALUE	ACTUAL SPEED (rpm)	SET VALUE	ACTUAL SPEED (rpm)	SET VALUE	ACTUAL SPEED (rpm)	SET VALUE	ACTUAL SPEED (rpm)
FF8A	-5	EF8A	-165	DF8A	-325	CF8A	-485
FF15	-9	EF15	-169	DF15	-329	CF15	-489
FEA0	-14	EEA0	-174	DEA0	-334	CEA0	-494
FE2B	-18	EE2B	-178	DE2B	-338	CE2B	-498
FDB6	-23	EDB6	-183	DDB6	-343	CDB6	-503
FD41	-27	ED41	-187	DD41	-347	CD41	-507
FCCC	-32	ECCC	-192	DCCC	-352	CCCC	-512
FC57	-37	EC57	-197	DC57	-357	CC57	-517
FBE2	-41	EBE2	-201	DBE2	-361	CBE2	-521
FB6D	-46	EB6D	-206	DB6D	-366	CB6D	-526
FAF8	-50	EAF8	-210	DAF8	-370	CAF8	-530
FA83	-55	EA83	-215	DA83	-375	CA83	-535
FA0E	-59	EA0E	-219	DA0E	-379	CA0E	-539
F999	-64	E999	-224	D999	-384	C999	-544
F924	-69	E924	-229	D924	-389	C924	-549
F8AF	-73	E8AF	-233	D8AF	-393	C8AF	-553
F83A	-78	E83A	-238	D83A	-398	C83A	-558
F7C5	-82	E7C5	-242	D7C5	-402	C7C5	-562
F750	-87	E750	-247	D750	-407	C750	-567
F6DB	-91	E6DB	-251	D6DB	-411	C6DB	-571
F666	-96	E666	-256	D666	-416	C666	-576
F5F1	-101	E5F1	-261	D5F1	-421	C5F1	-581
F57C	-105	E57C	-265	D57C	-425	C57C	-585
F507	-110	E507	-270	D507	-430	C507	-590
F492	-114	E492	-274	D492	-434	C492	-594
F41D	-119	E41D	-279	D41D	-439	C41D	-599
F3A8	-123	E3A8	-283	D3A8	-443	C3A8	-603
F333	-128	E333	-288	D333	-448	C333	-608
F2BE	-133	E2BE	-293	D2BE	-453	C2BE	-613
F249	-137	E249	-297	D249	-457	C249	-617
F1D4	-142	E1D4	-302	D1D4	-462	C1D4	-622
F15F	-146	E15F	-306	D15F	-466	C15F	-626
F0EA	-151	E0EA	-311	D0EA	-471	C0EA	-631
F075	-155	E075	-315	D075	-475	C075	-635
F000	-160	E000	-320	D000	-480	C000	-640

SDN-SP2-050-100S-F
SPEED SETTING LIST
(Positive rotation)

