

MITSUBISHI TENSION CONTROLLER MODEL LD-05ZX INSTRUCTION MANUAL



- Read through this manual, and use the unit correctly.
- Make sure to understand "Cautions on safety" completely.
- Store this manual carefully, and make sure to sent it to the end user.

Cautions on Safety



(Make sure to read this page before using the unit.)



Please read through this instruction manual and other technical data, and handle the unit correctly while paying rigid attention to safety.



In this manual, the level of safety precautions are classified into "DANGER" and "CAUTION".



 DANGER	Erroneous handling may cause a dangerous situation in which the possibility of death or serious injury is expected.
 CAUTION	Erroneous handling may cause a dangerous situation in which the possibility of not so serious or slight injury is expected or occurrence of material damages exclusively is expected.

Store this manual carefully so that it can be referred to when required, and make sure to sent it to the end user.

 DANGER	Shut down all the phases of the external power supplies during installation and wiring.
 CAUTION	Otherwise, electrical shock or damages in unit may be caused. Make sure to shut down all the Phases of the external power supplies before starting installation and wiring.

 DANGER	Never use the unit in an atmosphere in which inflammation or explosion is expected.
 CAUTION	Otherwise, inflammation or explosion may be caused.

 DANGER	Assemble the emergency circuit outside the tension controller.
 CAUTION	Malfunction in the tension controller may occur out of order and cause an accident. Assemble the emergency circuit outside the tension controller.

 CAUTION	Check the environments.
 CAUTION	Never install the unit in a location in which dust, soot, conductive dust and corrosive gas are present nor a location subject to high temperature, condensation, wind and rain. Never install the unit directly in a location on which vibrations or impacts are applied. Otherwise, damages, malfunction of deterioration in the unit may be caused.

Caution

- We shall not be responsible for the damages caused by repair, disassembly, modification or others erformed by any third party other than the MITSUBISHI ELECTRIC CORPORATION personnel or the personnel specified by MITSUBISHI ELECTRIC CORPORATION.

The specifications mentioned in this "Cautions on Safety" and other sections in this instruction manual are subject to change without notice.

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The tension controller LD-05ZX controls the excitation current applied to the 80 V Series powder brake or clutch.

Functions and features

Constant current control method

- Because the constant current control type output circuit is adopted, a stable output current is assured without affected by changes in the winding resistance in the powder brake or clutch and fluctuations in the supply voltage.

Semi-automatic tension control function

- To control the tension, the semi-automatic tension control function which changes the output current-based on the winding diameter is provided.
The following two methods are offered for detecting the winding diameter, and either one can be selected.

- 1) Speed - thickness setting method (sensorless method)
- 2) Thickness setting, winding axis pulse detection method

For the details, refer to page 19.

Inertia compensation function at stop

- Fluctuation in the tension caused by inertia at stop can be reduced by setting the stop gain, stop bias and stop timer. For the details, refer to page 20.

Taper tension function

- Wrinkles caused by winding can be prevented by the control function which automatically increases or decreases the operation tension in accordance with the winding diameter. For the details, refer to page 20.

Manual power supply function

- This tension controller can function as a manual power supply unit by switching over the built-in switch. In this case, the current corresponding to the setting of the trimmer provided on the panel is output.

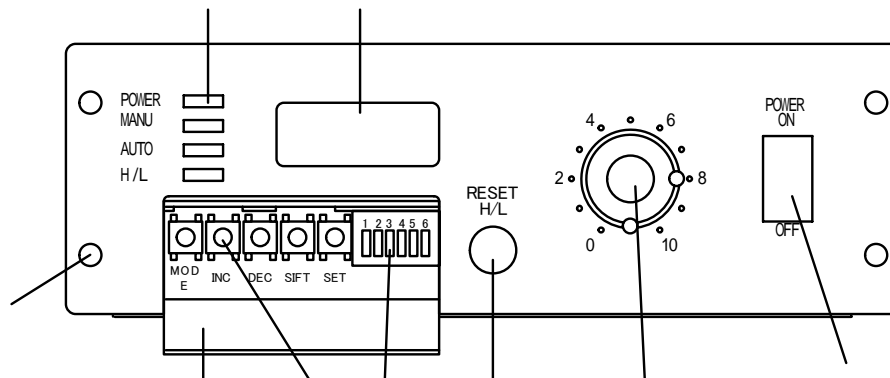
Setting / display function

- The seven-segment of four digits display, five key switches and six-pole DIP switch are built in to facilitate the setting of the maximum output current and inertia compensation parameters.
- On the monitor, the tension can be displayed while performing the semi-automatic tension control and the output torque can be displayed while functioning as a manual power supply using to this function. For the details, refer to page 6.

The following three types of setting modes are offered. For the details, refer to pages 11 to 13 and 18.

- 1) Basic constant setting mode (in which the basic values used both in the manual and semi automatic modes are set)
- 2) System constant setting mode (in which the system values used in the semi-automatic mode are set)
- 3) Operation constant setting mode (in which the operation values used in the semi automatic mode are set)

The tension controller LD-05ZX made of plastic case is compact in design, and attached to the panel or placed on the floor.



1) Mounting holes on four corners

The unit is fixed inside the control panel using these holes.

2) Power switch (ON/OFF)

3) Seven-segment of four digits display (red)

The output current is displayed here. The display is used also for diversified setting operations.

4) Status LED indicators

POWER LED: Lit while the power is turned on.

MANU LED: Lit while the manual power supply mode is selected.

AUTO LED: Lit while the semi-automatic mode is selected.

H / L LED: Indicates the gain status while the manual power supply mode is selected, and lit while the high gain is selected.

Note :These LED indicators notify errors also. When an LED indicator flashes, refer to the error list shown in page 18.

5) Small cover for set keys and DIP switch Open this cover, and perform diversified setting.

6) Set keys

Set the inertia compensation at stop and initial diameter using these keys.

7) DIP switch

Set a mode such as manual and semi-automatic using this switch. For the details, refer to page 7.

8) RESET switch

The winding diameter is reset during the semi-automatic mode.

The gain is switched over between high and low during the manual mode.

The high gain is the standard setting in which the torque corresponding to the setting of the trimmer is generated.

While the low gain is selected, approximately half of the torque in the high gain is generated.

9) Tension adjustment trimmer

The tension is adjusted in accordance with the winding diameter while the semi-automatic tension control is performed. The torque is adjusted while the unit is functioning as a manual power supply unit.

10) The terminal block is provided inside the rear cover.

2.1 Cautions on installation

⚠	DANGER	Never drop cutting chips and cable chips into the unit.
⚠		Otherwise, danger such as damages, fume or inflammation in the unit may be caused.

⚠	DANGER	Attach the terminal cover.
⚡		There is a dangerous possibility of electrical shock. Make sure to attach the terminal cover to the rear side of the main unit before turning on the power and starting operations after installation and wiring.

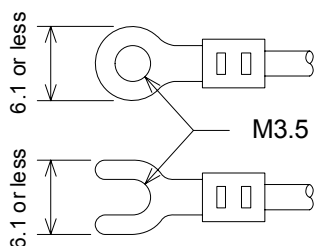
⚠	DANGER	Make sure to perform solid grounding (100Ω) to the ground terminal using a cable whose cross section is 2mm ² or more.
⚡		There is a dangerous possibility of electrical shock and failure in the unit. A qualified person (electrical engineer) shall perform the grounding work. Never share the ground with a heavy electric system.

⚠	CAUTION	Perform wiring of the power supply correctly.
		Otherwise, the unit may be damaged. Perform wiring correctly in accordance with the external wiring diagram.

⚠	CAUTION	Assure a sufficient withstand voltage in a device connected to the SN terminal.
		Otherwise, the unit may be damaged. The SN terminal is not insulated from the AC power supply. Make sure to assure a sufficient withstand voltage in a device connected to the SN terminal. Never ground the SN terminal on such device..

