



POWER AMPLIFIER

MODEL **LE-50PAU**

TENSION CONTROLLER

MODEL **LE-50PAU-SET**

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 send it to the end user.

This manual confers no industrial property rights or any rights of any other kind, nor does it confer any patent licenses.



Mitsubishi Electric Corporation cannot be held responsible for any problems involving industrial property rights which may occur as a result of using the contents noted in this manual.

Cautions on Safety



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


To assure safety	
<ul style="list-style-type: none"> •Make sure the user thoroughly read this instruction manual before using the unit , and pay attention in assuring safety while using the unit. •The unit is manufactured under the severe quality control . When a severe accident or loss is expected in the equipment used due to failure of the unit , provide a backup function or the fail-safe function in the system . 	



In this manual , cautions of safety are classified into "WARNING" and "CAUTION".


 WARNING:	When the unit is handled incorrectly , a dangerous situation may occur and the possibility of death or serious injury is expected .
 CAUTION:	When the unit is handled incorrectly , a dangerous situation may occur and the possibility of medium or slight injury is expected or property damage exclusively is expected.



Even an item is classified as "CAUTION", its contents are important and it may lead to a serious result depending on the situation. Make sure to observe every item .



 WARNING	Turn off all the phases of the external power supply before starting installation and wiring .
	Otherwise, electrical shock or damage in the unit may occur. Make sure to turn off all the phases of the external power supply before starting installation and wiring.



 WARNING	Design the installation plan using the wire size suitable to the current capacity .
	Use the wire size suitable to the current capacity to supply the power to the load . If a wire having smaller current capacity is used, the insulation sheath will be melted and insulation will become defective . In this situation, electrical shock or a short-circuit may occur, and fire may occur .


 WARNING	Perform grounding (grounding resistance 100Ω or less).
	Otherwise, electrical shock may occur. Perform grounding (grounding resistance 100Ω or less) to the unit using a wire of 2 mm ² or more, otherwise, electrical shock may occur. Never share the grounding with a strong electric system.


 WARNING	Set up the emergency stop circuit independently of the product .
	Otherwise, the unit may become out of order and an accident may occur when malfunction occurs in the tension controller . Make sure to assemble the emergency stop circuit outside the tension controller .


 WARNING	Never open the covers while the power is supplied to the unit or when the unit is operating.
	Never supply the power to the unit nor operate the unit while the main body cover and the terminal cover are open . When the covers are open , a high voltage area may be exposed and electrical shock may occur .


 WARNING	Never use the unit in an atmosphere where inflammation or explosion can occur .
	Otherwise, inflammation or explosion may occur .


 WARNING	Never touch a switch with a wet hand .
	Never touch a switch with a wet hand , otherwise, electrical shock may occur.

 CAUTION	Separate the wiring of the strong electric system from the wiring of the weak electric system.
	Separate the wiring of the strong electric system from the wiring of the weak electric system, and make sure that noises are not superimposed on the wiring of the weak electric system. Otherwise, the unit may not operate correctly.

 WARNING	Never drop cutting chips and wire chips while screw holes are tapped and wiring work is performed.
	Damage , fume, fire, malfunction or others may be caused in the unit .

 CAUTION	Confirm the ambient environments .
	Never install the unit with an environment where dusts , soot, conductive dusts or corrosive gas is present or a place exposed to high temperature , condensation or wind and rain. Otherwise, the unit may be damaged , malfunction or be deteriorated .

 WARNING	Never modify nor disassemble the unit
	Never modify nor disassemble the unit . Otherwise, the unit may become defective or an accident such as fire , damage , etc. may occur.

 CAUTION	Do not use any unused terminals for any external lines.
	Correctly connect the AC power cable to the specified terminal, and do not use any unused terminals for any external lines. Improper connection may seriously damage the product .

CAUTION

- We shall not be responsible for any damage caused by repair , disassembly, modification, etc. performed by a third party other than MITSUBISHI or a company specified by MITSUBISHI .
- The cautions on safety and the specifications described in the instruction manual are subject to change without notice .

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CHAPTER-2

WINDING DIAMETER DETECTION TYPE SEMI-AUTOMATIC TENSION CONTROLLER ----- 24

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This chapter described the handling procedure of LE-5-PAU power amplifier for cases with it is used as a power amplifier itself by using each tension control unit in combination and when it is used as a manual power source, using the valuable resistor.

For case when the power amplifier is used as a winding diameter detection type semi-automatic tension control unit by using the LE-5AP operator panel in combination, refer to the description given in chapter-2.

The power amplifier is used to control the excitation current of powder clutch / brake and hysteresis clutch / brake, depending on the input signal voltage.

The control system used comes in "Voltage control system" by output voltage feedback and "Current control system" by output current feedback.

The power amplifier of this type is applicable to both systems, however, it is generally recommended to use it by the current control system.

The power amplifier is incorporated with such function as to compensate the non-linearity of transmission torque characteristic against excitation current for clutch / brake, and is suitable to the execution of correct tension control.

1. General description

1.1 Features / applications

The LE-50PAU power amplifier is used to control the excitation current of the excitation coil for clutch / brake such as powder clutch / brake, hysteresis clutch / brake, etc.

The power amplifier is applicable mainly to the winding / unwinding tension control for long-size material, torque limiter for general machinery, etc.

The power amplifier is operative on wide range power source of 85VAC ~ 264VAC and is provided with control output of 24VDC, 4A or less and a aux. Power output of 10VDC, 2.0A, 10sec rating.

Main features

<Current / voltage control system >

- The clutch / brake may have resistance fluctuation of approx. 20% against the excitation coil temperature fluctuation of 50 °C. Consequently, it is necessary for the open-loop type control to control the excitation current not to control the voltage.
- The power amplifier is designed as to be able to ensure the output current of 0~ I_{max} against the input signal voltage of 0~ V_{max} . The input signal level (V_{max}) is adjustable to 0.5~8V, and the full-scale output (I_{max}) to 0.2~4A respectively.
- For the closed-loop type control, the voltage control system is applicable without problem, as the command input is compensated automatically even if any temperature fluctuation occurs in the clutch / brake. (The adoption of current control system will be idealistic for reduction of control error.)
- Particularly for the application in which the current distribution is adjusted by the variable resistor with multiple clutch / brakes connected to one power amplifier, the use of voltage control method will facilitate the adjustment operation.

The power amplifier is also designed as to use the voltage control method for this purpose.

< Non-linearity compensation >

- The power amplifier is provided with such function as to compensate the non-linearity characteristic of transmission torque of the excitation current for clutch / brake by 5-stage polygonal approximation, which can ensure the transmission torque proportional to the input signal voltage.
- The characteristic is an essential function for the open-loop type control, while it is also an essential function for the closed-loop type control to reduce the control error, or to execute the internal taper control.
- The internal taper control is such a control that the winding diameter is found by calculating it inversely from the output current (or transmission torque) to reduce the setting tension automatically along with the increase of winding diameter.

< Built-in setting / display function >

- To allow the input signal level, output full-scale value, non-linearity data, etc. to be readily set, the power amplifier is incorporated with a 4-digit / 7-segment display unit, 4 key switches and 10-pole DIP switch.
- It is also possible to execute the inertia compensation or output monitor display, using this function during baking.

Main applications

< Power amplifier for tension control >

- The power amplifier is used in combination with the closed-loop type tension control unit such as LE-40MTA-E, LE-40MTB-E, LE-30CTN, etc. tension control unit to amplify the output signal or such control unit, and to apply the power source to the excitation coil of clutch / brake.

< Manual power source, using external setting type valuable resistor >

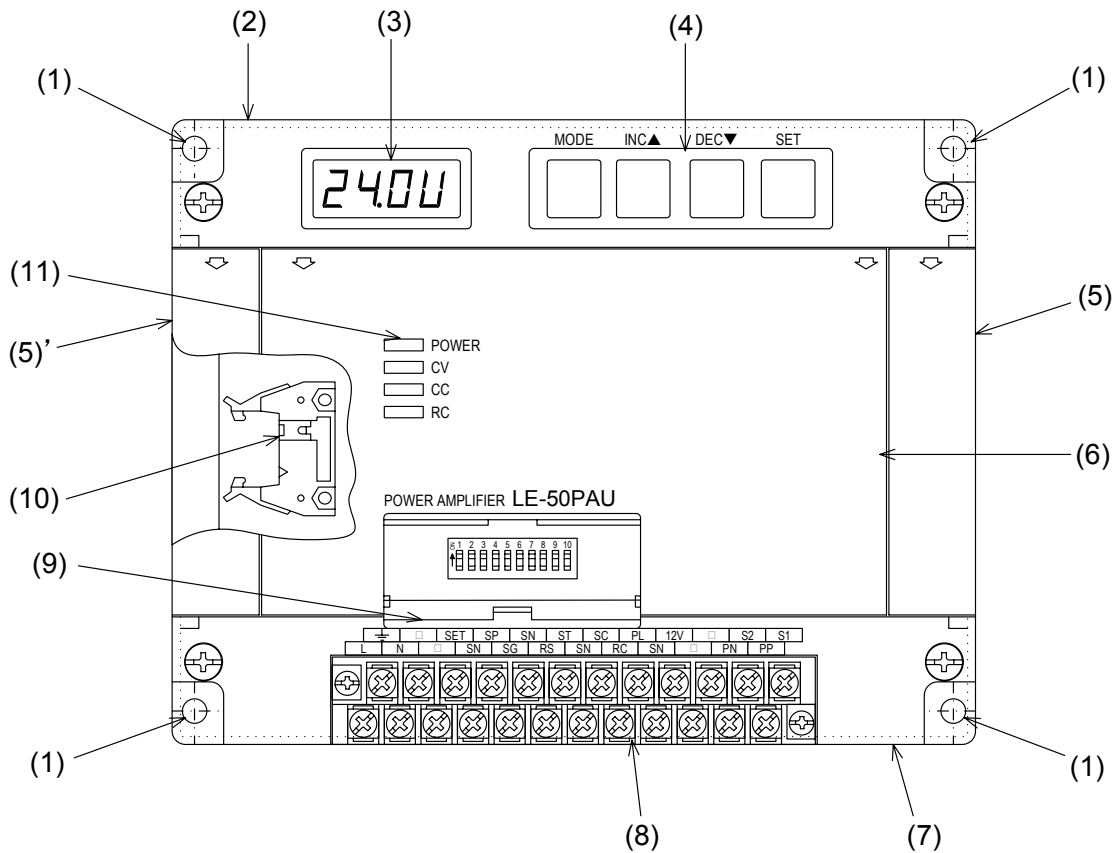
- The power amplifier will appear to be a variable current (or variable voltage) power source, using manual operation simply by connecting the variable resistor (8V, 2kW) to the input terminal of this power amplifier.
Since the non-linearity compensation is executed, the operation is easy.

< Semi-automatic tension control unit >

- As described in chapter-2 of this manual, the power amplifier can be also used as semi-automatic tension control unit by using the LE-5AP operator panel in combination.
- the semi-automatic tension control unit is provided with winding diameter detection function which is intended to ensure the desired tension by controlling the output current automatically in accordance with the winding diameter. It can ensure the simplified open-loop control in which no tension detector is used.
- Using the LE-5AP operator panel described previously will also allow the basic characteristic of power amplifier to be set easily.

1.2 General description of the unit

The LE-50PAU power amplifier is a compact type unit designed to be incorporated in the panel, using aluminum die cast and plastic cover.



- (1) : Mounting holes arranged at four corners of the main unit, used to fix the unit within the control panel.
- (2) : Transparent cover prepared for display unit and operation key.
- (3) : 4-digid red 7-segment display unit used to display the output current / voltage, or to execute each setting operation.
- (4) : operation key used to set the input signal level, non-linearity data, stop gain, stop bias, stop timer, etc.
- (5) : Side cover.
- (5)' : Side cover.
- (6) : Panel cover. Each cover can be opened by inserting the pawl in the position marked with arrowhead.
- (7) : Transparent cover for terminal block.
- (8) : Terminal block for input / output and power source. When the right / left mounting screw are loosened evenly, it is possible to remove the entire terminal block.
- (9) : Small window cover for DIP switch. The cover is opened, to see the DIP switch. The DIP switch is used to set each mode or full-scale value of output current.
- (10) : Type LE-5AP operator panel connecting connector. The cable is connected by opening the side cover (5).
- (11) : LED used to display the power source and each status.

2. General description of function

2.1 Description of operation

The internal block diagram of LE-50PAU power amplifier is as shown in page 8.

1. Role of DIP switch

- SW1

Keep the SW1 turned on all times under the power amplifier mode and manual power mode.
(For case to turn it off, refer to the chapter-2.)

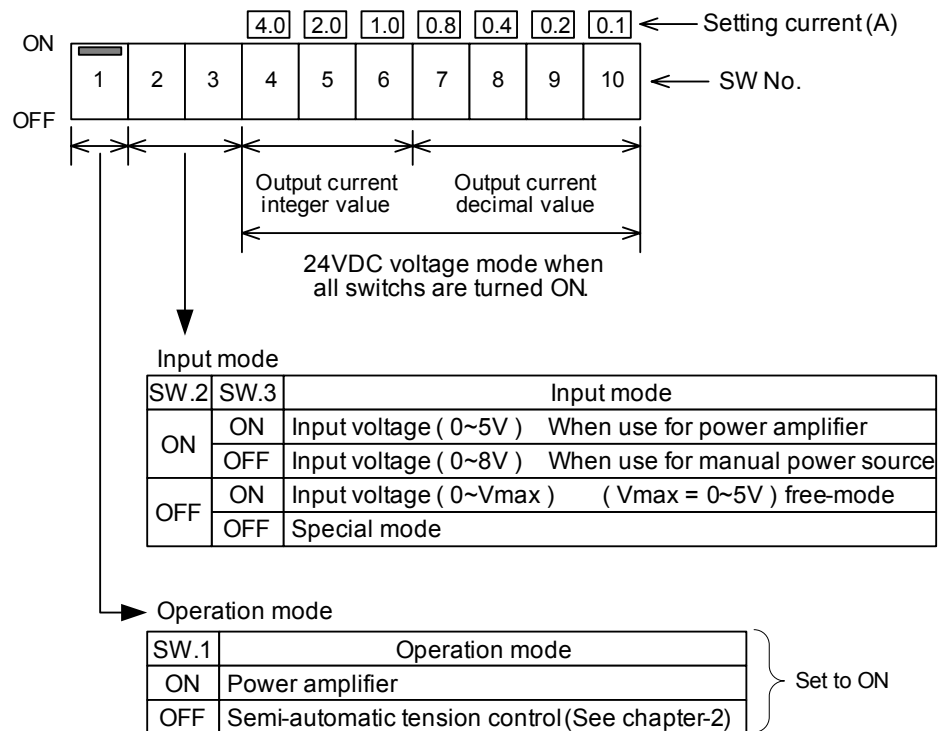
- SW2, SW3

These switches are prepared to set the input signal level, and are as shown at following table.
If the SW2 has been turned on, it is readily possible to select 0 ~ 5V or 0 ~ 8V.

- SW4 ~ SW10

These switch are used to determin the full-scale value of output current.

When the SW5 ~ SW9 are turned on, for example, the full-scale value of output current will be 3.6A. Select the rated current, depending on the type name of clutch / brake used in combination.
Note that the 24VDC voltage output mode is set when all DIP switches (SW4 ~ SW10) are turned on.

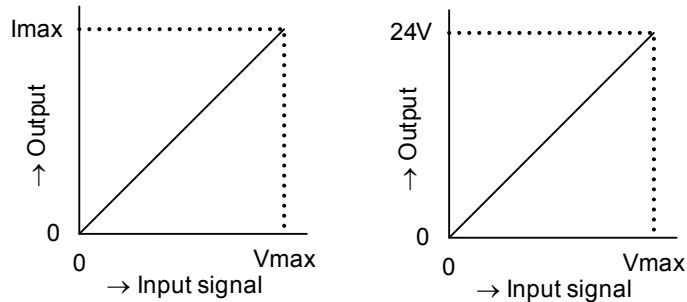


- The ON / OFF status of each SW is read when the power source is turned from off to on.
Even if the switch is changed over while the power source is turned on, the function remains invalid until the power source is turned from off to on again.

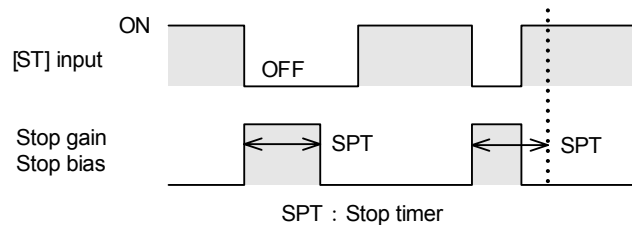
2. Description of internal circuit

- The signal voltage input to across input terminals [SA] - [SN] is output to the clutch / brake through the amplifiers A1, A2, A3.
- The amplifire A1 is prepared to set the input signal level.
“Vmax” is set to 5V, 8V, or 5 ~ 8V, using the DIP switches SW2 and SW3.

