

INSTRUCTION MANUAL

DIGITAL PROGRAMMABLE POWER SOURCE

MODEL DPS-C 20-1

KIKUSUI ELECTRONIC CORPORATION

81216

812162

On Power Supply Source, it is requested to replace the related places in the instruction manual with the following items.

(Please apply the item of mark.)

- Power Supply Voltage: to _ _ _ _ _ V AC
- Line Fuse: to _ _ _ _ _ A
- Power Cable: to 3-core cable (See Fig. 1 for the colors.)

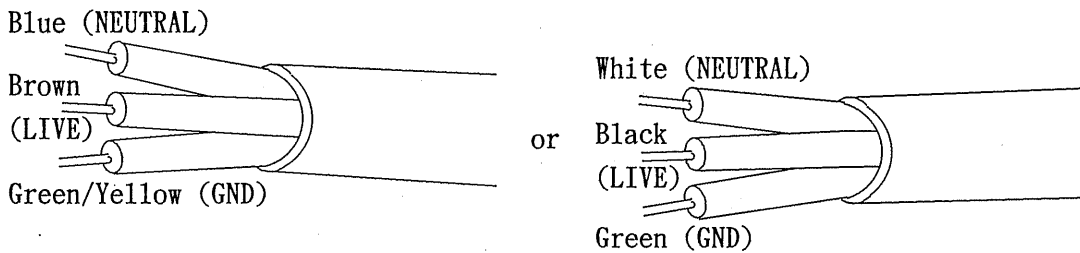


Fig. 1

Please be advised beforehand that the above matter may cause some alteration against explanation or circuit diagram in the instruction manual.

- * AC Plug: In case of Line Voltage 125V AC or more, AC Plug is in principle taken off and delivered, in view of the safety.
(AC Plug on 3-core cable is taken off in regardless of input voltages.)
To connect the AC plug to the AC power cord, connect the respective pins of the AC plug to the respective core-wires (LIVE, NEUTRAL, and GND) of the AC power cord by referring to the color codes shown in Fig. 1.

Before using the instrument, it is requested to fix a suitable plug for the voltage used.

90.11.14

905181

TABLE OF CONTENTS

| | PAGE |
|--|------|
| 1. GENERAL | 1 |
| 2. SPECIFICATIONS | 2 |
| 3. OPERATION METHOD | 4 |
| 3.1 Description of Front Panel | 4 |
| 3.2 Description of Rear Panel | 4 |
| 3.3 Pins of Control Input Connector | 7 |
| 3.4 Input/Output Control Signals | 8 |
| 3.5 Timing Charts of Control Signals | 9 |
| 3.6 Preparations for Operation | 13 |
| 3.7 Example of Control (1) | 14 |
| 3.8 Example of Control (2) | 17 |
| 3.9 Examples of Controls of DPS Series | 18 |
| 4. OPERATING PRINCIPLE | 19 |
| 4.1 Circuit Structure | 19 |
| 4.2 Operation Description | 20 |
| 5. MAINTENANCE | 23 |
| 5.1 Layout of Components | 23 |
| 5.2 Adjusting Procedures | 25 |

1. GENERAL

The DPS C 20-1 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 ± 99.99 mA (10 μ A resolution) and 0 to ± 999.9 mA (100 μ A resolution). Current setting, including polarity setting, can be controlled with a 17-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 $\pm(1.5$ V to 20 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 instrument 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 20-1

Output section

Type: Bipolar constant-current constant-voltage transfer type

Current: 0 to +999.9 mA

Ranges: Two ranges of 100 mA and 1 A

Resolutions: 10 μ A and 100 μ A

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

Ripple and noise: 40 μ A rms or less (at 10 Hz - 1 MHz)

Programming noise: \pm 500 μ A peak or less (at rear terminal)

Load regulation: 0.008% of range or less (at rear terminal),
for 0 - 100% load change

Line voltage regulation: 0.005% of range + 1 μ A or less, for
 \pm 10% line voltage change

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

Output voltage: 20 V maximum

Setting: Manual, approx. \pm (1.5 to 20) V

Control section

Input/output signals: TTL level

812105

Control signals

| | | | |
|----------------|----------|---------|-------------------|
| Data | Polarity | 1 bit | |
| | Current | 16 bits | (BCD) |
| Strobe | | 1 bit | (edge) |
| Address | | 4 bits | |
| <u>Standby</u> | | 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. 100 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 $\pm(1A, 1.5$ to $20 V)$. 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 1.5 to 20 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.

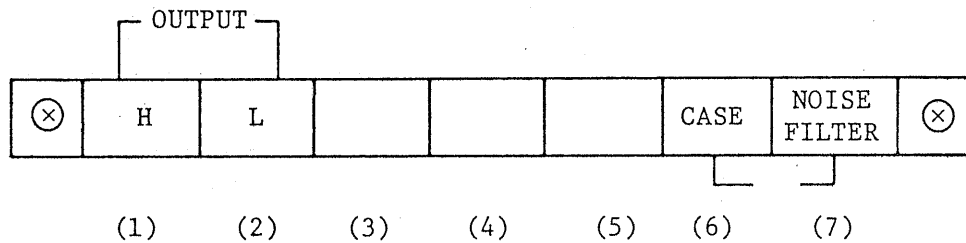
⑥ Fan motor:

Cooling fan motor.

