OPERATOR'S MANUAL

FORCE-DISPLACEMENT TRANSDUCER

MODEL TB-611T
MODEL TB-612T

NIHON KOHDEN

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 safely 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.

(3) Technical information such as circuit diagrams, parts list, descriptions, calibration instructions or other information will be available for suitably qualified user technical personnel upon request from your Nihon Kohden distributor.

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 prepaid.

In the USA and Canada other warranty policies may apply.

CONTENTS

INTRODUCTION

This manual describes the TB-611T and TB-612T (high sensitive) Force-Displacement Transducers and contains operating information, construction, and specifications.

This transducer is used to measure tension or displacement occuring in muscle or other tissues, principally in the fields of physiology, pharmacology, etc. Its construction, combining a strain gage and a spring, allows it to cover a wide range of tension, from 50mg to 1kg by merely changing auxillary springs and displacement up to 2mm at the hook end.

The transducer is fixed on a supporter-rod, which can be readily mounted on a stand for chemical experiments. A removal hook is fitted on one of two pairs of coil springs (white and black springs), and the displacement or tension of the living specimen is applied to the hook. An experimental bench-top stand is optionally available for mounting the transducer. The output from the transducer is connected to the carrier amplifier, AP-600G (input isolation, square-wave excitation) or AP-620G (sine-wave excitation).

Please read this manual thoroughly before attempting to operate the instrument. This will assure optimum performance and long service life.

CONSTRUCTION

A removal hook is screwed in the straining board on which the strain gage is mounted. When displacement or tersion is applied to the transducer hook, a strain gage converts the mechanical strain into an electrical signal.

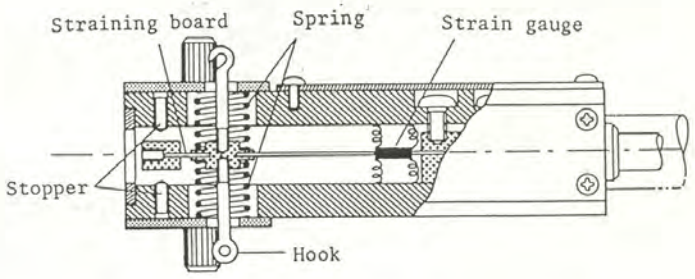

Figure 1 TB-611T Construction

DESCRIPTION OF TRANSDUCER

(1) Transducer Mounting Rod
(2) Transducer Main Unit
(3) Hook Securing Hole for displacement and tension measurements
(4) Hook Securing Hole for displacement measurement
(5) Hook Securing Hole for tension measurement
(6) Cover
(7) Cover Retaining Screw

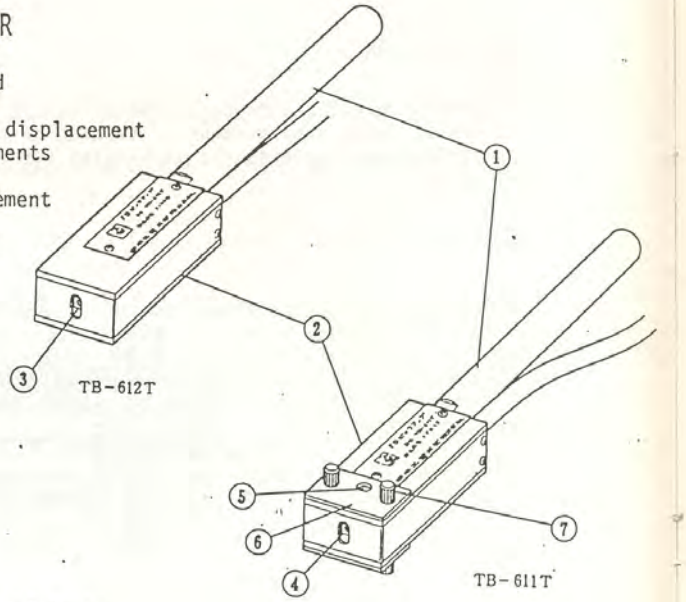

Figure 2 Location of parts

HANDLING PRECAUTIONS

1. Be sure to select the hook mounting position at the time the measurement parameter (displacement or tension measurement) is changed.
   Do not try to measure such a dynamic movement as muscle contraction velocity with two hooks mounted in the transducer.
   Excessive weight caused by an additional hook mount will increase the mass of the movable part in the transducer, resulting in the reduced response characteristic.

