X-PAQ™
PRECISION | ACCURACY | QUALITY

Trace Control Unit
Tracer Arm

OPERATION MANUAL

ASG
Assembly • Industrial • Precision Fastening

Version 1.02

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1. BEFORE USE

Thank you for purchasing the **X-PAQ^{TM} EH2 Series Trace Control Unit, Tracer Arm**.

For your safety, read this operation manual carefully before using the tool in order to familiarize yourself with its capability. Please keep this manual in a proper place for future reference.

1.1. Precautions

1. This operation manual is copyrighted.   Note that it is prohibited to copy this manual in part or in whole without our permission.

2. The contents of this operation manual have been prepared with utmost care, but should there be any questions, errors or omissions, please inform us of them.

3. This operation manual is subject to change without notice.

4. As for the resultant influences of operating this product, we shall not bear any responsibility regardless of section 2. We appreciate your understanding on this point.

1.2. Precautions for Safety

In order to prevent the occurrence of harm or damage to the users and other persons or their property, be sure to thoroughly read this operation manual and all the appendices before the installation, operation, maintenance and inspection of the apparatus.

In this manual, the levels of risks and damages caused due to ignorance of the indications and improper use are classified into "Danger," "Warning," and "Caution."   However, even a matter of "Caution" level may lead to a serious result.   Since all the contents are very important, please be sure to strictly observe them.

◆ The indication marks and their meanings are described in the following.

⚠ Danger

If not observed, it will cause a severe wound or a risk of life.   Also, it will result in a serious injury (loss of body part, etc.) or a risk of life.

⚠ Warning

If not observed, it may lead to a severe wound or a risk of life.   Also, it can result in a serious injury (loss of body part, etc.) or a risk of life.

⚠ Caution

If not observed, it may lead to a slight wound (scratches, bruises, etc.).   Also, material damage is regarded as a "Caution" level.

⚠️Danger

This product is not explosion-proof.   It should not be used in the presence of combustible or explosive gas or anything involving the danger of explosion.   Improper use may cause severe damage.

⚠️Warning

1)   Be sure to ground this product.   If not properly grounded, it may cause electric shock.

2)   This product is a precision apparatus.   Do not apply impact or vibration to the apparatus by dropping nor use it near water or other liquid.

3) When installing this product, select a place away from heat or electric noise sources.

4)   Do not handle cables such that they are scratched, excessively stressed or squeezed.   Do not bend cables less than 100mm radius.

5)   Do not perform fastening with a torque exceeding the applicable torque range of this product. Doing so will cause breakage.

⚠️Caution

1)   In case of a system error, check and eliminate the cause of trouble before resuming the system operation.   It may cause malfunction or trouble.

2)   Correctly make the connection of the control unit, tool and tool connection cables. Improper connection may cause electric shock or system malfunction.
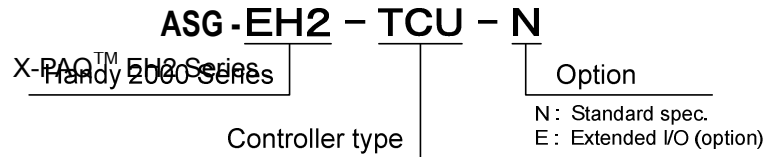
2. PRODUCT SPECIFICATION

The "Tracer arm" is an assistance arm that does away with the burden on the operator due to the reaction force caused at the time of fastening or the weight of the tool and has the function of detecting the current position of the tool.
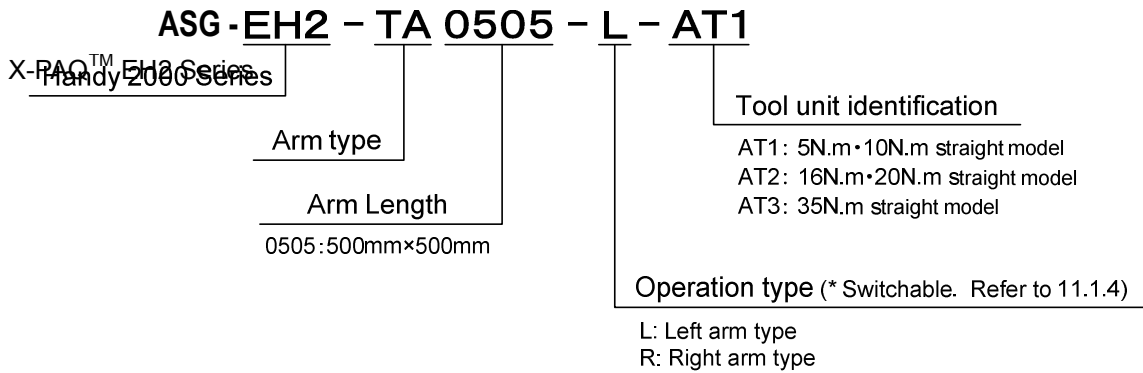
This product eliminates errors due to human factors caused in processes where fastening sequences and fastening positions were specified based on operating instruction, improves the operating efficiency and provides high-dimensional traceability by associating the fastening torque with the fastening position (coordinate).

2.1. Unit Type

Trace Control Unit

ASG - EH2 - TCU - N

X-PAQ™ EH2 Series
Handy 2000 Series

Controller type

Option

N : Standard spec.
E : Extended I/O (option)

Tracer Arm

ASG - EH2 - TA 0505 - L - AT1

X-PAQ™ EH2 Series
Handy 2000 Series

Arm type

Arm Length
0505 : 500mm×500mm

Tool unit identification

AT1 : 5N.m・10N.m straight model
AT2 : 16N.m・20N.m straight model
AT3 : 35N.m straight model

Operation type (* Switchable. Refer to 11.1.4)

L: Left arm type
R: Right arm type

2.2. General Specification

Electrical and Environmental specification

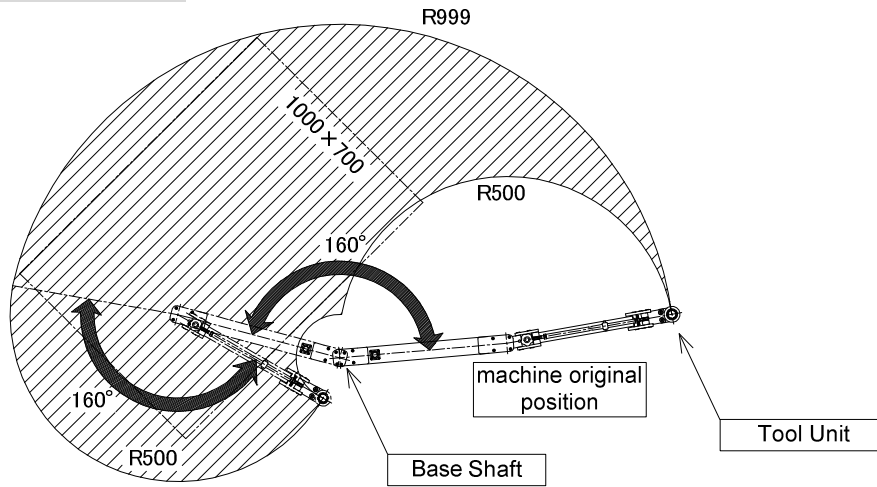|	ASG-EH2-TCU-* (Trace Control Unit)	ASG-EH2-TA****-*-AT* (Tracer Arm)
Power Supply	DC24V±10%	—
Power consumption	10W or less	
Environment	No corrosive gasses, dust or condensation	
Ambient Temperature	-10～60° (free from freezing)	
Ambient Humidity	No greater than 90% RH (free from condensation)	
Storage Temperature	-20~60℃ (free from freezing)	
Storage Humidity	No greater than 90% RH (free from condensation)	
Altitude	No greater than 1000m	

2.3. Performance Specification

	ASG-EH2-TCU-* (Trace Control Unit)	ASG-EH2-TA0505-*-AT* (Tracer Arm)
Display/Operation	SW: 3 pieces, Indicator lamp: 3 pieces	－
Control Input/Output	PIO (IN/OUT): 6 points EXTPIO (IN/OUT): 24 points (option)	－
Number of assignable work pieces	99 types (Up to 63 positions can be registered per type.)	－
Input sensor	Resolver: 3 points, Encoder: 3 points	－
Repetitive position detection accuracy	－	±1mm
Detection area accuracy	－	Horizontal direction: ±2mm
		Vertical direction: ±1mm

2.4. Tracer Arm Performance Chart

Model	Arm Length (mm)	Maximum arm up/down distance (mm)	Tool model used	Applied Torque (N.m)	Recommended load (kg) (Including tool unit)	Sensor used	Weight of arm main body (kg)
ASG-EH2-TA0505-*-AT1	500×500	330	ASG-EH2-R0005-S* ASG-EH2-R0010-S*	1.0～10.0	1.2～1.5	Resolver	5.5kg
ASG-EH2-TA0505-*-AT2	500×500	330	ASG-EH2-R1016-S ASG-EH2-R1020-S	3.2～20.0	1.3～1.6	Resolver	5.5kg
ASG-EH2-TA0505-*-AT3	500×500	330	ASG-EH2-R2035-S	7.0～35.0	2.0～2.3	Resolver	5.5kg

2.5. Tracer Arm Work Area

ASG-EH2-TA0505-R-***

R999

1000×700

R500

160°

160°

R500

machine original position

Tool Unit

Base Shaft

TOP VIEW

ASG-EH2-TA0505-L-***

R999

1000×700

R500

160°

160°

R500

machine original position

Tool Unit

Base Shaft

TOP VIEW

1000

R500

R500

Z coordinate:+165

165

330

Z coordinate:0

165

Z coordinate:−165
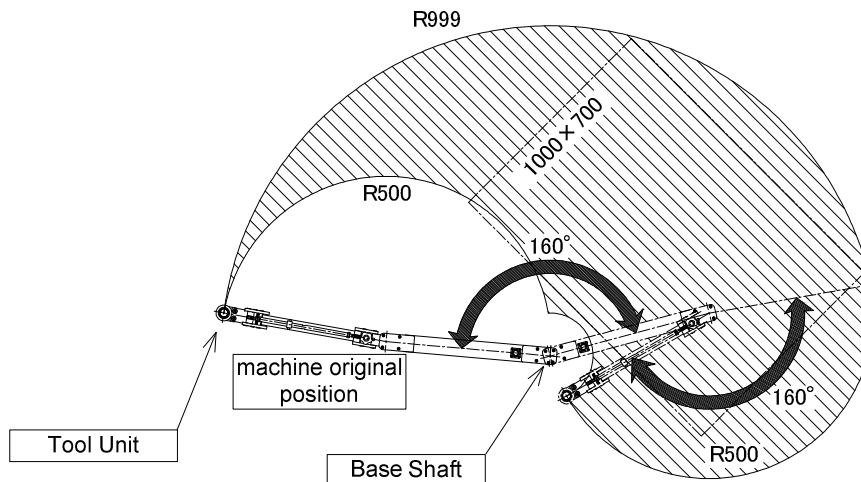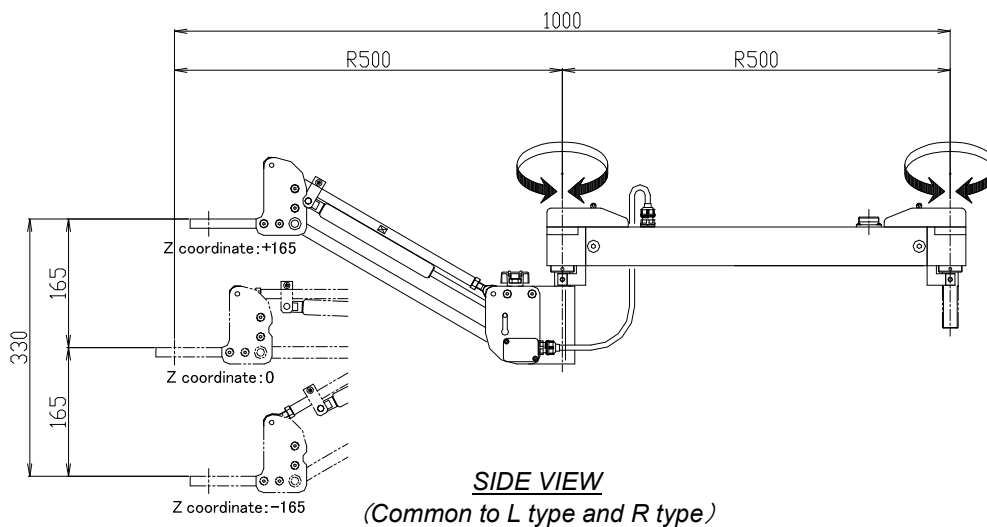
SIDE VIEW
(Common to L type and R type)

3. PRODUCT SECTION NAME & EXTERNAL DIMENSION

3.1. Trace Control Unit Section

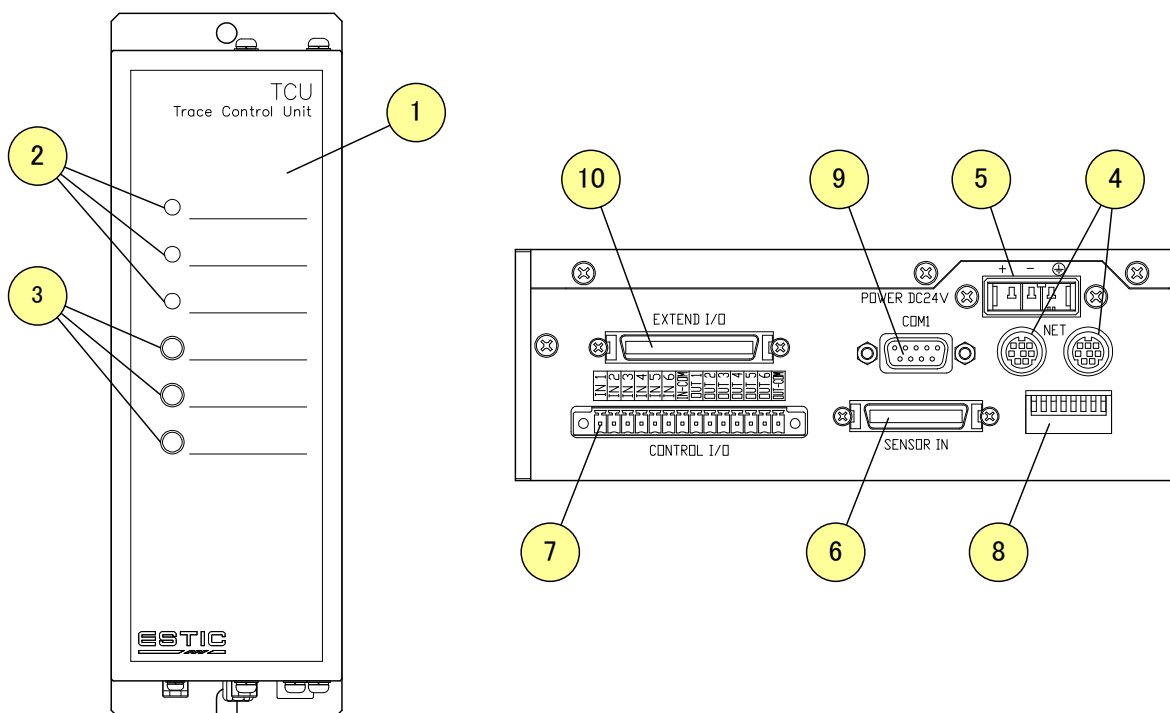| No.	Name	Function
1	Front Panel	The LED lamps light to indicate the status and the switches are operated on this panel section.
2	LED Lamp	Three 3-color LED lamps are provided. It is possible to allocate functions from the X-PAQ^{TM} controller. 1st: (Default) $\Rightarrow$ Power (Power supply illuminated in green) 2nd: (Default) $\Rightarrow$ STATUS (Controller status Green: Normal, Red: Error occurrence) 3rd: (Default) $\Rightarrow$ COM (NET communication status Green)
3	Pushbutton SW	3 switches. It is possible to allocate functions from the X-PAQ^{TM} controller. 1st to 3rd: No function allocation (default)
4	NET	Connector for the communication cable connected between the trace control unit and the X-PAQ^{TM} controller.
5	POWER DC24V	Connector for DC power input. Cable-side connector: Housing 1-178128-3 (TYCO ELECTRONICS): 1 Contact 175218-2 (TYCO ELECTRONICS): 3
6	SENSOR IN	Connector for the position detection sensor cable.
7	CONTROL I/O	Input: 6 points, Output: 6 points (PNP/NPN-ready)
8	D.I.P. SW	DIP switch for system setting.
9	COM1	(Used by the manufacturer)
10	EXTEND I/O	(Option) Extended I/O connector Input: 24 points, Output: 24 points (PNP/NPN-ready)

3.2. Tracer Arm Section
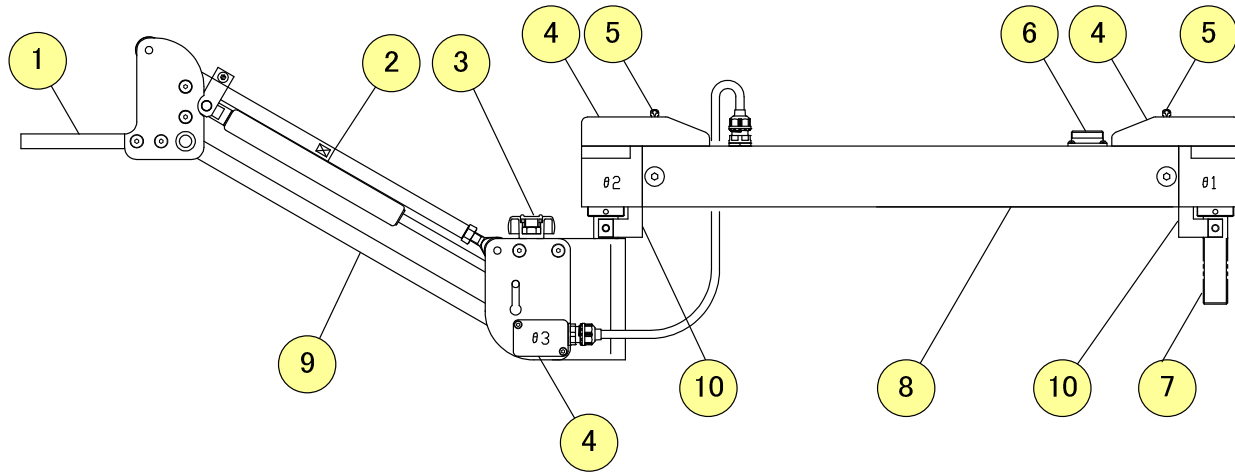
No.	Name	Function
1	Attachment Tool	This bracket is used to attach the tool unit.
2	Gas Spring	This spring supports the weight of the tool unit.
3	Support adjustment knob	This knob is used to adjust the support force of the gas spring. Turning the knob counterclockwise will increase the support force of the gas spring.
4	Rotation sensor	This sensor detects the position of the tool unit.
5	Cable Support	This support is used to fix the tool cable and sensor cable with the unity band.
6	Sensor Cable Connector	This is a connector for the cable connected between the trace control unit and the tracer arm.
7	Base Shaft	This shaft is used to install the tracer arm. It is the origin of the tool position coordinate.
8	Arm1	Swing arm
9	Arm2	Swing and lift arm
10	Swing stopper	This stopper restricts the swinging of the arm.