- Never put the PL, RS and ST input signals together with other power cables in the same duct. Never bind such input signals together with other power cables. The wiring length up to approximately 50 to 60 m is allowed in principle. However, it is recommended to set the wiring length to 20 m or less to assure safety against noises.
- Assure a space of 50 mm or more between the unit and other device or structure. Keep the unit away from high voltage lines, high voltage devices and power cables as much as possible.

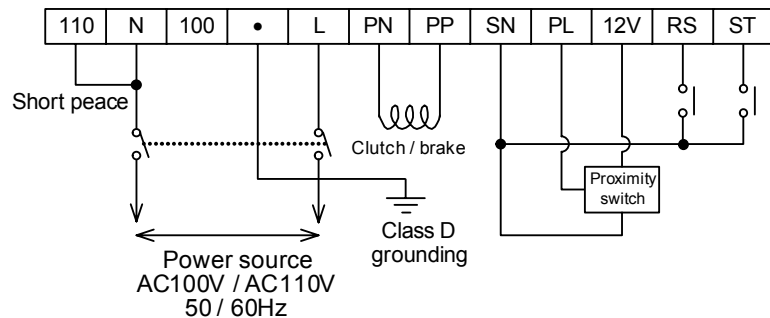
Wiring



- Use crimp-style terminals of the dimensions shown in the figure on the left.
- Set the terminal tightening torque to 0.5 to 0.8 Nm (5 to 8 kgfcm). Tighten the terminal securely to eliminate a possibility of malfunction.

External connection

<Common in 100 VAC and 110 VAC>



Input terminals

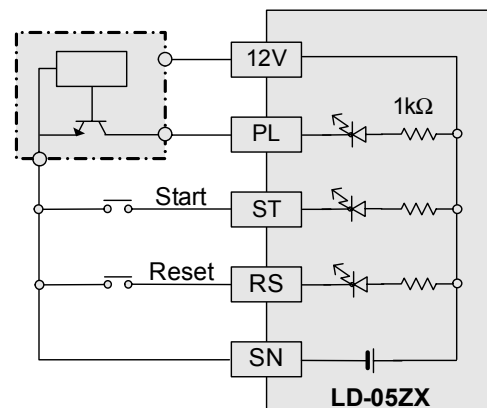
- At each contact input, use a switch for micro signals suitable to the micro current of 12 VDC, 5 mA.

< PL terminal > Winding axis pulse input

Connect a proximity switch to this terminal when the pulse/thickness setting method is used. Use an open collector type proximity switch for power supply of 10 to 16 VDC, power consumption of 30 mA or less and output current of 10 mA or more.

Example 1 : E2E-X2E1 (cylinder type) manufactured by OMRON

Set the ON time and OFF time to 2 ms or more respectively and the frequency to 250 Hz or less.



< ST terminal > Operation stop input

- This is the input terminal for stop gain. Even when the stop gain is not used, turn off the input to this terminal to stop the operation when the unit is turned off.
- Especially when the rest time is long in the speed/thickness setting method, setting of the mean speed exclusively may generate error in the operation. Accordingly, the operation stop input using this terminal is required.
- When malfunction occurs in the proximity switch by vibrations caused by stop of the reel in the pulse/thickness setting method, turn off the ST input when the unit is turned off to eliminate malfunction.
- While the ST terminal signal is turned on, diversified settings cannot be performed. Turn off the ST signal once, then perform settings.

< RS terminal > Reset input

- The RS terminal signal functions in the same way as the reset switch provided on the front face. Either one between the RS terminal and reset switch is available.
- When a new reel is attached in the semi-automatic mode, turning on the RS terminal input sets the initial diameter.
- In the manual power supply mode, turning on the input of this output torque functions as the selector switch between the high gain and low gain.

Display

The four digits numeric display shows the following contents after the power of this unit is turned on. When the power is turned on, the maximum output current is displayed for 2 seconds.

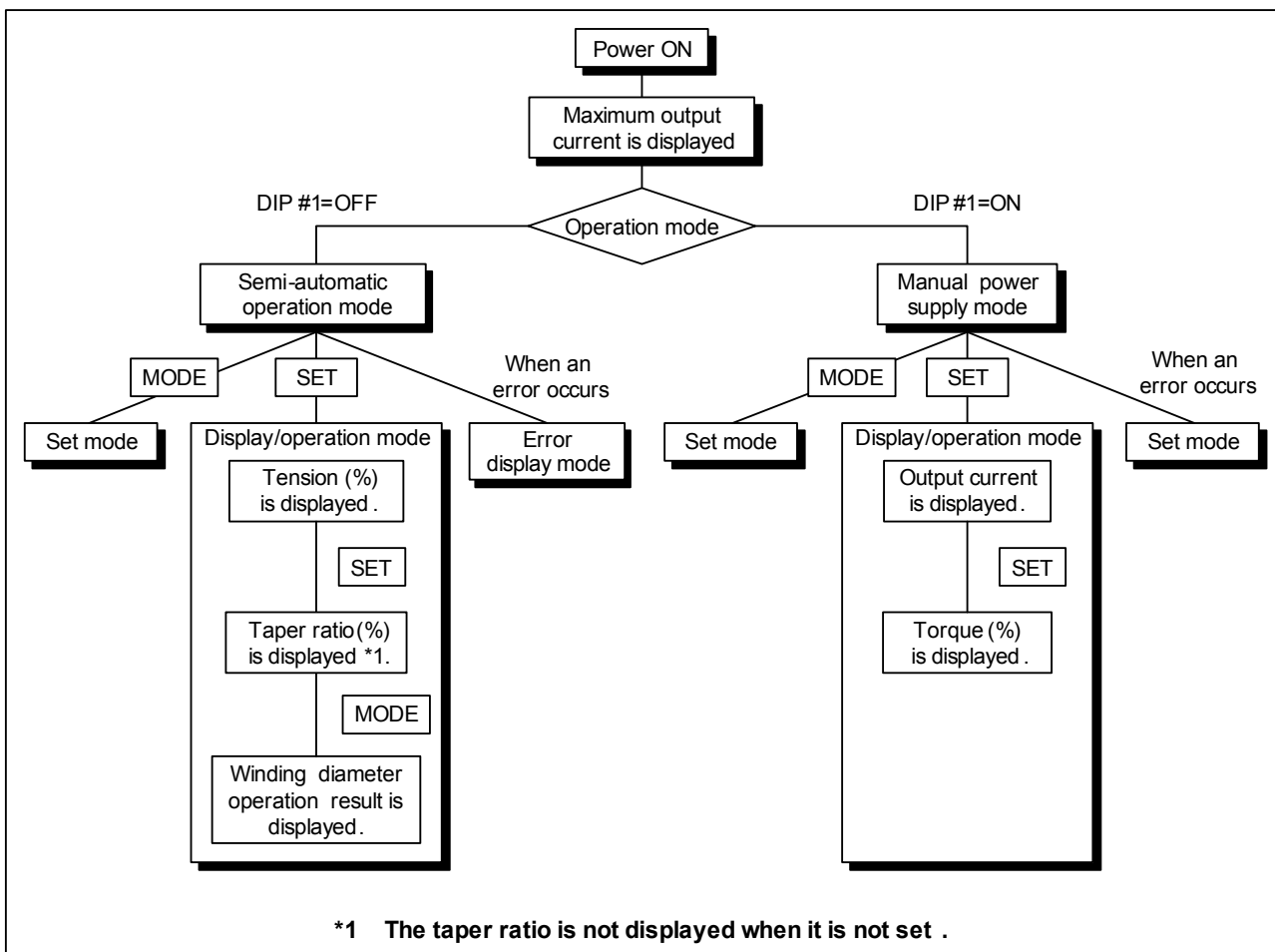
< Manual mode >

- In the manual power supply mode, the output current or torque is displayed. Pressing the SET key switches over the displayed value between output current and torque. The torque is represented in % against the maximum output current. Pressing the MODE key specifies the mode to set the basic constants (such as inertia compensation at stop).

