INSTRUCTION MANUAL

DIGITAL PROGRAMMABLE POWER SOURCE

MODEL DPS V 40-1

KIKUSUI ELECTRONIC CORPORATION

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.)

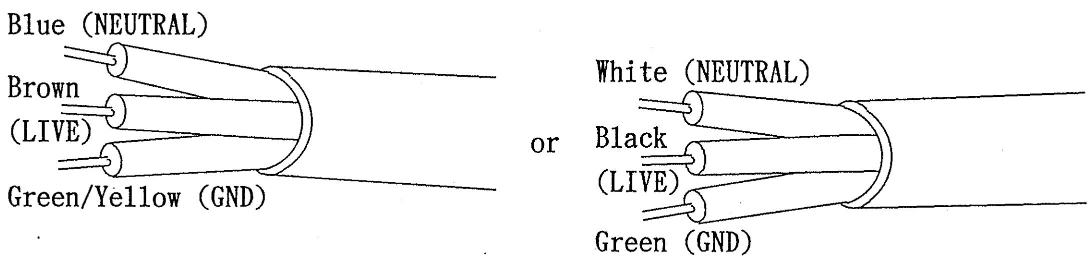

Fig. 1

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.

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1. GENERAL

The DPS V 40-1 Digital Programmable Power Source is a bipolar constant-current constant-voltage power source designed for use in automatic test systems. Its output voltage can be controlled with an external signal.

Voltage setting can be done 0 to ±39.99 V (10 mV resolution). Voltage setting, including polarity setting, can be controlled with a 15-bit signal.

The output voltage is controlled with a TTL level negative logic BCD signal. When the required data is ready, a strobe signal turns on. The data is stored in an internal register and at the same time the output voltage swiftly and accurately shifts to the preset values.

Compliance can be set for a range of approximately ±(50 mA to 1 A) using a manual knob on the front panel. When the set value is reached, the operation changes to the constant-current mode.

The output section is electrically isolated from the input control section. Addresses can be specified as required. A multiple-channel power source system can be easily set-up, making this instrument extremely versatile.

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

2. SPECIFICATIONS

Instrument name:	Digital Programmable Power Source
Model No. :	DPS V 40-1

Output section

Type:	Bipolar constant-voltage constant-current transfer type
Voltage:	0 to ±39.99 V
Resolution:	10 mV
Setting accuracy:	0.05% +0.02% of maximum output voltage (at 25°C (77°F))
Ripple and noise:	300 μV rms or less (at 10 Hz - 1MHz)
Programming noise:	±50 mV peak or less (at rear terminal)
Load regulation:	0.005% of range + 500 μV or less (at rear terminal), for 0 - 100% load change
Line voltage regulation:	0.002% or less, for ±10% line voltage change
Response speed:	500 μsec or faster, for "-" maximum voltage to "+" maximum voltage within the range
Output current:	1 A maximum
Setting:	Manual, approx. ±(50 mA to 1 A)

Control section

Input/output signal:	TTL level

Control signals

Data	Polarity	1 bit	
	Voltage	14 bits	(BCD)
Strobe		1 bit	(edge)
Address		4 bits	
$\overline{\text{Standby}}$		1 bit	
Direct zero		1 bit	
Data clear		1 bit	(except polarity)

Output signals

Thermal down

Constant-current transfer (CC)

$\overline{\text{Ready}}$

Analog input (AMP)	Gain: Approx. 5 times Frequency: DC to approx. 1 kHz
Ambient temperature:	5°C to 35°C (41°F to 95°F)

Withstanding voltage of input/output circuit: 500 V maximum

Power requirements:	117 V +10%, 50/60 Hz AC, approx. 104 VA (with full load)
Dimensions:	142W x 140H x 420D mm (5.59W x 5.51H x 16.54D in.)
Maximum dimensions:	146W x 160H x 445D mm (5.75W x 6.30H x 17.52D 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 is a toggle type.
The instrument power is turned on as the ON side in an depressed.

② OUTPUT terminals:

The output terminals (binding posts) provide an output of ±(0 to 40 V, 1 A). The white terminal is an L-side terminal. These terminals are connected in parallel with the output terminals on the rear panel.

③ CURRENT:

The current limiting knob has a range of approximately 50 mA to 1 A. When the current has reached the limit value, the operation is transferred into the constant-current mode.

④ DISPLAY lamps:

These LEDs indicate the operating state of "+", "-", "+C.C", "-C.C" and "STANDBY".

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

⑤ DIP switches 1 - 4 (ADDRESS):

These switches are for address setting of each individual instrument. The depressed and locked state is for the logical "1" state. The switch numbers correspond to orders of digits as follows:

$1 \rightarrow 2^0$ $2 \rightarrow 2^1$ $3 \rightarrow 2^2$ $4 \rightarrow 2^3$

When the controller's address line is H.H.H.H (open), all attached power supplies will be controlled regardless of their address setting.

DIP switches 5 and 6:

Not used.

DIP switch 7 (STANDBY OFF):

For on-off control of the standby state. When no external control is required, flip this switch to the lower position. If this switch is in the ON state, the external control function remains idle.

DIP switch 8 (AMP):

For on-off control of the analog input signal. When this switch is set in the ON state (lower position), the external signal applied via terminals 5 and 6 is added to the data signal. This function may be used to superimpose an AC signal on the DC signal (data signal) or to use the instrument as an amplifier.

(6) Fan motor:

Cooling fan motor.

(7) Fuse:

Input fuse holder for AC line.

(8) Power cord:

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

⑨ Terminal block

1	+S
2	+H
3	-L
4	-S
5	H AMP
6	L
7	CASE
8	NOISE FILTER
9	
10	

(1) When no sensing is required, short-circuit this sensing terminal (H side) to terminal (2).

(2) Output terminal (H side)

(3) Output terminal (L side)

(4) When no sensing is required, short-circuit this sensing terminal (L side) to terminal (3).

(5) Analog input terminal (H side)

(6) Analog input terminal (L side)

(7) Case ground terminal

(8) Center power line noise filter terminal. If this terminal is connected to the case ground terminal, a current leak occurs, although the filtering effect is improved. Connection of this terminal will vary depending on the usage.

⑩ Connector

For connection of control input (50-pin connector)

See section 3.3 Pins of Control Input Connector.