3.3. Trace Control Unit External Dimension

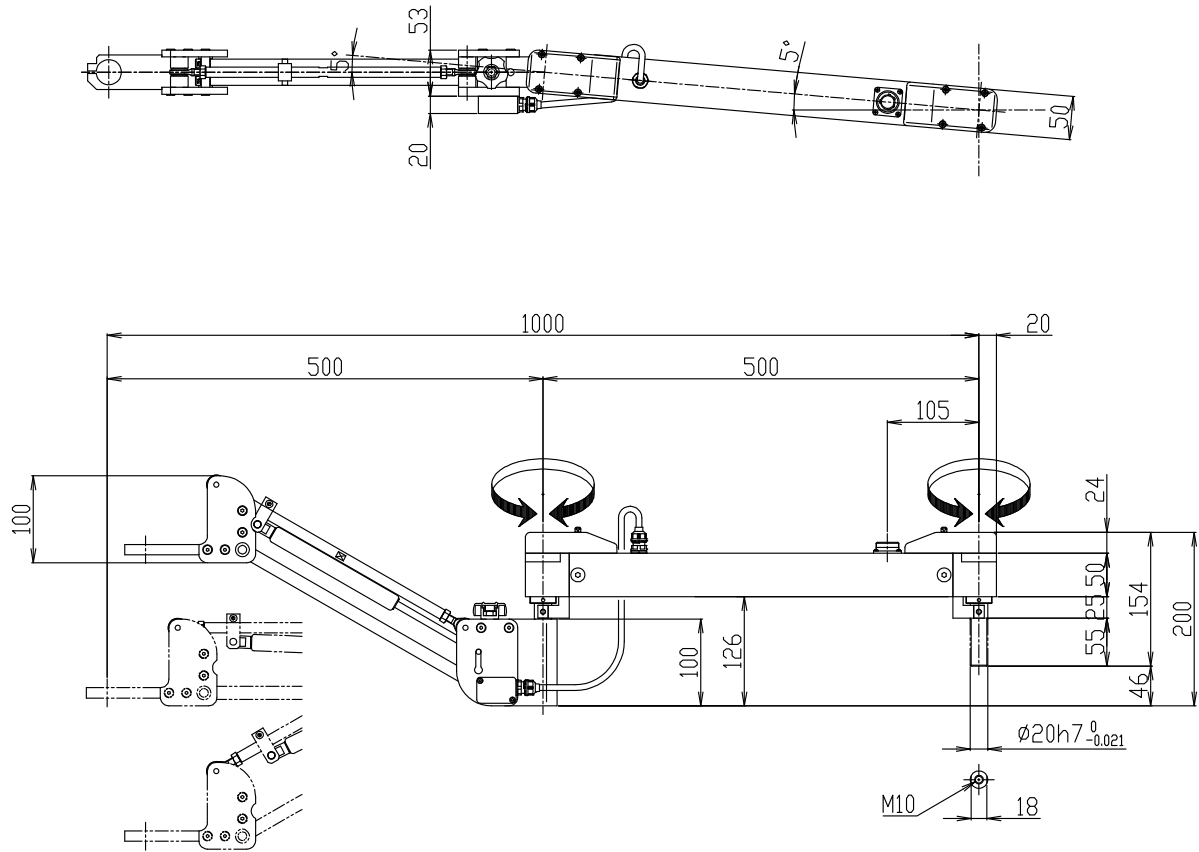This is a compact and light controller dedicated to the tracer arm.

ASG-EH2-TCU-N
ASG-EH2-TCU-E
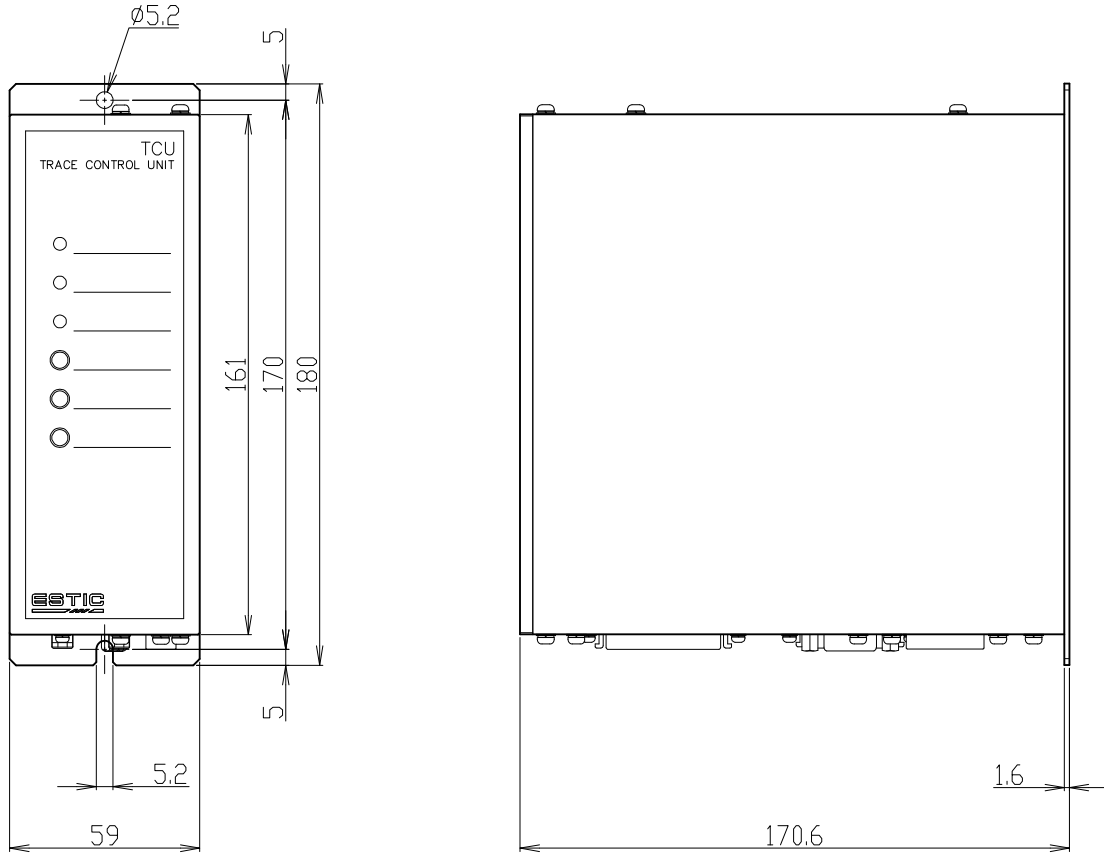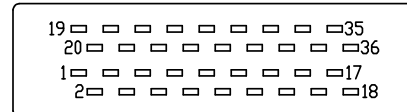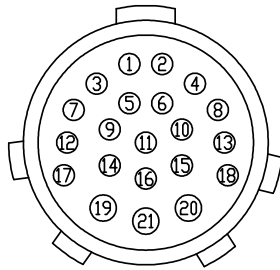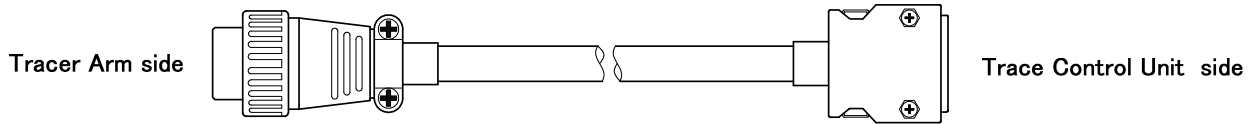

Weight: Approx. 0.9 kg

3.4. Tracer Arm External Dimension

4. INSTALLATION

4.1. Sensor Cable

This cable is connected between the tracer arm and the trace control unit.

Tracer Arm side   Trace Control Unit side

Tracer Arm side Pin No.	Signal Name	Trace Control Unit side Pin No.
1	θ1-R1	1
3	θ1-R2	19
2	θ1-S1	3
4	θ1-S3	21
5	θ1-S2	2
6	θ1-S4	20
19	θ1-FG	22
7	θ2-R1	4
9	θ2-R2	5
12	θ2-S1	7
17	θ2-S3	25
14	θ2-S2	6
16	θ2-S4	23
20	θ2-FG	24
8	θ3-R1	8
10	θ3-R2	26
11	θ3-S1	10
15	θ3-S3	11
13	θ3-S2	9
18	θ3-S4	27
21	θ3-FG	28

Adaptable Model	Cable Length	Part Number
ASG - EH2 - TA0505 - * - ***	1.0m	ASG-EH2-CVR3-010
	5.0m	ASG-EH2-CVR3-050

4.2. TCU Power Cable (Standard Accessory of Trace Control Unit)

This cable is connected between the DC power input connector of the trace control unit and the DC power output connector of the X-PAQ^{TM} controller.

Ground the grounding terminal to the trace control unit.

Ground terminal

Trace Control Unit side

Handy2000Lite Controller side
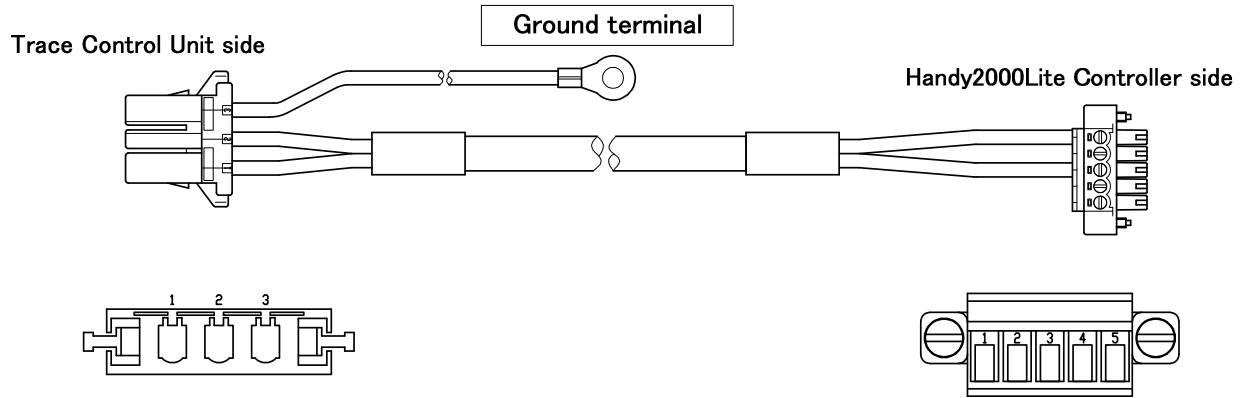
Trace Control Unit side Pin No.	Signal Name	Controller side Pin No.
1	DC+24V	1
2	GND	3
3	⏚	–

Adaptable Model	Cable Length	Part Number
ASG－EH2－TCU－*	3.0m	ASG-EH2-CVDC-030

4.3. Arm Mounting Bracket

This mounting bracket is used to install the arm main body. Select a bracket type in accordance with the installation layout at the time of placement of order.

Type : ASG-EH2-SAFM500

This type is used to install the tracer arm on a horizontal surface (floor, ceiling).

73
Ø25
Arm
Base Shaft side
Shaft Clamp
Clamp Bolt：M6×4
450
500
50
50
M8×25
F.L.
Ø100

Complete bracket main body

4-M8
P.C.D.75

Mounting dimension
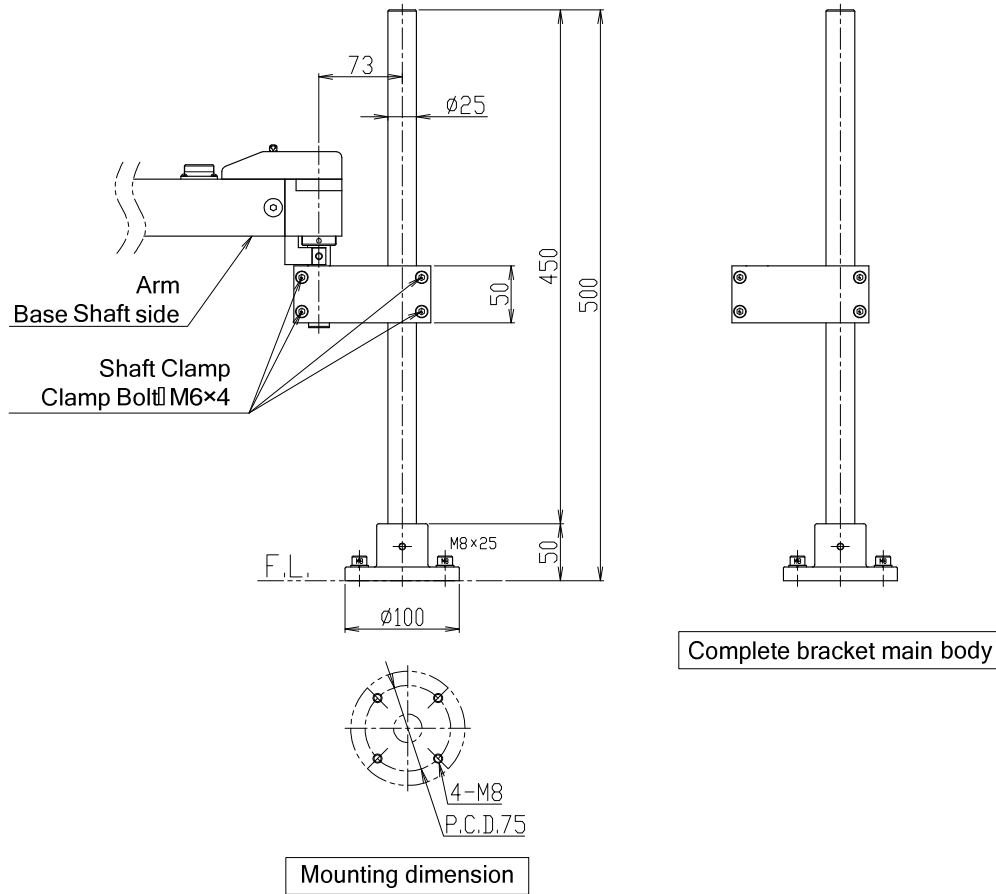
Type : ASG-EH2-SAWM200

This type is used to install the tracer arm on a vertical surface such as a wall surface.