< Semi-automatic mode >

- In the semi-automatic mode, the tension, taper ratio or current winding diameter is displayed. Pressing the SET key switches over the displayed value between tension, taper ratio or current winding diameter. Pressing the MODE key specifies the mode to set the operation constants (such as material thickness).

Display flow chart



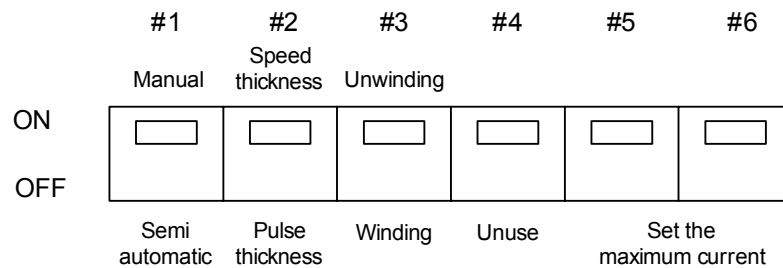
Each value is displayed in the seven-segment display.

Example: A → A

For the details of the output display, refer to the output display item list shown in page 18.

Setting the DIP switch

< DIP switch layout >



< Setting the operation mode >

DIP switch No. 1: Turned off always in the semi-automatic tension control mode.

#1	Description
ON	Manual power supply mode
OFF	Semi-automatic tension control mode

< Setting the control method in the semi-automatic operation mode >

DIP switch No. 2: Semi-automatic tension control mode

#2	Description
ON	Speed / thickness set method (sensorless method)
OFF	Pulse / thickness set method

< Setting the semi-automatic operation mode >

DIP switch No. 3: Semi-automatic tension control mode

#3	Description
ON	Unwinding control
OFF	Winding control

DIP switch No. 4: Unused

< Setting the maximum output current >


DIP switch Nos. 4 and 5: Determine the maximum output current.

#5	#6	Maxim output current	Brake (model name)
ON	ON	0.05A	
	OFF	0.12A	ZX-0.3YN-80, ZX-0.6YN-80
OFF	ON	0.16A	ZX-1.2YN-80
	OFF	Set by key switch*1	

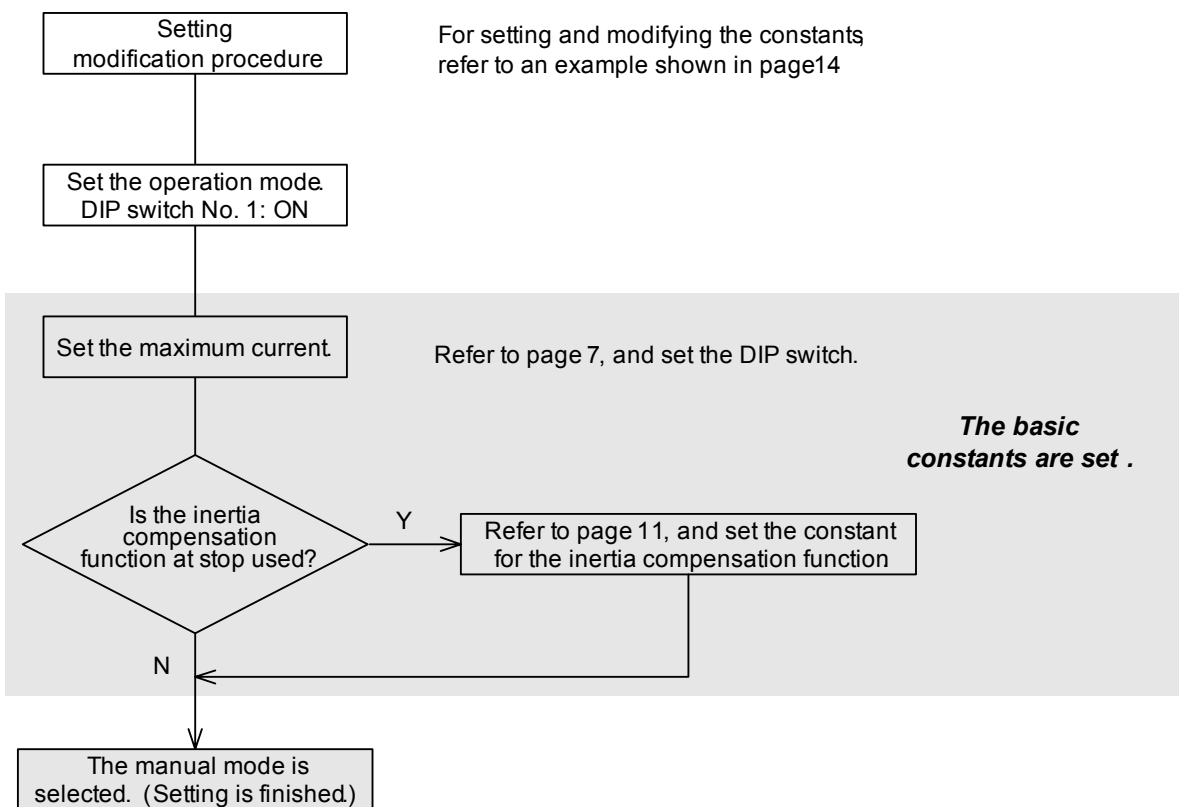
*1 Refer to page 11, and set the maximum current.

- The ON/OFF status of each switch is loaded when the power is turned on. Accordingly, even if the setting of a switch is changed while the power is turned on, the new setting is not effective until the power is turned off and turned on again.
- The DIP switch Nos. 2 and 3 are invalid in the manual power supply mode.

