

# Non-Contacting Displacement Meter

Non-Contacting Micro-Displacement Meter

502-F | 503-F | T-5306 | T-5001

## Short Form Catalog

Non-Contacting Displacement Meter  
Non-Contacting Micro-Displacement Meter



# High-accuracy measurement large displacement can be pr

Delta Series

**Non-Contacting Micro-Displacement Meter M**

## Non-Contacting Micro-Displacement Meter

High-accuracy eddy-current effect applied displacement meter that can measure micro-displacement of a target material without contacting it.

■ Measuring range : **0 to 2** mm / Frequency range : **DC to 20** kHz

**Non-Contacting Displacement Meter Model 503-F**

## Non-Contacting Displacement Meter

High-accuracy eddy-current effect applied non-contacting displacement meter that can measure displacement up to 50 mm (sensor : option).

■ Measuring range : **0 to 50** mm

**Non-Contacting Micro-Displacement Meter M**

## Non-Contacting Micro-Displacement Meter

The probe for measuring the axial vibration of a rotating shaft at a high temperature (200 °C) is also available. Popular eddy-current effect applied non-contacting displacement meter for measuring relative distance between a shaft and housing.

**Non-contacting Micro-Displacement Meter M**

## Non-Contacting Micro-Displacement Meter

High accuracy and resolution eddy-current effect applied non-contacting displacement meter for measuring a small object.

■ Measuring range : **0 to 500**  $\mu\text{m}$

# from micro-displacement to provided.

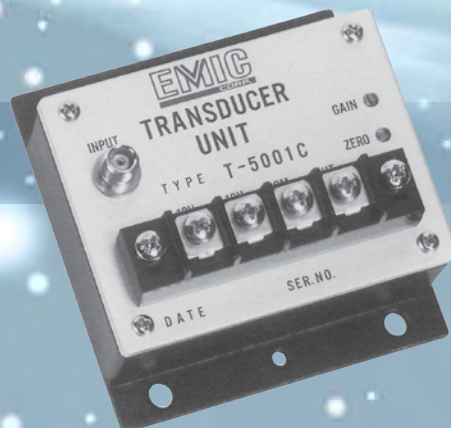
odel **502-F**



odel **T-5001**



odel **T-5306**





# Non-Contacting Micro- High-accuracy mea

Delta Series

# 502-F

High-accuracy eddy-current effect applied non-contacting displacement meter that can measure micro-displacement of a target material.

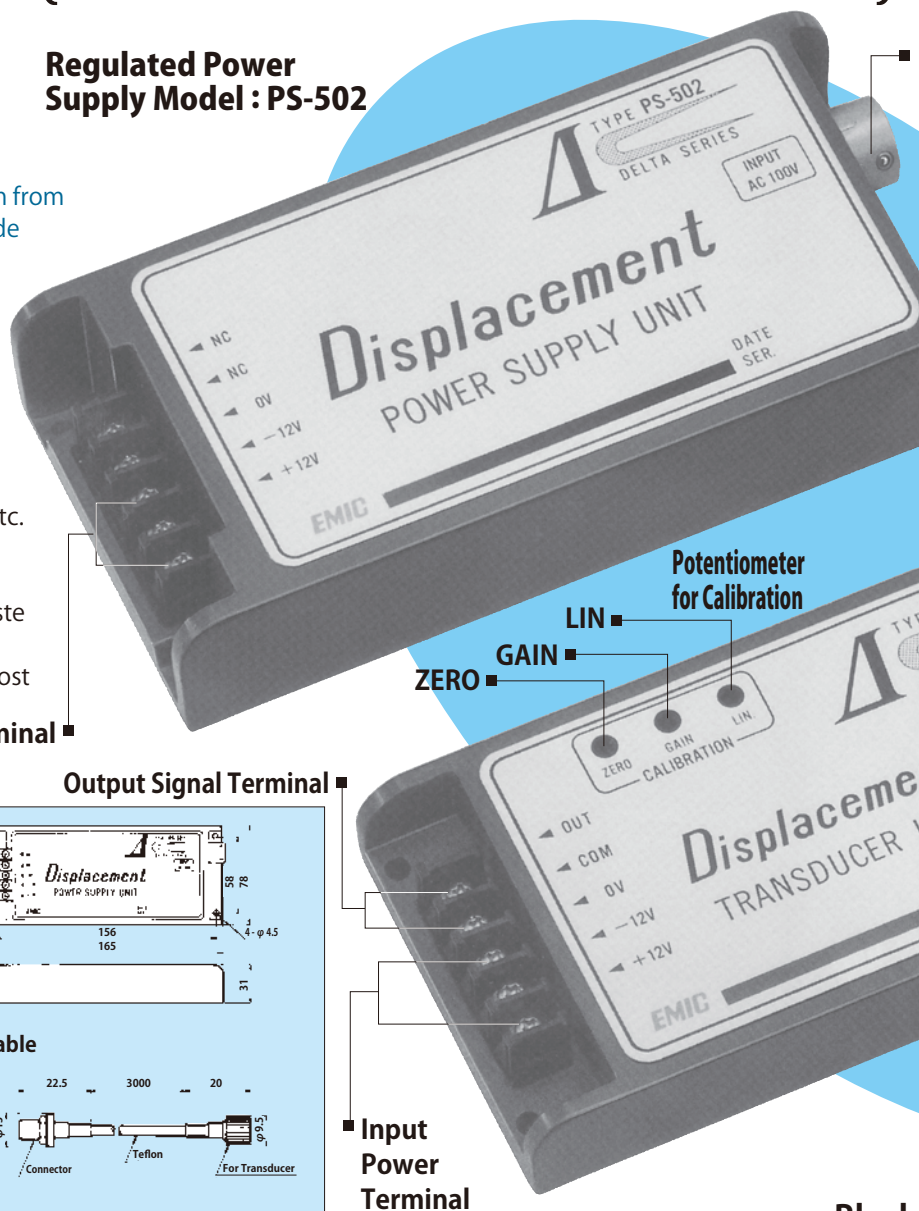
**Regulated Power  
Supply Model : PS-502**

■ Since an available measuring range is 0 to 2 mm from DC to 20 kHz, this displacement meter has a wide variety of applications as follows;

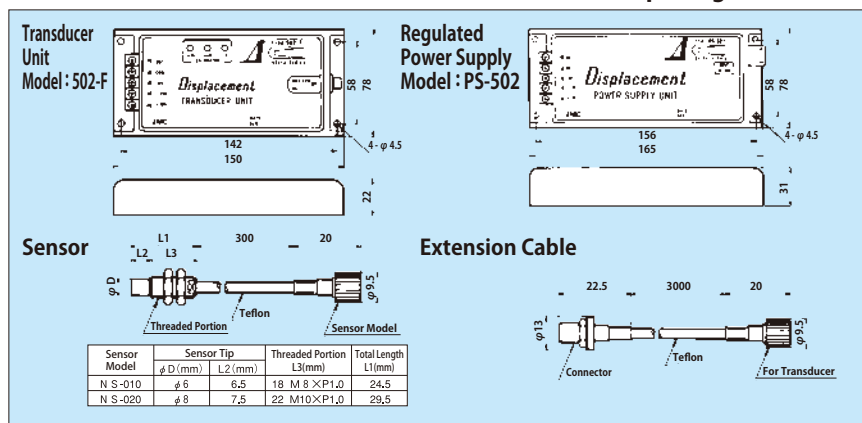
- Measurement of axial vibration of equipment such as motor, turbine, etc.
- Levitation control of linear-motor train
- Measurement of elastic coefficient of a small object
- Thickness measurement of coating and others
- Measurement of dimensions in cutting work
- Measurement of displacement in oil, vacuum, etc.