73
Ø25
Arm
Base Shaft side
Shaft Clamp
Clamp Bolt：M6×4
50
140
200
60
M8×35
60.5

Complete bracket main body

4-M8
36
75
100

Mounting dimension

- 15 -
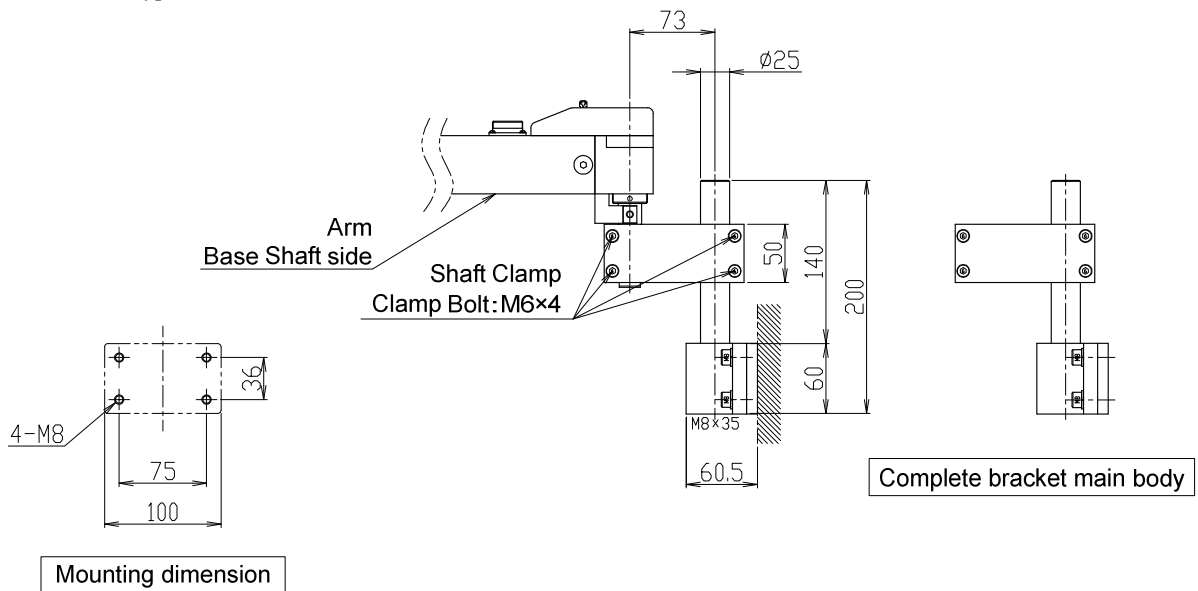
4.4. TCU Mounting Bracket

This mounting bracket is used to install the trace control unit. Select a mounting method in accordance with the installation layout.
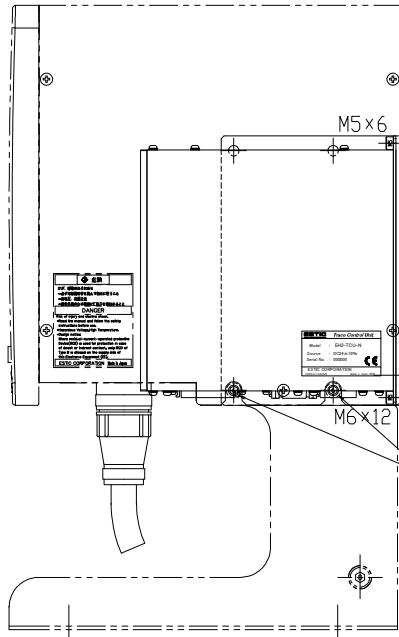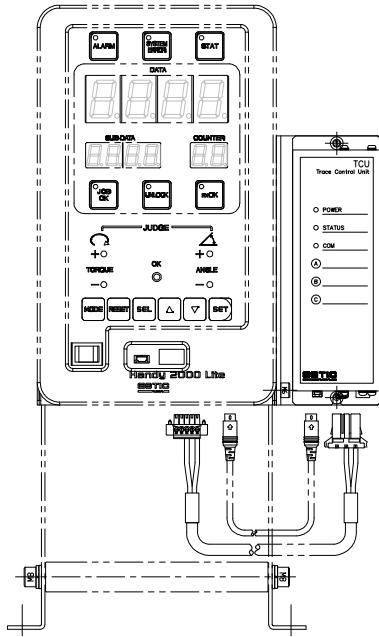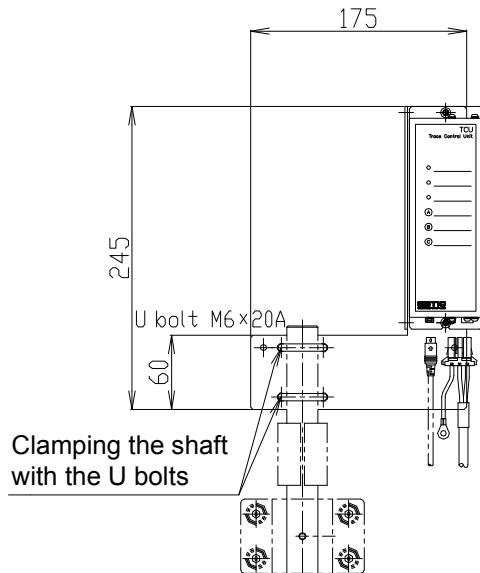
TCU mounting bracket description

Parts	Qty	Application
①TCU Bracket	1	TCU mounting
②Cap Bolt （M6×12L）	2 each	Used when mounting on the controller
②Nut		
⑤Cap Bolt （M5×6L）	2	TCU mounting bolt

M5×6

M6×12

Mounting Portion on Side of Handy 2000 Lite Controller

Mounting Position

Mounting on the Side of the X-PAQ™ Controller:
（Type：ASG－EH2－TCU－BRKT）

175

245

M5×6

U bolt M6×20A

60

Clamping the shaft with the U bolts

M6
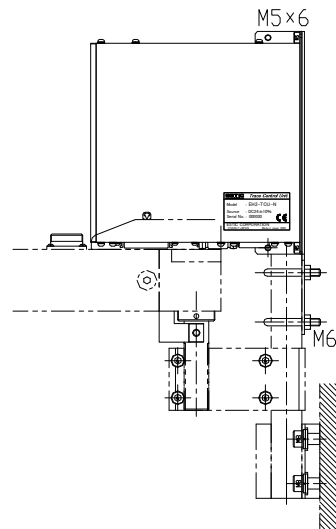
TCU mounting bracket description

Parts	Qty	Application
①TCU Bracket	1	TCU mounting
③U Bolt	2	Used when mounting on the shaft for arm mount
④Nut（M6）	4	Used when mounting on the shaft for arm mount
⑤Cap Bolt （M5×6L）	2	TCU mounting bolt

Mounting on Shaft for Arm Mount
（Type：ASG－EH2－TCU－BRKT）

4.5. Tool Attachment (Standard Accessory of Arm Main Body)

This bracket corresponds to the installation of the tool unit. When changing the tool unit model being used, place an order separately according to the following table.

Arm model used	Tool model used	Part Number
ASG-EH2-TA0505-*-AT1	ASG-EH2-R0005-SL/SP/SC ASG-EH2-R0010-SL/SP/SC	ASG-EH2-AT1
ASG-EH2-TA0505-*-AT2	ASG-EH2-R1016-S ASG-EH2-R1020-S	ASG-EH2-AT2
ASG-EH2-TA0505-*-AT3	ASG-EH2-R2035-S	ASG-EH2-AT3

4.6. Gas Spring (Standard Accessory of Arm Main Body)

This gas spring supports the up/down motion of the tool unit. If it is regarded as a spare part at the time of part replacement, place an order separately according to the following table.

Note that the model of the gas spring corresponds to the model of the tool attachment.

For the procedure for changing the gas spring, refer to "11.3. Gas Spring".

Adaptable Model	Part Number
ASG-EH2-TA0505-*-AT1	ASG-EH2-GS1
ASG-EH2-TA0505-*-AT2	ASG-EH2-GS2
ASG-EH2-TA0505-*-AT3	ASG-EH2-GS3

5. INPUT AND OUTPUT SIGNALS

5.1. Sensor In Connector

This connector is used to input the signal from the position detection sensor of the tracer arm.

Sensor In Connector Pin Arrangement Drawing (as viewed from wiring side)
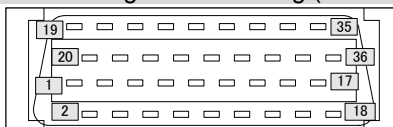
Contents of Input Signals

No.	Signal	No.	Signal
1	$\theta 1 - R1$	19	$\theta 1 - R2$
2	$\theta 1 - S2$	20	$\theta 1 - S4$
3	$\theta 1 - S1$	21	$\theta 1 - S3$
4	$\theta 2 - R1$	22	$\theta 1 -$ Shield
5	$\theta 2 - R2$	23	$\theta 2 - S4$
6	$\theta 2 - S2$	24	$\theta 2 -$ Shield
7	$\theta 2 - S1$	25	$\theta 2 - S3$
8	$\theta 3 - R1$	26	$\theta 3 - R2$
9	$\theta 3 - S2$	27	$\theta 3 - S4$
10	$\theta 3 - S1$	28	$\theta 3 -$ Shield
11	$\theta 3 - S3$	29	X-axis－A-phase
12	X-axis－GND	30	X-axis－Shield
13	X-axis－+5V	31	X-axis－B-phase
14	Y-axis－GND	32	Y-axis－Shield
15	Y-axis－+5V	33	Y-axis－A-phase
16	Y-axis－B-phase	34	Z-axis－A-phase
17	Z-axis－+5V	35	Z-axis－B-phase
18	Z-axis－GND	36	Z-axis－Shield

＜**Connector specification**＞

|	
Plug	: 10136-3000 PE（Sumitomo 3M Limited）
Shell kit	: 10336-52A0-008(Sumitomo 3M Limited)
Adaptable power cable	: AWG25～AWG21(0.2～0.5mm^2)
Cable outlet diameter	: Φ15～Φ16

5.2. Control I/O Connector

This is a connector for the I/O signal for controlling the control unit. Make wire connections on your part.

Input specification:Input voltage DC24V, Input current 7mA

Output specification: Output voltage DV24V, Max current 50mA

Control I/O Connector Contact Arrangement Drawing (as viewed from wiring side)
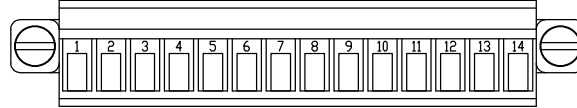
Input side

For the details on various allocatable input signals, refer to "X-PAQ^{TM} OPERATION MANUAL - FREE ALLOCATION FUNCTION - Internal Input Signals".

Allocation settings are made using the optional management software (TYPE4 or later versions). For the setting method, refer to "X-PAQ^{TM} MANAGEMENT SOFTWARE OPERATION MANUAL".

Pin No.	Input Signal	Default Setting	Changeable
1	IN1	(none)　　※1 (Origin input X)	Yes
2	IN2	(none)　　※1 (Origin input Y)	Yes
3	IN3	(none)　　※1 (Origin input Z)	Yes
4	IN4	(none)	Yes
5	IN5	(none)	Yes
6	IN6	(none)	Yes
7	Controlling signal power input COM		

※1. When "XY TBL" or "XYZ TBL" is selected in system parameter "S18.1.TABLE SELECT", each origin input signal is automatically allocated.

Output side

For the details on various allocatable output signals, refer to "X-PAQ^{TM} OPERATION MANUAL - FREE ALLOCATION FUNCTION - Internal Output Signals".

Allocation settings are made using the optional management software (TYPE4 or later versions). For the setting method, refer to "X-PAQ^{TM} MANAGEMENT SOFTWARE OPERATION MANUAL".
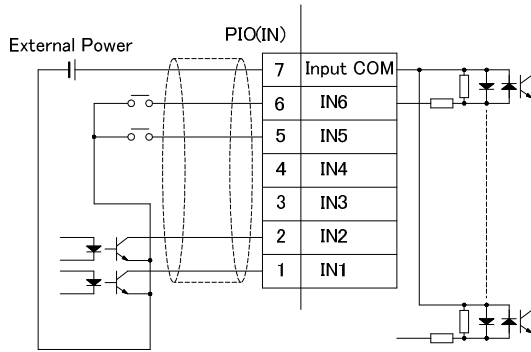
Pin No.	Output Signal	Default Setting	Changeable
8	OUT8	(none)	Yes
9	OUT9	(none)	Yes
10	OUT10	(none)	Yes
11	OUT11	(none)	Yes
12	OUT12	(none)	Yes
13	OUT13	(none)	Yes
14	Controlling signal power output COM		

<Adaptable Connector>

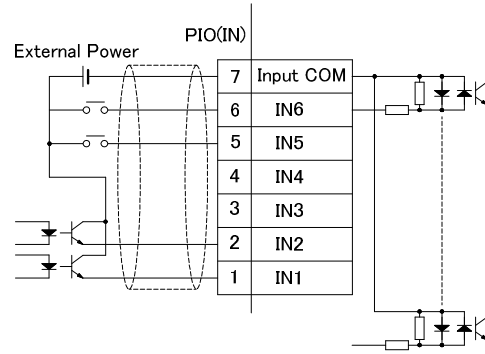Connector   : MC 1.5/14-STF-3.5(Phoenix Contact)

Adaptable power cable   : AWG28～AWG16(0.08～1.5mm^2)

< Input wiring diagram >

Sink (minus COM) connection   Source (plus COM) connection
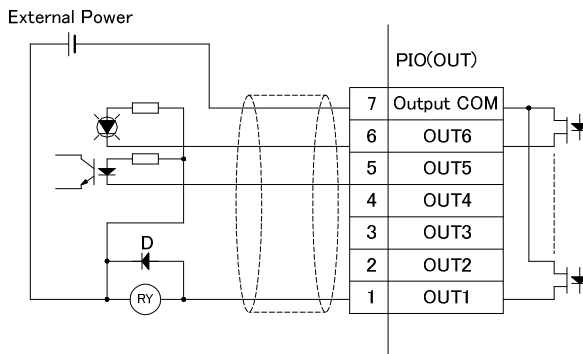

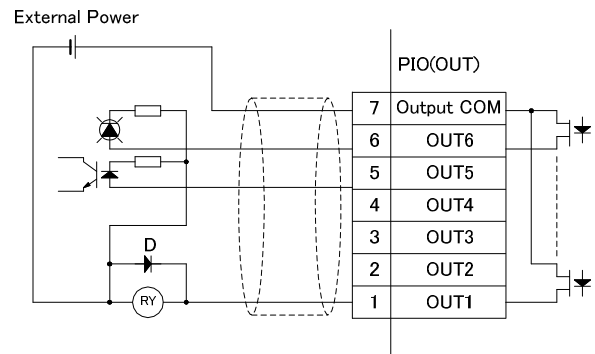## < Output wiring diagram >

Sink (minus COM) connection   Source (plus COM) connection
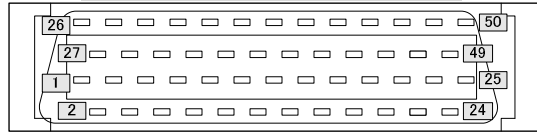
5.3. Extended I/O Connector

This control connector is an I/O signals connector to control unit. The wiring should be prepared at the user's side.

Input specification：Input voltage DC24V, Input current 7mA

Output specification: Output voltage DV24V, Max current 50mA

Pin Layout of CONTROL Connector)

Input side

For the details on various allocatable input signals, refer to "X-PAQ^{TM} OPERATION MANUAL - FREE ALLOCATION FUNCTION - Internal Input Signals".

Allocation settings are made using the optional management software (TYPE4 or later versions). For the setting method, refer to "X-PAQ^{TM} MANAGEMENT SOFTWARE OPERATION MANUAL".

Pin No.	Input Signal	Default Setting	Changeable
1	IN1	(none)	Yes
2	IN2	(none)	Yes
3	IN3	(none)	Yes
4	IN4	(none)	Yes
5	IN5	(none)	Yes
6	IN6	(none)	Yes
7	IN7	(none)	Yes
8	IN8	(none)	Yes
9	IN9	(none)	Yes
10	IN10	(none)	Yes
11	IN11	(none)	Yes
12	IN12	(none)	Yes
13	IN13	(none)	Yes
14	IN14	(none)	Yes
15	IN15	(none)	Yes
16	IN16	(none)	Yes
17	IN17	(none)	Yes
18	IN18	(none)	Yes
19	IN19	(none)	Yes
20	IN20	(none)	Yes
21	IN21	(none)	Yes
22	IN22	(none)	Yes
23	IN23	(none)	Yes
24	IN24	(none)	Yes
25	Controlling signal power input COM		

Output side

For the details on various allocatable output signals, refer to "X-PAQ^{TM} OPERATION MANUAL - FREE ALLOCATION FUNCTION - Internal Output Signals".

Allocation settings are made using the optional management software (TYPE4 or later versions). For the setting method, refer to "X-PAQ^{TM} MANAGEMENT SOFTWARE OPERATION MANUAL".

