INSTRUCTION MANUAL

REGULATED DC POWER SUPPLY

PAB32-1.5DU (DUAL-OUTPUT)

Second Edition

KIKUSUI ELECTRONICS CORPORATION

(KIKUSUI PART NO Z1-723-120)

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.)

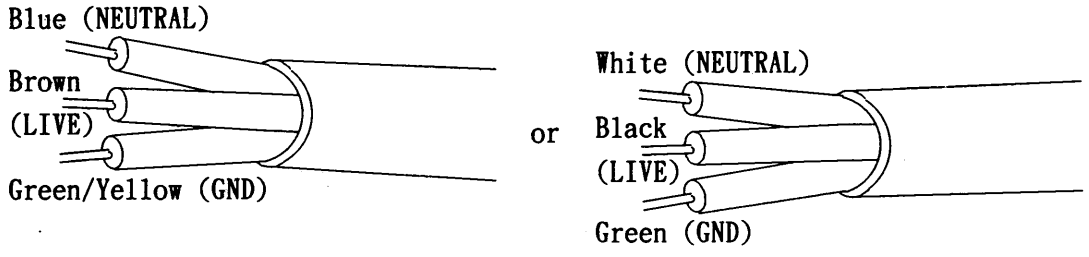

Fig. 1

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

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* 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

1.1 Description

Models PAB18-2.5DU and PAB32-1.5DU Regulated DC Power Supplies provide two outputs (one in positive polarity and the other in negative polarity) of ±18 V, 2.5 A, or ±32 V, 1.5 A. The two outputs are simultaneously delivered and are adjustable.

Model PAB25-1TR Regulated DC Power Supply provides three outputs, namely, two outputs of ±25 V, 1 A, plus one independent output of 6 V, 5 A (floating output). For all outputs, a constant-current transfer system is employed for protection against overload.

Of all models, the positive and negative output voltages are individually adjustable down to zero volts. Also, they are incorporated with a dual tracking function and the pair of positive and negative supply voltages can be varied with the same ratios by means of a single control knob. A 10-turn potentiometer is employed for this control, allowing very fine voltage adjustment.

All models of power supplies have a digital readout (3-1/2 digits) which can be used as a voltmeter or an ammeter (selectable). It measures the output voltage with an autorange function or the output current with a fixed range (10-mA resolution). It measures also an external voltage applied via the external voltage measuring terminals of the power supply.

All outputs can be simultaneously turned on or off with the output switch on the front panel. When the output switch is off, the digital readout indicates the output voltage allowing you to preset the output at the reqiured voltage.

The 6V-5A output circuit of PAB25-1TR is incorporated with an overvoltege protector (OVP) of a thyristor crowbar type, enhancing the protective feature for the load against overvoltage.

All models of power supplies are provided with remote control terminals on their rear panels. Through these terminals, the output voltages can be controlled in a dual tracking mode with an external resistance or voltage signal or can be ON/OFF-controlled with an external contact signal.

All models of power supplies employ a temperature proportional type of forced air cooling system and fan motor noise is very low except when the power supplies are serving a heavy load.

1.2 Specifications

Model			PAB 25-1TR
Input			
	Input supply		100V ±10%, 50/60Hz AC ※1
	Power consumption		Approx. 220VA
Output			
	Output 1	Output voltage (1 turn)	0 to +25V
		Output current (Semifixed)	0.1 to 1A
	Output 2	Output voltage (1 turn)	0 to -25V
		Output current (Semifixed)	-0.1 to -1A
	Output 3	Output voltage (Semifixed)	0.5V to 6V
		Output current (Fixed)	5A
	Tracking accuracy		±2% of maximum output voltage
	Dual tracking control Outputs 1 and 2		
		Output (10 turns)	0 to ±25V
		Voltage resolution ※2	4.7mV
Constant voltage characteristics			
	Regulation		
		Source effect For ±10% change of line voltage	
		Outputs 1 and 2	2mV
		Output 3	5mV
		Load effect For 0 to 100% change of output current	
		Outputs 1 and 2	3mV
		Output 3	5mV
	Ripple and noise (5Hz to 1MHz) ※3 Outputs 1, 2 and 3		0.5mV rms
	Transient response ※4 Outputs 1, 2 and 3		50μs Typical
	Temperature coefficient Outputs 1, 2 and 3		100ppm/°C Typical
Application			
	Remote control voltage		At 0 to 10V 0 to ±25V
	Remote control resistance ※10		At 100kΩ to 0Ω ±1.7V to ±25V
	Remote sensing		Output 3 (6V output) only

Model		PAB 25-1TR
Protections		
Current limiting Outputs 1, 2 and 3 ※10		Automatic constant-voltage/current crossover type (When the current limting function is brought into effect, the tracking function between outputs 1 and 2 is lost and their output voltages drop mutually independently.)
Overtemperature protection		Output is cut off when heat sink temperature has become higher than approx. 85°C (185°F).
Overvoltage protector (O.V.P) (Output 3 only)		Output is cut off with thyristor crowbar type of protector.
Output fuses	Outputs 1 and 2	2A each
	Output 3	7A
Thermal fuse (at transformer)		AC input power is cut off when power transformer temperature has become higher than approx. 126°C (259°F).
Input fuse		3A (S.B)
Meter performance		
Measuring system		Double integration system
Display and sampling rate		LCD, up to 1999, 2 samples/sec
View angles		50 to 80 degrees vertical 30 degrees horizontal
DC voltmeter (at OUTPUT, ON)		
	Range	Fully automatic 4-range 200mV/2.00V/20.0V/200V DC F.S
	Accuracy ※5	± (0.5% rdg + 3dgt), except preset value
DC ammeter	Range	Fixed range
	Accuracy ※6	± (1% rdg + 5dgt)
EXT V METER		
Maximum allowable application voltage		Between HI and LOW terminals 200V DC
Maximum allowable common-mode voltage		Between LOW and GND terminals 100V DC
Range		Fully automatic 4-range 200mV/2.00V/20.0V/200V DC F.S
Accuracy ※5		± (0.5% rdg + 3dgt)

Model		PAB 25-1TR
Indication		
Overload		Red light (LED) illuminates to indicate overloading of each of outputs 1, 2 and 3.
Output ON (Common for outputs 1, 2, 3)		Red light (LED) illuminates when output is ON.
Operated OVP (Output 3 only)		Indicated with red LED
Series output		The outputs can be connected in series to attain a higher voltage output.
Insulation resistance ※7		
Between chassis and line		500V DC, more than 30MΩ
Between chassis and output terminal		500V DC, more than 20MΩ
Isolation from ground		±250V DC
Polarity	Outputs 1 and 2	Positive, COM or negative grounded
	Output 3	Positive or negative grounded
Cooling method		Forced air cooling with controlled fan
Withstand voltage		
Between Input and output		1.5kV AC, 1 minute
Between Input and chassis		1.5kV AC, 1 minute
Ambient temperature & humidity rating		
Operating ※8		0 to 40°C (32 to 104°F), 10 to 80% RH
Storage ※9		-10 to 60°C (14 to 140°F), 90% RH or less
Dimensions		106W x 140H x 350D mm (4.17W x 5.51H x 13.78D in.)
Maximum dimensions		119W x 163H x 388D mm (4.69W x 6.42H x 15.28D in.)
Weight		Approx. 6 kg (13 lbs)
Rack mounting		
For JIS rack (mm-unit rack)		Rack mount frame RMF4M and bracket B42
For EIA rack (19-inch rack)		Rack mount frame RMF4 and bracket B42
Accessories		
Instruction manual		1 copy
Input fuse		3A (S.B) 1 ea.
Plugs		2 ea.
GND terminal		1 ea.
Input cord		1 ea. (For USA or Europe)
	USA:	VM033V-VM0076B AC cord set (85-10-1070)
	Europe:	KP4819D-KS16Y AC cord set (85-10-0141)

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※1: The power supply is shipped with its AC power input circuit set for a nominal 100V AC line. To convert it into a nominal 120V, 220V, 230V or 240V AC line, a conversion service by an authorized agent is necessary. For this service, please order your Kikusui agent.

※2: The resolution is theoritical value as calculated using the numbers of windings.

※3: Measured with the COM grounded.

※4: Time required by the output voltage for recovering to within 0.05% + 10 mV after output current change from 5% to 100%.

※5: At ambient temperature 23 ±5°C (73.4 ±9°F) and humidity 80% RH or less.

※6: At ambient temperature 23 ±5°C (73.4 ±9°F) and humidity 80% RH or less, as measured after allowing a stabilization time of 30 minutes or more in the state that the output current is fed.

※7: At ordinary temperature and humidity

※8: Humidity must not be higher than the dew point.

※9: Note that high temperature (40 to 60°C (104 to 140°F)) and high humidity adversely affect the longvity of Meter (LCD).

※10: For the input/output characteristics, see Figure 2-16.

Model			PAB 18-2.5DU	PAB 32-1.5DU
Input				
	Input supply		100V ±10%, 50/60Hz AC ※11	
	Power consumption		Approx. 240VA	Approx. 220VA
Output				
	Output 1	Output voltage (1 turn)	0 to +18V	0 to +32V
		Output currnet (Semifixed)	0.1 to 2.5A	0.1 to 1.5A
	Output 2	Output voltage (1 turn)	0 to -18V	0 to -32V
		Output current (Semifixed)	-0.1 to -2.5A	-0.1 to -1.5A
	Tracking accuracy		±2% of maximum output voltage	
	Dual tracking control Outputs 1 and 2			
		Output (10 turn)	0 to ±18V	0 to ±32V
		Voltage resolution ※12	4mV	6mV
Constant voltage charactoristics			(Outptu 1 and 2)	
	Regulation			
		Source effect For ±10% change of line voltage	2mV	2mV
		Load effect For 0 to 100% change of output current	3mV	3mV
	Ripple and noise (5Hz to 1MHz) ※13		0.5mV rms	0.5mV rms
	Transient coefficient ※14		50μs Typical	50μs Typical
	Temperature coefficient		100ppm/°C Typical	100ppm/°C Typical
Remote control				
	Control voltage (0 to approx. 10V)		0 to ±18V	0 to ±32V
	Control resistance (at 100kΩ to 0Ω) ※20		±1.2V to ±18V	±2.2V to ±32V
Protections				
	Current limiting		Automatic constant-voltage/current crossover type (When the current limting function is brought into effect, the tracking function between outputs 1 and 2 is lost and their output voltages drop mutually independently.)	
	Overtemperature protection		Output is cut off when heat sink temperature has become higher than approx. 85°C (185°F).	