⑦ Power cord:

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

⑧ Terminal block



- (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 particular 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)

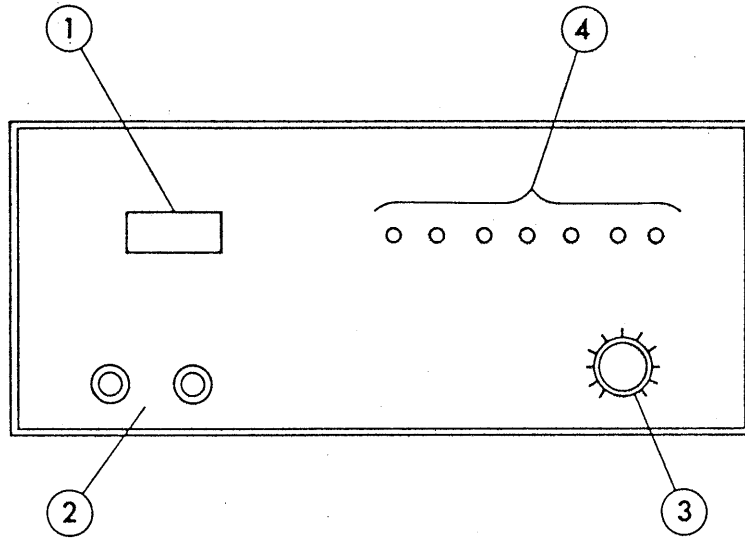


Figure 3-1. Front panel

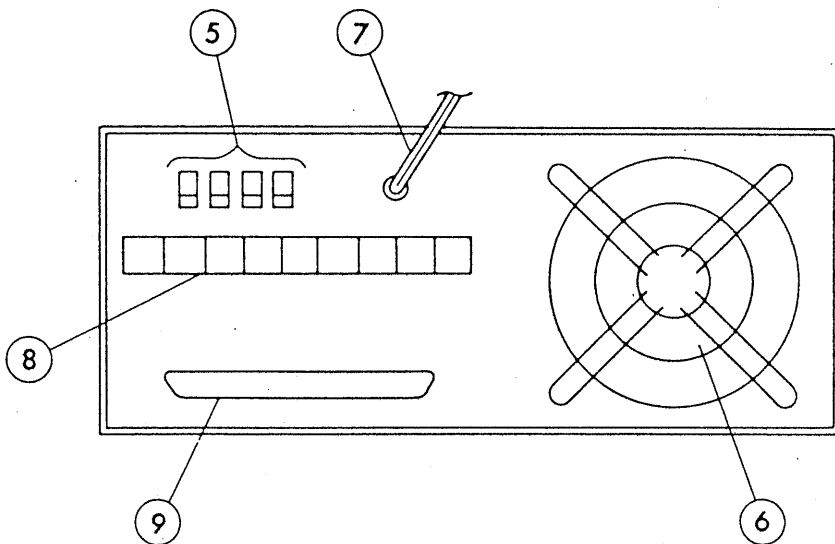


Figure 3-2. Rear panel

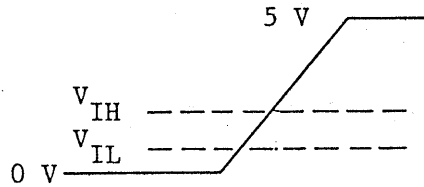
642199

3.3 Pins of Control Input Connector

| | | | | |
|----|--------------------------|----|------------------|-----------|
| 1 | STROBE | 26 | 1 | } LSD |
| 2 | | 27 | 2 | |
| 3 | | 28 | 4 | |
| 4 | | 29 | 8 | |
| 5 | | 30 | 1 | } |
| 6 | | 31 | 2 | |
| 7 | | 32 | 4 | |
| 8 | <u>STAND BY</u> | 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 | 8 | |
| 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 | <u>ERROR</u> | |
| 23 | +5 V OUT | 48 | <u>READY</u> | |
| 24 | ADDRESS COINCIDENCE | 49 | SET | |
| 25 | GND | 50 | GND | |

3.4 Input/Output Control Signals

Example: TTL level

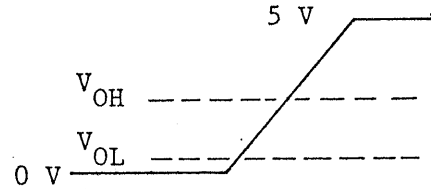


V_{IL} : 0.8 V max.

V_{IH} : 2 V min.

I_{IL} : -1.6 mA max. ($V_{IL}=0.4$ V)

I_{IH} : 40 μ A 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 \rightarrow L \rightarrow H | | Operation (with edge) | | |
| Address | Level | | Coincidence signal | | |
| Standby | At H level | | Standby ON | | |
| | At L level | | Standby OFF | | |
| Range | Level | strobe (data) | * (R: Ranges to be used for respective models) | | |
| | 2 ¹ | | | 2 ⁰ | |
| | H | | | H | $R \leq 1$ [mA] |
| | H | | | L | $1 < R \leq 10$ [mA] |
| | L | | | H | $10 < R \leq 100$ [mA] |
| L | L | $100 < R \leq 1000$ [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. | | |

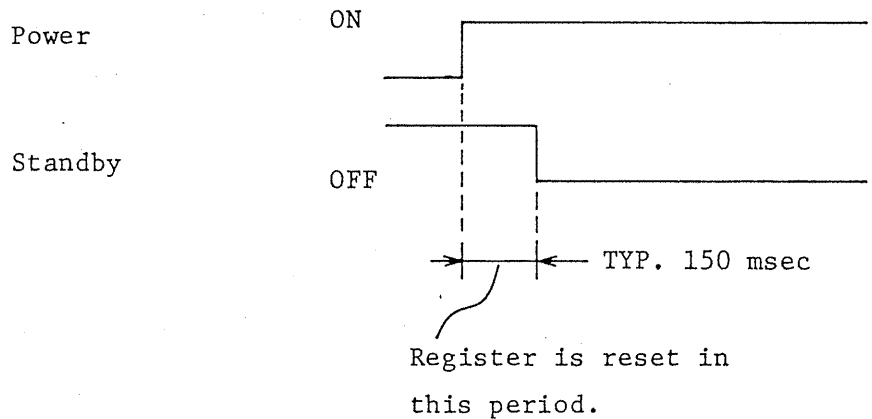
| | | |
|---------------------------------|--------------------|--------------------------------------|
| Address coincidence | L level | Coincidence of address code |
| DAC | ⌋⌋ (pulse) | Reception of strobe |
| Error set | L level | Data overflow, invalid range setting |
| Thermal down | Relay make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

* Example: For the model with 100 mA range, 2^1 and 2^0 becomes L and H.