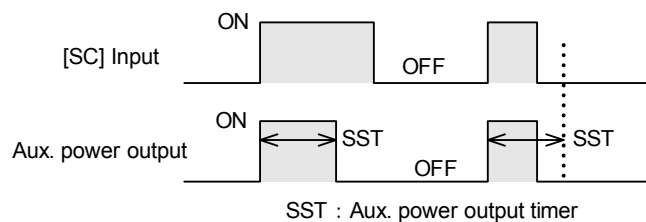
- The amplifier A4 is used to set the output signal full-scale value (I_{max}), using the DIP switches SW4 ~ SW10.
Note that the 24VDC voltage output mode is set when all DIP switches (SW4 ~ SW10) are turned on.



- The amplifier A2 is used to add the stop gain and the stop bias to the output.
When the [ST] input is turned off, the stop gain (multiplication of output at the [ST] input ON by 0 ~ 300%) and the stop bias (addition of 0 ~ 60 % of full-scale output) are validated.
The upper limit times is restricted by the built-in stop timer.

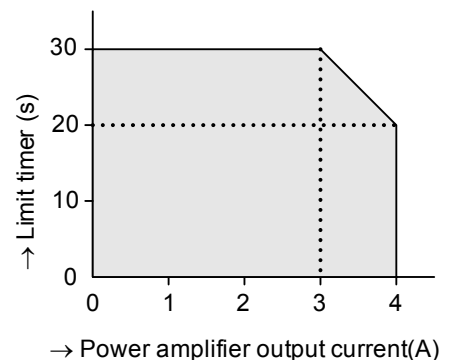


- When the [RC] input is turned off, the [PP] - {PN} output is also turned off.
The [RC] input is generally used while it is turned on.
It is also possible to inver the logic so that the output is validated when the [RC] input is turned off.
- When the [SC] input is turned on, the aux.pouer output is validated.
The upper limit time is restricted by the built-in aux.pouer output timer.

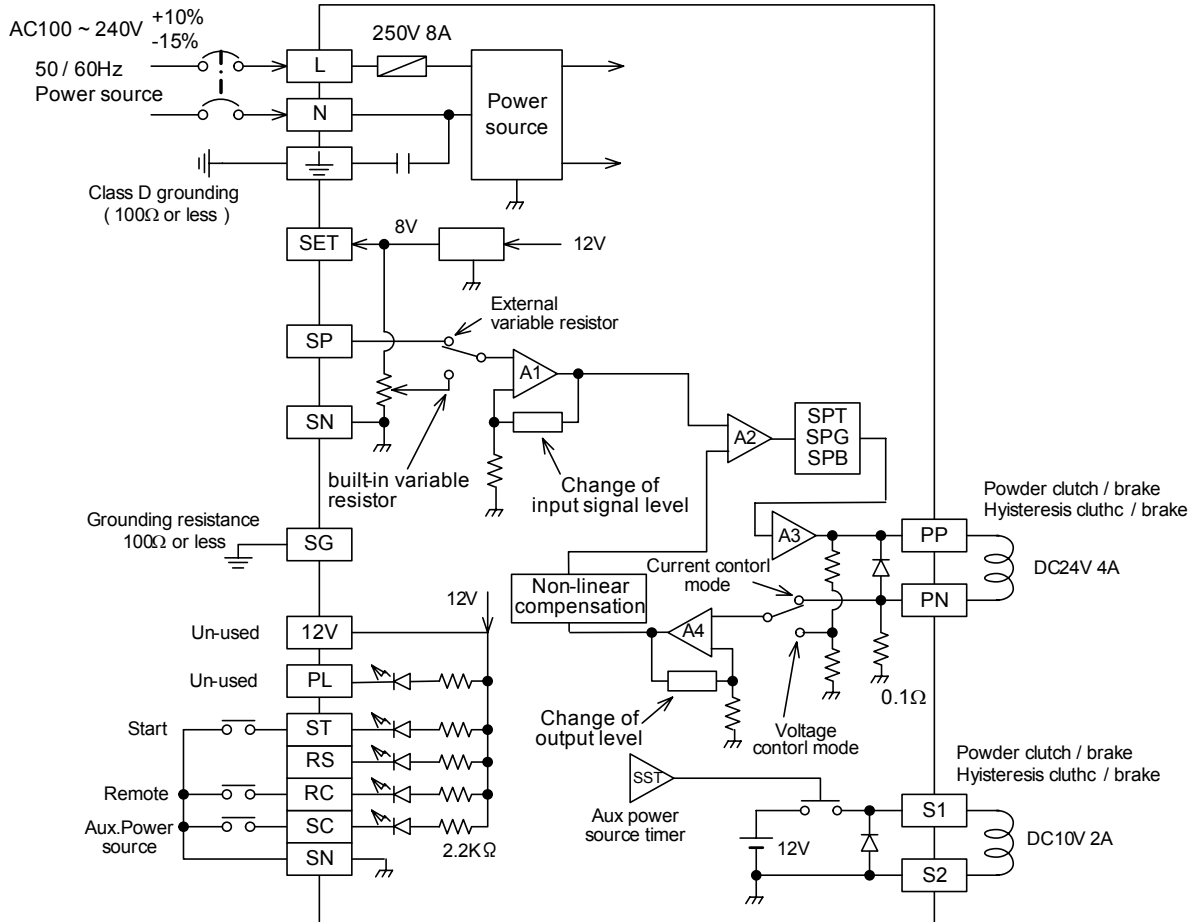


(Note) Restriction of Aux.pouer output

- Set the aux.pouer output timer (variable : 0 ~ 30sec) to the value shown in the right or less. (Any value out of this range will not be accepted.)
- Make it a rule to secure the [SC] input ON/OFF interval, to 3 minutes or more, which is used to validate the aux.pouer output.
- The output current of power amplifire is determined by the rated current of clutch / brake used in condition.
Note that the graph shown at right is not the output current as aux,pouer amplifire.



2.2 Equivalent block diagram



Be short-circuited between ST and SN terminal. when the stop gain or the stop bias is not used.

1. Setting items by key operation

-----Refre to page 12, 13, 16, 17 for setting.

(1) Input signal level (initial value : 5V)

When the power source is turned on with the DIP SW1 and SW3 turned on and the DIP SW2 turned off, the input voltage free mode is set, by which the input signal voltage level ($V_{max} = 0.5 \sim 8V$) is validated by the key operation.

(2) Non-linearity compensation (initial setting : Lineare line)

If the transmission torque (%) of clutch / brake at excitation current of 20%, 40%, 80% has been set, the non-linearity compensation is executed by 5-stage polygonal line approximation method.

(3) Inversion of remote input [RC] logic

Under the initial condition, the power amplifire output is validated when the input is turned on.

(4) Stop gain (initial value : 100%)

(5) Stop bias (initial value : 0%)

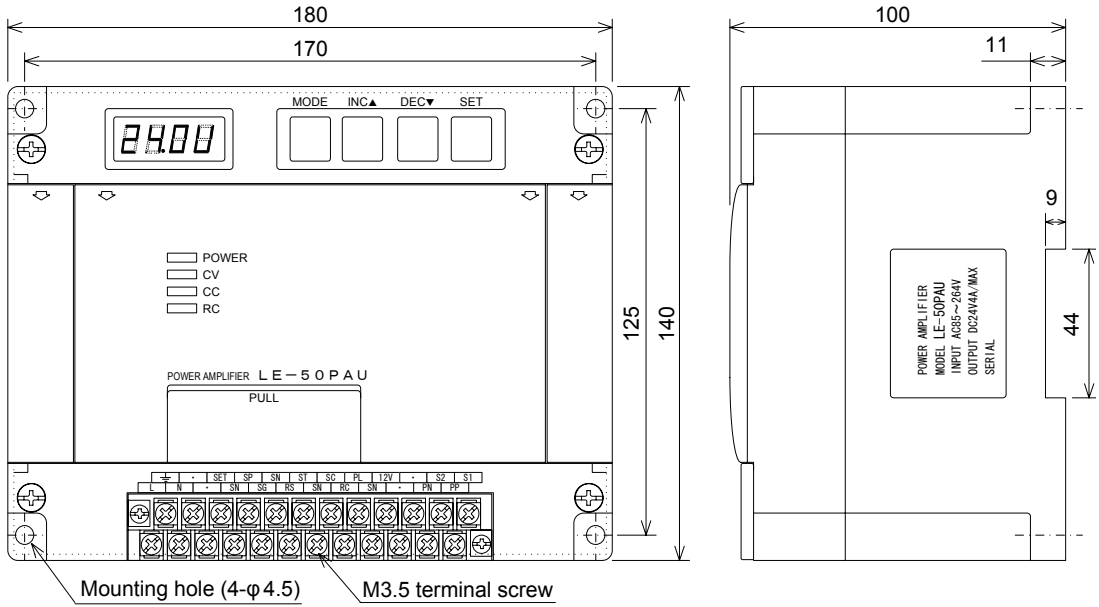
(6) Stop timer (initial value : 10 sec)

(7) Aux.power output limit time (initial value : 10 sec)

- The unit can be generally used as a power amplifire at the initial value (value at time of factory shippment). It is recommended to set the non-linearity compensation in accordance with the procedure shown in page 13.
- It is desirable to execute the setting of above items (4) ~ (7) at the tension control unit side. It will be convenient to set the power amplifire side timer, to as longer time as possible.

3. Specifications

3.1 Outside dimension



⊥	•	SET	SP	SN	ST	SC	PL	12V	•	S2	S1
L	N	•	SN	SG	RS	SN	RC	SN	•	PN	PP

• Outer painting color : Munsell 7.5Y7.5 / 1

• Weight : Approx.2.5kg

3.2 Input / output specifications

Item	Terminal name	Specifications		
Power supply	Input	L	<ul style="list-style-type: none"> • 100 to 240 VAC (-15% to +10%) , 50/60 Hz • Power consumption: 400 VA (at 24 VDC, 4A) • Allowable instantaneous power interruption: 10 ms 	<ul style="list-style-type: none"> • Power fuse : 250 V, 8 A ×2, built in • Rush current : 50A, 300ms
		N		
	Output	SET	• Service power supply for the external variable resistor	
		SN	• 8VDC. External variable resistor : 2kΩ	
Input signal	PP	• Power amplifire output		
	PN	• 0 to 24 VDC, 4 A or less • Load resistance :4.8Ω / 75°C or over		
	S1	[1] Aux.power output : 10VDC 2A Load resistance :4.8Ω / 75°C or over	Set output mode by setting operation	
	S2	[2] RUN (normal operation) output DC12V 100mA		
Output signal	SP	• Control signal Internal resisatnce : 22kW Signal level is set using DIP switch and key.		
	ST	• Start signal When input is turned off, stop gain, stop bias and stop timer are valid.		
	RC	<ul style="list-style-type: none"> • Output remote signal ON : power amplifier output ON OFF : power amplifier output OFF 	ON/OFF mode : Logic invrsion ready	Input current DC12V 5mA
	SC	<ul style="list-style-type: none"> • Aux.power output ON/OFF signal ON : Aux.power output ON OFF : Aux.power output OFF 		
	SN	• Input signal common terminal		

3.3 Environmental specifications

Ambient temperature	• 0 to 55°C- - - during operation	
Ambient humidity	• 35 to 85% RH (no condensation)during operation	
Vibration resistance	• 10 to 55Hz 0.5mm (19.6m/s ² max) 2 hours in each axis direction.	
Impact resistance	• 98m/s ² 3 times in each axis direction.	
Noise resistance	• By noise simulator with 1,000Vp-p noise voltage, 1μs noise width and 30 to 100Hz.	
withstand voltage	• 1,500V AC, 1 minute	Between power terminal and earth treminal
Insulation resistance	• 5MΩ or more by 500V DC megger	
Grounding	• Class D grounding. (100Ω or less. Grounding shall not be performed together with any high power system.)	
Operationatmosphere	• Free from corrosive or flammable gas and conductive dust, less dust.	

3.4 Set item list

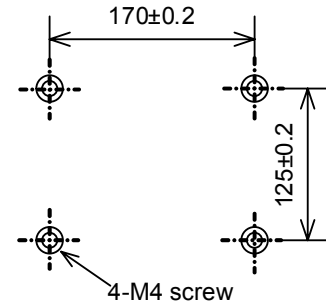
	Symbol	Unit	Range of setting		Initial value
			Minimum	Maximum	
Input signal voltage revel	Vmax	V	0.5 ~ 8V		5.0
Stop timer	SPT	s	0	30	10
Stop gain	SPG	%	0	300	100
Stop bias	SPB	%	0	60	0
Aux.power output timer	SST	s	0	30	10
Non-linearity compensasion	T10,T20, T40,T80	%	1.0	99.0	10, 20, 40, 80

4. Installation / wiring

4.1 Installation dimension / wiring work

1. Installation dimension

- Install and fix the LE-50PAU power amplifier at the inside of panel, using the fixing holes ($\phi 4.5$) prepared at four corners.
- The LE-50PAU power amplifier is provided with a groove at the bottom surface to avoid the DIN rail, however, it is unable to fit the LE-50PAU power amplifire to the DIN rail.



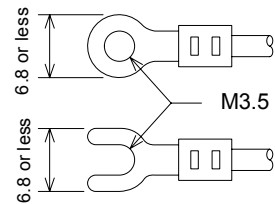
⚠ CAUTION

- Do not install the LE-50PAU power amplifire on the floor surface, for prevention of temperature rize, but be sure to install it directly to the sheet metal part on the wall surface
- Secure a space of over 100mm between each unit of between the equipment and other equipment or structure. Keep the equipment isolated from the highvoltage wire, high- voltage unit or power unit.

2. wiring work

----- The general external connection is shown on page 8.

- Use the crimp-style terminals. Dimensions shown in the right figure.
- Tighten the terminal securely at a torque of 0.5 to 0.8 N•m, so that any mal-function should not be generated.
- Do not connect the wire to the empty terminal [•] at the outside.
- Use a shield wire for analog input wire.
- Do not attempt to execute the input / output wiring in the same duct as that used for other power wire, or to bind such wire together with the other power wiere.
- A connection example for analog input is as shown on page 15.
- There is not any problem even if the input wiring is extended up to approx. several dozens of meters in accordance with the precautions (shown at avobe), however, it is generally advised to execute the wiring up to within 20m, taking safety against noise into consideration.
- Use a small signal switch for contact input, which is suitable to a small current of 12VDC 5mA,

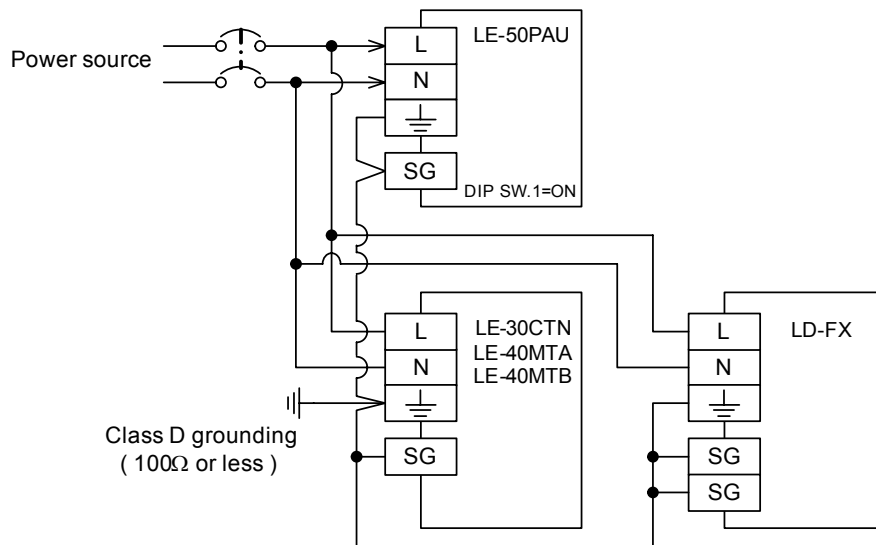


⚠ CAUTION

- To execute the installation/ wiring work, be sure to shut off all phases of power source externally in advance.
- Do not install the LE-50PAU power amplifire at a place of dust, oil mist, conductive dust, corrosive gas or inflammable gas
- Do not install the LE-50PAU power amplifire directly at a place where vibration or shock is applied
- Do not install the LE-50PAU power amplifire at a place which may be exposed to high temperature, dewing or rain/ wind.
- To execute the drilling or wiring be careful not to allow the cutting chip or wire chip to drop
- Since the case is made of aluminum die cast, the surface may reach high temperature during operation. Since this may cause the operator to get burned, use such installation method that will not allow the body to make direct contact with the surface of case.

4.2 Connection of power circuit

1. Example of connectiton



- Apply 85 to 264VDC 50 / 60Hz to the terminal [L] - [N].
The power consumption of the LE-50PAU power amplifier is 400VA.
When a fuse is arranged externally, however, it is advised to secure the fuse capacity of 10A or over, taking rush current into consideration. (The maximum rush current is 50A.)

