

DIFFERENTIATOR

Model ED-601G

GENERAL HANDLING PRECAUTIONS

This device is intended for use only by qualified medical personnel.

Please read these precautions thoroughly before attempting to operate the instrument.

1. To satisfy and effectively use the instrument, its operation must be fully understood.
2. When installing or storing the instrument, take the following precautions:
 - (1) Avoid moisture or contact with water, extreme atmospheric pressure, excessive humidity and temperatures, poorly ventilated areas, and dusty saline or sulphuric air.
 - (2) The instrument should be placed on an even, level floor. Vibration and mechanical shock should be avoided even during moving.
 - (3) Avoid placing in an area where chemicals are stored or where there is danger of gas leakage.
 - (4) The power line source to be applied to the instrument should correspond in frequency and voltage to specifications, and have allowable current capacity.
 - (5) Choose a room where a proper grounding facility is available.
3. Before Operation
 - (1) Check that the instrument is in perfect operating order.
 - (2) Check that the instrument is grounded properly.
 - (3) Check that all cords are connected properly.
 - (4) Pay extra attention when the instrument is in combination with other instruments to avoid misdiagnosis or other problems.
 - (5) All circuitry used for direct patient connection must be doubly checked.
 - (6) Check that battery voltage and battery condition are perfect when using battery-operated models.
4. During Operation
 - (1) Both the instrument and the patient must receive constant, careful attention.
 - (2) Turn power off or remove electrodes and/or transducers when necessary to assure the patient's safety.
 - (3) Avoid direct contact between the instrument and the patient.
5. To Shutdown After Use
 - (1) Turn power off with all controls returned to their original positions.
 - (2) Remove the cords gently; do not use force to remove them.
 - (3) Clean the instrument together with all accessories to keep them ready for their next use.
6. The instrument must receive expert, professional attention for maintenance and repairs. When the instrument is not functioning properly, it should be clearly marked to avoid operation while it is out of order.
7. The instrument must not be altered or modified in any way.

8. Maintenance and Inspection:

- (1) The instrument and parts should undergo regular maintenance inspection at least every 6 months.
- (2) If stored for extended periods without being used, make sure prior to operation that the instrument is in perfect operating condition.

9. When the instrument is used with an electrosurgical instrument, careful attention should be paid to the application and/or location of electrodes and/or transducers to avoid possible burn to the patient.

10. When the instrument is used with a defibrillator, make sure that the instrument is protected against defibrillator discharge. If not, remove patient cables and/or transducers from the instrument to avoid possible damage.

WARRANTY POLICY

Nihon Kohden Corporation (NKC) shall warrant its products against all defects in materials and workmanship for one year from the date of delivery. However, consumable materials such as recording paper, ink, stylus and battery are excluded from the warranty.

NKC or its authorized agents will repair or replace any products which prove to be defective during the warranty period, provided these products are used as prescribed by the operating instructions given in the operator's and service manuals.

No other party is authorized to make any warranty or assume liability for NKC's products. NKC will not recognize any other warranty, either implied or in writing. In addition, service performed by someone other than NKC or its authorized agents or technical modification or change of products without prior consent of NKC may be cause for voiding this warranty.

Defective products or parts must be returned to NKC or its authorized agents, along with an explanation of the failure. Shipping costs must be pre-paid.

In the USA and Canada other warranty policies may apply.

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Introduction

The Differentiator ED-601G is a plug-in unit for the Polygraph System RM-6000 series.

This unit is used in connection with a bioelectric amplifier, carrier amplifier, etc. The differentiator differentiates the waveforms such as blood pressure, impedance plethysmogram, and nystagmogram, to obtain the velocity of each parameter.

Simultaneous calibration of the original amplifier and the differentiator provides an accurate measurement.

Please read this manual thoroughly prior to operation. Also refer to the operator's manual of the main unit and the other plug-in units.