Model			PAB 18-2.5DU	PAB 32-1.5DU
Thermal fuse (at transformer)			AC input power is cut off when power transformer temperature has become higher than approx. 126°C (259°F).	
Input fuse			3A (S.B)	
Output fuses (Outputs 1 and 2)			4A each	3A each
Meter performance				
Measuring system			Double integration system	
Display and sampling rate			LCD, up to 1999, 2 samples/sec	
View angles			50 to 80 degrees vertical 30 degrees horizontal	
DC voltmeter (at OUTPUT, ON)				
	Range		Fully automatic 4-range 200mV/2.00V/20.0V/200V DC F.S	
	Accuracy	※15	±(0.5% rdg + 3dgt), except preset value	
DC ammeter	Range		Fixed range	
	Accuracy	※16	±(1% rdg + 5dgt)	
EXT V METER				
Maximum allowable application voltage			Between HI and LOW terminals 200V DC	
Maximum allowable common-mode voltage			Between LOW and GND terminals 100V DC	
Range			Fully automatic 4-range 200mV/2.00V/20.0V/200V DC F.S	
Accuracy		※15	± (0.5% rdg + 3dgt)	
Indication				
Overload			Red light (LED) illuminates to indicate overloading of each of outputs 1, 2 and 3.	
Output ON (Common for outpus 1 and 2)			Red light (LED) illuminates when output is ON.	
Operated OVP (Output 3 only)			0 to 36V	0 to 64V
Insulation resistance		※17		
Between chassis and line			500V DC, more than 30MΩ	
Between chaasis and output terminal			500V DC, more than 20MΩ	
Isolation from ground			±250V DC	
Polarity			Positive, COM or negative grounded	

Model		PAB 18-2.5DU	PAB 32-1.5DU
Cooling method		Forced air cooling with controlled fan	
Withstand voltage			
Between input and output		1.5kV AC, 1 minute	
Between input and chassis		1.5kV AC, 1 minute	
Ambient temperature & humidity rating			
Operating	※18	0 to 40°C (32 to 104°F), 10 to 80% RH	
Storage	※19	-10 to 60°C (14 to 140°F), 90% RH or less	
Dimensions		106W x 140H x 350D mm (4.17W x 5.51H x 13.78D in.)	
Maximum dimensions		119W x 163H x 388D mm (4.69W x 6.42H x 15.28D in.)	
Weight		Approx. 6.7 kg (15 lbs)	Approx. 6 kg (13 lbs)
Rack mounting			
For JIS rack (mm-unit rack)		Rack mount frame RMF4M and bracket B42	
For EIA rack (19-inch rack)		Rack mount frame RMF4 and bracket B42	
Accessories			
Instruntion manual		1 copy	
Input fuse		3A (S.B) 1 ea.	
Plugs		2 ea.	
Input cord		1 ea. (For USA or Europe)	
	USA: VM0033-VM0076B AC cord set (85-10-1070)		
	Europe: KP4819D-KS16Y AC cord set (85-10-0141)		

※11: The power supply is shipped with its AC power input circuit set for a nominal 100V AC line. To convert it into a nominal 120V, 220V 230V or 240V AC line, a conversion service by an authorized agent is necessary. For this service, please order your Kikusui agent.

※12: The resolution is theoretical value as calculated using the numbers of windings.

※13: Measured with the COM grounded.

※14: Period the output voltage takes before it is restored to steady state after the output current is changed stepwise between 5% and 100%.

※15: At ambient temperature 23 ±5°C (73.4 ±9°F) and humidity 80% RH or less.

※16: At ambient temperature 23 ±5°C (73.4 ±9°F) and humidity 80% RH or less, as measured after allowing a stabilization time of 30 minutes or more in the state that the output current is fed.

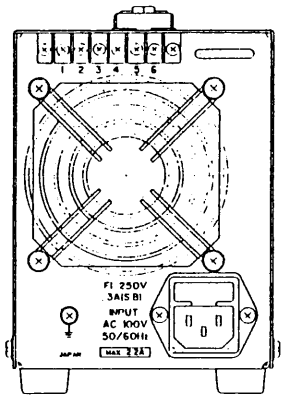
※17: At ordinary temperature and humidity

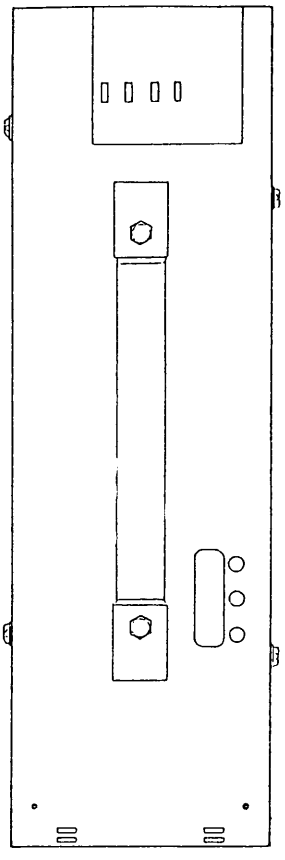
※18: Humidity must not be higher than the dwe point.

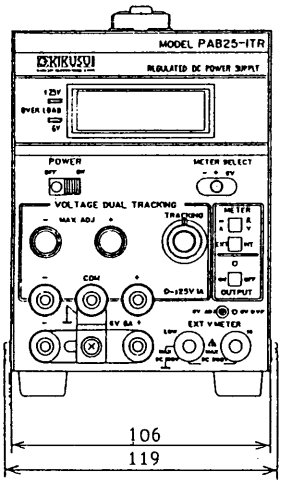
※19: Note that high temperature (40 to 60°C (104 to 140°F)) and high humidity adversely affect the longvity of Meter (LCD).

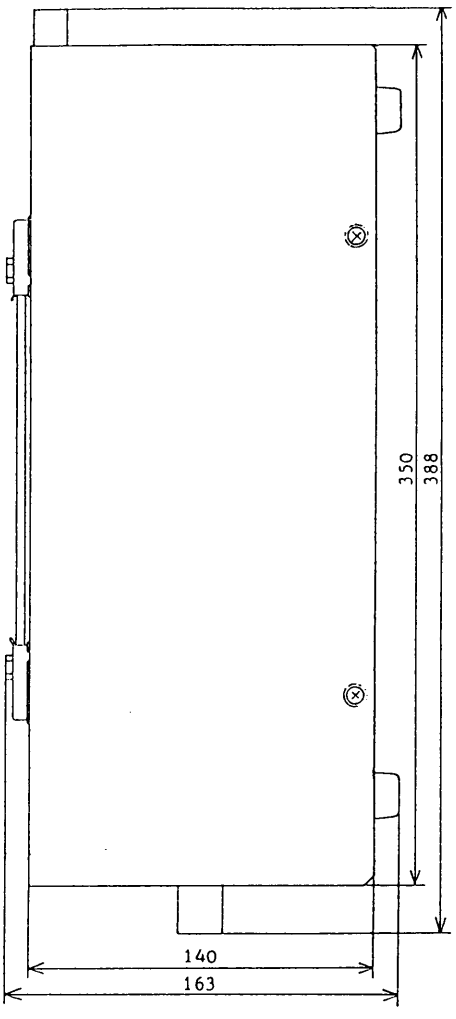
※20: For the input/output characteristics, see Figure 2-16.

1.3 Mechanical Outline Drawing









106W x 140H x 350D mm
(4.17W x 5.51H x 13.78D in.)
Max. 119W x 163H x 388D mm
(4.69W x 6.42H x 15.28D in.)

2. OPERATION METHOD

2.1 General Precautions

2.1.1 Rush Current

The power supply may draw a rush current of approximately 60 A peak (approximately 10 msec) when its power switch is turned on. Pay attention to this expecially when other devices also are connected to the same AC line or when two or more power supplies are turned on simultaneously. (The primary cause of the rush current is magnetic saturation of the main power transformer. The magnitude of rush current depends on the phase of the AC line voltage at the instant the power switch is turned on. The rush current is largest when the phase is 0° or 180° and it is closer to the steady current when the phase is 90° or 270°. Pay attention to this especially when a system which employs a zero-cross switch such as SSR is involved.)

2.1.2 External Voltage Measurement

(a) The maximum voltage measurable by the power supply in the EXT mode is 200 V DC. Do not apply any external voltage higher than this limit to the EXT V METER terminals of the power supply.

(b) The maximum allowable voltage between the GND terminal (chassis ground) and the "LOW" EXT V METER terminal is 100 V DC. Note that any voltage which has a potential difference of 100 V DC or more with respect to the power supply chassis cannot be measured.

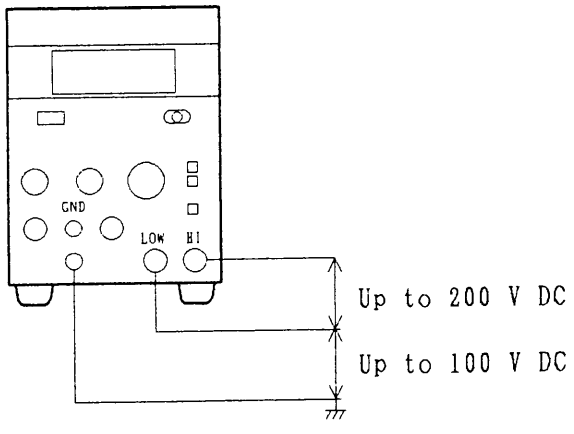


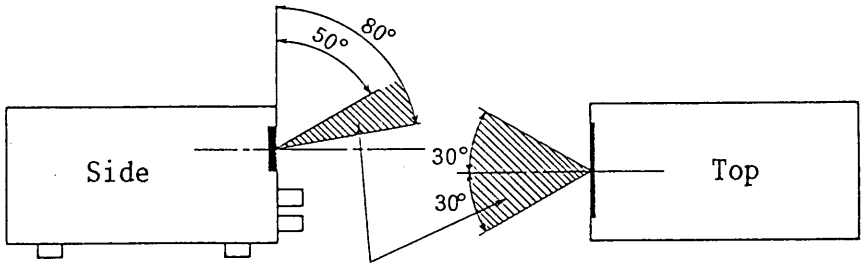
Figure 2-1

(c) The voltmeter is primarily for measurement of voltages of the power supply itself. When using it for measurement of an external voltage, note that some restrictions are imposed and the measuring accuracy may be degraded accordingly. For example, errors may be introduced depending on line noise rejection ratio and capacitive or inductive coupling with the line when measuring a voltage of a high impedance circuit.

2.1.3 Digital Readout

(a) The digital readout may flicker by a digit or two. This is not due to ripple noise of the output but due to the performance of the A/D converter.

(b) The viewing angles of the readout (liquid crystal) are as shown in Figuge 2-2. This is because the power supply has been designed primary for use as bench top device.