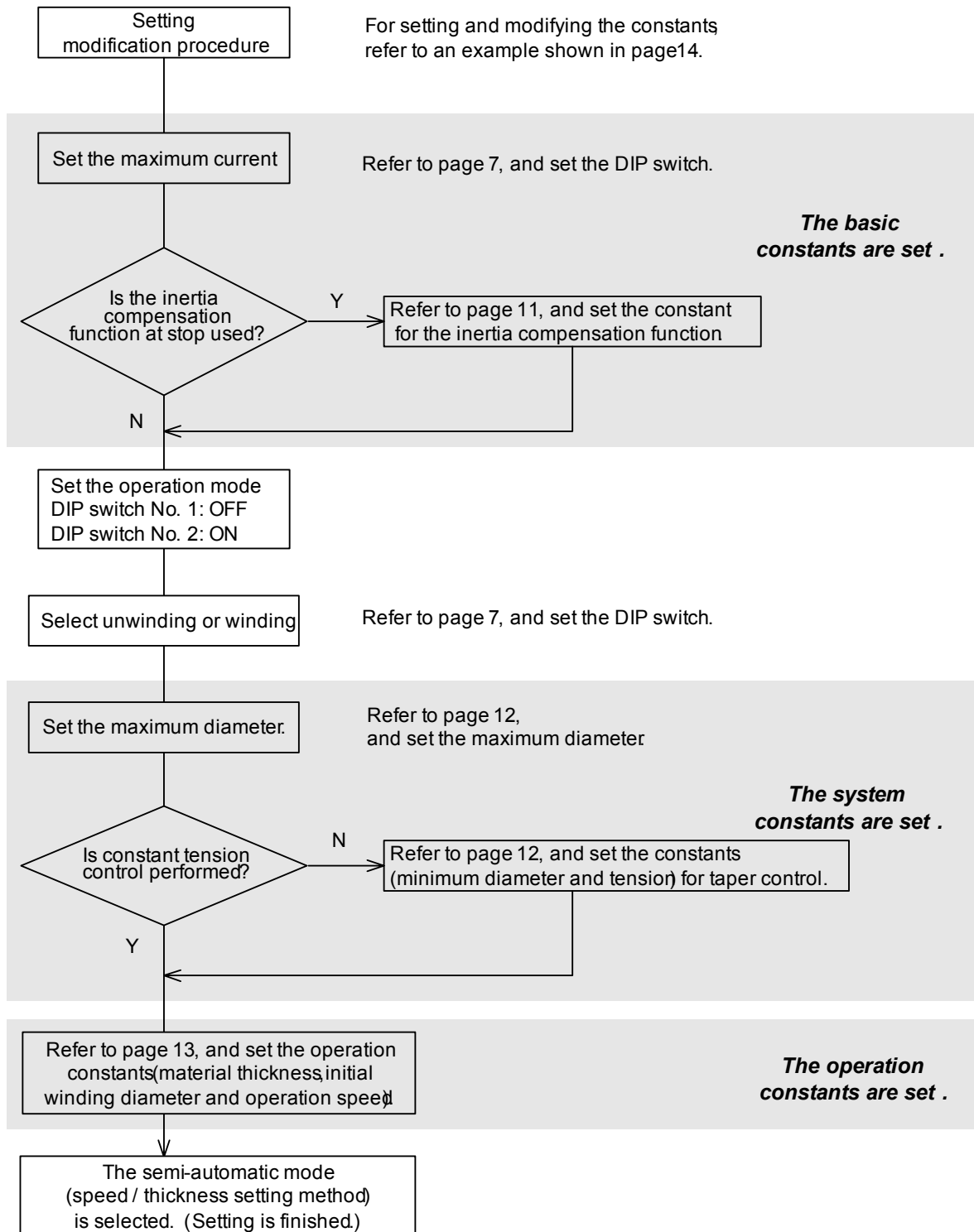
Model selecting procedures

 DANGER	Set the output trimmer to 0.
When the setting is finished, the output becomes the excitation status. Make sure to set the output trimmer to 0 before starting the setting.	

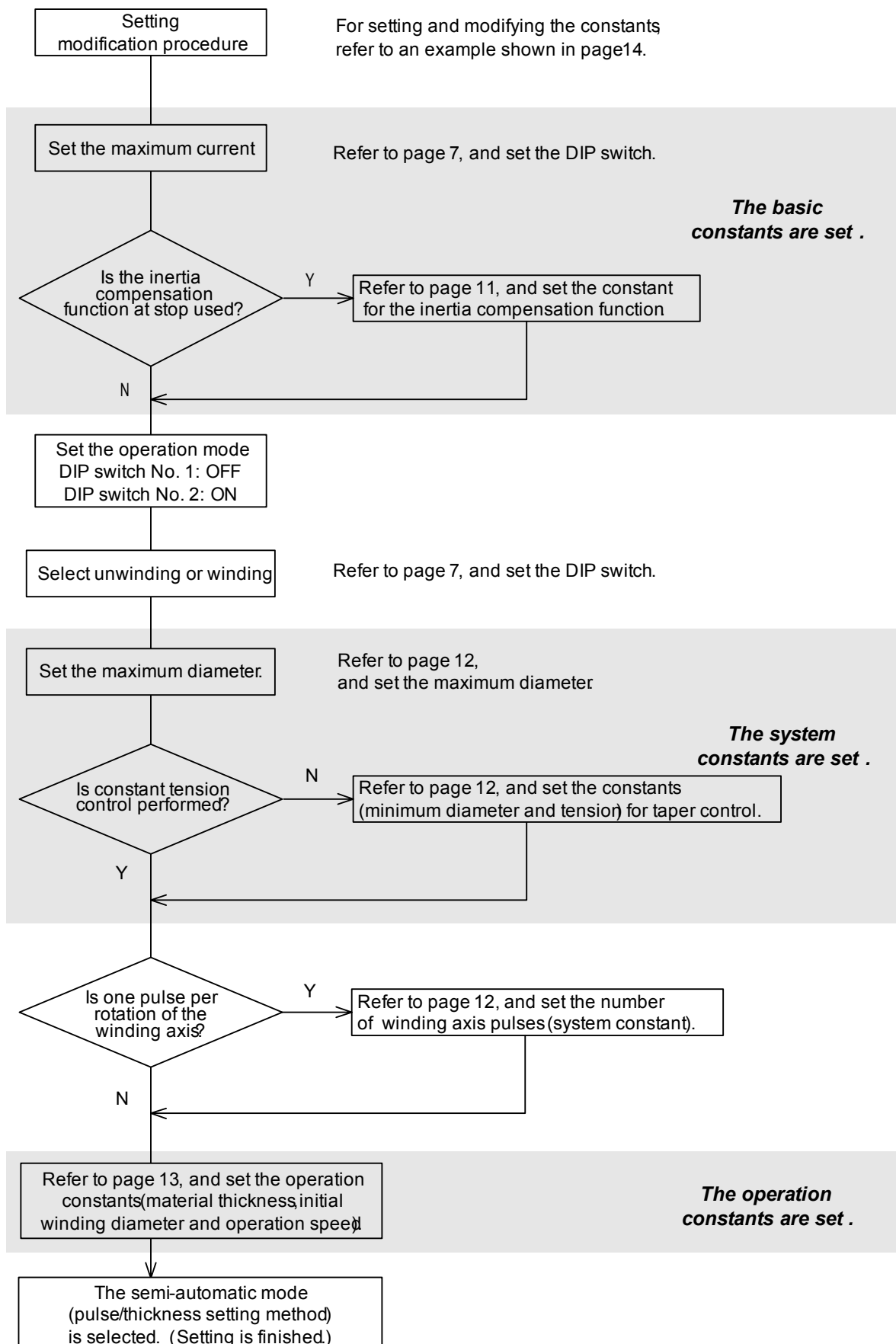
To select the manual power supply mode



To select the semi-automatic operation (speed/thickness setting method)



To select the semi-automatic operation (pulse/thickness setting method)



Setting the basic constants

- In the basic constant set mode, the inertia compensation value at stop and maximum current shown in the table below can be set.
- Each constant cannot be set when the ST terminal input is turned on. Turn off the ST terminal input before starting the setting.