⚠ WARNING

- Arrange the emergency stop circuit of the LE-50PAU power amplifire at the outside independent of tension controller
If the tension controller is used in a wrong manner of operated erroneously, the LE-50PAU power amplifire may run away, or other serious accident may occur

⚠ CAUTION

- The LE-50PAU power amplifire is an electronic equipment in which a micro compute(CPU) is incorporated
If a conductive foreign matter is mixed in the equipment or any unusual niise is applied from the external unit, causing the CPU to run away, the watch-dog timer is operated
- Execute the solid grounding(grounding resistance: 100Ω or less) to the earth terminal, using a wire of over 2mm².
In this case, however, be careful not to use the earth commonly to the high power system
- Connect the earth terminal of tension controller to that of the LE50PAU power amplifire to each other, and execute the earth at the tension controller side
- Eecute the earth for the earth terminals(for shield wire) such as [SG], [FG], [SG1], [SG2], etc. at the same time.
- The power source of the LE-50PAU power amplifire is prepared commonly for100VAC and 200VAC.
Connect the power source to across the terminal[L] - [N].
Note that connecting the power wire to the input/ output terminal or DC power terminal may cause the equipment to be broken
- Turn ON / OFF the power source of the LE-50PAU power amplifire together with that of tension controller.
Use a power wire of over 2mm² to avoid any voltage drop

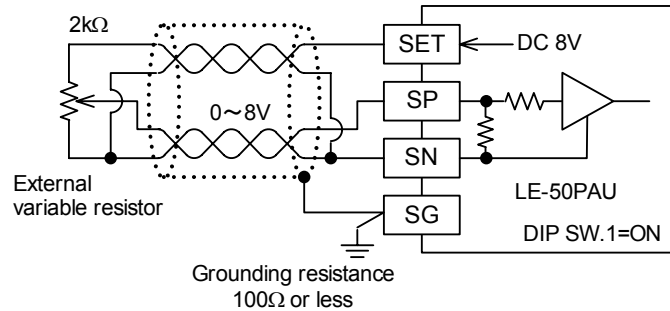
4.3 Connection of input circuit

1. Analog input

----- For 1 to 5V input and 4 to 20mA input, refer to page 48.

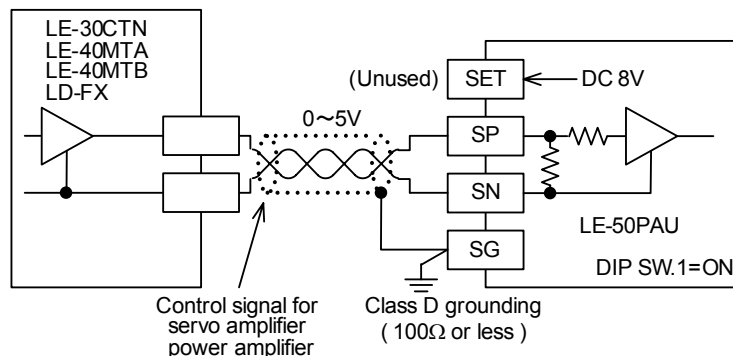
(1) External variable resistor

- To input the signal, using the external variable resistor, connect it as shown below in the following drawing, turn on the DIP switch SW2 and turn off the SW3 (input : 0 to 8V).
- Use a variable resistor of 2k Ω (linear characteristic).



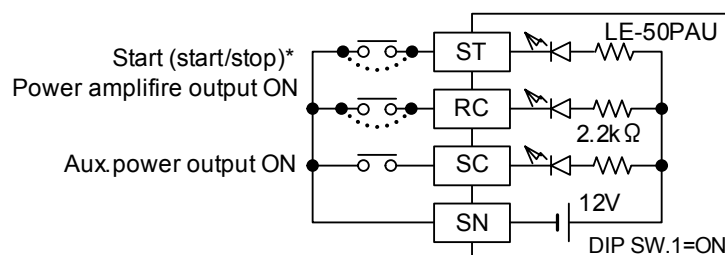
(2) LE-30CTN, LE-40MTA, LE-40MTB, LD-FX

- Connect the LE-50PAU power amplifire to the LE-30CTN, LE-40MTA, LE-40MTB or LD-FX tension controller as shown below in the following drawing, turn on the DIP switch SW2 and SW3, and set the input to 0 to 5V.



2. Digital input

- Use a switch for small signal suitable to small current (12VDC 5mA).
- When the power amplifire output is not turned ON / OFF remotely, keep across [RC] - [SN] short-circuited.
- When the stop gain, bias or aux.power amplifire is not used, keep the [ST] terminal short-circuited and the [SC] terminal opened.

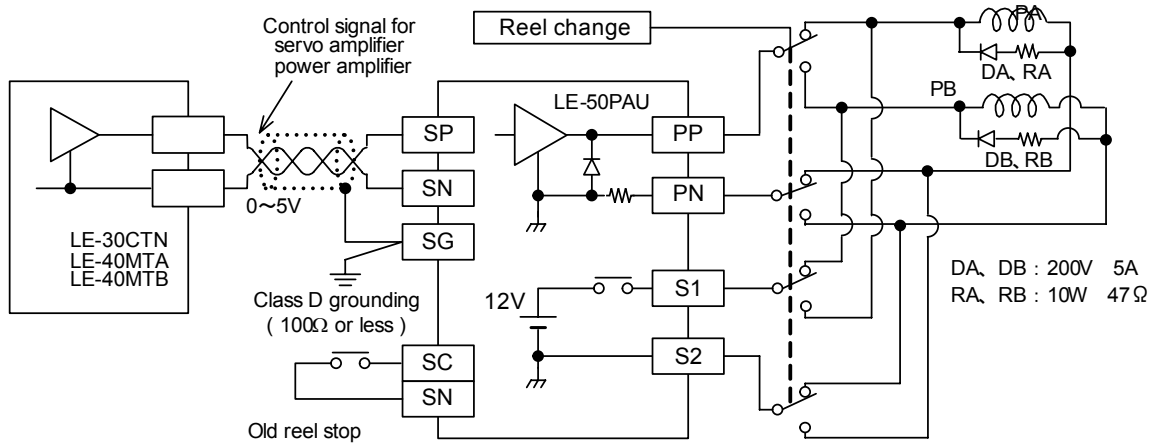


4.4 Connection of output circuit

The one-reel controller or feed roll controller does not use any aux. power amplifire.

Set the DIP switch SW4 to SW10 in accordance with the rated current of clutch / brake connected to the LE-50PAU power amplifire output [PP] - [PN]. (See page 5.)

Type LE-30CTN, LE-40MTA, LE-40MTB tension controller

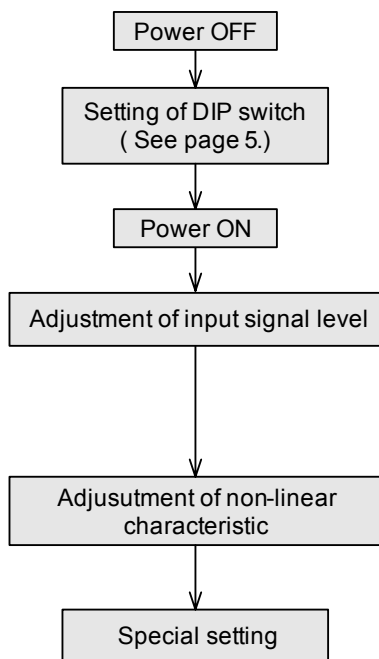


- The reel change circuit is as shown above.
Prepare a switch which is turned on while the old reel is stopped, and connect it to across the terminals [SC] and [SN].
- Do not short circuit across the terminals [PN] and [S2], for current control of power amplifire and for detection of over-current.
For this reason, use a bipolar (negative / positive) switching curcuit.
- Be sure to connect a sires resistor (RA, RB) to the commutation diode (DA, DB) used for protection of changeover switch, by which the normal commutation current flows in the diode built in the power amplifire, which allows the current to be detected correctly.

5. Initial setting

5.1 Setting procedure / Input signal level

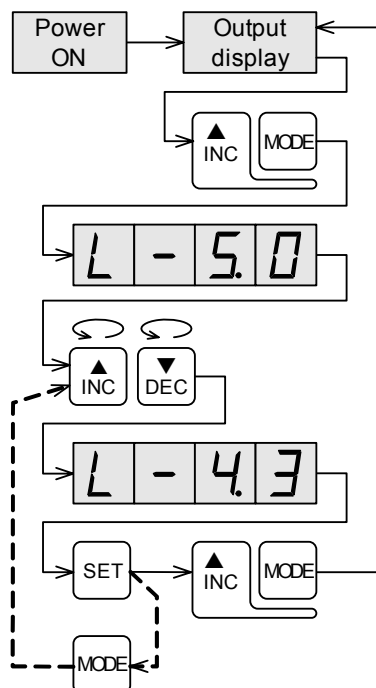
1. Setting procedure



- Turn on the DIP SW1 to set the power amplifire mode.
- Turn on the DIP SW4 to SW10 to set the output to full-scale (0.2 to 0.4A) or 24VDC.
- When the DIP SW2 and SW3 are turned on, the output is defined to be set to 0 to 5V.
- When the DIP SW2 is turned on and SW3 is turned off, the output is defined to be set to 0 to 8V.
- When the DIP SW2 is turned off and SW3 is turned on, it is possible to adjust the input signal level to 0 to V_{max} ($V_{max} = 0.5$ to 8V). The adjustment procedure in this case is described as below.
- Set the non-linear characteristic in accordance with the procedure shown on the next page. It is teated as a linear characteristic unless the setting is made.
- Set the [RC] input logic, stop gain, stop bias, stop timer and aux.power output timer as reqierd in accordance with the procedure given on page 25, 26.

2. Input signal level

The adjustment is executable at any time, and it is validated when the DIP SW1 is turned on, SW2 is turned off, SW3 is turned on and the power source is closed.

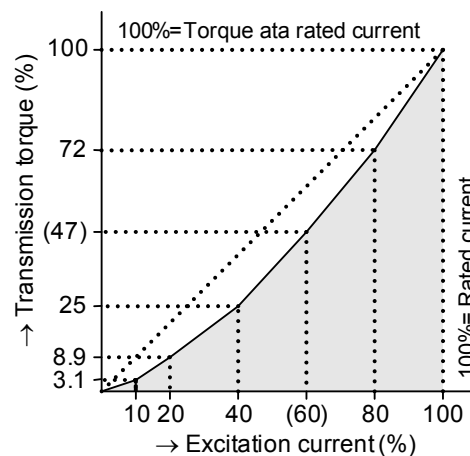


- When the power source of LE-50PAU is closed, the output current or output voltage is displayed soon in accordance with the sequence shown on page 23.
- When the [MODE] key is pressed with the [INC▲] key pressed, the input signal level adjustment mode is turned on.
- [L] indicate that the input signal level adjustment mode is turned on, in which the current adjustment value is indicated.
- Press the [INC▲] key or [DEC▼] key several times to display the target input signal level (0.5 to 8.0V). When the key is kept pressed, the numeric value is incremented or decremented at high speed automatically.
- The drawing given at left shows a screen of numeric value displayed by operation of [INC▲] key or [DEC▼] key, in which the value is set to 4.3V for instance.
- When the [SET] key is pressed, the numeric value set in this case is updated and stored in the EEPROM memory within the LE-50PAU power amplifire. When the [INC▲] key is pressed with the [MODE] key pressed, the input signal adjustment mode is reset.
- If only the [MODE] key is pressed before the operation, it is possible to correct the input signal level again.

5.2 Non-linear compensation

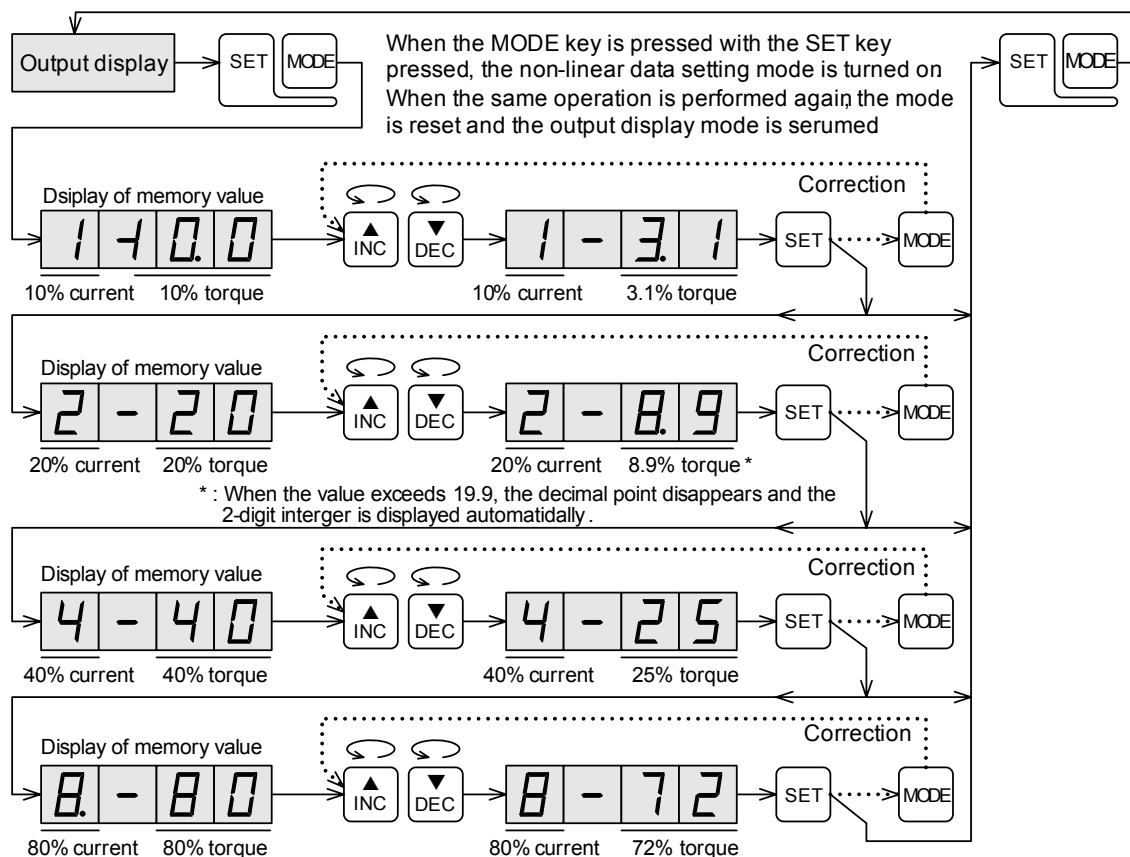
1. Non-linear characteristic

- The excitation current vs. transmission torque characteristic of clutch / brake is of non-linear characteristic as shown at right, and may be different, depending on the type name of each clutch / brake.
Set the transmission torque value at 10%, 20%, 40% and 80% current for non-linear data.
- In this case, "100%" current is a rated current of clutch / brake, and "100%" torque is a transmission torque at the rated current, and is greater than the value of nominal torque of clutch / brake for new product.
- The following shows a setting example based on the example shown in the drawing at right.
The practical clutch / brake setting value is as shown in the list given on the page 21,22.



2. Setting procedure

- When the [INC▲] key or [DEC▼] key is pressed, the numeric value displayed is increased or decreased.
- When the key is kept pressed, the numeric value is incremented or decremented at high speed automatically.



- When it is not necessary to change the numeric value, press the [SET] key as it is, by which the step is advanced to the succeeding step. The last step is resumed each time when the [MODE] key is pressed.

6. Maintenance / inspection

6.1 Initial inspection / Fault inspection

1. Initial inspection

- Check that the applied load (24VDC, 4A or less) is proper prior to closing the power source.
- The mal-connection of power terminal, contact failure between DC input / output terminal and power wiring, short-circuit in output wiring, etc. may result in a cause of serious damage.
Check that the power source is connected to the earth correctly and that the input / output wiring is executed correctly prior to closing the power source.
- Perform the wiring check to see that the commutating diode is not connected directly to the excitation coil of clutch / brake to be connected to the control output terminal, and that the circuit across terminals {PN} and {S2} is not short-circuited.
- When it is necessary to measure the equipment for dielectric strength and insulation resistor, proceed as follows even if it is troublesome.

Note that performing the test in a wrong manner may cause the inside to be broken.

[1] Disconnect all wiring such as amplifire input / output wiring and power wiring.

[2] Measure the amplifire between all terminals and casing independently for dielectric strength and insulation resistance.

Dielectric strength : 1,500VAC for one minute

Insulation resistance : 5MW or over when measured with a 500VDC megger

- Check that the power source is prepared commonly for 100VAC and 200VAC.

2. Fault inspection

When the proper output current fails to be assured even if the input signal is applied, perform the fault inspection in accordance with the following procedure, referring to each display described furthe on. The positions where the numeric display unit and LED are mounted are as shown below in the following drawing.

[1] POWER display LED

Comes on when the power source is applied.