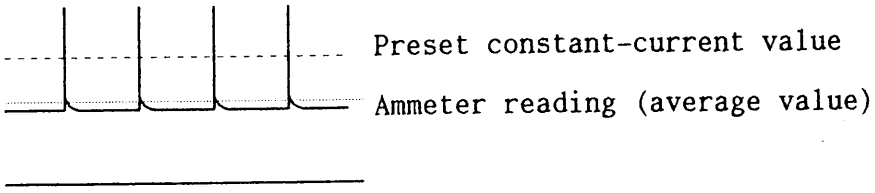


Viewing angles

Figure 2-2

2.1.4 Type of Load

Note that the output may become unstable depending on the characteristics of the load, such that it draws a load current with spikes or that of a pulse waveform. Since the ammeter is of an average-value indication type, even when meter reading is not higher than the preset value, the peak values may exceed the preset value and the operation may be driven instantaneously into the constant-current domain and the output voltage may fall. Observing carefully, it can be seen that the constant-current indicator lamp becomes dim.



Figrue 2-3. Load current with spikes

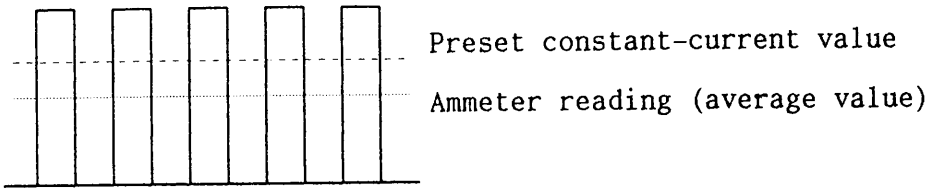


Figure 2-4. Load current of pulse waveform

2.1.5 Environmental Requirements

Do not operate the power supply in adverse environments which do not meet the following requirements:

(a) Ambient temperature must be within 0 to 40°C (32 to 104°F)

(b) Ambient humidity must not be higher than 90% RH.

(c) Atmosphere must not be dusty.

(d) Atmosphere must not be corrosive to metals.

(e) The place of use must not be subjected to unreasonably large mechanical vibration.

(f) Within 10 cm (4 in.) from the fan air outlet, there must not be a wall or other object which may obstruct the air flow.

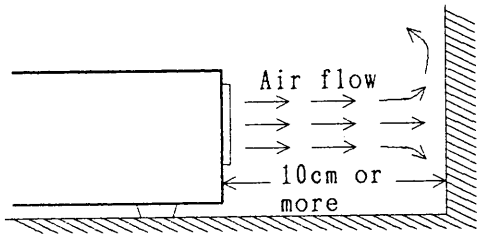


Figure 2-5. Clearance for Fan Outlet Air Flow

2.2 Description of Panel Items

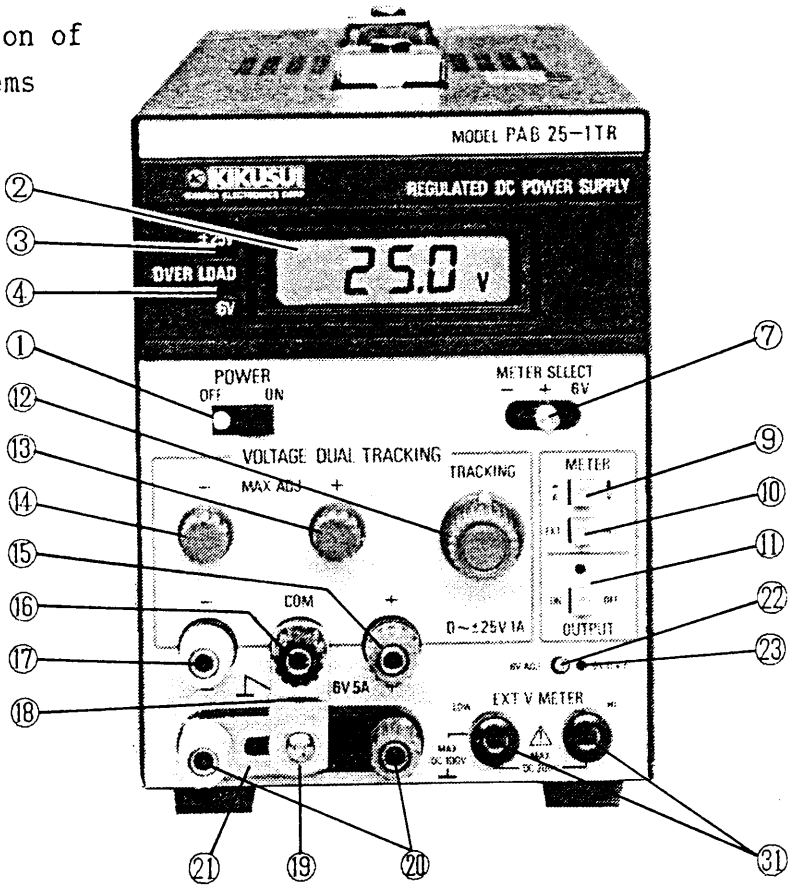


Figure 2-6
Front Panel
of PAB25-1TR

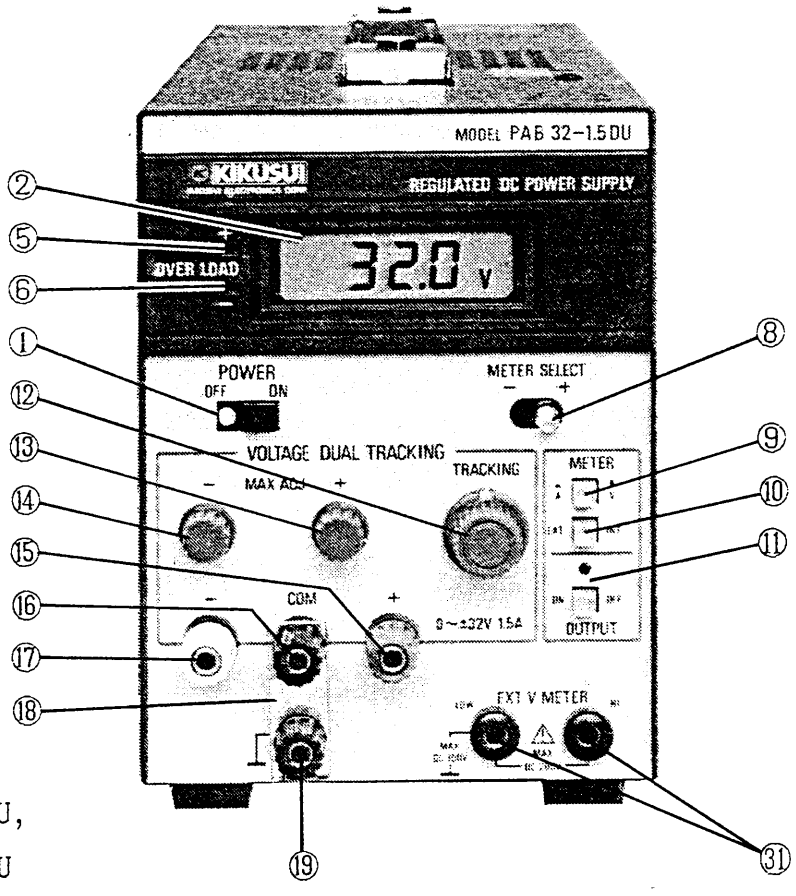


Figure 2-7
Front Panel
of PAB18-2.5DU,
PAB32-1.5DU

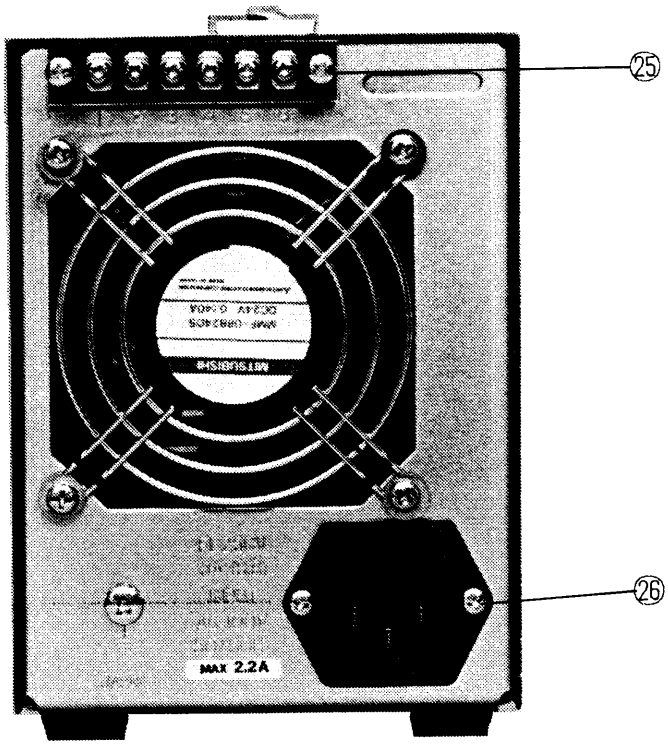


Figure 2-8
Rear Panel

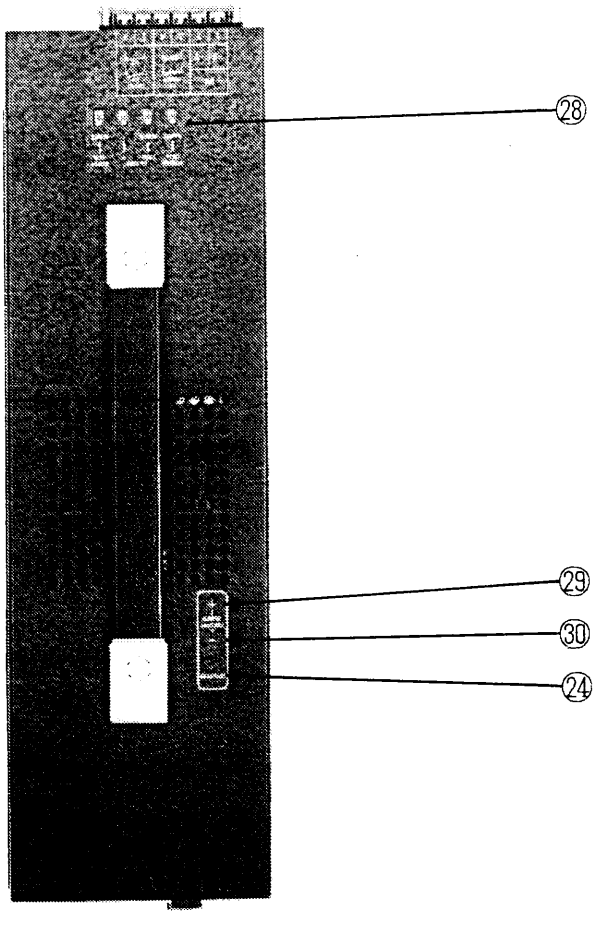


Figure 2-9
Top Panel

① POWER Switch

ON/OFF-controls the AC input power. As you throw the switch to the right, the orange light illuminates to indicate that the AC input power is ON.