Features

1. Easy and simultaneous calibration of both the amplifier and the differentiator.
2. Selectable differentiation time constants and high cut filters provide a suitable differentiation for each waveform.
3. Cardiac output is calculated by connection with an impedance plethysmograph AI-601G.

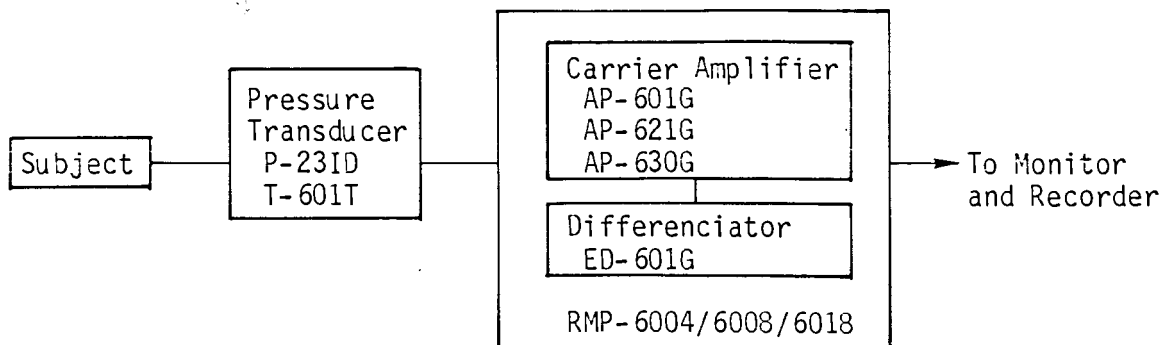
Composition

The differentiator is plugged in the Polygraph Amplifier Console RMP-6004/6008/6018. It differentiates various kinds of waveforms such as blood pressure, impedance plethysmogram and nystagmogram.

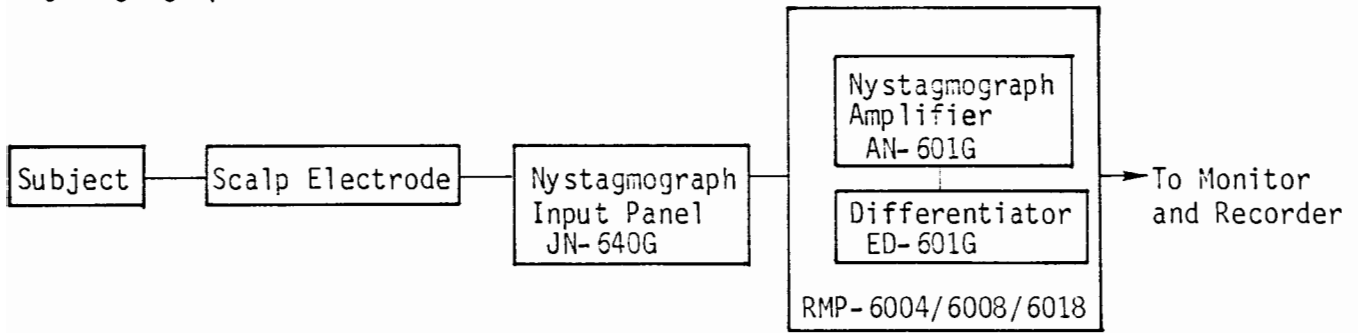
Examples of the system composition and a block diagram of the differentiator are shown in the following figures:

COMPOSITION EXAMPLES

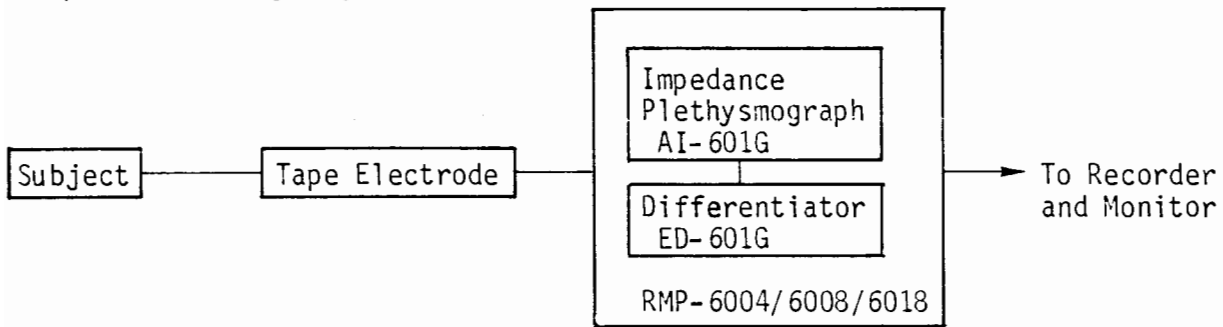
Pressure Differentiation



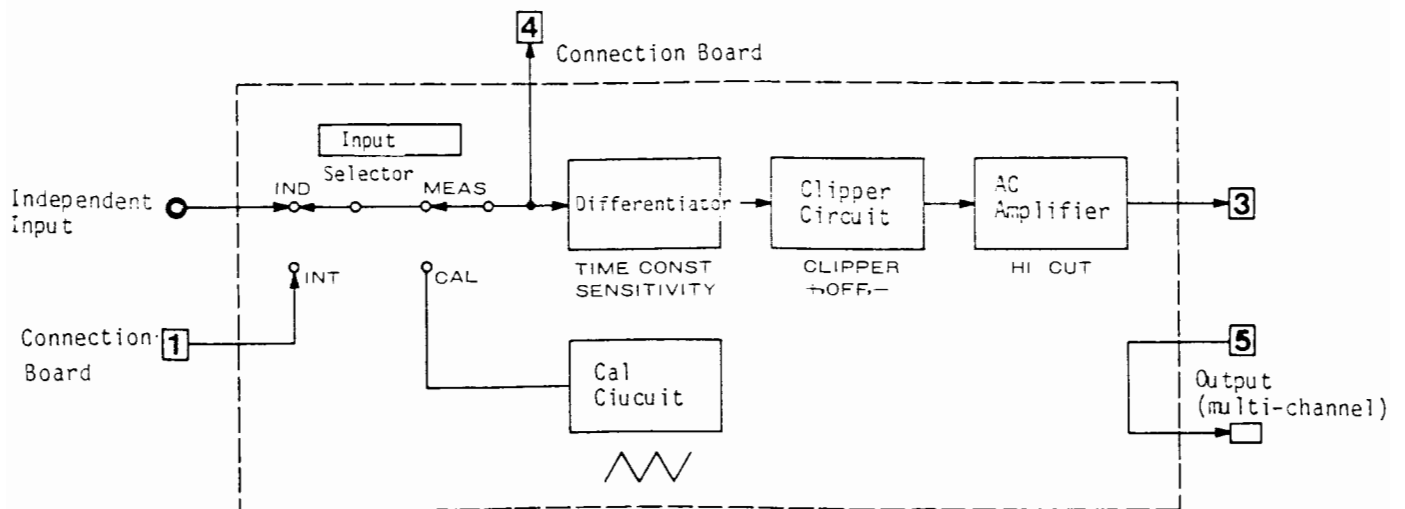
Nystagmograph Differentiation



Impedance Plethysmogram Differentiation



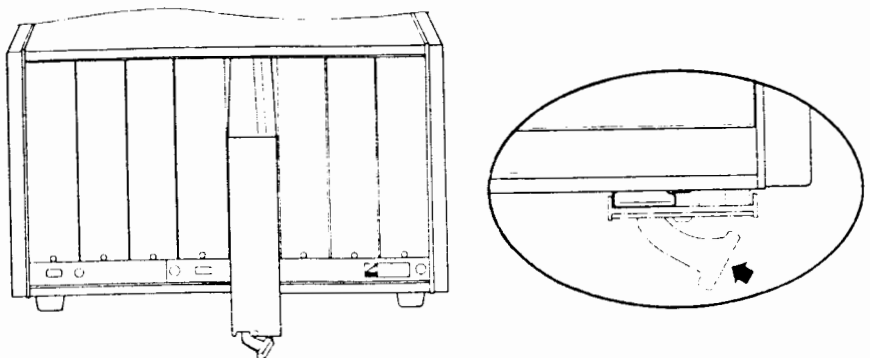
BLOCK DIAGRAM



Controls and Switches

Refer to Panel Illustration on page 11.

