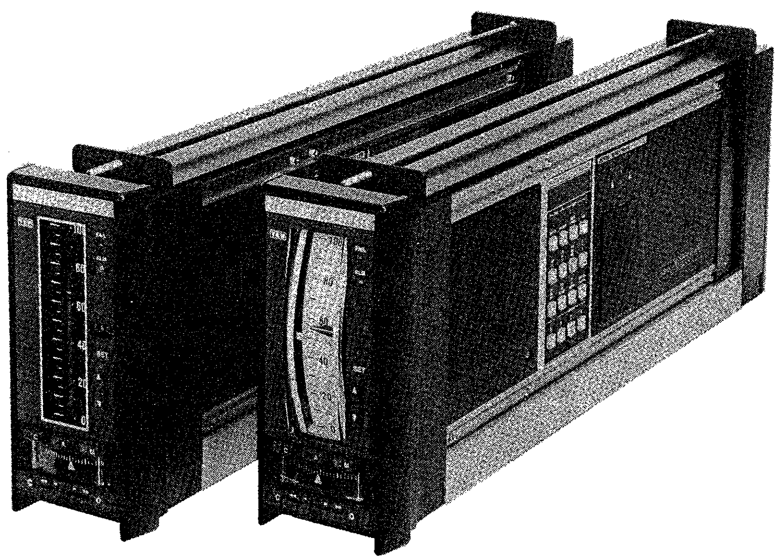
YEW SERIES 80

Instruction Manual

Model SLPC
PROGRAMMABLE INDICATING CONTROLLER



YEW
YOKOGAWA ELECTRIC WORKS

IM 1B4C2-01E

CONTENTS

Disk No. 0004b (Id 0025B)

1. INTRODUCTION.

1-1. Inspection.

This instrument was thoroughly tested at the factory before shipment. However, when you receive this instrument, you should check the following:

1) Check for visible damage.
2) Check the model and suffix codes, shown on the shipping documents and also on the name plate on the rear of the instrument, and confirm that you received what you ordered.
3) Check that all accessories (see section 2-4) are present.

If you have any questions about this instrument, please contact either your nearest Yokogawa (YEW) Sales & Service Office or Yokogawa Electric Works, Tokyo, Japan.

1-2. Scope of This Manual and Associated Manuals.

This Instruction Manual covers handling, operating and simple maintenance procedures for the SLPC Programmable Indicating Controller.

The operation and functions of this controller require that it be programmed — a program flow chart must be created, a program written, and the program must be stored in SLPC ROM (Read Only Memory). (See Figure 1-2-1).

Refer to the following manuals and materials:

STEP 1. Materials covering programming.

STEP 1 covers everything from process flow diagrams through to writing the SLPC program.

① Function and applications of SLPC Programmable Indicating Controller: Technical Information TI 1B4C2-01E.
② SLPC work sheet WS 1B4C2-01E.
③ SLPC data sheet WS 1B4C2-02E.
④ SLPC program sheet WS 1B4C2-03E.
⑤ SLPC control function stickers (see WS 1B4A1-50E).

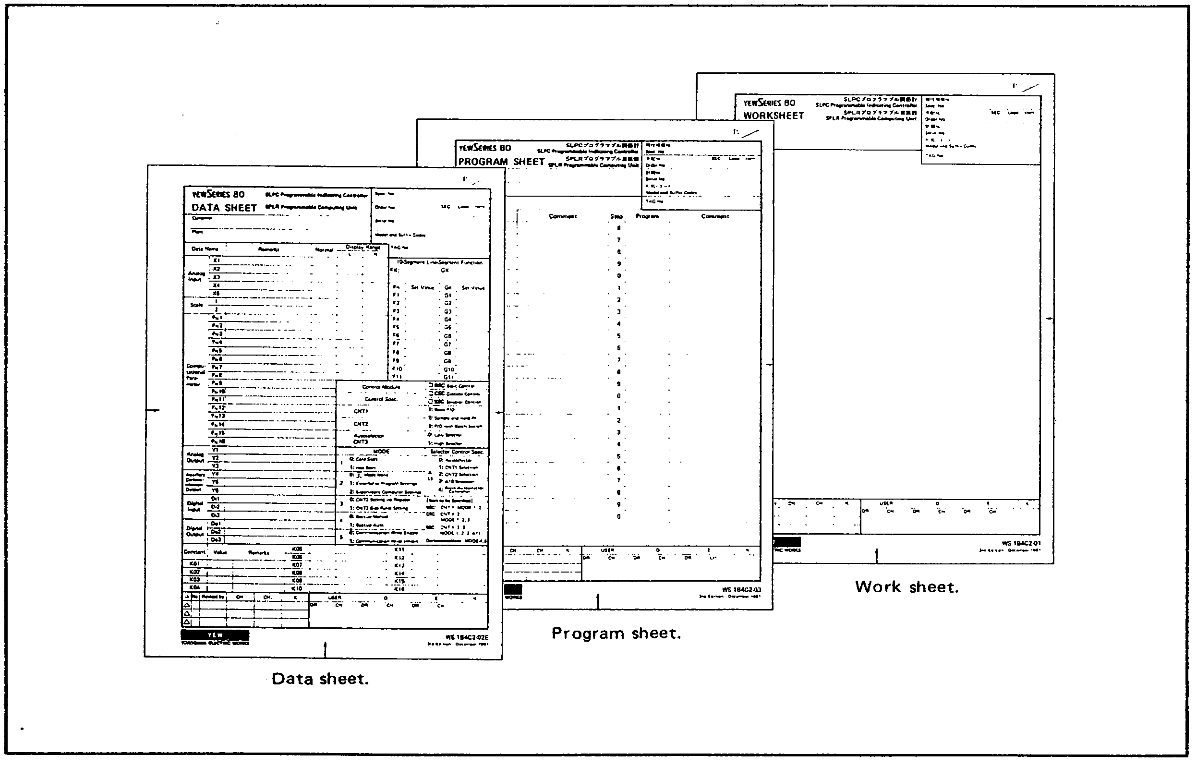


Figure 1-2-1. Sheets to be used in STEP 1.

STEP 2. Manuals covering storing programs in ROM.

(1) SPRG Programmer Instruction Manual IM1B4W1-E.
(2) Functions and Applications of SLPC Programmable Indicating Controller TI 1B4C2-01E.

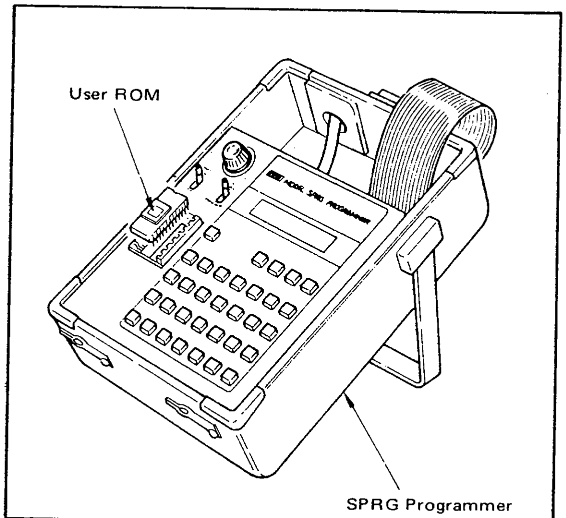


Figure 1-2-1. User ROM and SPRG Programmer.

STEP 3. Installation of ROM in SLPC and initiation of operation.

This step is covered by this Instruction Manual.

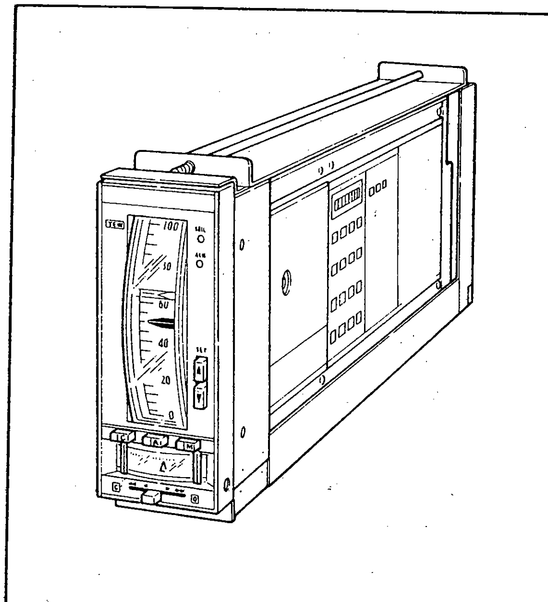


Figure 1-2-3. SLPC Programmable Indicating Controller.

2. GENERAL.

The SLPC Programmable Indicating Controller is provided with PID control, signal conditioning (arithmetical computation) and sequence logic functions. It is capable of various types of control, ranging from simple PID control to batch control, sampled-value PI control, non-linear control and dead time compensation control. Cascade control or auto-selector control can be performed by a single SLPC controller.

Desired sequence logic computations and other arithmetic computations can be synthesized by combining approximately 32 types of computational functions.

The SPRG Programmer enables the user to create programs easily — using a language like that of a programmable pocket calculator. Figure 2-1-1 shows an external view of the SLPC Programmable Indicating Controller.

2-1. Standard Specifications.

2-2. Model and Suffix Codes.

2-3. Options.

2-4. Accessories.

For sections 2-1 thru 2-4, refer to the "SLPC Programmable Indicating Controller General Specifications (GS 1B4C2-E)" at the back of this manual.

3. INSTALLATION.

For general precautions regarding installation of this instrument, refer to the instruction manual "Installation of Panel-Mounting Instruments" (IM 1B4F1-01E).

3-1. Wiring.

The terminal board is located on the rear of the controller housing. Remove the terminal board cover, and connect external signal wires to the (M4 size) screw terminals. After wiring, be sure to replace the cover. (See Figures 3-1-1 and 3-1-2.)

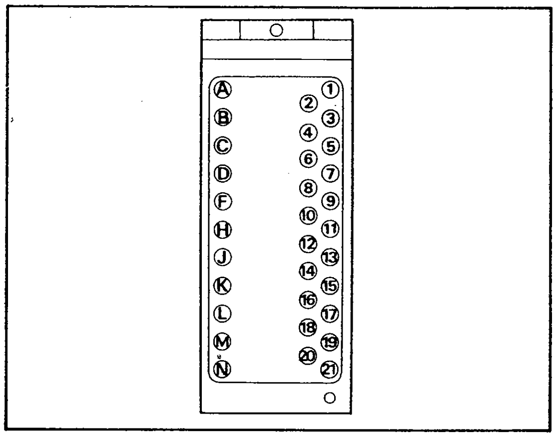


Figure 3-1-1. Terminal Layout.

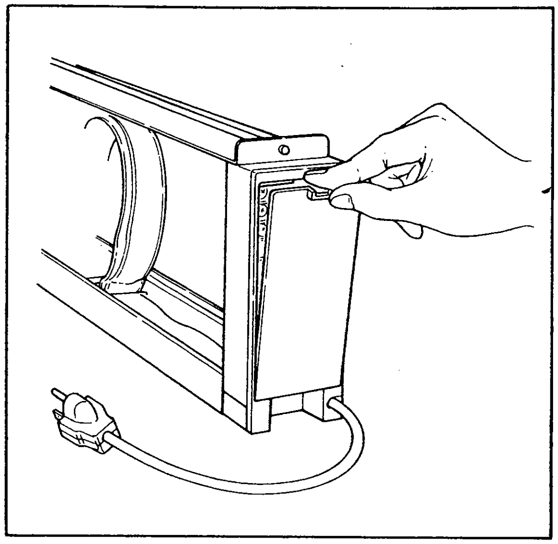


Figure 3-1-2. Terminal Cover.

Table 3-1-1 shows the terminal designations and signals to be connected.

■ **Terminal connections**

Table 3-1-1. SLPC Terminal Connections.

Terminal Designation		Description	Terminal Designation		Description
1	+	> Analog input 1	17	+	> Communications
2	–		18	–	
3	+	> Analog input 2	19	+	> Contact output 3
4	–		20	–	
5	+	> Analog input 3	21	–	Fail (– terminal)
6	–		A	+	> Analog ~~input~~ OUT 1 (current output)
7	+	> Analog input 4	B	–	
8	–		C	+	> Analog output 2
9	+	> Analog input 5	D	–	
10	–		F	+	> Analog output 3
11	+	> Contact input 1	H	–	
12	–		J	+	> Contact output 1
13	+	> Contact input 2	K	–	
14	–		L	+	> Contact output 2
15	+	> Contact input 3	M	–	
16	–		N	+	Fail (+ terminal)

Note: Use shielded twisted-pair cable SCCD.

3-1-1. Wiring Precautions.

(1) Be sure to terminate all cable connections in solderless crimp-on lugs.

(2) Each contact and voltage input must be as per SLPC specifications. Note the limits on lead-wire resistance, voltage drop in lead-wires, and voltage (high/low) levels. (Refer to the SLPC General Specification at the back of this manual).

(3) The fail and digital outputs are transistor contact signals, (isolated from power supply and other internal circuitry). When connecting external devices, pay attention to the following: (See Figure 3-1-3.)

- Observe correct polarity of contact output terminals.
- When connecting a relay or other such inductive device, connect a surge absorber (protective diode – Figure 3-1-3, CR circuit, etc.) in parallel with the load.
- Note that contact outputs cannot be connected directly to an AC circuit. Use a relay to switch an AC circuit (see Figure 3-1-3).
- Do not connect any load which exceeds the contact rating. (Max. 30V DC, 200 mA).

(4) Use shielded twisted-pair SCCD cable for communication lines (terminals 17, 18).

(5) Short-circuit unused current output terminals.

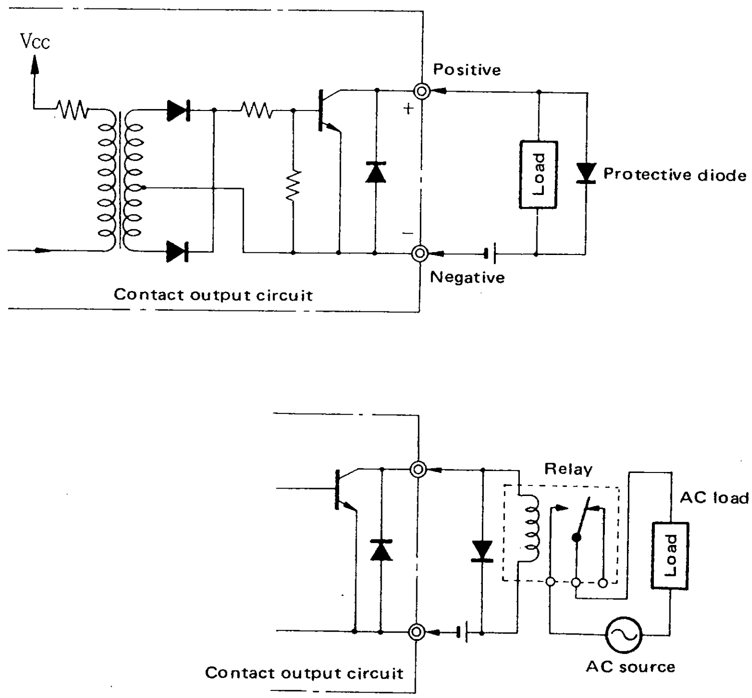


Figure 3-1-3. Connection of Contact Outputs.

4. PRINCIPLES OF OPERATION.

4-1. Description of Circuit Operation.

Refer to the SLPC circuit block diagram in Section 4-4 below.

4-1-1. Analog Input Circuit.

A voltage input signal enters the input circuit comprising R_{IN}, R_1 and C_1. R_{IN} resistance is high (1 M ohm), so it normally does not affect circuit operation. If the input circuit is open (input disconnected), however, it provides a DC path between (+) and (−) input terminals to prevent the buildup of static charge on the (+) input line. 0V DC input (e.g. input open) is equivalent to −25% of range.

R_1 and C_1 form an input filter of time constant approximately 0.1 sec.

All analog-input negative leads are connected to a common line inside the SLPC.

4-1-2. A/D (Analog/Digital) Converter Circuit.

