INSTRUCTION MANUAL

DIGITAL PROGRAMMABLE POWER SOURCE

MODEL DPS C 50-0.5

KIKUSUI ELECTRONIC CORPORATION

Power requirements of this product have been changed and the relevant sections of the Operation Manual should be revised accordingly.
  (Revision should be applied to items indicated by a check mark ☑.)

☐ Input voltage

  The input voltage of this product is _____ VAC,
  and the voltage range is _____ to _____ VAC. Use the product within this range only.

☐ Input fuse

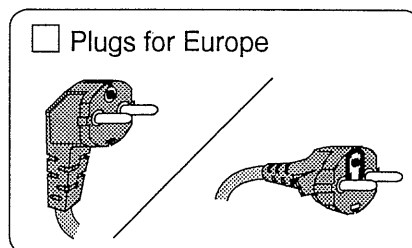 The rating of this product's input fuse is _____A, _____VAC, and _____ .
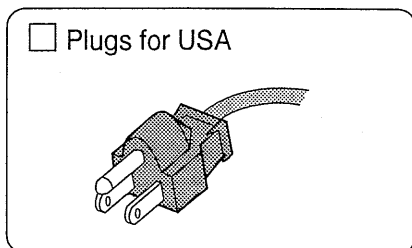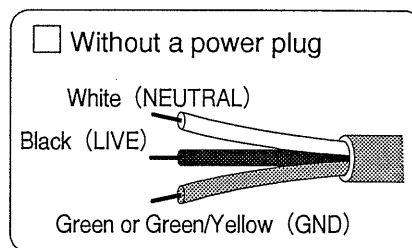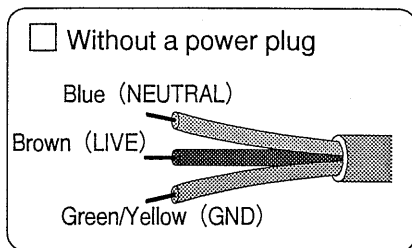
▬▬▬▬▬▬▬ WARNING ▬▬▬▬▬▬▬

· To avoid electrical shock, always disconnect the AC power cable or turn off the switch on the switchboard before attempting to check or replace the fuse.

· Use a fuse element having a shape, rating, and characteristics suitable for this product. The use of a fuse with a different rating or one that short circuits the fuse holder may result in fire, electric shock, or irreparable damage.

☐ AC power cable

  The product is porvided with AC power cables described below. If the cable has no power plug, attach a power plug or crimp-style terminals to the cable in accordance with the wire colors specified in the drawing.

▬▬▬▬▬▬▬ WARNING ▬▬▬▬▬▬▬

· The attachment of a power plug or crimp-style terminals must be carried out by qualified personnel.

☐ Without a power plug

Blue (NEUTRAL)
Brown (LIVE)
Green/Yellow (GND)

☐ Without a power plug

White (NEUTRAL)
Black (LIVE)
Green or Green/Yellow (GND)

☐ Plugs for USA

☐ Plugs for Europe

☐ Provided by Kikusui agents

  Kikusui agents can provide you with suitable AC power cable.
  For further information, contact your Kikusui agent.

☐ Another Cable _____

KIKUSUI

TABLE OF CONTENTS

1. GENERAL

The DPS C 50-0.5 Digital Programmable Power Source is a bipolar
constant-current constant-voltage power source designed for use
with automatic test systems. Its output current can be controlled
with an external signal.

Current setting can be done with two ranges: 0 to ±49.99 mA (10 μA
resolution) and 0 to ±499.9 mA (100 μA resolution). Current setting,
including polarity setting, can be controlled with a 16-bit signal.

The output current is controlled with a TTL level negative logic
BCD signal. As a strobe signal is applied when the required data
is ready, the data is stored in an internal register and at the same
time the output voltage varies to the preset limit values at a high
accuracy and a high speed.

Compliance can be set for a range of approximately ±(3 V to 50 V)
with a manual knob on the front panel. When the set value is reached,
the operation changes to the constant-voltage mode.

The output section is electrically isolated from the input control
section. Addresses can be specified as required. Thus, a multiple-
channel power source system can be readily obtained, making this inst-
rument applicable for various applications.

This instrument can be used as a power source for semiconductor test
stands, IC test stands, circuit board test stands as well as regular
power source for many electronic devices. When used in conjunction
with Kikusui GP-IB Interface, this instrument is compatible with many
types of computers to make up various kinds of automatic measuring
systems.

2. SPECIFICATIONS

Instrument name: Digital Programmable Power Source

Model No.:   DPS C 50-0.5

Output section

  Type: Bipolar constant-current constant-voltage transfer type

  Current: 0 to +499.9 mA

  Ranges: Two ranges of 50 mA and 500 mA

  Resolutions: 10 µA and 100 µA

  Setting accuracy: 0.05% + 0.02% of range (at 25°C (77°F))

  Ripple and noise: 30 µA rms or less (at 10 Hz – 1 MHz)

  Programming noise: ±500 µA peak or less (at rear terminal)

  Load regulation: 0.005% of range + 5 µA or less (at rear terminal), for 0 – 100% load change

  Line voltage regulation: 0.005% of range + 1 µA or less, for ±10% line voltage change

  Response speed: 500 µsec or faster (with 1 ohm load), for "–" maximum current to "+" maximum current within the range

  Output voltage: 50 V maximum

    Setting: Manual, approx. ±(3 to 50) V

Control section

  Input/output signals: TTL level

Control signals

    Data   Polarity   1 bit
                  Current   15 bits   (BCD)
        Strobe   1 bit   (edge)
        Address   4 bits
        Standby   1 bit
        Range   2 bits
        Set   1 bit
        Direct zero   1 bit
        Direct standby   1 bit
        Data clear   (except polarity)

  Output signals

        Address coincidence
        Data accept (DAC)
        Error flag   o Data overflow
                        o Range inconformity
        Thermal down
        Constant-voltage transfer (CV)
        Ready

Ambient temperature: 5°C to 35°C (41°F to 95°F)

Withstanding voltage of input/output circuit: 500 V maximum

Power requirements: 100 V ±10%, 50/60 Hz AC, approx. 98 VA (with
                       full load)

Dimensions: 210W × 90H × 370D mm (8.3W × 3.6H × 14.6D in.)
(Maximum dimensions): 220W × 100H × 400D mm (8.7W × 4.0H × 15.8D in.)

Weight: Approx. 8.7 kg (19 lbs.)

Accessories: Instruction manual   1 copy
                       50P plug   1

3. OPERATION METHOD

3.1 Description of Front Panel (See Figure 3-1.)

① POWER switch:

> The power switch (circuit breaker) of a rocker type.
> The instrument power is turned on as the ON side is
> depressed.

② OUTPUT terminals:

> The output terminals (binding posts) which provide an
> output of ±(500 mA, 0 to 50 V). The white terminal is
> L-side terminal. These terminals are connected in
> parallel with the output terminals of the rear panel.

③ COMPLIANCE control:

> The voltage limiting knob for a range of approximately
> 3 to 50 V. When the voltage has reached the limit
> value, the operation is transferred into the constant-
> voltage mode.

④ DISPLAY lamps:

> These LEDs indicate the operating state of the instrument.