Setting the inertia compensation value at stop

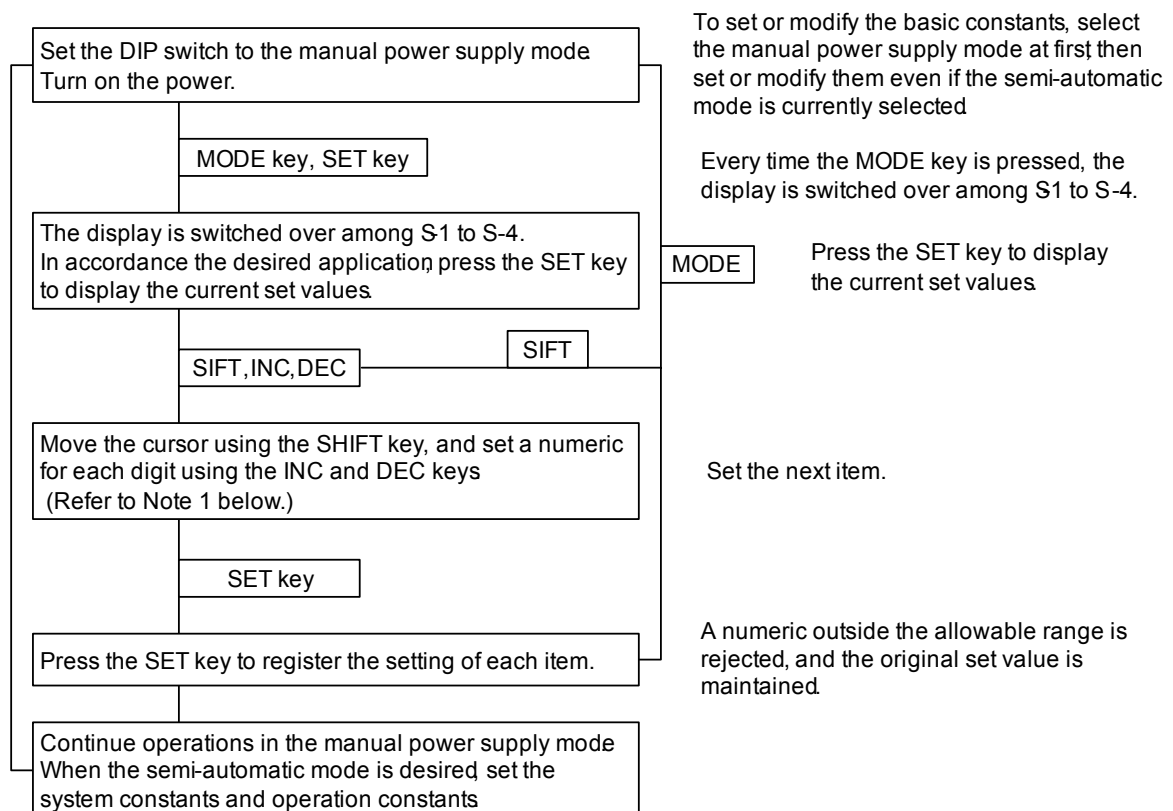
- This value is not required to be set when the inertia compensation function is not used.
- For the details of this function, refer to the explanation on special functions in page 20.

Setting the maximum output current

- When the DIP switch Nos. 5 and 6 are turned off, the S-4 display is selected. Set the maximum output current. (Refer to Note 2 mentioned below.) The table below shows the basic constants.

Basic constants

Set Item	Set range	Initial value	Display	Remarks
Inertia compensation				
Stop gain	0~300%	100	S-1	Effective in any setting of DIP switch.
Stop bias	0~60%	0	S-2	
Stop timer	0~30 s	0	S-3	
Maximum output current	0.05~0.50A	0	S-4	Effectibe when DIP switch No.5 and 6 are set to OFF.



- To the torque output (set by the trimmer) in the manual power supply mode, the non-linear compensation for the brake clutch is performed.

Note 1: Pressing and holding the INC or DEC key increases or decreases a numeric continuously.

Note 2: When the DIP switch Nos. 5 and 6 are set to OFF, the MANU LED flashes until the maximum output current is set and the error code (E-4) is displayed until the MODE key is pressed.

Setting the basic constants

- In the system constant set mode, the minimum and maximum diameter, the tension at each time and number of winding axis pulses can be set.
- The setting mentioned below is not required when the unit is used in the manual power supply mode exclusively.

Setting the minimum/maximum diameter and tension

- When the tension parameters T1 and T2 are set to 100%, the taper tension control function is not available. The constant tension operation is performed.
- When winding is performed, the minimum diameter tension T1 is fixed to 100%.
When unwinding is performed, the maximum diameter tension T2 is fixed to 100%.
- For the details of the function, refer to the explanation on special functions shown in page 20.

Setting the number of winding axis pulses

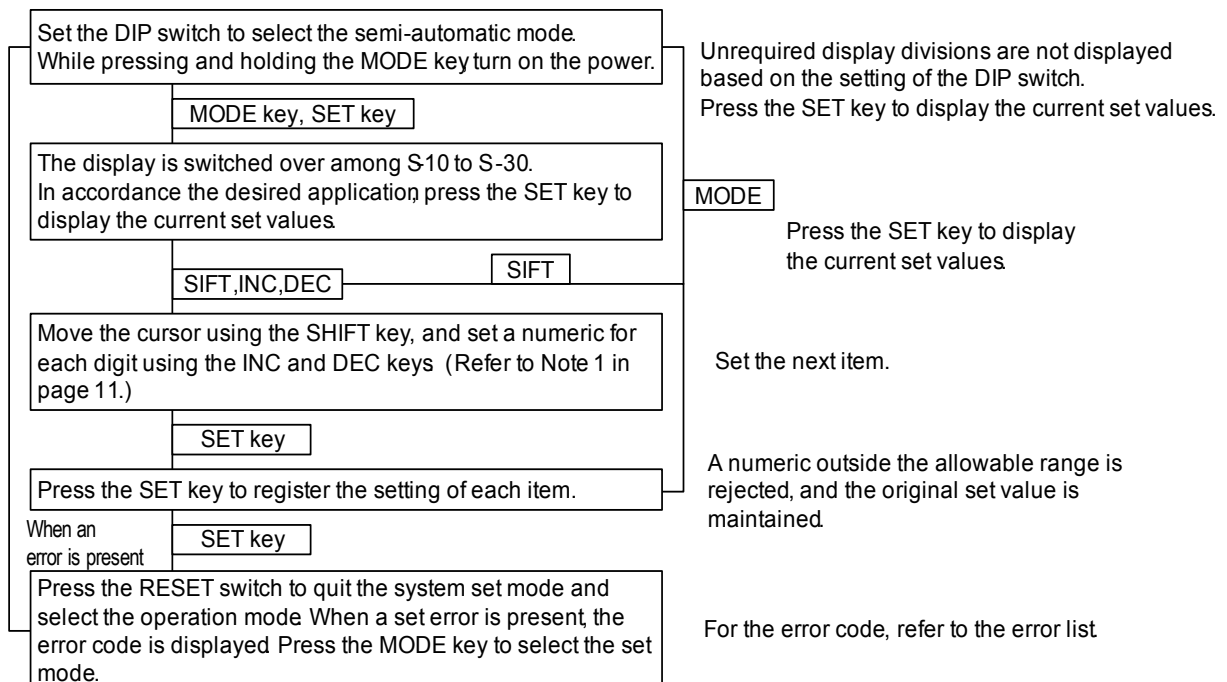
- Set the number of winding axis pulses for 100 rotations of the winding axis. The initial value is 100 pulses. When the number of pulse per rotation of the winding axis is 1, the set value is 100.

System constants (in the semi-automatic operation)

Set Item	Set range	Initial value	Display	Remarks
Minimum diameter D1	1~1999mm	0	S-10	D1 ≤ D2
Minimum diameter tension t1	20~500%	100	S-11	Fixed to 100% for winding
Maximum diameter D2	1~1999mm	0	S-20	D1 ≤ D2
Maximum diameter tension T2	20~500%	100	S-21	Fixed to 100% for unwinding
Number of coil axis pulses	10~100	100	S-30	When DIP switch No.2 is set to OFF

Table : System constant set item list

		Minimum diameter D1	Minimum diameter tension	Minimum diameter D2	Maximum diameter tension
Constant tension operation	Winding	Not required	Not required (fixed to 100%)	Required	Not required (fixed to 100%)
	Unwinding				
Taper control	Winding	Required	Not required (fixed to 100%)	Required	Required
	Unwinding		Required		Not required (fixed to 100%)



Setting the operation constants

- In the operation constant set mode, the material thickness, initial diameter and operation speed shown in the table below can be set.
- These operation constants are not required to be set in the manual power supply mode.
- For the details of the function, refer to the explanation on special functions shown in page 20.