Analog input signals entering the input circuit are selected in turn by the input multiplexer. The comparator compares an input signal with the output of the D/A (digital/analog) converter circuit, and the CPU adjusts the D/A converter output so that the two signals are equal — basically a successive-approximation type A/D converter. The corresponding digital value is stored in the data memory (RAM).

4-1-3. Digital Input Circuit.

Digital (status) input signals are each isolated by a transformer in the input circuit. Input status is read via an input port and transmitted via the data bus to RAM.

At the same time as the digital inputs are read, the status of switches (SET, C/A/M, MV, TUNING, ACTION) on the instrument front and side panels is also read and stored in RAM.

4-1-4. Digital Computing Circuit.

When all the input data are read, the microprocessor (CPU) performs data processing according to the computation/control program stored in user ROM.

The results of computation and control are output via the D/A circuit or output ports.

If a supervisory system is connected, data communications is performed via a communications interface (SICU). The communications line is isolated from the controller by a photocoupler.

The WDT (watch dog timer) connected to the CPU supervises the CPU operation — it causes the FAIL lamp to light and outputs a fail contact signal if the CPU fails. In such a case, the manipulated output current signal (Y1) is automatically isolated from the digital circuit, and can be varied manually. The process variable indicator then automatically displays the value of input signal No. 1 (X1).

4-1-5. Analog Output Circuit.

The analog output signals, after D/A conversion, are fed via the output multiplexer and buffer amplifier to the current and voltage output circuits.

The analog output signal negative line is common, and is connected directly to the analog input signal common negative line.

4-1-6. Digital Output Circuit.

Signal from the output ports are transformer-isolated, and are output to the field as open-collector contact signals.

4-2. Principles of Computation and Control.

4-2-1. Principles of Computational Operations.

The SLPC performs three basic operations — reading the input signal, computation, and outputting the computed result. The example in Figure 4-2-1 shows how the addition of two input signals is programmed, and Figure 4-2-2 shows how the stack registers change during the program. Computations are performed in the common stack registers S. Connection of signals to the registers — that is, inputting to the S registers — is performed by means of the LOAD (LD) instruction. The S registers S_1 thru S_5 comprise a "stack", and data in S is pushed down (S_1 to S_2, etc.) each time data is input by the LD instruction.

Arithmetical operations can be performed on the data thus input by using FUNCTION instructions. There are 32 kinds of computational and control FUNCTION instructions, and these instructions are written using a corresponding mnemonic symbol, such as +, ÷, HSL, etc. The computation is performed on data stored in the S registers, and the result is popped up to the top register, S1.

The STORE (ST) instruction is used for copying a computed result from the top register of stack to an output register. The contents of the S registers are not changed by an ST instruction.

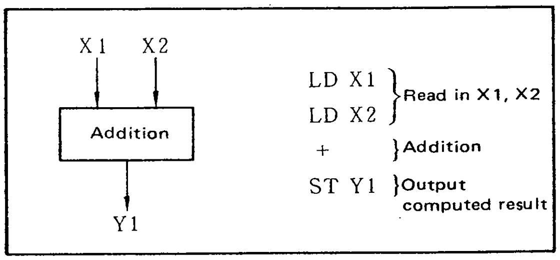


Figure 4-2-1. Two-input Arithmetic Unit and Program.

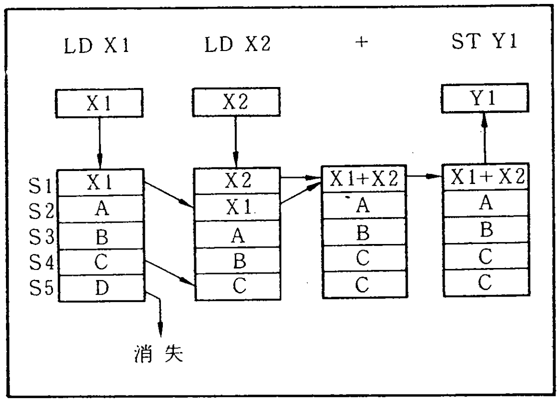


Figure 4-2-2. Program and Effect on Arithmetic Registers.

4-2-2. Configuration of Input-Output Registers.

Figure 4-2-3 shows the SLPC register configuration. Analog, digital and set parameter inputs are read into the registers X_N, DI_N and P_N before execution of the user program begins. The user program reads necessary input signals and parameters from the respective input registers into the arithmetic registers using LD instructions, and copies the computed results to the output registers (Y_N, DOn) using ST instructions. Finally, the controller outputs the contents of the output registers (Y_N, DOn) as analog or digital values.

This cycle repeats every 0.2 sec.

4-2-3. Principles of Operation of Control Function.

There are three kinds of control functions; the basic control function BSC – one computing function representing one controller, the cascade control function CSC representing two controllers connected in series, and the autoselector control function SSC – with two controllers connected in parallel – which selects one of three signals: either one of two controller outputs or an input signal.

The basic control function BSC is a PID controller that accepts the process variable PV and outputs the control signal MV.

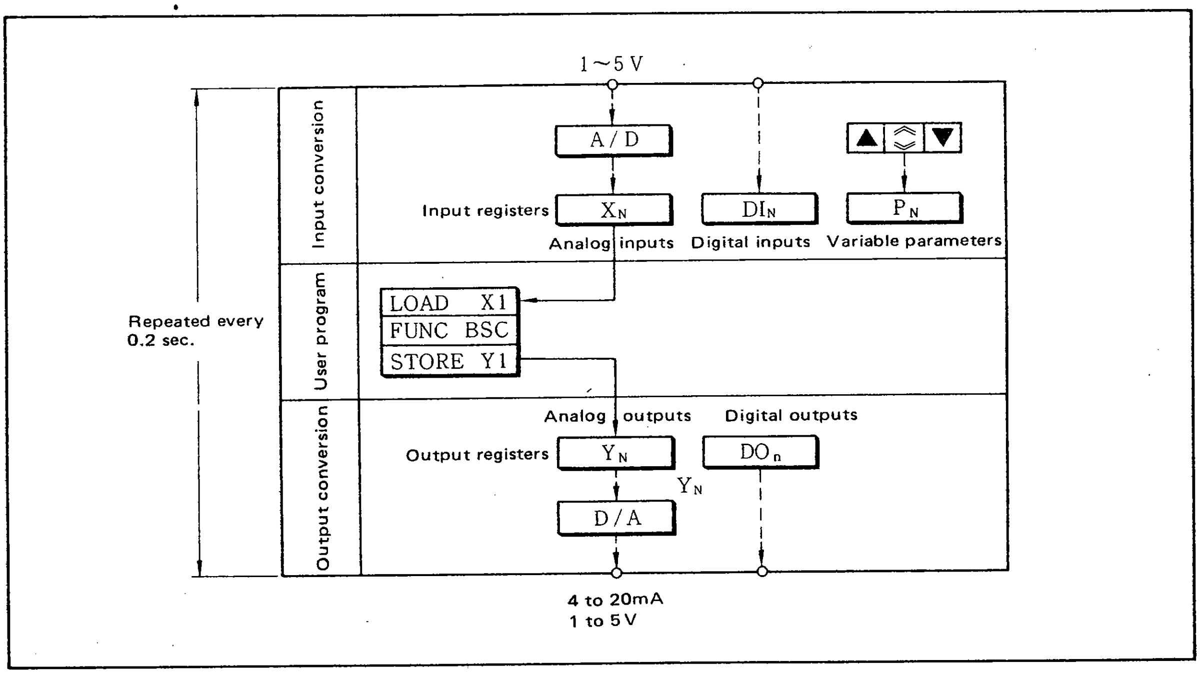


Figure 4-2-3. Configuration of Input-Output Registers.

The program for operating the SPLC as a PID controller is as simple as shown below.

(Program step) (Instruction)

1. LD X1
2. BSC
3. ST Y1
4. END

BSC incorporates not only simple functions such as shown above, but also a number of complex functions as shown in Figure 4-2-4. These functions can be utilized by using the An and FLn registers in the program.

For example, if a cascade set value input is needed, connect the cascade set value input to A1 by using a ST instruction; if feedforward compensation is needed, the feedforward signal must be connected to A4. If the input high/low alarm status must be output, the contents of FL1 and 2 must be connected to digital output registers DOn.

The registers An and FLn are initialized so that they will have no effect unless they are used.

Additional control algorithms are provided as controller functions which may be used in a program. The control element functions include standard PID, sampled-value PI, and PID control with batch switch.

With the cascade control function CSC, the SLPC can be operated as a cascade controller. The cascade loop can be opened/closed using a switch on the side panel. With the selector control function SSC, the SLPC can be operated as an autoselector controller for automatic output signal selection, or as a tracking controller for arbitrary selection of output signal. Both CSC and SSC incorporate the control functions of two basic controllers, the SLPC front panel displays correspond to the first control element, and the side panel displays are used for the second control element.

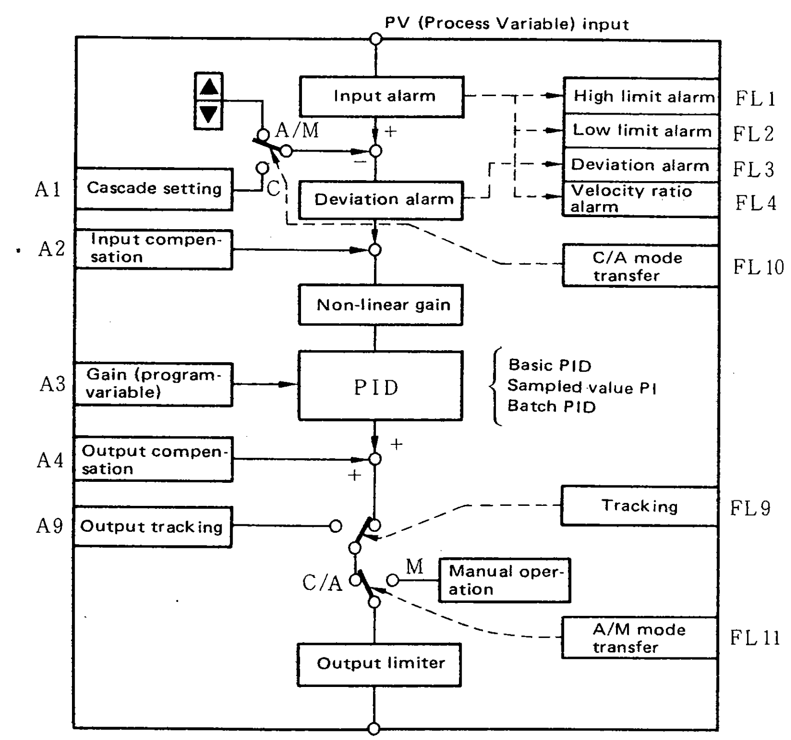
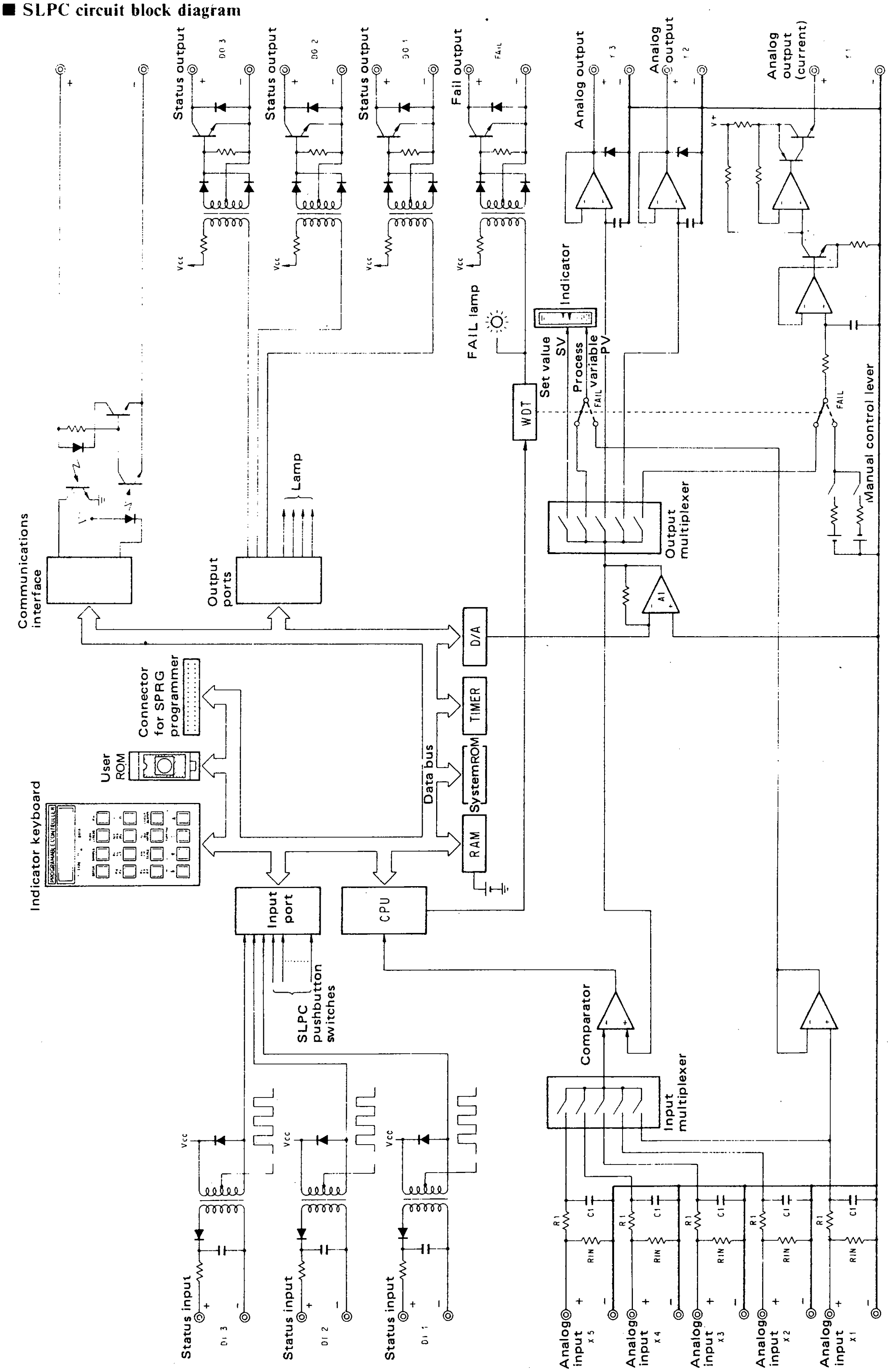


Figure 4-2-4. Functions of BSC.

■ SLPC circuit block diagram



5. OPERATION.

5-1. Front- and Side-Panel Features.

5-1-1. Controller with Moving Coil Indicator.

This controller uses a moving coil type indicator for indicating the process variable and set value (set point). Figure 5-1-1 shows the front view of this type of controller (SLPC-1□0*A), and Figure 5-1-2 shows the side view. The names of panel controls etc. are also shown in these figures.

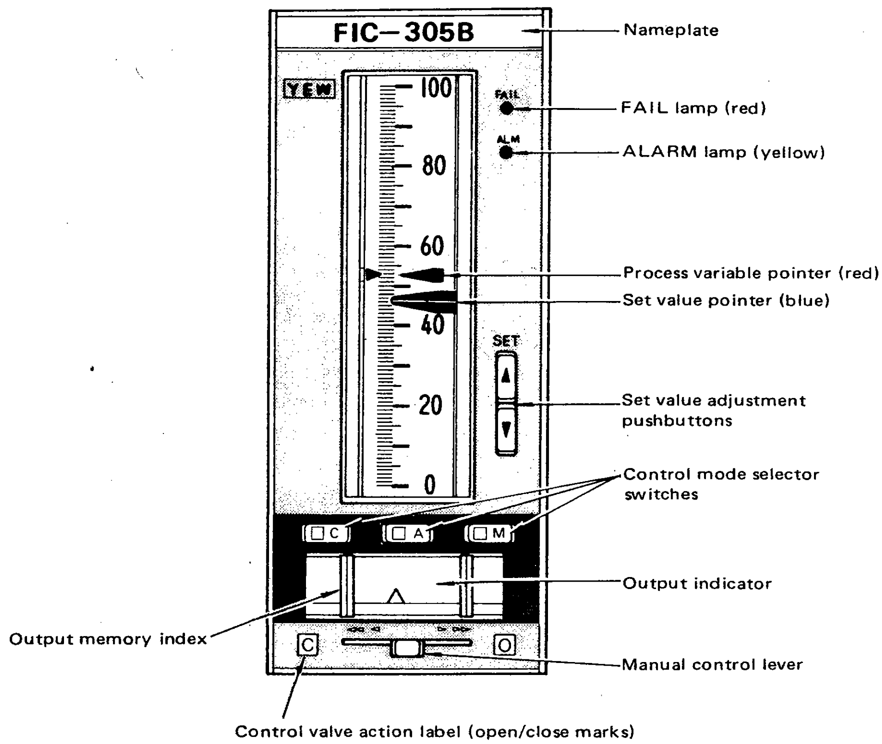


Figure 5-1-1. Front View of Instrument.