3.2 Description of Rear Panel (See Figure 3-2.)

⑤ ADDRESS switches:

> These slide switches are for address setting of this
> instrument. When the address line is H.H.H.H or the
> control line is open, writing can be done irrespective
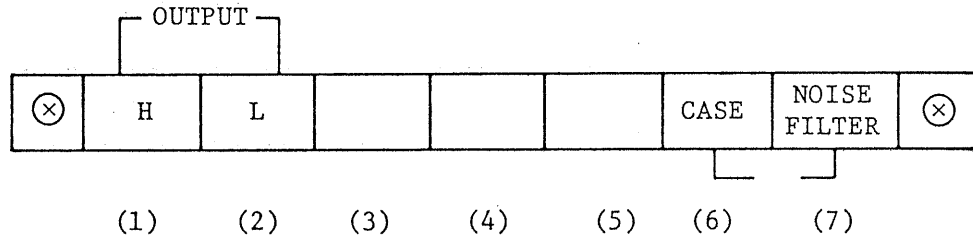> of setting of these address switches.

⑥ Fan motor:

> Cooling fan motor.

⑦ Power cord:

   To be connected to an AC line outlet of the correct
   voltage and frequency.

⑧ Terminal block

```
        ┌─ OUTPUT ─┐
┌──────┬──────┬──────┬──────┬──────┬──────┬──────┬────────┬──────┐
│  ⊗   │  H   │  L   │      │      │      │ CASE │ NOISE  │  ⊗   │
│      │      │      │      │      │      │      │ FILTER │      │
└──────┴──────┴──────┴──────┴──────┴──────┴──────┴────────┴──────┘
                                                 └──┐  ┌──┘

        (1)    (2)    (3)    (4)    (5)    (6)    (7)
```

(1) Output terminal of H side

(2) Output terminal of L side

(3) L-side terminal to monitor the output current

(4) H-side terminal to monitor the output current. No parti-
     cular relationships with ranges.

(6) Case ground terminal

(7) Center terminal of noise filter of power line. If this
     terminal is connected to the case ground terminal, a leak
     current flows although the filtering effect is improved.
     Connect this terminal depending on the type of use.

⑨ Connector

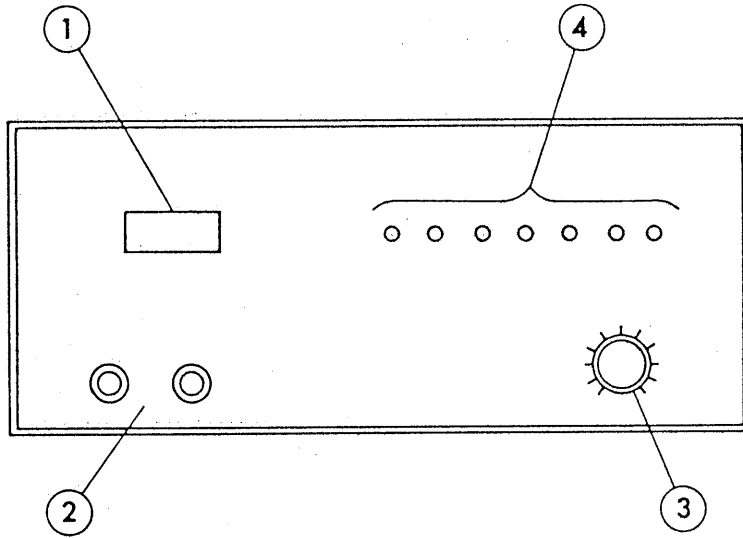   For connection of control input (50-pin connector)
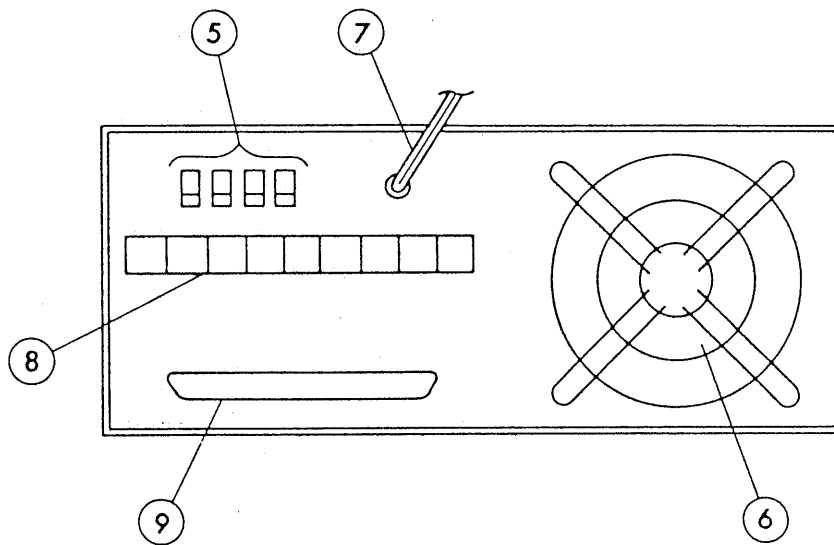
Figure 3-1.   Front panel

Figure 3-2.   Rear panel

3.3 Pins of Control Input Connector

1	STROBE	26	1 ⎞
2		27	2 ⎟ LSD
3		28	4 ⎟
4		29	8 ⎠
5		30	1 ⎞
6		31	2 ⎟
7		32	4 ⎟
8	$\overline{\text{STAND BY}}$	33	8 ⎠
9		34	1 ⎞
10		35	2 ⎟
11		36	4 ⎟
12		37	8 ⎠
13		38	1 ⎞
14	DATA CLEAR	39	2 ⎟
15	DIRECT STAND BY	40	4 ⎟
16	DIRECT ZERO	41	⎠
17	2^0 ⎞ RANGE	42	THERMAL DOWN
18	2^1 ⎠	43	DAC
19	2^0 ⎞ ADDRESS	44	2^2 ⎞ ADDRESS
20	2^1 ⎠	45	2^3 ⎠
21	C V	46	POLARITY
22	POWER ON SIG	47	ERROR
23	+5 V OUT	48	$\overline{\text{READY}}$
24	ADDRESS COINCIDENCE	49	SET
25	GND	50	GND

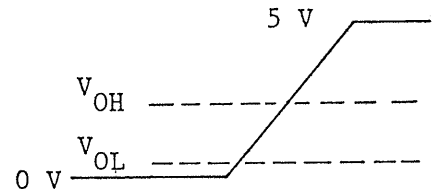## 3.4 Input/Output Control Signals

Example: TTL level
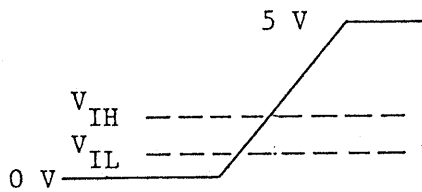
V_{IL}: 0.8 V max.

V_{IH}: 2 V min.

I_{IL}: -1.6 mA max. (V_{IL}=0.4 V)
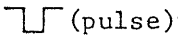
I_{IH}: 40 μA max. (V_{IH}=2.4 V)

V_{OL}: 0.4 V max.

V_{OH}: 2.4 V

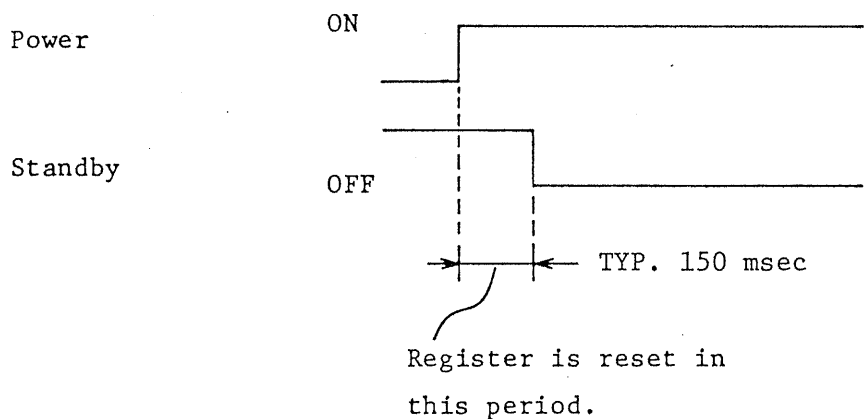| Output voltage control signal	At L level		Operation (1)
Polarity	At H level		+
	At L level		−
Strobe (data)	H → L → H		Operation (with edge)
Address	Level		Coincidence signal
Standby	At H level		Standby ON
	At L level		Standby OFF
Range	Level		* (R: Ranges to be used for respective models)
	2^1 | 2^0		
	H | H	strobe	R $\leqq$ 1 [mA]
	H | L		1 < R $\leqq$ 10 [mA]
	L | H	(data)	10 < R $\leqq$ 100 [mA]
	L | L		100 < R $\leqq$ 1000 [mA]
Set	At L level		Standby release
Direct zero	At L level		Output is zero irrespective of address.
Direct standby	At L level		Standby ON irrespective of address.