② Digital Readout

Indicates with 3-1/2 digits the selected output voltage or current, preset value, or external voltage. (The item to be displayed is selectable with the METER A/V switch and METER EXT/INT switch.)

③ ±25 V OVERLOAD Light

Illuminates to indicate that the "+" output, "-" output, or both outputs are in the currrent-limited state.

④ 6 V OVERLOAD Light

Illuminates to indicate that the 6V-5A output is in the current-limited state.

⑤ "+" OVERLOAD Light

Illuminates to indicate that the "+" output is in the current-limited state.

⑥ "-" OVERLOAD Light

Illuminates to indicate that the "-" output is in the current-limited state.

⑦ METER SELECT Switch

Selects the "+" output, "-" output, or 6V-5A output for the meter.

⑧ METER SELECT Switch

Selects the "+" output or "-" output for the meter.

⑨ METER V/A Switch

Selects the meter function for voltmeter or ammeter.
The pushed-out state of the switch is for voltmeter mode and the pushed-in state for ammeter mode.

⑩ METER EXT/INT Switch

Selects the item to be measured by the meter--the INT for the output voltage or current of the power supply itself or the EXT for an external voltage applied via the EXT V METER terminals. The pushed-out state of the switch is for the INT mode and the pushed-in state for the EXT mode.

⑪ OUTPUT Switch

Turns ON or OFF the power supply outputs. When the switch is in the pushed-in state, the red lights (LED's) illuminate to indicate that the outputs are being delivered.
When the switch is in the pushed-out state, the red lights go off to indicate that the outputs are not being delivered. When in the OUTPUT OFF state, as you select the INT and V modes for the meter, the readout displays the preset outputs voltage allowing you to adjust it.

⑫ TRACKING Knob

Allows to adjust the "+" and "-" outputs simultaneously with the same ratio.

⑬ "+" MAX ADJ Knob

Allows to adjust the maximum voltage (limit voltage) of "+" output. When adjusting the maximum voltage, keep the TRACKING knob at the full clockwise position.

⑭ "-" MAX ADJ Knob

Allows to adjust the maximum voltage (limit voltage) of "-" output. When adjusting the maximum voltage, keep the TRACKING knob at the full clockwise position.

⑮ "+" OUTPUT Terminal

Delivers the "+" output with reference to the COM terminal.

⑯ COM Terminal

The reference terminal used in common for both "+" and "-" outputs.

⑰ "-" OUTPUT Terminal

Delivers the "-" output with reference to the COM terminal.

⑱ Shorting Bar

Allows to connect the COM terminal to the GND terminal.

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⑲ GND Terminal

Connected to the chassis of the power supply.

⑳ 6V 5A OUTPUT Terminals

Deliver the 6V-5A output.

㉑ Shorting Bar

Allows to connect the "+" or "-" OUTPUT terminal to the GND terminal.

㉒ 6V ADJ Potentiometer

Allows to adjust the 6V-5A output within a range of 0.5 to 6 V.

㉓, ㉔ 6V OVP Trip Light and 6V OVP ADJ Potentiometer

The 6V-5A output is incorporated with a thyristor crowbar type of overvoltage protector (OVP). When the output voltage has exceeded the trip voltage which can be preset by the 6V OVP ADJ potentiometer which is located on the top panel, the 6V-5A output is cut off and the 6V OVP trip light illuminates. To reset the OVP from the tripped state, turn off the POWER switch, wait for 5 seconds or more, and then turn on the POWER switch again. For the presetting procedure of OVP, see Section 2.4.2.

㉕ Remote Control Terminals and Remote Sensing Terminals

These terminals are located on the rear panel.
The remote sensing terminals are for Model PAB25-1TR only.
See Section 2.6.

㉖ AC Input Power Connector

Accepts the AC input power cable.

㉗ GND Terminal

To ground the power supply. Be sure to connect the GND terminal to an earth line when operating the power supply employing the accessory AC input power cable which accompanies the power supply. (This may not be necessary when employing a 3-conductor power cable with a 3-pin connector which directly provides an earth line connection.)

㉘ Remote Control Switches

Select the various modes of remote control. (See Section 2.6.)

㉙ "+" CURRENT LIMIT ADJ Potentiometer

Allows to adjust the limit current of "+" output.

㉚ "-" CURRENT LIMIT ADJ Potentiometer

Allows to adjust the limit current of "-" output.

㉛ EXT V METER Terminals

Accepts an external voltage to be measured by the meter.
As you set the METER EXT/INT switch to the EXT state (pushed-in state) and apply the external voltage to the HI and LOW terminals, the readout displays the measured value of the external voltage. The maximum allowable voltage between the LOW terminal and GND terminal is 100 V DC; that between the HI terminal and LOW terminal is 200 V DC.

2.3 "+" and "-" Output Operation Procedure

2.3.1 Setting Procedure of Output Voltages

(1) Connect the AC input power cable to the power supply, turn off the OUTPUT switch, and turn on the POWER switch.

(2) Set the METER V/A switch to V, the METER EXT/INT switch to INT, and the METER SELECT switch to "+".

(3) Turn the TRACKING knob to the full clockwise position.
Adjust the "+" MAX ADJ knob so that the readout displays the desired voltage. By this procedure, the voltage for the "+" output is preset.

(4) Change the METER SELECT switch to "-". Adjust the "-" MAX ADJ knob so that the readout displays the desired voltage.
By this procedure, the voltage for the "-" output is preset.

At this stage of the procedure, although the output voltages have been preset, they are not delivered to the OUTPUT terminals yet.

(5) As you turn on the OUTPUT switch, the outputs of the preset voltages will be delivered to the OUTPUT terminals.

2.3.2 Setting Procedure of Current Limit Value

(1) Turn off the OUTPUT switch, turn on the POWER switch, and preset the output voltage as desired.

(2) Short the OUTPUT terminal to the COM terminal and turn on the OUTPUT switch. The OVERLOAD light at the left hand side of the readout and the light above the OUTPUT switch will illuminate.

(3) Set the METER V/A switch to A (pushed-in state), set the METER SELECT switch to the required output polarity, and adjust the CURRENT LIMIT ADJ potentiometer on the top panel so that the readout displays the desired current limit value. By this procedure, setting of the current limit value is complete.

Note: Of Model PAB25-1TR, the ±25V OVERLOAD light will illuminate when either one of the "+" and "-" outputs is driven into the current-limited state.

2.3.3 Dual Tracking Mode of Operation

This mode of operation is such that both "+" and "-" output voltages can be varied at the same time by turning the TRACKING knob. So far as the output voltages are within the constant-voltagre operation range, they can be varied from zero volts to the rated voltages keeping the ratios of voltage changes the same--as can be expressed by the following formula referring to Figure 2-10.

$$\frac{b}{a} = \frac{d}{c}$$

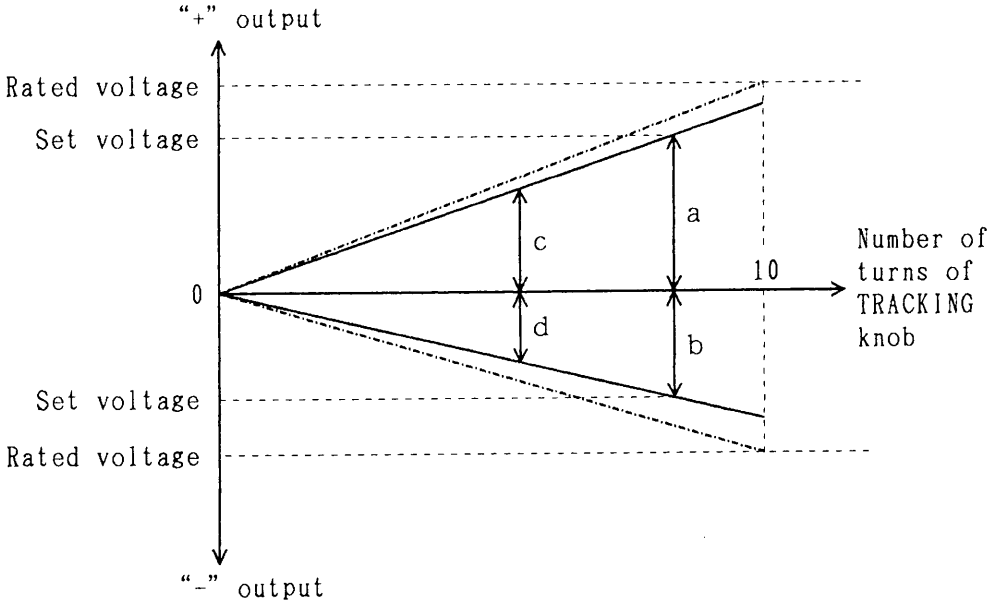


Figure 2-10. Dual Tracking Mode of Voltage Setting

Note: When one of the two outputs is driven into the current-limited state, although its output voltage is reduced depending on the load, the other output remains unaffected.

2.4 Operating Procedure for 6V-5A Output (PAB25-1TR only)

2.4.1 Setting Procedure of Output Voltage

(1) Connect the input power cable, turn off the OUTPUT switch, and turn on the POWER switch.

(2) Set the METER V/A switch to V, the METER EXT/INT switch to INT, and the METER SELECT switch to 6 V.

(3) Adjust the 6V ADJ potentiometer (adjustable with a screwdriver) so that the readout displays the desired output voltage.
At this stage of the procedure, although the output voltage has been preset, it is not delivered to the 6V-5A OUTPUT terminals yet.

(4) As you turn on the OUTPUT switch, the output with the preset voltage will be delivered to the 6V-5A OUTPUT terminals.

Note: (a) The current-limit value of the 6V-5A output is fixed. When the power supply is shipped from the manufacturer's factory, it is set at approximately 5.2 A.

(b) Make sure that the OVP is set properly. If its trip voltage is lower than the output voltage, no output will be delivered even when the above procedure of steps (1) through (4) is done and the 6V OVP trip light will illuminate.
If this is the case, turn off the POWER switch, turn the 6V OVP ADJ potenti-ometer fully clockwise, and then repeat the above procedure.

2.4.2 OVP (Overvoltage Protector)

The OVP is provided for the 6V-5A output only. When the output voltage has exceeded the OVP trip voltage, the thyristor connected at the output end conducts to short the output terminals and at the same time the output is turned off. To indicate this state, the 6V OVP trip light (LED) illuminates.