## ■ High Cost Performance

Functional design and cost reduction that cut waste realize the low-price. Combining with high performance, we pride ourselves on its excellent cost performance.



## External Dimensions



## Specifications of Sensor (achievable using 502-F Transducer)

Model	NS-010	NS-020
Measuring Range	0 to 1 mm	0 to 2 mm
Offset Do	0.1 mm	0.2 mm
Tip Diameter	φ 6 mm	φ 8 mm
Output Voltage	0~1 Vfs. 0 to 1 Vfs.	0~2 Vfs. 0 to 2 Vfs.
Resolution	0.05% f.s.	
Linearity	less than 0.5% of full scale	
Frequency Response	DC to 20 kHz -2 dB	
AC Sensitivity	1 mV / $\mu$ m	
Operating Temperature	-20 to +120°C	
Extension Cable	BC -030 RP 3m	
Mass	0.03 kg	0.05 kg

f.s. stands for full scale.

## Specifications of Transducer

Model	502-F
Adjustment Point	ZERO, GAIN, LIN. three-point adjustment
Input Power Voltage	DC $\pm$ 12 V
Output Impedance	100 $\Omega$
Operating Temperature	0 to 60°C
Dimensions	150(W) $\times$ 22(H) $\times$ 78(D) mm
Mass	0.3 kg

Note: The transducer unit for the NS-010 sensor cannot be used with the NS-020 and vice versa. If the sensor is the same model, it can be available after calibrated it.  
Note: A switching-mode power supply may generate noise. Therefore, please use our PS-502 regulated power supply as possible.

## Specifications of Regulated Power Supply

Model	PS-502
Input Voltage	AC 100 V $\pm$ 10 V 50 / 60 Hz
Output Voltage	DC $\pm$ 12 V ( $\pm$ 0.3 V)
Output Current	100mA $\cdot$ Max
Stability	Within 0.5%
Operating Temperature	0 to 60°C
Ripple	Less than 5 mV p-p
Dimensions	165(W) $\times$ 31(H) $\times$ 78(D) mm
Mass	0.65 kg

Power supply for driving the transducer unit with AC 100 V input power.

Note: A switching-mode power supply may generate noise.

Block



Target Material

# Measurement of micro-displacement

Measuring range : 0 to 2 mm /  
Frequency range : DC to 20 kHz

AC 100 V Input Terminal

Sensor Model : NS-020

■ Sensor Connector

Transducer Unit  
Model : 502-F

■ Extension Cable

## Highly-stabilized sensor becomes available

An introduction of newly-developed highly-stabilized coil as sensing element can reduce a change with temperature in the output very much.

## High accuracy linearizer circuit

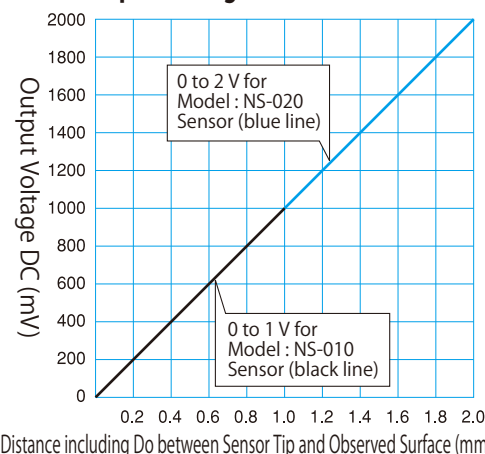
An introduction of the high accuracy linearizer circuit realizes the non-linearity of less than  $\pm 0.5\%$ FS.

## Very Easy Calibration

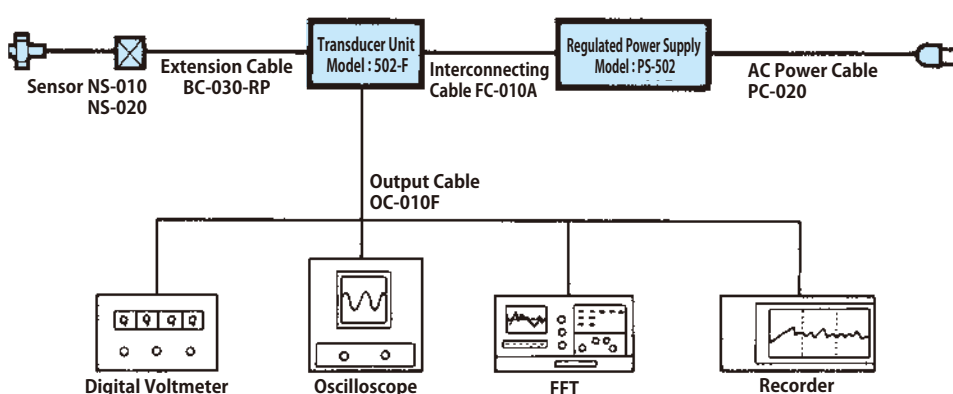
It will be ready for measuring the distance between the sensor tip and observed surface by adjusting twice or thrice using an accessory spacer, etc. the output voltage, for example, to 0 V, 0.5 V and 1 V for the NS-010, at the offset (Do), half the full scale and full scale respectively.

Sensor Model : NS-010

Plot of Output Voltage at Various Distances



## Diagram

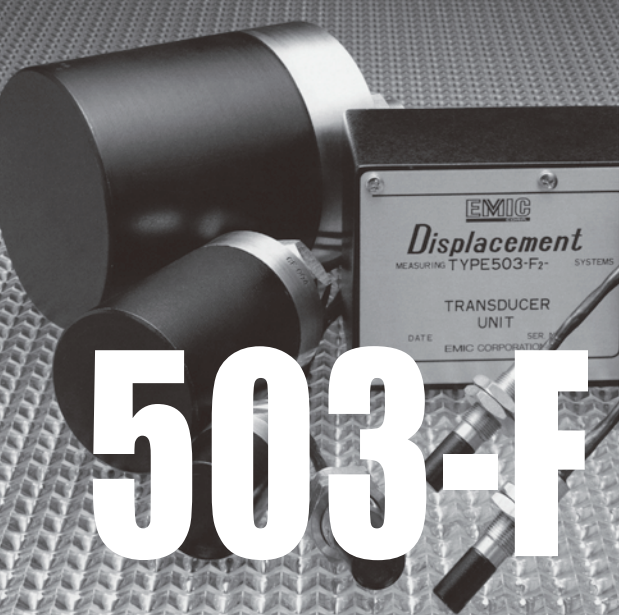


The standard measuring system consists of the following integrated components:

- 1 ea Model : 502-F Transducer Unit
- 1 ea Model : PS-502 Regulated Power Supply
- 1 ea Model : NS-010 (for 1mm fs) or Model : NS-020 (for 2mm fs) Sensor
- 1 ea Model : BC-030-RP Extension Cable (length : 3 m)
- 1 ea Model : FC-010A Interconnecting Cable (length : 1 m)
- 1 ea Model : OC-010 Output Cable (length : 1 m)
- 1 ea Model : PC-020 Power Cable (length : 2 m) (Accessory for Power Supply)

※Specifications and designs may be changed without notice.