MODERATING RATIO : 1/27.6
POSITIVE ROTATION
MAXIMUM SPEED 545 rpm

SET VALUE	ACTUAL SPEED (rpm)	SET VALUE	ACTUAL SPEED (rpm)	SET VALUE	ACTUAL SPEED (rpm)	SET VALUE	ACTUAL SPEED (rpm)
0076	4	1076	140	2076	276	3076	413
00EB	8	10EB	144	20EB	280	30EB	417
0160	12	1160	148	2160	284	3160	420
01D5	16	11D5	152	21D5	288	31D5	424
024A	19	124A	156	224A	292	324A	428
02BF	23	12BF	160	22BF	296	32BF	432
0334	27	1334	163	2334	300	3334	436
03A9	31	13A9	167	23A9	304	33A9	440
041E	35	141E	171	241E	308	341E	444
0493	39	1493	175	2493	311	3493	448
0508	43	1508	179	2508	315	3508	452
057D	47	157D	183	257D	319	357D	455
05F2	51	15F2	187	25F2	323	35F2	459
0667	54	1667	191	2667	327	3667	463
06DC	58	16DC	195	26DC	331	36DC	467
0751	62	1751	199	2751	335	3751	471
07C6	66	17C6	202	27C6	339	37C6	475
083B	70	183B	206	283B	343	383B	479
08B0	74	18B0	210	28B0	346	38B0	483
0925	78	1925	214	2925	350	3925	487
099A	82	199A	218	299A	354	399A	490
0A0F	86	1A0F	222	2A0F	358	3A0F	494
0A84	90	1A84	226	2A84	362	3A84	498
0AF9	93	1AF9	230	2AF9	366	3AF9	502
0B6E	97	1B6E	234	2B6E	370	3B6E	506
0BE3	101	1BE3	237	2BE3	374	3BE3	510
0C58	105	1C58	241	2C58	378	3C58	514
0CCD	109	1CCD	245	2CCD	381	3CCD	518
0D42	113	1D42	249	2D42	385	3D42	522
0DB7	117	1DB7	253	2DB7	389	3DB7	526
0E2C	121	1E2C	257	2E2C	393	3E2C	529
0EA1	125	1EA1	261	2EA1	397	3EA1	533
0F16	128	1F16	265	2F16	401	3F16	537
0F8B	132	1F8B	269	2F8B	405	3F8B	541
1000	136	2000	272	3000	409	4000	545

SDN-SP2-050-100S-F
SPEED SETTING LIST
(Reverse rotation)

MODERATING RATIO : 1/27.6
REVERSE ROTATION : -545 rpm
MAXIMUM SPEED

SET VALUE	ACTUAL SPEED (rpm)	SET VALUE	ACTUAL SPEED (rpm)	SET VALUE	ACTUAL SPEED (rpm)	SET VALUE	ACTUAL SPEED (rpm)
FF8A	-4	EF8A	-140	DF8A	-276	CF8A	-413
FF15	-8	EF15	-144	DF15	-280	CF15	-417
FEA0	-12	EEA0	-148	DEA0	-284	CEA0	-420
FE2B	-16	EE2B	-152	DE2B	-288	CE2B	-424
FDB6	-19	EDB6	-156	DDB6	-292	CDB6	-428
FD41	-23	ED41	-160	DD41	-296	CD41	-432
FCCC	-27	ECCC	-163	DCCC	-300	CCCC	-436
FC57	-31	EC57	-167	DC57	-304	CC57	-440
FBE2	-35	EBE2	-171	DBE2	-308	CBE2	-444
FB6D	-39	EB6D	-175	DB6D	-311	CB6D	-448
FAF8	-43	EAF8	-179	DAF8	-315	CAF8	-452
FA83	-47	EA83	-183	DA83	-319	CA83	-455
FA0E	-51	EA0E	-187	DA0E	-323	CA0E	-459
F999	-54	E999	-191	D999	-327	C999	-463
F924	-58	E924	-195	D924	-331	C924	-467
F8AF	-62	E8AF	-199	D8AF	-335	C8AF	-471
F83A	-66	E83A	-202	D83A	-339	C83A	-475
F7C5	-70	E7C5	-206	D7C5	-343	C7C5	-479
F750	-74	E750	-210	D750	-346	C750	-483
F6DB	-78	E6DB	-214	D6DB	-350	C6DB	-487
F666	-82	E666	-218	D666	-354	C666	-490
F5F1	-86	E5F1	-222	D5F1	-358	C5F1	-494
F57C	-90	E57C	-226	D57C	-362	C57C	-498
F507	-93	E507	-230	D507	-366	C507	-502
F492	-97	E492	-234	D492	-370	C492	-506
F41D	-101	E41D	-237	D41D	-374	C41D	-510
F3A8	-105	E3A8	-241	D3A8	-378	C3A8	-514
F333	-109	E333	-245	D333	-381	C333	-518
F2BE	-113	E2BE	-249	D2BE	-385	C2BE	-522
F249	-117	E249	-253	D249	-389	C249	-526
F1D4	-121	E1D4	-257	D1D4	-393	C1D4	-529
F15F	-125	E15F	-261	D15F	-397	C15F	-533
F0EA	-128	E0EA	-265	D0EA	-401	C0EA	-537
F075	-132	E075	-269	D075	-405	C075	-541
F000	-136	E000	-272	D000	-409	C000	-545