Address coincidence	L level	Coincidence of address code
DAC	⊓ (pulse)	Reception of strobe
Error set	L level	Data overflow, invalid range setting
Thermal down	Relay make contact	Overheat of instrument inside
CV (constant-voltage transfer)	L level	Constant-voltage state
$\overline{\text{Ready}}$	H level	
Data clear (10 μsec or over)	L level	Clears resister

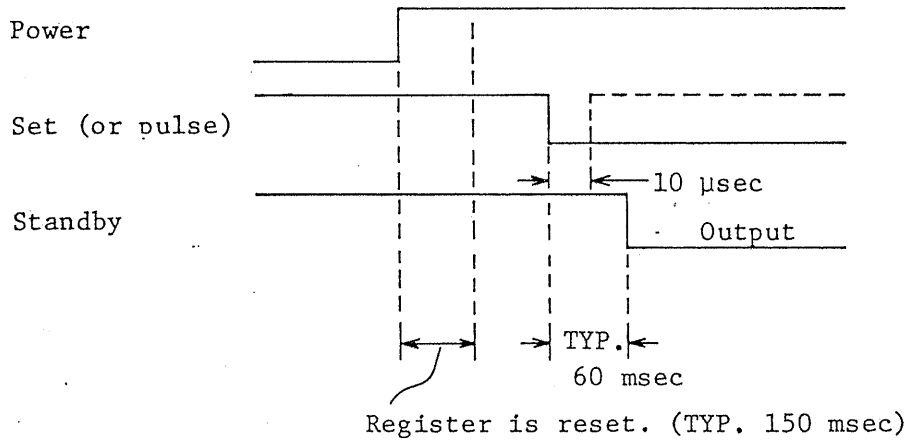* Example: For the model with 50 mA range, 2^1 and 2^0 becomes L and H.

3.5 Timing Charts of Control Signals
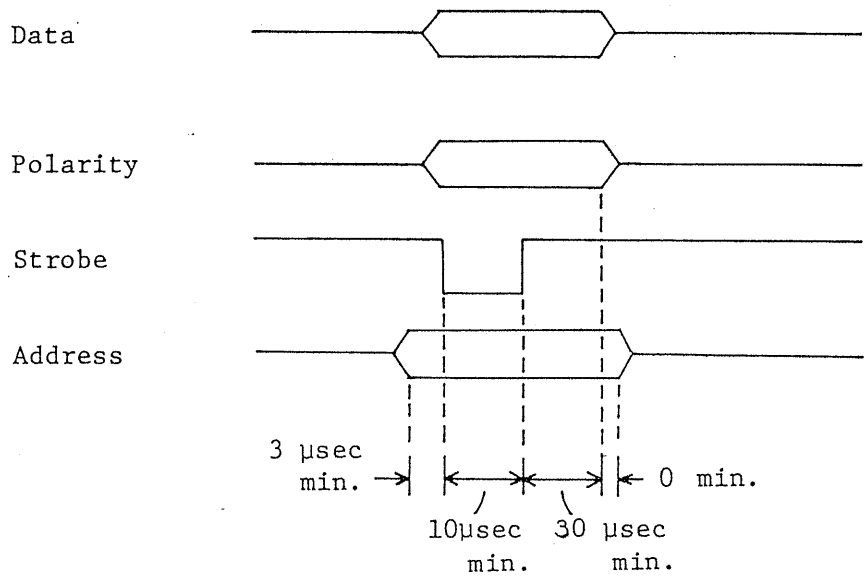
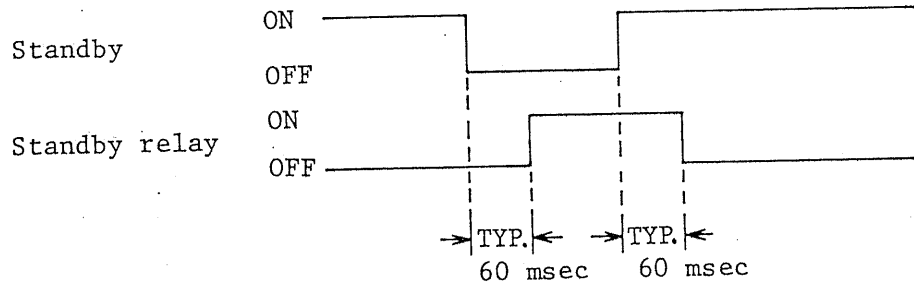(1) When power is ON

o When the SET signal and STANDBY signal are L

Register is reset in this period.

o   When the SET signal is H and the STANDBY signal is L

Power

Set (or pulse)

Standby

─10 µsec

Output

TYP.
60 msec

Register is reset. (TYP. 150 msec)

(2)   Data, polarity, strobe and address

Data

Polarity

Strobe

Address

3 µsec
min.

10µsec   30 µsec
min.   min.

0 min.

- 10 -

(3) Standby switch

Standby

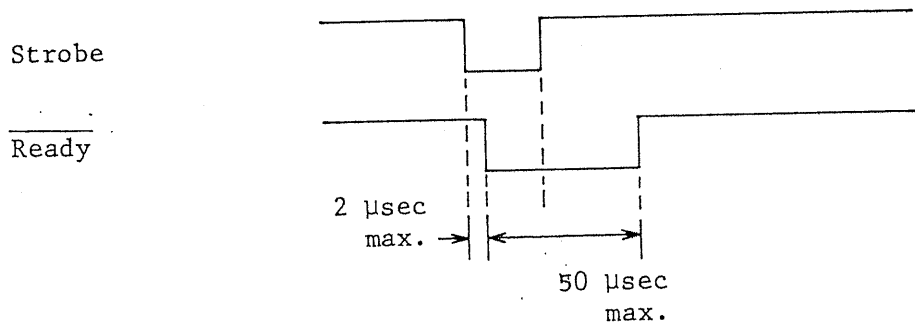ON

OFF

Standby relay

ON

OFF

→|TYP.|←   →|TYP.|←
  60 msec   60 msec
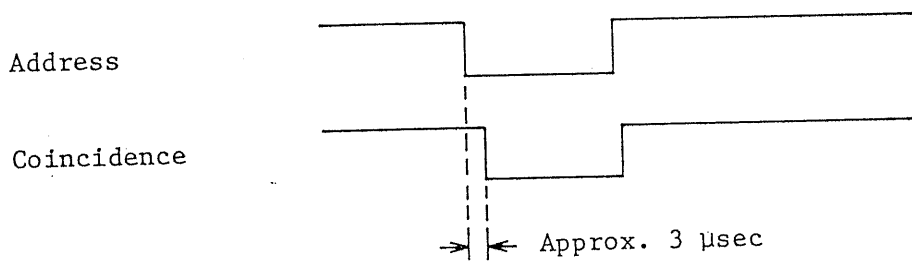
Electromagnetic relay is used for
standby switch.