# 503-F

## Non-Contacting Displacement Measurement

### High-accuracy measurement of small to large displacement (measurement range can be provided).

High-accuracy displacement meter can measure displacement up to 50 mm (sensor : option) without contacting it based on the eddy-current principle.

■ If the target material is made of metal, the application can spread infinitely to measuring of displacement in every field as follows;

- Measurement of amplitude and resonance
- Measurement of static displacement
- Measurement of sheet thickness and diameter
- Spin finishing and die matching
- Measurement of deviation and positioning control
- Measurement of axial vibration of rotating body
- Measurement of thickness of nonconductive material
- Gap control, etc.

**Transducer Unit**  
**Model : 503-F<sub>2</sub>**

■ High accuracy and wide frequency range

Frequency response : DC to 20 kHz / Linearity : Better than 0.5% of full scale  
Realization of 0.05% of full scale resolution The transducer that gathers together state-of-the-art technology as well as the newly developed high stable sensor and high performance linearizer offers the measurement of high accuracy in the wide frequency range.

■ High stability

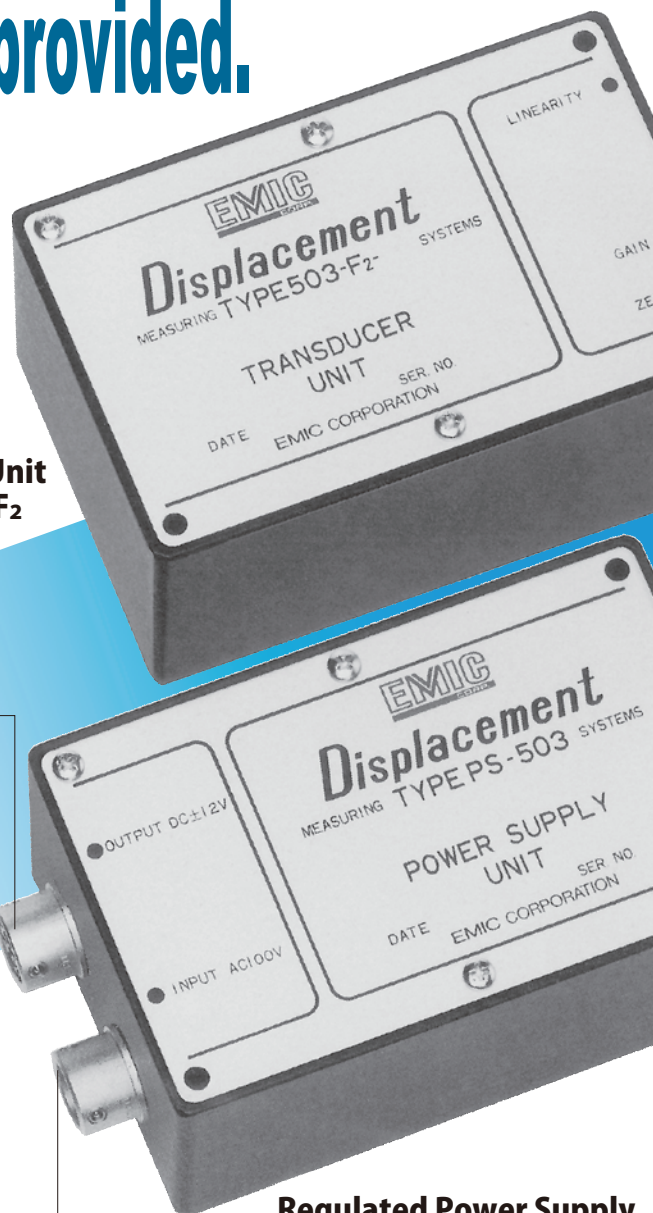
The drift with temperature of 0.03 to 0.06%/°C, more excellent than relevant art, can be realized, therefore, the stable measurement result can be obtained.

■ Abundant variety of sensor

6 types of sensors being different in full scale value and their high temperature resistive versions (NPC series) designed to measure under the high temperature conditions up to 170°C are available and can serve all the measurement's need.

Output Terminal

AC 100 V Input Terminal



**Regulated Power Supply**  
**Model : PS-503**

### Specifications of Transducer

Model	503-F <sub>2</sub>
Method of Adjustment	Three-point adjustment of ZERO, GAIN and LIN
Output Impedance	100 Ω
Input Power Voltage	DC ± 12V 55mA
Operating Temperature	-10 to +50°C
Outside Dimensions	122W × 57H × 77Dmm
Mass	0.57kg

### Interchangeability between Sensor and Transducer Unit

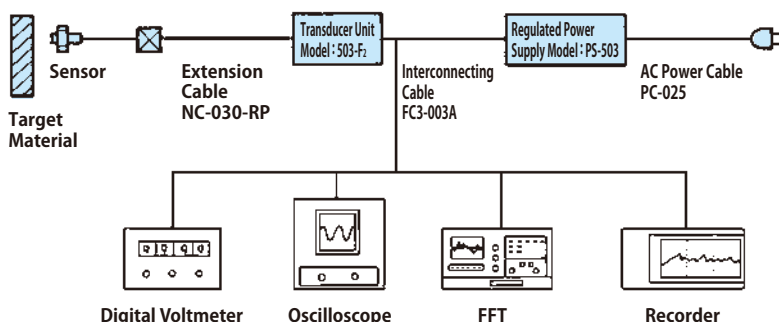
	Sensor Code	Transducer Model
For NPA	B	503-F <sub>2</sub> -2
	C·D	503-F <sub>2</sub> -3
	E	503-F <sub>2</sub> -4
	Other than those above	503-F <sub>2</sub> -5
For NPB and NPC	CB	503-F <sub>2</sub> -C2
	CC·CD	503-F <sub>2</sub> -C3
	CE·CF·CG	503-F <sub>2</sub> -C4
	BF·BG	503-F <sub>2</sub> -C5

### Specifications of Regulated Power Supply

Model	PS-503
Input Voltage	AC 100 V ± 10 V 50 / 60 Hz
Output Voltage	DC ± 12 V (± 0.3 V)
Output Current	100 mA · Max
Stability	Within 0.5%
Ripple	Less than 5 mV p-p
Drift	0.01 % / °C
Operating Temperature	-10 to +50°C
Protective Circuit	Current Limiter
Outside Dimensions	122 W × 57 H × 77 Dmm
Mass	0.78 kg

## f micro-displacement ing range : up to 50 mm)

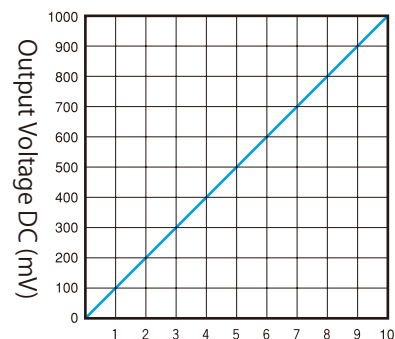
### Block Diagram



The standard measuring system consists of the following integrated components :