2. The displacement of the hook is limited by a pair of stoppers for excessive displacement or tension and is factory-adjusted for ±2mm.
   However, do not apply an excessive force to the hook to avoid damaging the moving parts.
   Refer to SPECIFICATIONS for allowable ratings.

PREPARATION

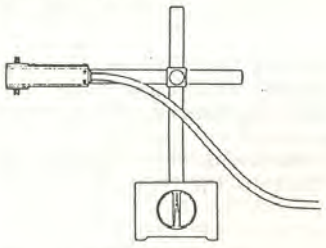

Figure 3 Transducer mounting on a stand

CONNECTION

Firmly mount the transducer mounting rod on a stand for chemical experiments or the optional experimental bench-top stand (Figure 3).
Connect the transducer output cable to the input socket of the carrier amplifier (AP-600G or AP-620G) or to the amplifier through the connection panel.
Make sure that the instrument is grounded properly and the power cord is connected to an AC outlet.
Then turn on the instrument's power.

ZERO BALANCE ADJUSTMENT FOR DISPLACEMENT MEASUREMENT USING TB-611T

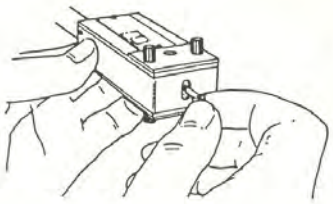

Figure 4

1. Screw the hook into the Hook Securing Hole (4) until it stops (Figure 4).

2. Mount the transducer on a stand and perform the zero balance adjustment of the carrier amplifier.
   Refer to ZERO BALANCE ADJUSTMENT in the AP-600G or the AP-620G operating manual.

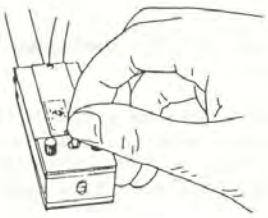

Figure 5

ZERO BALANCE ADJUSTMENT FOR TENSION MEASUREMENT USING TB-611T

Without spring (tension measurement up to 20g)

1. Screw the hook into the Hook Securing Hole (5) until it stops (Figure 5).

2. Mount the transducer on a stand and perform the zero balance adjustment of the carrier amplifier. Refer to the ZERO BALANCE ADJUSTMENT in the AP-600G or AP-620G operating manual.

With springs (tension measurement up to 200g using a pair of white springs and up to 1kg using a pair of black springs)

1. Remove four Cover Retaining Screws (7) and take off the Covers (6) on both sides.

2. Using a pair of white springs or black springs, insert springs into the hole; one from the top and the other from the bottom (Figure 6). Observe that both springs do not touch the surroundings in the hole.

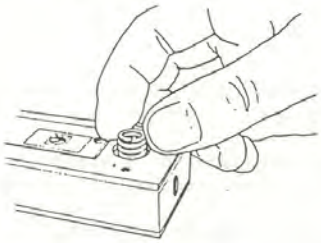

Figure 6

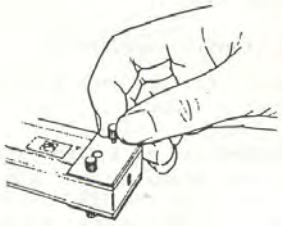

Figure 7

3. Secure the Cover to the transducer with screws (Figure 7).

4. Screw the hook into the hook securing hole until it stops.

5. Mount the transducer on a stand. Then perform the zero balance adjustment of the carrier amplifier. Refer to the ZERO BALANCE ADJUSTMENT in the AP-600G or the AP-620G operating manual.