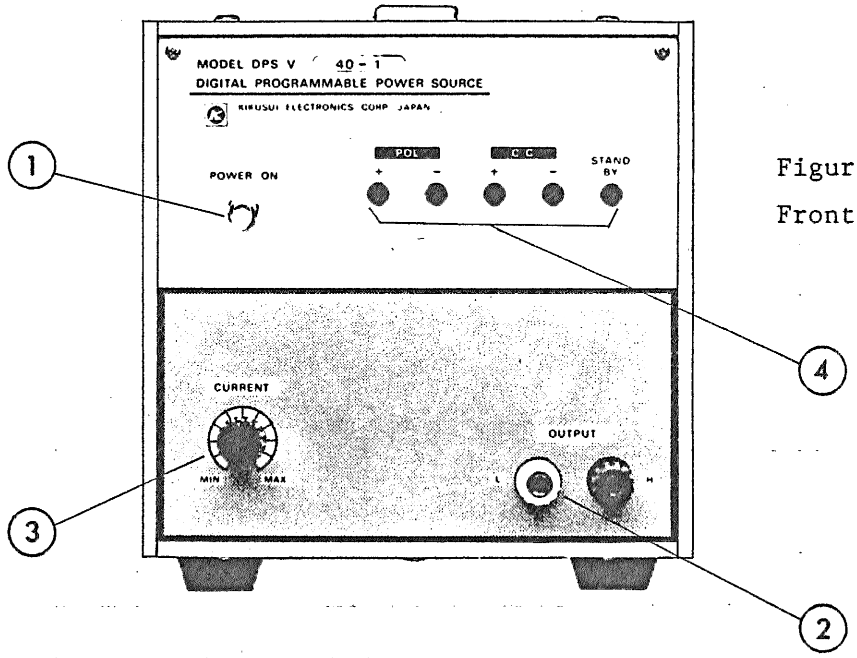


Figure 3-1.
Front panel

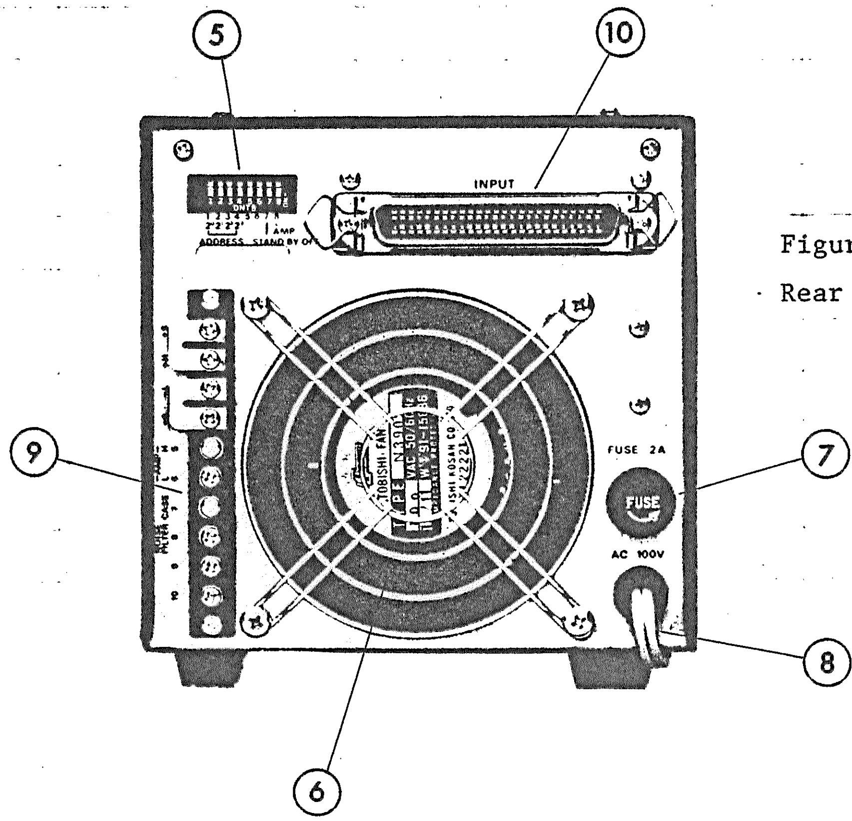


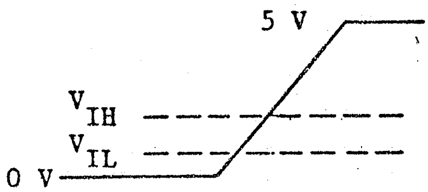
Figure 3-2.
Rear panel

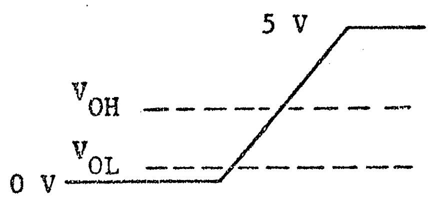
3.3 Pins of Control Input Connector

1	STROBE	26	1	
2		27	2	
3		28	4	LSD
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		40		
16	DIRECT ZERO	41		
17		42		
18		43		
19		44		
20		45		
21	C C	46	POLARITY	
22		47		
23	+5 V OUT	48	$\overline{\text{READY}}$	
24		49		
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.

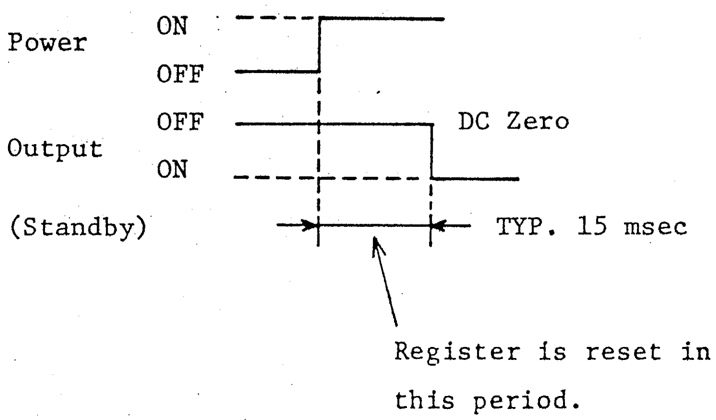
V_{OH}: 2.4 V min.