SDN-SP3-180 S-F
SPEED SETTING LIST
(Positive rotation)

MODERATING RATIO : 1/32.2
POSITIVE ROTATION
MAXIMUM SPEED 465 rpm

SET VALUE	ACTUAL SPEED (rpm)	SET VALUE	ACTUAL SPEED (rpm)	SET VALUE	ACTUAL SPEED (rpm)	SET VALUE	ACTUAL SPEED (rpm)
0076	3	1076	120	2076	236	3076	352
00EB	7	10EB	123	20EB	239	30EB	355
0160	10	1160	126	2160	242	3160	359
01D5	13	11D5	130	21D5	246	31D5	362
024A	17	124A	133	224A	249	324A	365
02BF	20	12BF	136	22BF	252	32BF	369
0334	23	1334	139	2334	256	3334	372
03A9	27	13A9	143	23A9	259	33A9	375
041E	30	141E	146	241E	262	341E	379
0493	33	1493	149	2493	266	3493	382
0508	37	1508	153	2508	269	3508	385
057D	40	157D	156	257D	272	357D	389
05F2	43	15F2	159	25F2	276	35F2	392
0667	46	1667	163	2667	279	3667	395
06DC	50	16DC	166	26DC	282	36DC	399
0751	53	1751	169	2751	286	3751	402
07C6	56	17C6	173	27C6	289	37C6	405
083B	60	183B	176	283B	292	383B	409
08B0	63	18B0	179	28B0	296	38B0	412
0925	66	1925	183	2925	299	3925	415
099A	70	199A	186	299A	302	399A	418
0A0F	73	1A0F	189	2A0F	306	3A0F	422
0A84	76	1A84	193	2A84	309	3A84	425
0AF9	80	1AF9	196	2AF9	312	3AF9	428
0B6E	83	1B6E	199	2B6E	316	3B6E	432
0BE3	86	1BE3	203	2BE3	319	3BE3	435
0C58	90	1C58	206	2C58	322	3C58	438
0CCD	93	1CCD	209	2CCD	325	3CCD	442
0D42	96	1D42	213	2D42	329	3D42	445
0DB7	100	1DB7	216	2DB7	332	3DB7	448
0E2C	103	1E2C	219	2E2C	335	3E2C	452
0EA1	106	1EA1	223	2EA1	339	3EA1	455
0F16	110	1F16	226	2F16	342	3F16	458
0F8B	113	1F8B	229	2F8B	345	3F8B	462
1000	116	2000	232	3000	349	4000	465

SDN-SP3-180 S · F
SPEED SETTING LIST
(Reverse rotation)