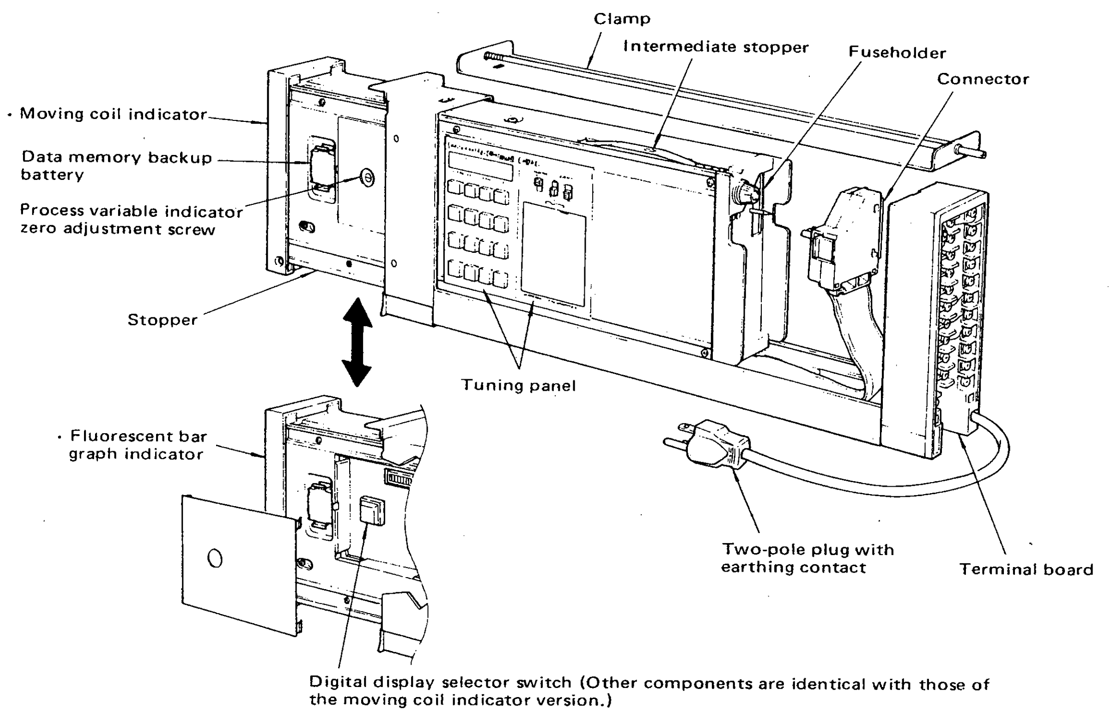


Figure 5-1-2. Side View of Instrument.

(1) FAIL lamp.
Lights if the controller fails.

(2) ALM lamp.
Lights to indicate alarm status, and flashes when data backup battery voltage drops.

(3) Process variable pointer.
Indicates the value of the process variable*.

(4) Set value pointer.
Indicates the set value* of the controller.

(5) Set value adjustment pushbuttons.
Used for adjusting the set value** of the controller. It may be adjusted in A (auto) or M (manual) modes.
Setting:
▲ The set value increases when the button is pressed.
▼ The set value decreases when the button is pressed.
(If both buttons are pressed, the set value remains unchanged.)
Rate of change:
40 sec./full scale.
4 sec./full scale.
Fine adjustment:
Momentarily depressing the button (for approx. 0.2 sec.) changes the set value by 0.1%.

(6) C/A/M control mode selector switch.
The desired control mode can be selected by pressing the relevant pushbutton.
Mode C:
Automatic control. The set value** is set using the computational functions, or by communications data.
Mode M:
Manual operation. The control output signal can be increased or decreased using the manual control lever. The set value** can also be adjusted.

(7) Output indicator.
Indicates the current output signal.
Left end 4 mA DC; Right end 20 mA DC.

(8) Manual control lever.
Used for adjusting the control output signal of the controller in manual (M) mode.
Action:
Signal output decreases as the lever is moved to the left.
Signal output increases as the lever is moved to the right.
Rate of change:
◀ , ▶ 40 sec/full scale.
◀◀, ▶▶ 4 sec/full scale.
Fine adjustment:
Momentary (0.2 sec.) movement of the lever left ◀ or right ▶ from the neutral position changes the control signal by 0.1%.

* For cascade or selector control: Process variable of the first control element (CNT1).

** For cascade or selector control: Set value of the first control element (CNT1) .

5-1-2. Controller with Fluorescent Bar Graph Type Indicator.

This controller uses a fluorescent bar graph type indicator for indicating the process variable value and set value. Figure 5-1-3 shows the front view of this type of controller (SLPC-2□0*A). The names of panel controls etc. are also shown. For a side view of the instrument, see Figure 5-1-2.

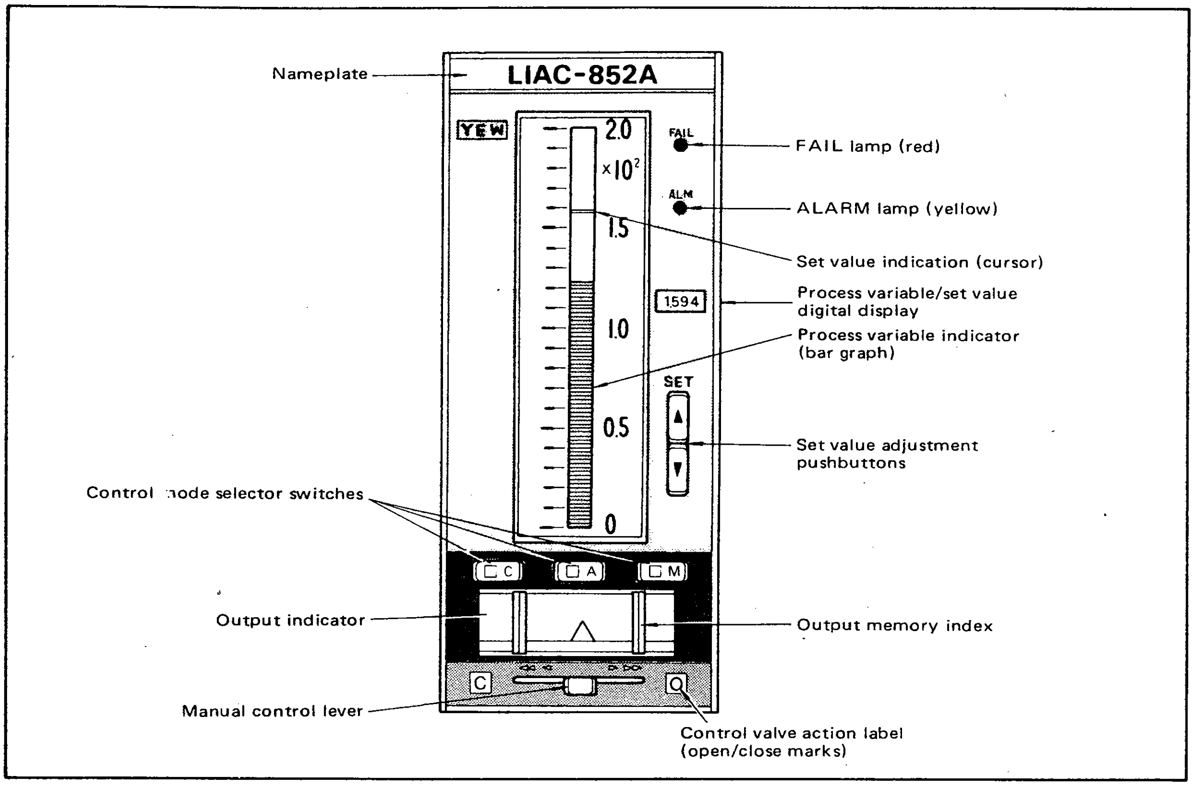


Figure 5-1-3. Front View of the Instrument.

(1) Process variable bar graph display.
Displays the value of the process variable* as a bar graph.

(2) Set value indicating cursor.
Indicates the set value** of the controller.

(3) The value of the process variable is displayed as a 4-digit number. The indicator displays the set value while the display selector pushbutton on the right side of the SLPC controller is pressed. (See Figure 5-1-4.)

* For cascade control or selector control: Process variable of the first control element (CNT1).

** For cascade or selector control: Set value of the first control element (CNT1).

Other functions are identical with those described in par. 5-1-1.

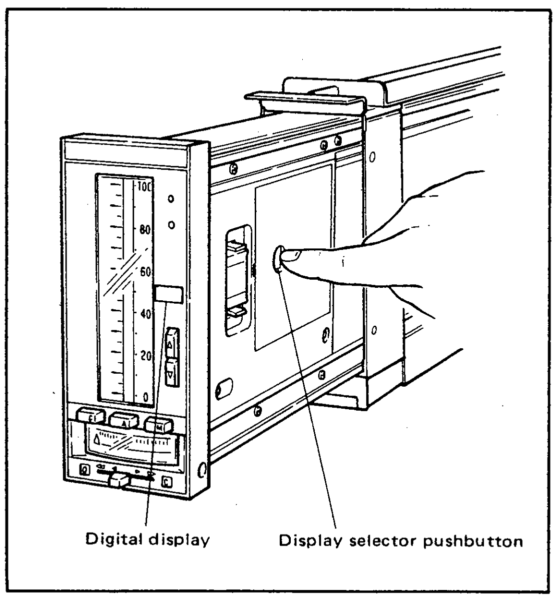


Figure 5-1-4. Display Selector for Digital Display.

5-1-3. Names and Functions of Tuning Panel Controls.

□ **Panel Configuration.**

The tuning panel for parameter setting and data display is on the right side of the SLPC controller. (See Figure 5-1-6).

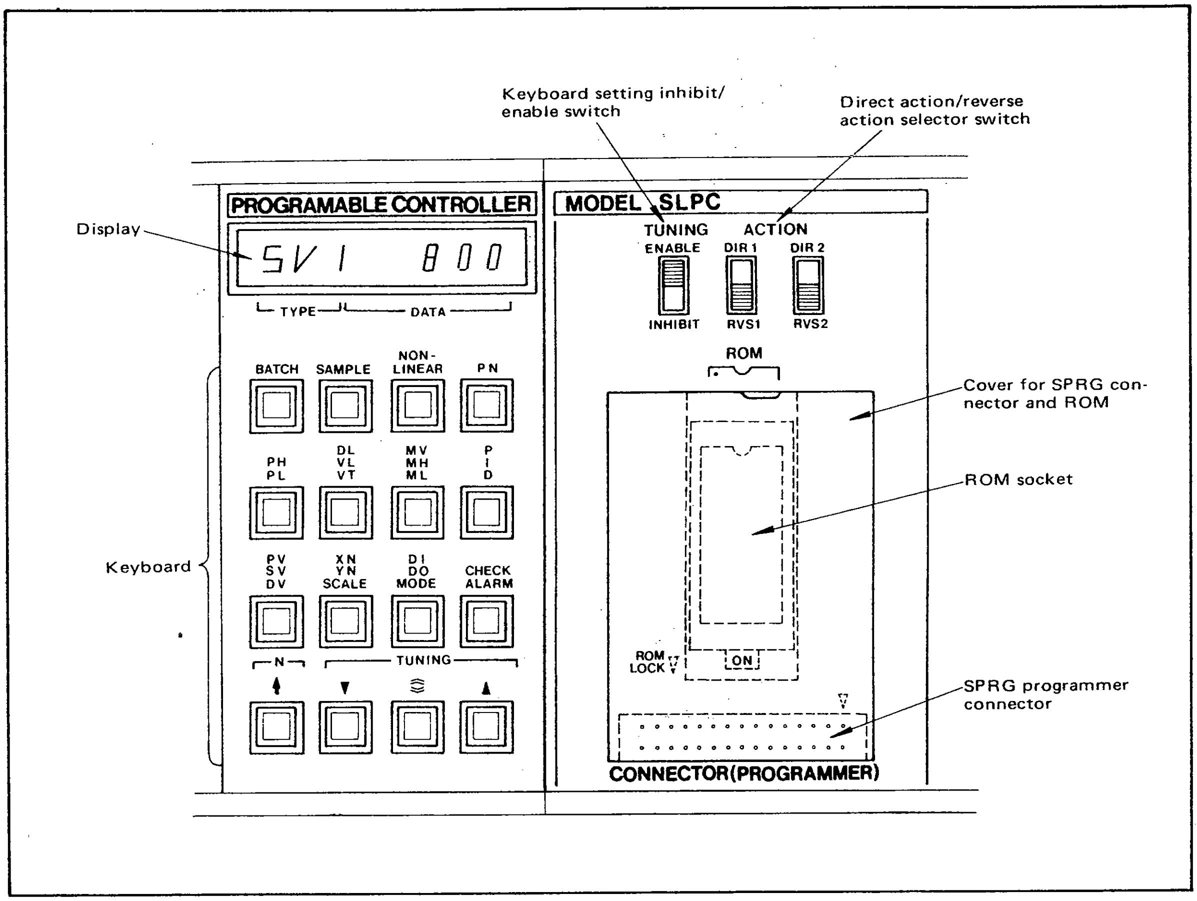


Figure 5-1-5. Tuning Panel.

(1) Display.

Displays the data type code (TYPE) and data value (DATA) for data selected from the keyboard.

(Display example)

PV2 432.1

TYPE DATA

(2) Keyboard.

Used for setting parameters, displaying and changing data, and so on. The names and functions of pushbutton switches are shown in Table 5-1-1.

(MODE Setting/Display items)

MODE sets the basic operating status of SLPC.

MODE 1: This defines mode of restart after power failures of longer than approximately two seconds:

0 = COLD start. The controller is restarted in manual mode, with control output signal set to −6.3%, irrespective of its status before power failure.

1 = HOT start. The controller is restarted with exactly the same mode and status it had immediately before power failure.

MODE 2: This defines whether or not a remote set value (SV) is used for the controller. (For cascade control or selector control, SV means the set value of the first control element.)

0 = Local setting. The set value is set by the SET pushbuttons on the instrument front panel. (No remote setting.)

1 = Analog setting. When switch [C] on the instrument front panel is pressed, a signal computed by the controller is used for the set value.

In A mode, the set value is set by the SET switches.

Table 5-1-1. Names and Functions of Tuning Panel Keyboard Switches.