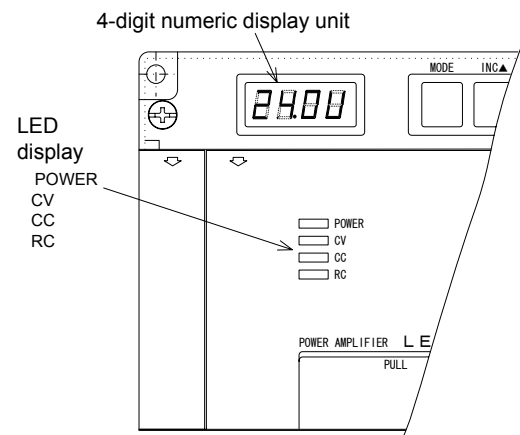
If the LED fails to turn on when 85 to 264VAC is applied across the terminals [L] and [N], the amplifire must be defective.

[2] CV, CC display LED

“CV” LED comes on when the DIP SW4 to SW10 are all turned on (voltage control mode), and “CC” LED comes on when the current is set to 0.2 to 4.0A (current control mode).

“CC” and “CV” LEDs will not come on for other cases.

It is normal the either LED comes on. When both LEDs are found to be turned off, reexamine the setting of DIP SW4 to SW10.



[3] RC (remote control) display LED

The RC display LED comes on when the RC input of amplifire is turned on, by which the control output is executable.

If the “RC” LED is found not to be turned on, the control output is not executed.

Since the output is turned on with the RC input turned off, and turned off with the RC input turned on when the inversion mode is set by the special operation (shown on page **), as to the RC input, determine it in accordance with the LED display.

Even if the RC input mode is different, the control output is executed when the “RC” LED is turned on.

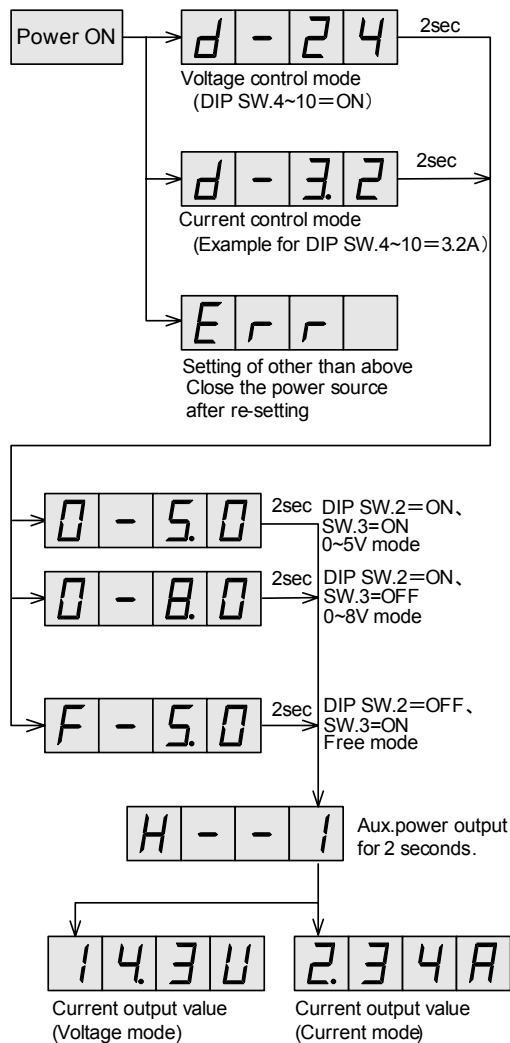
[4] Output shu-off (between PP and PN and between S1 and S2)

When any load short-circuit is generated between the terminals PP and PN, and between S1 and S2, the output may be shut off by the overload detection function.

In such a case, keep the power source shut off for more than 30 seconds after checking the external connection, and re-close the power source, by which the trouble is normalized.

[5] Inspection of numeric display

After closing the power source, the 4-digit display unit displays the following contents.



< Display of output full-scale > 2sec.

- When the DIP SW4 to SW10 are all turned on, the contents shown left is displayed for 2 seconds. (It is invalid to change the switch ON/OFF after turn on the power source.)
- When the DIP SW4 to SW10 are set to 0.2 to 4.0A, the contents shown left is displayed for 2 seconds. (It is invalid to change the switch ON/OFF after the closing the power source.)
- The error is displayed except when the DIP SW4 to SW10 are set to the other than above. In such a case, turn on the power source after setting the DIP SW4 to SW10 correctly.

< Display of input signal level > 2sec.

- When the DIP SW2 is turned on, the input signal level is set to 0 to 5V (SW3=ON), or set to 0 to 8V (SW3=OFF), by which the current setting value is displayed for 2 seconds as shown left.
- When the DIP SW2 is turned off and SW3 is turned on, the input signal level is set by key operation. In this case, the current setting value is displayed for 2 seconds as shown left. When the DIP SW2 and SW3 are turned off, the mode is set to the built-in variable resistor.
- The current value of output voltage or output current is displayed all the time as shown left.

6.2 Maintenance inspection

- The equipment does not contain any consumable parts which may run down in a short time. The standard guideline replacement period of smoothing capacitor is 5 to 10 years. Since the standard replacement period may vary, depending upon the magnitude of output current, ambient temperature or operation rate, place an order or smoothing capacitor from the Service Center of Mitsubishi Electric as required.
- The EEPROM (used for storage of setting data) is serviceable for 100,000 re-writing, and the power source ON/OFF operation is limited to 100,000 times or less.
- For periodical inspection, check for the following items;
 - Check that the panel temperature is not unusually increased due to heating element, direct sunshine, etc.
 - Check that the powder dust or conductive dust does not enter the panel.
 - Check that the wiring terminal is not loosened, and that there is not any other failure.

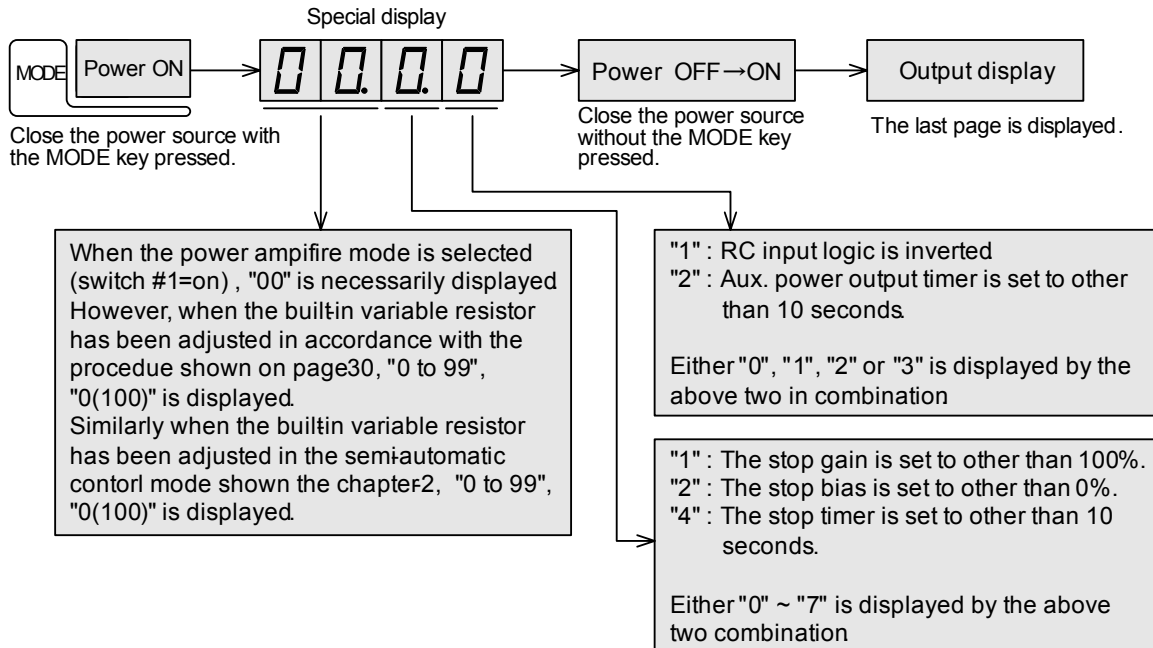
7. Supplementary items

7.1 Special setting operation

It is possible to execute the following special settings by turning on the power source with [MODE] key pressed.

This special setting mode is reset when the power source is turned on without the [MODE] key pressed.

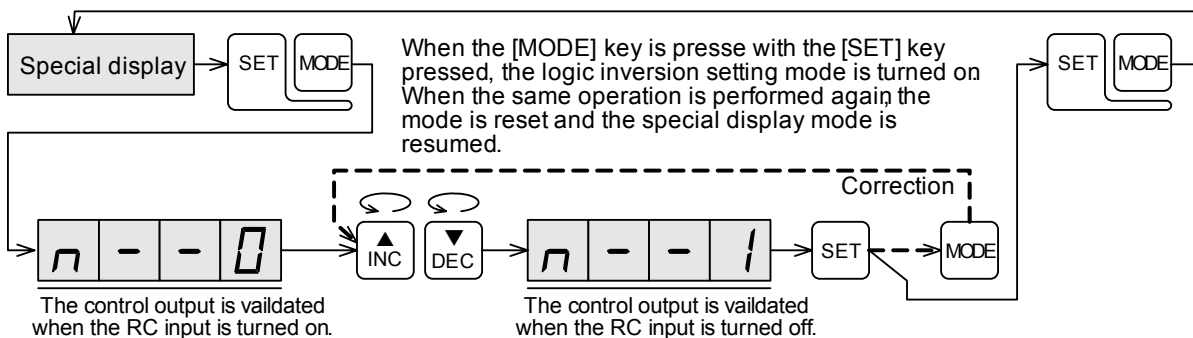
1. Special display



2. RC input logic

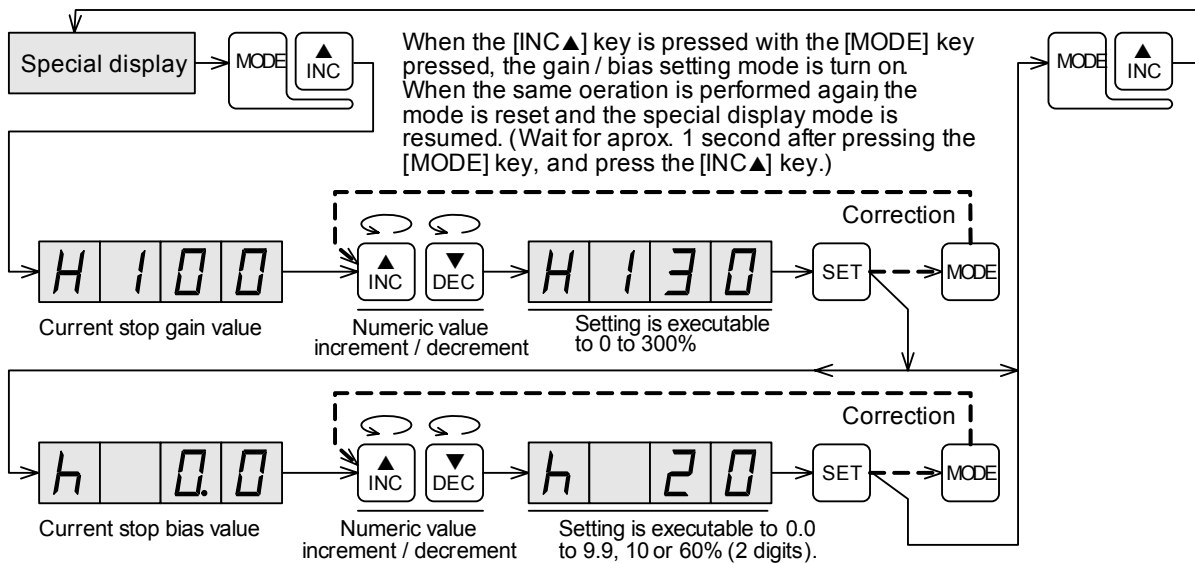
The standard mode is used to validate the PP-PN output when the RC input is turned on.

On the contrary, the standard mode also makes it possible to validate the PP-PN output when the RC input is turned off.



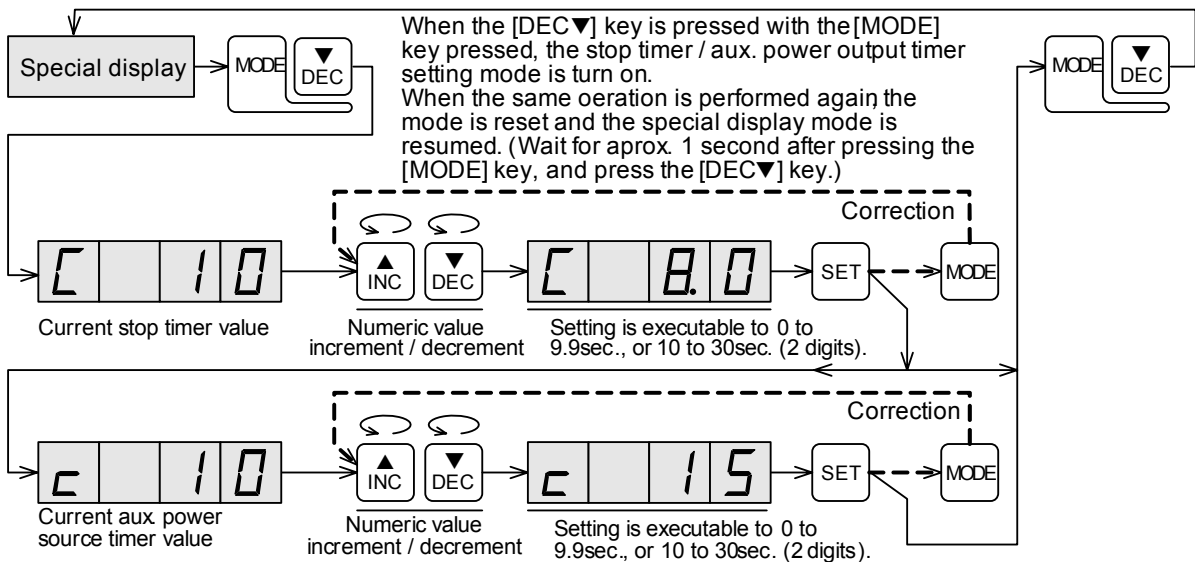
- Change the setting from "0" to "1" or from "1" to "0" by pressing the [INC▲] key or [DEC▼] key, and press the [SET] key.

3. Stop gain / stop bias



- The numeric value displayed is incremented / decremented each time when the [INC▲] key or [DEC▼] key is pressed during numeric value increment / decrement operation. When these keys are kept pressed, the numeric value is incremented / decremented at high speed automatically.
- When it is not necessary to change the numeric value, press the [SET] key as it is, by which the following setting is executable. The step is resumed to the last setup each time when the [MODE] key is pressed.

4. Timer setting



- The numeric value displayed is incremented / dencremented each time when the [INC▲] key or [DEC▼] key is pressed during numeric value increment / decrement operation. When these keys are kept pressed, the numeric value is incremented / decremented at high speed automatically.
- When it is not necessary to change the numeric value, press the [SET] key as it is, by which the following setting is executable. The step is resumed to the last setup each time when the [MODE] key is pressed.

7.2 Clutch / brake characteristics

1. Powder clutch

Powder clutch								
Type name		Rated current (A)	100% torque (N•m)	Transmission torque (%)				
				10%	20%	40%	80%	
Projection shaft type	Self-cooling	ZKG-5AN	0.4	0.88	2.3	7.0	21	72
		ZKG-10AN	0.5	1.5	4.0	10.	27	77
		ZKG-20AN	0.6	2.9	3.0	11.0	38	83
		ZKG-50AN	0.8	7.2	4.1	10.4	31	77
		ZKG-100AN	1.0	13.5	5.9	13.3	35	81
		ZKB-0.06AN	0.5	1.4	4.0	9.2	20	64
		ZKB-0.3AN	0.5	5.1	2.0	7.1	27	79
		ZKB-0.6AN	0.8	8.5	2.2	7.1	27	77
	Self-cooling (Air-cooling)	ZKB-1.2BN	0.9	17	2.4	7.6	23	71
		ZKB-2.5BN	1.2	33	2.7	7.6	27	78
		ZKB-5BN	2.2	78	3.8	10.3	32	82
		ZKB-10BN	2.4	190	1.6	5.3	27	80
		ZKB-20BN	2.7	300	2.6	7.7	30	82
	Explosion-proof Self-cooling	ZKB-40BN	3.5	540	1.9	5.6	24	78
		ZKB-1.2B4-909	1.4	18	1.7	6.1	22	72
		ZKB-5B4-909	2.8	76	3.0	8.3	26	80
ZKB-10B2-909		3.6	220	3.6	10.0	29	80	
Penetration shaft type	Self-cooling	ZKB-20B2-909	3.8	300	2.7	6.7	23	75
		ZA-0.6A	0.7	8.1	4.3	13.5	41	82
		ZA-1.2A1/AN	0.9	17	3.6	10.1	33	83
		ZA-2.5A1/AN	1.1	33	3.0	8.5	30	82
		ZA-5A1/AN	1.4	70	3.4	10.7	33	83
		ZA-10A1/AN	2.0	134	5.2	11.9	34	84
	Self-cooling	ZA-20A1	2.5	260	6.9	15.0	42	92
		ZKA-1A1	0.7	17	5.9	14.1	39	85
		ZKA-2A1	0.5	33	4.2	10.9	30	76
		ZKA-6A2	1.4	104	5.6	13.5	35	81
		ZKA-10A2	2.1	190	6.3	15.8	41	85
		ZKA-20A3	2.0	298	4.7	13.4	37	82
		ZKA-45AT	3.8	620	6.0	17.17	48	87
		ZKA-65AT	3.8	950	8.0	20	54	89
ZKA-100A *	4.8	1300	6.1	15.0	38	86		

For product type marked with *, use it at the output torque of 4A or less.
Do not use it at the constant voltage mode.