ZERO BALANCE ADJUSTMENT FOR
DISPLACEMENT OR TENSION MEASUREMENT
USING TB-612T

1. Screw the hook into the hook securing hole until it stops.

2. Mount the transducer on a stand.
Then perform the zero balance adjustment of the carrier amplifier.
Refer to ZERO BALANCE ADJUSTMENT in the AP-600G or the AP-620G operating manual.

SENSITIVITY ADJUSTMENT AND CALIBRATION
USING THE AP-600G CARRIER AMPLIFIER

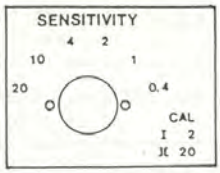

Figure 8
Sensitivity plate
(Without unit)

The following describes the sensitivity adjustment and calibration procedures using a pair of white springs when the transducer output is connected to the AP-600G carrier amplifier which is equipped with the optional sensitivity plate (without unit). The sensitivity adjustment and calibration procedures with a pair of black springs or without springs are referred to in Table 1 on page 9. Also refer to the AP-600G operating manual. The following step numbers (1 thru 7) correspond to the numbers shown in the step column of Table 1.

1. Set the chart speed selector to a lower speed and set the recording switch to RUN. Press the OFF button of the MEAS-OFF-CAL switch; adjust the pen position to a baseline with the POSITION control on the AP-600G; then rotate the SENSITIVITY selector to "20".

2. Press the CAL II button and adjust the pen amplitude to 20mm with the Sensitivity Fine Control (screwdriver adjustment).

3. The SENSITIVITY selector remains set to the 20 position when a pair of white springs is loaded for tension measurement and when no springs are used for displacement measurement. For tension measurement up to 1kg using a pair of black springs set to "4", and set to "10" for tension measurement up to 20g without springs. Refer to Table 1.

4. Press the MEAS button and check the transducer -amplifier system for complete zero balance adjustment. If balance adjustment is not completed, perform the ZERO BALANCE ADJUSTMENT procedures (page 5 through 7). Then suspend the 200g weight (standard accessory) on the transducer hook using a thread to give a 200g load to the transducer.

5. Adjust the pen amplitude to 20mm (the same amplitude as that obtained in step 2) with the GAIN FACTOR control.

6. The CAL II button memorizes the tension calibration of 200g (input equivalent) and pressing the CAL II button provides a tension calibration of 200g.

7. When the CAL II is calibrated by performing above procedures, the operation of the CAL I button provides a tension calibration of 20g (input equivalent).

Table 1 Sensitivity adjustment and calibration procedures in combination with the AP-600G Carrier Amplifier equipped with the optional Sensitivity plate (without unit)

Steps	Model / Item	TB-611T				TB-612T	
	Parameter	Displacement	Tension			Displacement	
	Springs / Full scale	Not loaded / 2mm	Not loaded / 20g	White springs / 200g	Black springs / 1kg	Not loaded / 2mm	
1	SENSITIVITY control setting	20	20	20	20	20	Bo*
2	Press CAL II . Adjust SENS. Fine.	Pen amplitude: 20mm	20mm	20mm	20mm	20mm	Co*
3	SENSITIVITY control setting	20	10	20	4	20	
4	Load	2mm	10g	200g	200g	2mm	
5	GAIN FACTOR	Pen amplitude: 20mm	20mm	20mm	20mm	20mm	
6	CAL II value (input equivalent)	2mm	20g	200g	1kg	2mm	Ao*
7	CAL I value (input equivalent)	0.2mm	2g	20g	100g	0.2mm	

* ; Refer to Formula 1 on page 15.

SENSITIVITY ADJUSTMENT AND CALIBRATION
USING THE AP-620G CARRIER AMPLIFIER

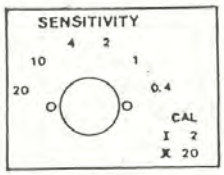

Figure 9
Sensitivity plate

The following describes the sensitivity adjustment and calibration procedures using a pair of white springs when the transducer output is connected to the AP-620G carrier amplifier, which is equipped with sensitivity plate (without unit).