- | | |
|------------------------------------|--|
| (1) MEAS-OFF-CAL
Input Selector | Selects input.
MEAS : Differentiates the waveform in this position
OFF : Stops differentiation
CAL : Applies the calibration signal to the differentiator. |
| (2) Calibration Amplitude | Adjusts the calibration amplitude of triangle waveform from 0 to 5V. |
| (3) TIME CONST | Selects differentiation time constant.
Sensitivity adjustment is required when the time constant is changed. |
| (4) HI CUT | Selects cut-off frequency. |
| (5) SENSITIVITY
Step control | Selects the rough amplitude of the signal. |
| (6) SENSITIVITY
Fine control | Adjusts the fine amplitude of the signal. |
| (7) CLIPPER | Clips the signal.
+ : Negative signal is clipped, and only a positive signal is obtained at the output.
OFF : Both a positive and negative signal are obtained.
- : Positive signal is clipped, and only a negative signal is obtained at the output. |
| (8) Module Lock Lever | Pull this lever to draw out the unit from the Polygraph Amplifier Console.
After setting the internal switch, be sure to attach the side shield plate to the plug-in unit and restore the unit to the Console. |



(9) **0.1sec-1sec**
Calibration Interval
Selector

Selects the calibration interval.

1sec : Used for slow wave differentiation such as
nystagmograph.

Repetition interval is 2sec.

0.1sec : Used for rapid wave differentiation such as
blood pressure or cardiac output.

Repetition interval is 0.2sec.

(10) **IND-INT**
Input Connection
Selector

Selects the input signal connection.

IND : The signal is supplied via the Input Panel
PI-680G or individual input connector on the
rear panel of the Polygraph Amplifier Console
RMP-6004/6008/6018)

INT : The signal is supplied via the connection board
from an other channel.

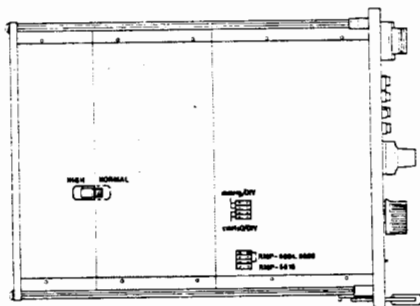
Measurement (dp/dt)

dp/dt is measured in combination with the Carrier Amplifier AP-601G or AP-621G.

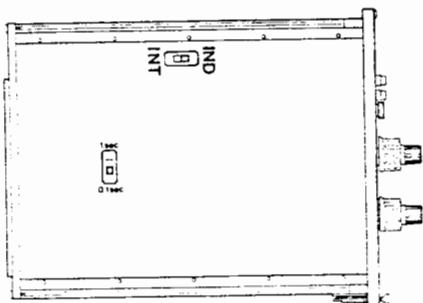
INTERNAL SWITCH SETTING

Pull the unit lock lever and draw the ED-601G out from the Polygraph Amplifier Console. Remove the side shield plate from the amplifier and check to see that the following switches are set properly as follows.

AP-601G HIGH-NORMAL selector : HIGH



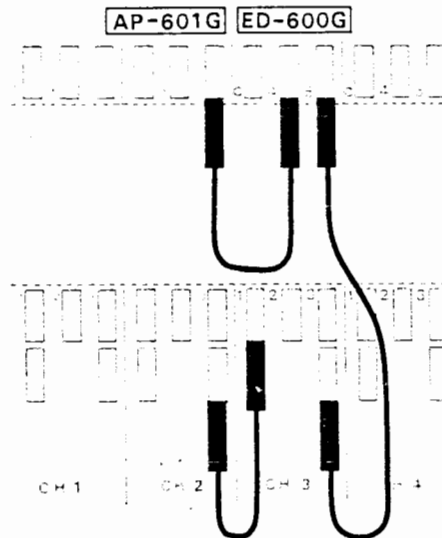
ED-601G IND-INT selector : INT
1sec-0.1sec selector : 0.1sec



After setting switches, be sure to restore the unit to the console and lock the lever.