2. Hysteresis clutch

Histeresis clutch							
Type name		Rated current (A)	100% torque (N•m)	Transmission torque (%)			
				10%	20%	40%	80%
Projection shaft type	ZHA-0.6B	0.4	0.072	1.0	2.2	11.0	78
	ZHA-1.2A	0.4	0.167	1.0	1.5	12.6	71
	ZHA-2.5A	0.5	0.270	1.0	1.5	11.9	72
	ZHA-5A	0.6	0.595	1.0	1.7	16.8	77
Penetration shaft type	ZHA-10A	1.0	1.32	1.0	3.0	18.2	80
	ZHA-20A	1.2	2.64	1.0	3.0	22	83
	ZHA-40A	1.6	5.35	1.0	6.5	28	85
	ZHA-60A	2.1	7.90	1.0	3.8	14.6	77

How to read table

- The rated current is a value at voltage of 24VDC and coil temperature of 75°C.
- 100% torque shows a typical transmission torque for case when the rated current is applied.
- The value of transmission torque(%) is given by the percentage of output torque against 100% torque for case when 10%, 20%, 40% and 80% of rated current is applied.

3 Powder brake

Powder clutch								
Type name		Rated current (A)	100% torque (N•m)	Transmission torque (%)				
				10%	20%	40%	80%	
Projection shaft type	Self-cooling	ZKG-5YN	0.4	1.0	5.0	11.0	30	80
	Self-cooling	ZKG-10YN	0.4	1.3	4.6	10.8	30	78
		ZKG-20YN	0.5	2.6	7.7	15.4	37	80
		ZKG-50YN	0.6	6.6	7.6	18.2	42	84
		ZKB-0.06YN	0.5	1.4	4.0	9.2	20	64
		ZKB-0.3YN	0.5	5.1	2.0	7.1	27	79
		ZKB-0.6YN	0.8	8.5	2.2	7.1	27	77
	Self-cooling (Air-cooling)	ZKB-1.2XN	0.9	17	2.4	7.6	23	71
		ZKB-2.5XN	1.2	33	2.7	7.6	27	78
		ZKB-5XN	2.2	78	3.8	10.3	32	82
		ZKB-10XN	2.4	190	1.6	5.3	27	80
		ZKB-20XN	2.7	300	2.6	7.7	30	82
	Thermo-block	ZKB-40XN	3.5	540	1.9	5.6	24	78
		ZKB-2.5HBN	1.2	33	2.7	7.6	27	78
		ZKB-5HBN	2.2	78	3.8	10.3	32	82
		ZKB-10HBN	2.4	190	1.6	5.3	27	80
		ZKB-20HBN	2.7	300	2.6	7.7	30	82
	Water-cooling	ZKB-40HBN	3.5	540	1.9	5.6	24	78
		ZKB-2.5WN	1.2	33	2.7	7.6	27	78
		ZKB-5WN	2.2	78	3.8	10.3	32	82
ZKB-10WN		2.4	190	1.6	5.3	27	80	
ZKB-20WN		2.7	300	2.6	7.7	30	82	
Penetration shaft type	Self-cooling	ZKB-40WN	3.5	540	1.9	5.6	24	78
		ZA-0.6Y	0.3	9.4	5.1	14.0	38	85
		ZA-1.2Y1	0.4	17	4.1	14.1	33	85
		ZA-2.5Y1	0.7	35	6.0	13.0	43	82
		ZA-5Y1	0.9	70	6.0	18.6	46	87
		ZA-10Y1	1.2	140	7.8	19.6	46	87
		ZA-20Y1	1.9	254	7.8	18.9	46	88
	Water-cooling	ZA-40Y	1.3	32	5.1	13.8	38	88
		ZKA-2W	1.3	32	5.1	13.8	38	88
		ZKA-6W	1.9	100	7.5	16.0	38	82
	ZKA-10W	2.1	182	7.9	13.8	37	83	
	ZKA-20W	2.2	280	4.3	12.0	35	80	
	ZKA-45W	2.4	730	4.1	10.8	33	84	

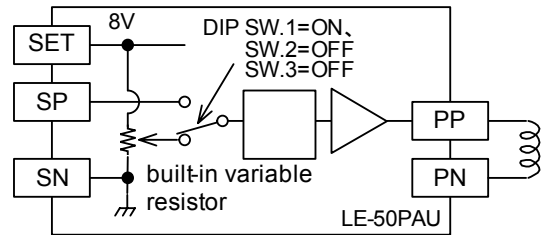
4. Hysteresis brake

Histeresis clutch							
Type name		Rated current (A)	100% torque (N•m)	Transmission torque (%)			
				10%	20%	40%	80%
Projection shaft type	ZHY-0.6B	0.2	0.09	0.5	1.0	7.1	78
	ZHY-1.2A	0.3	0.17	1.0	2.3	9.9	67
	ZHY-2.5A	0.4	0.43	1.0	2.3	17.9	79
	ZHY-5A	0.5	0.68	1.0	3.7	23	84
Penetration shaft type	ZHY-10A	1.0	1.78	1.0	2.0	11.2	79
	ZHY-20A	1.3	3.60	1.0	3.6	25	89
	ZHY-40A	1.6	5.75	1.0	3.5	21	87
	ZHY-60A	2.2	9.00	1.0	3.9	24	87
	ZHY-100A2	2.0	13.70	1.0	2.9	20	84

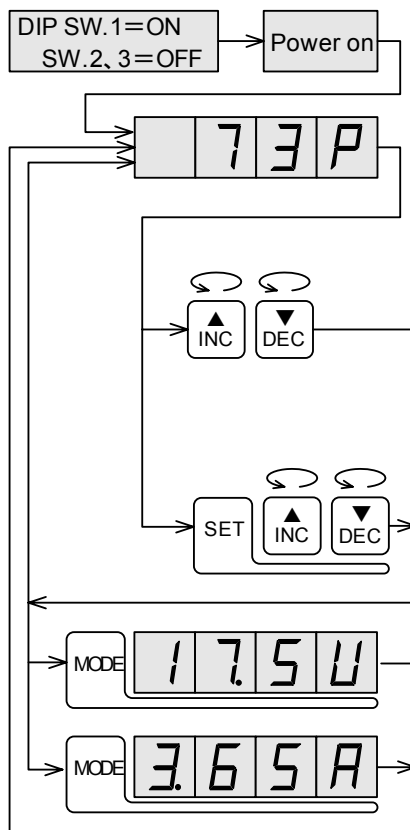
7.3 Manual power source with no variable resistor

1. Setting of built-in variable resistor mode

- When the DIP SW1 is turned on (power amplifier mode) and SW2, SW3 are turned off, the power amplifier is set to built-in variable resistor mode.



2. Built-in variable resistor adjustment procedure



- The setting value (0 to 100%) of built-in variable resistor is displayed.
When the setting value is 100%, the full-scale output set by the DIP SW4 to SW10 is sent out.
- The setting value is incremented or decremented each time when the [INC▲] key or [DEC▼] key is pressed.
- When the [INC▲] key or [DEC▼] key is kept pressed, the setting value is incremented or decremented at high speed automatically.
- Even if the [SET] key is not pressed, the adjustment is valid. When the power source is interrupted, the adjustment contents is saved in the EEPROM memory.
- When the [INC▲] key or [DEC▼] key is pressed with the [SET] key pressed, the numeric value at digit of 10 is incremented or decremented.
- While the [MODE] key is pressed, the output is displayed in substitute for input signal display (0 to 100%).
The voltage of 0 to 24.0V is displayed for voltage mode, and the current value (A) is displayed for current mode, of which maximum value is full-scale.

LE-50PAU-SET

CHAPTER-2 WINDING DIAMETER DETECTION TYPE SEMI-AUTOMATIC TENSION CONTROLLER

The LE-50PAU power amplifier is incorporated with an additional function that can be utilized as a winding diameter detection type semi-automatic tension control unit by using the LE-5AP type operator panel in combination.

This chapter describes the function of such additional function and operation procedure for LE-5AP operator panel.

Since the function of the LE-50PAU power amplifier is utilized as it is, be sure to refer to the description given in chapter-1 at the same time.

The open-loop type tension controller, using winding diameter detection is called "Semi-automatic type" as compared with the closed-loop type tension controller (LE-40MTA-E, LE-40MTB-E, LE-30CTN, etc.) which feeds back the tension detection, by using the tension detector in combination.

The winding diameter is detected in the following three ways;

- [1] Speed / thickness setting method
- [2] Thickness setting winding reel pulse detection method
- [3] Proportion calculation method by detection of winding reel pulse / measure pulse

The winding diameter detection to be described in this chapter is concerned with the above items [1] and [2], and uses the most simplified method.

The unit of type name LE-50PAU-SET is made up of LE-50PAU and LE-5AP in combination.

1. General description

1.1 Principle of winding diameter detection

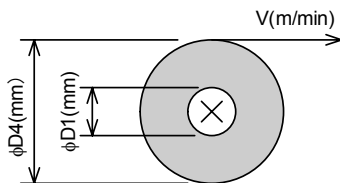
The LE-50PAU-SET tension controller can use either one of the following two types of winding diameter detection methods selectively.

1. Speed / thickness setting method (sensor-less method)

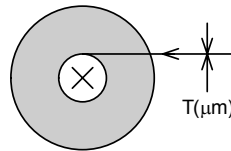
- The winding diameter D (mm) for case when winding / unwinding the material (thickness: $T\mu\text{m}$) at line speed of V (m/min) is given by the following formula;

$$D = \sqrt{D_4^2 - 4TVt / \pi} \text{ --- Unwinding}$$

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



Unwinding



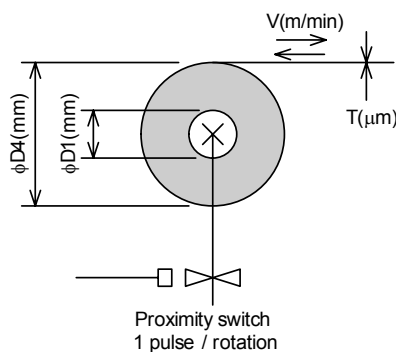
Winding

D_1 = Minimum diameter (mm)
 D_4 = Maximum diameter (mm)
 t = Operation time (min.)

- If the initial diameter is set to D_1 (winding) or D_4 (unwinding), and then the material thickness (t) and average speed (V) are set, it is possible to calculate the winding diameter (D) automatically along with time elapsed, using the above formula. This is called "Speed / thickness setting method".
- Since it is unable to execute the correct calculation if any error exists in setting, it is necessary to set D_4 (winding) and D_1 (unwinding) for final diameter, to restrict the calculation result.

2. Pulse / thickness setting method (winding reel sensor method)

The winding reel is prepared with proximity switch in substitute for line speed (V) setting to supply 1 pulse / rotation signal to the LE-50PAU. The winding diameter in this case is calculated automatically, using the following formula;



$$\begin{aligned} \text{Winding} & D = D_1 + 2NT \times 10^{-3} \\ \text{Unwinding} & D = D_4 - 2NT \times 10^{-3} \end{aligned}$$

Where, N : Count value of winding reel pulse
 D : Current winding diameter (mm)
 D_1 : Initial winding diameter (mm)
 T : Material thickness (μm)

- If the initial diameter is set to D_1 (winding) or D_4 (unwinding), and then the material thickness (T) is set, it is possible to calculate the winding diameter (D) automatically. This is called "Pulse / thickness setting method".
- Since it is unable to execute the correct calculation if any error exists in thickness setting, it is necessary to set D_4 (winding) and D_1 (unwinding) for final diameter, to restrict the calculation result.

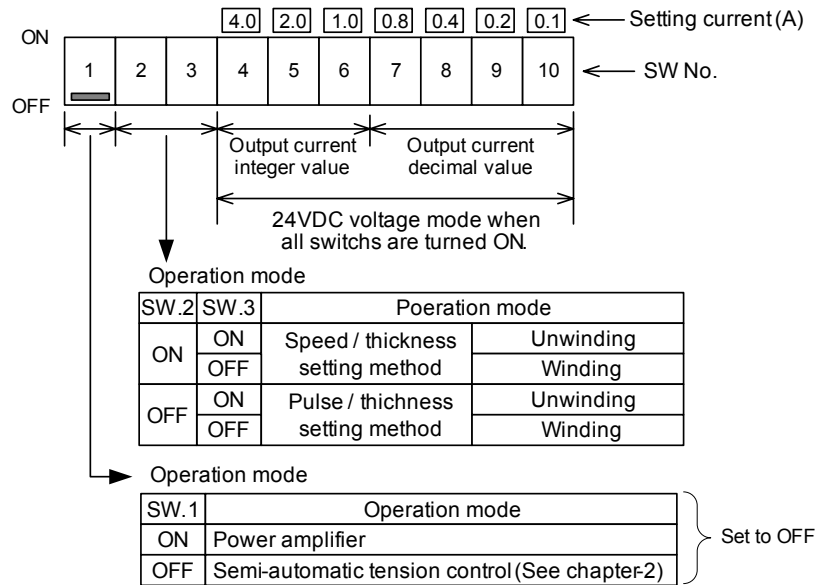
<Appendix> Taper tension control

The LE-50PAU-SET is also designed as to execute the taper tension control when the winding diameter is large, in which the operation is performed at smaller tension than that when winding diameter is small, and it is possible to set two intermediate diameter points as required.

1.2 Additional function of power amplifire

1. Setting of DIP switch

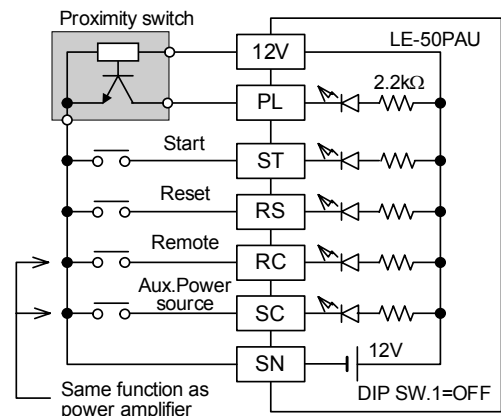
- When the DIP SW1 is turned off (semi-automatic tension control mode), th input signal level is set to 0 to 8V automatically. The function is not executable for other input mode. (The input level setting at power amplifire mode remains stored as it is.)
- The operation mode is determined as shown at following table, depending on ON / OFF of DIP SW2 and SW3. The setting changeis executable when the power source is turned from off to on.



2. Handling of input terminal

(1) PL terminal -----Winding reel pulse input

- For pulse / thickness setting method, connect the proximity switch to the terminal. Use the voltage output type proximity switch having power source of 10 ~ 16VDC, current consumption of 10mA or less and output current of 10mA or over. (Example)
- Type TL-G3D-3 ----- Made by OMRON
- Type E2E-X2E1----- Made by OMRON
- Set the ON time / OFF time to 2msec or over respectively.
- The response frequency is 250Hz (max.).



(2) ST terminal ----- Operation stop input

- The ST terminal is an input terminal for stop gain. Even when the stop gain is not used, turn it off as calculation stop input while the operation is stopped.
- This setting is necessary for speed / thickness setting method particularly when the pause time is long, as error may occur in calculation if only the aveage speed set. The winding diameter calculation is paused after elapse of time set on the built-in stop timer.
- When the proximity switch is operated erroneously due to vibration while winding reel is stopped even for pulse / thickness setting method, turn off the ST input while the operation is stopped, to invalidate it.

(3) RS terminal----- Reset input

- The winding diameter calculation data is stored in the RAM memory. When any power failure occurs, however, the data is saved in the EEPROM memory automatically, to hold the memory contents.
- If the input is turned on when the winding reel is replaced with a new one, the winding diameter is preset to the initial diameter. (When ST input is turned off.)
- When the RS input is turned on by turning on the ST input, the output corresponding to the SP input is sent out.