The sensitivity adjustment and calibration procedures with a pair of black springs or without springs are referred to Table 2 on page 14. Also refer to the AP-620G operating manual.

The following step numbers (1 thru 7) correspond to the numbers shown in the step column of Table 2.

1. Set the chart speed selector to a lower speed and set the recording switch to RUN. Press the OFF button of the MEAS-OFF-BAL-CAL switch; adjust the pen position to a baseline with the POSITION control on the AP-620G; then rotate the SENSITIVITY selector to "20".

2. Press the MEAS button and check the transducer-amplifier system for complete zero balance adjustment. If not, perform the ZERO BALANCE ADJUSTMENT procedures (page 5 through 7). Then suspend the 200g weight (standard accessory) on the transducer hook using a thread to give a 200g load to the transducer.
3. Adjust the Sensitivity Fine control using a screwdriver so that the pen deflects to an easily readable amplitude of, for example, 20mm.
4. The SENSITIVITY selector remains set to the 20 position when a pair of white springs is loaded for tension measurement up to 200g and when no spring is loaded for displacement measurement. For tension measurement up to 1kg using a pair of black springs, set to "4", and set to "10" for tension measurement up to 20g without springs. Refer to Table 2.
5. Press the CAL II button. Using a screwdriver, adjust the pen amplitude to the same amplitude as that obtained in step 3 (20mm in this case) with the CAL ADJ control.

6. The CAL II button memorizes the tension calibration of 200g (input equivalent) and pressing the CAL II button provides the tension calibration of 200g to the system.

7. When the CAL II is calibrated by performing above procedures, the pushing of the CAL I button provides a tension calibration of 20g (input equivalent).

6. The CAL II button memorizes the tension calibration of 200g (input equivalent) and pressing the CAL II button provides the tension calibration of 200g to the system.

7. When the CAL II is calibrated by performing above procedures, the pushing of the CAL I button provides a tension calibration of 20g (input equivalent).

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Table 2 Sensitivity adjustment and calibration procedure in combination with the AP-620G Carrier Amplifier equipped with the Sensitivity plate(without unit)

	Model / Item	TB-611T				TB-612T	
	Parameter	Displacement	Tension			Displacement	
	Springs / Full scale	Not loaded / 2mm	Not loaded / 20g	White springs / 200g	Black springs / 1kg	Not loaded / 2mm	
1	SENSITIVITY control setting	20	10	20	4	20	
2	Load	2mm	10g	200g	200g	2mm	
3	SENS Fine control adjust	Pen amplitude: 20mm	20mm	20mm	20mm	20mm	
4	SENSITIVITY control setting	20	20	20	20	20	Bo*
5	Press CAL II Adjust CAL ADJ.	Pen amplitude: 20mm	20mm	20mm	20mm	20mm	Co*
6	CAL II value (input equivalent)	2mm	20g	200g	1kg	2mm	Ao*
7	CAL I value (input equivalent)	0.2mm	2g	20g	100g	0.2mm	

*: Refer to Formula 1 on page 15.

RECORDING

After zero balance adjustment, sensitivity adjustment and calibration have been completed, perform the following steps to record displacement or tension.

1. Connect the subject (muscle or other tissues) to the hook on the transducer.
2. Press the MEAS button on the carrier amplifier (AP-600G or AP-620G).
3. Set the SENSITIVITY selector and CAL button to their appropriate positions respectively.
4. Start measuring displacement or tension.
5. At the beginning of measurement, the end of measurement, and at the time the sensitivity is changed, the recording of the calibration waveform is recommended for calculating the value of displacement or tension.
6. After measurement, the value of displacement or tension can be obtained by using the follwoing formula.

$$A = Ao \cdot \frac{B}{Bo} \cdot \frac{C}{Co} \quad \cdots\cdots\cdots \text{Formula 1}$$

where, A : Displacement or tension of the subject to be measured (mm or gram)

Ao : Calibration value (input equivalent, mm or gram)

B : SENSITIVITY control setting position during measureemnt

Bo : SENSITIVITY control setting position during calibration

C : Pen amplitude reading (measurement)

Co : Pen amplitude reading (calibration)

[EXAMPLE]

A pair of white springs is mounted in the transducer.
Assume that the SENSITIVITY selector is set to 10 (B = 10) position,
the amplitude reading of the recorded waveform is 15mm (C = 15),
and the CAL II values (Ao = 200, Bo = 20, Co = 20) shown in Table 1 are used.