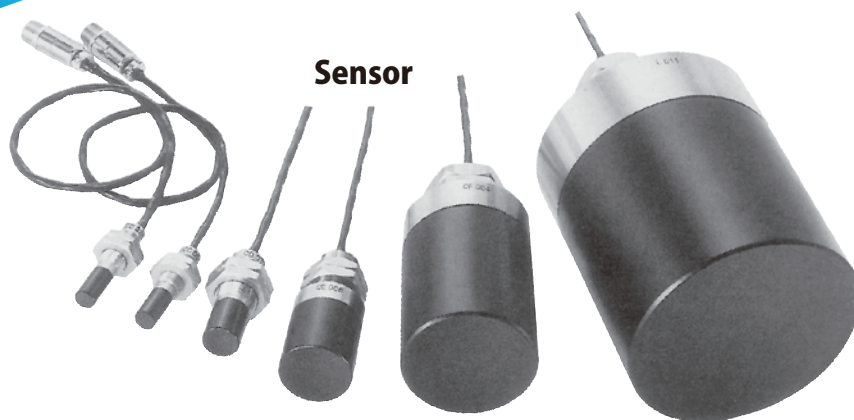
- 1 ea Model : 503-F 2 Transducer Unit
- 1 ea Model : PS-503 Regulated Power Supply
- 1 ea Sensor suitable for your application
- 1 ea Model : NC-030-RP Extension Cable (length : 3 m) (Accessory for Sensor)
- 1 ea Model : FC3-003A Interconnecting Cable (length : 1 m) (Accessory for Transducer) or Model : FC3-003B Interconnecting Cable (when used other than PS-503)
- 1 ea Model : PC-025 Power Cable (length : 2.5 m) (Accessory for Power Supply)

### Plot of Output Voltage at Various Distances



Distance including Do between Sensor Tip and Target (mm)  
Typical data for Model : NPA-100

### Sensor



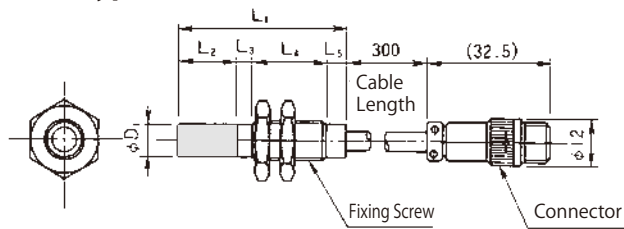
Specifications of Sensor when used 503-F 2 Transducer. Parenthetic values are for the NPC series high-temperature sensor.

Model		B	NPA-010	C	NPA-020	D	NPA-050	E	NPA-100	BF	NPB-250	BG	NPB-500
Code	Model	CB	NPC-010	CC	NPC-020	CD	NPC-050	CE	NPC-100	CF	NPC-250	CG	NPC-500
Measuring Range		0 to 1 mm		0 to 2 mm		0 to 5 mm		0 to 10 mm		0 to 25 mm		0 to 50 mm	
Offset Do		0.1 mm		0.2 mm		0.5 mm		1 mm		2.5 mm		5 mm	
Tip Diameter		φ 10.5 mm (φ 8.5 mm)		φ 10.5 mm (φ 8.5 mm)		φ 18 mm (φ 14 mm)		φ 30 mm (φ 27 mm)		φ 52 mm		φ 92 mm	
Output Voltage		0 to 1 V (Output of 0 to 5 V can be obtained by disconnecting the jumper in the transducer unit)											
Sensitivity		1 mV / π m		0.5 mV / π m		0.2 mV / π m		0.1 mV / π m		0.04 mV / π m		0.02 mV / π m	
Resolution		0.05% of full scale											
Linearity		less than 0.5% of full scale											
Frequency Response		DC to 20 kHz -1dB (0 to 1,200,000rpm)											
Velocity Response		62 m / sec		125 m / sec		314 m / sec		628 m / sec		1570 m / sec		3141 m / sec	
Drift with temperature		0.06 % / °C F.s (0.05 % / °C F.s)		0.06 % / °C F.s (0.05 % / °C F.s)		0.06 % / °C F.s (0.04 % / °C F.s)		0.06 % / °C F.s (0.04 % / °C F.s)		0.04 % / °C F.s (0.03 % / °C F.s)		0.04 % / °C F.s (0.03 % / °C F.s)	
		guaranteed operating temperature range : 0 to +100°C for NPA and NPB (-10 to +140°C for NPC)											
Operating Temperature		-30 to +120°C (-30 to +170°C)											
Integral Cable of Sensor		300 mm (300 mm)		300 mm (300 mm)		0 mm (300 mm)		0 mm (500 mm)		0 mm (500 mm)		0 mm (500 mm)	
Extension Cable		Model : NC-030-RP											
Outside Dimensions		See next page.											
Mass		0.04 kg (0.04 kg)		0.04 kg (0.04 kg)		0.083 kg (0.075 kg)		0.13 kg (0.14 kg)		0.37 kg (0.72 kg)		1.23 kg (2.9 kg)	

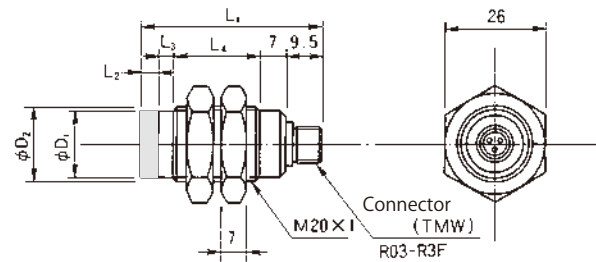
# Non-Contacting Displacement Meter 503-F

## Outline Drawing

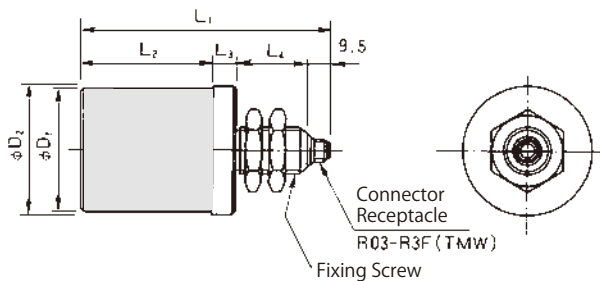
### Various Types of Sensors



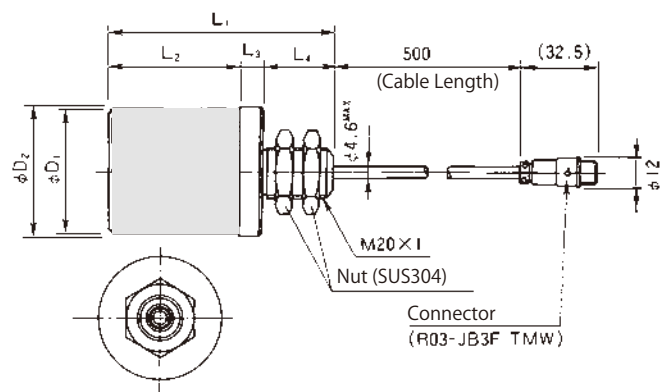
Model	Total Length L <sub>1</sub> (mm)	Sensor Tip φD <sub>1</sub> (mm) L <sub>2</sub> (mm)	Case L <sub>3</sub> (mm)	Fixing Screw L <sub>4</sub> (mm)	L <sub>5</sub>	Nut Thickness (mm) Opposite Side Distance(mm)
NPA-010 NPA-020	39.2	10.5 2.7	6.5	25 M12P1	5	3.5 19
NPC-010 NPC-020	42	8.5 15	4	18 M10P0.75	5	3.5 17
NPC-050	45	14 17	3	20 M16P1	5	5 22