MODERATING RATIO : 1/32.2
REVERSE ROTATION
MAXIMUM SPEED -465 rpm

SET VALUE	ACTUAL SPEED (rpm)	SET VALUE	ACTUAL SPEED (rpm)	SET VALUE	ACTUAL SPEED (rpm)	SET VALUE	ACTUAL SPEED (rpm)
FF8A	-3	EF8A	-120	DF8A	-236	CF8A	-352
FF15	-7	EF15	-123	DF15	-239	CF15	-355
FEA0	-10	EEA0	-126	DEA0	-242	CEA0	-359
FE2B	-13	EE2B	-130	DE2B	-246	CE2B	-362
FDB6	-17	EDB6	-133	DDB6	-249	CDB6	-365
FD41	-20	ED41	-136	DD41	-252	CD41	-369
FCCC	-23	ECCC	-139	DCCC	-256	CCCC	-372
FC57	-27	EC57	-143	DC57	-259	CC57	-375
FBE2	-30	EBE2	-146	DBE2	-262	CBE2	-379
FB6D	-33	EB6D	-149	DB6D	-266	CB6D	-382
FAF8	-37	EAF8	-153	DAF8	-269	CAF8	-385
FA83	-40	EA83	-156	DA83	-272	CA83	-389
FA0E	-43	EA0E	-159	DA0E	-276	CA0E	-392
F999	-46	E999	-163	D999	-279	C999	-395
F924	-50	E924	-166	D924	-282	C924	-399
F8AF	-53	E8AF	-169	D8AF	-286	C8AF	-402
F83A	-56	E83A	-173	D83A	-289	C83A	-405
F7C5	-60	E7C5	-176	D7C5	-292	C7C5	-409
F750	-63	E750	-179	D750	-296	C750	-412
F6DB	-66	E6DB	-183	D6DB	-299	C6DB	-415
F666	-70	E666	-186	D666	-302	C666	-418
F5F1	-73	E5F1	-189	D5F1	-306	C5F1	-422
F57C	-76	E57C	-193	D57C	-309	C57C	-425
F507	-80	E507	-196	D507	-312	C507	-428
F492	-83	E492	-199	D492	-316	C492	-432
F41D	-86	E41D	-203	D41D	-319	C41D	-435
F3A8	-90	E3A8	-206	D3A8	-322	C3A8	-438
F333	-93	E333	-209	D333	-325	C333	-442
F2BE	-96	E2BE	-213	D2BE	-329	C2BE	-445
F249	-100	E249	-216	D249	-332	C249	-448
F1D4	-103	E1D4	-219	D1D4	-335	C1D4	-452
F15F	-106	E15F	-223	D15F	-339	C15F	-455
F0EA	-110	E0EA	-226	D0EA	-342	C0EA	-458
F075	-113	E075	-229	D075	-345	C075	-462
F000	-116	E000	-232	D000	-349	C000	-465

SDN-SP3-320 S · F
SPEED SETTING LIST
(Positive rotation)

MODERATING RATIO : 1/49.8
POSITIVE ROTATION
MAXIMUM SPEED 300 rpm

SET VALUE	ACTUAL SPEED (rpm)	SET VALUE	ACTUAL SPEED (rpm)	SET VALUE	ACTUAL SPEED (rpm)	SET VALUE	ACTUAL SPEED (rpm)
0076	2	1076	77	2076	152	3076	227
00EB	4	10EB	79	20EB	154	30EB	229
0160	6	1160	81	2160	156	3160	231
01D5	9	11D5	84	21D5	159	31D5	234
024A	11	124A	86	224A	161	324A	236
02BF	13	12BF	88	22BF	163	32BF	238
0334	15	1334	90	2334	165	3334	240
03A9	17	13A9	92	23A9	167	33A9	242
041E	19	141E	94	241E	169	341E	244
0493	21	1493	96	2493	171	3493	246
0508	24	1508	99	2508	174	3508	249
057D	26	157D	101	257D	176	357D	251
05F2	28	15F2	103	25F2	178	35F2	253
0667	30	1667	105	2667	180	3667	255
06DC	32	16DC	107	26DC	182	36DC	257
0751	34	1751	109	2751	184	3751	259
07C6	36	17C6	111	27C6	186	37C6	261
083B	39	183B	114	283B	189	383B	264
08B0	41	18B0	116	28B0	191	38B0	266
0925	43	1925	118	2925	193	3925	268
099A	45	199A	120	299A	195	399A	270
0A0F	47	1A0F	122	2A0F	197	3A0F	272
0A84	49	1A84	124	2A84	199	3A84	274
0AF9	51	1AF9	126	2AF9	201	3AF9	276
0B6E	54	1B6E	129	2B6E	204	3B6E	279
0BE3	56	1BE3	131	2BE3	206	3BE3	281
0C58	58	1C58	133	2C58	208	3C58	283
0CCD	60	1CCD	135	2CCD	210	3CCD	285
0D42	62	1D42	137	2D42	212	3D42	287
0DB7	64	1DB7	139	2DB7	214	3DB7	289
0E2C	66	1E2C	141	2E2C	216	3E2C	291
0EA1	69	1EA1	144	2EA1	219	3EA1	294
0F16	71	1F16	146	2F16	221	3F16	296
0F8B	73	1F8B	148	2F8B	223	3F8B	298
1000	75	2000	150	3000	225	4000	300

SDN-SP3-320 S · F
SPEED SETTING LIST
(Reverse rotation)