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
$\overline{\text{Standby}}$	At H level	Standby ON
	At L level	Standby OFF
Direct zero	At L level	Output is zero irrespective of address.
CC (constant-current or thermal down)	L level	Constant-current state or instrument overheating
Ready	H level	
Data clear	L level	Clears resistor

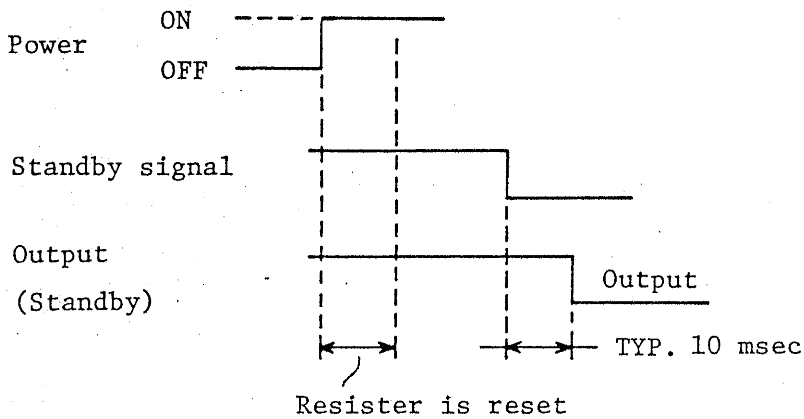
3.5 Timing Charts of Control Signals

(1) When power is ON

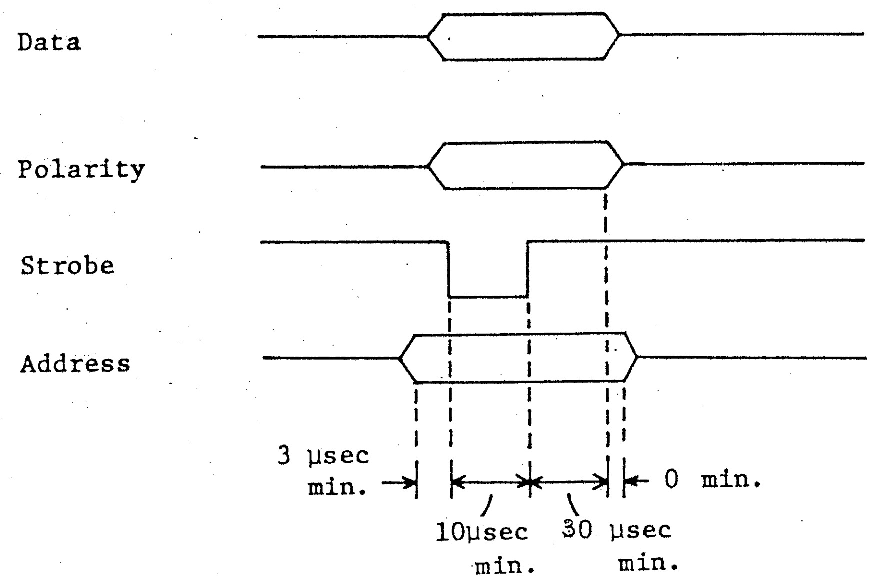
(a) When the STANDBY signal is L (DIP switch)



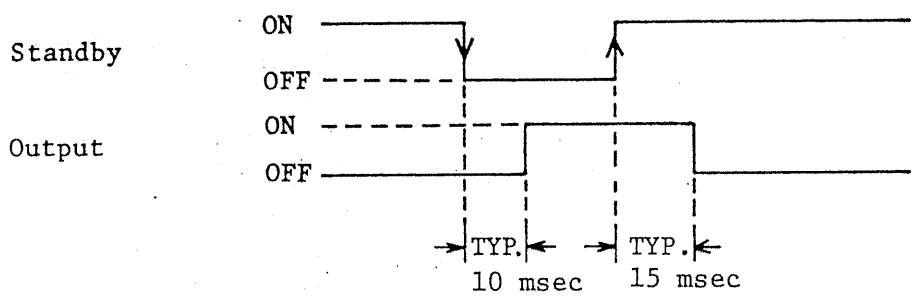
(b) Standby mode (Standby state when the instrument power is turned on.)



(2) Data, polarity, strobe and address

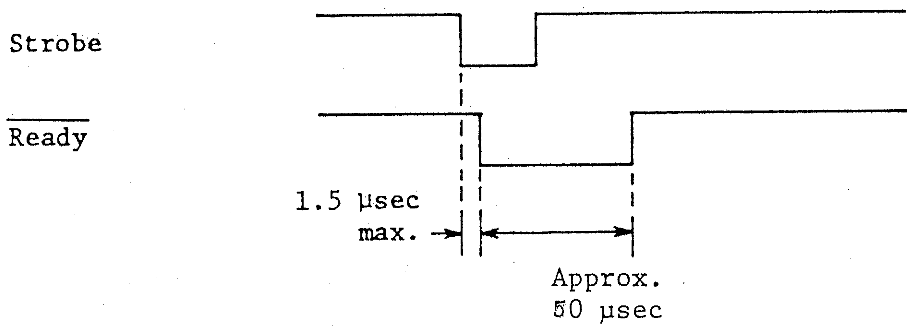


(3) Standby switch



Electromagnetic relay is used for standby switch.

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



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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 several minutes after turning on the power. When high accuracy is required, allow a stabilization period of 30 minutes or more.

(4) Enter data and set the initial values.

(5) Adjust the current limit knob to the required value.

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

o The direct zero signal can be controlled independently of address specification. The direct zero signal electrically switches the output signal to zero volts. When the direct zero is removed, the original state is automatically restored.

o If the controller's address setting is HHHH (0000) or if the address input is open, all attached power supplies will be controlled regardless of their individual addresses.

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

3.7 Example of Control

o Although various input/output signals are available, output voltage alone can be controlled only with data and strobe signals.

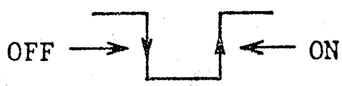
(1) For multi-channel operation, address setting on each instrument's rear panel must be set. The control code is a 4-bit binary negative logic signal (pin numbers 19, 20, 44 and 45).