Model	Total Length L <sub>1</sub> (mm)	Sensor Tip φD <sub>1</sub> (mm) L <sub>2</sub> (mm)	Case L <sub>3</sub> (mm)	Fixing Screw L <sub>4</sub> (mm)	Outer Case Diameter φD <sub>2</sub> (mm)	Nut Thickness (mm) Opposite Side Distance(mm)
NPA-050	50.5	18 4	5	25 M20P1	20	7 26

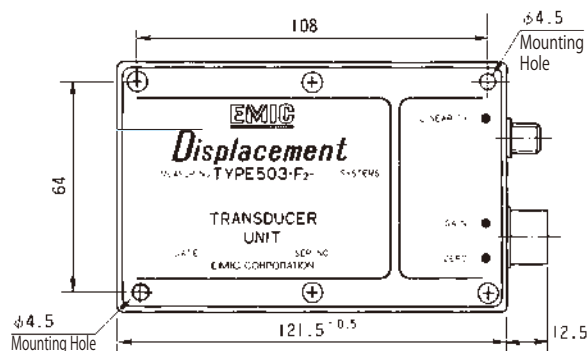
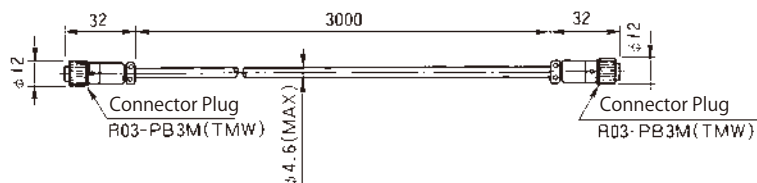


Model	Total Length L <sub>1</sub> (mm)	Sensor Tip φD <sub>1</sub> (mm) L <sub>2</sub> (mm)	Case L <sub>3</sub> (mm)	Fixing Screw L <sub>4</sub> (mm)	Outer Case Diameter φD <sub>2</sub> (mm)	Nut Thickness (mm) Opposite Side Distance(mm)
NPA-100	67.5	30 5.5	23	29.5 M20P1	30	7 26
NPB-250	104.5	52 55	10	30 M20P1	54	7 30
NPB-500	144.5	92 85	10	40 M20P1	94	7 30

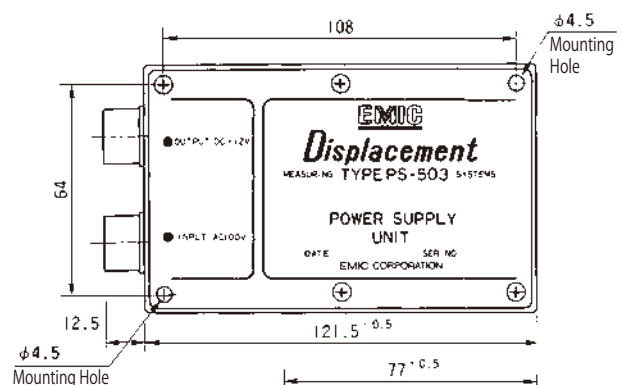
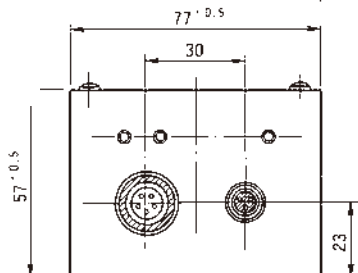


Model	Total Length L <sub>1</sub> (mm)	Sensor Tip φD <sub>1</sub> (mm) L <sub>2</sub> (mm)	Case L <sub>3</sub> (mm)	Fixing Screw L <sub>4</sub> (mm)	Outer Case Diameter φD <sub>2</sub> (mm)	Nut Thickness (mm) Opposite Side Distance(mm)
NPC-100	61	27 26	9	26 M16P1	27	5 22
NPC-250	95	52 55	10	30 M20P1	54	7 30
NPC-500	135	92 85	10	40 M20P1	94	7 30

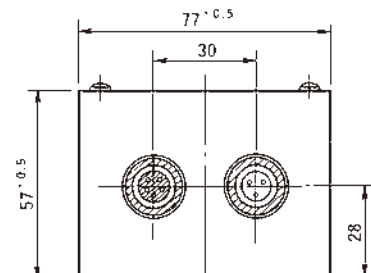
### Extension Cable NC-030-RP



### 503-F 2 Transducer Unit



### Regulated Power Supply Model : PS-503





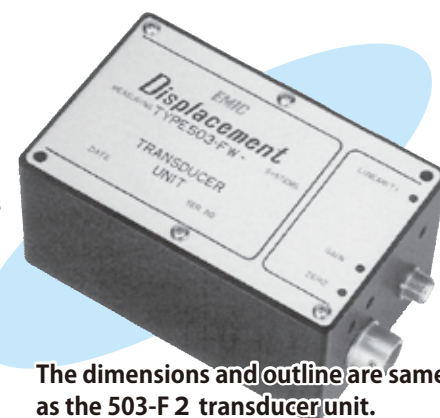
High performance transducer unit that eliminated mutual interference between sensors.

## Transducer Unit Model : 503-FW

When the multiple sensors for the non-contacting displacement meter using the eddy-current principle come close, they cause the beat phenomenon due to the interference with each other. The 503-FW unit introduces the add-on feature of common carrier method to eliminate the above interference between sensors to make the multipoint measurement in a small place possible.

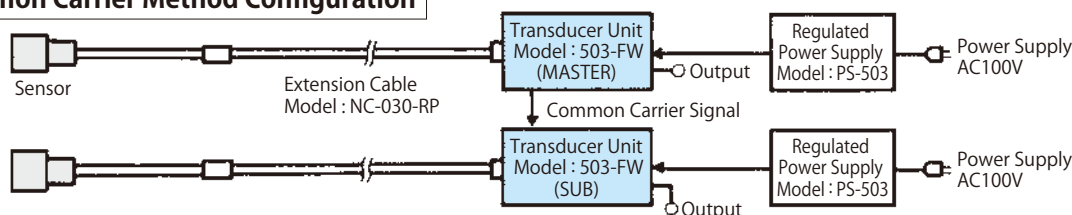
### Feature

- Introduction of the common carrier method to use the same carrier frequency for all sensors allows for using the multiple sensors to come close each other.
- To make the simultaneous multipoint measurement easier one master 503-FW unit can drive up to 6 sub 503-FW units.



The dimensions and outline are same as the 503-F 2 transducer unit.