CONNECTION BOARD WIRING

Draw out the connection board from the Polygraph Amplifier Console. Connect as follows.



Pin No.3 and 5

For output signal connection

Pin No.3 and 1

Inputs the signal such as blood pressure from the Carrier Amplifier to the Differentiator.

Pin No.5 and 4

For simultaneous calibration of the Carrier Amplifier and the Differentiator.

POWER ON

After making sure that the ground lead and power cord are properly connected, turn on the power of the rack, console, monitor and recorder.

Check to see that the power indication lamps light.

TRANSDUCER CONNECTION

Connect the transducer to the input connector of the Carrier Amplifier. Insert a catheter to the patient.

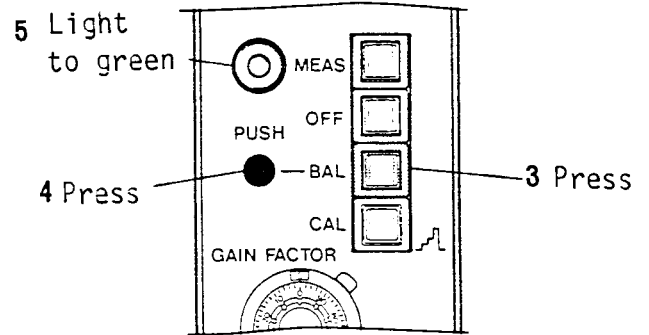
BALANCE ADJUSTMENT

1. Set the switches as follows.

MEAS-OFF-CAL switch : OFF
 GAIN FACTOR dial : Set to the value indicated on the transducer.
 (Ex. P-23ID 50 μ V/V/cmHg : G.F.=500)

2. Vent the transducer to the air.

5. Press the PUSH switch for balancing. When the green lamp lights, balancing is completed.

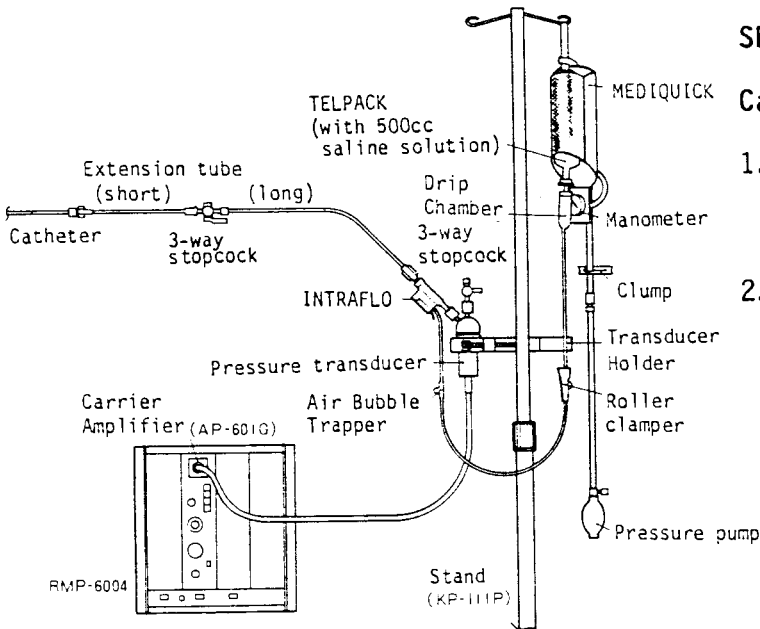
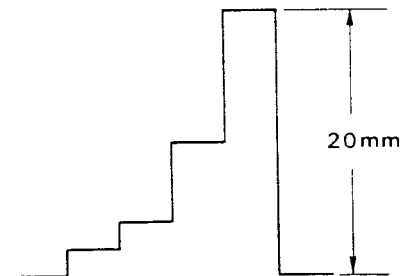


If the green lamp already lights when the BAL switch is pushed, balancing is completed at that time.