2. General description of function

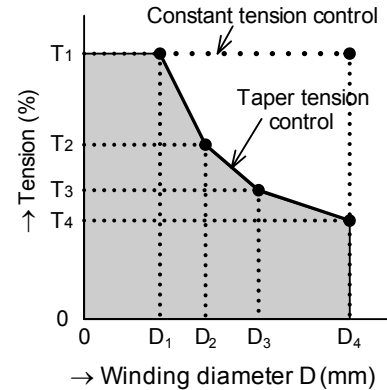
2.1 Description of additional function operation

The equivalent block diagram of power amplifire as tension controller for which additional function is added to the basic function of power amplifire is as shown in page 28.

It is so configured that the winding diameter compensation function is added between the amplifire A1 and amplifire A2.

1. Winding diameter compensation function

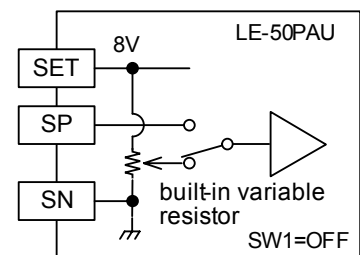
- If the target tensions T_1, T_2, T_3, T_4 (for winding diameter $D_1 < D_2 < D_3 < D_4$) have been set, using the LE-5AP operator panel, it is possible to execute the taper tension control as shown at right.
- For constant tension operation, it is possible to execute the operation at T_1 of 100 (initial value) and T_4 of 100 (initial value) as they are with D_1 and D_4 set.
- The winding diameter D is calculated from speed / thickness or pulse / thickness and the target tension corresponding to current winding diameter is calculated from graph shown at right. The calculation value multiplied by current radius will appear to be the control output.
- It is necessary to set (D_1, T_1) and (D_4, T_4) by all means. (D_2, T_2) are ignored when they are set to "0" . When T_2 is set to "0" even if D_2 is set, for instance, such D_2 is ignored.
- It is possible to set $T_1 \sim T_4$ to 20 ~500%, however, T_4 must be set to 10% for winding and T_1 must be set of 100% for unwinding respectively. For each winding diameter, the output will not exceed full-scale.
- If the irregular tension setting is made, (D_2, T_2) and (D_3, T_3) are deemed not to have been set. (D_2, T_2) and (D_3, T_3) are stored once they are set. When necessary to ignore them, reset D_2 and D_3 to D_1 or less, or to D_4 or over. (If T_2 and T_3 are set to T_1 or over, or to T_4 or less, they are ignored similarly.)



2. Tension setting function

(1) Internal adjustment

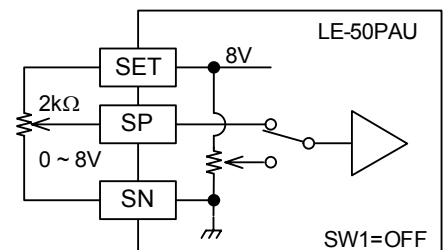
- When the built-in variable resistor (adjustable by software) is validated by the LE-5AP operator panel, it is possible to adjust the input, using operator panel in a substitute for external variable resistor.
- The variable resistor adjustment procedure is shown in page 36.



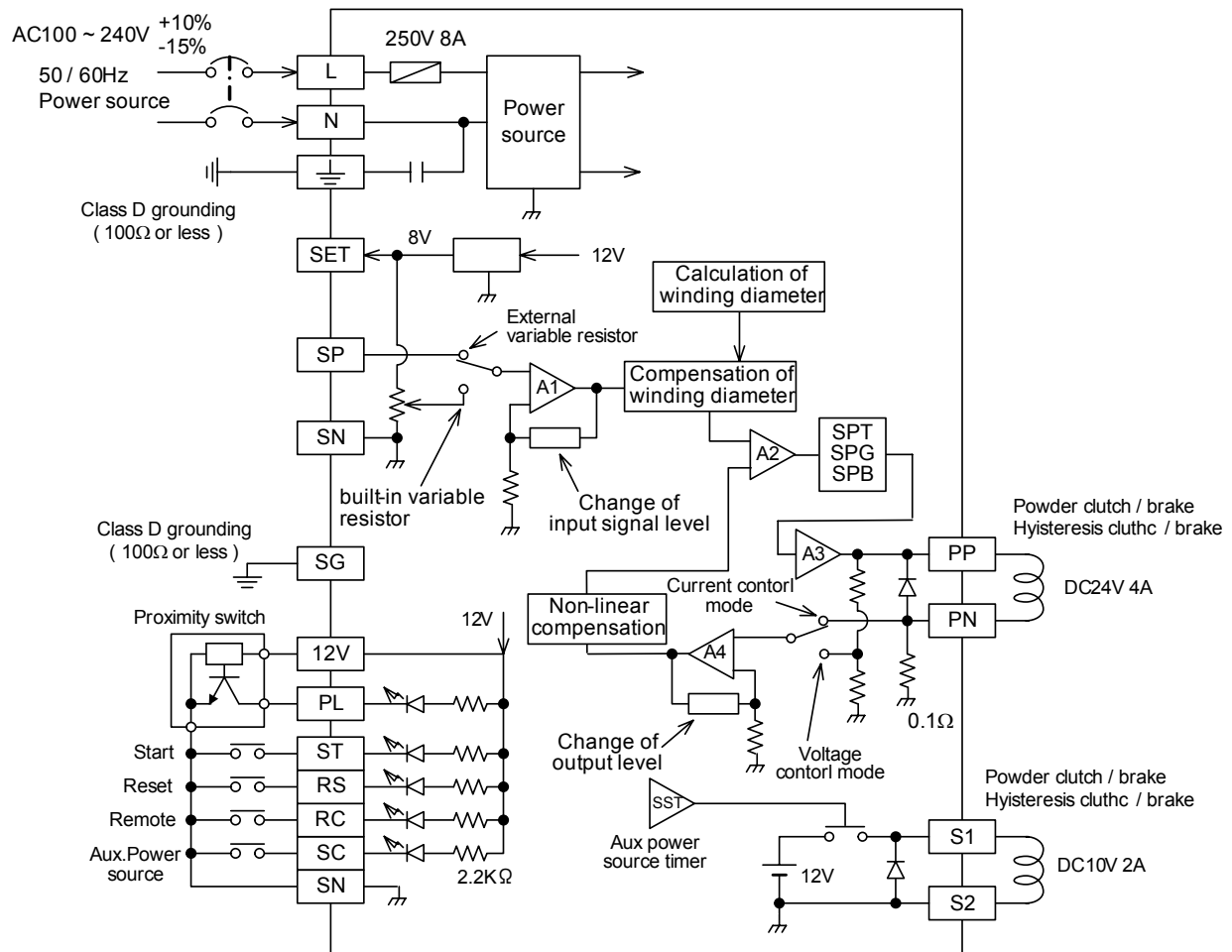
(2) External variable resistor

- When the built-in variable resistor is invalidated using the LE-5AP operator panel, and connect the external variable resistor, the input signal is adjustable using the external variable resistor.

The example of variable resistor connection diagram is shown in page 35.



2.2 Equivalent block diagram

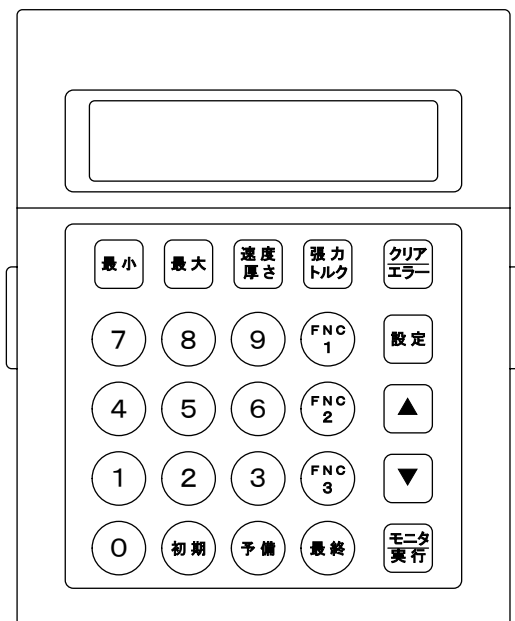


< Reset input / start input >

- [1] When the reset input RS is turned on with start input ST turned off, the winding diameter calculation data is reset to the initial diameter.
The initial diameter means "Maximum diameter" for unwinding, and "Minimum diameter" for winding.
- [2] When the reset input RS is turned on with start input ST turned on, the winding diameter calculation is stopped, the output will become corresponding to the SP input.
It is used for manual operation mode.

3. Operator panel

3.1 Introduction / Set item list



- The LE-5AP operator panel is installed in the panel surface of the control console.
- The LE-5AP operator panel has LCD with LED back light of 16 character two line. Various setting and monitors are done with 25 keys.
- The key which the operator operates at actual operation is (最小), (最大), (速度/厚さ), (張力/トルク), (クリア/エラー).
- The FNC1 ~ FNC3 keys are used to set the initial setting.
- The (初期), (予備), (最終) keys are not used. 0 ~ 9 and other keys are shown in item 4 or item 5.

- The last screen display appears when the power supply is turned on again by memorize the display screen before blacking out.

< Set item list >

Set item	Set range	Initial value
Minimum diameter D1	1~ 1,999mm	0
Small diameter D2	1~ 1,999mm	0
Large diameter D3	1~ 1,999mm	0
Maximum diameter D4	1~ 1,999mm	0
Speed SPD	1~ 999m/min	0
Adjustment variable resistor	0 ~ 100% *1	0%
Stop gain	0 ~ 300% *2	100%
Stop timer	0 ~ 30 sec	10 sec
Input level	0.5 ~ 8.0V	5V
10% torque	1.0 ~ 99.0% *3	10%
40% torque	1.0 ~ 99.0% *3	40%

Set item	Set range	Initial value
Minimum dia. Tension T1	20 ~ 500% *4	100%
Small dia. Tension T2	20 ~ 500% *4	0%
Large dia. Tension T3	20 ~ 500% *4	0
Maximum dia. Tension T4	20 ~ 500% *4	100%
Thickness THK	0.1 ~ 3,276.7 μ m	0
Variable resistor validity / invalidity	1 or 0	0 (invalidity)
Stop bias	0 ~ 60% *5	0%
Aux. Timer	0 ~ 30 sec	10 sec
Winding maximum taper ratio	20 ~ 500%	100%
20% torque	1.0 ~ 99.0% *3	20%
80% torque	1.0 ~ 99.0% *3	80%

These set data is memorized in the EEPROM memory in the LE-50PAU power amplifire.

*1 The set input signal level 8V is assumed 100%.

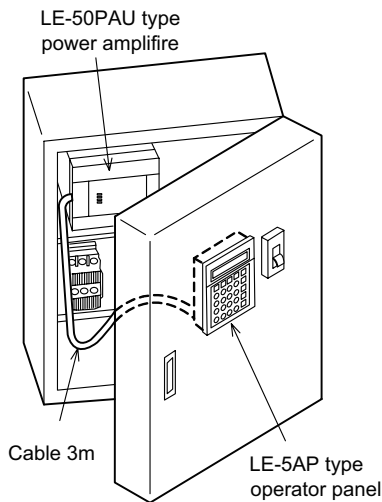
*2 The output ins assumed 100% before stopping.

*3 If the transmission torque at the rated current is assumed 100%, it is a transmission torque at the current of 10%, 20%, 40%, 80% of the rated current.

*4 If the tension of an initial diameter (it is maximum diameter in the unwinding and minimum diameter in the winding) is assumed 100%, it is one that the tension in present diameter was expressed by the percentage.

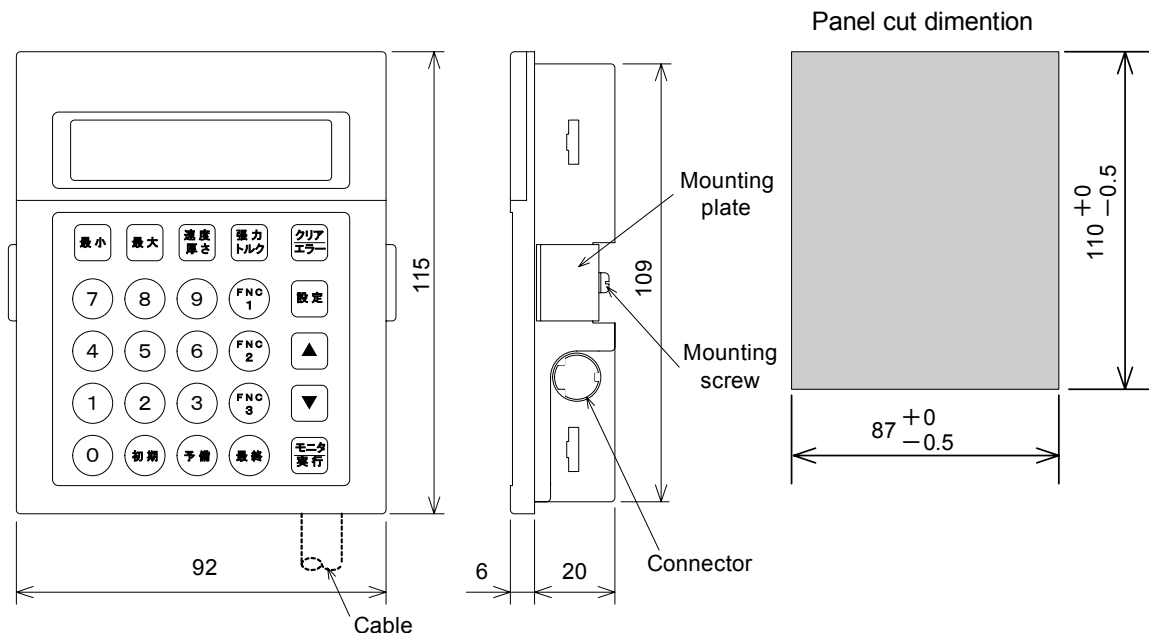
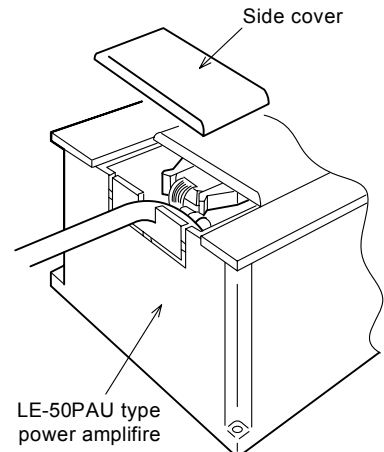
*5 The torque when the rated current enegizes (full scale output) is assumed 100%.

3.2 Installation and Outline / Specification



The LE-5AP operator panel is installed in the panel surface of the control console.

LE-50PAU in the control console is connected and draws out the cable with an attached cable of LE-5AP through the hook as shown in a right picture.



< Mounting method >

- [1] Detache the mounting plate on the back of the LE-5AP.
- [2] Insert the LE-5AP from the surface of the control console panel.
- [3] Fix the LE-5AP to the control console panel with the mounting plate and the mounting screw.
- [4] Screw tightening torque = 30 ~ 50N•m
- [5] Give the thickness of the installation panel as 4mm or less.

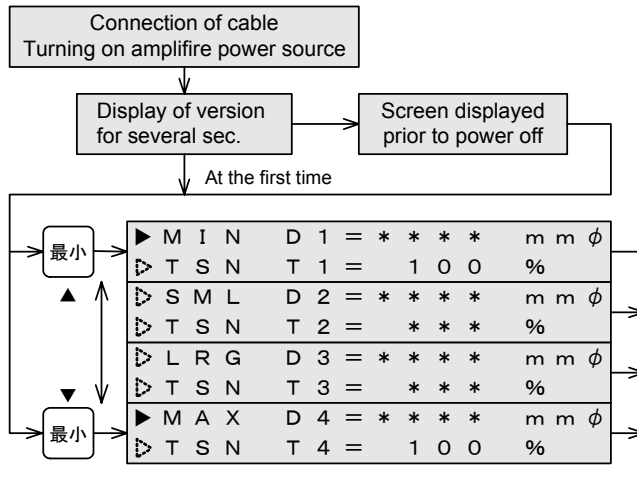
< General specification >

Power source	• 5VDC \pm 5% 220mA (from LE-50PAU)
Ambient temperature	• 0 to 50°C - - - - during operation
Ambient humidity	• 35 to 85% RH (no condensation) - - - - during operation
Vibration resistance	• 10 to 55Hz 0.5mm (4.9m/s ² max) 2 hours in each axis direction.
Impact resistance	• 98m/s ² 3 times in each axis direction.
Operation atmosphere	• Free from corrosive or flammable gas and conductive dust, less dust.
Keyboard	• 25 keys (Membrane seat)
Display	• LCD with indicator LED back light

4. Practical operation

4.1 Setting of winding diameter / taper ratio

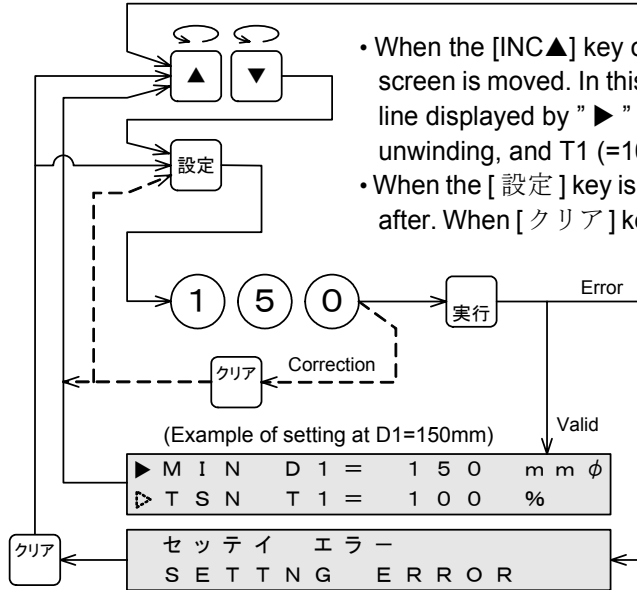
The practical operation procedure for operator is as shown below;



- When the power source to the LE-50PAU is turned of after connecting the cable between LE-5AP and LE-50PAU, the initial screen is displayed in a meanwhile.