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

Although control at the TTL level is most recommendable, control may be done with relays, transisters, switches, etc. (pin number 1 (strobe), pin numbers 26 - 39 (data)).

(3) 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.

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

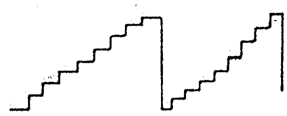
This signal is for DC ON/OFF control of the output voltage. When this signal is at the L level, the output voltage becomes zero. This signal does not clear the contents of the register and, therefore, the previous set voltage is restored when this signal is returned to the H level.

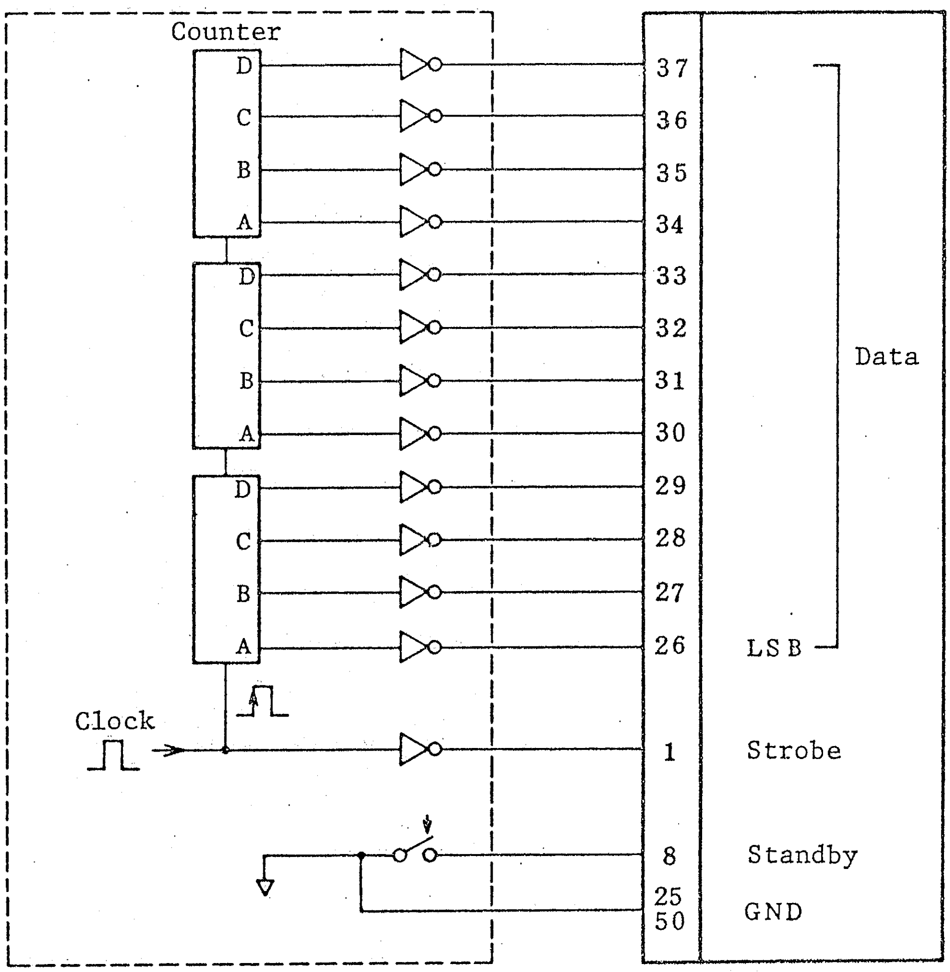
(5) Data clear (If not required, set OPEN or H) (Pin number 14)

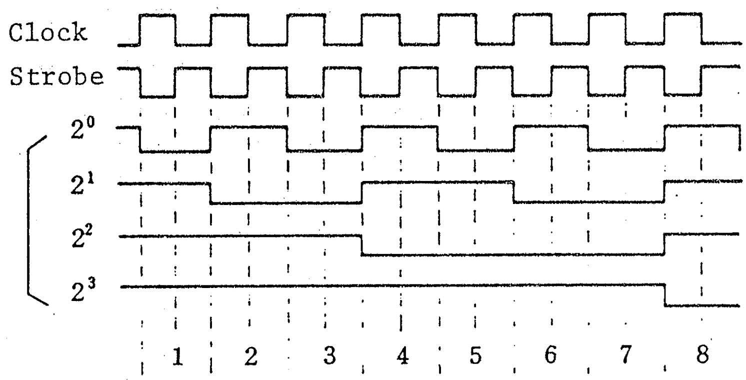
This is the clear bit signal of the data register. When this signal is set at the L level, the contents of the resister are cleared and the output becomes zero. And standby state is set.