SENSITIVITY CALIBRATION

Calibration for the AP-601G

- Set the switches as follows.
 MEAS-OFF-BAL-CAL switch : CAL
 SENSITIVITY : 100mmHg/DIV.
- Make sure that pen deflection is exactly 20mm. (Provided that a recorder of 1cm/1V sensitivity is used.)



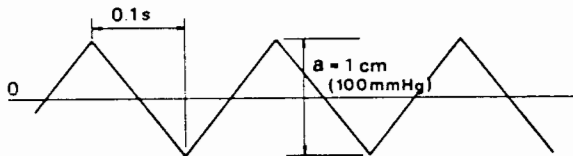
3. Adjust the position of the recorder and monitor as desired.

4. Push the BAL switch of the MEAS-OFF-BAL-CAL switch.

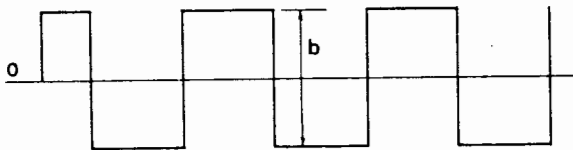
Calibration for the ED-601G.

1. Set the switches as follows.
AP-601G
MEAS-OFF-BAL-CAL switch : MEAS
ED-601G
MEAS-OFF-CAL switch (1) : CAL
TIME CONST selector (3) : 1ms
HI CUT selector (4) : 150Hz
2. Feed the recording paper of the recorder at a slow speed.
3. Make sure that the following waveforms are recorded.

AP-601G



ED-601G



4. Adjust the calibration amplitude (indicated in the figure as "a") to exactly 1cm with the calibration amplitude adjustment (2).
5. Adjust the differentiated waveform amplitude (indicated as "b") to 2cm with the SENSITIVITY selector (5),(6). Then a 1cm deflection gives 1000mmHg/sec.

NOTE

The amplitude of the original and differentiated waveforms are calibrated simultaneously, however, the amplitude of the differentiated waveform changes greatly according to TIME CONST setting. If the TIME CONST is changed during measurement, perform the above calibration again.

MEASUREMENT

After making the preceding adjustments;

AP-601G

1. Set the DIRECT-MEAN selector as desired.
2. Push the MEAS switch of the MEAS-OFF-BAL-CAL switch.
3. Adjust the SENSITIVITY control for easy observation.

ED-601G

1. Push the MEAS switch of the MEAS-OFF-CAL switch.
2. Adjust the SENSITIVITY control to get amplitude for easy observation.

If the TIME CONST is changed during measurement, perform the above calibration again.

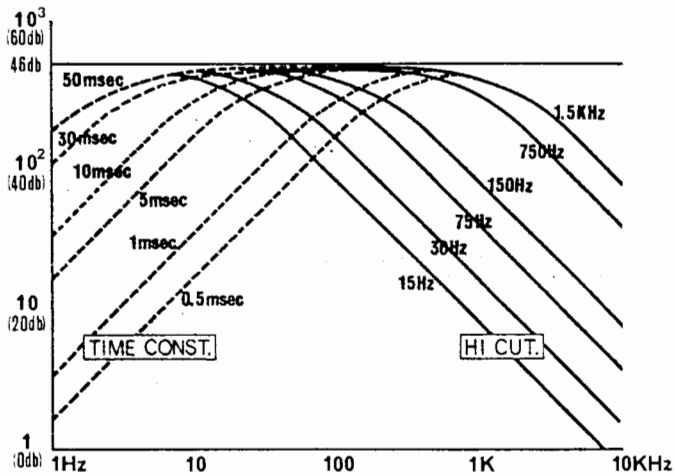
DIFFERENTIATION TIME CONSTANT SELECTION

Differentiation time constant should be selected according to the frequency characteristic of the original waveform. Although a shorter time constant provides more accurate differentiation, too short a time constant provides a differentiated waveform of insufficient amplitude. Therefore select the most suitable time constant by manipulating the TIME CONST selector (3) step by step.