To adjust the OVP trip voltage setting, proceed as follows:

(1) Turn fully clockwise the 6V OVP ADJ potentiometer on the top panel.

(2) Adjust the 6V ADJ potentiometer on the front panel so that the readout indicates the output voltage (the desired OVP trip voltage).

(3) Turn gradually counterclockwise the 6V OVP potentiometer on the top panel to the point where the 6V OVP trip light illuminates.

(4) Turn counterclockwise the 6V ADJ potentiometer on the front panel.

(5) To reset from the OVP tripped state, turn off once the POWER switch and then turn it on again.

Precaution: As the OVP trips, the thyristor conducts and draws a large current even from the load. If the load is of a type which can feed power (a battery, a large capacitor, or the like), both power supply and load may be damaged by the large current drawn by the thyristor. To guard against this, connect a reverse-current check diode in series to the load as shown in Figure 2-11. (This is essential when the load is a battery which can feed a short-circuit current of 5 A or more for a long period.)

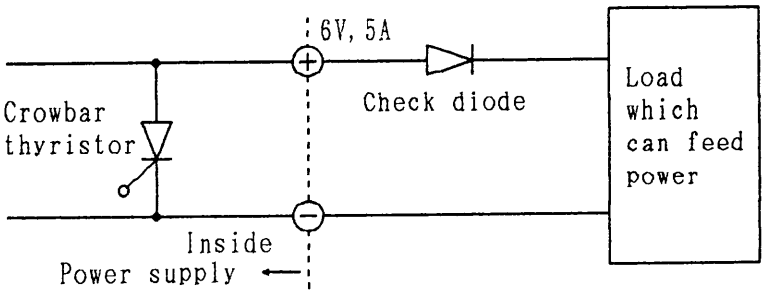


Figure 2-11. Check Diode to Prevent Reverse Current

2.5 Series Operation

2.5.1 Series-connected Output (PAB18-2.5DU, PAB32-1.5DU, PAB25-1TR)

A higher output voltage can be attained by connecting the load between the "+" and "-" OUTPUT terminals as shown below.

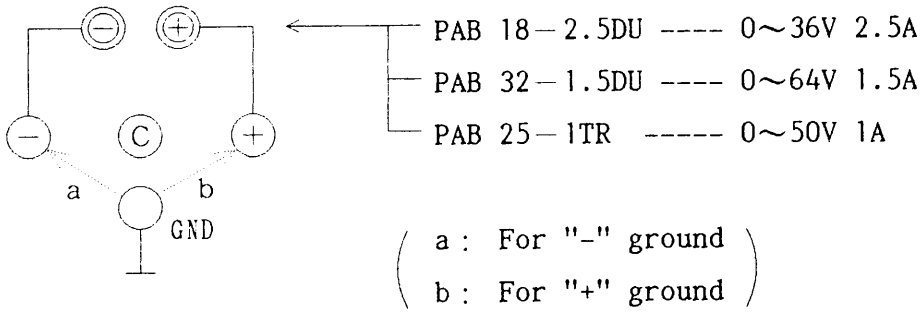


Figure 2-12. For Series-connected Output

2.5.2 Series-connected Outputs (PAB25-1TR Only)

Higher output voltages (6A-5A, 31V-1A, 56V-1A) can be attained with a setup as shown below.

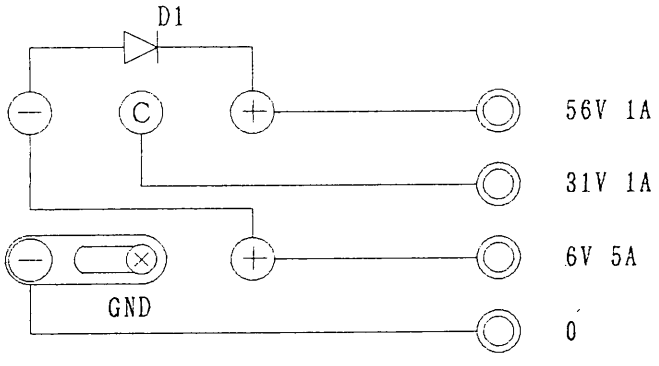


Figure 2-13. Series-connected Outputs (an example with negative ground)

Note 1: When a setup as shown above is used, if the output is shorted inadvertently, a current of 5 A will flow in the ±25 V output circuit and the protective diode may be damaged. Be sure to employ a diode whose current rating is 5 A or more.

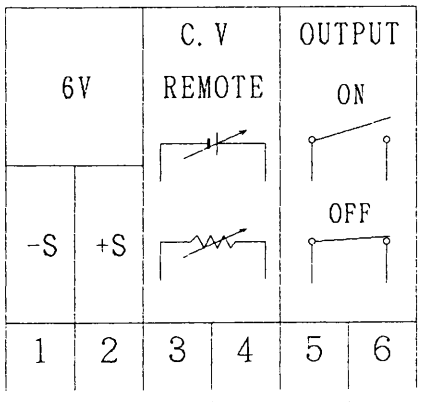
Note 2: When two or more outputs are used simultaneously, the available currents are limited by the rated currents of respective outputs. For example, when 0.8 A is used for the 56 V output, 0.2 A is available for the 31 V output. For another example, when 0.3 A is used for the 56 V output and 0.5 A for the 31 V output, 4.2 A is available for the 6 V output.

2.6 Remote Control

2.6.1 Setup for Remote Control

To operate the power supply in the remote control mode, connect the control signals to the rear terminals and set the selector switches on the top panel as indicated below.

Precaution: Be sure to turn off the POWER switch before changing the selector switches on the top panel.



Terminals for contact signal for on/off control of outputs

Terminals for voltage or resistance signal for tracking control

Terminals for remote sensing of 6V-5A output (for PAB25-1TR only)

Figure 2-14. Rear Terminals

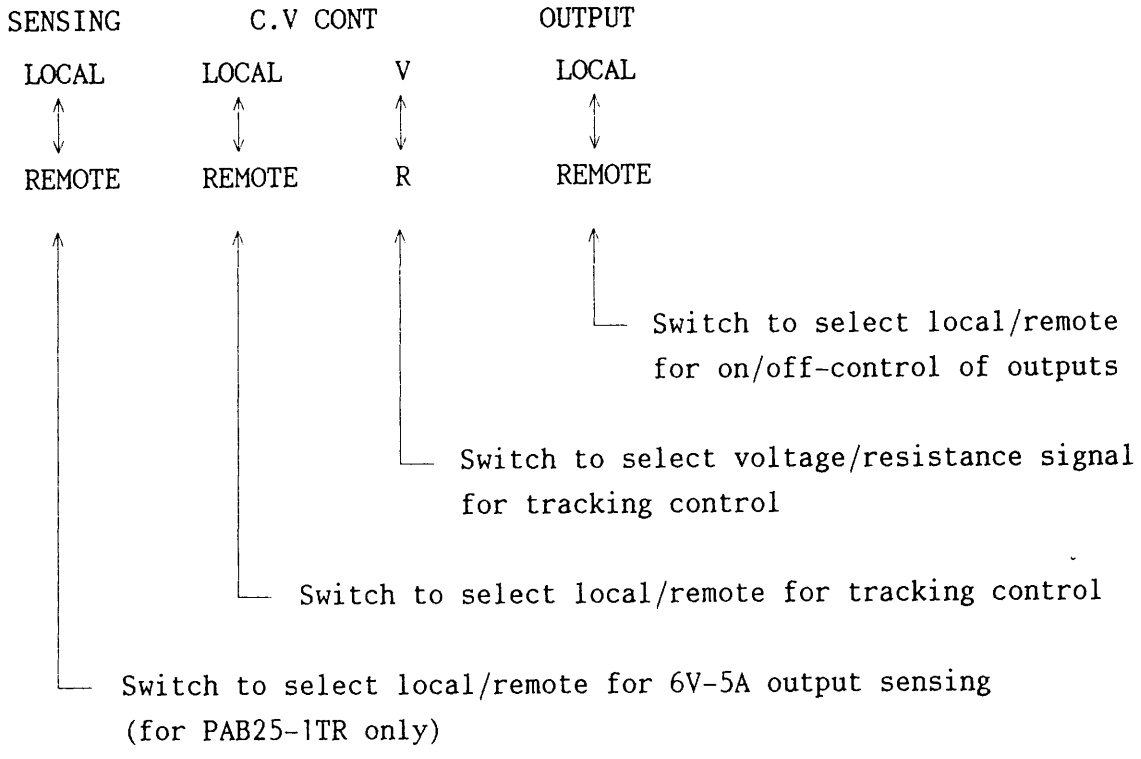


Figure 2-15. Remote Control Selector Switches on Top Panel

2.6.2 ON/OFF Control of Outputs with Contact Signal

With an external contact signal, the "+" and "-" outputs (the 6V-5A output also for the PAB25-1TR) can be ON/OFF-controlled simultaneously. For this control, proceed as follows:

(1) Turn off the POWER switch.

(2) Connect a contact signal between rear terminals 5 and 6.

(3) Set the OUTPUT LOCAL/REMOTE switch (see Figure 2-15) to REMOTE. (As you this, the OUTPUT switch on the front panel is disabled.)

(4) Turn on the POWER switch. Now the output can be ON/OFF-controlled with the contact signal (ON when the contact is made and OFF when broken.)

Precaution: Exercise care so that the rear terminals are not brought into contact with the chassis, the output terminals or other undesirable object. Note that the power supply may be damaged if an abnormal potential is applied to the rear terminals.

2.6.3 TRACKNIG Control with Voltage Signal

Both "+" and "-" output voltages can be simultaneously controlled with a voltage signal of zero volts to approximately 10 volts.
For this control, proceed as follows:

(1) Turn the TRACKING dial to the full clockwise position.

(2) Set at the desired voltages the "+" and "-" outputs with the "+" and "-" MAX ADJ potentiometers, respectively.

(3) Turn off the POWER switch.

(4) Connect a voltage signal between rear terminals 3 and 4 as shown in Figure 2-14.

(5) Set the C.V CONT LOCAL/REMOTE switch to REMOTE and the V/R switch to V. (See Figure 2-15.)

(6) Now, as you vary the voltage signal, both "+" and "-" output voltages will vary simultaneously.

2.6.4 TRACKING Control with Resistance Signal

Both "+" and "-" output voltages can be simultaneously controlled with a resistance signal of 0 to 100 kΩ. For this control, proceed as follows:

(1) Turn off the POWER switch.

(2) Connect a 100 kΩ potentiometer between rear terminals 3 and 4 as shown in Figure 2-14.

(3) Set the C.V CONT LOCAL/REMOTE switch to REMOTE and the V/R switch to R.

(4) Turn on the POWER switch.