Type (TYPE)	Number (N)	Name and function	Display/setting range	Units	Settable?
PN	1 to 8	Variable parameters	Engineering units display		○
	9 to 16	Variable parameter	−799.9 to 799.8	–	○
NON-LINEAR		Non-linear control & 10-segment line-function parameters:			
GW	1, 2	Non-linear control; dead band width	0.0 to 100.0	%	○
GG	1, 2	Non-linear control; gain	0.000 to 1.000	–	○
F	1 to 10	10-segment linearizer; output set points	0 to 100.0	–	○
G	1 to 11	10-segment linearizer; output set points	0 to 100.0	–	○
SAMPLE		Sampled-value PI control parameters:			
ST	1, 2	Sample time (period)	0 to 9999	sec.	○
SW	1, 2	Control time	0 to 9999	sec.	○
BATCH		PID control parameter plus batch switch			
BD	1, 2	Deviation set value	0 to 100.0	%	○
BB	1, 2	Bias value	0 to 100.0	%	○
BL	1, 2	Lockup width	0 to 100.0	%	○
P	1, 2	Proportional band	6.3 to 999.9	%	○
I	1, 2	Integral time	1 to 9999	sec.	○
D	1, 2	Derivative time	0 to 9999	sec.	○
MV	1	Control signal	−6.3 to 106.3	%	○
MH	1, 2	Control signal; high limit value	−6.3 to 106.3	%	○
ML	1, 2	Control signal; low limit value	−6.3 to 106.3	%	○
DL	1, 2	Deviation alarm set value	0 to 100.0	%	○
VL	1, 2	Velocity alarm; MV % change in time VT	0 to 100.0	%	○
VT	1, 2	Velocity alarm; time set value (cf. VL)	0 to 9999	sec.	○
PH	1, 2	Process variable high limit alarm set value	Same as SCALE		○
PL	1, 2	Process variable low limit alarm set value	Same as SCALE		○
DI	1 to 3	Status input Di1, Di2, Di3	ON: 1, OFF: 0	–	×
DO	1 to 8	Status output Do1, Do2, Do3 Internal status Do4 thru' Do8	1: ON, 0: OFF	–	×
MODE	1 to 5	Control mode	Refer to "MODE display/setting items"	–	○
XN	1 to 5	Analog input signal	Engineering units display		×
YN	1 to 6	Analog current output signal YN1	−6.3 to 106.3	%	×
		Analog voltage output signal YN2, 3	−6.3 to 106.3	%	×
		Auxiliary output data YN4, 5, 6	−6.3 to 106.3	%	×
SCALE	1, 2	Process variable/set value scale specification	Engineering units display		○
PV	1, 2	Control; Process variable input value	Same as SCALE		×
SV	1, 2	Control; Set value	Same as SCALE		○
DV	1, 2	Control; Deviation	Same as SCALE		×
CHECK		Self-diagnostic; Cause of fault is indicated by code.	Refer to Sec. 5.4.		
ALARM		Process alarm; Cause of alarm is indicated by code.			
▲		Data increase setting	–	–	–
▤		Setting speed (Press together with ▼ or ▲ buttons.)	–	–	–
▼		Data decrease setting	–	–	–
N ↑		Item number change (The data type number (N) is changed.)	–	–	–

– : Not Applicable ○ : Yes × : No

2 = Remote setting by communications functions. When switch [C] on the instrument front panel is depressed, data transmitted from a supervisory system* is used as SV.
In [A] mode, SV is set using the SET switch.
* Other than the UOPC Operator's Console. Setting from the UOPC Operator's Console is allowed in [A] and [M] modes.

MODE 3: Second loop set value selector switch.
Switches the set value signal of the second loop (CNT2) in cascade or selector control.
For CSC cascade control function:
0 = The output signal of the first loop is used as the set value of the second loop. ("Closed loop" status).
1 = The set value of the second loop is adjusted by pushbuttons (SV2) on the tuning panel. ("Open loop" status).
For SSC selector control function:
0 = The data stored in register A5 of SSC is used as the set value of the second loop. ("Closed loop" status).
1 = The set value of the second loop is adjusted by pushbuttons (SV2) on the tuning panel. ("Open loop" status).

MODE 4: Supervisory system backup function.
Sets the backup mode of SLPC with communications function.
0 = Manual·backup mode.
1 = Automatic backup mode.

MODE 5: Setting inhibit switch.
Enables or inhibits setting/operation by the supervisory level system (including UOPC Operator's Console) in an SLPC with communications function.
0 = Setting by the supervisory system is enabled.
1 = Setting by the supervisory system is inhibited.
For the "1" switch setting, the supervisory system is able to perform monitoring only.

The above mentioned MODEs are listed below.

Table 5-1-2. Control Modes (MODE).

Mode No.	Description	Set value		
		0	1	2
1	Start mode	Cold	Hot	
2	Remote setting mode	None	Analog	Communications
3	Setting of secondary loop	Closed	Open	
4	Communications backup	Man	Auto	
5	Setting by supervisory system	Enabled	Inhibited	

(3) TUNING switch.
The function of the TUNING pushbutton switches (▼ , ≋ , ▲) on the keyboard is enabled/inhibited.
ENABLE: Settings and alterations are allowed.
INHIBIT: Settings and alterations are not allowed.

(4) ACTION switch.
Direct (DIR)/reverse (RIV) control action is set.
DIR1/RIV1:
Sets the action of basic controller or the first control element (CNT1) of cascade or selector controller.
DIR2/RIV2:
Sets the action of the second control element (CNT2) of cascade or selector controller.
DIR (direct action) : Deviation value = process variable − set value.
RIV (reverse action): Deviation value = set value − process variable.

(5) ROM socket.
The ROM containing the user's program is installed in this socket. The ROM is fixed when the lever of ZIF (Zero Insertion Force) socket is pushed down (locks ROM). The ROM can be removed by lifting the lever (releases ROM).

(6) CONNECTOR (PROGRAMMER).
This is used for the connecting cable of SPRG programmer.

■ **Keyboard operation (See Figure 5-1-6.)**

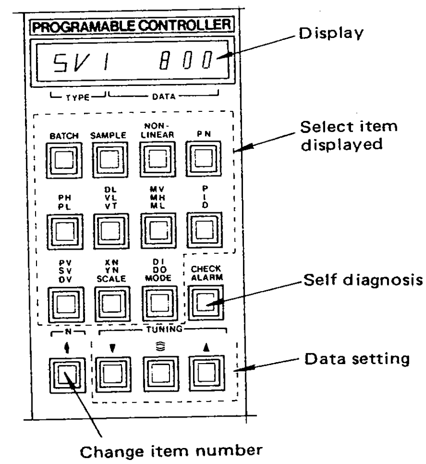


Figure 5-1-6. Functions of Keyboard.

(1) Displaying item (TYPE).
Press the key of desired item to display the data type code of the item and its value.
If more than one item is assigned to a key, the displayed item is changed each time the key is pressed.

(Example of key operation and display)

① PV SV DV key. The arrow mark indicates one operation of the key.

→ PV I → SV I → DV I →

② NONLINEAR key. The arrow mark indicates one operation of the key.

→ GW I → GG I → FD I → GD I →

(2) Changing the item number.
The item number can be changed by pressing the N [↑] key.

(Example of key operation and display)

(1) XN key. The arrow mark indicates the effect of pressing the key once.

→ X 1 → X 2 → X 3 → X 4 → X 5 →

(3) Changing data value.
A data value can be increased or decreased by pressing one of the TUNING keys ([▼], [≋], [▲]).
These keys are active only when the TUNING slide switch is set to the ENABLE side.

[▲] : Data increase setting.
[≋] : Sets fast rate of change. (Press simultaneously with [▲] or [▼]).
[▼] : Data decrease setting.

(4) Self diagnosis.
The operating state of the controller can be checked by pressing the CHECK or ALARM key. The method of display is identical with (1).

(5) Display turn-off.
When data setting is completed and all the key operations are finished, the display goes out automatically after approx. 60 minutes. This eliminates unnecessary current consumption. The display lights again when key operation is restarted.

Unused signals and parameters

Input-output signals, and parameters that are not used in the application program, can also be "displayed" and "set" by keyboard operations. However, such data remain irrelevant to the execution of control and computation, and have no effect.

5-2. Preparations for Operation.

Perform preparation with the controller installed in the panel, or removed and placed on a work table. (Suppose that the instrument module is in the housing.)

Removing the instrument module from the housing:

① To remove the instrument module, push up the stopper located below the front panel. When it is drawn out halfway, the instrument module is stopped by an intermediate stopper. (Figure 5-2-1).

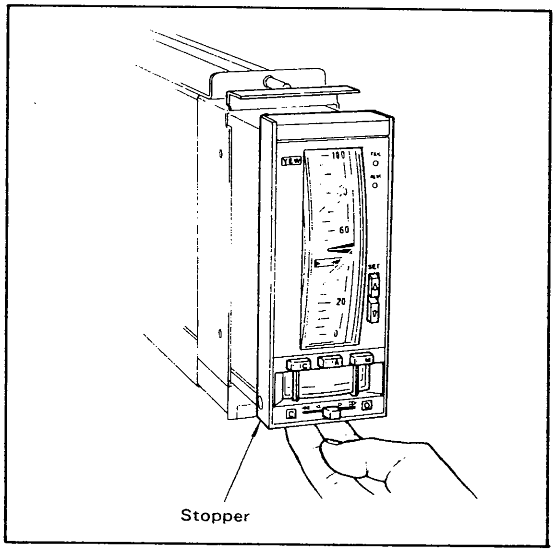


Figure 5-2-1. Removing Instrument Module.

② To remove the instrument module from the housing, push down on the intermediate stopper while pulling the instrument module out of the housing as shown in Figure 5-2-2.

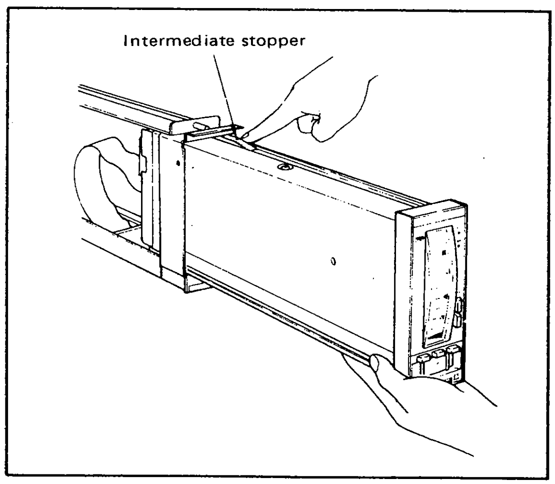


Figure 5-2-2. Removing Instrument Module.

③ Detach the connector from the instrument module. The instrument module is now separated from the housing. (Figure 5-2-3.)

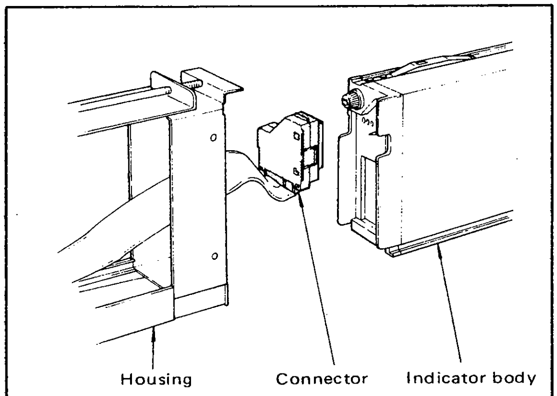


Figure 5-2-3. Detaching the Connector.

5-2-1. Check Special Parts are Installed.

Check to see that the fuse, data memory backup battery and user (applications) ROM are installed.

If any of them has not been installed, refer to Chapter 7 "Parts Replacement" for installation procedure.

5-2-2. Preparations for Operation.

(1) Mounting control valve action labels (Figure 5-2-4).
Match the label location with the action (direct or reverse action) of the control valve. The labels can be removed using tweezers or fingers.
[C]: Closed (control valve closed direction).
[O]: Open (control valve open direction).

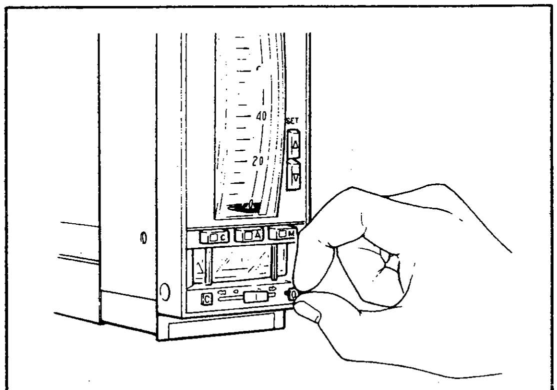


Figure 5-2-4. Mounting Control Valve Action Label.

(2) Setting of tuning panel (Figure 5-2-5).
Set the DIR/RIV selector switch on the tuning panel to the required position.
Next, turn on the power, and set the TUNING switch to ENABLE. The parameters can now be set from the keyboard.

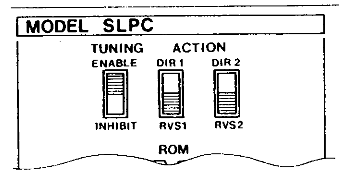


Figure 5-2-5. Setting Selector Switches.

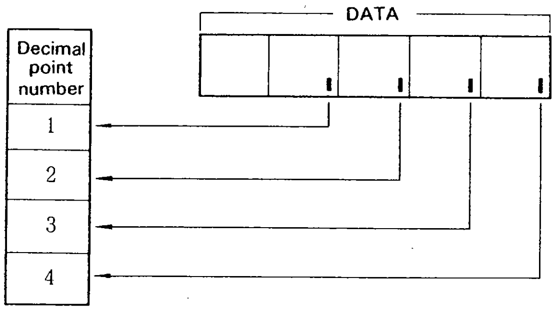
(3) Setting of MODE.
Display MODE by keyboard operations, and set the desired mode by pressing pushbuttons [▲] or [▼].

(Display and Setting Example)

Pushbutton operation	Display	Remarks
[MODE]	MODE1 0	
[▲]	MODE1 1	If initial "0" setting is O.K., go to the next mode setting.
[↑]	MODE2 1	
[▼]	MODE2 0	If initial "1" setting is O.K., go to the next mode setting.
[↑]	MODE3 0	
⋮	⋮	

To change the mode using [▲] and [▼] keys, keep the keys pressed for approx. one second. (This time is required to prevent accidental setting.)

(4) Setting of SCALE.
Set the scale – for indicating the process variable and set value in engineering units – in the order: maximum value, minimum value and decimal point.
Maximum value (HI1):
Set the value to be displayed when the internal data is 1.0. A signed 4-digit integer is entered.
Minimum value (LO1):
Set the value to be displayed when the internal data is 0.0. A signed 4-digit integer is entered.
Decimal point (DP1):
Specify the decimal point position as a number (see figure below).



(Example) When setting the scale to cover the range −100.0 to 400.0

Pushbutton	Display	Description
[SCALE]	HI1 └TYPE┘ └DATA┘	The initial value is displayed in the DATA part.
[▲]	HI1 4000	[≋] may be used simultaneously.
[SCALE]	LO1 └TYPE┘ └DATA┘	The initial value is displayed in the DATA part.
[▼]	LO1 -1000	
[SCALE]	DP1	Decimal point setting
[▲]	DP1 3	□□□.□
[SCALE]	HI1	X1→Y1→HI1
[↑]	HI2	For cascade or selector control, the scale for the second control element must be set in the same way as for the first control element.
[SCALE]	LO2	
[SCALE]	DP2	

(5) Setting of other parameters.
Set all parameters necessary for control and computation. First write out (on a data sheet) all parameters that must be set, so that you do not forget to set any. Table 5-1-1 above lists the parameters and their setting range.

(Parameter setting example)
When setting integral time No. 2 to 600 sec:

Pushbutton	Display	Description
[I]	I 1	
[↑]	I 2 1000	The initial value is displayed.
[▼]	I 2 600	[≋] may be used at the same time.

Other parameters can also be set in the following sequence.
① Item displayed: Use the eleven item (type) keys (Figure 5-1-6) to select this.
② Selected item number: Change using [↑] key.
③ Data (value) setting: Set data values using [▼], [≋] and [▲] keys.

(6) Initial value
The value that is displayed before setting any data in steps (3), (4) and (5) is called the initial value. Initial values are provided for all data that can be set from the keyboard.
Initial values can be written into ROM – simultaneously with the user program – by the SPRG programmer. If a value set from the keyboard is lost due to power supply failure and lack of data backup battery, this initial value is used as the set value when control is restarted.

(7) Inclined mounting
When mounting the instrument at an angle to the vertical, the indicator needs zero adjustment. Refer to Section 6-2 "Indicator inspection, calibration and adjustment" for instructions on how to perform zero adjustment.
After completing all the necessary preparations, disconnect the power plug, install the instrument in the panel, connect the I/O signal wires, and finally connect the power supply.

5-3. Startup and Operation.

NOTE

This section explains the procedure for starting up and operating the instrument.
The procedure for starting up and operating the instrument may vary with the computation and control programs used. The example below illustrates simple PID control. The reader should perform the procedure shown in this tutorial example.

5-3-1. Manual Startup.