3.8 Actual Example of control

To obtain an output with varied steps







4. OPERATING PRINCIPLE

4.1 Circuit Structure

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

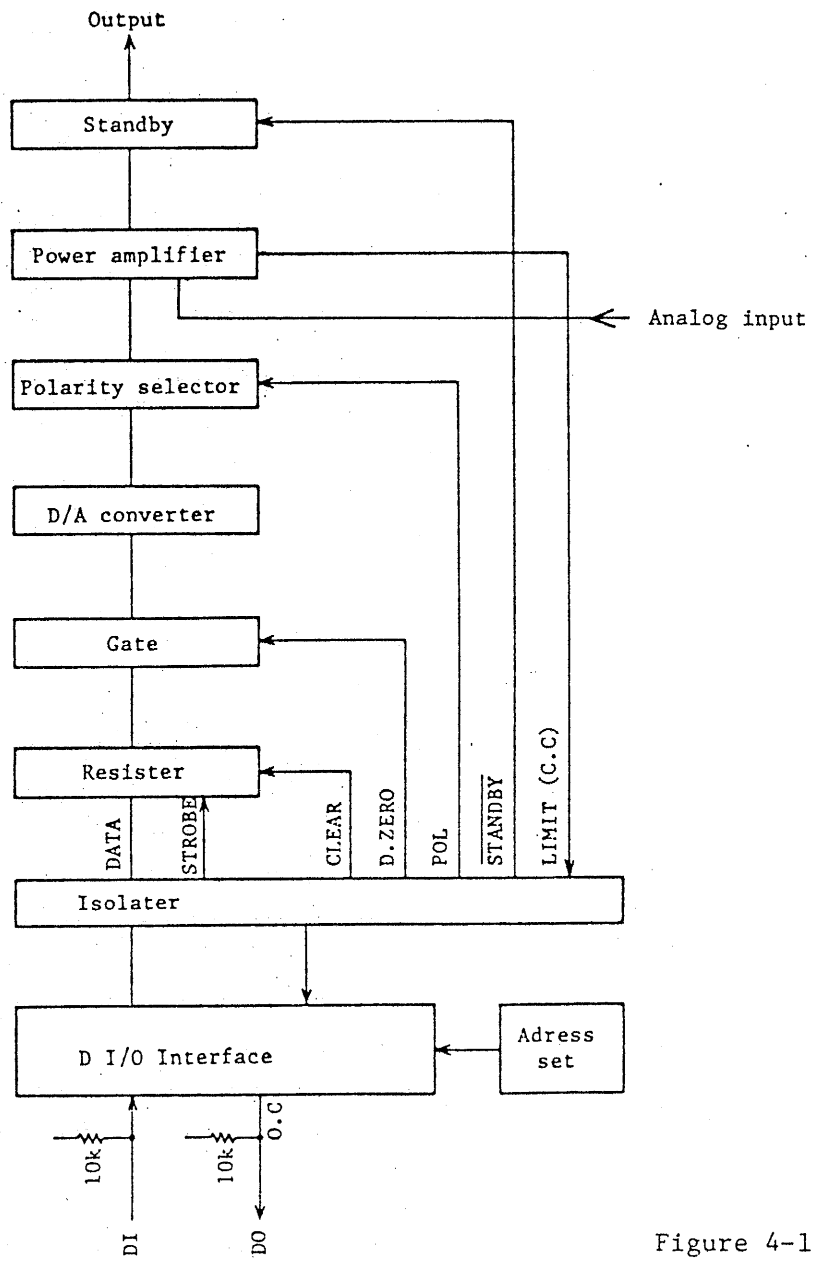


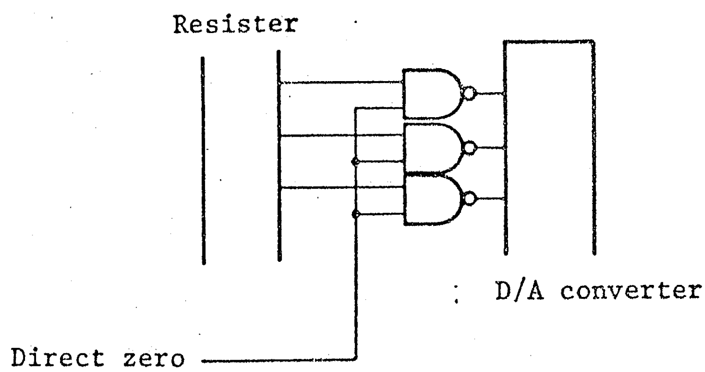
Figure 4-1

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 let the data stored in the register. The stored data is maintained, until the next Strobe signal is applied, even when the input is varied.

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, and is capable of making all bits "0" temporarily without clearing the register.



For the gate, a NAND gate is used as 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.

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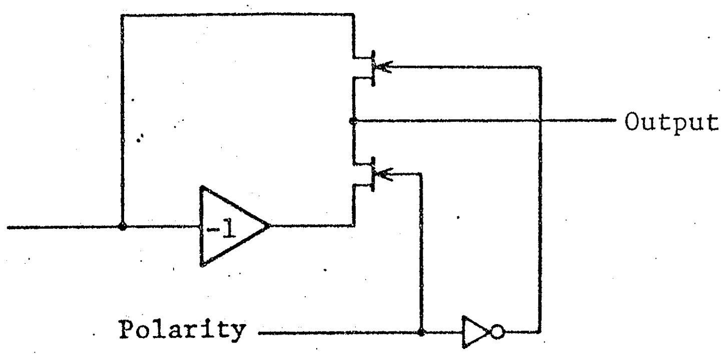
The Polarity Selector, being controlled with the Polarity signal and an FET switching circuit, selects between polarity inversion and non-inversion.



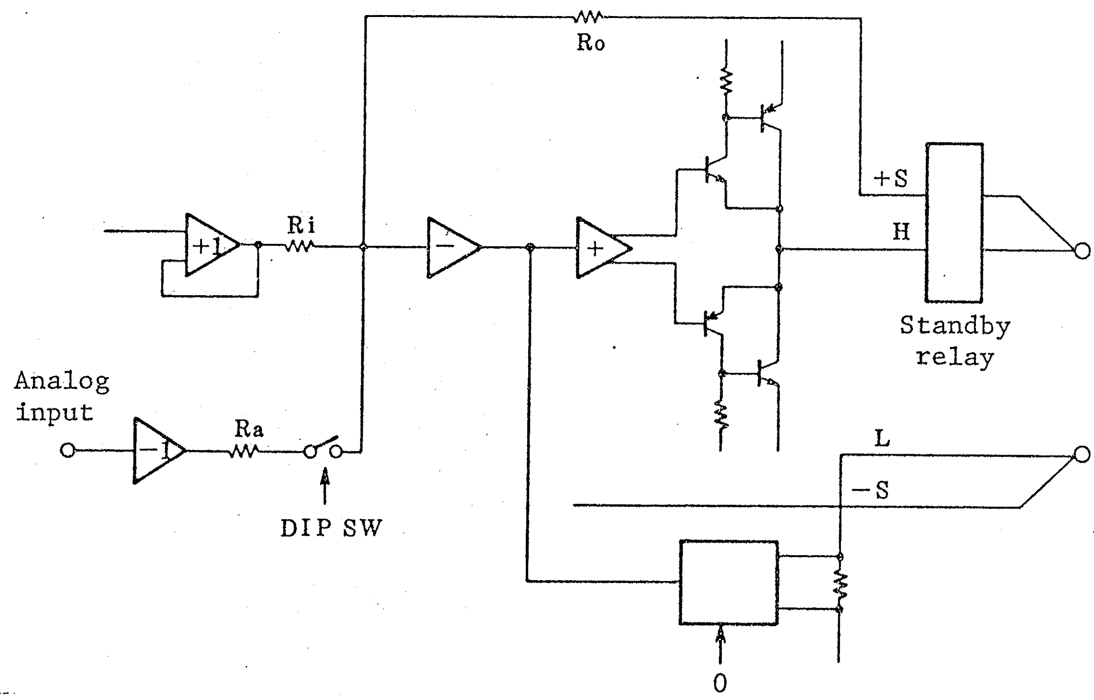
To reduce the effects of the ON resistance of the FET switch circuit, the voltage is received with a voltage follower and its output is fed to the output amplifier.