Pin No.	Output Signal	Default Setting	Changeable
26	OUT26	(none)	Yes
27	OUT27	(none)	Yes
28	OUT28	(none)	Yes
29	OUT29	(none)	Yes
30	OUT30	(none)	Yes
31	OUT31	(none)	Yes
32	OUT32	(none)	Yes
33	OUT33	(none)	Yes
34	OUT34	(none)	Yes
35	OUT35	(none)	Yes
36	OUT36	(none)	Yes
37	OUT37	(none)	Yes
38	OUT38	(none)	Yes
39	OUT39	(none)	Yes
40	OUT40	(none)	Yes
41	OUT41	(none)	Yes
42	OUT42	(none)	Yes
43	OUT43	(none)	Yes
44	OUT44	(none)	Yes
45	OUT45	(none)	Yes
46	OUT46	(none)	Yes
47	OUT47	(none)	Yes
48	OUT48	(none)	Yes
49	OUT49	(none)	Yes
50	Controlling signal power output COM		

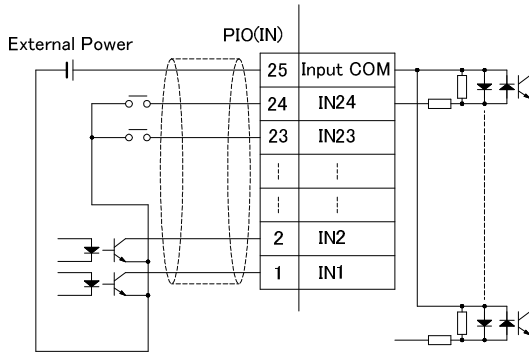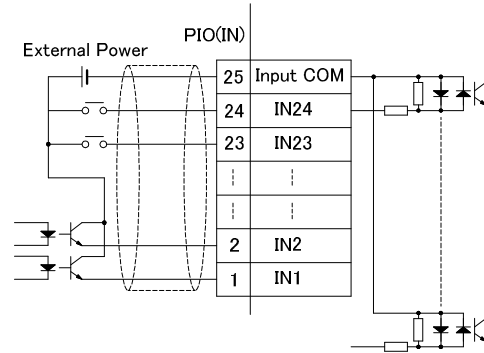<Adaptable Connector>

Plug   : 10150-3000 PE（Sumitomo 3M Limited）
Shell kit   : 10350-52A0-008(Sumitomo 3M Limited)
Adaptable power cable   : AWG25～AWG21(0.2～0.5mm^2)
Cable outlet diameter   : Φ15～Φ16

＜ Input wiring diagram ＞

Sink (minus COM) connection   Source (plus COM) connection

External Power   PIO(IN)   External Power   PIO(IN)

25	Input COM
24	IN24
23	IN23
⋮	⋮
⋮	⋮
2	IN2
1	IN1

＜ Output wiring diagram ＞

Sink (minus COM) connection   Source (plus COM) connection

External Power   External Power

PIO(OUT)

50	Output COM
49	OUT49
48	OUT48
⋮	⋮
⋮	⋮
27	OUT27
26	OUT26

D
RY
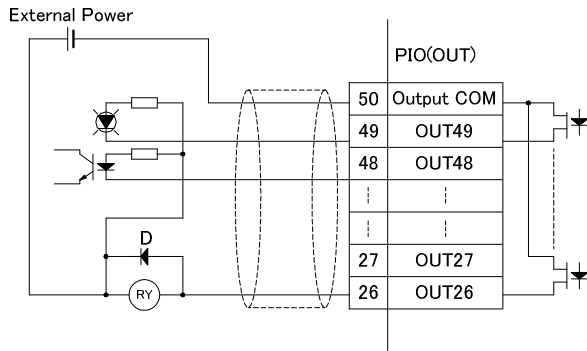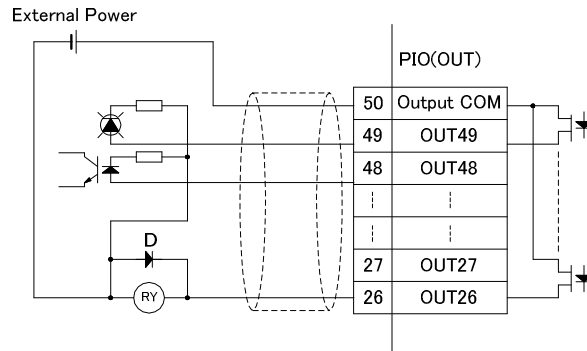
5.4. Trace Control Unit Display (LED Lamp) Function Allocation

Various output signals can be allocated freely to the LED lamps on the front panel of the trace control unit.
Identify the freely allocated function by attaching the allocation nameplate (included with the trace control unit) beside the LED lamp.
For the details on various allocatable output signals, refer to "X-PAQ^{TM} OPERATION MANUAL - FREE ALLOCATION FUNCTION - Internal Output Signals".
Allocation settings are made using the optional management software (TYPE4 or later versions). For the setting method, refer to "X-PAQ^{TM} MANAGEMENT SOFTWARE OPERATION MANUAL".
The LED lamp to which a function is allocated lights in orange.

From above	Default	Function	Changeable
1st	POWER	Power supply illuminated in green)	Yes
2nd	STATUS	Controller status (Green: Normal, Red: Error occurrence)	Yes
3rd	COM	NET communication status illuminated in green)	Yes

5.5. Trace Control Unit Operating Portion (Pushbutton SW) Function Allocation

Various input signals can be allocated freely to the pushbutton SWs on the front panel of the trace control unit.
Identify the freely allocated function by attaching the allocation nameplate (included with the trace control unit) beside the pushbutton SW.
For the details on various allocatable input signals, refer to "X-PAQ^{TM} OPERATION MANUAL - FREE ALLOCATION FUNCTION - Internal Input Signals".
Allocation settings are made using the optional management software (TYPE4 or later versions). For the setting method, refer to "X-PAQ^{TM} MANAGEMENT SOFTWARE OPERATION MANUAL".

| From above	Default	Changeable
1st (A)	(none)	Yes
2nd (B)	(none)	Yes
3rd (C)	(none)	Yes

5.6. DIP-SWITCH

These are dip-switches used for system setting. Please be sure to turn OFF unused switches.

No.	Function Name	Function Description	Ex-factory setting
1	Used by the manufacturer	Not usable. Please turn it OFF.	OFF
2	Used by the manufacturer	Not usable. Please turn it OFF.	OFF
3	Used by the manufacturer	Not usable. Please turn it OFF.	OFF
4	Used by the manufacturer	Not usable. Please turn it OFF.	OFF
5	Used by the manufacturer	Not usable. Please turn it OFF.	OFF
6	Used by the manufacturer	Not usable. Please turn it OFF.	OFF
7	Used by the manufacturer	Not usable. Please turn it OFF.	OFF
8	Used by the manufacturer	Not usable. Please turn it OFF.	OFF

6. System Configuration and Wiring

This system is used in combination with the X-PAQ^{TM} EH2 SERIES HANDHELD NUTRUNNER SYSTEM and composed of the X-PAQ^{TM} controller, tool unit, tool cable, trace control unit, tracer arm, sensor cable, NET cable and two NET end resistors.
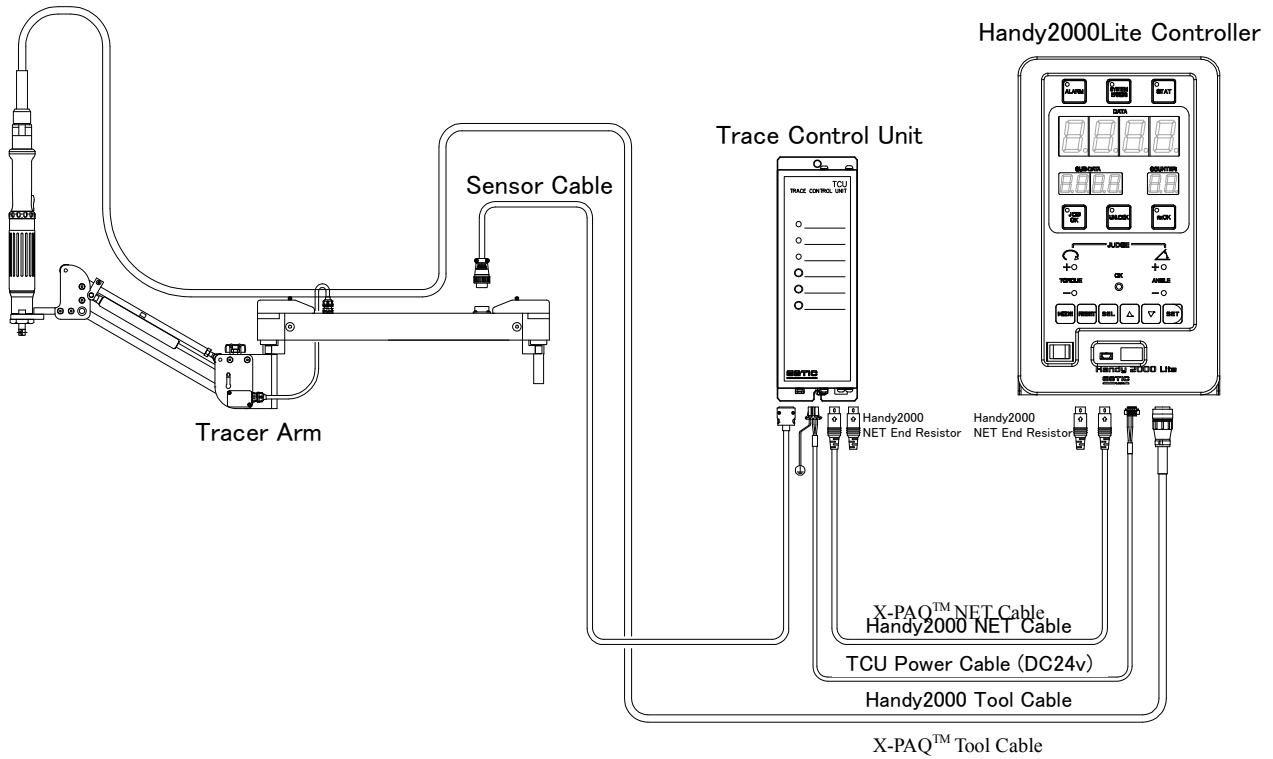
7. Trace Function

This system controls the fastening operation using the trace job function of the X-PAQ^{TM} controller and the position data obtained from the trace control unit.

Various settings relating to the trace function are registered in the X-PAQ^{TM} controller.

7.1. Trace Job Function

The trace job is a function that can establish a series of fastening operation sequences by specifying the fastening operation channel based on a fastening enabled position. This is done using internal parameters without the need for external control equipment (PLC etc).

The trace control unit detects the current position of the tool. If the tool is at the specified position, the lock is released to enable fastening, the "Job step number" becomes equal to the "Position number", and at which position fastening was performed can be judged from the fastening process result data entry "STEP".

The "Number of trace jobs = Number of workpieces" that can be set in the X-PAQ^{TM} controller is 99 maximum. The "Number of steps = Number of positions" that can be registered per trace job is 66 steps maximum.

The trace job function, unlike the job function, does not have a count function in each step. It completes one step when one fastening operation is completed. In the case of the trace job function, the following two control methods are available.

7.1.1. Sequence Fastening Disable Mode

In this mode, regardless of the step sequence of the trace job, the tool lock is released and fastening is allowed when the tool is at the position registered with the trace job number being selected.

The fastening status of each position is stored and a judgment of JOB OK or JOB NG is made based on it.

On a position where fastening result status is OK or NG, fastening and loosening is disabled, and it avoids double tightening. On Loosening, behavior is differs depending on the setting of 8.2. Trace Job Setting, 8. LOOSENING.

When it is loosened, this position is recognized as un-tightened and fastening is enabled again.

7.1.2. Sequence Fastening Enable Mode

In this mode, fastening is performed according to the step sequence of the trace job list.

If not at the specified step (position), both fastening and loosening is disabled. For loosening operation, this mode is the same as sequence fastening disable mode.

7.2. Fastening Completion Position Judgment

When "10. END POS." is set to ON, it is judged whether the fastening completion position is within the tolerance of the registered position. If the position is out of the tolerance, a judgment of NG is made as "POSITIONING NG" (fastening completion position out of tolerance) regardless of fastening judgment. It can be used for simple washer presence/absence detection, bolt length error detection, etc.

8. Parameter for Trace Arm

When using the trace system, set the following controller parameters.

8.1. Tracer Arm Setting

S18 TRACE ARM (Trace Job Function)

1. TABLE SELECT: Selects a positioning unit.

        NONE   : No setting (default)

        ARM   : Arm type (Resolver specification, Position detection with XYZ coordinate)

        XY TBL   : XY table type (Encoder specification, Position detection with XY coordinate)

        XYZ TBL : XYZ table type (Encoder specification, Position detection with XYZ coordinate)

2. LENGTH 1: Sets the length of arm 1. Connected spindle length from θ1.

        It is enabled when "ARM" is selected in "1. TABLE SELECT".

        (Setting range: 100-3000 mm, Default = 500 mm)

3. LENGTH 2: Sets the length of arm 2. Connected spindle length from θ2.

        It is enabled when "ARM" is selected in "1. TABLE SELECT"

        (Setting range: 100-3000 mm, Default = 330 mm)*1

4. LENGTH 2 OFFSET: Sets the offset distance of arm 2.

        It is enabled when "ARM" is selected in "1. TABLE SELECT".

        (Setting range: 100-1000 mm, Default = 170 mm)*1

5. ARM TYPE: Selects an arm operating range. Right arm type or left arm type.

        It is enabled when "ARM" is selected in "1. TABLE SELECT".

        0: RIGHT ARM   Right arm type

        1: LEFT ARM   Left arm type

6. X-LEAD: Sets the shift distance per turn of the X-axis encoder.

        It is enabled when "XY TBL" or "XYZ TBL" is selected in "1. TABLE SELECT".

        (Setting range: 0-650.00 mm, Default = 1.00 mm)

7. Y-LEAD: Sets the shift distance per turn of the Y-axis encoder.

        It is enabled when "XY TBL" or "XYZ TBL" is selected in "1. TABLE SELECT".

        (Setting range: 0-650.00 mm, Default = 1.00 mm)

8. Z-LEAD: Sets the shift distance per turn of the Z-axis encoder.

        It is enabled when "XYZ TBL" is selected in "1. TABLE SELECT".

        (Setting range: 0-650.00 mm, Default = 1.00 mm)

9. X-PULSE: Sets the number of pulses per turn of the X-axis encoder.

        It is enabled when "XY TBL" or "XYZ TBL" is selected in "1. TABLE SELECT".

        (Setting range: 1000-65000pls, Default = 1000 pls)

10. Y-PULSE: Sets the number of pulses per turn of the Y-axis encoder.

        It is enabled when "XY TBL" or "XYZ TBL" is selected in "1. TABLE SELECT".

        (Setting range: 1000-65000pls, Default = 1000 pls)

11. Z-PULSE: Sets the number of pulses per turn of the Z-axis encoder.

                It is enabled when "XYZ TBL" is selected in "1. TABLE SELECT".

                (Setting range: 1000-65000pls, Default = 1000 pls)

  *1:   LENGTH 2 is the operating radius of arm 2 and LENGTH 2 OFFSET is the distance from the reference point to the operating radius base point. The actual length of arm 2 is the sum of the settings of LENGTH 2 and LENGTH 2 OFFSET.

8.2. Trace Job Setting

1. TRACE JOB LIST (Trace Job List Setting)

The position data is displayed by step. Set the tolerance (error) and the channel number for operation. Up to 63 positions can be registered per trace job.

Set the horizontal direction tolerance, vertical direction tolerance and operation channel in the position.

POINT (STEP)	CHANNEL (Set channel)	TOLERANCE 1 (Horizontal direction tolerance)	TOLERANCE 2 (Vertical direction tolerance)
1			
2	Operation channel 1-99 (Default: 0)	Tolerance Radius: 1-99 mm (Default: 20 mm)	Tolerance ±1-999 mm (Default: 100 mm)
•			
63			

TOLERANCE1   : Sets the radius of the circular tolerance around the registered position.
TOLERANCE2   : Sets the length of the vertical tolerance relative to the registered position.

The operation of TOLERANCE2 (vertical direction tolerance) varies depending on the setting of "10. END POSITION".

＜END POSITION setting disabled＞
When fastening is not performed, tolerance monitoring is performed and the tool is locked if the tool position is not within the tolerance.

＜END POSITION setting enabled＞
When fastening is not performed, vertical tolerance monitoring is not performed and horizontal tolerance monitoring only is performed.
When fastening is completed, whether the current coordinate is within both the horizontal tolerance and vertical tolerance is checked and a judgment of fastening NG (POSITIONING NG) is made if it is out of the tolerance.

It is possible to register maximum of 8 times on the same position.
The same position is defined that the tightening allowed area which is set by TOLERANCE 1, 2.
If it is registered for teaching or tolerance setting more than 8 times for the same position, "POS INVALID" is indicated and Tightening will be disabled during executing Trace Job.

2. SEQUENCE

Set the trace job fastening position sequence.