Now, assuming that the "+" and "-" MAX ADJ knobs are set in the full clokwise position, the "+" and "-" output voltages (Eo) can be varied by varying the potentiometer resistance (R) as expressed by the following formulas:

For ±18V outputs: $$\pm Eo = \frac{130}{R + 7.2}$$

For ±25V outputs: $$\pm Eo = \frac{180}{R + 7.2}$$

For ±32V outputs: $$\pm Eo = \frac{230}{R_1 + 7.2}$$

The relationship between the control resistance and the output voltages is as shown in Figure 2-16.

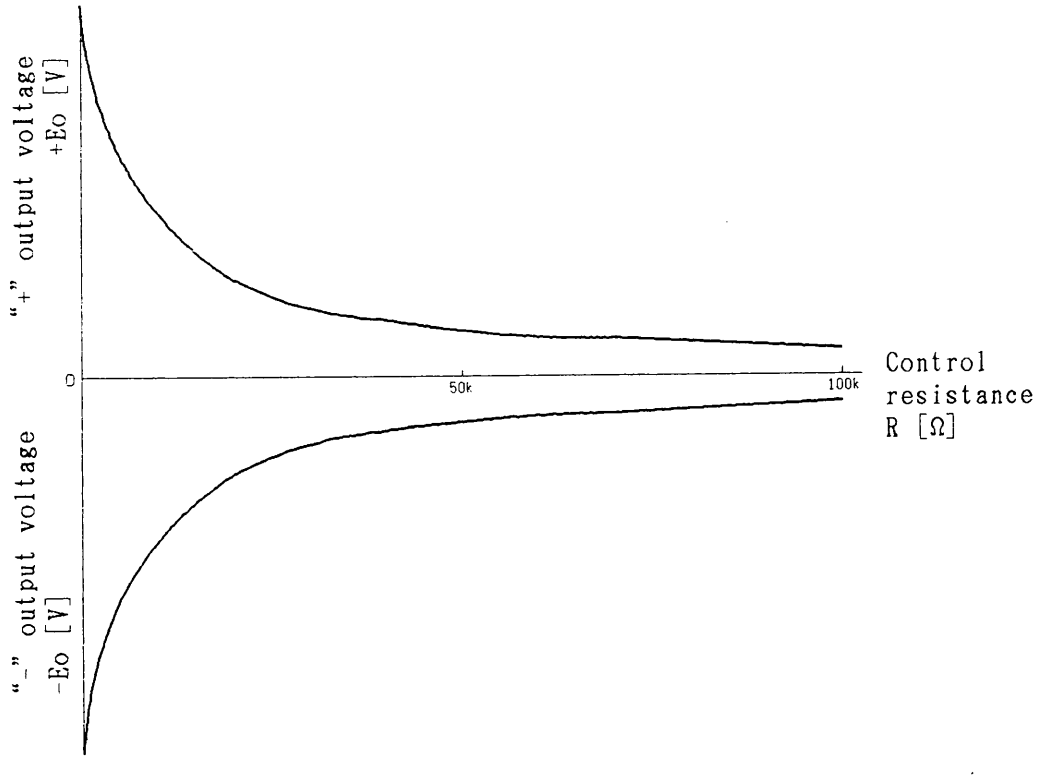


Figure 2-16. Control Resistance vs. Output Voltages

2.7 Remote Sensing (PAB25-1TR only)

The 6V-5A output of Model PAB25-1TR has a remote sensing function to compensate for the voltage drop caused by the wiring resistance (contact resistance and cable resistance) of connection between the power supply and the load. To make use of the function for betterment of load regulation when the voltage drop is not tolerable, proceed as follows:

(1) Turn off the POWER switch.

(2) Connect rear terminals 1 (-S) and 2 (+S) to the point where the output voltage is to be sensed and regulated. For this connection, strand the two sensing wires to suppress induction noise.

(3) Set the SENSING LOCAL/REMOTE switch on the top panel to REMOTE.

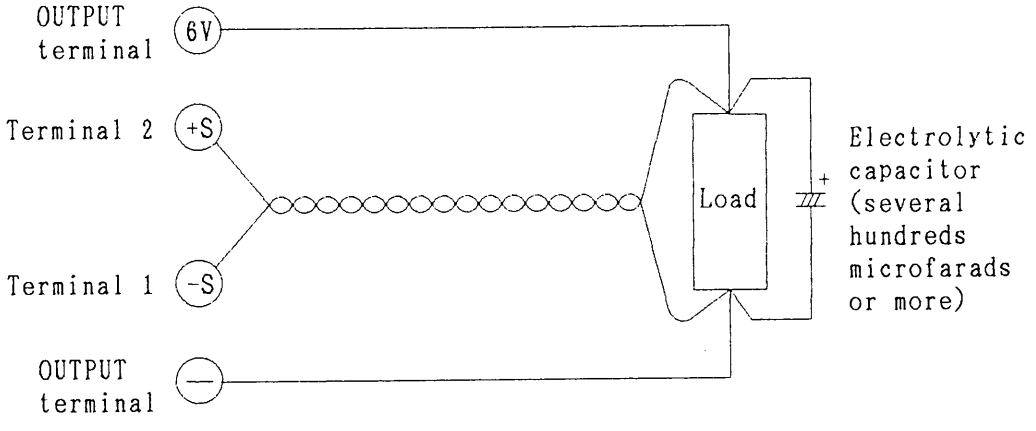


Figure 2-17. Remote Sensing Setup

Note: The voltage drop caused by the wiring resistance reduces the maximum available output voltage by the corresponding amount.

3. THEORY OF OPERATION

3.1 Constant-voltage Circuit

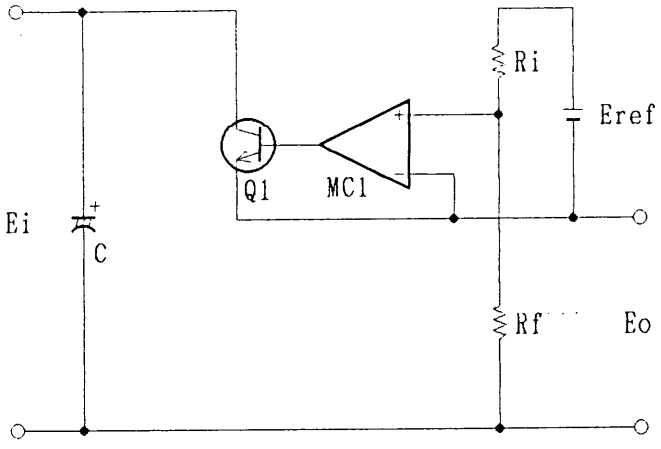


Figure 3-1

The concept of the constant-voltage circuit is shown in Figure 3-1. Assuming MC1 to be an ideal amplifier of infinitive agin, infinitive input resistance and zero output resistance, the following equation can be written.

$$\frac{Eref}{Eo} = \frac{Ri}{Rf}$$

Output voltage Eo can be written as follows:

$$Eo = \frac{Rf}{Ri} Eref$$

This equation indicates that output voltage Eo can be maintained constant by maintaining, Rf, Ri and Eref constant.

3.2 Current-limiting Circuit

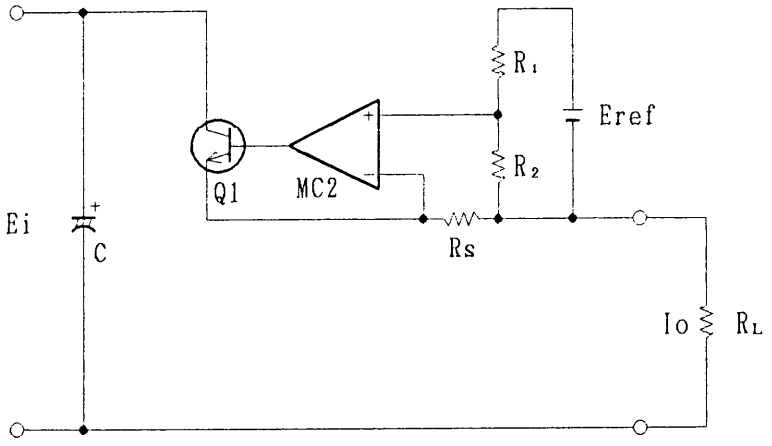


Figure 3-2

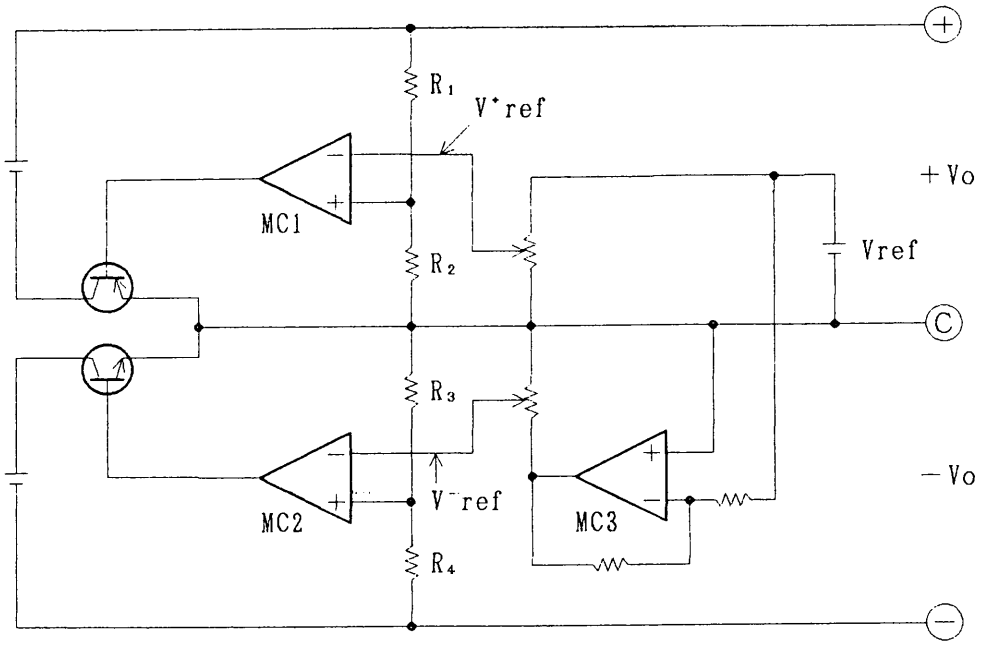
The concept of the current limiting circuit is shown in Figure 3-2. When the voltage drop across current detecting resistor Rs has exceeded the voltage obtained by dividing reference voltage Eref with dividing resistors R_1 and R_2, the output voltage of ideal amplifier MC2 falls and the instrument operation enters into the constant-current region. The relationship between Io and Eref is expressed as follows:

$$Rs \cdot Io = \frac{R_2}{R_1 + R_2} Eref$$

Io is written as follows:

$$Io = \frac{R_2}{Rs(R_1 + R_2)} Eref$$

3.3 Dual Tracking Circuit



MC1 - MC3 denote an ideal amplifier.