The power amplifier consists of an IC (initial stage), transistor circuits, and control transistors. It is a high speed, high stability, high accuracy operational amplifier.

The output current limiter monitors the voltage developed across the resistor inserted in series with the load circuit. When the monitored voltage has exceeded the preset voltage, the limiter circuit makes up a closed loop with the final stage of the constant-voltage amplifier. The instrument operation switches to the constant-current mode and remains 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.

In order to guard against instrument overheating, a thermal sensor has been installed on the heat sink of the control transistors. The thermal sensor trips at 70°C (158°F) and the instrument is released into the standby state.

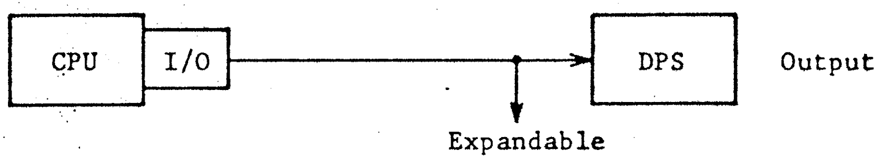


5. APPLICATION

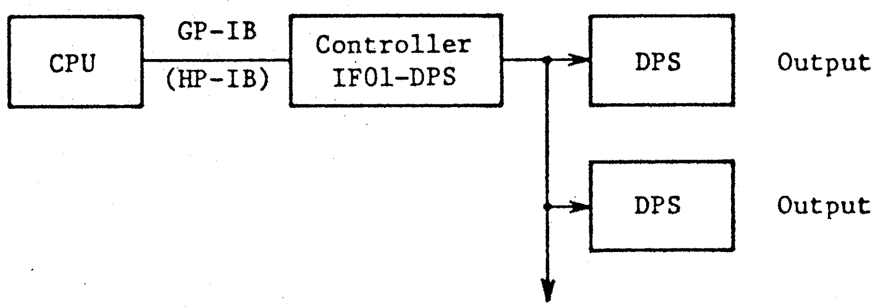
5.1 Examples of Controls of DPS Series

(1) Direct control with CPU

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

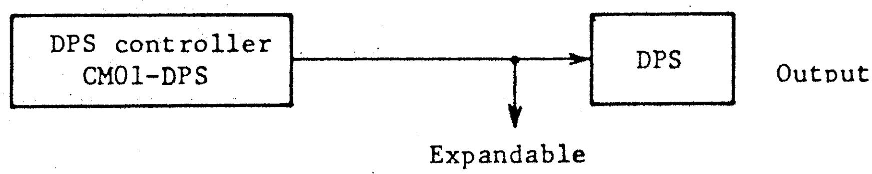


(2) Control with standard interface



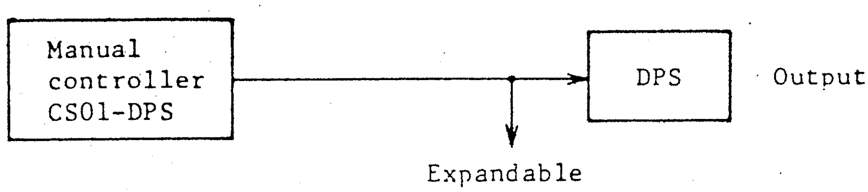
Up to 15 units can be controlled.

(3) Function generation with KIKUSUI MODEL CM01-DPS



Non-volatile memory of 64 steps available

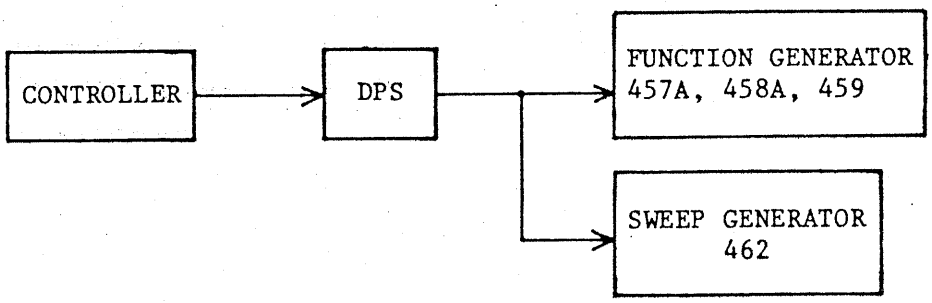
(4) Remote control



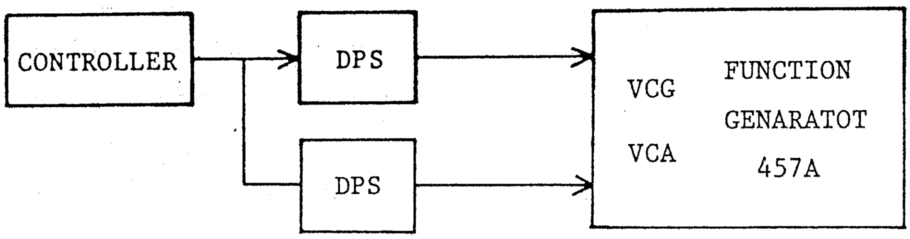
5.2 Examples of Use of DPS Series

(1) For programmable control of generator

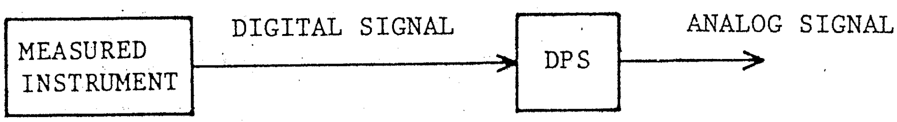
Oscillating frequencies of a frequency generator can be program-controlled. For example, apply the DPS output to the VCG (voltage-controlled generator) terminal of a function generator.