(1) Manual operation by manual control lever.
(a) Of the C/A/M mode selector switches, select M. (The lamp inside the pushbutton lights.) (Figure 5-3-1).

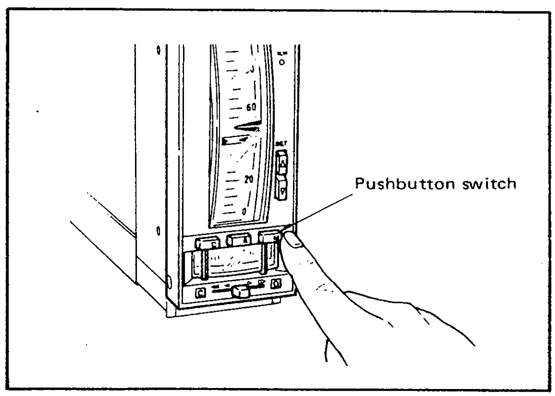


Figure 5-3-1. Selecting the Control Mode.

(b) Move the manual control lever left (or right) to adjust the output signal. (Figure 5-3-2).

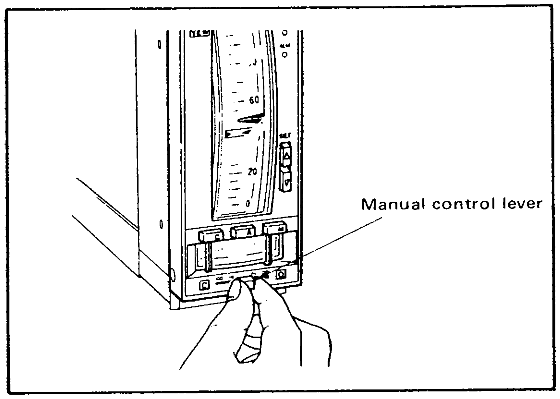


Figure 5-3-2. Manual Control of Output.

(c) Set the desired value using the SET pushbutton switches. (Figure 5-3-3).

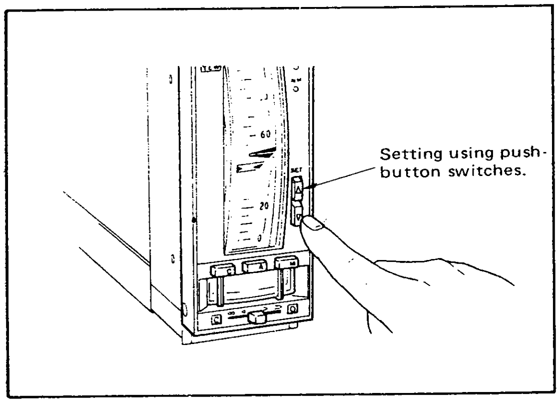


Figure 5-3-3. Adjusting Set Value.

(d) Move the manual control lever to adjust the output and bring the process variable value as close to the set value as possible.

5-3-2. Alarm Check and Transfer to Automatic Operation.

Assume that smooth response has been obtained through manual operation, and that the process variable has stabilized around the set point. Then proceed as follows:

(1) Alarm check (Figure 5-3-4).
If the ALM lamp on the front panel is on, it indicates that there is some signal failure. Use the [CHECK] [ALARM] item on the tuning panel, diagnose the failure, and correct the cause of it.
If the FAIL lamp is on, there is some trouble in the controller itself. Refer to Sec. 5-4.

(2) Transfer from manual to automatic control.
Depress the [C] [A] [M] control mode selector switch marked [A]. The lamp in switch [A] lights, and the controller transfers to automatic mode. No balancing operation is needed when transferring between modes.

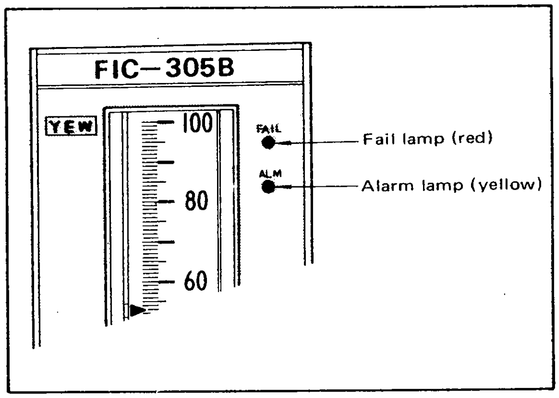


Figure 5-3-4. FAIL Lamp and ALM Lamp.

5-3-3. Normal Operation.

(1) Transfer between control modes.
The control mode of the controller can be changed freely by depressing the [C] [A] [M] pushbutton switches. (Figure 5-3-1). (Note, however, that direct transfer from [M] to [C] modes is not allowed.) Transfer between modes is bumpless, and no balancing operation is needed.

(2) Parameter setting on tuning panel.
If parameters must be set or altered, remove the controller module from its housing, and set or alter the parameters on the tuning panel. After setting, set the TUNING switch back to the INHIBIT side, preventing accidental changes to the parameters.

5-3-4. Tuning PID Parameters.

When applying the controller to an unknown process, it is useful to examine the performance of the process in manual mode.

This can be useful in estimating the proportional band, integral time and derivative time required for automatic mode.

For example, if a small change in the controller output causes a large fluctuation in the process variable value, the width of the proportional band must be increased (the gain must be reduced) to assure stability. In the converse case, the proportional band must be narrowed.

For a process which responds quickly to a change in the controller output, the integral and derivative time constants must be short. Conversely, for a process having a long recovery time, the integral and derivative time constants must be long.

(1) "Proportional + integral" controller
a) Set the control mode to [M], decrease the integral time to the minimum (1 sec.), then set it to 9999 sec. Set the proportional band to a sufficiently

large value, and then set the control mode to [A].

b) Set the derivative time to 0 sec.

c) Perform the following operations to obtain the optimum value for the proportional band.

Lower the proportional band in steps from a sufficiently large value (for example, 100% → 50% → 20%). Take a sufficiently long time for each step, so that the state of control can be observed fully. Continue this operation until the control loop begins cycling. (Cycling means periodic (cyclic) oscillation of the process variable pointer around the set point, and this phenomenon is caused by setting the proportional band narrower (setting the gain higher) than the optimum value for the process.) The optimum proportional band is approx. 2.2 times that of the proportional band which causes such cycling.

Next measure the period of the cycling. The optimum integral time can be obtained by multiplying this oscillation period by 0.83.

Up to a point, decreasing the integral time improves the speed of response of the controller, but if the integral time is shortened too far, cycling is caused due to dead time in the process. In such a case, increase the integral time gradually until the cycling disappears.

(2) "Proportional + integral + derivative" controller

a) Set the operation mode to [M], lower the integral time to the minimum (one sec.), and then set it to 9999 sec. Set the proportional band to a sufficiently wide value, and set the operation mode to [A].

b) Set the derivative time to 0 sec.

c) Change the proportional band as described above, and find the point where cycling just starts to occur. Measure the value (PBu) of the proportional band at this point and the cycling period (Pu).

d) The optimum settings can be determined as follows:

Proportional band = 1.7 PBu
Integral time = 0.5 Pu
Derivative time = 0.125 Pu

The method explained above is called the Ziegler-Nicolls' threshold sensitivity method, and provides a response characteristics with approximately 25% of amplitude attenuation.

Various adjustment methods – such as the step response method – have been given as alternatives to the Ziegler-Nicholls' method: please refer to textbooks on automatic control.

5-4. Action to be Taken When FAIL or ALM Lamps Light.

Any faults in the controller or in the signal connections are indicated by the FAIL or ALM lamps lighting. If either of these lamps lights (or begins flashing), please take appropriate measures (as described below) without delay.

5-4-1. Action to be Taken When the FAIL Lamp Lights.

When the FAIL lamp lights and the FAIL contact output opens, this means that a serious fault has occurred in the controller.

(1) Monitor the current output signal, and set it to a safe level using the manual control lever.
(In FAIL status, the current output can be directly controlled by the manual control lever. The value of other analog and digital output signals depends on the type of fault.) The process variable indicator indicates the value of analog input signal No. 1 (X_1).

(2) Select the "CHECK" item on the tuning panel, and examine the cause of the trouble. (Refer to 5-4-4.)
Carry out the appropriate corrective action.

(3) If the tuning panel does not function normally, it can be presumed that the microprocessor has stopped operation. This occurs due to:
- A fault in the microprocessor itself.
- Intense (signal or power line) noise input that causes the microprocessor to stop itself.

Disconnect the power cord and then reconnect it. If the trouble was caused by noise, the microprocessor should restart operation. (The FAIL lamp goes out.)
Check that all the set data are normal, and then resume normal operation. (The set data values may have been affected by the noise input.)

5-4-2. Action to be Taken When the ALM Lamp Lights.

The ALM lamp lights if the high or low limit alarms of the controller operate, or when input-output signals are disconnected.

Select the "CHECK" item and "ALARM" item on the tuning panel, and display the cause of failure. (Refer to 5-4-4 and 5-4-5.)

Take appropriate measures corresponding to the cause of the fault.

5-4-3. Action to be Taken When the ALM Lamp Flashes.

The ALM lamp begins flashing if the voltage of the data memory backup battery drops. Replace the battery with a new one. (Refer to 6-3-4 for replacement procedure.)

Notes:

(1) If the ALM lamp begins to flash during normal operation, replace the battery within one month.

(2) The flashing of the ALM lamp has precedence over its continuous lighting. Thus, other alarms cannot be displayed while the lamp is flash-

ing. (But other alarms can still be displayed on the tuning panel display.)

5-4-4 CHECK Display.

The CHECK display items are listed below.

Lamp	CHECK display	Diagnosis
—	0 0	Normal.
FAIL	0 1	Fault in A/D converter.
FAIL	0 2	Fault in D/A converter.
ALM	0 4	Arithmetic range overflow.
ALM	0 8	Input overrange.
FAIL	1 0	Unmounted or failed user ROM.
ALM	2 0	Data memory backup battery not installed, or (Lamp flashing) low battery voltage.
ALM	4 0	Current output signal line open or short circuit.
FAIL	8 0	RAM memory data lost.
FAIL	—	Microprocessor faulty (display not possible).

If two or more faults occur at the same time, the displayed value is the total of the individual display values (sum of hexadecimal numbers).

(Examples)

CHECK 0C

0C = 04 + 08 (arithmetic range overflow, input overrange)

CHECK A0

A0 = 20 + 80 (battery low, data lost)

The displayed value returns to 00 upon removal of the causes of the fault. However, the display 80 (internal data lost) does not return to 00 automatically.

The [↑] key must be used to set the display to 00.

5-4-5. ALARM Display.

The alarm state of the control function is displayed as a 2-digit number. Also, the ALM lamp lights.

Display: ALARM [ ][ ]

- Alarm of first control element
- Alarm of second control element

ALARM display	Diagnosis
0	Normal
1	High limit alarm
2	Low limit alarm
4	Deviation alarm
8	Velocity alarm

If two or more alarms occur at the same time, the total of the individual display values is indicated. (Hexadecimal addition).

(Examples)

ALARM 0 6

6 = 2 + 4 (Lower limit alarm and deviation alarm)

ALARM E 5

E = 2 + 4 + 8 (Low limit, deviation and velocity alarms)

5 = 1 + 4 (High limit and deviation alarms)

The display value reverts to 0 when the alarms are cleared.

6. MAINTENANCE.

This chapter explains the indicator adjustment and parts replacement procedures.

6-1. Test Equipment required for Adjustment.

Standard DC voltage source:
Type 2554, manufactured by Yokogawa, or equivalent: 1 unit
SPRG programmer: 1 unit

6-2. Inspection, Calibration and Adjustment of Indicator.

6-2-1. Creating Adjustment Program.

Connect the controller to be adjusted and the SPRG programmer, and create the following program.

(Adjustment program)

Step	Program
01	LD X2
02	ST A1
03	LD X1
04	BSC
05	LD X3
06	ST Y1
07	END

No other operations – such as setting of parameters and so forth – are needed.

After writing the program, set the SPRG programmer mode to TEST RUN, set MODE2 of the SLPC controller tuning panel to "1", and set the C/A/M switch to the [C] mode. Then perform the following adjustment.

6-2-2. Adjusting Zero Point of Process Variable Indicator (Moving Coil Type).

(1) Apply a 3.0 V DC standard voltage to input terminal X1 (terminal nos. 1(+) and 2(−)) from a standard voltage source.
(2) Check that the process variable pointer is at the 50% ± 0.5% calibration mark on the scale.
(3) If the indication is not within the specified range, adjust the zero adjustment screw as shown in Figure 6-2-1 until the pointer correctly indicates 50%.
(4) Change the input signal in turn to 1.0V, 2.0V, 4.0V and 5.0V, and ensure that the indication is respectively 0%, 25%, 75% and 100%, using the calibration marks. Tolerance for each indication is ±0.5% of the span.
(5) If the indication is not within the ±0.5% tolerance at any position, again input 3.0V DC, and adjust the indicated value slightly – within the range 50% ± 0.5%.
(6) Repeat step (4). As necessary, repeat steps (4) and (5) until all points fall within the tolerance range.

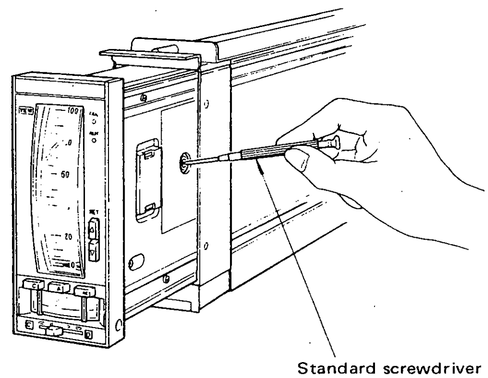


Figure 6-2-1. Adjusting Zero Point of Process Variable Indicator

6-2-3. Adjusting Zero Point of Set Value Indicator (Moving Coil Type).

(1) Apply the standard 3.0 V DC voltage to input X2 (terminals 3(+) and 4(−)) from a standard voltage source.

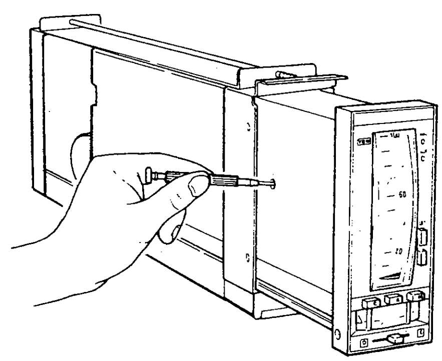


Figure 6-2-2. Adjusting Zero Point of Set Value Indicator.

(2) Adjust using the same procedure as described in steps (2) thru (6) for the process variable indicator (6-2-2). Figure 6-2-2 shows zero point adjustment for set value indicator.

6-2-4. Adjusting Fluorescent Bar Graph Indicator.

It is unnecessary to adjust zero point of either the process variable or set value indicators. Perform checks (1), (2) and (3) of par. 6-2-2.

6-2-5. Adjusting Zero Point of Control Output Indicator.

(1) Apply the standard 3.0 V DC voltage to input terminal X3 (terminal nos. 5(+) and 6(−)) from a standard voltage source.
(In this case, keep the current output terminals A(+) and N(−) short circuited.)

(2) Make sure that the output indicating pointer is just on the thick center scale mark. The tolerance is ±2.5% (Equivalent to 1/2 of a scale division.) (See Figure 6-2-3.)

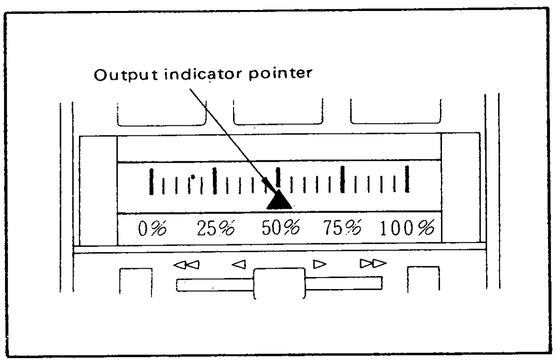


Figure 6-2-3. Output Indicator Center Scale Mark.

(3) If the pointer is not within this tolerance range, turn the zero adjustment screw as shown in Figure 6-2-4 until the pointer is aligned with the center scale mark.