(4) $\overline{\text{Ready}}$

Strobe

$\overline{\text{Ready}}$

2 μsec
max. →|

50 μsec
max.

(5) Address coincidence

Address

Coincidence

→| |← Approx. 3 μsec

(6) Error   o Invalid range setting

          o Data overflow

Strobe

Error

→| |←Approx. 3 μsec

Reset with
valid input.

(7) DAC (data accept)

Strobe

DAC

20   20
μsec μsec

(8) Range

2^0

2^1

min
10μ
sec

min
30μsec

Strobe

min
25μsec
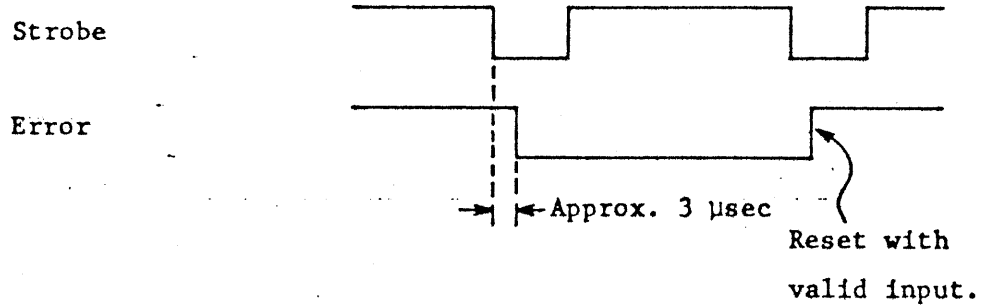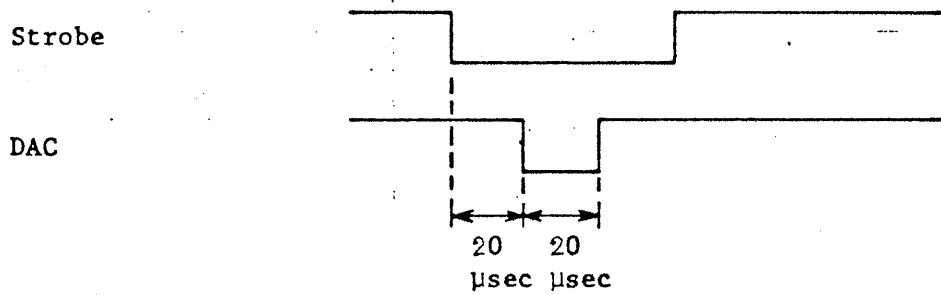
Range
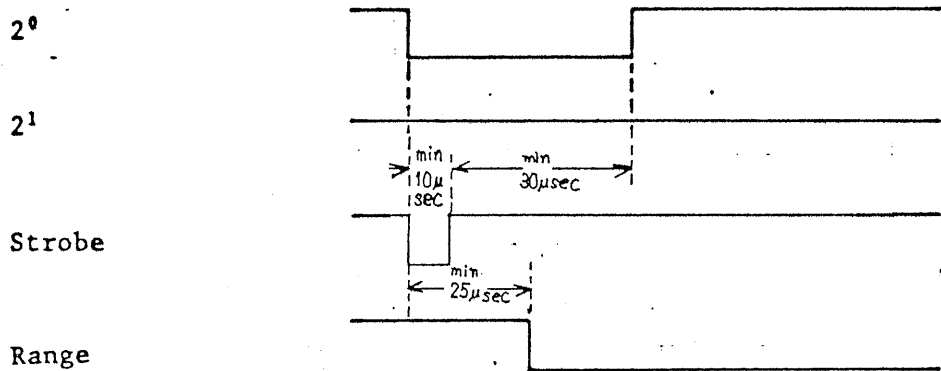
3.6 Preparations for Operation

(1) Connect the power cord to an AC line outlet of the correct voltage and frequency.

(2) Turn on the power switch.

(3) The instrument is ready for operation in several minutes after turning on the power. When a high accuracy is required, allow a stabilization period of 30 minutes or over.

(4) Enter data and set the initial values.

(5) Set the voltage limit knob at the required value.

(6) Apply the set signal.

(7) Release the standby state. Note that relay chattering and overshoots may occur when the standby state is released.

o   Once the set signal is applied, it is not required to be applied until the power is turned on again.

o   The direct standby and zero signals can be controlled irrespective of address specification. The direct zero signal is to make electrically the output signal zero. The standby signal is to isolate mechanically the signal. When the direct zero or standby signal is removed, the original state is automatically restored.

o   If the address is HHHH (0000) or if the address input is open, the condition is the same as if that address is specified.

Notes: 1. No overshoots or undershoots are caused when the current varies in the same polarity. Note, however, that slight overshoots or undershoots may be caused if the current is small and both polarity and data are changed at the same time.

2. Overshoots may be caused when a load is connected from the open state. (Overshoots can be prevented by connecting the load when in the standby state and, then, releasing the standby state.)

3.7 Example of Control (1)

o Although various input/output signals are available, the minimum operations can be done with only data and strobe signals.

(1) For the multi-channel operation, address setting must be done at the instrument rear. When a single unit is operated without external address control, all bits (4 bits) may be held at the H level (pulled up by the instrument itself even when no signal is connected) so that address specification is done irrespective of setting of the switches. The control code is a 4-bit binary negative logic signal (pin numbers 19, 20, 44 and 45).

(2) For a model which has different ranges, a range specification is required (pin numbers 17 and 18). The range specification is done with 2-bit structure. If a fixed-range is required, this can be done by means of electrical connections.

The ranges are written with a strobe signal in the instrument. If range setting is invalid, an error is caused and data cannot be written. Be sure to check the code before setting the ranges. The range codes are as follows:

When the maximum value is	2^1	2^0
0.1 to less than 1	0	0
1 to less than 10	0	1
10 to less than 100	1	0
100 to less than 1000	1	1

Of the 2-bit negative logic code, "1" is the L level. The
V series is in the [Volt] unit and the C series is in the [mA]
unit.

Examples:		2^1	2^0
V 20-1	2 V range	0	1
	20 V range	1	0
C 20-1	100 mA range	1	0
	1 A range	1	1

(3) When setting is not required for a model which incorporates
with the set signal feature, make electrical connections so
that the bit signal is "1" (L level). When the power is turned
on, an output signal of 0 V DC will be produced. To operate
this model of instrument, set it in the "1" state when the
preparations for operation are ready. Alternatively, a nega-
tive-going pulse signal (⊔) may be applied (pin number 49).

(4) Set data with a negative logic BCD signal and apply a strobe
signal.

> Although control at the TTL level is recommended, control
> may be done with relays, transisters, switches, etc.
> (pin number 1 (strobe), pin numbers 26 - 41 (data)).

(5) For standby control (isolation with output relay)

> The standby state is reset as the level is changed from
> H to L. It is set as the level is changed from L to H.
> (Edge operation) (Pin number 8)
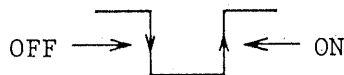
OFF ⟶ ⎺⎸__⎸⎺ ⟵ ON   The standby state is controlled
in the addressed state.

(6) Direct standby (If not required, set OPEN or H) (Pin number 15)

    This standby state is controlled irrespective of address.
    This standby state is reset by the H level and set by the
    L level. (Level operation)

(7) Direct zero (If not required, set OPEN or H) (Pin number 16)

    This signal is for DC ON/OFF control of the output voltage.
    When this signal is at the L level, the output voltage
    becomes zero. This signal does not clear the contents of
    the register and, therefore, the previous set voltage is
    restored when this signal is returned to the H level.