Setting in the speed/thickness set mode

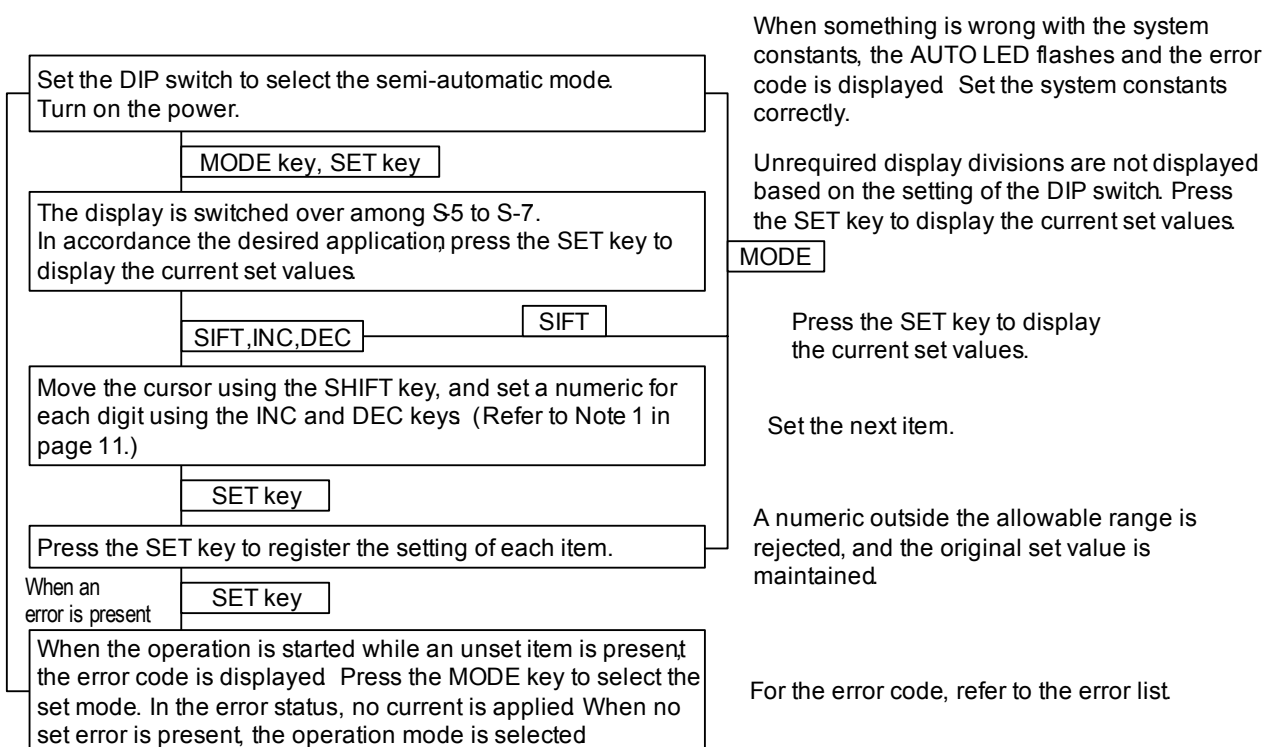
- Set the operation constants (material thickness, initial diameter and operation speed).

Setting in the pulse/thickness set mode

- Set the operation constants (material thickness and initial diameter).

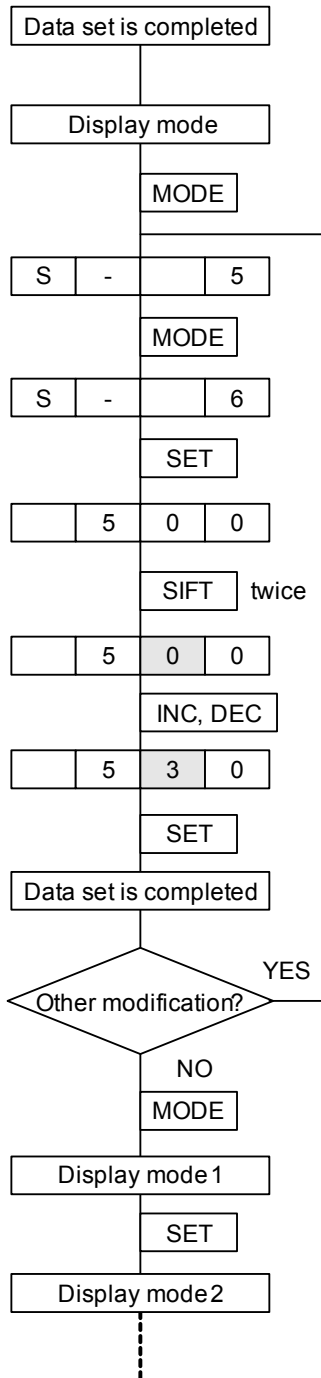
Operation constants (in the semi-automatic operation mode)

Set Item	Set range	Initial value	Display	Remarks
Thickness T	1~1999 μ m	0	S-5	
Initial diameter D0	1~1999mm	0	S-6	$D1 \leq D0 \leq D2$
Speed V	1~1999m/min	0	S-7	When the DIP switch No.2 is set to ON



[Example : Setting the initial diameter]

In the example shown here, the initial diameter is set in the semi-automatic tension control mode. Other items must be set in the same way.



- Set the DIP switch in the unit to select the semi-automatic mode. Turn on the power of the main unit. The maximum output current will be displayed as mentioned in page 6. Then, the tension, current diameter or taper ratio will be displayed.
- Press the MODE key to select the set mode. The S-5 display is selected at first. When the MODE key is selected again, the display is switched over to S-6 which is the initial diameter set mode. Every time the MODE key is pressed, the display is switched over between S-5 and S-6.
- When the SET key is pressed in the S-6 display, the initial diameter set value is displayed.
- Press the SHIFT key, and move the blinking cursor to the digit to be set.
- Set the desired initial diameter by pressing the INC, DEC or SHIFT key.
- In the example here, the initial diameter is set to 1530 mm using the INC and DEC keys. (The allowable set range is 1 to 1999 mm.)
- When the SET key is pressed, the entered value is registered and the initial value is updated.
- When the MODE key is pressed, the set mode or display mode is selected.
- Press the SET key to change over the display mode.

⚠ DANGER	Turn off all the phases of the external power supply before starting maintenance or inspection.
<p>Otherwise, electrical shock or damage in the product may be caused. Make sure to turn off all the phases of the external power supply at first, then perform installation, wiring or inspection.</p> <p>⚡ The power switch of this product is one-way type. Even when the power switch is turned off, there is the possibility of electrical shock. The voltage is remaining in the capacitor for approximately 3 minutes after the power is turned off. Never touch the components nor terminals inside during this period.</p>	
⚠ DANGER	Check connection of the lead wires.
<p>⚡ Incorrect connection may cause electrical shock or damages in the product. Make sure that the lead wires are connected correctly in the electrical and mechanical points of view.</p>	
⚠ CAUTION	Check the environments again.
<p>Inappropriate environments may cause damages, malfunction or deterioration in the product. Never install the product at a location in which dusts, soot, conductive dusts or corrosive gas is present or a location subject to high temperature, condensation, wind or rain. Never install the product at a location on which vibrations and impacts are directly applied. Make sure dusts or conductive dusts are not inserted into the cabinet. If such dusts are found, clean the inside of the cabinet.</p>	
⚠ CAUTION	Perform the withstand voltage and measure the insulation resistance in the following way.
<p>An incorrect test may damage the inside of the product. Remove all the output cables of the tension controller so that it operates independently. Measure the voltage and resistance between the ground terminal and power terminal. Apply 1500 VAC for 1 minute in the withstand voltage test. The insulation resistance shall be 5 MΩ¹ or more with the 500 VDC megger.</p>	

Troubleshooting

When an appropriate output current cannot be obtained, perform troubleshooting in the following way while referring to the display and indication.