(4) Change the input signal to 1.0 V, 2.0 V, 4.0 V and 5.0 V DC in turn, and make sure that the pointer aligns respectively with the 0%, 25%, 75% and 100% scale marks. The tolerance is ±2.5% of the span (1/2 of a scale division).

(5) If the indication is not within this range at any position, input 3.0 V DC, and adjust the indicated value within the tolerance range.

(6) Repeat step (4). Repeat steps (4) and (5) as necessary until all points fall within the tolerance range.

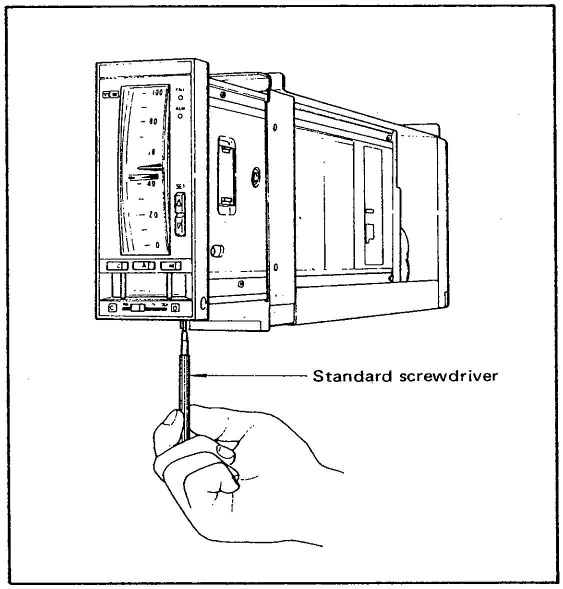


Figure 6-2-4. Adjusting Zero Point of Output Indicator.

6-2-6. Inclined Mounting.

If the instrument is to be mounted at an angle, adjust the process variable indicator (6-2-2) and set value indicator (6-2-3) with the instrument mounted at the actual mounting angle.

6-2-7. Adjusting Brightness of Fluorescent Bar Graph Indicator.

The brightness of the fluorescent bar graph can be adjusted as shown in Figure 6-2-5.

Note: Do not increase the brightness; otherwise, this may shorten the life of the fluorescent tube.

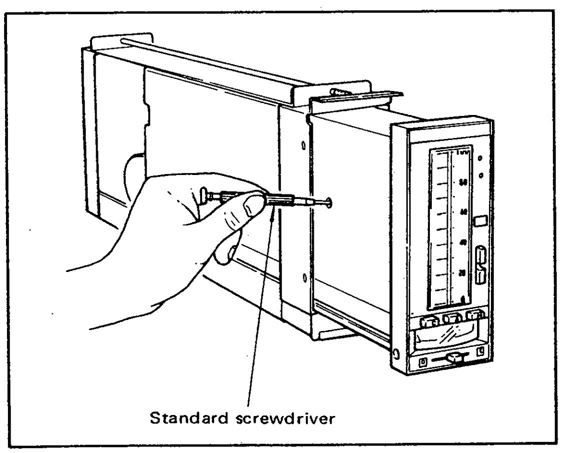


Figure 6-2-5. Adjusting Brightness of Fluorescent Bar Graph Indicator.

6-2-8. Setting Scale of Digital Display.

Note: Setting of the 8-digit DIP switch should be performed with extreme care, using a small screwdriver or finger nail.

The fluorescent bar graph type instrument is provided with a 4-digit display on the right side of the bar graph indicator on the front panel.

The numeric value displayed on the digital display corresponds with that displayed on the bar graph indicator scale.

When the scale plate is changed, the digital display setting must also be changed by the following procedure.

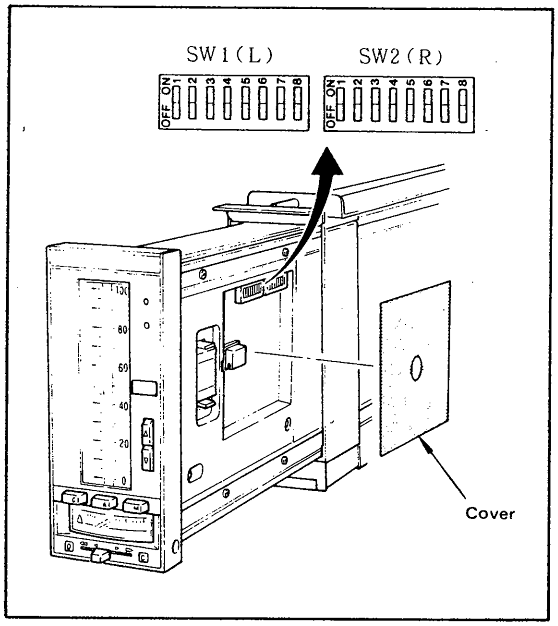


Figure 6-2-6. 8-digit DIP Switch.

(1) Remove the cover as shown in Figure 6-2-6.
(2) Two 8-digit DIP switches (L and R) are visible. (See Figure 6-2-6.)
(3) The DIP switch setting direction mark is printed on the scale plate. (See Figure 6-2-7.)
(4) Set the DIP switches as indicated by the direction mark of the scale plate; the digital display coincides with the scale marks of the scale plate.

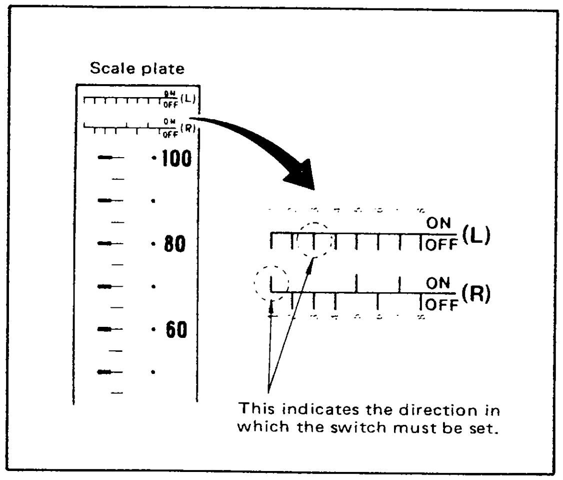


Figure 6-2-7. DIP Switch Setting Direction Mark Printed on the Scale Plate.

6-3. Parts Replacement.

6-3-1. Replacing Nameplate.

Draw out the instrument module a little, and open the lid located on the top of the front panel. Remove the nameplate, and install a new one. (Figure 6-3-1).

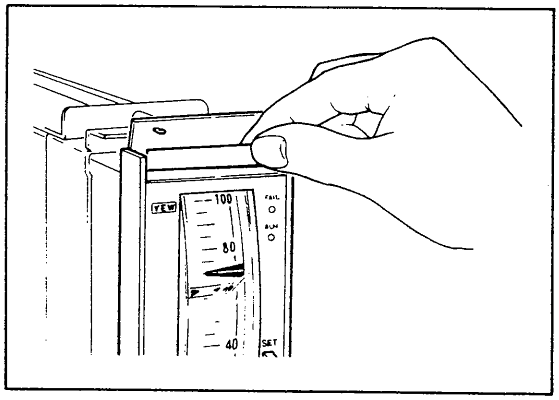


Figure 6-3-1. Replacing Nameplate.

6-3-2. Replacing Scale.

Open the lid on the top of the front panel. Remove the scale plate retaining cap* using a small standard screwdriver. To remove the scale, use a pair of tweezers as shown. Insert a new scale plate, and replace the cap*. (Moving coil type only).

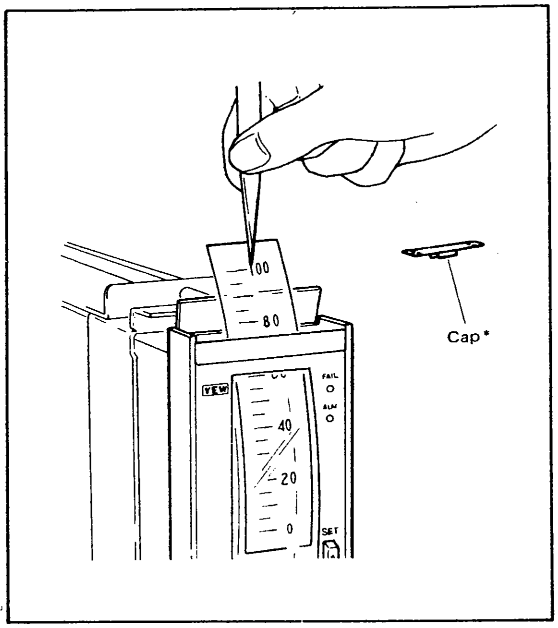


Figure 6-3-2. Replacing Scale Plate.

6-3-3. Replacing Fuse.

If it seems that the fuse may be faulty, check the inside of the fuse holder for contamination or poor contact with fuse.

(1) To remove the fuse, unscrew the fuseholder cap (turn it in the direction marked on the cap (counterclockwise); the cap and fuse may then be removed.

(2) Install a new fuse of the correct rating. Replace the cap securely.

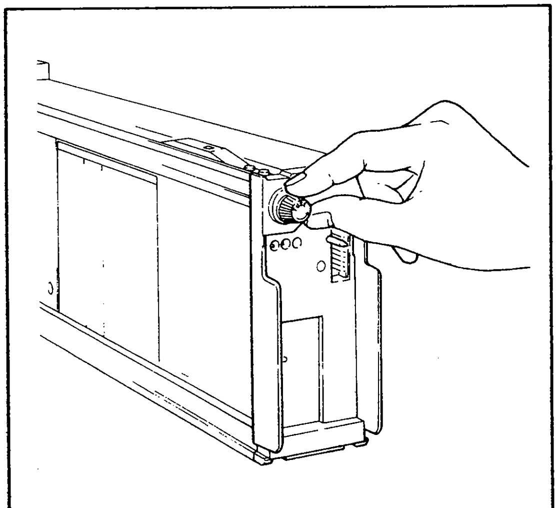


Figure 6-3-3. Replacing the Fuse.

6-3-4. Replacing Data Memory Backup Battery.

If the ALM lamp on the front panel of the instrument begins flashing, please replace the battery without delay.

> **NOTE**
>
> Leave power applied to the instrument while replacing the battery. If the battery is removed while the power is off, some data (parameter) settings may be lost.

(1) Draw out the controller module a little from the housing, and remove the battery cover and the battery. (Figures 6-3-4 and 6-3-5.)

(2) Install a new battery, and fit the battery cover securely.

(3) Make sure that the ALM lamp has stopped flashing.

(Precautions for storage and handling of data memory backup batteries)

(1) Storage conditions:
Ambient temperature: −10 to 60°C.
Ambient humidity: 5 to 95% (non-condensing).
Location free from corrosive gases.

(2) Where possible, replace all the batteries at once. Be sure to observe correct battery polarity when installing batteries.

(3) When measuring the battery voltage, be sure to use a high impedance voltmeter. Do not attempt to measure the voltage with a circuit tester or the like.

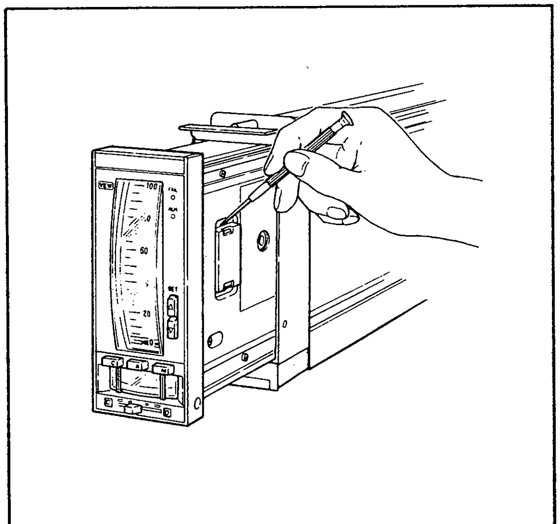


Figure 6-3-4. Removing Battery Cover.

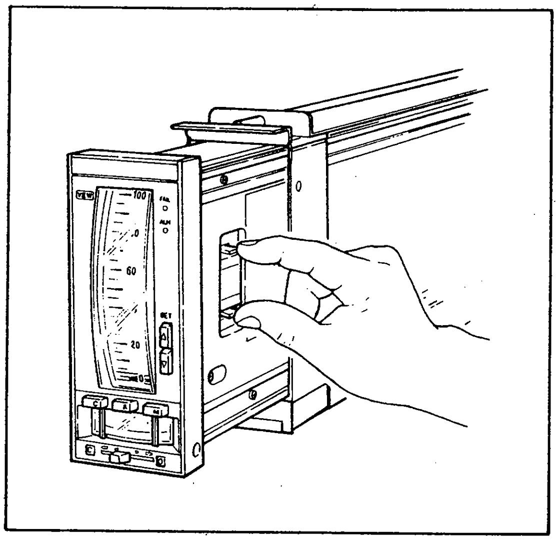


Figure 6-3-5. Removing Battery.

(4) Cautions in handling batteries
- Do not charge batteries.
- Do not heat or put into a fire.
- Do not short the positive and negative poles together.
- Do not apply shock; do not attempt to disassemble.

6-3-5. Replacing User ROM.

CAUTION

Do not attempt to install or remove the user ROM while the instrument is energized: otherwise, the controller mode may switch to FAIL, and the ROM may be damaged.

(Precautions in handling user ROM)

The user ROM is a EPROM – a MOS (metal oxide semiconductor) IC. This type of IC must be handled carefully, as it may be damaged by static electricity. Note also that the program written into it will be lost if ultraviolet rays are applied through the window of this element.

Observe the following cautions when handling the ROM:

- **Cautions against static electricity:**
  Be sure to use a conductive mat when carrying and storing this element. Do not bring the EPROM into contact with clothes and other substances that can be charged easily. Do not handle the PROM using chemical fiber gloves.
- **Cautions against ultraviolet rays:**
  Do not remove the seal of PROM except when erasing the contents.
  When attaching a new PROM to the controller, be sure to affix the specified seal to the PROM.
- **Caution not to deform pins:**
  If the pins are deformed, straighten them, taking care not to apply force to the root of each pin.

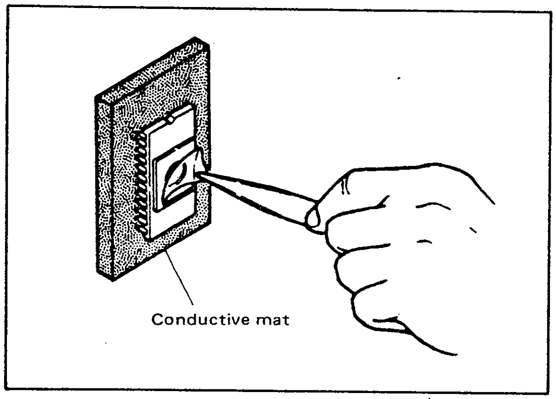


Figure 6-3-6. ROM Seal.

To replace the user ROM, proceed as follows:

(1) Removing user ROM.

a) Turn off the power supply to the instrument. (Leave the backup battery in position.)

b) Remove the tuning panel cover plate; the user ROM will be visible. (Figure 6-3-7).

c) Lift the lever of the ROM socket, and set it to the OFF position using the tip of a screwdriver. (Figure 6-3-7).

d) Hold the ROM in the fingers and pull it out of the socket, taking care not to deform the pins. (Figure 6-3-8).