Output amplitude control also is programmable. For example, apply the DPS output to the VCA (voltage-controlled amplitude) terminal of a function generator.

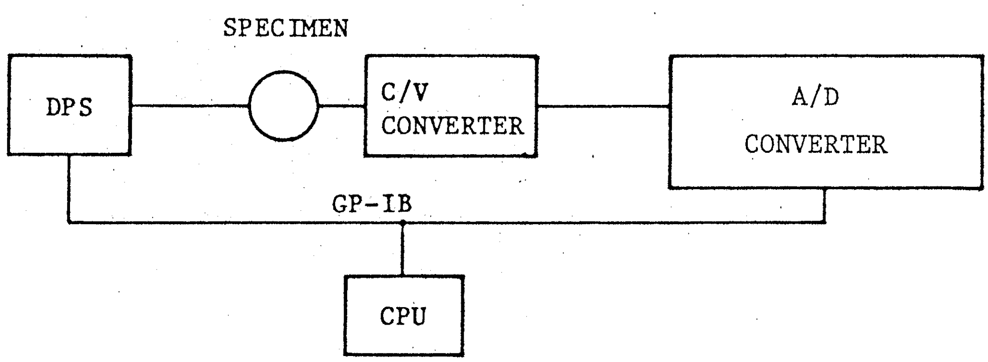


(2) To use as a simple D/A converter



Digital voltmeter
Frequency counter etc.

(3) To use as a signal source (an example for impurity density measurement of semiconductors)



6. MAINTENANCE

6.1 Layout of Components

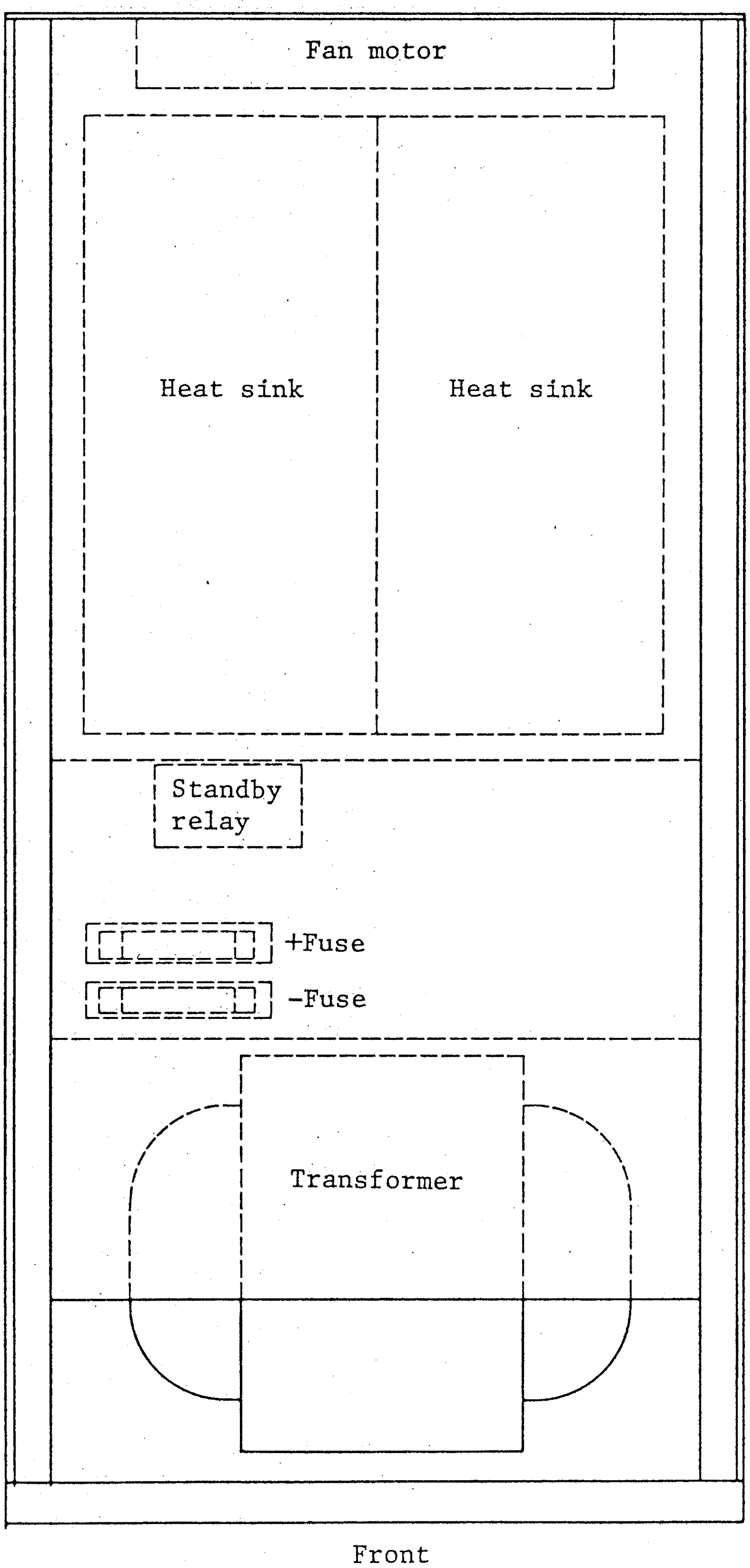


Figure 6-1
(Top view)