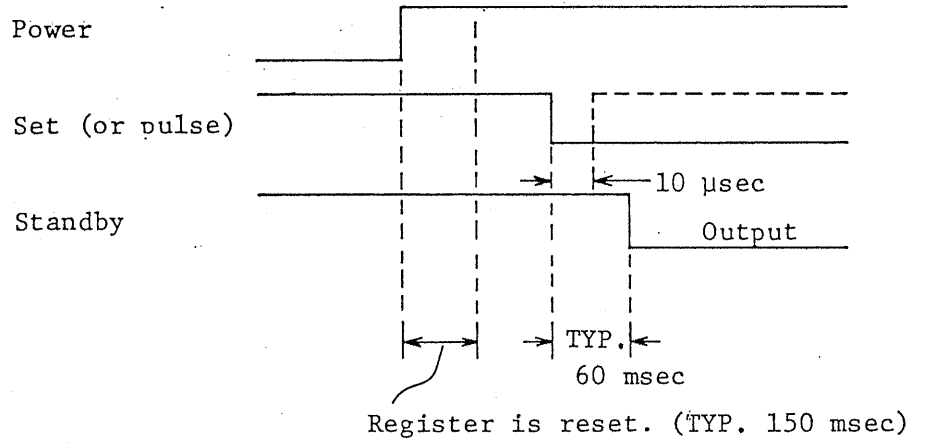
3.5 Timing Charts of Control Signals

(1) When power is ON

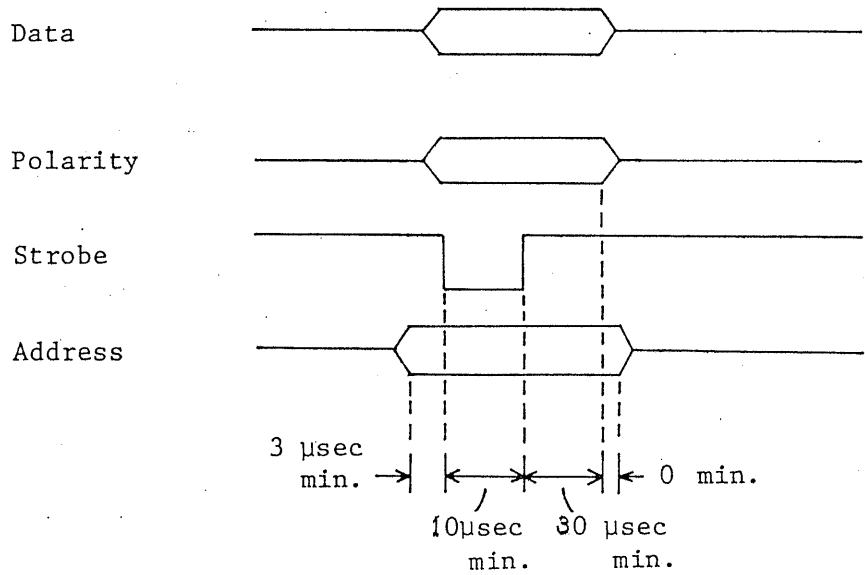
- o When the SET signal and STANDBY signal are L



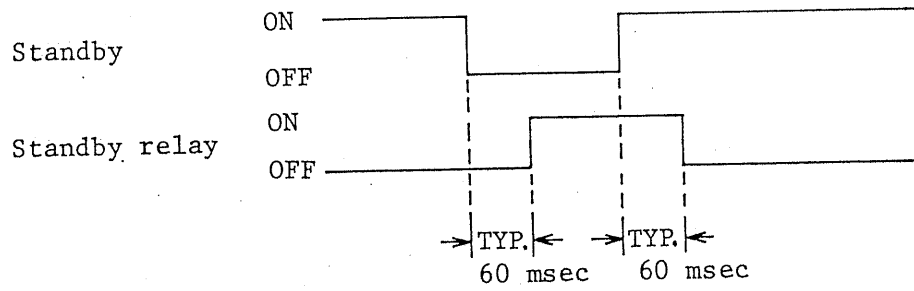
- o When the SET signal is H and the STANDBY signal is L



(2) Data, polarity, strobe and address

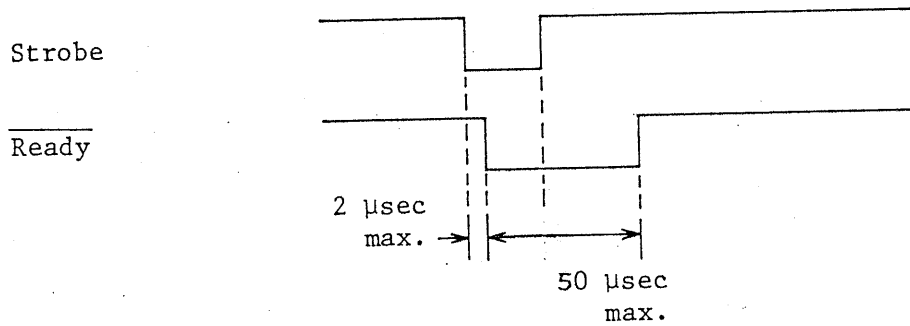


(3) Standby switch

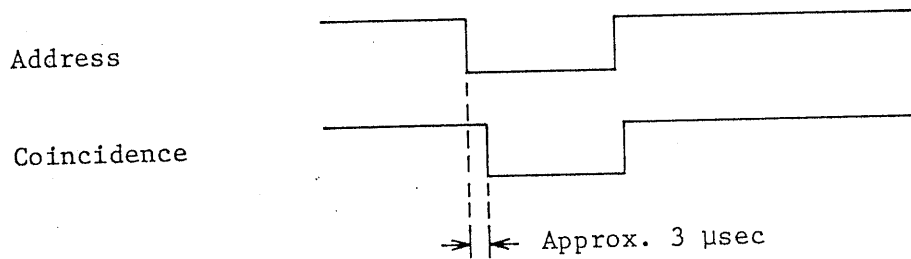


Electromagnetic relay is used for standby switch.