Figure 3-3

Referring to Figure 3-3, the output voltages (+Vo and -Vo) can be expressed as follows:

$$+Vo = A \cdot V^{+}ref \qquad (\text{where, } A = 1 + \frac{R_1}{R_2})$$

$$-Vo = B \cdot V^{-}ref \qquad (\text{where, } B = 1 + \frac{R_4}{R_3})$$

The output voltages +Vo and -Vo can be varied by varying the reference voltage $V^{+}ref$ and $V^{-}ref$ respectively, while keeping the resistances R_1 - R_4 constant.

Assume that Vref is selected so that it satisfies the following conditions:

$$\alpha \cdot Vref = V^{+}ref$$
$$\beta \cdot Vref = V^{-}ref$$

When in the above conditions, the following equations can be written.

$$+Vo = \alpha \cdot A \cdot Vref$$
$$-Vo = \beta \cdot B \cdot Vref$$

The above equations indicate that the two output voltages can be simultaneously changed by changing Vref alone.

Assuming that α, β, and R_1 through R_4 are constant, the ratio $\left(\frac{+Vo}{-Vo} \right)$ between the two output voltages remains constant, even when Vref is changed.
Of the power supply, Vref is adjustable with the TRACKING knob, V^+ref with the "+" knob and V^-ref with the "-" knob, and the resistances are $R_1 = R_4$ and $R_2 = R_3$.

4. CALIBRATION

4.1 Calibration of Digital Meter

To calibrate the digital meter, proceed as follows:

(1) Set the METER EXT/INT switch to EXT (to the pushed-in state). Apply an external calibration voltage of 190.0 mV DC (accuracy 0.05% or better) to the EXT V METER terminals (between HI and LOW terminals). Adjust potentiometer RV701 (see Figure 4-1) so that the digital meter indicates 190.0 ±1 digits, at ambient temperature 23°C ±1°C (73°F ±1.8°F).

(2) Change the calibration voltage to 1.9000 V DC (accuracy 0.05% or better). Adjust potentiometer RV702 (see Figure 4-1) so that the digital meter indicates 1.900 ±1 digits, at ambient temperature 23°C ±1°C (73°F ±1.8°F).

Further, check the 20V and 200V ranges by changing the calibration voltage to 19.00 V and 190.0 V, respectively, and if deviations are found, adjust the potentiometers to minimize them.

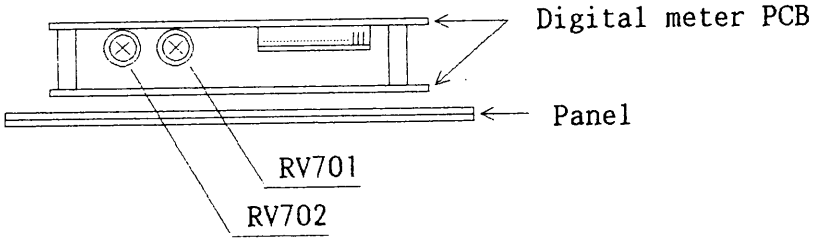


Figure 4-1. Locations of Calibration Potentiometers

4.2 Calibration of Preset Output Voltages and Currents

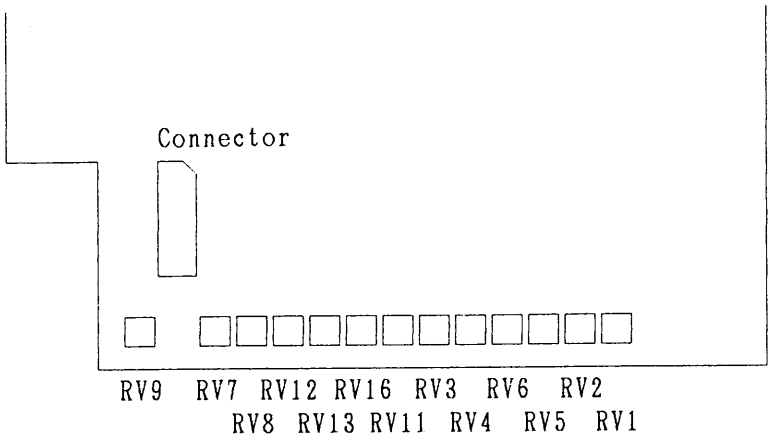


Figure 4-2. Layout of Calibration Potentiometers (PCB A-966)

To calibrate the presettings of the output voltages and currents, proceed as explained subsequently. For this calibration, set the METER EXT/INT switch to EXT (to the pushed-in state).

4.2.1 Calibration of 6V-5A Output

(1) Calibration of Preset Output Voltage

Set the METER SELECT switch to 6V-5A, the METER V/A switch to V, and the OUTPUT switch to ON. Adjust the output voltage to 1.750 V with the 6 V ADJ potentiometer.

Next, set the OUTPUT switch to OFF and adjust potentiometer RV12 so that the meter indicates 1.750 V.

(2) Calibration of Maximum Output Current

Set the METER SELECT switch to 6V-5A, the OUTPUT switch to OFF, and the METER V/A switch to A. Connect an external ammeter (accuracy 0.2% or better) to the 6V-5A OUTPUT terminals (between "+" and "-" terminals) and sdjust potentiometer RV13 so that the external ammeter reads 5.20 A. In this state, adjust potentiometer RV11 so that the digital meter (readout) indicates 5.20 A.

4.2.2 Calibration of "+" and "-" Dual Tracking Outputs

(1) Calibration of Maximum "+" Output Voltage

Connect an external voltmeter (accuracy 0.05% or better) between the "+" and "COM" OUTPUT terminals. Set the TRACKING knob and "+" MAX ADJ knob to the full clockwise position, the METER SELECT switch to "+", the OUTPUT switch to ON, and the METER V/A switch to V. Deliver the rated output voltage. In this state, adjust potentiometer RV9 so that the digital meter of the power supply indicates the voltage mentioned in the following table.

PAB18-2.5DU	PAB32-1.5DU	PAB25-1TR
19.00 V	33.0 V	26.0 V

Table 4-1

(2) Calibration of "+" Preset Output Voltage

Set the METER SELECT switch to "+", the METER V/A switch to V, and the OUTPUT switch to ON. Adjust the TRACKING knob so that the "+" output becomes 17.50 V. In this state, set the OUTPUT switch to OFF and adjust potentiometer RV7 so that the digital meter indicates 17.50 V.

(3) Calibration of "-" Preset Output Voltage

Set the METER SELECT switch to "-", the METER V/A switch to V, and the OUTPUT switch to ON. Adjust the TRACKING knob so that the "-" output becomes -17.50 V. In this state, set the OUTPUT switch to OFF and adjust potentiometer RV8 so that the digital meter indicates -17.50 V.

(4) Calibration of "+" Maximum Output Current

Set the METER SELECT switch to "+", the METER V/A switch to A, and the OUTPUT switch to OFF. Connect an ammeter (accuracy 0.2% or better) between the "+" OUTPUT and "COM" terminals. Set the OUTPUT switch to ON and adjust potentiometer RV5 so that the digital meter indicates the current mentioned in the following table.

PAB18-2.5DU	PAB32-1.5DU	PAB25-1TR
2.55 A	1.53 A	1.05 A

Table 4-2

In the above state, adjust RV1 so that the digital meter indicates the same current value.

(5) Calibration of "-" Maximum Output Current

Set the METER SELECT switch to "-", the METER V/A switch to A, and the OUTPUT switch to OFF. Connect an ammeter (accuracy 0.2% or better) between the "-" OUTPUT and "COM" terminals. Set the output switch to ON and adjust potentiometer RV4 so that the digital meter indicates the current mentioned in the following table.

PAB18-2.5DU	PAB32-1.5DU	PAB25-1TR
-2.55 A	-1.53 A	-1.05 A

Table 4-3

In the above state, adjust RV2 so that the digital meter indicates the same current value.

5. RACK MOUNT

The power supply can be installed on standard rack (EIA or JIS) by employing the mounting brackets and frame which are available as optional items. Brackets B42 are fixed on the power supply. Frame RMF4 (EIA) or RMF4M (for JIS rack) are installed on the rack.

5.1 Fixing the Rack Mount Brackets B42

Fix the brackets B42 to the top and bottom panels of the power supply as illustrated below.

BRACKETS B42

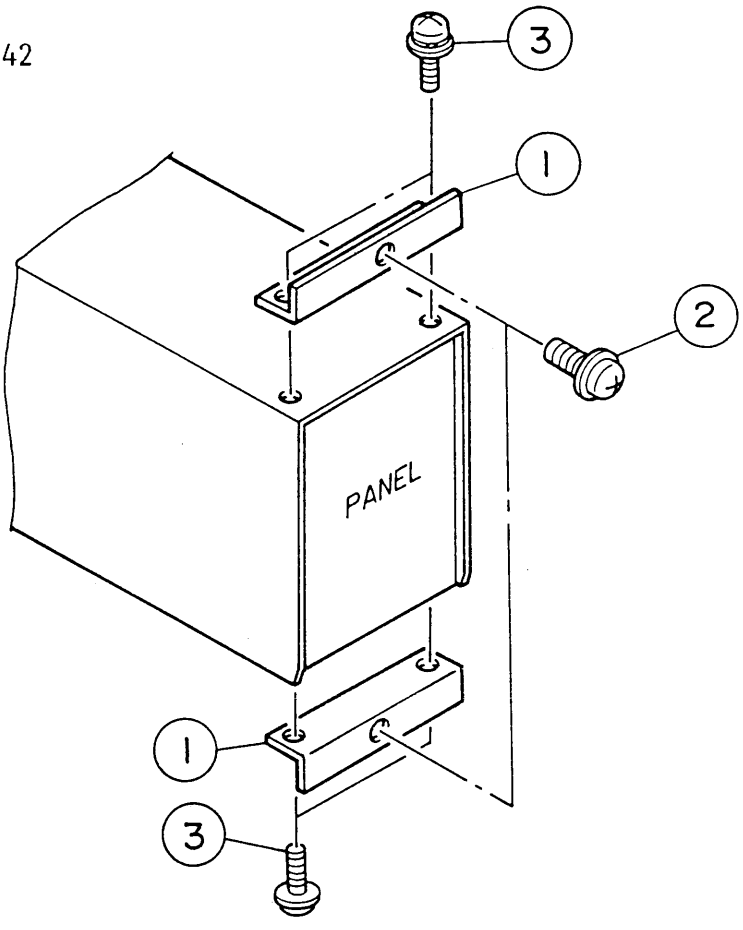


Figure 5-1

NO.	DESCRIPTION	QTY
1	BRACKET B42	2
2	SCREW WITH PW (S) M4x8 B–NI	2
3	SCREW WITH SW, PW M3x6 S–ZN	4

5.2 Installing the Power Supply in a Frame

Model RMF4 rack mount frame is for an EIA rack and Model RMF4M rack mount frame is for a JIS rack.