If the time constant is changed during measurement, perform sensitivity calibration again.

HIGH CUT FREQUENCY SELECTION

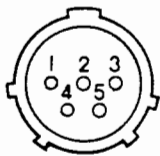
High cut frequency should be selected according to the frequency characteristic of the original waveform. Select the frequency so that noise induced by the differentiated waveform is not so conspicuous. The following figure shows the characteristic of the time constant and high cut filters.



DIFFERENTIATION OF EXTERNALLY INPUT SIGNAL

When the signal supplied from an external instrument is differentiated, apply an input signal to the input connector on the rear of the Polygraph Amplifier Console directly or via the Input Panel on the rack.

Pin assignment is as follows.



1. Shield
2. (+) Input
3. Not connected
4. 0V
5. Not connected

Connector type SRC06A13-5P
Code No. 5310067

Connection board wiring of the channel which ED-601G is plugged are only pins No.3 and 5.

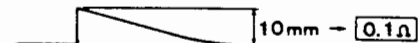
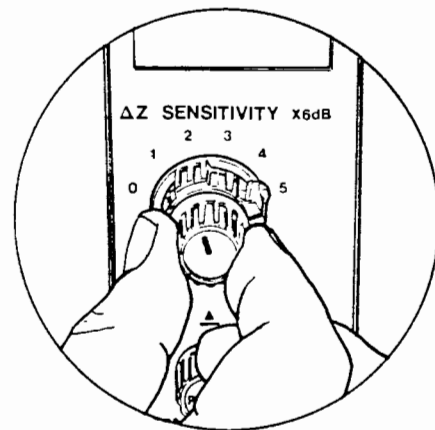
Impedance Differentiation Plethysmogram

(CARDIAC OUTPUT COMPUTATION)

Refer to the operator's manual of the Impedance Plethysmograph AI-601G for cardiac output computation in detail. This section describes calibration of ΔZ and $\Delta Z/dt$.

SENSITIVITY CALIBRATION OF ΔZ (AI-601G)

1. Push the CAL switch of the MEAS-OFF-CAL switch.
2. Set the recording switch of the recorder to RUN.
3. Press the CAL switch of the Polygraph Amplifier Console and ΔZ calibration waveform will be recorded.
4. Set the SENSITIVITY selector to "5".
5. Adjust the amplitude of calibration waveform on the recorder to 10mm with the ΔZ SENSITIVITY knob.



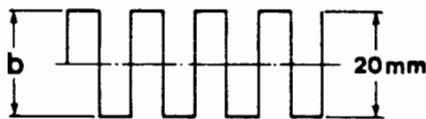
CALIBRATION FOR ΔZ AND dZ/dt

1. Set the switches as follows.
 TIME CONST (3) : 5ms
 HI CUT (4) : 75Hz
 1sec-0.1sec : 0.1sec
2. Push the CAL switch of the MEAS-OFF-CAL switch.
3. Set the recording switch of the recorder to RUN and the following waveform will be recorded.

AI-601G



ED-601G



4. Adjust the amplitude of calibration waveform "a" to 10mm with the calibration amplitude adjustment (2) of ED-601G.
5. Adjust the amplitude of differentiated waveform "b" to 20mm with the SENSITIVITY step and fine control (5) of ED-601G.

After above setting, both units are calibrated as follows.