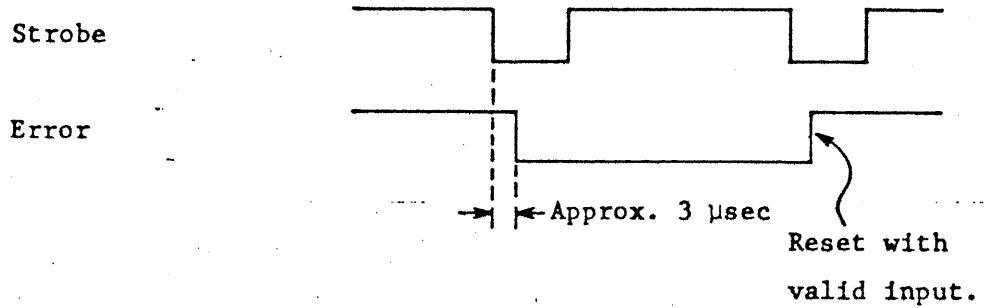
(4) Ready



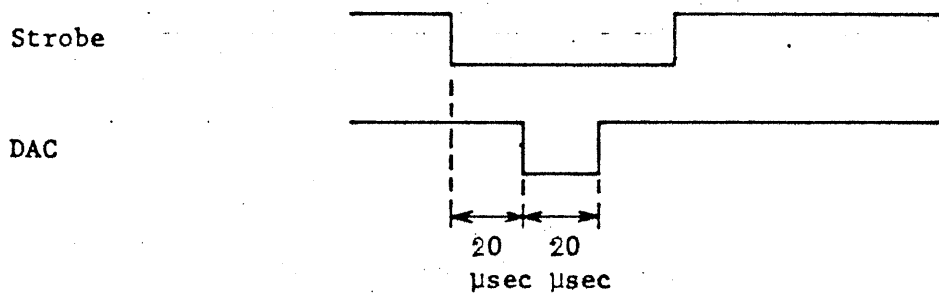
(5) Address coincidence



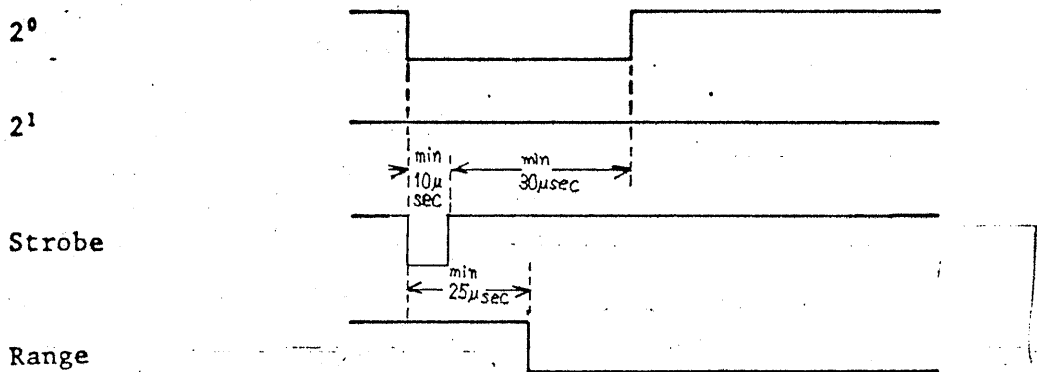
- (6) Error
- o Invalid range setting
 - o Data overflow



- (7) DAC (data accept)



- (8) 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 negative-going pulse signal ($\bar{1}$) 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, transistors, 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)



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)