- When the [最小] key or [最大] key is pressed, the screen as shown at left is displayed.

- The screen is changed over every 2 lines.



- When the [INC▲] key or [DEC▼] key is pressed, "▶" mark within the screen is moved. In this case, it becomes possible to set the numeric at the line displayed by "▶" mark. Note that only T4 (=100%) is acceptable for unwinding, and T1 (=100%) for winding.

- When the [設定] key is pressed, the numeric setting mode is validated hereafter. When [クリア] key or [実行] key is pressed, the setting mode is reset.

- The left drawing shows an example for case when D1 is set to 150mmφ with "▶" mark placed at MIN line. When the setting is executed erroneously, press the [クリア] key and start the operation from [設定] key.

- If [0] key is pressed, it is possible to change to correct value directly.

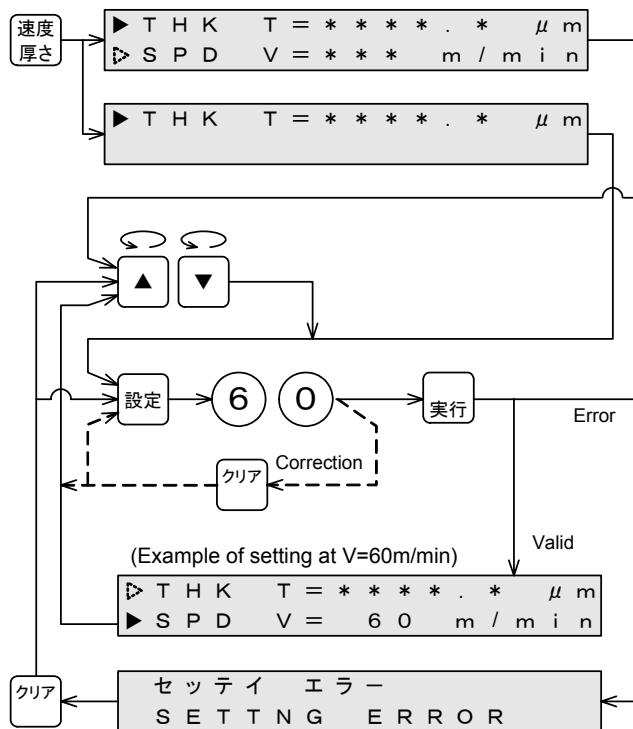
- [最小] key or [最大] key is acceptable in any screen. The operation remains invalid until [実行] key is pressed within the screen being changed.

< Appendix >

- When performing the constant tension operation, the operation is executable simply by setting the minimum diameter (D1) and maximum diameter (D4).
- When D1 or D4 is "0" (initial value), no power amplifire output is sent out. When D1 is equal to or greater than D4 (D4 is not equal to 0) after setting both values to range of 1 ~ 1,999, the setting error message is displayed. In such a case, reset the message by pressing the [クリア] key, and correct D1 or D4.
- D1 ~ D4 can be set to range of 1 ~ 1,999, and T1 ~ T4 to that of 20 ~ 500. If they are set to out of designated range, the setting error message is displayed when the [実行] key is pressed. In such a case, no setting is acceptable.
- (D2, T2) and (D3, T3) may be used directly at initial value (0, 0). When T2 is "0" even if D2 is set, such setting is ignored. The same applies to D3 and T3 (See page 17.)
- When setting, be sure to secure the following relationship.
 $D1 < D2 < D3 < D4$
 Note that only T1 (=100%) is acceptable to winding, and T4 (=100%) to unwinding. For other than $D1 < D2 < D3 < D4$ (excluding D2, D3=0), the error is displayed when it is detected during error check.
- Such data is written in EEPROM memory built in LE-50PAU each time when the [実行] key is pressed.

4.2 Speed / thickness setting

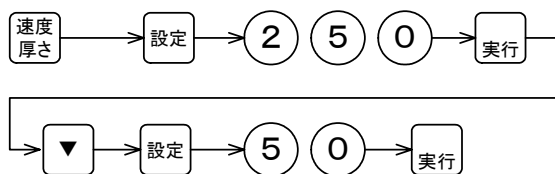
Similarly to description given on last page, [速度 / 厚さ] key is acceptable from any screen condition on the screen displayed prior to power failure after turning on the power source.



- Screen when speed / thickness type (DPI SW2=ON) is selected.
- Screen when pulse / thickness type (DPI SW2=OFF) is selected.
- Select SPD or THK using cursor keys (▲,▼). This operation is invalid for pulse / thickness setting method.
- The left drawing shows an example for case when V = 60 is written with set to SPD.
- The following range is valid to V and T respectively.
 $V = 1 \sim 1,999 \text{ m/min}$
 $T = 0.1 \sim 3,276.7 \mu\text{m}$
 If they are set to out of designated range, the setting error message is displayed when the [実行] key is pressed, by which no setting is accepted.
 In such a case, press the [クリア] key or correction.

< Setting example >

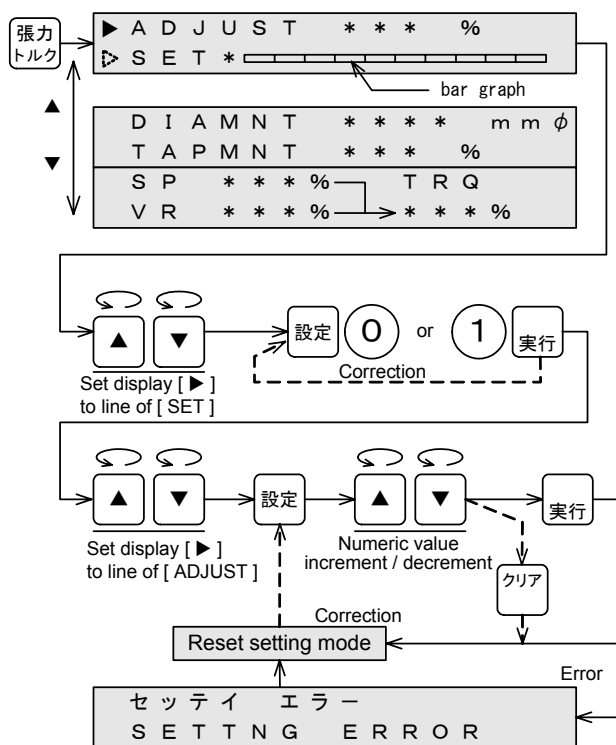
T = 25 μm , V = 60 m/min



- After completion of setting of 25 μm , move the "▶" mark to SPD line.
- After completion of setting of 60m/min, it is ready to move to the other setting item.

4.3 Tension / torque setting

Similarly to description given on page 31, [張力 / トルク] key is acceptable from any screen condition on the screen displayed prior to power failure after turning on the power source.



- When the [張力 / トルク] key is pressed, the screen as shown at left is displayed, in which the line or screen changeover is executable, using cursor keys (▲, ▼). The screen without "▶" mark indicates the monitor screen.

- When it is set to "0", the built-in variable resistor is invalidated (external variable resistor is validated), and when it is set to "1", the built-in variable resistor is validated (external variable resistor is invalidated).

< ADJUST (adjustment) > ----- SET=1

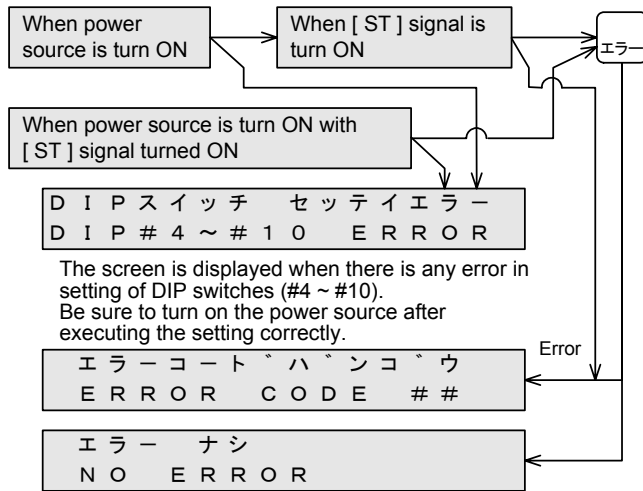
- The cursor key after pressing the [設定] key functions to increase / decrease the numeric. The numeric is increased / decreased each time when the [INC▲] key or [DEC▼] key is pressed. If such key is pressed continuously, the numeric is increased / decreased at high speed. Such numeric increase / decrease is valid even if the [実行] key is not pressed. When necessary to reset the setting mode, press the [実行] key or [クリア] key.
- When the numeric is input, such input numeric is validated when the [実行] key is pressed. If the numeric other than 0 ~ 100% is input, however, it is not accepted, but error message is displayed. In such a case, press the [クリア] key and input the correct numeric.
- The value adjusted can be also displayed by bar graph. When the SET is set to "0", the ADJUST displays "0%" and the setting will not be changed.
- If any power failure occurs, the value of ADJUST is saved from RAM to EEPROM memory.

< MNT (monitor) >

- DIA MNT displays the result of winding diameter calculated, while TAP MNT displays the current taper ratio.
- SP is used to monitor the input voltage (8V = 100%), using the external variable resistor, while VR to monitor the adjustment value (V = 100%) using the built-in variable resistor. 0% is displayed for invalid side.
- TRQ displays the current output with full-scale at 100%. When the non-linearity compensation is executing, it is output as torque conversion value.
- When the [張力 / トルク] key is pressed, and then the [DEC▼] key two times, the screen is changed to DIA MNT, TAP MNT screen. When the [DEC▼] key is further pressed, the screen is changed to SP, VR, TRQ screen.

4.4 Error check

When the setting is executed erroneously or some setting is neglected for the LE-50PAU, the following error check is executed.



- The error check operation is remains invalid after pressing the [設定] key until [クリア] key or [実行] key is pressed.
- While the error message is currently displayed, the error check is executed by pressing the [エラー] key after pressing the [クリア] key.
- When the ST input is turned on, the display is turned on only when the errors (1 ~ 4) exist.
- When multiple errors exist, execute the error check again after correcting the error of error No. displayed.

No	Error contents	Processing when operation is continued with error remained
1	Minimum diameter (D1) is not set.	Control output off. No setting is accepted when D1 is equal to or greater than D4.
2	Maximum diameter (D4) is not set.	
3	Thickness (T) is not set. (pulse / thickness, speed / thickness)	Winding diameter will not be changed and initial diameters (winding = D1, unwinding = D4) remain unchanged.
4	Speed (V) is not set. (speed / thickness)	
11	Only either small diameter (D2) or small diameter tension (T2) is set.	Setting of D2, T2 is ignored.
12	Only either large diameter (D3) or large diameter tension (T3) is set.	Setting of D3, T3 is ignored.
13	Incorrect relationship of $D1 < D2 < D3 < D4$. When D2 is set to "0" and D3 to "0", "Small / large" judgement will not be executed.	Operation is continued with (D2, T2) and (D3, T3) ignored.

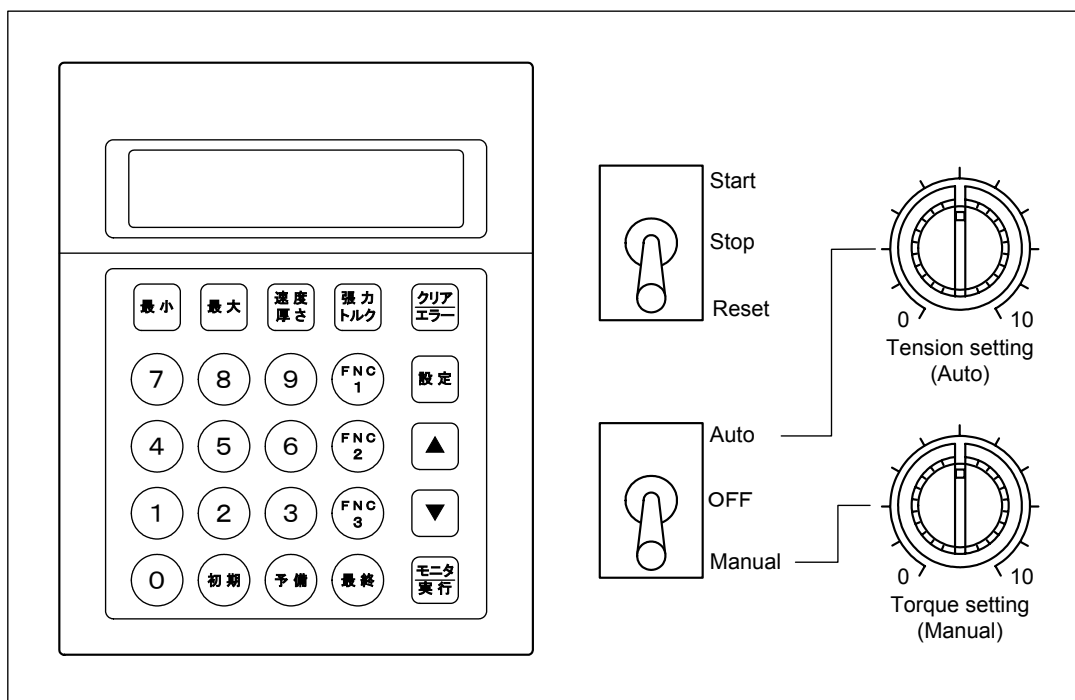
< Appendix >

- [1] If the operation is performed with RS input of the LE-50PAU turned on, the winding diameter remains at initial diameter (winding : D1, unwinding : D4).
- [2] If the RC input has been turned off, on control output will be sent out.
If the logic is inverted at the LE-50PAU side, however, the RC input is turned on and the output is turned off.
- [3] For errors generated at the LE-50PAU side, check them in accordance with the procedure shown separately.
- [4] When no display is given by the LE-5AP with the power display LED of the LE-50PAU lighting, check the cable connection.

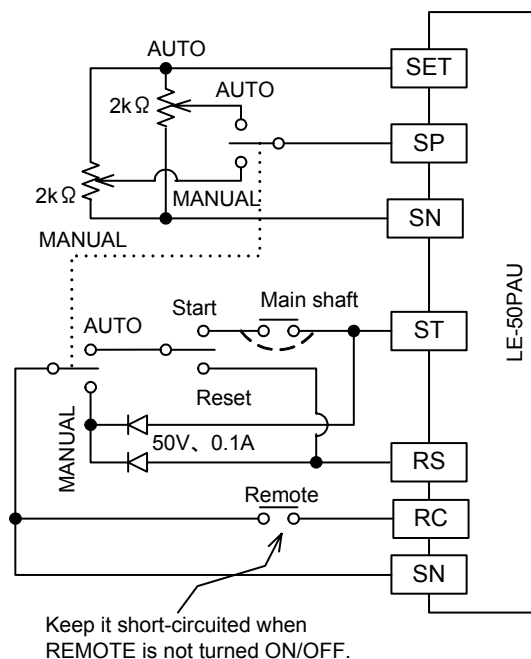
5. Supplementary items

5.1 Panel design example (external variable resistor)

The following shows a design example of operation panel surface and a connection example relevant input by using the external variable resistor.



- When the [Auto] is selected, the tension setting variable resistor is validated.
When the [Manual] is selected, the torque setting variable resistor is validated.
When the switch is turned off, the output is turned off immediately. (Same as when the RC input is turned off.)
- When the [Start] switch is selected with [Auto] selected, the ST input is turned on.
When there is a switch prepared to interlock with the main reel operation, it is ideal to operate them in series.
When the ST input is turned off, the calculation of winding diameter is stopped.
- When the [Reset] switch is turned off (start input = off) with [Auto] selected, the winding diameter calculation data is pre-set to the initial diameter.
- When the switch is changed from [Start] to [Stop] with [Auto] selected, the stop gain is validated.
- When the [Manual] is selected, the ST input and RS input are both turned on, which appear to be an output corresponding to the SP input.
In this case, the calculation of winding diameter is continued. (refer to page 38.)