AI-601G : $0.1 \Omega/cm$
 ED-601G : $1 \Omega/sec/cm$

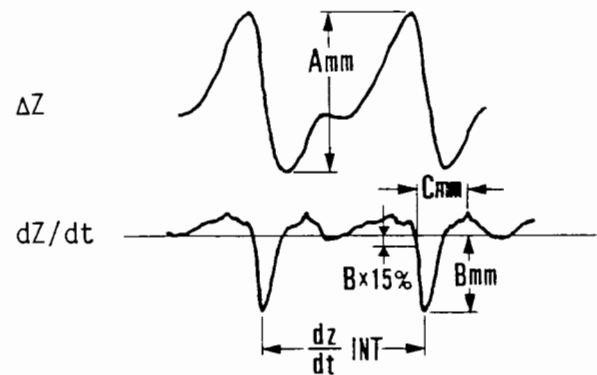
DIFFERENTIATION TIME CONSTANT SELECTION

HIGH CUT FREQUENCY SELECTION

Refer to pages 7 and 8.

ΔZ , dZ/dt MEASUREMENT

1. Run the recorder at paper speed of 50mm/sec to record calibration waveforms of ΔZ and dZ/dt .
2. Push the MEAS switches of both AI-601G and ED-601G, and the following waveform will be recorded. Since ΔZ waveform is affected by patient's respiration, measure while having the patient hold their breath to record stable waveform.



Paper speed 50mm/sec

The value of ΔZ and dZ/dt are calculated from the recorded waveform by the following equations.

$$\begin{aligned} \Delta Z &= 0.1(\Omega) \times A(\text{mm})/10(\text{mm}) \\ &= 0.1 \times A/10 (\Omega) \end{aligned}$$

$$dZ/dt(\text{min}) = 1.0(\Omega/\text{sec}) \times B/10 (\Omega/\text{sec})$$

The ventricle ejection period (T) can be obtained as follows.

$$\begin{aligned} T &= C(\text{mm})/50(\text{mm}/\text{sec}) \\ &= C/50 (\text{sec}) \end{aligned}$$

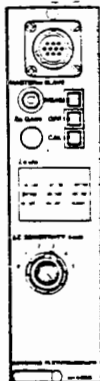
Where C is a distance between the point whose amplitude is 15% of the negative peak value (Bmm) of the dZ/dt waveform, and the peak of the positive going spike.

Specifications

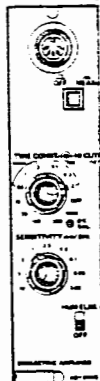
Input Impedance	100K Ω \pm 5%
Maximum Sensitivity	>46dB
Internal Noise	<50 μ Vp-p
Differentiation Time Constant	50-30-10-5-1-0.5ms, \pm 15%
High Cut Frequency	15-30-75-150-750Hz, \pm 20%, OFF (>1.5KHz)
Sensitivity	6dB x 8 steps, \pm 5%
Calibration	V/sec or V/0.1sec, internal selection 0 to 5V continuously variable
Clipper	+/-/OFF
Output Impedance	<50 Ω
Dimensions and Net Weight	50(W) x 200(H) x 280(D) mm approx. 1kg

Related Instruments

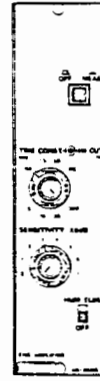
IMPEDANCE PLETHYSMOGRAPH
AI-601G



BIOELECTRIC AMPLIFIER
AB-601G AB-621G



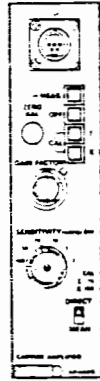
ENG AMPLIFIER
AN-601G



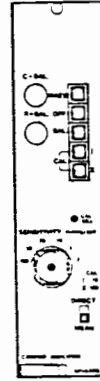
RESP/SPHYGMO COUPLER
AR-650H
COUPLER AMPLIFIER
AA-601H



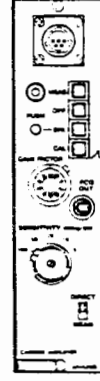
AP-601G



CARRIER AMPLIFIER
AP-621G



AP-630G



Panel Illustration