To install the power supply in the frame, remove the bar*, put the power supply into the frame, fix the removed bar in the original position, and fix the power supply to the frame with the screws.

*: For RMF4M, remove ⑫ BAR (3) (front top bar) shown in drawing "CONSTRUCTION OF MODEL RMF4M."

For RMF4, remove ③ BAR (1) (front top bar) shown in drawing "CONSTRUCTION OF MODEL RMF4."

CONSTRUCTION OF MODEL RMF4M

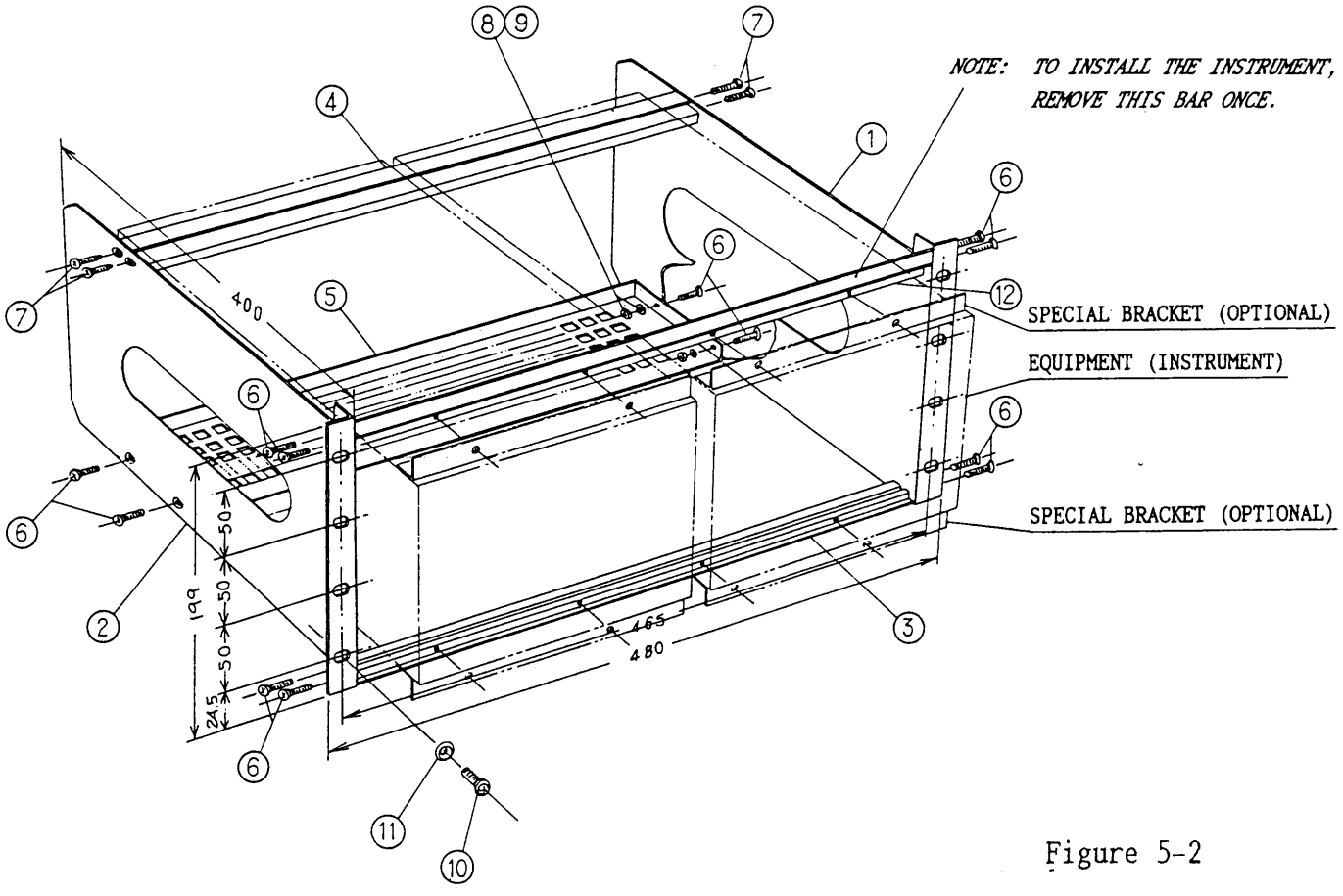


Figure 5-2

TABLE OF PARTS

ITEM NO.	PARTS	ITEM NO.	
①	RIGHT SIDE PANEL	1	
②	LEFT SIDE PANEL	1	
③	BAR (1)	1	
④	BAR (2)	1	
⑤	RUBBER STUD BRACKET	1	
⑥	SCREWS, COUNTERSUNK, M3 X 8	12	
⑦	TAPPING SCREWS, FLAT HEAD, M3 X 12	4	) OR FLANGE
⑧	SPRING WASHER, M3 SW	4	) NUTS
⑨	NUTS M3N	4	
⑩	SCREWS, OVAL CONTERSUNK, M5 X 14	8	
⑪	CUP WASHERS, M5	8	
⑫	BAR (3)	1	

CONSTRUCTION OF MODEL RMF4

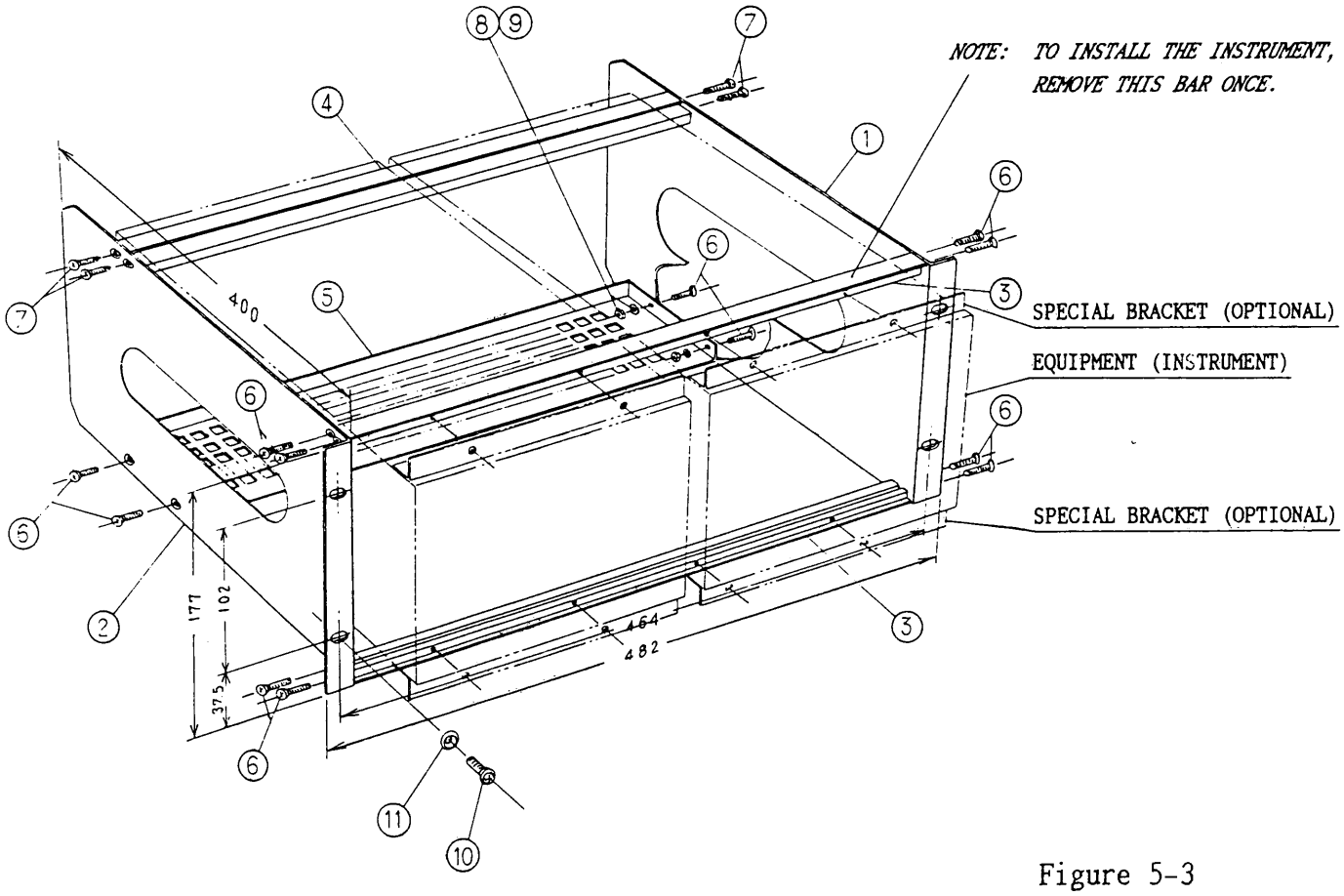


Figure 5-3

TABLE OF PARTS

ITEM NO.	PARTS	ITEM NO.	
①	RIGHT SIDE PANEL	1	
②	LEFT SIDE PANEL	1	
③	BAR (1)	2	
④	BAR (2)	1	
⑤	RUBBER STUD BRACKET	1	
⑥	SCREWS, COUNTERSUNK, M3 x 8	12	
⑦	TAPPING SCREWS, FLAT HEAD, M3 x 12	4	OR FLANGE
⑧	SPRING WASHER, M3 SW	4	NUTS
⑨	NUTS M3N	4	
⑩	SCREWS, OVAL CONTERSUNK, M5 x 14	4	
⑪	CUP WASHERS, M5	4	

After the above installation procedure is over, check that the power supply is securely installed.

Note: The power supply is fixed and held by the brackets (B42) only. Note that the rubber studs at the rear bottom of the power supply will not be rested on the rubber stud bracket.

Up to four units of power supplies can be accommodated in one unit of rack mount frame. To cover up the blank space of the frame, blank panels (BP2 or BP4) are available as optional items.

5.3 Installing the Frame on a Rack

Install the frame, in which the power supply or supplies have been installed, onto an EIA rack or a JIS rack.

Note: For cooling air ventilation, provide one-shelf blank space at both above and below the rack shelf where the power supply is installed. Thermal insulator panels may be used as required.

To cover up the blank shelves, blank panels (BP191-M for EIA or BP1H-M for JIS) are available as optional items.