OFF   : Sequence fastening disabled
The fastening sequence is disregarded. Fastening is allowed when the current position is at the step (position) registered with the selected trace job.

ON   : Sequence fastening enabled (default)
Fastening is performed according to the step (position) sequence of the selected trace job.

3. START TIME

Set the maximum waiting time between trace job selecting and first step starting.
If fastening is not started within the set time, the selected job is disabled and terminated.
If this time is set to "0", time monitoring is not performed.

(Setting range: 0-9999 sec, Default = 0 sec)

4. END TIME

Set the maximum waiting time between trace job selecting and trace job completing.
If the trace job is not completed within the set time, the subsequent STEP operations are disabled.
If this time is set to "0", time monitoring is not performed.

(Setting range: 0-9999 sec, Default = 0 sec)

5. COUNT METH
Select a trace job step counting method.

OK COUNT   : Counts OK fastening judgments only (default).
ALL COUNT   : Counts all fastening judgments.

6. LINE CONTROL
Set the trace job start condition.

OFF   : JOB START signal input not required (default)
ON   : JOB START signal input required

7. REPEAT
Set whether to repeat the set job after the completion of the trace job.

OFF   : Operation not allowed after completion of trace job
ON   : Repeated operation allowed after completion of trace job

8. LOOSING
Set whether to enable or disable the reverse rotation operation.

ENABLE   : Reverse rotation operation enabled (default)
DISABLE   : Reverse rotation operation disabled
NG-ENA   : Reverse rotation operation enabled when fastening NG occurs

When "ENABLE" is selected, loosening is enabled regardless to the status.
When "NG-ENA" is selected, if the status of the position is Fastening OK, loosening is disabled.

9. TOOL LOCK
Set whether to lock the tool after the completion of the trace job.

OFF   : Tool lock disabled (default)
ON   : Tool lock enabled

10. END POSITION
Set whether to make a position judgment at the completion of fastening.

OFF   : Completion position judgment disabled (default)
ON   : Completion position judgment enabled

When it is set to ON, set the tolerance in 1.TRACE JOB LIST "TOLERANCE1" , "TOLERANCE2".

11. POSITION LIST
This is a list of registered position data. (Unit: mm)

POINT (STEP)	X-axis position	Y-axis position	Z-axis position
1			
2			
•			
63			

12. POSITION MONITOR （Available Ver. HA1200 or later.）
This is a function to monitor the position whether it is in the range or not during tightening.
When this function is ON, if the position is strayed out of the OK range, it is judged as "POSITIONING NG".
It stops the tool but it does not judge if it was before start torque is detected.

OFF   : Position Monitor Invalid (default)
ON   : Position Monitor Valid

When it is set to ON, set the tolerance in 1.TRACE JOB LIST "TOLERANCE1" , "TOLERANCE2".

9. SYSTEM SETUP

The setup procedure for wiring between units to actual operation is described below.

This chapter explains for the setting up procedure of the trace system when Tracer Arm ASG-EH2-TA0505-*-**** is used independently.

Parameters not related to Trace Job and its details are not described here.

Please refer to [X-PAQ^{TM} Operation Manual] [X-PAQ^{TM} Management Software Operation Manual] for the details of settings and other settings.

Before system setup, check that the X-PAQ^{TM} system (Only connecting the controller unit and tool unit) starts up independently.

9.1. Setup procedure before power-on

(1)   Connect wiring between the X-PAQ^{TM} controller, tool unit, trace control unit and tracer arm.
        (For more details on wiring, refer to "6. System Configuration and Wiring".)

(2)   Power on the X-PAQ^{TM} controller. Before powering it on, check that the wiring and connections are proper.

9.2. Setup procedure after power-on

9.2.1. Setting up by creating a new file

This explains the procedure by creating a new file using Management Software

（1）Create a Project
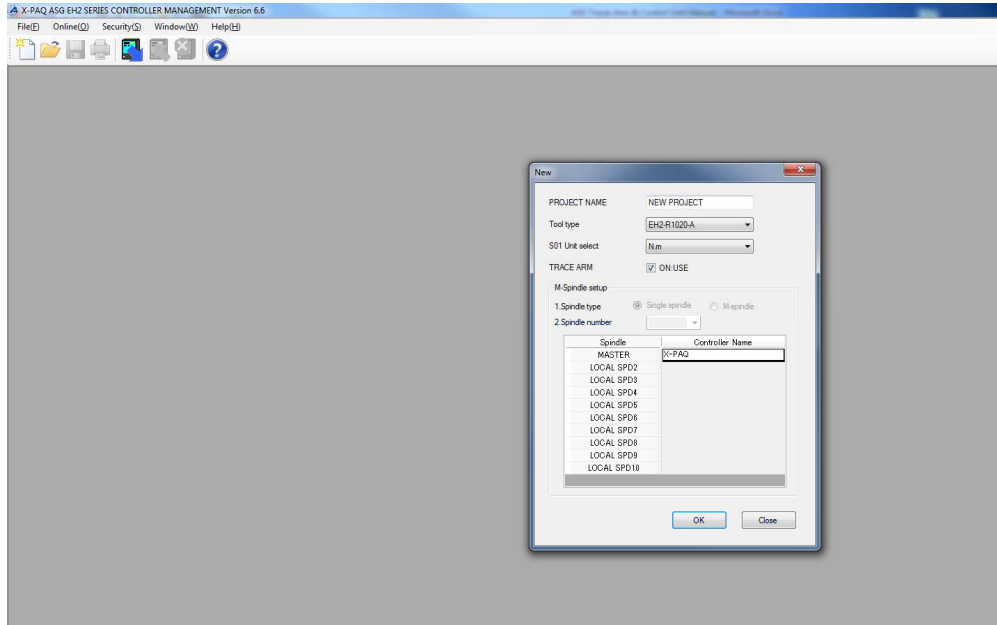
① Press [New File] button and a [New] window will appear

② Select [Tool type] to be used

③ Select [Unit] to be used

④ Tick [TRACE ARM]

⑤ Press [OK] to create a new file

(2) System parameter setting

This menu is to make settings for system environment for using trace job functions.

In order to use Trace Job, JOB function has to be used and created.
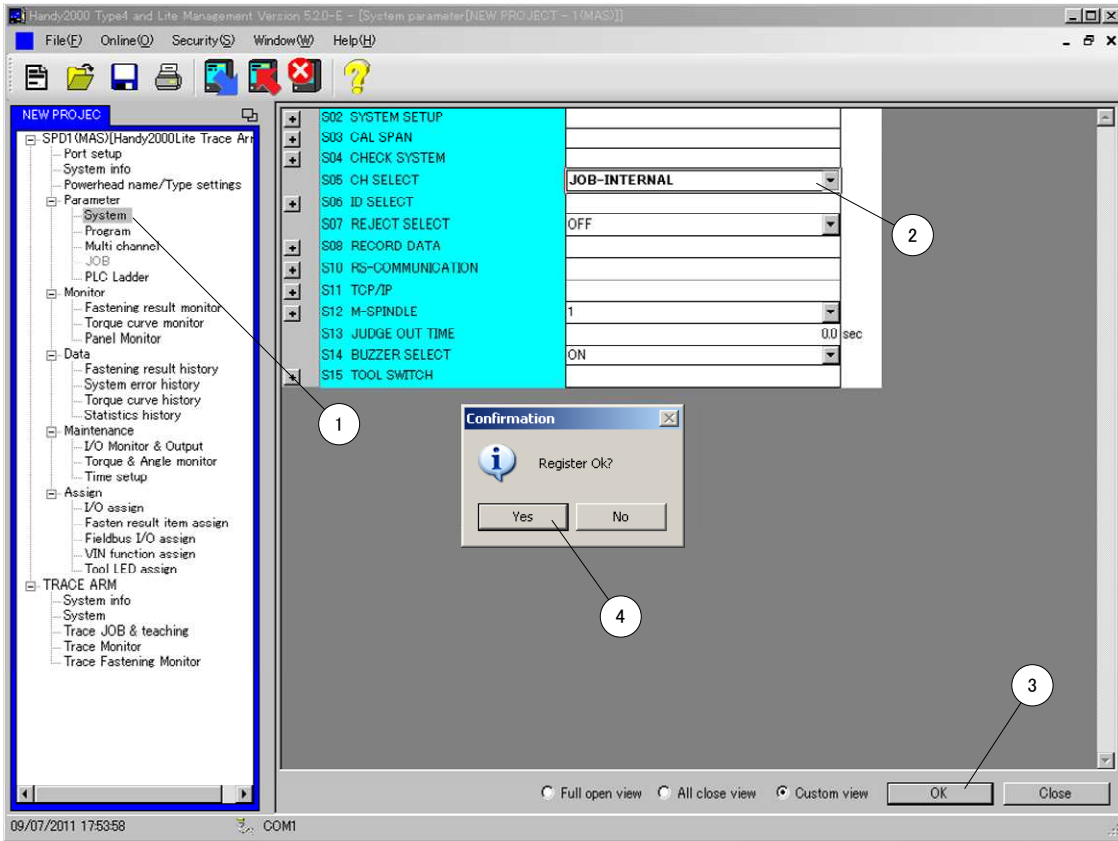
① Press [SYSTEM] from the parameters tree on the left, and open System parameters menu

② Select either [JOB-INT] [JOB-EXT] [ID].

Please refer to [X-PAQ^{TM} Operation Manual] for the details.

③ Press [OK] and confirmation window opens.

④ Press [Yes] to register

(3) Program parameter setting

Setup Tightening Channel which is used on Trace Job.

Tightening Channels have to be set before Trace Job is programmed.

For the procedure of setting tightening Channel, please see "X-PAQ^{TM} Operation Manual" and "X-PAQ^{TM} Management Software Operation Manual"
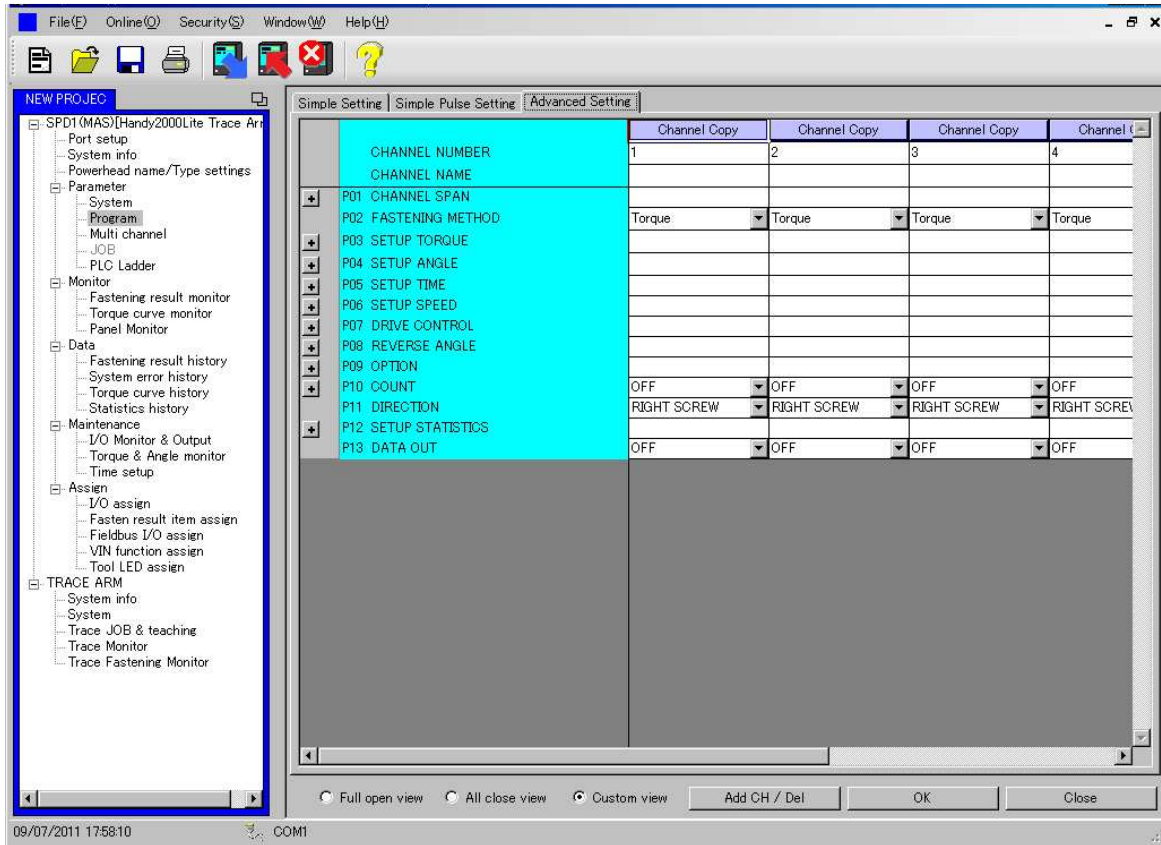
(4) Trace arm system setting

Setup Arm type

Arm type and specification is indicated on the label at the arm join.
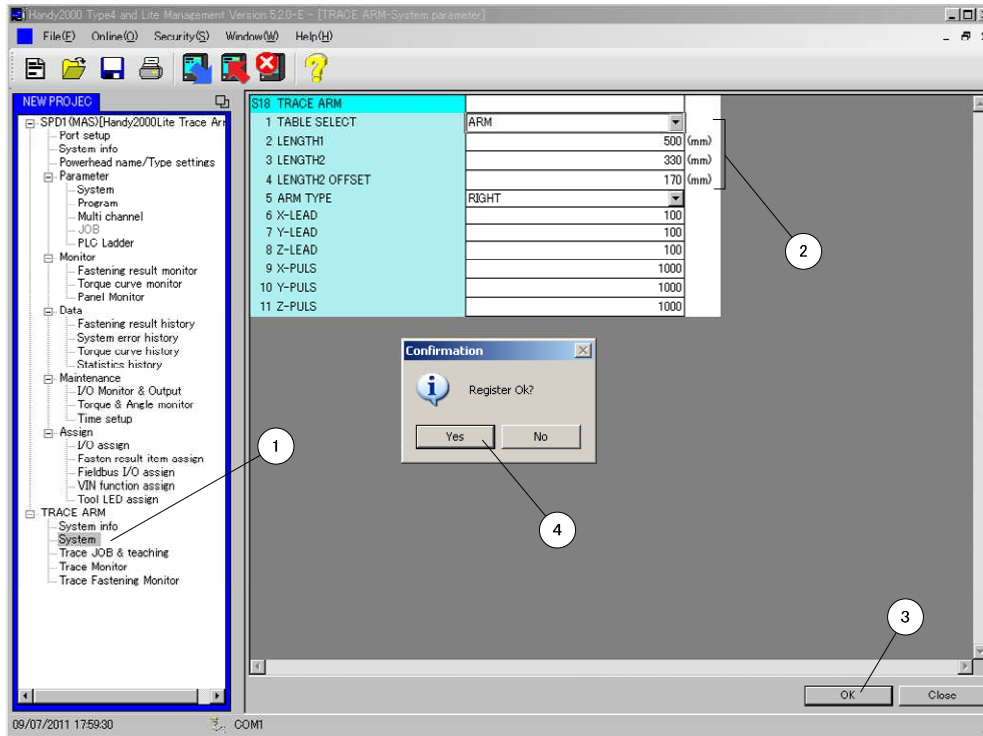
① Open a window for trace arm editing.

② Setup arm type and specification. Information is indicated on the label at the arm join.

"ARM" must to be selected on [1. TABLE SELECT]

③ Press [OK] and Confirmation window opens.