(8) Data clear (If not required, set OPEN or H) (Pin number 14)

    This is the clear bit signal of the data register. When
    this signal is set at the L level, the contents of the
    register is cleared and the output becomes zero.
    (A negative-going pulse may be used instead.)
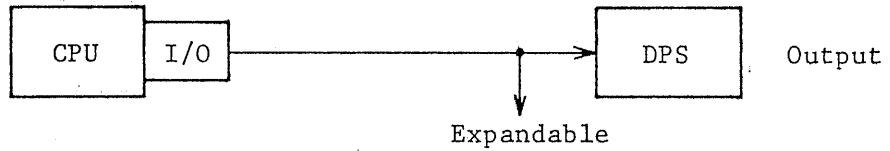
3.8 Example of Aomtrol (2)

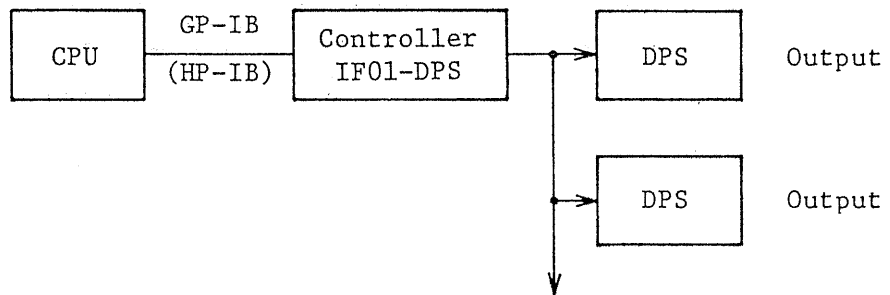To obtain an output which varies stepwise
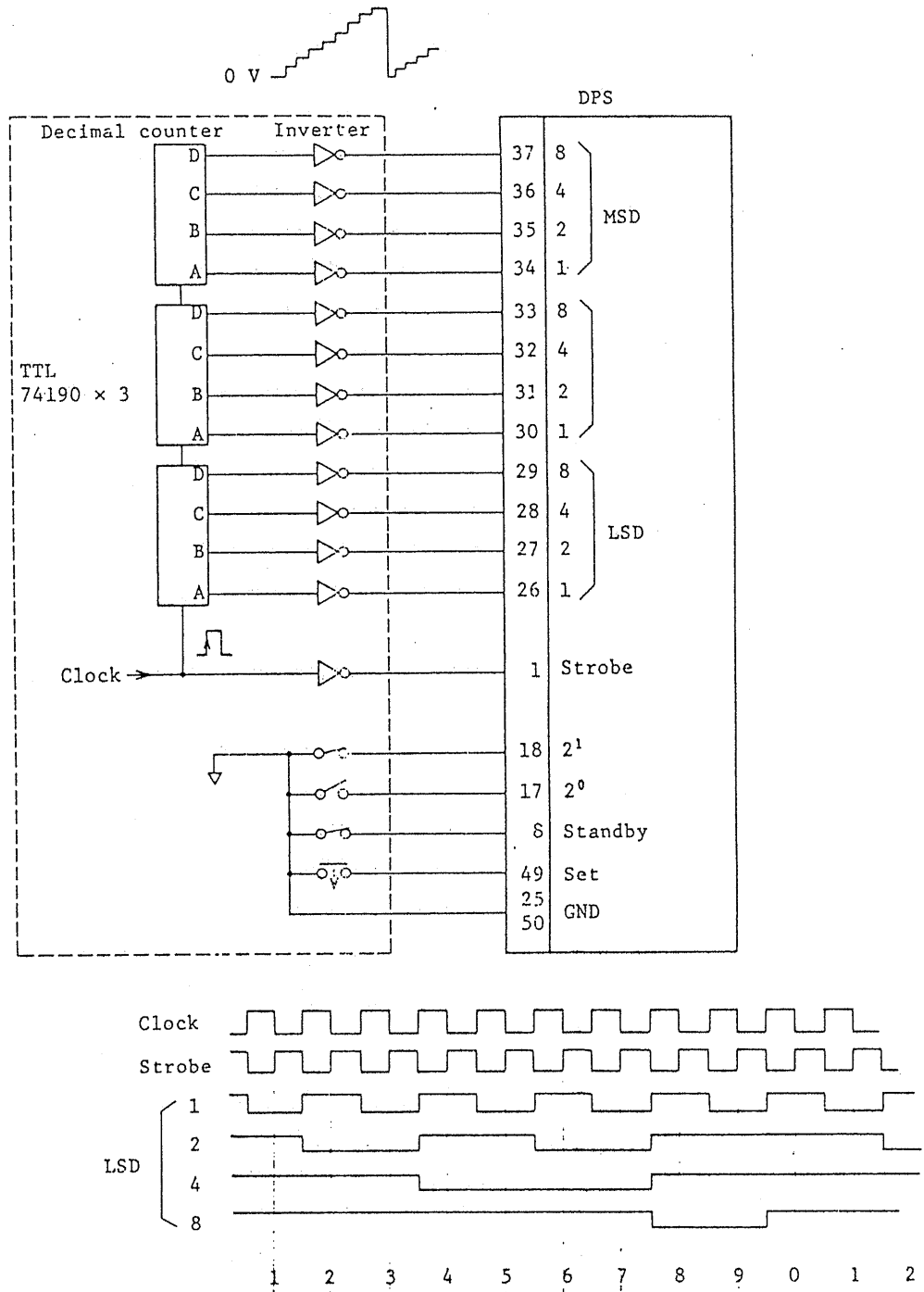
3.9 Examples of Controls of DPS Series

(1) Direct control with CPU

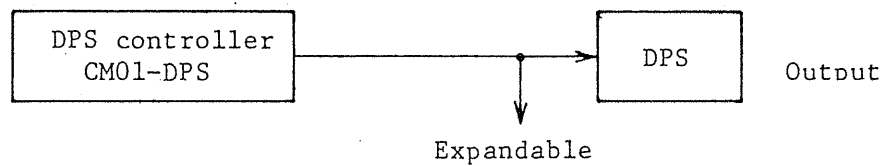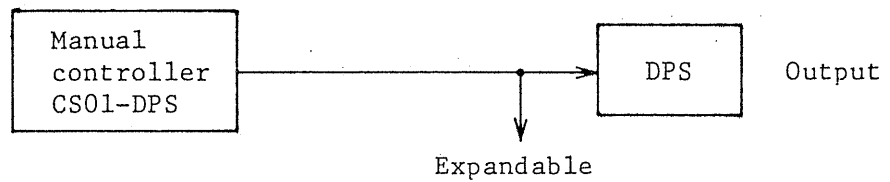CPU: Various controllers (computers, digital equipment, etc.)

```
┌──────┬─────┐                    ┌──────────┐
│ CPU  │ I/O │──────────●───────▶ │   DPS    │  Output
└──────┴─────┘          │         └──────────┘
                        ▼
                   Expandable
```

(2) Control with standard interface

```
┌──────┐  GP-IB   ┌────────────┐       ┌──────────┐
│ CPU  │          │ Controller │───●──▶ │   DPS    │  Output
│      │ (HP-IB)  │  IF01-DPS  │   │    └──────────┘
└──────┘          └────────────┘   │
                                   │    ┌──────────┐
                                   ●──▶ │   DPS    │  Output
                                   │    └──────────┘
                                   ▼
```

Up to 15 units can be controlled.