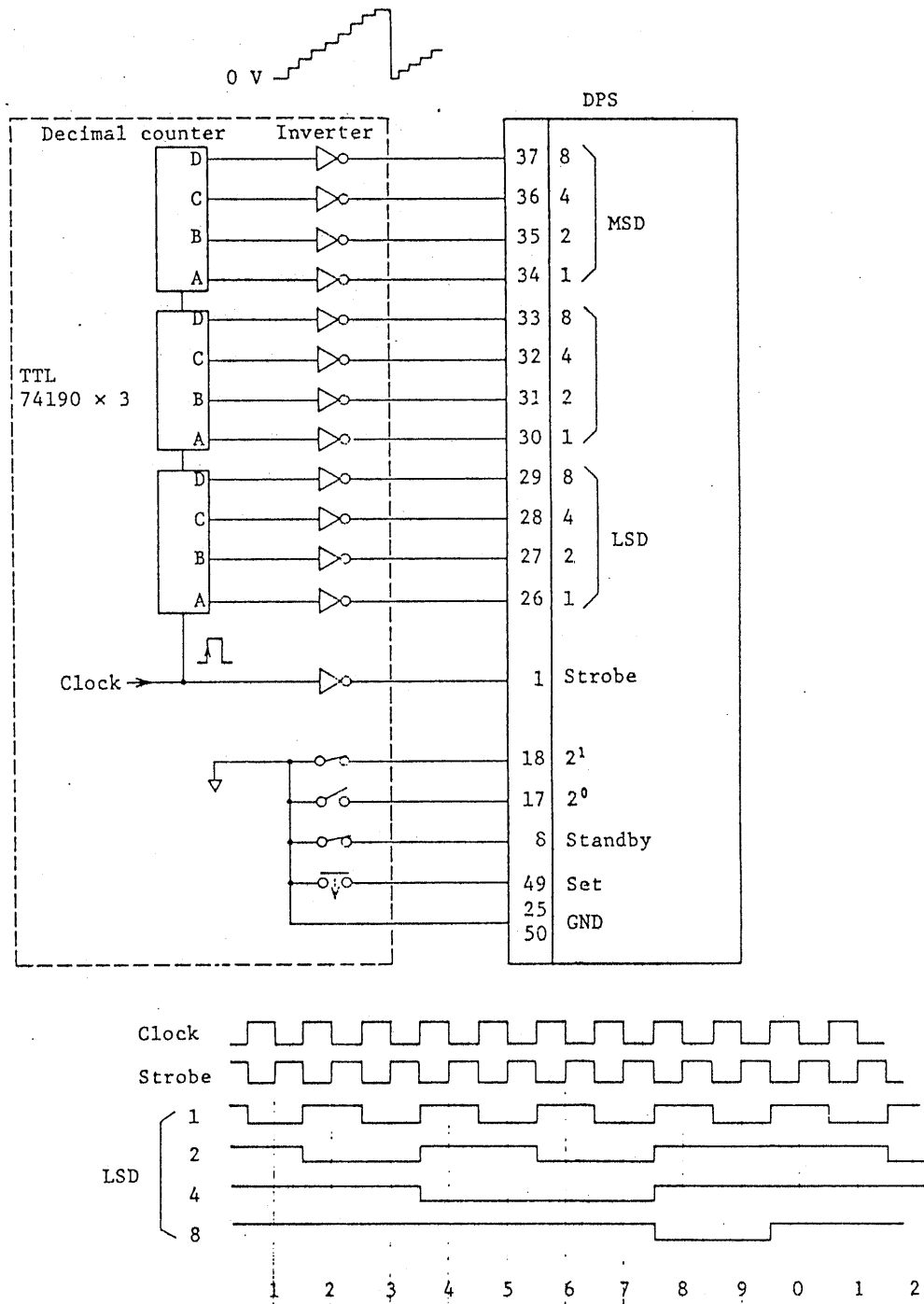
This signal is for DC ON/OFF control of the output voltage. When this signal is at the L level, the output voltage becomes zero. This signal does not clear the contents of the register and, therefore, the previous set voltage is restored when this signal is returned to the H level.

- (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)

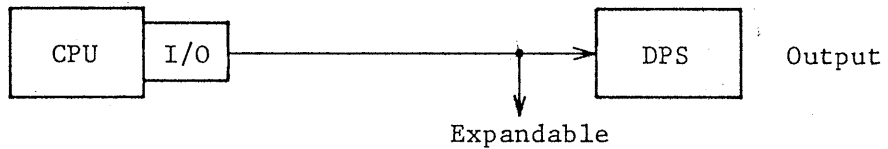
To obtain an output which varies stepwise



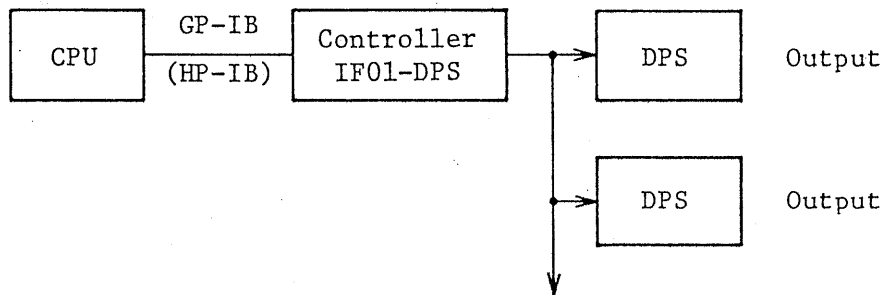
3.9 Examples of Controls of DPS Series

(1) Direct control with CPU

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

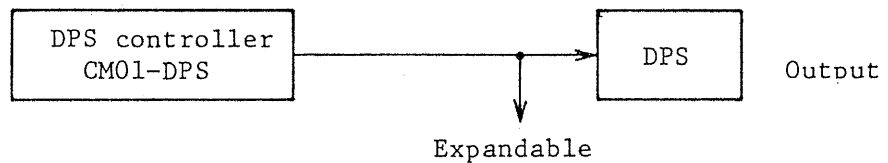


(2) Control with standard interface



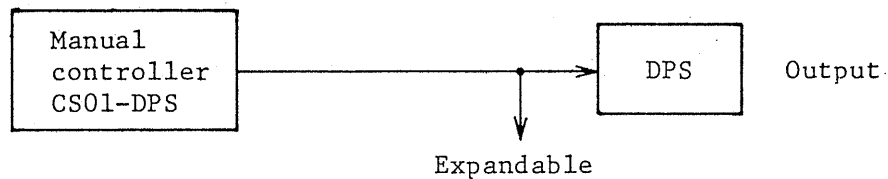
Up to 15 units can be controlled.