④ Click [YES] to register

(5) Create Trace Job

Create Trace Job to be used
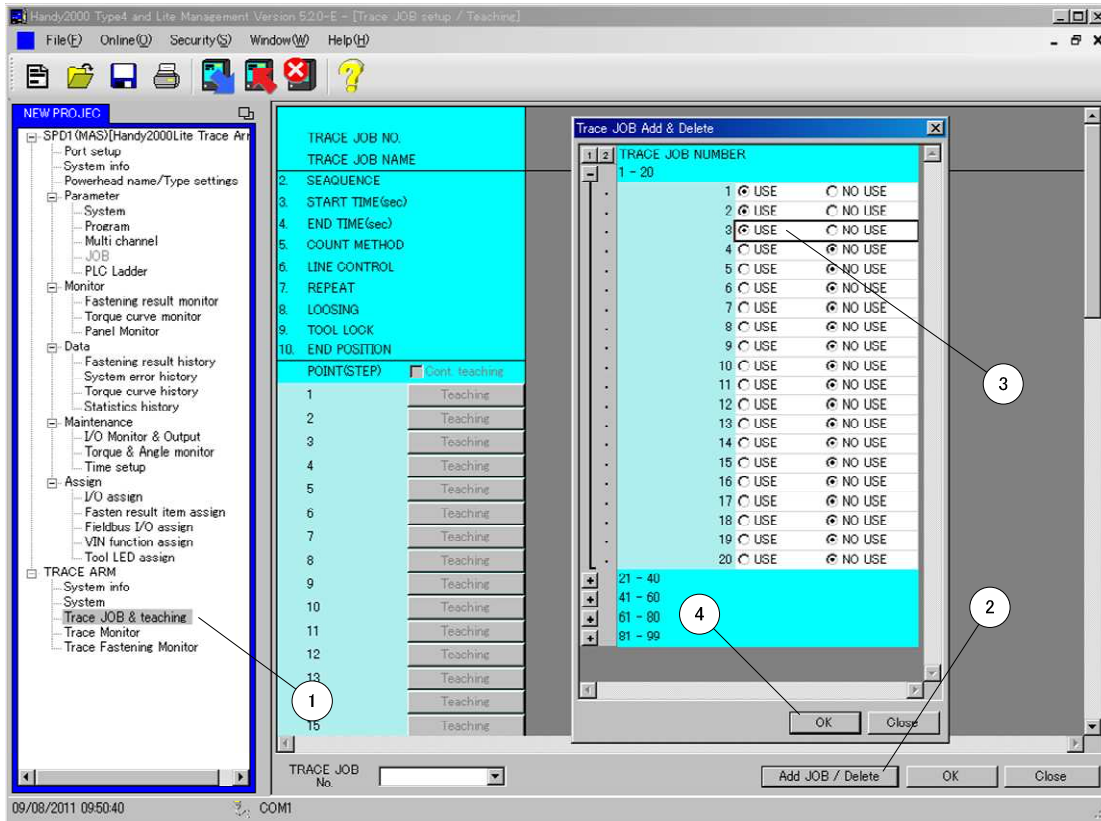
① Open a window for Trace Job editing

② Open a window for Trace Job Add/Delete

③ Tick [USE] for the Trace Job number to be used

④ Press [OK] to register

Trace Job edit window will be displayed as shown below.
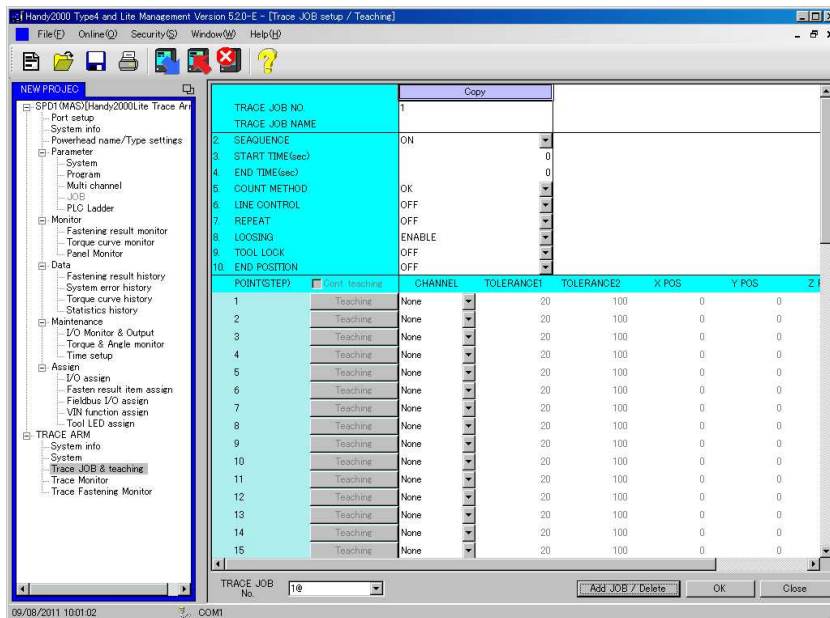
(6)   Trace job system setting
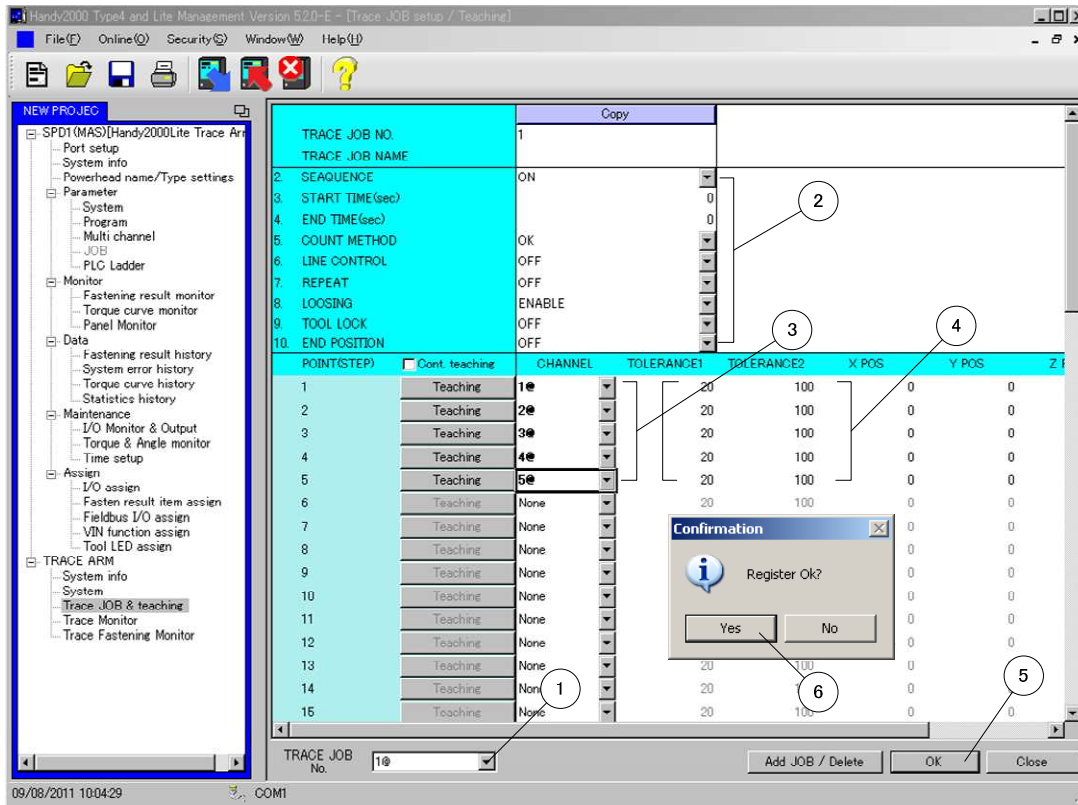
① Select Trace Job number to be edited.

② Setup Job Parameter

For the details, please refer to 8.2. TRACE JOB SETTINGS

③ Setup Tightening Channel which is used on each position.

This tightening channel must be set in prior to setup Trace Job.

④ Setup tolerance range for each position

Please refer to 8.2. Trace Job Settings

⑤ Press [OK] and a window for confirmation opens.

⑥ Press [YES] to register.

(7) Upload edited parameters.

Upload a file to X-PAQ^{TM} controller.
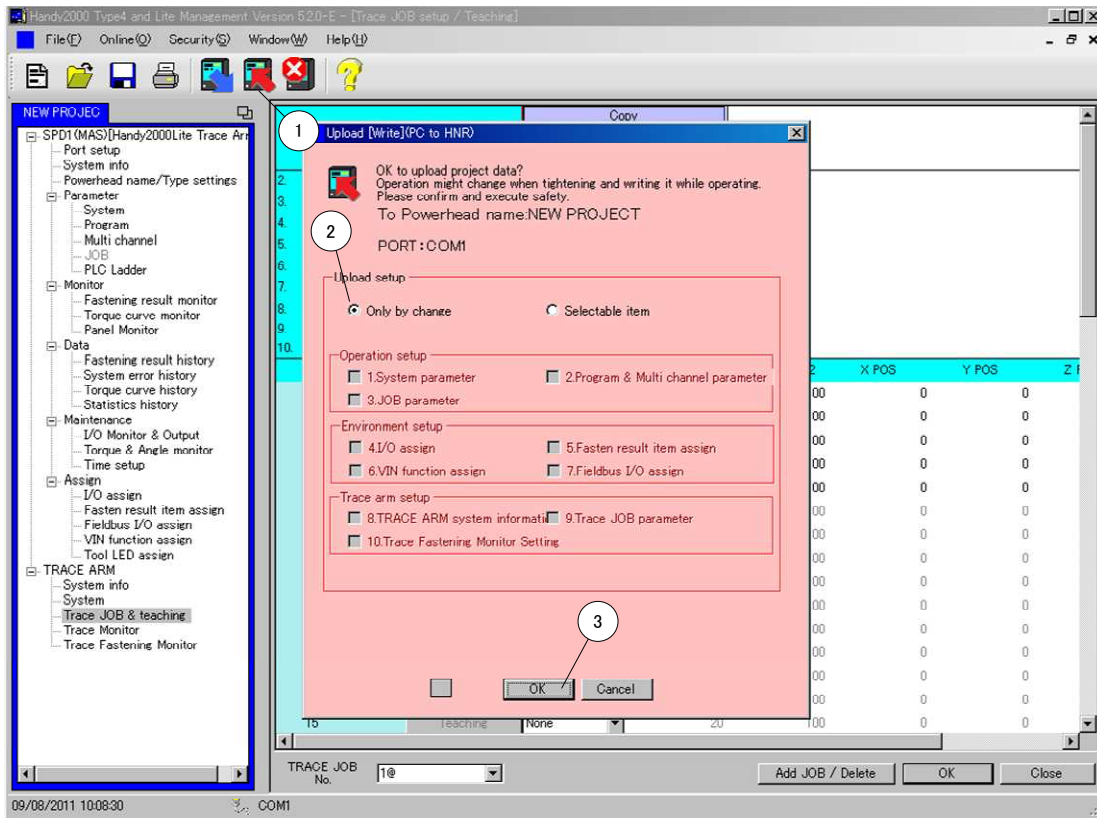
① Press [Upload [Write] PC to HNR] and a window for uploading opens.
② Select [Only by change]
③ By pressing [OK], uploading starts.

A window will automatically close after completion of uploading.

(8) Teaching for tightening positions.

Setup for each position on Trace Job

Please refer to 10. Teaching method for settings..

Now all setup is completed.

9.2.2. Setup by using existing project file

This is a procedure by using an existing project file without Trace Arm settings.

(1) Add Trace Arm function
    Add Trace Arm function on existing project file.
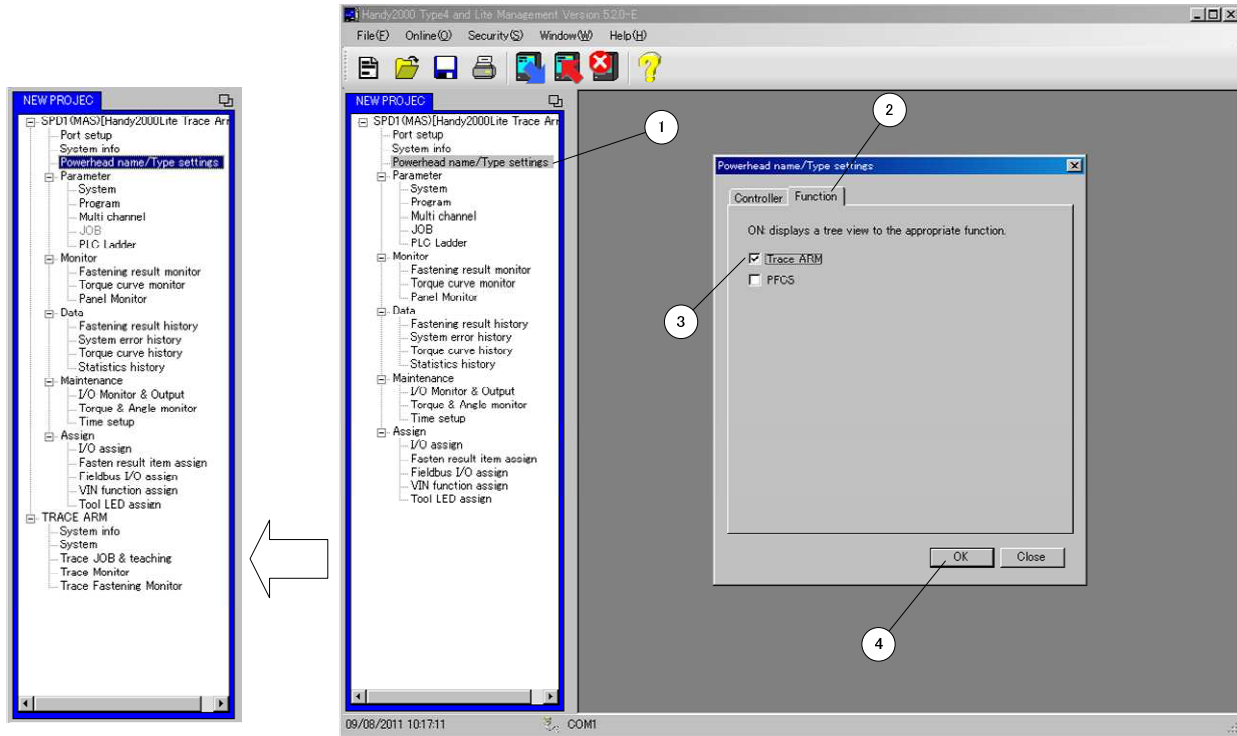
① Press [Powerhead name/Type settings] and a window opens
② Select [Function] tab
③ Tick a [Trace ARM] box
④ Press [OK] and TRACE ARM parameters appear on the parameter tree.

Procedure after this is same as 9.2.1 Setting up by creating a new file

10. Teaching

Teaching means to set position data on [POSITION LIST] for TRACE JOB parameters.

There are 4 ways for Teaching method.

10.1. Direct Teaching by using Management Software

Direct Teaching is a function to teach positions by using Management Software and an Arm together.

This is a procedure by placing an Arm to the position to be registered with using either Continuous Teaching mode or Designated point Teaching mode on Management Software.

Procedure is explained as follows.
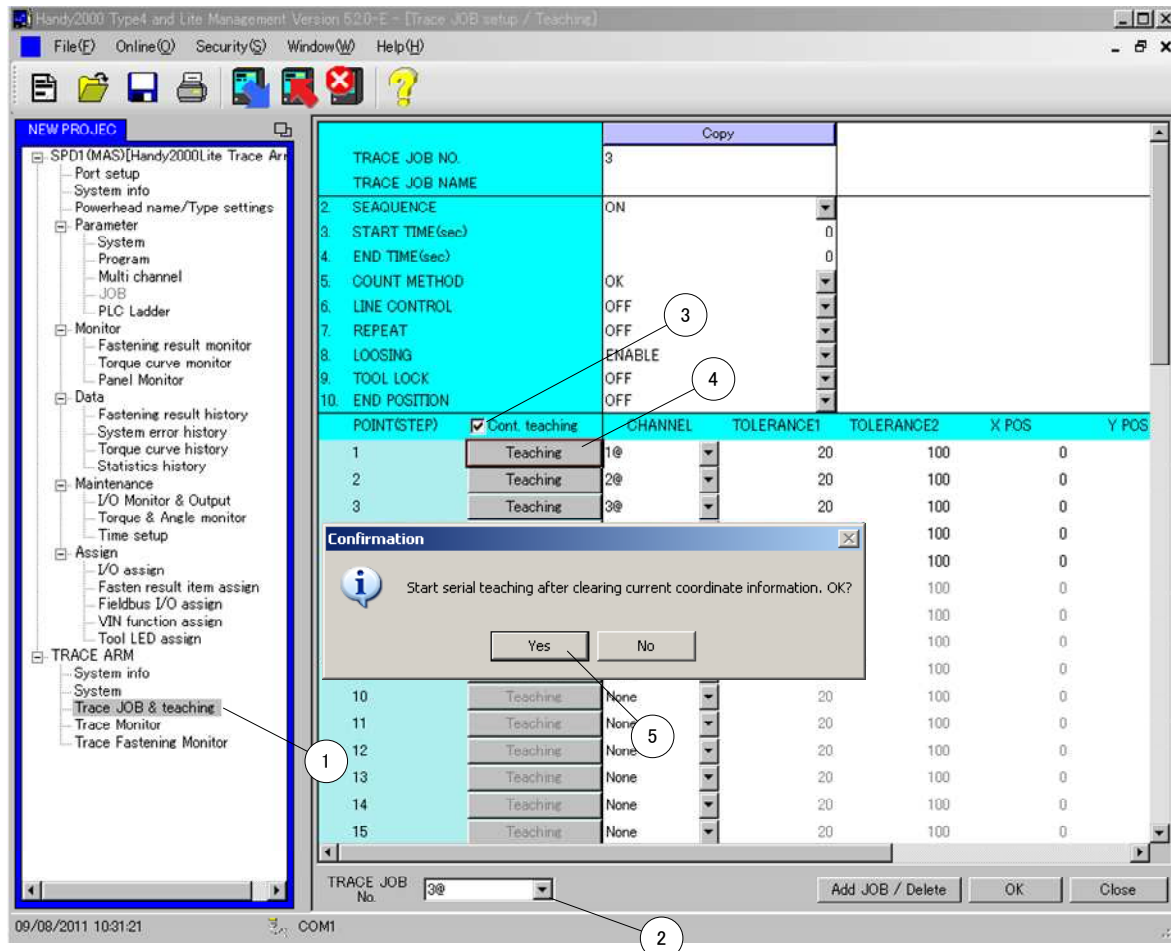
Before execute Teaching, setup Trace Job and upload to the controller. Refer to 9.2.1 Setting up by creating a new file (6) Trace Job settings

① Press [Trace Job & Teaching] and a window opens

② Select Job Number for teaching on [TRACE JOB No.]