(3) Function generation with KIKUSUI MODEL CM01-DPS

```
┌────────────────┐                ┌──────────┐
│ DPS controller │──────●───────▶ │   DPS    │  Output
│    CM01-DPS    │      │         └──────────┘
└────────────────┘      ▼
                   Expandable
```

Non-volatile memory of 64 steps available

(4) Remote control

```
┌────────────┐                    ┌──────────┐
│ Manual     │                    │   DPS    │  Output
│ controller │──────────●───────▶ └──────────┘
│ CS01-DPS   │          │
└────────────┘          ▼
                   Expandable
```

4. OPERATING PRINCIPLE

4.1 Circuit Structure

The circuit structure of this instrument is shown with a block diagram in Figure 4-1.
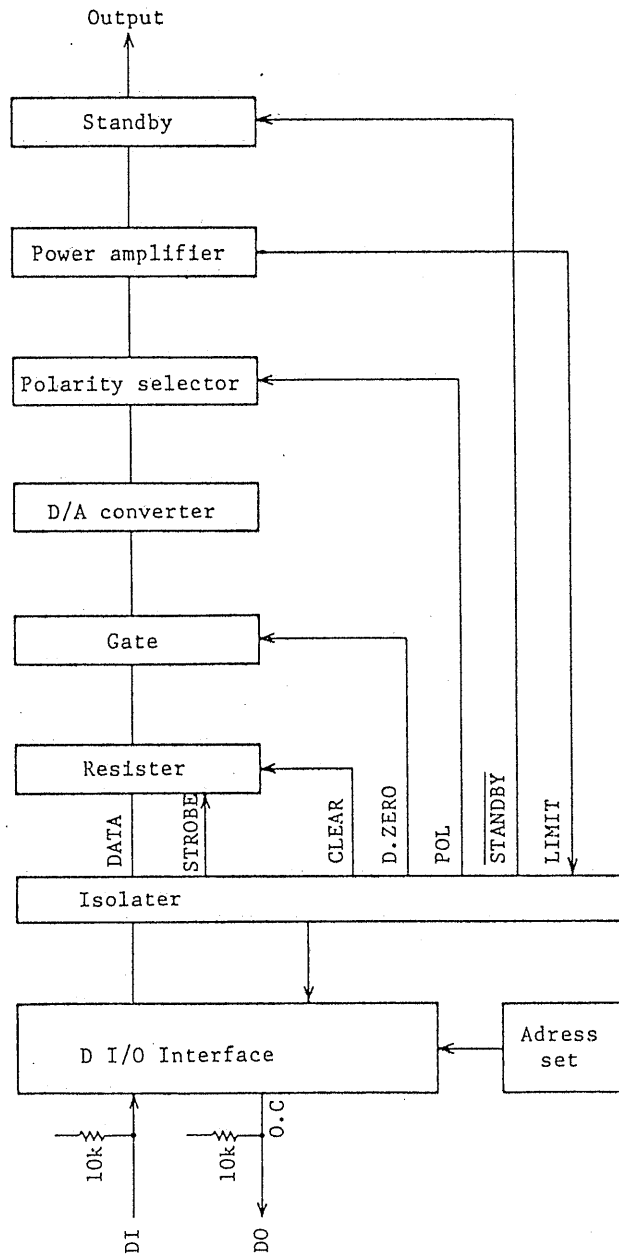

Figure 4-1

4.2 Operation Description

The input/output logic level signal is pulled up by a resister
(10 kΩ). Data entered at the TTL level is subjected to a
buffer effect at the D I/O interface section, it is isolated
with a photocoupler, and then it is stored in the register.

The strobe signal is passed on when address "0" is specified
(or when open) or when the address set at the instrument (main
unit) conforms with the specified address. The strobe signal
then is fed via the isolator to the register to store the data
in the register. The stored data is maintained even when the
input is varied, until the next strobe signal is applied.

The data clear signal clears the register, making all bits "0".
The stored data is fed via a gate to the D/A converter. The
gate is for the direct zero signal, which is capable of making
all bits "0" temporarily by means of the gate without clearing
the register.

Resister

D/A converter

Direct zero
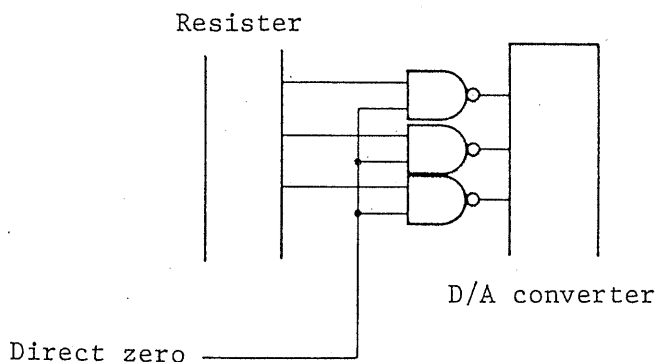
A NAND gate is used. (The D/A converter input is a complimentary
type.) When the gate is closed, its output becomes the H level.

The digital signal is converted into an analog signal by the
D/A converter, the polarity of the analog signal is selected
by the polarity signal, and the resultant signal is fed to the
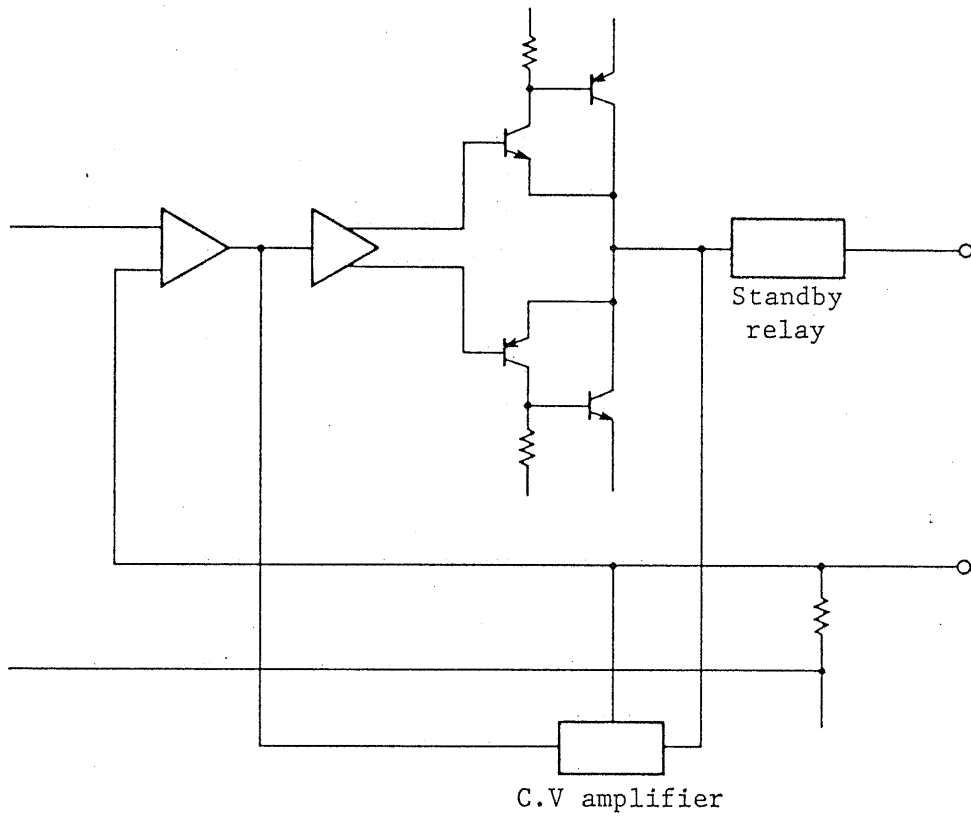output amplifier.