(3) Function generation with KIKUSUI MODEL CM01-DPS



Non-volatile memory of 64 steps available

(4) Remote control



4. OPERATING PRINCIPLE

4.1 Circuit Structure

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

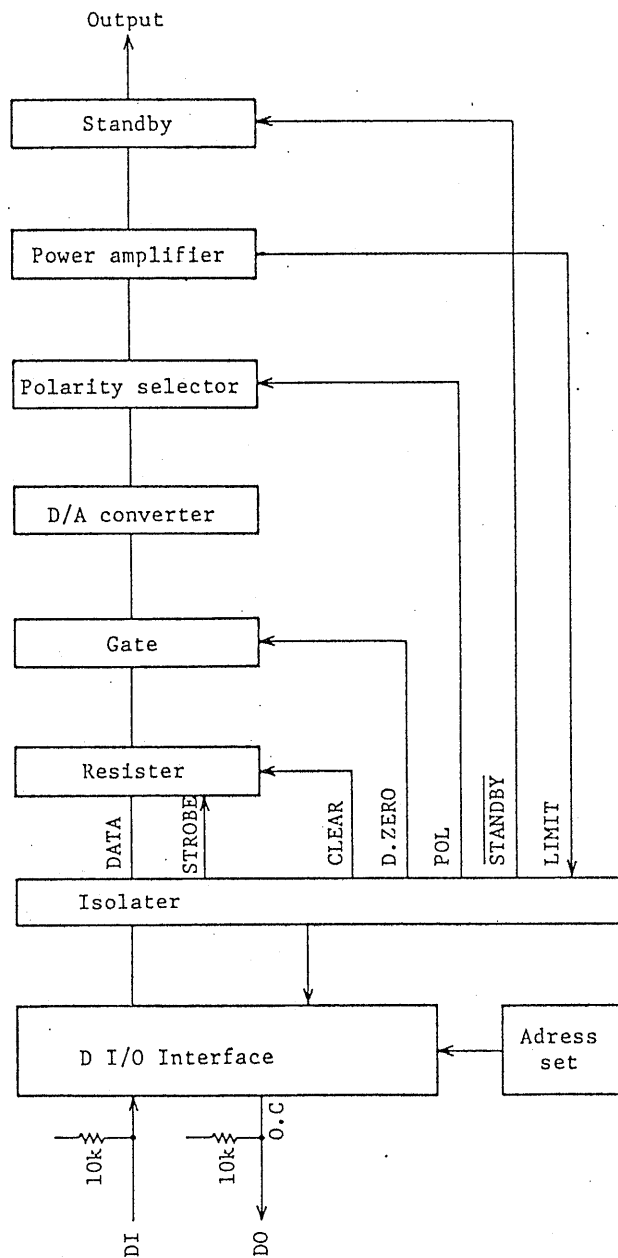


Figure 4-1

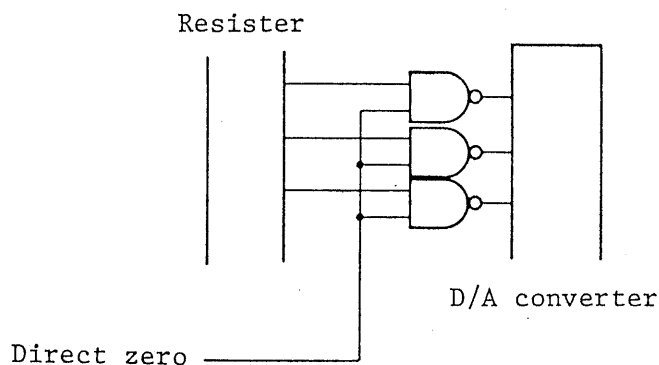
212212

4.2 Operation Description

The input/output logic level signal is pulled up by a resistor (10 k Ω). 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.

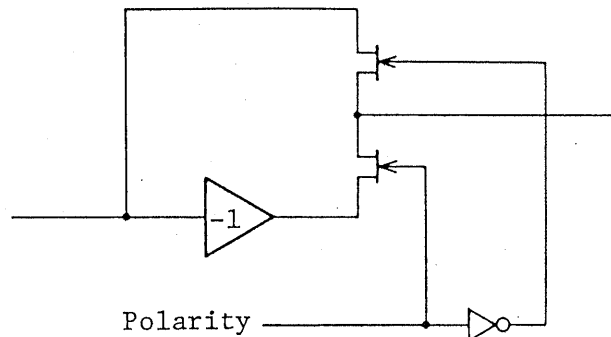
The data clear signal clears the register, making all bits "0". The stored data is fed via a gate to the D/A converter. The gate is for the direct zero signal, which is capable of making all bits "0" temporarily by means of the gate without clearing the register.



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.

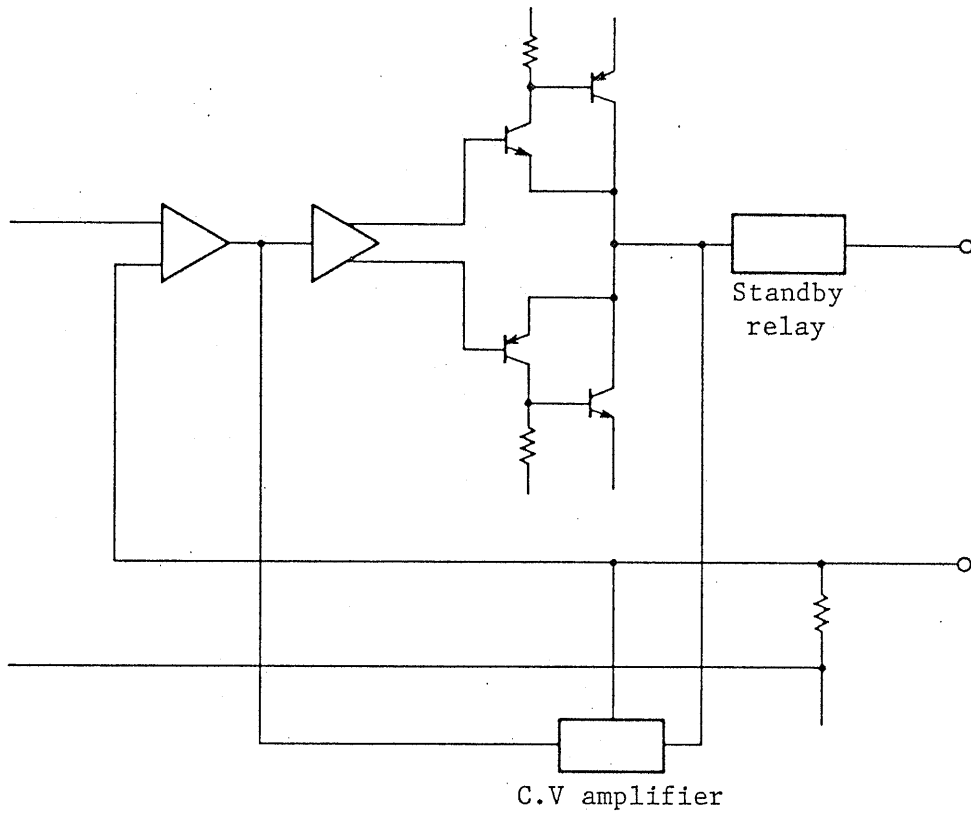
The polarity selector, being controlled with the polarity signal and an FET switching circuit, selects between polarity inversion and non-inversion.