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Layout of potentiometers

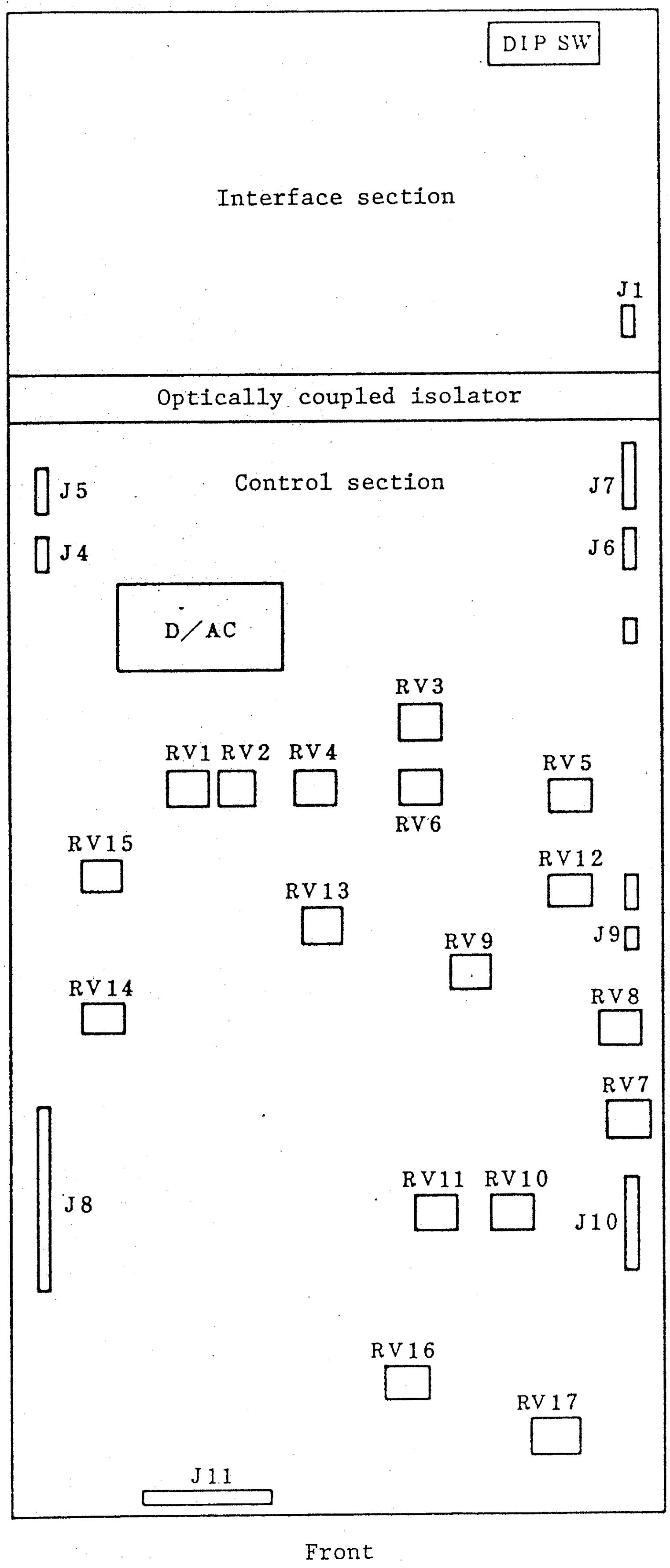

Figure 6-2

6.2 Adjusting Procedures (See Figure 6-2.)

(1) Check and Adjustment of Supply Voltages

1-1 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.

1-2 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 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 14.5 V to 15.5 V. Connect a voltmeter between control GND terminal and -15 V terminal, and check that the voltage is within -14.5 V to -15.5 V.

1-4 Adjustment of $\pm$48 V supplies of control circuit

Connect a volmeter between control GND terminal and +48 V terminal. Adjust the potentiometer R16 so that the voltmeter reads within 47.5 V to 48.5 V. Connect a voltmeter to -48 V terminal and so adjust potentiometer RV17 that the voltmeter reads within -47.5 V to -48.5 V.

(2) Offset adjustment of IC

o Enter data [-0000]. AMP mode is off stale.

2-1 Connect a digital voltmeter between pin 6 (TP1) of MC1 and GND terminal, and adjust the potentiometer RV4 so that the digital voltmeter reads within $\pm$30 μV.

2-2 Connect a digital voltmeter between output terminal (TP3) of the amplifier consist of MC3 and transistor and GND terminal, and adjust the potentiometer RV7 so that the digital voltmeter reads within ±30 μV.

2-3 Connect a digital voltmeter to the output terminal, and adjust the potentiometer RV11 so that the voltmeter reads within ±100 μV.

o Change data to [+0000].

2-4 Adjust the potentiometer RV6 so that the output voltage within ±100 μV

o Change data to [-0999].
Set the potentiometer RV10 to the mid-position.

2-5 Adjust the potentiometer RV3 so that the output voltage becomes -9.99 V ±500 μV.

o Change data to [-1000].

2-6 Adjsut the potentiometer RV1 so that the output voltage becomes -10.00 V ±500 μV.

o Change data [-2000].

2-7 Adjust the potentiometer RV2 so that the output voltage becomes -20.00 V ±1 mV.

o Change data [-3999].

2-8 Check the output voltage within -39.99 V ±2 mV. If it is not within the tolerance, adjust it with the corresponding potentiometer.

o Change data [+3999].

2-9 Adjust the potentiometer RV5 so that the output voltage becomes +39.99 V ±2 mV.

2-10 Vary each input data and measure the output voltage checking that it is within the tolerance. If it is not within the tolerance, adjust it with the corresponding potentiometer again.

(3) Adjustment of output current

Set the output voltage at zero. Connect a slide-wire rheostat and a DC ammeter in series to the output terminals. (Select a slide-wire rheostat of a resistance which will let a current of 1 A or over to flow when the output voltage is applied.)

3-1 Turn the current limit knob on the front panel to the extremely counterclockwise position. Enter "-" data to produce the output voltage. Varying the resistance of the rheostat, adjust the potentiometer RV15 so that the operation is transferred into the constant-current mode when the output current is approximately -45 mA.

3-2 Turn the current limit knob to the extremely clockwise position. Reduce the resistance of the rheostat and adjust the potentiometer RV12 so that the operation is transferred into the constant-current mode when the output current is approximately -1.05 A.

3-3 Repeat alternately the procedures of 3-1 and 3-2 so that the best conditions are obtained for both requirements.

3-4 Turn the current limit knob on the front panel to the extreme counterclockwise position. Enter "+" data to produce the output voltage. Varying the resistance of the rheostat, adjust the potentiometer RV14 so that the operation mode is transferred to the constant-current mode when the output current is approximately +45 mA.

3-5 Turn the current limit knob to the extremely clockwise position. Reduce the resistance of the rheostat and adjust the potentiometer RV13 so that the operation is transferred to the constant-current mode when the output current is approximately +1.05 A.

3-6 Repeat alternately the procedures of 3-4 and 3-5 so that the best conditions are obtained for both requirements.