The polarity selector, being controlled with the polarity signal
and an FET switching circuit, selects between polarity inversion
and non-inversion.
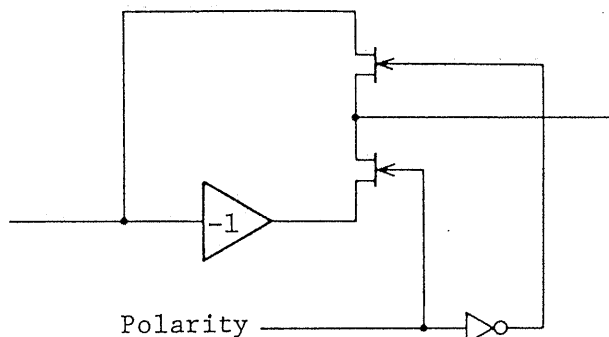
The output amplifier consists of an IC (initial stage), transis-
tor circuits, and control transistors. It is a high speed,
high stability, high accuracy amplifier.

The output voltage limiter circuit monitors the output voltage.
When the voltage has exceeded the voltage preset by the knob,
the limiter circuit makes up a closed loop with the final stage
of the constant-current amplifier, thereby transferring the
instrument operation into the constant-voltage mode and main-
taining in this mode. This mode is indicated on the front
panel. When in this mode, the output is delivered through the
isolator.

This instrument has a motor-driven fan to cool the control tran-
sistors of the output section. When the ambient temperature is
abnormally high or when the fan motor has failed and the instru-
ment inside temperature has become abnormally high, the control
transistors may be overheated and damaged. In order to guard
against this, a thermal sensor is installed on the heat sink of
the control transistors. The thermal sensor trips at 70°C and
the instrument is released into the standby state in order to
guard against damage by overheating.

Standby
relay

C.V amplifier

5. MAINTENANCE

5.1 Layout of Components

Figure 5-1 (Top view)

IC
D/A CONV.

R84

R13
OFFSET
R12
MAX
R6

Monitor amplifier

R55   R53   R51

R76

R79

R73

R68

TP3   GND   TP2   TP1

○
○   ○ +5V
○   ○ GND) *1
○   ○
○
○ +15V
○) GND   *2
○
○ −15V
○   ○ +5V) *3
○↔○ GND
○   ○
○ −15V
○ +15V
○   *4
○
○
○ GND
○
○

Power supply

(+33V) TP4
R51

R54

(−33V) TP5
−C.V MIN R29

+C.V MIN R8
−C.V MAX R45
+C.V MAX R37

C.C, C.V amplifier

OUTPUT
OFFSET
R4

Power amplifier
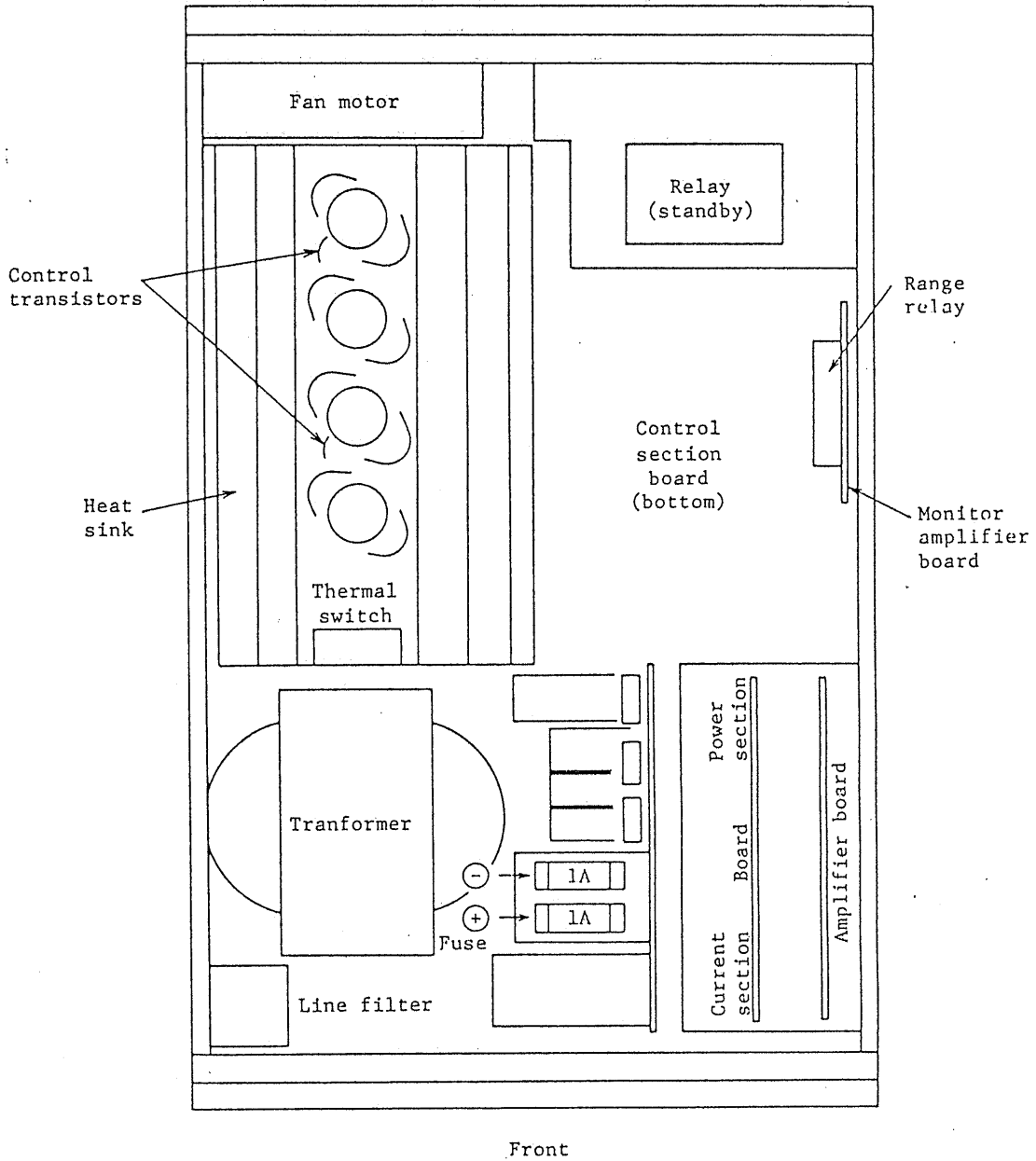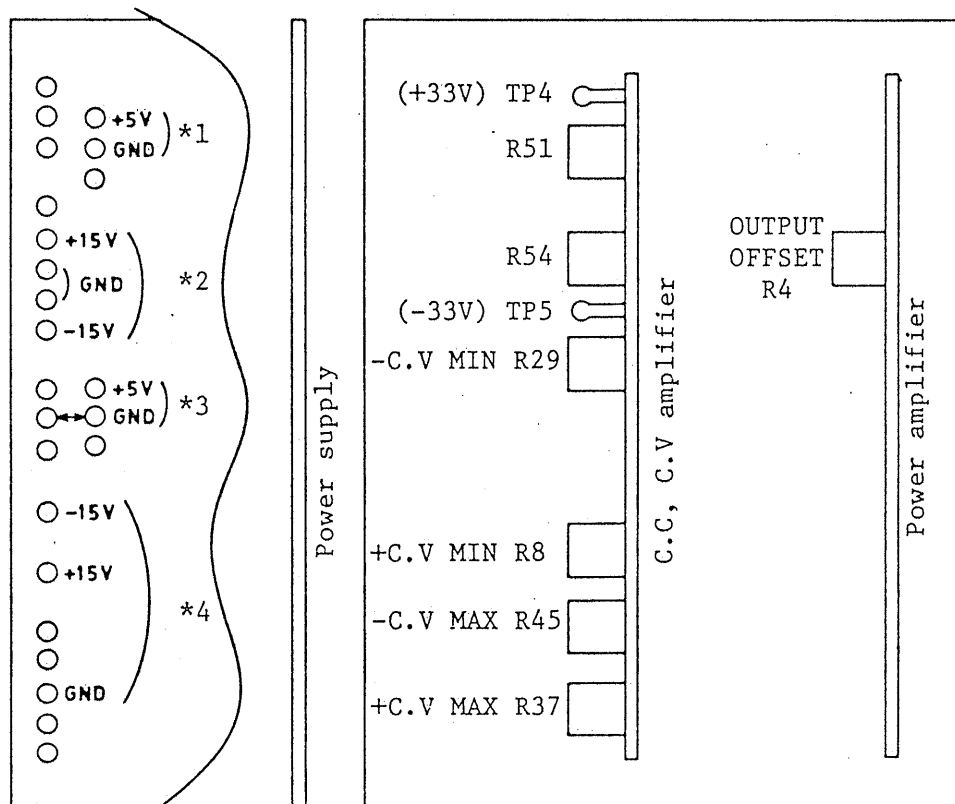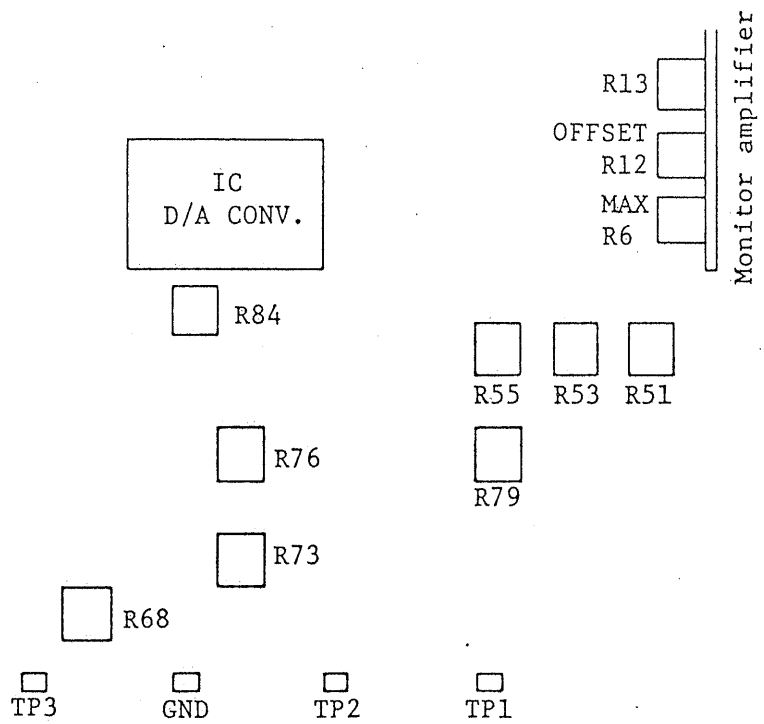
Left side