MODERATING RATIO : 1/49.8
REVERSE ROTATION
MAXIMUM SPEED -300 rpm

SET VALUE	ACTUAL SPEED (rpm)	SET VALUE	ACTUAL SPEED (rpm)	SET VALUE	ACTUAL SPEED (rpm)	SET VALUE	ACTUAL SPEED (rpm)
FF8A	-2	EF8A	-77	DF8A	-152	CF8A	-227
FF15	-4	EF15	-79	DF15	-154	CF15	-229
FEA0	-6	EEA0	-81	DEA0	-156	CEA0	-231
FE2B	-9	EE2B	-84	DE2B	-159	CE2B	-234
FDB6	-11	EDB6	-86	DDB6	-161	CDB6	-236
FD41	-13	ED41	-88	DD41	-163	CD41	-238
FCCC	-15	ECCC	-90	DCCC	-165	CCCC	-240
FC57	-17	EC57	-92	DC57	-167	CC57	-242
FBE2	-19	EBE2	-94	DBE2	-169	CBE2	-244
FB6D	-21	EB6D	-96	DB6D	-171	CB6D	-246
FAF8	-24	EAF8	-99	DAF8	-174	CAF8	-249
FA83	-26	EA83	-101	DA83	-176	CA83	-251
FA0E	-28	EA0E	-103	DA0E	-178	CA0E	-253
F999	-30	E999	-105	D999	-180	C999	-255
F924	-32	E924	-107	D924	-182	C924	-257
F8AF	-34	E8AF	-109	D8AF	-184	C8AF	-259
F83A	-36	E83A	-111	D83A	-186	C83A	-261
F7C5	-39	E7C5	-114	D7C5	-189	C7C5	-264
F750	-41	E750	-116	D750	-191	C750	-266
F6DB	-43	E6DB	-118	D6DB	-193	C6DB	-268
F666	-45	E666	-120	D666	-195	C666	-270
F5F1	-47	E5F1	-122	D5F1	-197	C5F1	-272
F57C	-49	E57C	-124	D57C	-199	C57C	-274
F507	-51	E507	-126	D507	-201	C507	-276
F492	-54	E492	-129	D492	-204	C492	-279
F41D	-56	E41D	-131	D41D	-206	C41D	-281
F3A8	-58	E3A8	-133	D3A8	-208	C3A8	-283
F333	-60	E333	-135	D333	-210	C333	-285
F2BE	-62	E2BE	-137	D2BE	-212	C2BE	-287
F249	-64	E249	-139	D249	-214	C249	-289
F1D4	-66	E1D4	-141	D1D4	-216	C1D4	-291
F15F	-69	E15F	-144	D15F	-219	C15F	-294
F0EA	-71	E0EA	-146	D0EA	-221	C0EA	-296
F075	-73	E075	-148	D075	-223	C075	-298
F000	-75	E000	-150	D000	-225	C000	-300

SDN-SP3-580 S · F
SPEED SETTING LIST
(Positive rotation)

MODERATING RATIO : 1/98.3
POSITIVE ROTATION
MAXIMUM SPEED 155 rpm

SET VALUE	ACTUAL SPEED (rpm)	SET VALUE	ACTUAL SPEED (rpm)	SET VALUE	ACTUAL SPEED (rpm)	SET VALUE	ACTUAL SPEED (rpm)
0076	1	1076	40	2076	79	3076	117
00EB	2	10EB	41	20EB	80	30EB	118
0160	3	1160	42	2160	81	3160	120
01D5	4	11D5	43	21D5	82	31D5	121
024A	6	124A	44	224A	83	324A	122
02BF	7	12BF	45	22BF	84	32BF	123
0334	8	1334	46	2334	85	3334	124
03A9	9	13A9	48	23A9	86	33A9	125
041E	10	141E	49	241E	87	341E	126
0493	11	1493	50	2493	89	3493	127
0508	12	1508	51	2508	90	3508	128
057D	13	157D	52	257D	91	357D	130
05F2	14	15F2	53	25F2	92	35F2	131
0667	15	1667	54	2667	93	3667	132
06DC	17	16DC	55	26DC	94	36DC	133
0751	18	1751	56	2751	95	3751	134
07C6	19	17C6	58	27C6	96	37C6	135
083B	20	183B	59	283B	97	383B	136
08B0	21	18B0	60	28B0	99	38B0	137
0925	22	1925	61	2925	100	3925	138
099A	23	199A	62	299A	101	399A	139
0A0F	24	1A0F	63	2A0F	102	3A0F	141
0A84	25	1A84	64	2A84	103	3A84	142
0AF9	27	1AF9	65	2AF9	104	3AF9	143
0B6E	28	1B6E	66	2B6E	105	3B6E	144
0BE3	29	1BE3	68	2BE3	106	3BE3	145
0C58	30	1C58	69	2C58	107	3C58	146
0CCD	31	1CCD	70	2CCD	108	3CCD	147
0D42	32	1D42	71	2D42	110	3D42	148
0DB7	33	1DB7	72	2DB7	111	3DB7	149
0E2C	34	1E2C	73	2E2C	112	3E2C	151
0EA1	35	1EA1	74	2EA1	113	3EA1	152
0F16	37	1F16	75	2F16	114	3F16	153
0F8B	38	1F8B	76	2F8B	115	3F8B	154
1000	39	2000	77	3000	116	4000	155