1) POWER LED

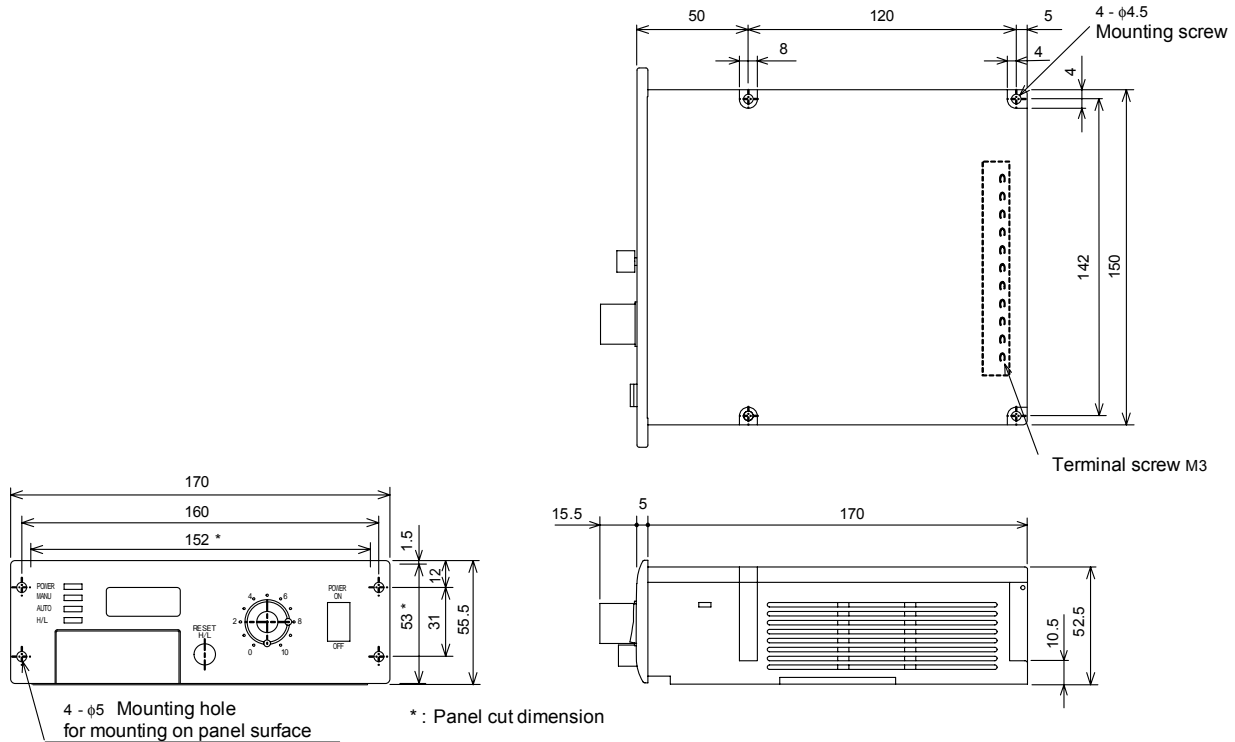
- When the power supply is correct and the POWER LED is not lit, the unit may be defective.
- When a conductive foreign object is inserted inside the unit or other abnormality has occurred, a fuse inside the unit may be blown out.
- When this LED is not lit or is lit for a very short time when the power is turned on, or when the error code E-90 is displayed, check the output cables of the unit. Short-circuit or overload may have occurred. Check the cables, then turn on the power again.

2) Seven-segment display

- When "E-oo" is displayed on the seven-segment display, refer to the error code list shown in page 18.

The unit is so designed to be protected against short-circuit by the output shutdown function, fuses are not blown out usually. If a fuse is blown out, other parts inside the unit may be damaged also. Replace the unit as a whole.

Overall dimensions



General specifications

Ambient temperature	0 ~ 55°C during operation
Ambient humidity	35 ~ 85%RH (no condensation allowed)during operation
Vibration resistance	In accordance with JIS C0911, 10 to 55 Hz, 0.5 mm (2G maximum) * for 2 hours in each of three axes Impact resistance.
Impact resistance	In accordance with JIS C0912, 10G three times in each of three axse
Noise resistance	By noise simulator of noise voltage of 1000 Vp-p, noise width of 1μsec and cycle of 30 to 100 Hz
Withstand voltage	1500 VAC for 1 minute
Insulation resistance	5 MΩor more by 500 VDC megger
Grounding	Solid grounding (No grounding may be allowed when grounding is impossible.)
Ambient atmosphere	No corrosive gas. A little dust.

* 1 G when the unit is attached to the panel

I/O Specification

Item	Terminal name	Specification	Remarks	
Power supply	L-N	85 to 121VAC, 50 / 60Hz, 75VA 5A fuse built in	Protection function against overload is built in. Allowable power interruption time : 10ms	
Output	PP-PN	Power amplifier output 80VDC, 0.5A maximum Load resistance : 160Ω/ 75°C or more	Maximum output current can be set by key switch.	
	12V-SN	Power output for signals 12VDC, 30mA		
Input signal	ST-SN	Stop gain, stop bias, stop timer are effective when input is set to OFF.	Stop timer : 0 ~ 30sec. variable	Input current: 12VDC, 10mA
	RS-SN, RESET switch H/L switch	After a new reel is attached, stop gain, stop bias and stop timer are reset to initial values when power is turned on (in semi-automatic mode exclusively.) In manual power supply mode, gain is switched over between H and L. While L is selected, torque is set to half of H. H/L LED is lit while H is selected.		
	PL-SN	Winding axis pulse input (in semi-automatic mode exclusively.)	250Hz or less 2 ms or more for both ON and OFF	

	Item	Specification	Remarks
Set data	I max	Maximum output current . Allowable range : 0.05 ~ 0.5A	<ul style="list-style-type: none"> • Each data is set by keys. Vr exclusively is set by trimmer. • Set data is saved in EEPROM memory even during power interruption. • EEPROM can be updated up to 100,000 times. • Sum of stop gain and stop bias is limited to maximum output current or less.
	SP.G	Stop gain. Magnification against output indication when ST input is set to ON. Allowable range : 0 ~ 300%. Initial value : 100%	
	ST.B	Stop bias. Addition of 0 ~ 60% of maximum output current. Initial value : 0%	
	SP.T	Maximum effective time for stop gain and stop bias. Allowable range : 0 ~ 30s. Initial value : 0s	
	D1,D0, V,T	Semi-automatic control data. Diameter and tension data : D1,T1,D2,T2,D0 Speed data : V,T (in semi-automatic mode exclusively)	
	Vr	Tension adjustment (in semi-automatic mode exclusively) Torque adjustment (in manual mode exclusively)	

Output display item

<Manual mode>

Display item	Display range	Initial value	Display	Effective numeric	Unit
Output current	0.050 ~ 0.500A	---	A.###	3 digit after decimal point	A
Torque display	0 ~ 100%	---	P###.	0 digit after decimal point	%

< Semi-automatic mode >

Display item	Display range	Initial value	Display	Effective numeric	Unit
Tension display	0 ~ 500%	---	F###.	0 digit after decimal point	%
Taper ratio display	0 ~ 500%	---	P###.	0 digit after decimal point	%
Winding diameter operation	1 ~ 1999mm	---	d(1)###.	0 digit after decimal point	mm

* As to the winding diameter, an intact calculated value is displayed when the value is 1,000 mm or more. id1 is displayed in the fourth digit when the calculated value is less than 1,000 mm.
Example : d550 (D = 550 mm)

Setting item list

< Basic constants >

Set Item	Set range	Initial value	Display	Remarks
Inertia compensation				
Stop gain	0 ~ 300%	100	S-1	Effective in any setting of DIP switch
Stop bias	0 ~ 60%	0	S-2	
Stop timer	0 ~ 30s	0	S-3	
Maximum output current	0.05 ~ 0.50A	0	S-4	Effective when DIP switch Nos.5 and 6 are set to OFF

< System constants (in the semi-automatic mode exclusively) >

Set Item	Set range	Initial value	Display	Remarks
Semi-automatic control system				
Minimum diameter D1	1~1999mm	0	S-10	$D1 \leq D2$
Tension at minimum diameter T1	20~500%	100	S-11	Fixed to 100% for winding
Maximum diameter D2	1~1999mm	0	S-20	$D1 \leq D2$
Tension at maximum diameter T2	20~500%	100	S-21	Fixed to 100% for unwinding
Winding axis pulses *1	10~1000	100	S-30	Effective when DIP switch No.2 is set to OFF

*1 Number of winding axis pulses for 100 rotations of winding axis

*2 When the winding axis rotates once in a pulse (1:1) with the unwinding taperless, the system constant is not required to be set.