*1, *2: For control

*3: For interface

*4: For power amplifier

Figure 5-2

- 24 -

5.2 Adjusting Procedures (See Figure 5-2.)

(1) Check and Adjustment of Supply Voltages

1-1. Check of +15 V and -15 V supplies of control circuit

Each of these supplies employs a 3-terminal fixed-output IC. Connect a voltmeter between control GND terminal and +15 V terminal, and check that the voltage is within 14.2 V to 15.8 V. Connect a voltmeter between control GND terminal and -15 V terminal, and check that the voltage is within -14.2 V to -15.8 V.

1-2. Check of +5 V supply of control circuit

This supply employs a 3-terminal fixed-output IC. Connect a voltmeter between control GND terminal and +5 V terminal, and check that the voltage is within 4.75 V to 5.25 V.

1-3. Check of +15 V and -15 V supplies of power amplifier

Each of these supplies employs a 3-terminal fixed-output IC. Connect a voltmeter between power GND terminal and +15 V terminal, and check that the voltage is within 14.2 V to 15.8 V. Connect a voltmeter between power GND terminal and -15 V terminal, and check that the voltage is within -14.2 V to -15.8 V.

1-4. Check of 5 V supply of interface circuit

This supply employs a 3-terminal fixed-output IC. Connect a voltmeter between interface GND terminal and +5 V terminal, and check that the voltage is within 4.75 V to 5.25 V.

1-5. Adjustment of ±63 V supplies of power amplifier
(CC, CV amplifier board)

Connect a voltmeter between power GND pin No. 4 (L side)
and TP4. So adjust potentiometer R34 that the voltmeter
reads within 62.5 V to 63.5 V. Connect a voltmeter to
TP5 and so adjust potentiometer R37 that the voltmeter
reads within -62.5 V to -63.5 V.

(2) Offset adjustment of IC

Connect a 100-ohm standard resistor to the output terminal
and enter range 50 mA [1, 0] and data [+0000].

2-1. Connect a digital voltmeter between pin 6 (TP1) of MC16
of D/A converter and GND terminal, and so adjust poten-
tiometer R79 that the digital voltmeter reads within·
±20 µV.

2-2. Connect a digital voltmeter between pin 6 (TP2) of MC15
of inverter and GND terminal, and so adjust potentiometer
R73 that the digital voltmeter reads within ±20 µV.

2-3. Connect a digital voltmeter across the standard resistor
at the output terminal (or to the sensing terminal if
provided) and so adjust potentiometer R4 of the power
amplifier that the voltmeter reads less than 50 µV.

(3) Gain adjustment of D/A converter

Set potentiometer R76 at a midposition of its control range.
Enter data [+0999].

3-1. So adjust potentiometer R84 that the voltage becomes
999 mV ±10 µV.

3-2. Enter data [+1000]. So adjust potentiometer R55' that the voltage becomes 1 V ±100 μV.

3-3. Enter data [+2000]. So adjust potentiometer R55 that the voltage becomes 2 V ±100 μV.

3-4. Enter data [+4000]. So adjust potentiometer R53 that the voltage becomes 4 V ±200 μV.

3-5. Enter data [-4999]. So adjust potentiometer R68 that the voltage becomes -4.999 V ±500 μV.

3-6. Vary each input data and measure the output voltage (current) to check that it is within the tolerance. If it is not within the tolerance, adjust it with corresponding potentiometer.

3-7. Change the standard resistor with a 10-ohm resistor. Enter range 500 mA [1, 1] and data [+4999] . So adjust potentiometer R13 that the voltage becomes 4.999 V +500 μV.

3-8. Vary each input data and check that the output is within the tolerance. If it is not within the tolerance, repeat the adjustment.

(4) Adjustment of monitor output

Connect a digital voltmeter to the monitor output terminal on the rear panel. Enter data [+0000].

4-1. So adjust potentiometer R12 that the output voltage becomes 0 V ±20 μV.

4-2. Enter data [+4999]. So adjust potentiometer R6 that the output voltage becomes 499.9 mV ±50 μV.

(5) Adjustment of output voltage (CV amplifier)

Make the output terminal open and connect directly to it a digital voltmeter. Enter range 50 mA [1, 0] and data [+4999].

5-1. Set the voltage limit knob of the front panel in the extremely counterclockwise position. So adjust potentiometer R8 that the output voltage becomes approximately 2.5 V.

5-2. Turn the voltage limit knob to the extremely clockwise position. So adjust potentiometer R37 that the output voltage becomes approximately 53 V.

5-3. Repeat the procedures of 5-1 and 5-2 until both requirements are met at the same time.

5-4. Enter data [-499.9]. Turn the voltage limit knob to the extremely counterclockwise position. So adjust ptentiometer R29 that the output voltage becomes approximately -2.5 V.

5-5. Turn the voltage limit knob to the extremely clockwise position. So adjust potentiometer R45 that the output voltage becomes approximately -53 V.

5-6. Repeat the procedures of 5-4 and 5-5 until both requirements are met at the same time.