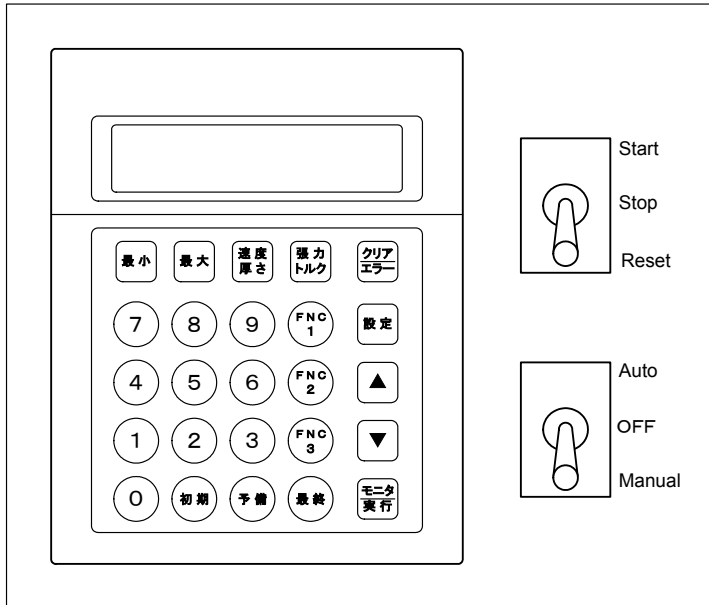


< Appendix >

- When the stop gain and output OFF mode are not used, it is possible to use the [Auto / Manual] switch and [Start / Reset] bipolar switch in substitute for neutral OFF switch.
- It is also possible to use the [Auto / Manual] switch for this purpose, however, note that using the switch may cause the output to change abruptly during [Auto / Manual] changeover.

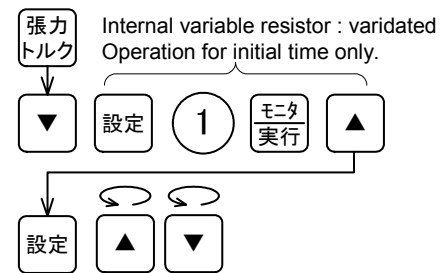
5.2 Panel design example (built-in variable resistor)

The following shows a design example of operation panel surface and a connection example relevant input by using the built-in variable resistor.



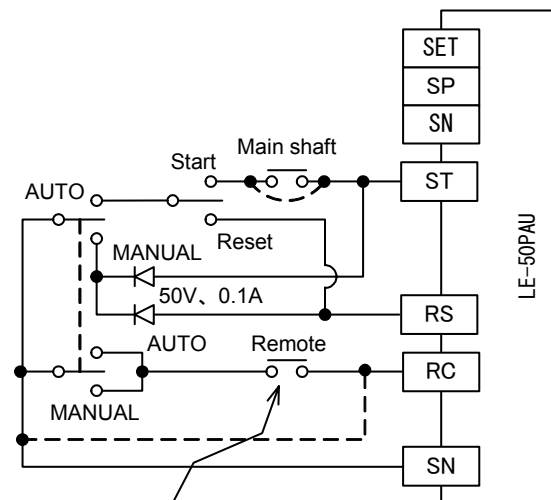
- The built-in variable resistor used is a software type variable resistor, using the LE-5AP operator panel.

<Main point of operation procedure>



See page 33 for details.

- When the [START] switch is turned on with [AUTO] selected, the ST input is turned on. When there is a switch prepared to interlock with the main reel operation, it is ideal to connect them in series. When the ST input is turned off, the calculation of winding diameter is stopped.
- When the [START] switch is turned on (start input = off) with [AUTO] selected, the winding diameter calculation data is pre-set to the initial diameter.
- When the switch is changed from [START] to [STOP] with [AUTO] selected, the stop gain is validated.
- When [MANUAL] is selected, the ST input and RS input are both turned on, which appear to be an output corresponding to the SP input. In this case, the calculation of winding diameter is continued. (Refer to page 38.)



Keep it short-circuited when REMOTE is not turned ON/OFF.

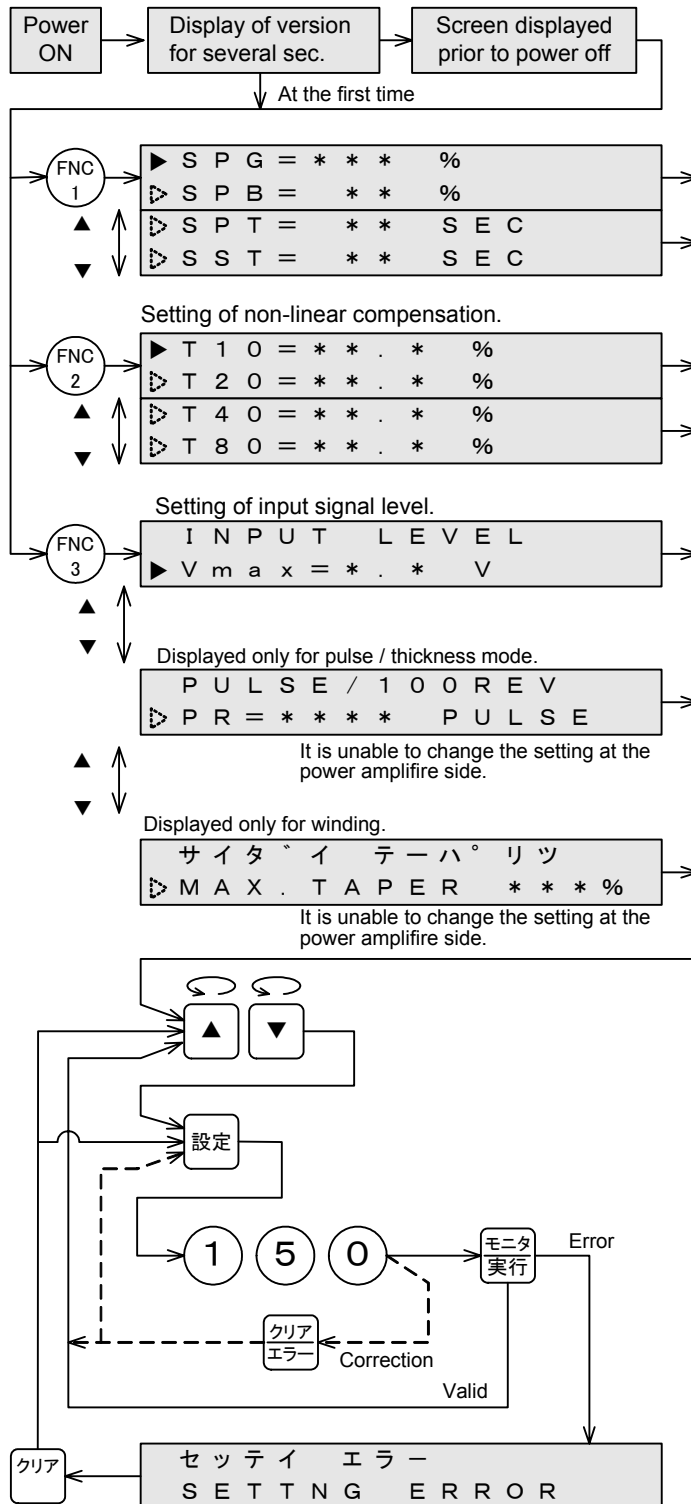
< Appendix >

- When the stop gain and output OFF mode are not used, it is possible to use the [AUTO / MANUAL] switch and start / reset 2-pole switch in substitute of neutral OFF switch.
- When the mode is changed from [AUTO] to [MANUAL] or from [MANUAL] to [AUTO], the value of built- in variable resistor is initialized, so that the same output current as that before switching flows. When the mode is changed from [MANUAL] mode with large output current to [AUTO] mode at the small reel diameter, for instance, it may become unable to generate a sufficient output current, which maybe smaller than that before changin. (See pag 39.)

5.3 Setting of basic function

It is possible to readily set the data, using the LE-5AP in substitute for numeric value setting, using 4 keys arranged on the LE-50PAU.

In addition, it is also possible to set the maximum taper ratio for winding. (See next page.)



The FNC1 to FNC3 keys are acceptable within any screen.

- Stpo gain -----0 to 300%
- Stop bias -----0 to 60%
- Stop timer -----0 to 30 sec.
- Aux. power output timer--0 to 30 sec.

- Torque of 10% current ---1.0 to 99.0%
- Torque of 20% current ---1.0 to 99.0%
- Torque of 40% current ---1.0 to 99.0%
- Torque of 80% current ---1.0 to 99.0%

Input signal level -----0.5 to 8.0V
 The free mode of input signal level is validated when the DIP SW1 is turned on, SW2 is turned off, SW3 is turned on and the power source is closed.

Set the number of winding reel pulses / 100 rotations fo reel to 0 to 1,000. It has been initially set to 100.

The initial value of maximum taper ratio is 100%, and the effective range is 20 to 500%. (See next page.)

Select the screen or line, using the cursor key (▲ key or ▼ key).

When the [設定] key is pressed with the "▶" mark displayed at the desired line, the setting mode is turned on, and reset when the [CLEAR] key is pressed.

The setting operation is invalid unless the [実行] key is pressed.

If the numeric value is out of applicable setting range, the message "SETTING ERROR" is displayed when the [実行] key is pressed, by which the setting is not accepted.

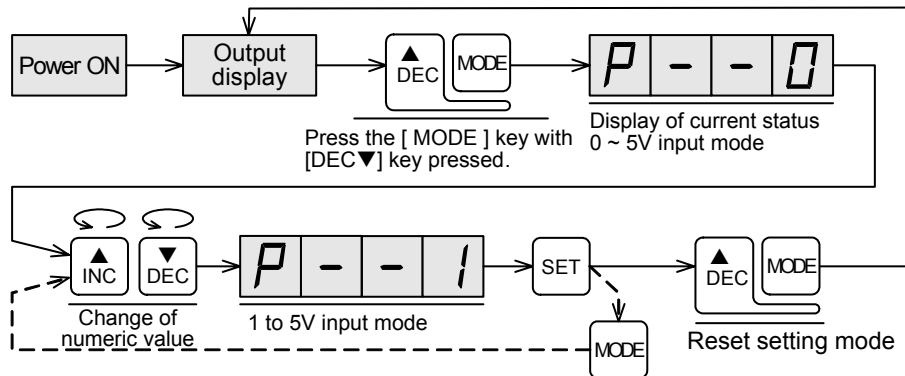
In such a case, set the correct numeric value after pressing the [クリア] key.

6. Supplementary description

< 1 to 5V input and 4 to 20mA input of power amplifire >

When the power amplifire is operated under "0 to 5V input mode" (DIP SW1 to SW3= ON), it is possible to change the mode to "1 to 5V input mode" by performing the following operation.

When using the power amplifire under "4 to 20 mA mode", connect a precision resistor (250Ω, 1W) across the terminals SP and SN, and use it as "1 to 5V input mode".



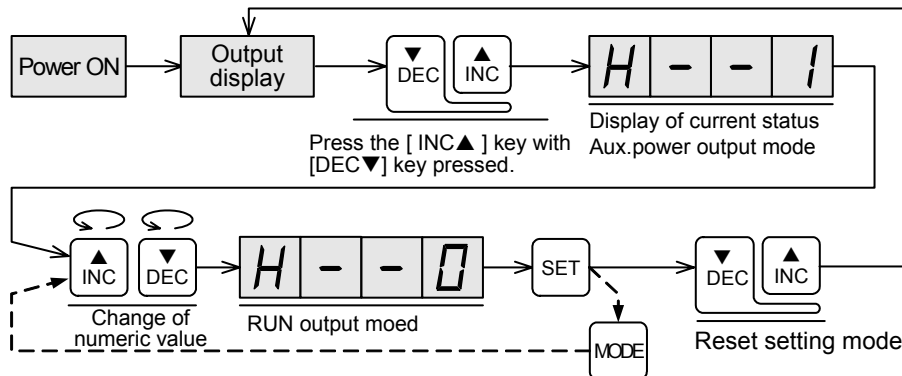
< 1 to 5V input and 4 to 20mA input of power amplifire >

It is possible to change the terminals S1-S2 (aux. power output) of the LE-50PAU from the aux. power output mode to the [RUN] output mode by performing the following operations.

[RUN] output means that 12VDC (load current : 100mA or less) is output while the LE-50PAU is operating properly.

When any wire deconnection or short-circuit occurs in the clutch / brake for one second or over, which is connected across the terminals PP and PN, the output is turned off (0V).

When the terminals S1-S2 are used under [RUN] output mode, the remote input SC of aux. power source is invalidated, and the timer setting value (SST) of aux. power source is also invalidated.

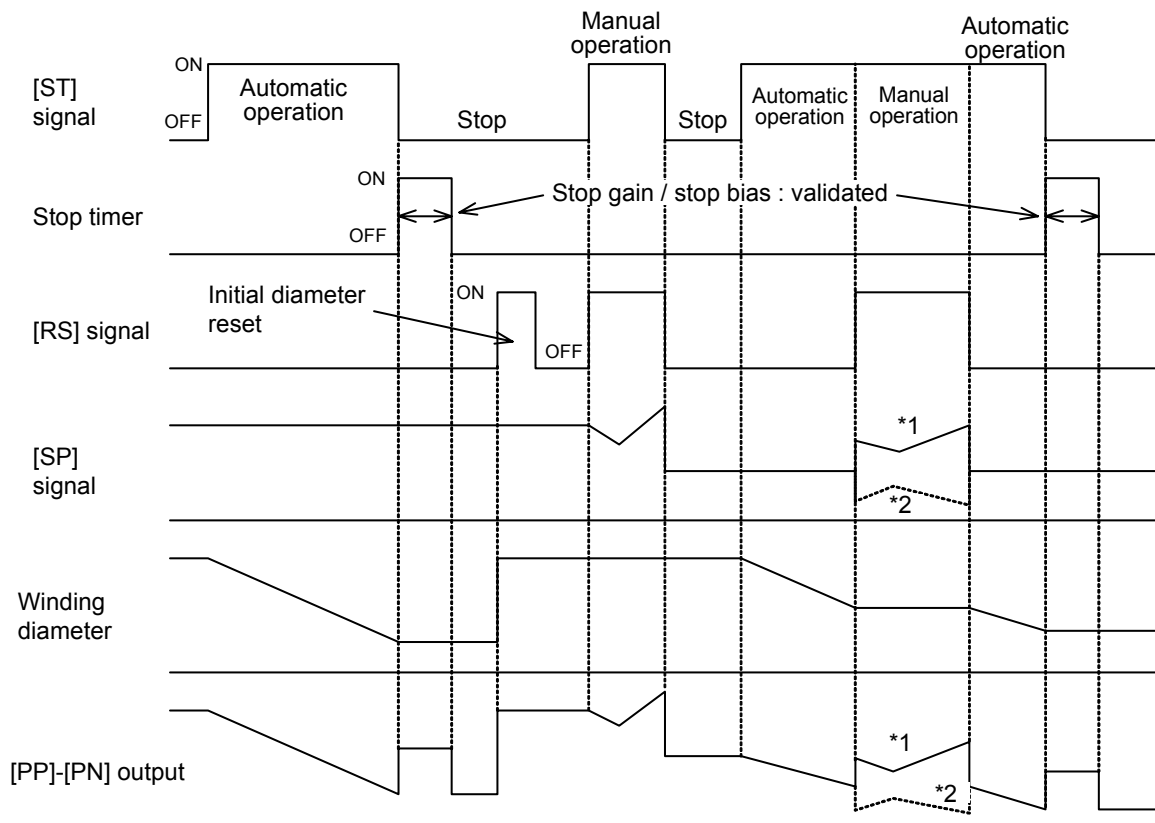


< 1 to 5V input and 4 to 20mA input of power amplifire >

ST input, RS input and AUTO mode / MANUAL mode

	RS input = ON	RS input = OFF
ST input = ON	Manual operation mode <ul style="list-style-type: none"> • Output correspondeng to SP input • Last condition is retained for calculation of winding diameter. 	Automatic operation mode (START) <ul style="list-style-type: none"> • Calculation output of winding diameter • Calculation of winding daimeter
ST input = ON	Automatic operation mode (Initial diameter reset) <ul style="list-style-type: none"> • Output of calculated initial diameter • Stop of winding diameter calculation 	Automatic operation mode (STOP) <ul style="list-style-type: none"> • Last condition is retained for calculation output of winding diameter. • Stop of winding diameter calculation

< Operation example of unwinding control >



*1 : When the mode is changed to manual mode while two variable resistors (AUTO / MANUAL) are used during automatic operation under external variable resistor mode, the PP-PN output appears to be the output corresponding to the manual variable resistor.

*2 : When the mode is changed to [MANUAL] during automatic operation under built-in variable resistor mode, the ADJUST value is changed automatically so that the back-up output at the time appears to be the winding diameter calculation output.

MEMO

POWER AMPLIFIER

MODEL **LE-50PAU**

TENSION CONTROLLER

MODEL **LE-50PAU-SET**

mitsubishi ELECTRIC CORPORATION

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Specifications are subject to change without notice.