< Operation constants (in the semi-automatic mode exclusively) >

Set Item	Set range	Initial value	Display	Remarks
Thickness T	1~1999 μ m	0	S-5	
Initial diameter D0	1~1999mm	0	S-6	$D1 \leq D0 \leq D2$
Speed V	1~1999m/min	0	S-7	When the DIP switch No.2 is set to ON

Error display

E	-	n
---	---	---

 n : Error No.

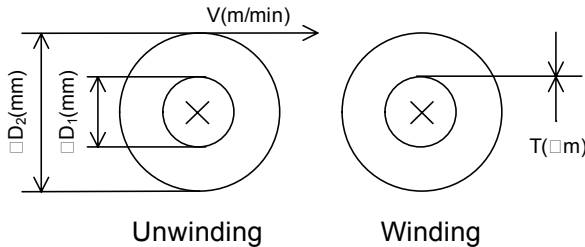
No	Description	When operation is continued with error status
4	Maximum output current is motest	Control output is turned off
5	Thickness (T) is not set	
6	Initial diameter (D0) is not set	
7	Speed (V) is not set	
10	Minimum diameter (D1) is not set	
20	Maximum diameter (D2) is not set	
25	$D1 < D2$ is not satisfied	
90	Output is short-circuited	

Principle of winding diameter detection

In the tension controller LD-05ZX, the following two types of winding diameter detection methods.

< Speed/thickness set method >

Sensorless method



- The winding diameter D (mm) when the material with thickness of T (μm) is wound or unwound at the line speed V (m/min) is represented by the following equations. Here, D1 = Minimum diameter (mm)
 D2 = Maximum diameter (mm)
 t = Operating time (min)
 T = Material thickness (μm)

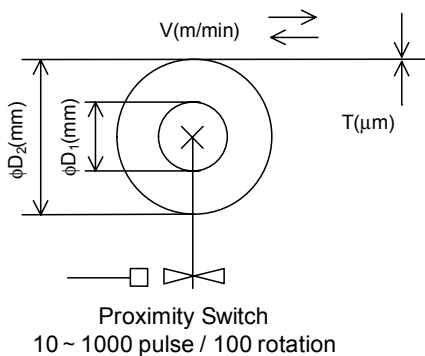
$$D = \sqrt{D_1^2 + 4TVt / \pi} \quad \text{--- Winding}$$

$$D = \sqrt{D_1^2 - 4TVt / \pi} \quad \text{--- Unwinding}$$

- Accordingly, when the initial diameters D1 (for winding) and D2 (for unwinding), material thickness T and mean speed V are set, the change in the winding diameter D as time passes can be calculated using the equations above. This method is called speed/thickness set method.

< Pulse/thickness set method >

Winding axis sensor method



- Instead of setting the line speed V, the proximity switch is provided on the winding axis and the signal of rotation is sent to the LD-05ZX. In this case, the winding diameter is automatically calculated by the following equations.

- Winding : $D = D_1 + 2NT \times 10^{-3}$ (1 pulse/rotation)
- Unwinding : $D = D_2 + 2NT \times 10^{-3}$ (1 pulse/rotation)
- Here, N = Count of winding diameter pulses (pulses)
 D = Current diameter (mm)
 D1 = Initial diameter for winding (mm)
 D2 = Initial diameter for winding (mm)
 T = Material thickness (μm)

- Accordingly, when the initial diameters D1 (for winding) and D2 (for unwinding) and material thickness T are set, the winding diameter D can be calculated using the equations above. This method is called pulse/thickness set method.

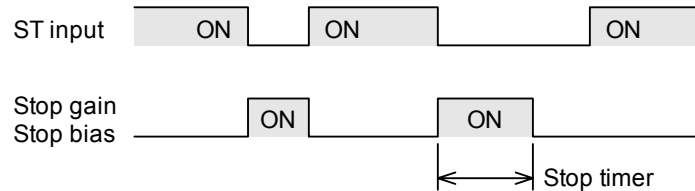
< Features >

Method	Merit	Demerit
Speed/thickness set method	Sensor is not required	Accuracy is worse compared with pulse method
Pulse/thickness set method	Accuracy is high.	Sensor is required

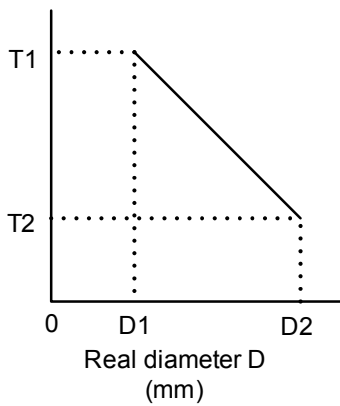
Special functions

< Inertia compensation at stop >

- The output current is obtained by adding the stop gain and stop bias. However, the upper limit of the output is the maximum output current set value. When the ST input is turned off, the stop gain (which is the output while the ST input is turned on multiplied by a magnification of 0 to 300%) and stop bias (in which 0 to 60% of the maximum output current is added) become effective. The upper limit time is determined by the stop timer built inside.



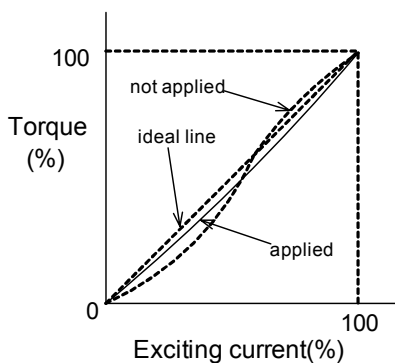
< Inertia compensation at stop >



- When the target tension T1 and T2 for the winding diameter D1 and D2 (D1 < D2) are set as system constants, the taper tension control shown in the figure on the left can be performed.
- T1 and T2 are not required to be set for the constant tension operation.
- The winding diameter D is calculated using the speed and thickness or using the pulse and thickness. This winding diameter multiplied by the current tension is the control output.

- The taper ratio is $\frac{\text{Tension at current diameter}}{\text{Tension at minimum diameter}}$ for winding and $\frac{\text{Tension at current diameter}}{\text{Tension at maximum diameter}}$ for unwinding.
- It means that the reference of tension is the maximum diameter for unwinding and the minimum diameter for winding.
- The maximum output current is generated when the trimmer is set to the largest value and the diameter is the maximum value.

< Non-linear correction function >



- The characteristics of the transmission torque against the excitation current of the brake, clutch and are represented as a non-linear graphic as shown in the figure on the left. The shape of the graphic varies depending on each brake, clutch.

When the non-linear correction function is applied, the characteristics graphic of the corrected torque comes nearer a straight line compared with that of the uncorrected torque.

- In this unit, the non-linear correction function is automatically applied (in the ZX-0.3YN-80, ZX-0.6YN-80 and ZX-1.2YN-80 exclusively). No setting by the operator is required.