### Common Carrier Method Configuration



Input power for 4 transducer units with only one unit

## Multichannel Regulated Power Supply Model : PS-503-4

All the features for the stand-alone PS-503 power supply are compactly put in one body to eliminate the troublesome wiring and installation for the simultaneous multipoint measurement.

### Specifications

Model	PS-503-4
Input Voltage	AC 100 V $\pm 10\%$ 50/60 Hz
Output Voltage	DC $\pm 12$ V ( $\pm 0.3$ V)
Output Current	400 mA Max.
Stability	Within 0.5%
Ripple	Less than 5 mV p-p
Drift	0.01 % / $^{\circ}$ C
Operating Temperature	-10 $\sim$ +50 $^{\circ}$ C
Protective Circuit	Current Limiter
Outside Dimensions	100W $\times$ 160H $\times$ 250D mm
Mass	2.5 kg



To guarantee the precise measurement

## Spindle Calibration Micrometer Model : CL-503

In the calibration from the offset to full scale value the distance between the target material and sensor tip can set with a high degree of accuracy.

CL-503S	Range : 1 to 25 mm
CL-503P	Range : 1 to 50 mm

503-F2-FW



The picture shows the CL-503S.

503-F Series with ease of use

## Digital Non-Contacting Displacement Meter Model : 503-FD

Model : 503-FD is the 503-F 2 that includes the digital display unit and power supply unit. Various types of non-contacting displacement meters with ease of use are available, that is the digital type Model : 503-FP 1 -3CD and analog type Model : 503-FP 1 -3CA include three transducer units, display unit and power supply unit in one body.

### Feature

- The digital display unit permits to directly read the displacement and remove an error in reading.
- The introduction of 10-turn potentiometer with the vernier dial for calibration makes the adjustment easier.
- The output can be selectable by switching between the original signal and average value obtained by rectifying the dynamic behavior.
- The display unit can be selectable between the digital and analog type with the built-in power supply.
- The housing for incorporating up to 3ch and up to 6ch are available.
- The common carrier method allows for using the multiple sensors to come close each other.
- The computing unit (option) can configure the most suitable system for measuring the thickness of a plate, positioning, etc..

### Specifications

Model	Portable Type	Multichannel Type		
	503-FD Digital Non-Contacting Displacement Meter	503-FP1 Transducer Unit	DMC-503D Power Supply for 3ch with Digital Display	DMC-503A Power Supply for 3ch with Analog Display
Measuring Range	※ All sensors are available.			
Display	Digital 4 1/2 figures	—	Digital 3 1/2 figures	Analog Meter
Output Voltage	0 to 1 Vfs.	0 to 1 Vfs.	—	—
Output Impedance	100 $\Omega$	100 $\Omega$	—	—
Filter	LPF 400 Hz HPF 5Hz	—	—	—
Operating Temperature	0 to +50 $^{\circ}$ C	0 to +50 $^{\circ}$ C		
Input Power	AC-100 V	By DC $\pm 12$ V Power Supply	AC-100 V	
Dimensions	120(W) $\times$ 180(H) $\times$ 260(D)	39(W) $\times$ 162(H) $\times$ 175(D)	79(W) $\times$ 162(H) $\times$ 175(D)	
Mass	3.4 kg	0.7 kg	1.5 kg	
Miscellaneous	The NPA sensor cannot be combined with the transducer for the NPB and NPC, exclusive use. But the transducer for the NPB can be used for the NPC, and vice versa.			The unit for 6ch is also available.



Portable Type Model : 503-FD



Digital Type Model : 503-FP 1-3CD



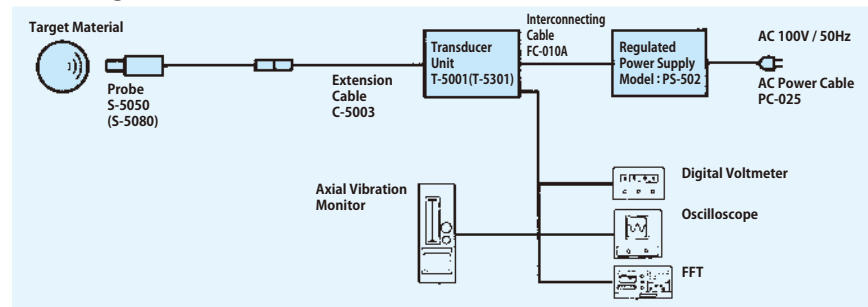
Analog Type Model : 503-FP 1-3CA

# Non-Contacting Micro-Displacement Meter

## It can measure micro-displacement of a target material without contacting it.

The probe for measuring the vibration of a rotating shaft at a high temperature (200 °C) is also available.  
Popular eddy-current effect applied non-contacting displacement meter for measuring relative distance between a shaft and housing.

### Block Diagram



# T-5001

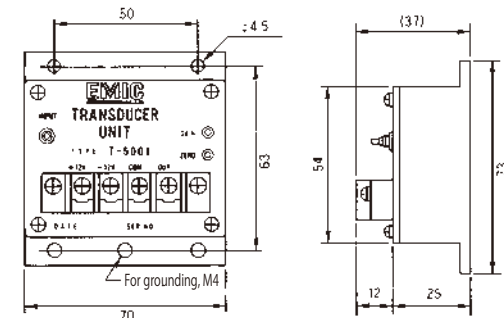
Transducer Unit Model : T-5001

### Application

- Measurement of axial vibration and thrust position of rotating machine
- Measurement of clearance gap
- Measurement of small target material
- Measurement in a hot environment at 200°C
- Measurement of dynamic behavior of piston
- Measurement of resonance and amplitude

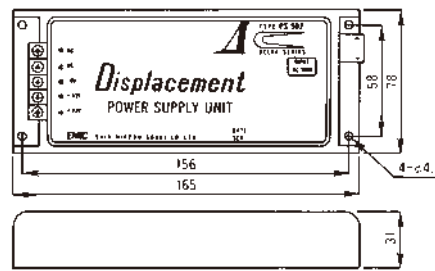
### Outline Drawings

#### Transducer Unit Model : T-5001



The dimensions of the T-5001 is same as the T-5301.

#### Regulated Power Supply Model : PS-502

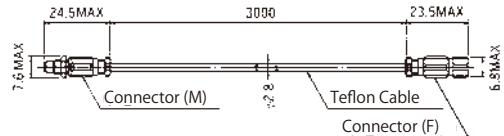


### Specifications

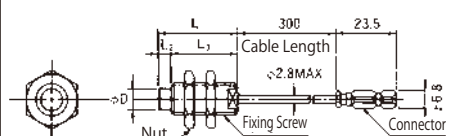
Model	PS-502
Input Voltage	AC 100 V ± 10 V 50 / 60 Hz
Output Voltage	DC ± 12 V (0.3 V)
Output Current	100 mA - Max
Stability	Within 0.5%
Operating Temperature	0 to 60°C
Ripple	Less than 5 mV p-p
Dimensions	165(W) × 31(H) × 78(D)mm
Mass	0.65 kg

Power supply for driving the transducer unit with AC 100 V input power.  
Note : A switching-mode power supply may generate noise.