③ If Teaching is made continuously for all positions, tick off [Cont. teaching] box. If this box is not ticked off, teaching is made on designated position only.

④ When Continuous Teaching is selected and [Teaching] is pressed, [Confirmation] window opens. When Designated position teaching is selected and [Teaching] is pressed, no window opens, teaching starts.

⑤ Press [YES] to start teaching for Continuous Teaching mode.
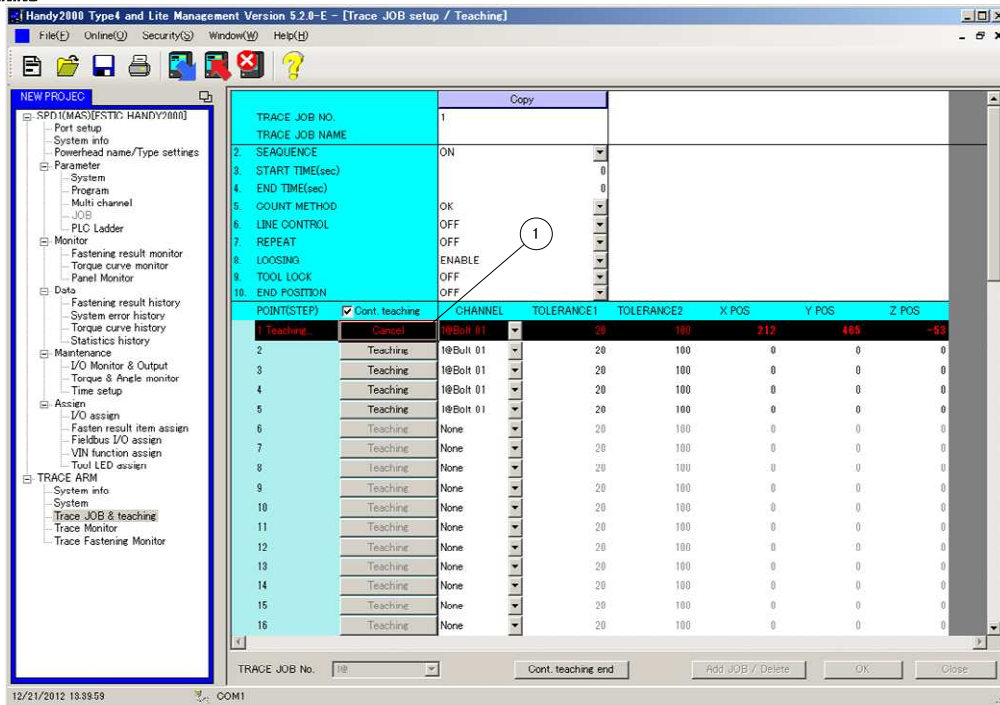
During teaching operation, management software displays like above image.

A position (step) which is displayed in red with back background is the position for teaching now.

Move the Arm to the position to be registered, and press Start Switch on the tool for 1 sec for registering this position. On Continuous Teaching, after 1 position registered, next position is ready for registration automatically. For designated position teaching, teaching will be completed once a position is registered

[Teaching] button turns [Cancel] while teaching operation is ongoing. Once [Cancel] is pressed, teaching is terminated. When [Cancel] is pressed, registration of position information is not executed, and position information for a selected Job Number will be all 0.
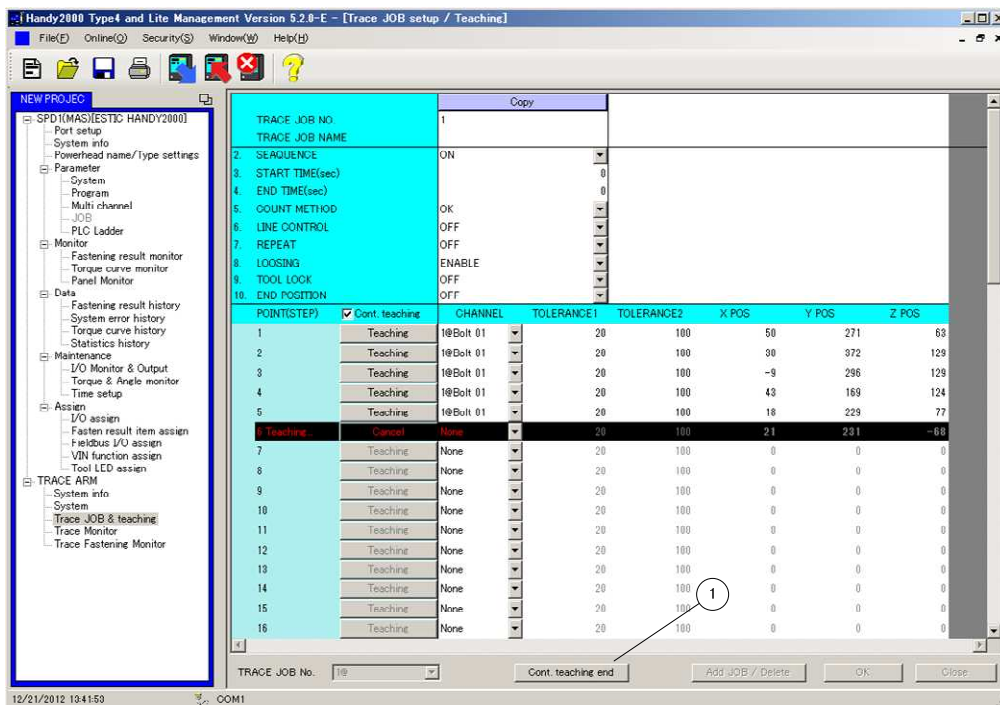
After completion of registration for all positions, press [Cont. teaching complete].

Now all procedure is done.

10.2. Manual Setup by using Management Software

Key in manually position information by Management Software.

① Key position information directly in Management Software manually.

② Press [OK] and a window opens.

③ Press [OK] and register the data

④ Press [Upload/Write] and upload parameter data.

Procedure after this is same as 9.2.1 Setting up by creating a new file (7) Upload edited parameters

10.3. Direct Teaching from Controller Panel

Settings are made from Controller Panel on X-PAQ™ controller.

Only continuous teaching can be made from Controller Panel.
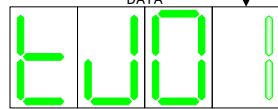
Procedure is explained below.

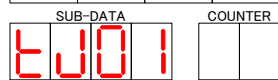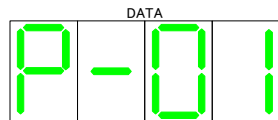**tJ01   0** (SUB-DATA / COUNTER)

↓ MODE key

tEAC   tC (SUB-DATA / COUNTER)
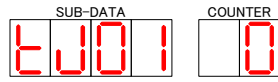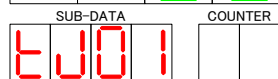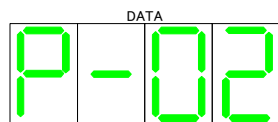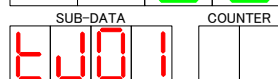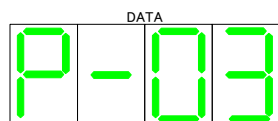
Press [MODE] key till tracer arm setting menu appears (as shown on he left)

↓ SET key

Blinking

tJ01 (DATA)

tEAC   tC (SUB-DATA / COUNTER)

Press [SET] key and Trace Job number is displayed.

Select Trace Job number by [▲] [▼] then press [SEL]

↓ SET key

P-01 (DATA)

tJ01 (SUB-DATA / COUNTER)

Position number to be registered is displayed on [DATA] area

↓

Move the arm to the position 1, and press tool switch for 1 sec

P-02 (DATA)

tJ01 (SUB-DATA / COUNTER)

↓

Move the arm to the position 2, and press tool switch for 1 sec

P-03 (DATA)

tJ01 (SUB-DATA / COUNTER)

↓

Move the arm to the position 3, and press tool switch for 1 sec

⋮

Consecutive positions numbers are to be followed the same procedure

Press [SET] key to complete teaching after all positions were registered
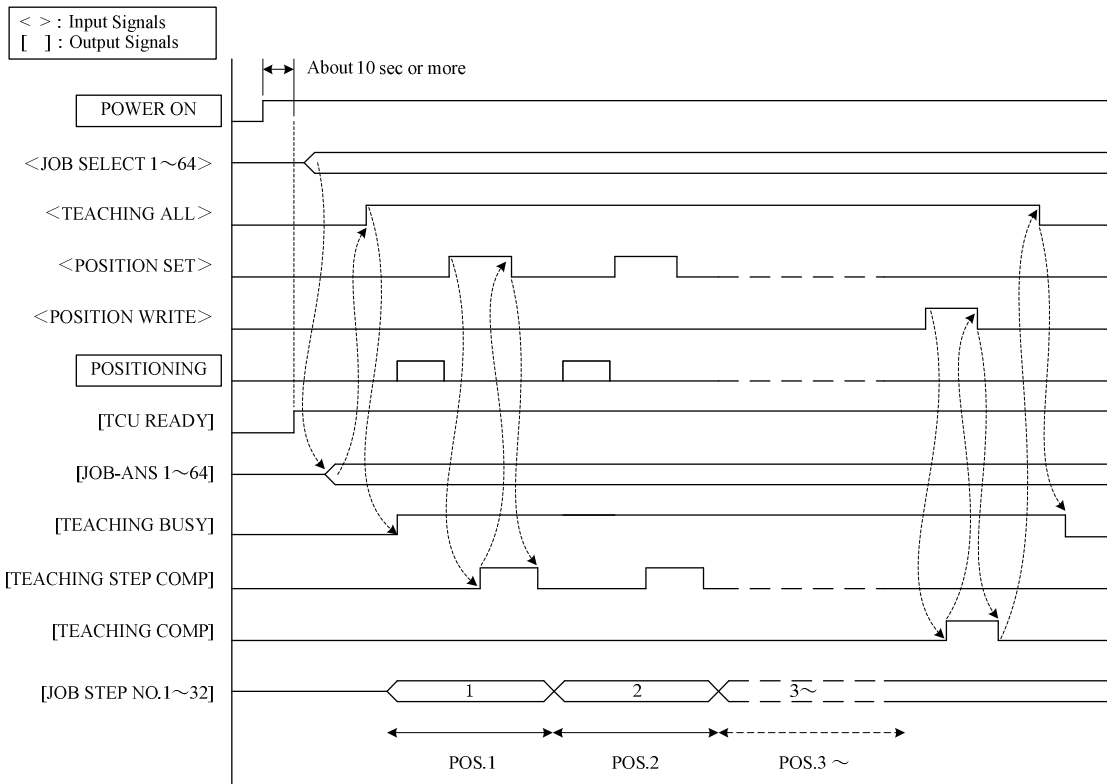
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10.4. Direct Teaching by using external signal input

＜All-Position Continuous Teaching Using External Input Signal＞

[1]   Using "JOB SELECT 1-64" input, specify a trace JOB No. at which teaching is to be performed.

[2]   Turn ON the "TEACHING ALL" input signal.

[3]   Move the arm to a position to be set as the currently selected position.

[4]   Turn ON the tool start switch or the "POSITION SET" input signal.

[5]   When performing teaching at the next point, repeat steps [3] ⇔ [4].

[6]   Turn ON the "POSITION WRITE" input signal.

[7]   Turn OFF the "TEACHING ALL" input signal.

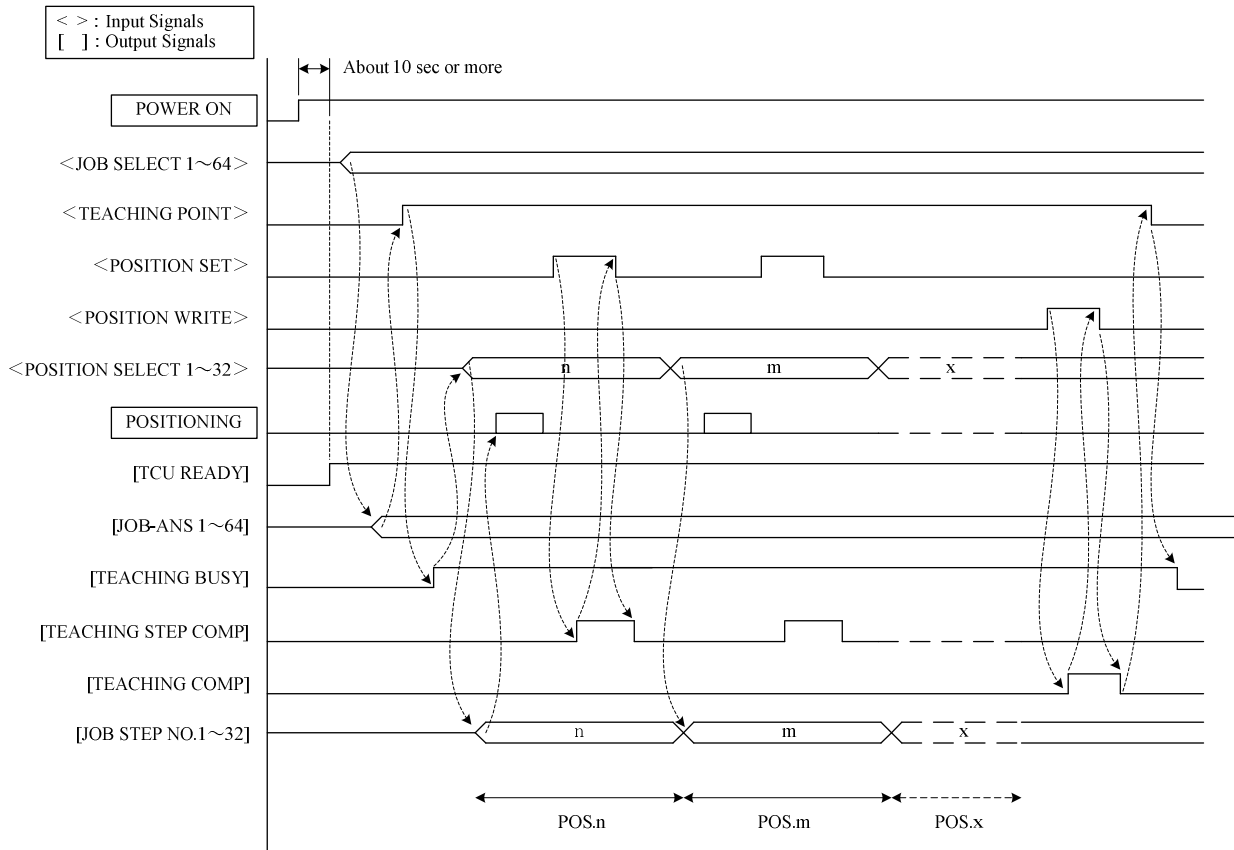＜Specified-Position Teaching Using External Input Signal＞

[1]   Using "JOB SELECT 1-64" input, specify a trace JOB No. at which teaching is to be performed.

[2]   Turn ON the "TEACHING POINT" input signal.

[3]   Using "JOB SELECT 1-32" output, specify a position at which teaching is to be performed.

[4]   Move the arm to a position to be set as the currently selected position.

[5]   Turn ON the tool start switch or the "POSITION SET" input signal.

[6]   When performing teaching at the next point, repeat steps 2 to 5.

[7]   Turn ON the "POSITION WRITE" input signal.

[8]   Turn OFF the "TEACHING POINT" input signal.

＜I/O timing＞

[1] Continuous teaching

< > : Input Signals
[   ] : Output Signals

About 10 sec or more

POWER ON

＜JOB SELECT 1～64＞

＜TEACHING ALL＞

＜POSITION SET＞

＜POSITION WRITE＞

POSITIONING

[TCU READY]

[JOB-ANS 1～64]

[TEACHING BUSY]

[TEACHING STEP COMP]

[TEACHING COMP]

[JOB STEP NO.1～32]   1   2   3～

POS.1   POS.2   POS.3 ～

[2] Point teaching

< > : Input Signals
[   ] : Output Signals

About 10 sec or more

POWER ON

＜JOB SELECT 1～64＞

＜TEACHING POINT＞

＜POSITION SET＞

＜POSITION WRITE＞

＜POSITION SELECT 1～32＞   n   m   x

POSITIONING

[TCU READY]

[JOB-ANS 1～64]

[TEACHING BUSY]

[TEACHING STEP COMP]

[TEACHING COMP]

[JOB STEP NO.1～32]   n   m   x

POS.n   POS.m   POS.x

11. Installation and Maintenance

11.1. Installation of Tracer Arm Main Body

The rotation sensor and sensor cable are built into the tracer arm main body. When installing the tracer arm, take extra care in handling it.