Using the formula to find tension (A) :

$$A = Ao \cdot \frac{B}{Bo} \cdot \frac{C}{Co}$$

Substituting the given values :

$$A = 200 \times \frac{10}{20} \times \frac{15}{20} = 75 \text{ (g)}$$

SPECIFICATIONS

Maximum Displacement : ±2mm (limited by stoppers)

Measuring Range :

Model	Hook Position	Springs	Tension	Displacement	Calibration Weight
TB-611T	Figure 2 (4)	Not loaded	0 to 10g	±2mm	10g
	Figure 2 (5)	Not loaded	1 to 20g	±1mm	10g
	Figure 2 (5)	White springs	15 to 200g	±1mm	100g, 200g
	Figure 2 (5)	Black springs	100g to 1kg	±1mm	100g, 200g
TB-612T	Figure 2 (3)	Not loaded	0 to 5g	±2mm	1g, 2g, 5g

→ Refer to Figure 2 on page 3 for location of the hook securing holes.

Maximum Sensitivity (in combination with the Polygraph System recorder) : TB-611T; 35mm/500mg or greater
TB-612T; 35mm/200mg or greater

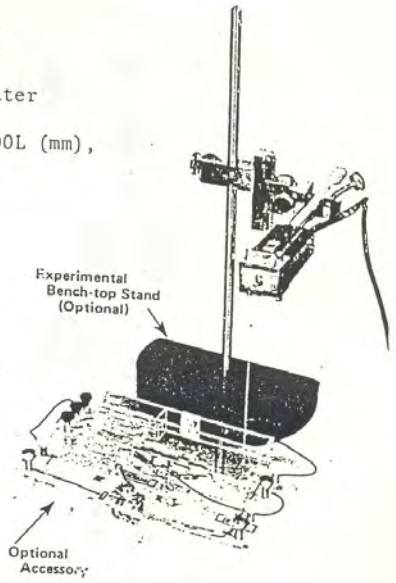
Zero-return Characteristic : Within ±2%

Input/Output Resistance : Approx. 20 ohms

Exciting Voltage : 3V(rating), 6V(maximum)

Insulation Resistance : 1000Mohms or greater

Dimensions and Net Weight : 33W x 30H x 200L (mm), approx. 380g



STANDARD ACCESSORIES

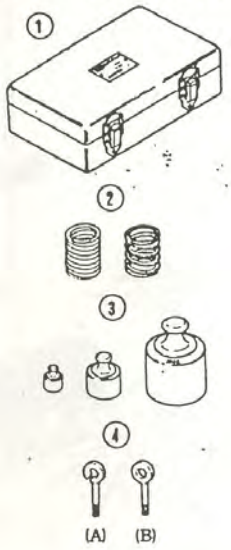


Figure 10

TB-611T

Description	Q'ty	Code No.
(1) Transducer case	1	1132-000233
(2) Spring (white)	2	1114-032936A
Spring (black)	2	1114-034498A
(3) Weight (200g)	1	6801711
Weight (100g)	1	6801729
Weight (10g)	1	6801738
(4) Hook (A)	2	1114-033008
Hook (B)	1	1114-032918

TB-612T

Desctiption	Q'ty	Code No.
(1) Transducer case	1	1132-001197
(3) Weight (5g)	1	6801747
Weight (2g)	1	6801756
Weight (1g)	1	6801765
(4) Hook (A)	1	1114-033008
Hook (B)	1	1114-032918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