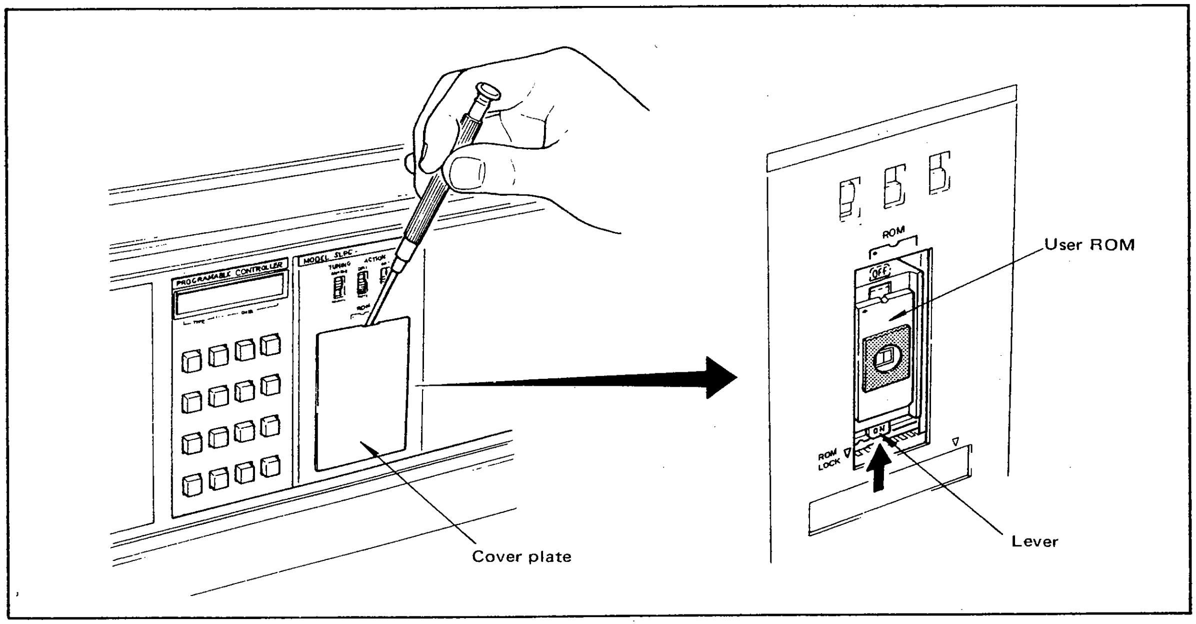


Figure 6-3-7. Removing Tuning Panel Cover Plate and ROM.

(2) Installing user ROM.
a) Install the ROM with the notched end up.
b) Make sure that the ROM pins are correctly aligned with their sockets.
c) Press the ROM carefully into position.
d) Push down the lever of the ROM socket to the ON position.

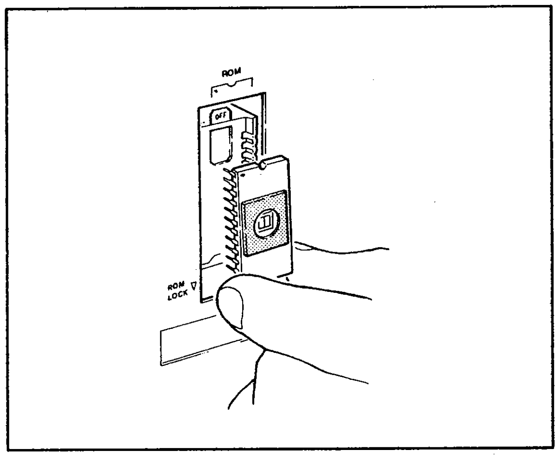


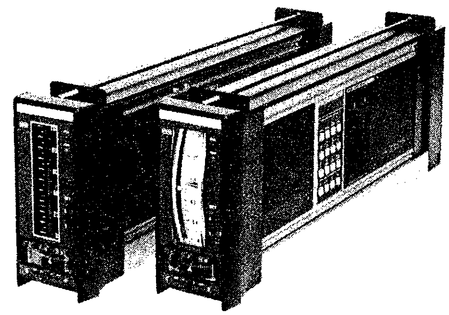
Figure 6-3-8. Removing ROM.

General Specifications

Model SLPC
PROGRAMMABLE INDICATING CONTROLLER

The SLPC Programmable Indicating Controller is a microprocessor-based, user-programmable instrument which allows powerful computational functions to be combined with control functions.

- *This controller will satisfy a wide variety of requirements, not just simple PID control or control with compensation — one SLPC can replace two conventional controllers in applications such as cascade loops, high or low autoselector control.*
- *Non-interacting PID settings; drift-free manual control.*
- *The front panel operation (setting set point, manipulating manual output, etc.) is identical to that of the SLCD Indicating Controller, and resembles that of conventional analog controllers.*
- *The user can construct his own algorithms (using a library of functions as building blocks).*
- *Incorporates self diagnostics, I/O signal level checks.*
- *Options such as remote setting, feedforward control, dead time compensation and output tracking are supported.*
- *Communication functions allow the SLPC controller to be used with a central CRT-display operator's console or supervisory computer.*



STANDARD SPECIFICATIONS

Input/Output Signals

Analog Input/Output Signals:

Analog Inputs	1 to 5 V DC	5 points	Input resistance 1 MΩ
Analog Outputs	1 to 5 V DC	2 points	Load at least 2 kΩ
Manipulated Output Signal	4 to 20 mADC	1 point	Load up to 750 Ω

Input Conversion Accuracy: ±0.2% of span.

Output Conversion Accuracy:
For current output, ±1% of span.
For voltage output, ±0.3% of span.

Contact Input Signals: 3 points (contact status may be read by program). Contact or voltage signals.

Input	Input status — ON	Input status — OFF
Contact*	Contact closed — source up to 200 Ω	Contact open — source at least 100 kΩ
Voltage	Low: −1 to +1 V	High: +4.5 to 25 V

* Contact rating at least 5 V DC, 20 mA.

Contact Output Signals: 3 points (contact status may be changed by program).
Transistor Contact Rating: 30 V DC, 200 mA (resistive load).
On: Contact closed, Off: Contact open.

Fail Output Signal: 1 point.
Transistor Contact Rating: 30 V DC, 200 mA (resistive load). (Contact open during power failure).

Note: Analog I/O signals are not isolated from each other, but use a common negative line and are isolated from power supply.
Contact I/O signals are each isolated from other internal circuitry and power supply.

Indicators

Process Variable & Set Point Indicators: Moving coil meter, or fluorescent bar graph display. Vertical scale.

Common Specifications:
Indication Range: 0 to 100%.
Scale: 100 mm long, interchangeable.
Scale Marking: Single scale with units marking. Major divisions are marked.

Moving Coil Version: Dual index (dual pointer) meter.
Index Color: Process variable — red; Set point — blue.
Indicator Accuracy: ±0.5% of span.

Fluorescent Bar Graph Version:
Bar Graph Resolution: 1% of span (101-segments).
Process Variable Indicator: Bar graph.
Set Point Indicator: Bright cursor.
Digital Display: 4-digit display of process variable or set point (selected by side-panel switch — process variable normally displayed). Linear display in engineering units, range −1999 to 4999.
Display Accuracy: ±0.5% of span ±1 digit.

Output Indicator: Moving coil type, with two memory indexes for limits and with valve open/close marks. Horizontal scale.
Scale: 39-mm scale with 20 equal divisions.
Indicator Accuracy: ±2.5% of span.

Mode Transfer: By Cascade (C)/Auto (A)/Manual (M) switches on front panel. Mode indicator lamp is built into each switch button. Mode can also be changed under program control or remotely (SICU/UFCU required – see "Communications Functions" below). Transfers between cascade, auto and manual modes are bumpless and balanceless.

Set Point: Manual, Cascade or Remote setting (side panel switch selects whether the set point comes from analog input or via communications bus – see "Communications Functions" below). Manual SET buttons (on front panel) vary set point at rate 40 sec./full scale.

Manual Output: Set by two-speed lever action.

SLOW: 40 seconds/full scale.

FAST: 4 seconds/full scale.

Setting Computational Coefficients/Parameters & Selecting Display Data: Uses a 16-key keypad on the tuning panel (side panel). A side-panel switch enables/inhibits parameter changes. Communication functions available for remote setting (see below).

Side-Panel Digital Display:

Parameter or Data Label: 3-digit alphanumeric.

Parameter or Data Value: 4-digit numeric.

Input data and some variable parameters are in engineering units (but units are not displayed).

Control Functions

The control functions are decided by "interconnection" of software modules in the controller. One of three control modules may be selected:

Basic Control Module: A single control module.

Cascade Control Module: Two control modules connected in cascade. One SLPC controller can implement a cascade loop.

Signal Selector Control Module: Two control modules connected in parallel. One SLPC controller can implement an autoselector control loop.

Control Elements: A control module comprises one of three control elements: Basic PID control element, Sample-and-hold control element or PID control element with batch switch. These control elements, described below, may contain the following common functions: output tracking, manipulated value output limiter and process variable limit alarms (−6.3 to 106.3%), deviation (0 to 100%) and velocity limit alarms, non-linear control (dead band gain: 0 to 1.0, dead band width: 0 to 100%). In addition to control elements, a variety of computational functions (described below) may be used.

Basic PID Control Element (with or without non-linear band):

P (Proportional band): 6.3 to 999.9%.

I (Integral time): 1 to 9999 seconds.

D (Derivative of process variable) – (Derivative time): 0 to 9999 seconds.

Scan and Control Period: 0.2 seconds.

PID Control Element with Batch Switch: When the control deviation exceeds a preset band – e.g. during startup – a fixed (preset) value is output. When the deviation decreases to within the preset band, a bias is added to or subtracted from the output (depending whether the control action is direct or reverse) and the controller switches to PID control. Control does not revert from PID to manual control unless the deviation exceeds (deviation set point + lockup band).

High or low limit batch control may be selected.

Deviation Set Point: 0 to ±100%.

Bias Set Point: 0 to 100%.

Lockup Band: 0 to 100%.

The PID parameters and scan/control period are the same as for basic control (above).

Sample-and-Hold PI Control Element: The control algorithms are executed after each input scan cycle, and the output is then held constant (until after the following scan). This is useful for processes with dead time.

Sample Period: 0 to 9999 seconds.

Control Period: 0 to 9999 seconds.

The PI parameters and scan period are the same as for basic control (above).

Computational Functions

Function	Funtion name:	Max. no. of times function may be used in program
General Functions	Addition, Subtraction	–
	Multiplication, Division	–
	Magnitude (absolute value)	–
	Square root	–
	High selector, Low selector	–
	High limiter, Low limiter	–
	10-segment transfer function (break points user-definable) (two functions)	–
	High limit alarms	4
	Low limit alarms	4
	First order lag	8
	First order lead	2
	Dead time and velocity computations	3 total
	Velocity limiter	6
	Timers	4
	Pulse rate output	2
Logical Functions	AND, OR, NOT	–
	CMP (compare greater than or equal)	–
	Branching, Conditional branching	–
	Signal switching	–

Note: Where limits are indicated by a dash "–" above, this means that there is no preset limit.

Computational Coefficients/Parameters (preset by user): 16 registers for general use, plus 22 for 10-segment line-segment functions.

Constants: 16.

Temporary Registers: 4.

Programming

No. of Program Steps: 99 (control instructions, arithmetic functions and data read/write instructions each take one step).

Programming: The SPRG Programmer is connected, and the program is entered using a calculator-like language. The completed program is written to UV EPROM (Erasable Programmable Read Only Memory).

Communication Functions

Communication with operator's console and supervisory computer via Interface Unit (SICU) or Field Control Unit (UFCU). Max. distance between SICU/UFCU and SLPC: 100 m.

Data Transmitted: Process variable*, set point*, manipulated output, instrument mode, output limits, PID constants*, variables (2), analog data (3 items).

Data with Remote Setting: Set point*, manipulated output, instrument mode, output limits, PID constants*, variables (2). A side-panel switch enables/inhibits both remote and local parameter changes.

* For a cascade controller or where selector functions are involved, these apply to the primary loop.

Backup Mode Selection: If the communications or supervisory computer systems fail, the YewSeries 80 system reverts to backup mode. Either auto or manual backup modes can be selected using a side-panel switch.

Power-Fail/Restart Functions

For a Power Failure of up to Approx. 2 Seconds: Status prior to power failure retained.

For a Power Failure Longer than Approx. 2 Seconds: Restart mode can be selected from the following by a switch on the side panel –

HOT (Computational data and status prior to power failure preserved).

COLD (Status reset to manual mode, manipulated variable output set to low limit (−6.3%)). Computational functions are initialized and temporary registers reset to 0.

Data Memory Backup during Power Failure: By internal battery.

Life of Backup Battery (temperature up to 45°C):
At least 5 years (normal operation),
At least 1 year (backup operation).

Self-Diagnostic Features

Computation and Control Abnormalities: "FAIL" lamp lights, "FAIL" contact output opens. ("FAIL" contact also opens during power failure). Manual operation is possible.

Input/Output Signal Abnormalities (Input overflow, current output wire open circuit, computational overflow): "ALM" lamp lights.

Memory Backup Battery Low: "ALM" lamp flashes.

Communications Abnormal: "C" lamp flashes (during communications).

For diagnostic purposes, numeric error codes corresponding to faults can be displayed on side panel display.

Normal Operating Conditions

Ambient Temperature: 0 to 50°C.

Ambient Humidity: 5 to 90% Relative Humidity (non-condensing).

Power Supply: AC or DC. (No change to instrument).
DC supply: 20 to 130 V, polarity reversible.
AC supply: 80 to 138 V, 47 to 63 Hz.

Maximum Power Consumption:

Maximum Current Consumption: 370 mA (with 24 V DC supply). With fluorescent bar graph indicator, 150 mA higher.

Maximum Power Consumption: 15 VA (with 100 V AC supply). With fluorescent bar graph indicator, 6 VA higher.

Insulation Resistance:

Between I/O Terminals and Ground: 100 MΩ/500 V DC.

Between Power and Ground: 100 MΩ/500 V DC.

Dielectric Strength:

Between I/O Terminals and Ground: 500 V AC for 1 minute.

Between Power and Ground: 1000 V AC for 1 minute.

Wiring:

Signal Wiring to/from the Field: ISO M4 size (4 mm) screws on terminal block.

Power and Ground Wiring: Two-pole plug with earthing contact (IEC A5-15, UL 498, JIS C8303: 125 V, 15 A) and 30-cm cord.

Mounting: Flush panel mounting. Instruments are in housings, and may be mounted individually or side-by-side.
Instrument may be inclined with front up to 75° from vertical (rear of instrument lower than front). (Indicator zero may need readjustment).

Nameplate: Size 8 x 65.3 mm, cream semi-gloss finish.

Lettering: In black, one or two rows each up to 14 alphanumeric characters long.

Bezel: Aluminium diecast, black baked-enamel finish.
Housing: Open front; connector for SPBD portable manual station.
Housing Dimensions: 182.5 (H) x 87 (W) x 480 ((D): depth behind panel) (mm).
Weight:
Controller less Housing: 3.3 kg.
Housing: 2 kg (excluding mounting kit).

OPTIONS

/SPR: Controller supplied with standard program configuration (see TI 1B4C2-02E for programs available).
/NPR: Controller supplied unprogrammed (with blank EPROM). The user can write a program to EPROM using the SPRG Programmer.
/MTS: Controller supplied with kit for individual mounting. For mounting in groups, see GS 1B4F1-E.
/SCF-G□M: Mounting kit bezel color change from standard color (black). Choose color from set of optional colors (see GS 22D1F1-E). Specify color code in space □.
/NH: No housing, instrument only. See GS 1B4F1-E to order housing separately.
/NP: With marking on front panel nameplate.

SPARE PARTS SUPPLIED

1 A fuse, quantity one.

ORDERING INSTRUCTIONS

Specify the following when ordering:
1. Model, suffix and option codes.
2. Main scale and engineering units marking (see GS 22D1C1-E).
3. Nameplate marking, if required (option /NP).
4. Mounting kit (option /MTS), if the instrument is to be mounted individually.
5. Program code, if a standard program or special user's program is required.
6. Fill out program worksheets if a special user's program is required.

MODEL & SUFFIX CODES

Model	Suffix codes	Style	Option codes	Description
SLPC				Programmable Indicating Controller
Indicator	-1			Moving coil version
	-2			Fluorescent bar graph version
Communications functions	0			None
	1			With communication functions
	0			Always 0
Style code		*A		Style A
Options			/SPR	With standard program
			/NPR	Unprogrammed
Common options			/MTS	With mounting kit
			/SCF-G□M	Bezel color change
			/NH	Without housing
			/NP	With nameplate marking

TERMINAL CONNECTIONS

Terminal Designation	Description	Terminal Designation	Description
1	+ Analog input 1	19	+ Contact output 3
2	− Analog input 1	20	− Contact output 3
3	+ Analog input 2	21	− Fail (negative terminal)
4	− Analog input 2		
5	+ Analog input 3	A	+ Analog output 1 (*2) (current output)
6	− Analog input 3	B	− Analog output 1 (*2) (current output)
7	+ Analog input 4		
8	− Analog input 4	C	+ Analog output 2
9	+ Analog input 5	D	− Analog output 2
10	− Analog input 5	F	+ Analog output 3
11	+ Contact input 1	H	− Analog output 3
12	− Contact input 1	J	+ Contact output 1
13	+ Contact input 2	K	− Contact output 1
14	− Contact input 2	L	+ Contact output 2
15	+ Contact input 3	M	− Contact output 2
16	− Contact input 3	N	+ Fail (positive terminal)
17	+ Communications (*1)		
18	− Communications (*1)		

Notes: *1: Use shielded twisted-pair cable (SCCD, see GS 34B5K3-02E).
*2: If these terminals are not used, connect them together.