#### Extension Cable Model : C-5003



#### Probe Model : S-5050 and S-5080



Model	Total Length L <sub>1</sub> mm	Sensor Tip φDmm	L <sub>2</sub> mm	Fixing Screw L <sub>3</sub> mm	Nut Thickness (mm)	Opposite Side (Distance)mm
S-5050 <sup>MH</sup>	21	5	5	16M8P1	3.5	12
S-5080 <sup>MH</sup>	30	8	5	25M12P1	3.5	19

### Specifications

Specifications when combined with the transducer. "MH" of the probe model designates high-temperature type and "LIN" of the transducer linearizer.

Target Material		Magnetic Substance		Non-Magnetic Substance	
Transducer Model		T-5001		T-5301 (with LIN)	
Probe Model		S-5050M S-5050MH	S-5080M S-5080MH	S-5050A	S-5080A
Extension Cable Model		C-5003 (Length 3m)		C-5003 (Length 3m)	
Measuring Range		1.5 m	2 m	1.4 m	2 m
Probe Tip Diameter		φ 5mm	φ 8mm	φ 5mm	φ 8mm
Reference ZERO		0.9 mm	1.2 mm	0.9 mm	1.2 mm
Linearity		±100 πm    1%	±200 πm    3%	2% F.s	2% F.s
		±200 πm    2.5%	±500 πm    5%		
		±600 πm    7%	±1000 πm    12%		
		distance from reference ZERO			
Output Voltage		±3.75 V	±5 V	±3.5 VF.s	±5 V
AC Sensitivity		5 mV / π m			
Minimum Detection		1 π m			
Frequency Range		DC to 10 kHz (-1dB)		0 to 600,00 rpm	
Operating	Transducer	-10 to + 60°C		0 to + 50°C	
Temperature	Probe	-40 to + 120°C		-40 to + 200°C for high-temperature type	
Probe Integral Cable		0.3 m			
Unit	Output Impedance	100 Ω			
	Input Power	DC ± 12 V    ±0.3 V			
	Dimensions	70W×37H×73Dmm			
	Mass	120 g			

※ We can also offer a custom-designed probe other than described here. Please contact us.  
1. The flange configuration can be changed freely.  
2. The probe tip diameter has direct effect on the measuring accuracy. Please advise us the details of your application including the measuring range and property of the target material. We will design the most suitable probe for your application.

## Non-Contacting Micro-Displacement Meter Model : T-5306

### High accuracy micro-displacement meter with the resolution of 1μm.

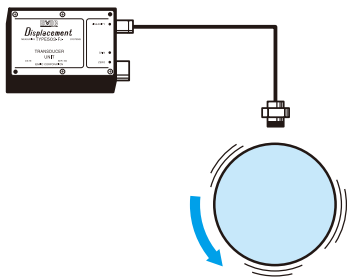
Eddy-current effect applied non-contacting displacement meter that can measure a small target material with high accuracy and resolution.

Measuring range of T-5306 : 0 to 500μm

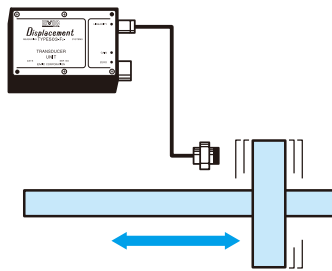
# Technical Information

(This is for your reference only.)

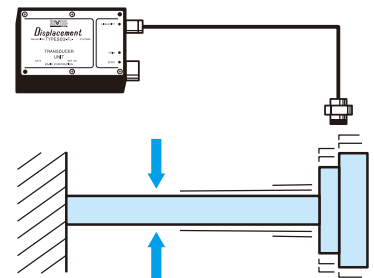
## Application Example



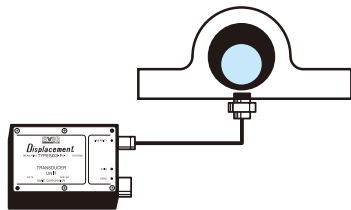
**Measurement of Axial Vibration and Eccentricity**



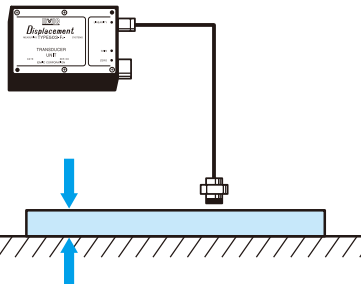
**Measurement of Thrust Position**



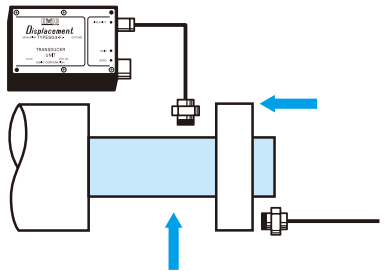
**Measurement of Vibration Frequency, Resonance Frequency and Displacement**



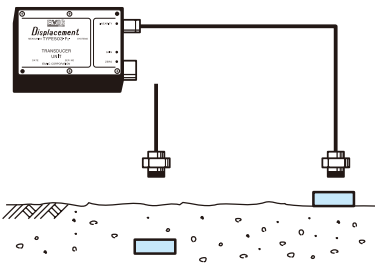
**Measurement of Oil Film Thickness**



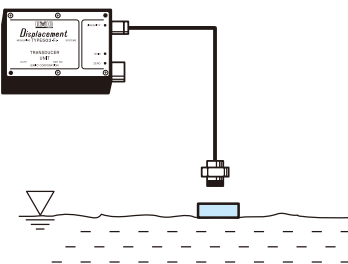
**Measurement of Nonconductive Material Thickness**



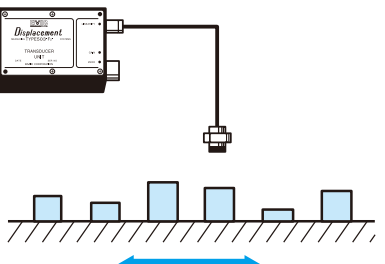
**Measurement of Cutting Dimensions**



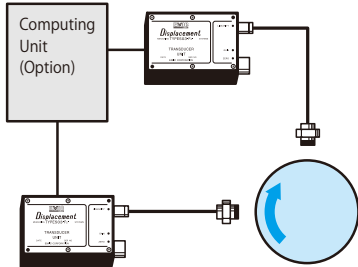
**Measurement of Sagging Road**



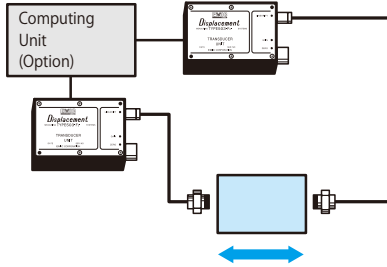
**Measurement of Fluid Level**



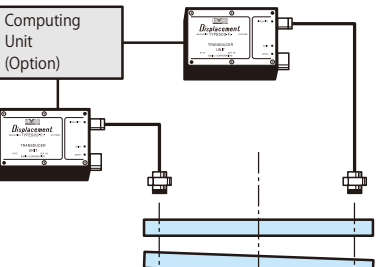
**Dimensional and Quantity Inspection of Metallic Body**