1. Installation placement of tracer arm

    Install the tracer arm in a stable place where vibration or shaking is scarcely caused.

2. Arm mounting bracket

    The base shaft portion of the tracer arm is fixed with the shaft clamp. Tighten the clamp bolt securely.
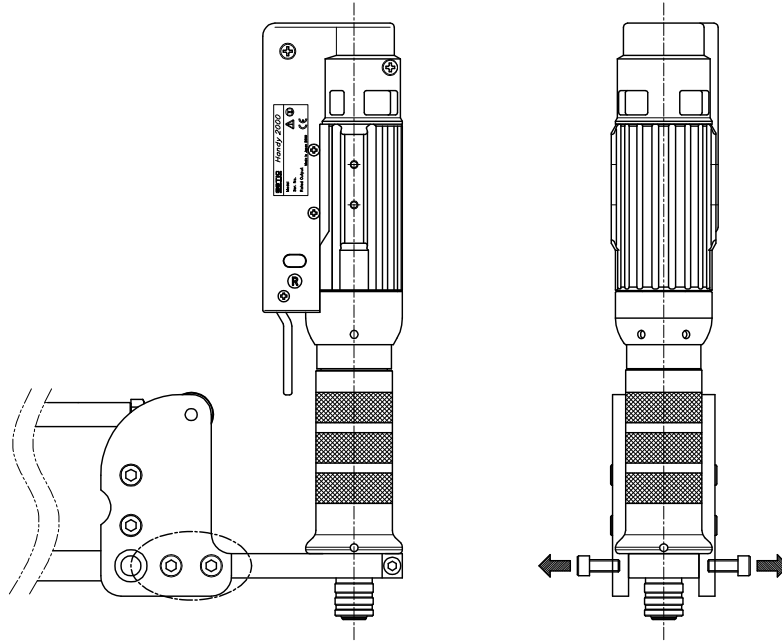   (Recommended torque: 15-20 N.m.)

3. Wiring

    Wiring between the units should be carried out after installation. If the tracer arm is installed after being wired, wire breakage will be caused.
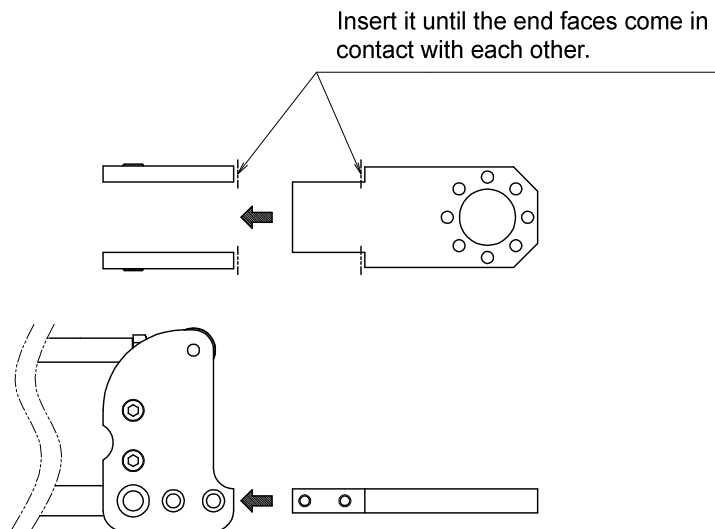
11.2. Replacement of Tool Attachment

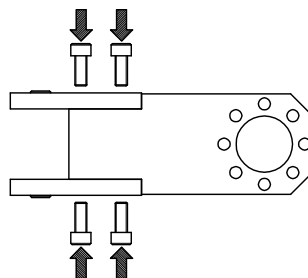Replace the tool attachment according to the following procedure.

1. Loosen the four cap bolts (M6) fixing the tool attachment and remove it.
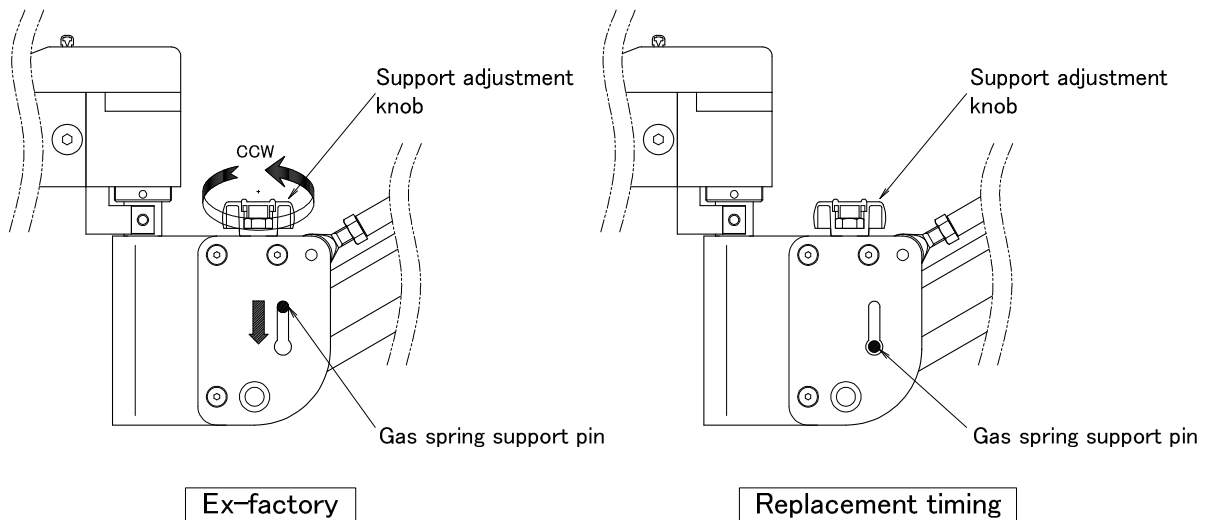
2. Insert a new tool attachment into place.

Insert it until the end faces come in contact with each other.

3. Install the cap bolts. (Recommended torque: 18 N.m.)
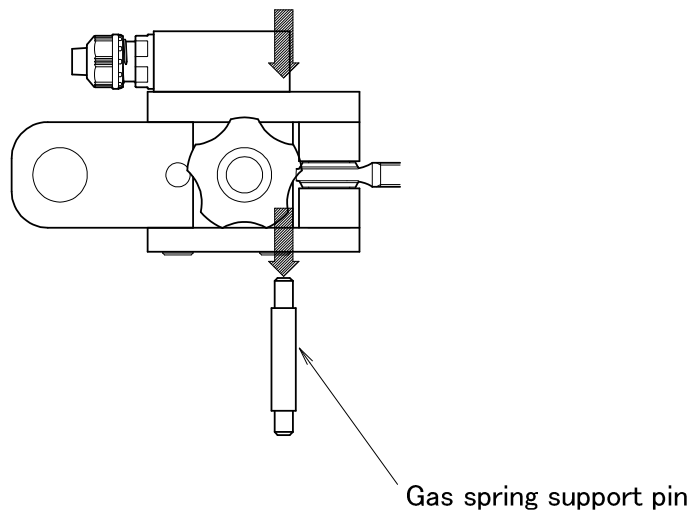
11.3. Gas Spring

The tracer arm uses the gas spring for the up/down motion of the tool. Due to its structure, the reaction force of the gas spring decreases as it is used. The reaction force is set to an optimum value at the factory before shipping. If the support force is felt to be weak, increase it with the adjustment knob. Turning the knob counterclockwise increases the support force. However there is a limit on the support force adjustment. When the knob turned counterclockwise till the end (the pin reaches the bottom of slot) and the support force seems not strong enough, it is the time that Gas Spring should be replaced. (See the figure below.)

Support adjustment knob

CCW

Support adjustment knob

Gas spring support pin

Gas spring support pin

Ex-factory

Replacement timing

Our warranty period of the gas spring is one year from the date of delivery or a period in which the number of times of fastening (the number of times of tool up/down motion) becomes 1,000,000, whichever is shorter.

11.3.1. Gas Spring Replacement Procedure

1. Using the support adjustment knob, move the rod-side gas spring support pin to the replacement timing position described above. Then push out the pin from the side.


Gas spring support pin

2. Pull out the fall-preventing snap pin from each end of the cylinder-side support pin and then pull out the support pin.
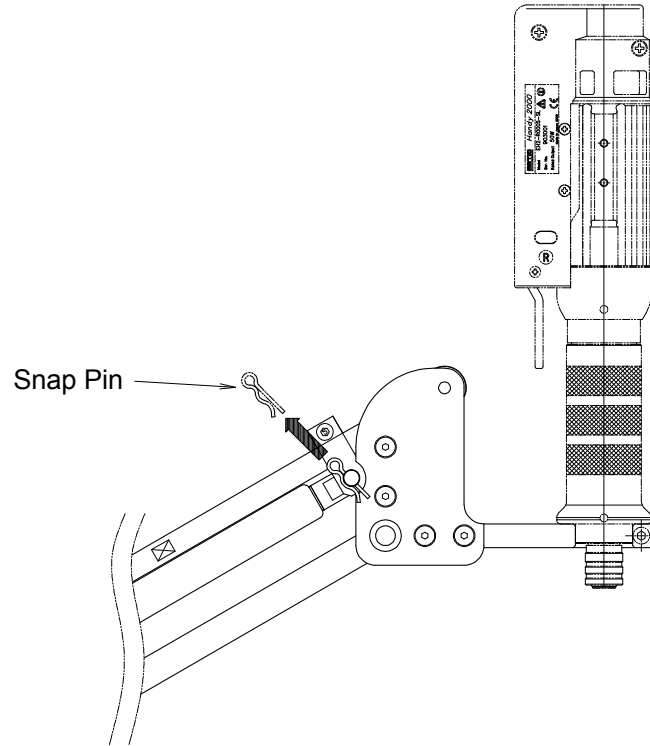
Snap Pin

3. Replace the gas spring with a new one. Insert the cylinder-side support pin and fall-preventing snap pin and insert the rod-side support pin. When inserting the support pin, lift the up/down portion of the arm to the upper limit. When replacing the gas spring, take care to orient it properly. (Attach the cylinder side of the gas spring to the tool unit side.)
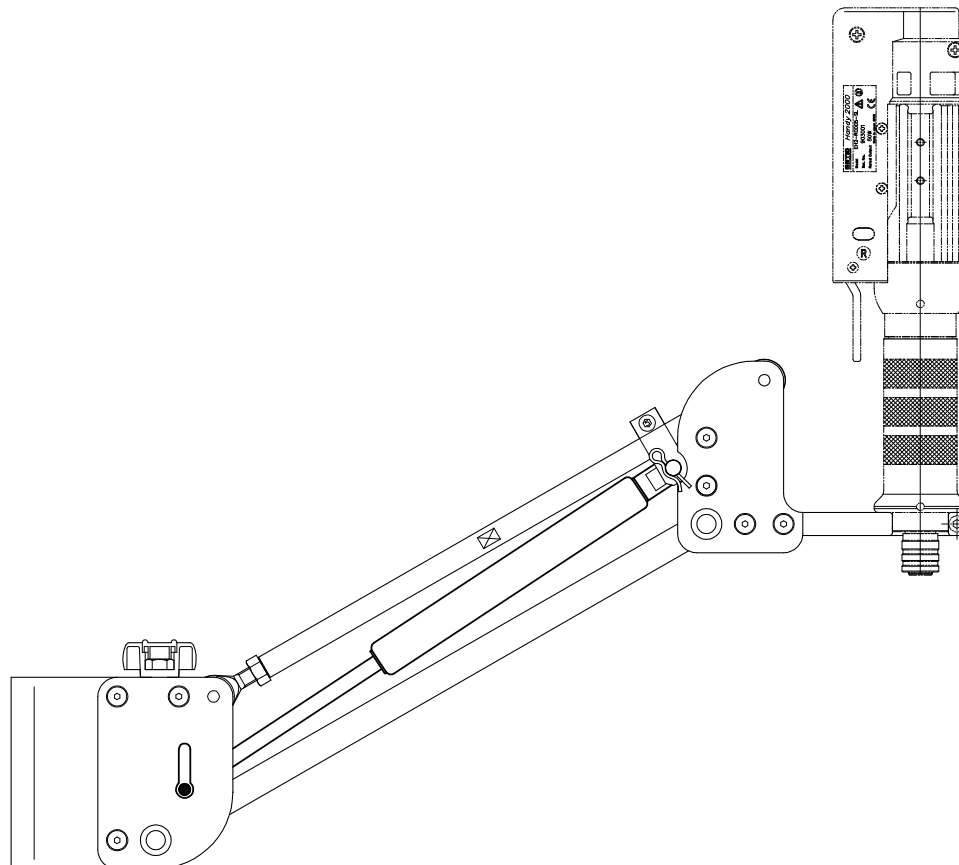
4. Move the rod-side support pin to the upper limit position by turning the support adjustment knob clockwise.

Support adjustment knob

CW
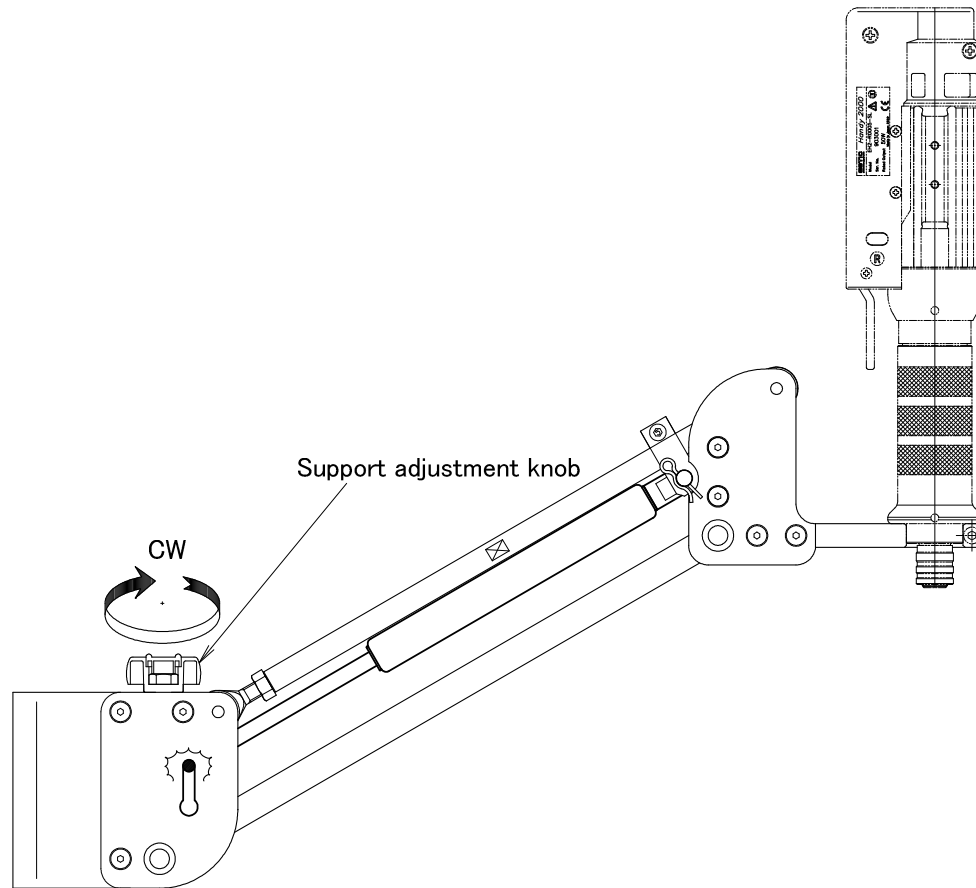
Replacement is completed.

⚠ Warning

11.3.2. Handling and Disposal of Gas Spring

When handling and disposing of the gas spring, observe the following precautions.

- Do not use the gas spring for anything other than this product.

- Do not disassemble the gas spring. The gas spring contains high-pressure gas, disassembling it is very dangerous.

- Do not throw the gas spring into fire. Though the gas spring does not catch fire, it may explode because the gas in the cylinder expands when exposed to fire.

- Do not use the gas spring in an environment where the rod is damaged or rusted. Doing so will cause the reaction force to be decreased.

- At the time of disposal, securely fix the gas spring and, using a drill with a diameter of 2 to 3 mm, make a hole in the body of the cylinder to vent gas. When venting gas, put the gas spring in a vinyl bag etc. and wear protective glasses. Internal oil or chips may scatter.

- After checking that gas is vented completely, dispose of the gas spring according to a local regulation.

REVISION HISTORY

Operation manual revision number is printed on the lower right side of cover.

Revision	Date	Revision Note
1.02	July 2013	[8.2. Trace Job Setting] Add a function 12. POSITION MONITOR. Deleted 4. Arm type switching from 11.1. Installation of Tracer Arm Main Body.

Notes

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