RELATED EQUIPMENT

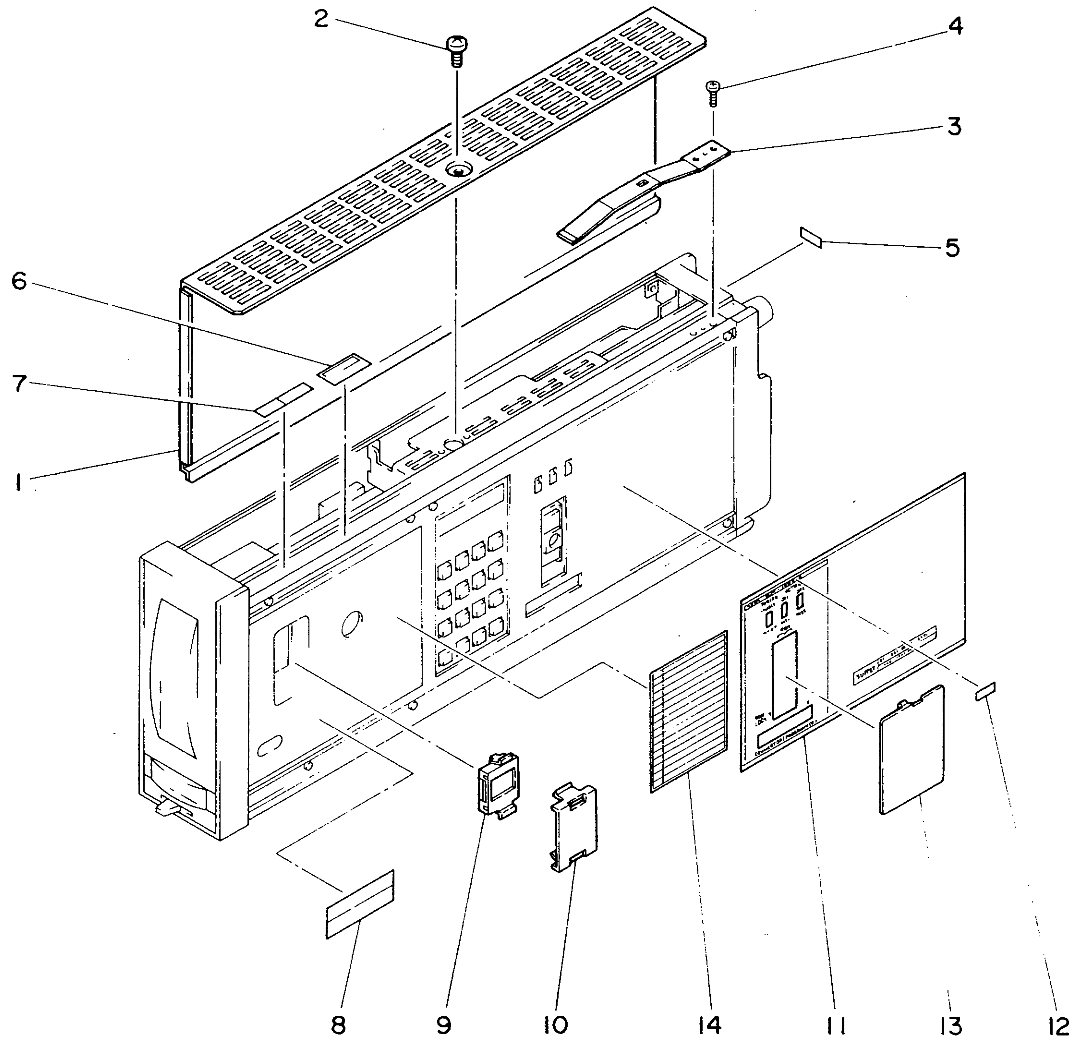
Related Instruments
Model SPRG Programmer . . . . See GS 1B4W1-E
Model SICU Interface Unit . . . . . . See GS 34B5C2-21E
Model UFCU Field Control Unit . . See GS 34B5C2-01E

Related Spare Parts
User's EPROM. . . . . Part No. G9003LT
Memory Backup Battery. . . . . Part No. E9711DH

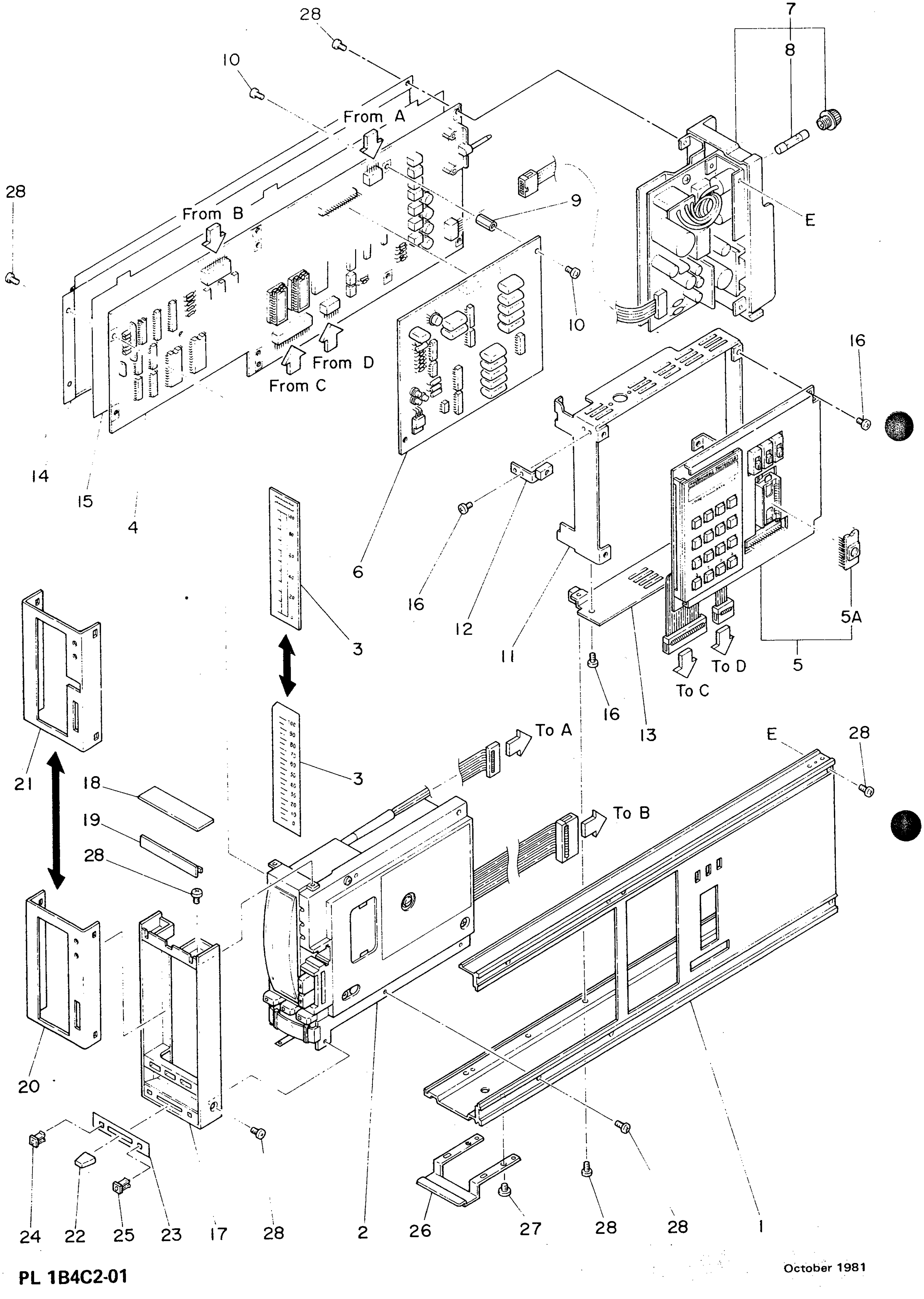
Parts List

YEWSERIES 80

Model SLPC PROGRAMMABLE INDICATING CONTROLLER



Item	Part No.	Qty	Description
1	E9711TG	1	Cover
2	Y9405LB	1	B. H. Screw, M4x5
3	E9711TC	1	Spring
4	E9711TE	2	Screw
5	G9325EM	1	Label – "1A"
6	–	1	Nameplate (Data plate)
7	Y9422NP	1	Tag No. Label (blank)
8	E9712DC	1	Label
9	E9711DH	1	Battery Assembly
10	E9711GQ	1	Cover
11	E9711WM	1	Nameplate
12	Below	1	Nameplate
	E9711DM		For Model SLPC-200
	E9711DN		For Model SLPC-210
	E9711DR		For Model SLPC-100
13	E9712BE	1	Cover
14	E9712DA	1	Label (for Models SLPC-200 and SLPC-210)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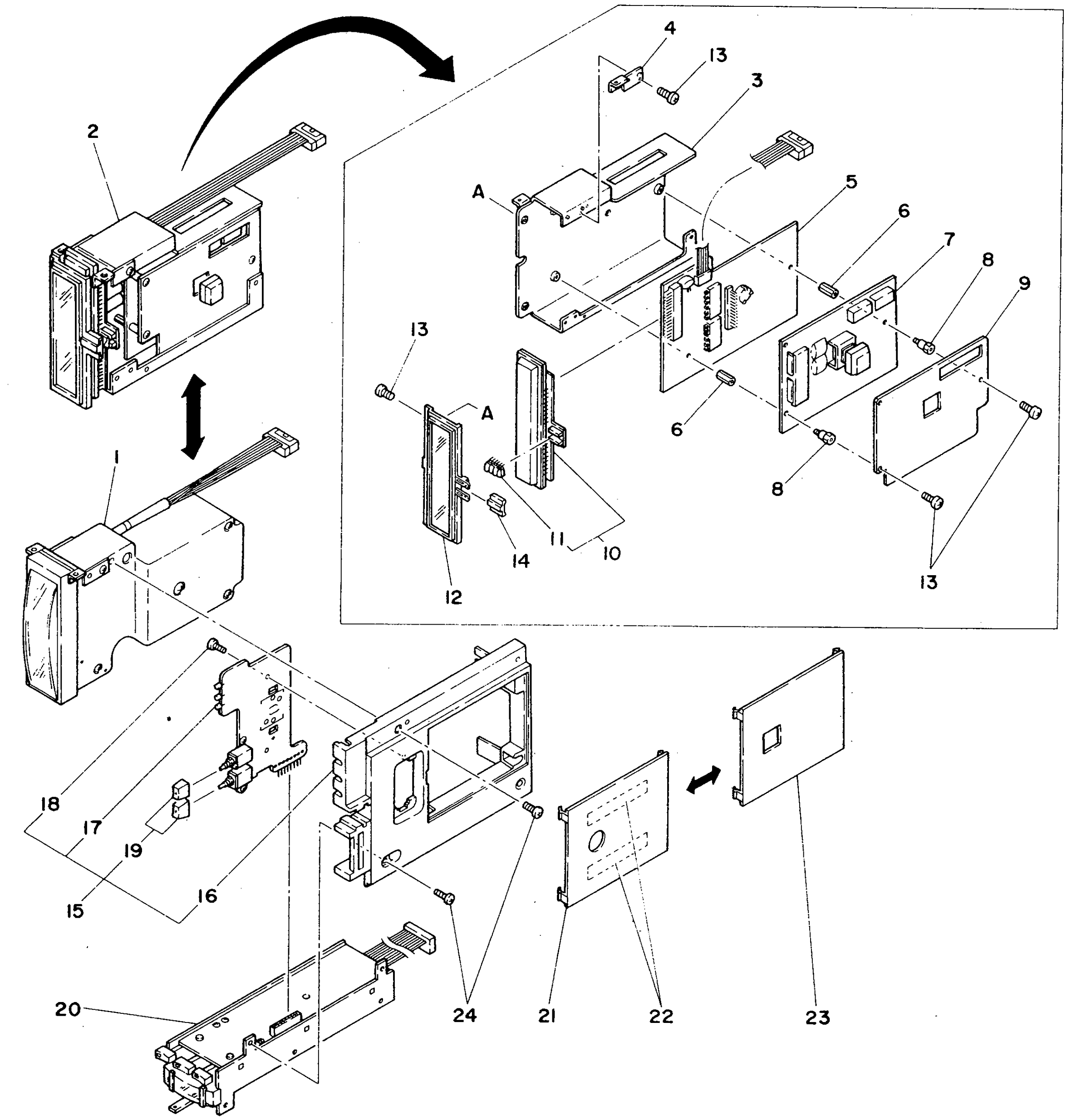
Item	Part No.	Qty: SLPC-1□*0	Qty: SLPC-2□*0	Description
1	E9711SP	1	1	Chassis
2	E9711AA	1		Meter Assembly } See Page 4
	E9711AM		1	Display Assembly } See Page 4
3	–	1	1	Scale (specify range when ordering)
–	E9711NM	1	1	Control Assembly (items 4 through 16)
4	E9716DA	1	1	Main Card
5	E9716DD	1	1	Tuning Card
5A	G9003LT	1	1	EP Rom
6	E9716DC	1	1	I/O Card
7	E9716YB	1	1	Power Supply Unit (for 80 to 138 V AC 47–63 Hz and 20 to 130 V DC power supplies)
8	G9001ZF	1	1	Fuse – "1A"
9	T9008ZB	2	2	Stud } except Model SLPC-□00
10	Y9306JB	4	4	Pan H. Screw, M3x6 } except Model SLPC-□00
11	E9712BM	1	1	Bracket Assembly
12	E9712BP	1	1	Bracket Assembly
13	E9712BR	1	1	Bracket Assembly
14	E9711QB	1	1	Cover
15	E9711QC	1	1	Plate
16	Y9306JB	12	12	Pan H. Screw, M3x6
17	E9711FP	1	1	Frame
18	E9711FD	1	1	Cover
19	E9711FG	1	1	Plate (blank)
20	E9711HA	1		Bracket
21	E9711HB		1	Bracket
22	E9711KA	1	1	Knob
23	E9711KE	1	1	Plate
24	E9711KC	1	1	Tip – "C"
25	E9711KD	1	1	Tip – "O"
26	E9711TD	1	1	Stopper
27	E9711TE	2	2	Screw
28	Y9306JB	14	14	Pan H. Screw, M3x6

* For suffix code details (indicated by □), refer to YEW GS sheets.

E9711AA Meter Assembly
E9711AM Display Assembly



Item	Part No.	Qty E9711AA	Qty E9711AM	Description
1	E9711CA	1		Meter Assembly
2	E9711CM		1	Display Assembly
3	E9711DZ		1	Bracket Assembly
4	E9711GT		1	Bracket
5	E9716HA		1	I/O Board Assembly
6	T9008YE		3	Stud
7	E9716WM		1	CTL Board Assembly
8	E9712BZ		3	Stud
9	E9712CH		1	Plate
10	E9716WN		1	Display Board Assembly
11	G9042HL		1	LED
12	E9711FR		1	Cover
13	Y9306JB		6	Pan H. Screw, M3x6
14	E9711FS		1	Block
15	E9711DA	1	1	Frame Assembly
16	E9711FM	1	1	Frame Assembly
17	E9716WG	1	1	Circuit Board Assembly
18	Y9306TT	2	2	Screw
19	E9711FH	2	2	Knob
20	E9711KM	1	1	A/M Unit
21	E9711FE	1		Cover
22	E9712BD	2		Tape
23	E9711GP		1	Cover
24	Y9306JB	5	5	Pan H. Screw, M3x6

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