The output amplifier consists of an IC (initial stage), transistor 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 maintaining in this mode. This mode is indicated on the front panel. When in this mode, the output is delivered through the isolator.

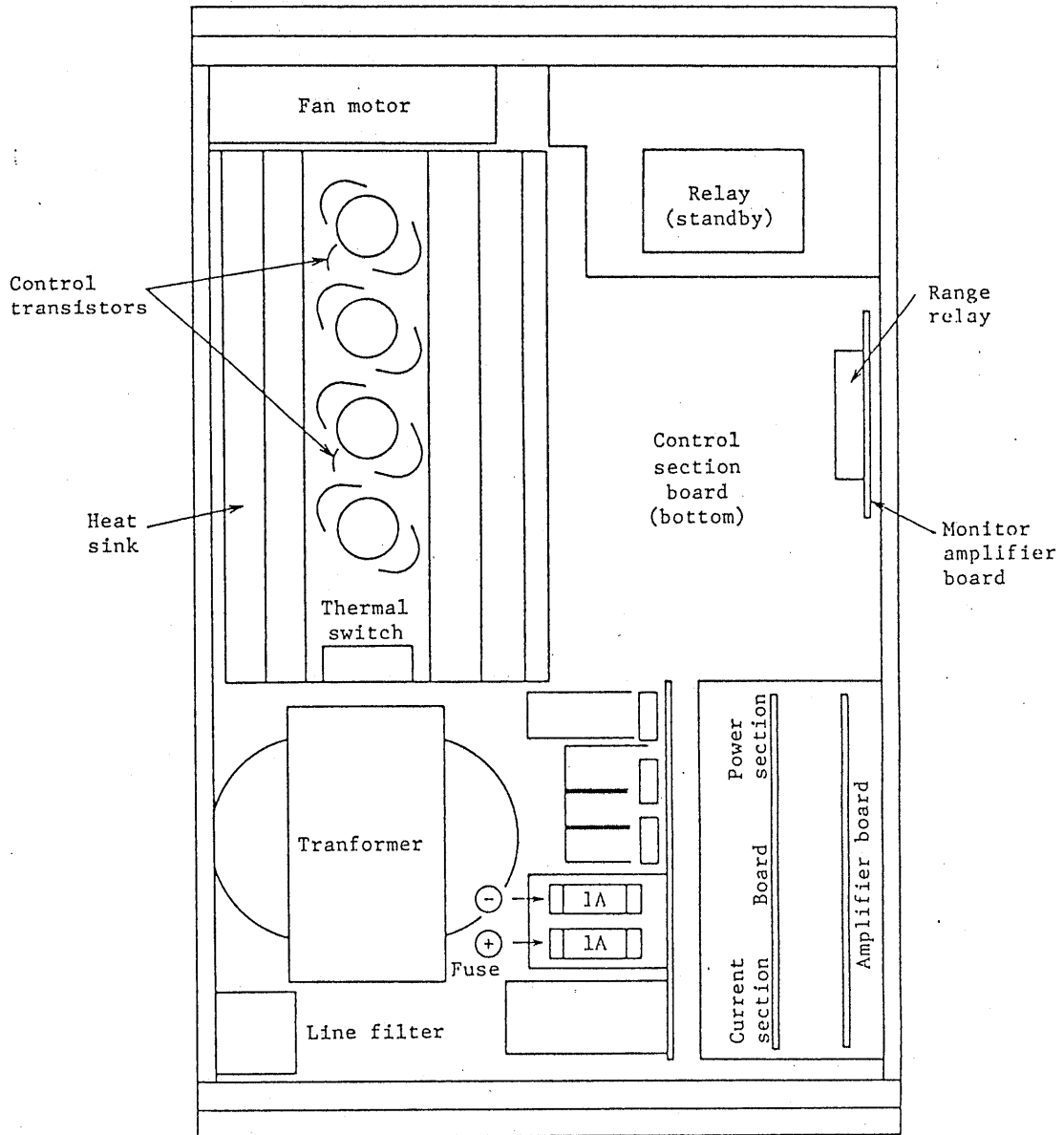
This instrument has a motor-driven fan to cool the control transistors of the output section. When the ambient temperature is abnormally high or when the fan motor has failed and the instrument inside temperature has become abnormally high, the control transistors may be overheated and damaged. In order 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.