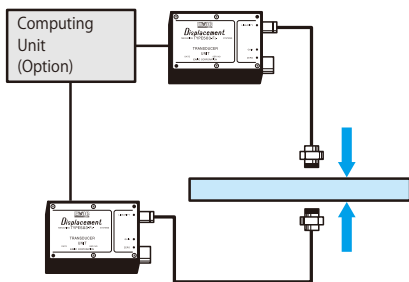
**Observation of Excursion**



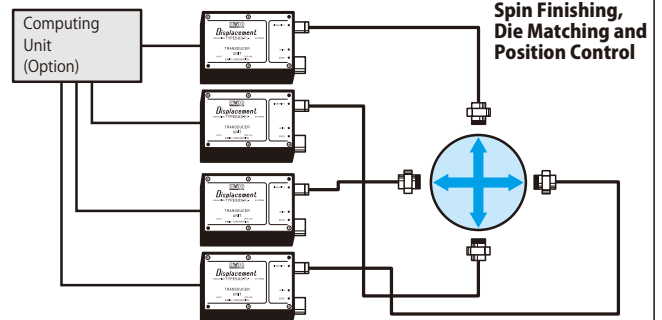
**Control of Deflection and Position**



**Change of Position of a Long Body**



**Measurement of Plate Thickness and Diameter**



**Spin Finishing, Die Matching and Position Control**



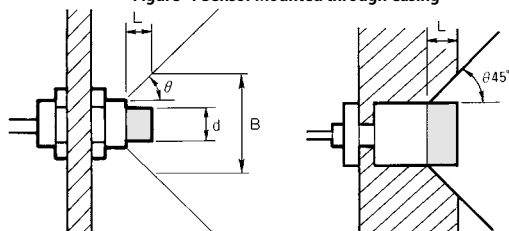
# Technical Information

(This is for your reference only.)

## Electromagnetic Interference to Sensor

If there exists a metallic substance near the sensor, the exact measurement of the distance between the target object may become impossible. Figure -1 shows chamfering to remove metal from the electrical field.

Figure -1 Sensor Mounted through Casing



Three times of either the ratio of B to d or L, whichever is larger.  $\theta$ : more than 45°  
Metal shall be removed from the electrical field produced by the sensor as specified by dimensions of B, L and d.

When using the NPA sensor, there shall not exist a metallic substance in the area specified by dimensions of L and  $\theta$ .

## Required Dimensions of Measuring Object

If the observed surface is flat, its required area for obtaining sufficient measuring sensitivity should be larger than 1.5 to 2 times of the sensor diameter. If it is smaller than that, the output voltage may fluctuate largely to increase the linearity error. Figure-2 shows how the output changes as the target diameter decreases, where it has been calibrated using the flat aluminum target whose diameter is four times of the sensor diameter. Even though the target is small, the linearity can be improved by calibrating with an actual object. For example, when the calibration has been performed with the target whose diameter is 1.5 times of the sensor, the linearity can be within about 1%.

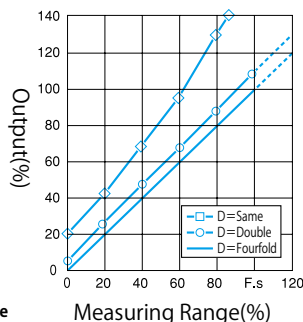
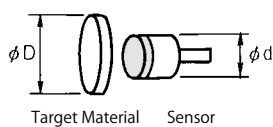


Figure-2 Output vs. Measuring Object Size

## Cylindrical Observed Surface

When measuring the cylindrical surface such as the side of shaft or drum, for a similar reason for dimensions of target object, the sensitivity does not lower very much if the cylindrical diameter of the target material is larger than five times of the sensor diameter. Figure-3 shows how the output changes as the target diameter decreases, where it has been calibrated using the cylindrical aluminum target whose diameter is ten times of the sensor diameter. When calibrated with the target whose diameter is 1.5 times of the sensor in the same manner as measuring object size, the linearity can be within about 1.5%.

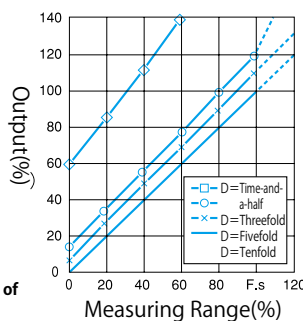
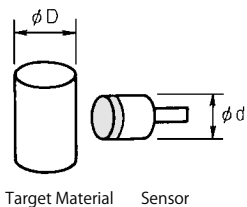


Figure-3 Output vs. Cylindrical Geometry of Measuring Object

## Material of Observed Surface

When the observed surface is nonmagnetic material, the larger the electrical conductivity the higher the output sensitivity and when magnetic material the larger the electrical conductivity and permeability the higher the output sensitivity. For example, assuming that the AC sensitivity for aluminum (A1050P) target is 100%, it is 90 to 95% for stainless target and 70 to 85% for iron target. Calibrate the displacement meter using the same material as the target object.

## Thickness of Target Object

When measuring with the non-contacting displacement meter, the required thickness of the observed surface for the good conductor such as aluminum, copper, etc. is about 50  $\mu\text{m}$  due to the skin effect. But the thickness of more than 300  $\mu\text{m}$  offers the reliable method of measuring the displacement.

## Nonconductive Target Object

When the observed surface is nonconductive, it can be measured by nickel or chrome plating of 300  $\mu\text{m}$  to 500  $\mu\text{m}$ .

## Temperature Drift

When the sensor is installed in the environment where the temperature fluctuates, the output voltage from the transducer unit also changes in an irregular way. The temperature drift is something changing that amount in parts per hundred per degree Celsius and full scale value. The temperature characteristic of the NPC sensor can be as shown in Figure-4 due to the temperature drift.

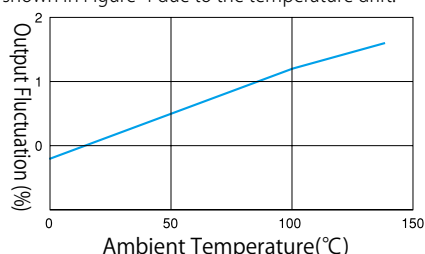


Figure-4 Temperature Characteristic of NPC Sensor

## Common Carrier Method

The common carrier method is the circuit logic for the transducer unit to use the same carrier frequency for all sensors allowing for eliminating the beat phenomenon to make it possible to use the multiple sensors to come close each other. Figure-5 shows the data comparison of how the common carrier method can improve the linearity when the sensors come near each other.

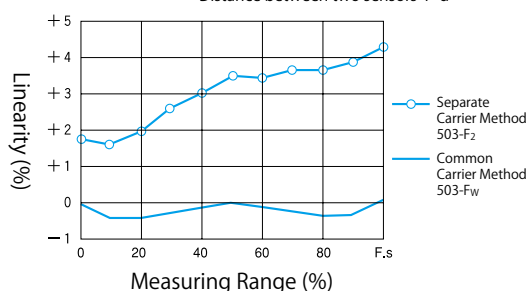
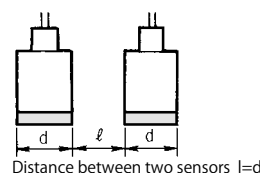


Figure-5 Linearity when two sensors come near ( $l=d$ )  
(The 503-FW has been calibrated under the condition that the sensors were installed)

**EMIC**  
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2010-Jan.

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representative Office