SDN-SP3-580 S · F
SPEED SETTING LIST
(Reverse rotation)

MODERATING RATIO : 1/98.3
REVERSE ROTATION : -155 rpm
MAXIMUM SPEED

SET VALUE	ACTUAL SPEED (rpm)	SET VALUE	ACTUAL SPEED (rpm)	SET VALUE	ACTUAL SPEED (rpm)	SET VALUE	ACTUAL SPEED (rpm)
FF8A	-1	EF8A	-40	DF8A	-79	CF8A	-117
FF15	-2	EF15	-41	DF15	-80	CF15	-118
FEA0	-3	EEA0	-42	DEA0	-81	CEA0	-120
FE2B	-4	EE2B	-43	DE2B	-82	CE2B	-121
FDB6	-6	EDB6	-44	DDB6	-83	CDB6	-122
FD41	-7	ED41	-45	DD41	-84	CD41	-123
FCCC	-8	ECCC	-46	DCCC	-85	CCCC	-124
FC57	-9	EC57	-48	DC57	-86	CC57	-125
FBE2	-10	EBE2	-49	DBE2	-87	CBE2	-126
FB6D	-11	EB6D	-50	DB6D	-89	CB6D	-127
FAF8	-12	EAF8	-51	DAF8	-90	CAF8	-128
FA83	-13	EA83	-52	DA83	-91	CA83	-130
FA0E	-14	EA0E	-53	DA0E	-92	CA0E	-131
F999	-15	E999	-54	D999	-93	C999	-132
F924	-17	E924	-55	D924	-94	C924	-133
F8AF	-18	E8AF	-56	D8AF	-95	C8AF	-134
F83A	-19	E83A	-58	D83A	-96	C83A	-135
F7C5	-20	E7C5	-59	D7C5	-97	C7C5	-136
F750	-21	E750	-60	D750	-99	C750	-137
F6DB	-22	E6DB	-61	D6DB	-100	C6DB	-138
F666	-23	E666	-62	D666	-101	C666	-139
F5F1	-24	E5F1	-63	D5F1	-102	C5F1	-141
F57C	-25	E57C	-64	D57C	-103	C57C	-142
F507	-27	E507	-65	D507	-104	C507	-143
F492	-28	E492	-66	D492	-105	C492	-144
F41D	-29	E41D	-68	D41D	-106	C41D	-145
F3A8	-30	E3A8	-69	D3A8	-107	C3A8	-146
F333	-31	E333	-70	D333	-108	C333	-147
F2BE	-32	E2BE	-71	D2BE	-110	C2BE	-148
F249	-33	E249	-72	D249	-111	C249	-149
F1D4	-34	E1D4	-73	D1D4	-112	C1D4	-151
F15F	-35	E15F	-74	D15F	-113	C15F	-152
F0EA	-37	E0EA	-75	D0EA	-114	C0EA	-153
F075	-38	E075	-76	D075	-115	C075	-154
F000	-39	E000	-77	D000	-116	C000	-155

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