812215

5. MAINTENANCE

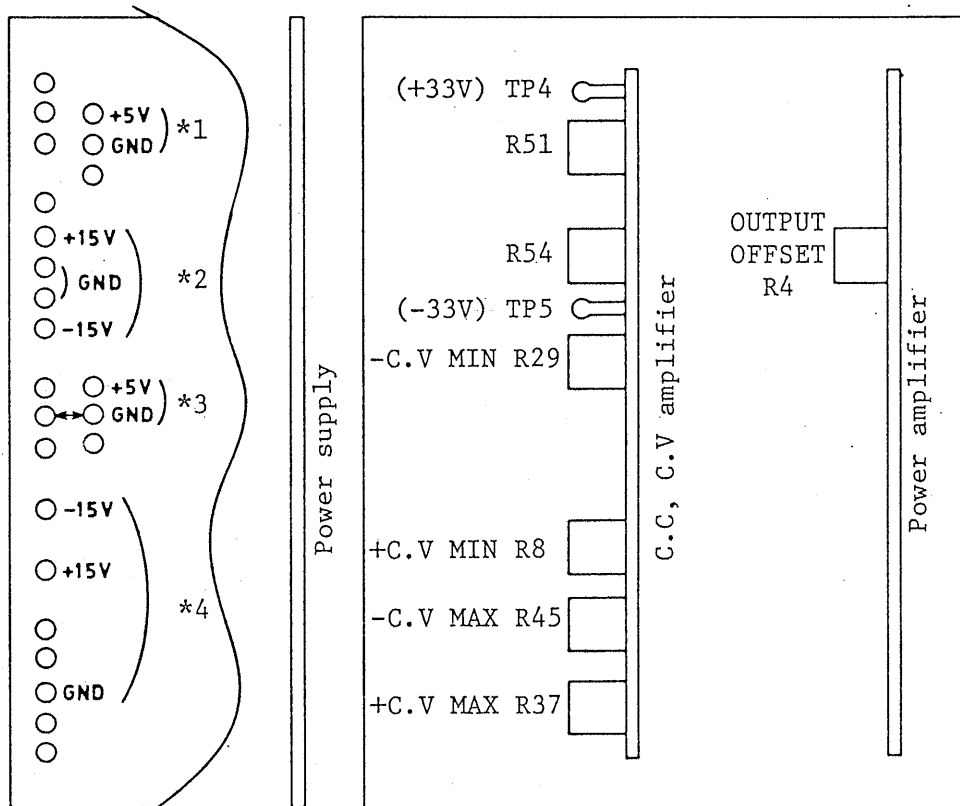
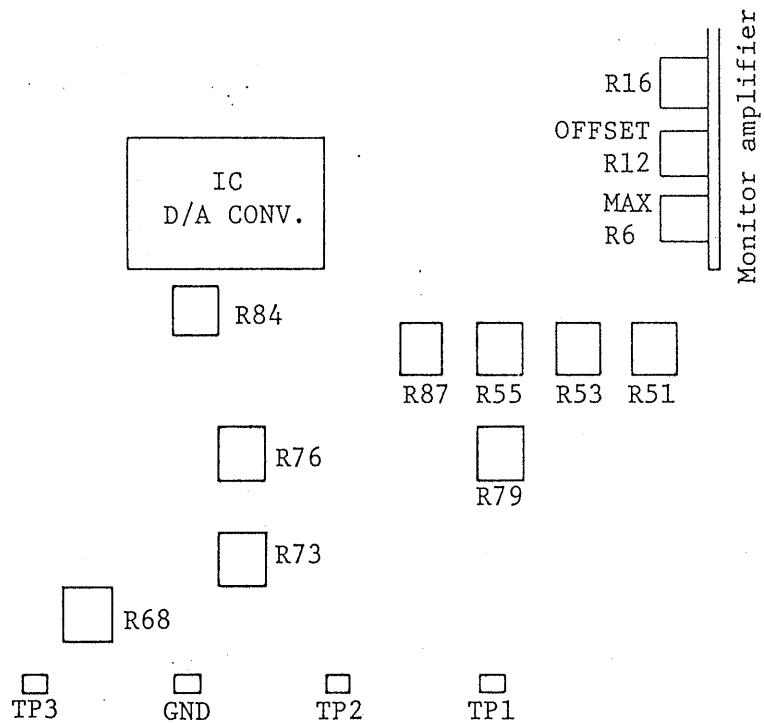
5.1 Layout of Components



Front

Figure 5-1 (Top view)

812218



Left side

- *1, *2: For control
- *3: For interface
- *4: For power amplifier

Figure 5-2

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.

2218

- 1-5. Adjustment of ± 33 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 32.5 V to 33.5 V. Connect a voltmeter to TP5 and so adjust potentiometer R37 that the voltmeter reads within -32.5 V to -33.5 V.

(2) Offset adjustment of IC

Connect a 100-ohm standard resistor to the output terminal and enter range 100 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 potentiometer R79 that the digital voltmeter reads within ± 20 μ V.
- 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 μ V.
- 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 μ V.

(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 μ V.

- 3-2. Enter data [+1000]. So adjust potentiometer R55' that the voltage becomes $1\text{ V} \pm 100\ \mu\text{V}$.
- 3-3. Enter data [+2000]. So adjust potentiometer R55 that the voltage becomes $2\text{ V} \pm 100\ \mu\text{V}$.
- 3-4. Enter data [+4000]. So adjust potentiometer R53 that the voltage becomes $4\text{ V} \pm 200\ \mu\text{V}$.
- 3-5. Enter data [+8000]. So adjust potentiometer R51 that the voltage becomes $8\text{ V} \pm 400\ \mu\text{V}$.
- 3-6. Enter data [-9999]. So adjust potentiometer R68 that the voltage becomes $-9.999\text{ V} \pm 500\ \mu\text{V}$.
- 3-7. 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.
- 3-8. Change the standard resistor with a 10-ohm resistor. Enter range 1 A [1, 1] and data [+9999]. So adjust potentiometer R16 that the voltage becomes $9.999\text{ V} \pm 500\ \mu\text{V}$.
- 3-9. 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 $0\text{ V} \pm 20\ \mu\text{V}$.

4-2. Enter data [+9999]. So adjust potentiometer R6 that the output voltage becomes $999.9 \text{ mV} \pm 50 \text{ } \mu\text{V}$.

(5) Adjustment of output voltage (CV amplifier)

Make the output terminal open and connect directly to it a digital voltmeter. Enter range 100 mA [1, 0] and data [+9999].

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 0.8 V.

5-2. Turn the voltage limit knob to the extremely clockwise position. So adjust potentiometer R37 that the output voltage becomes approximately 20.5 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 [-999.9]. Turn the voltage limit knob to the extremely counterclockwise position. So adjust potentiometer R29 that the output voltage becomes approximately -0.8 V.

5-5. Turn the voltage limit knob to the extremely clockwise position. So adjust potentiometer R45 that the output voltage becomes approximately -20.5 V.

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

812221