

# TENSION CONTROL SYSTEM

**Nireco Corporation —  
researching and developing all areas of web control**





# TENSION CONTROL SYSTEM

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# TENSION CONTROL SYSTEM

The NIRECO Tension Control System automatically controls tension during manufacturing and various treatment processes of paper, foil, film, rubber, fabric, and so on.

## INTRODUCTION

When a web of these materials is unwound or rewound the web tension varies as the roll diameter of the material changes. Web tension must be maintained at a constant level to prevent wrinkles, sags, changes in width or thickness, or breakage of the web. In printing processes, variable tension causes a paper web to stretch or shrink, causing sudden register errors. This problem necessitates tension control.

Tension sensors are mounted at both ends of a sensor roll.

The tension controller can be operated simply using a stable proportional + integral action with a constant loop-gain circuit.

This configuration provides both responsivity and stability regardless of roll diameter.

The actuators include both an electromagnetic brake and a pneumatic brake for use when unwinding. The electromagnetic brake can be connected directly from the controller but the pneumatic brake must be used with an electro-pneumatic converter. Winding can be achieved using many systems, including an electromagnetic or pneumatic clutch, and electromagnetic coupling motor or a torque motor. Intermediate tension control can also be handled where necessary.

## About Nireco Tension Controllers

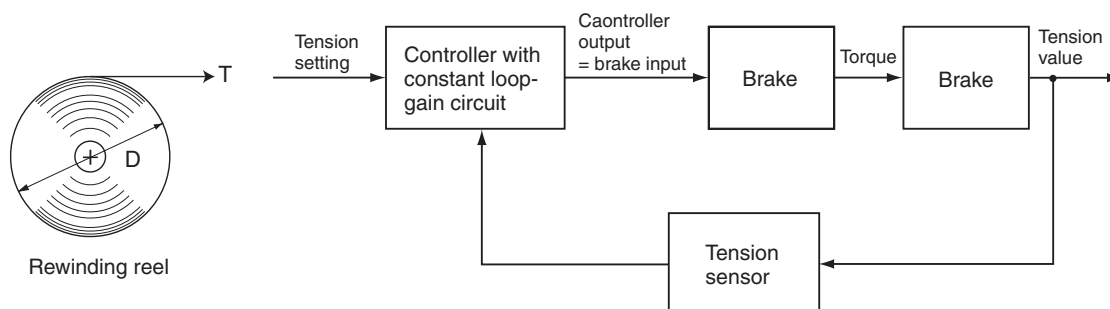
### ● Suppression of Hunting via Constant Loop Gain Circuit

Instability is a frequent problem with tension control. The main source of this instability is the fact that in order to set the tension, it is necessary to change the brake torque, which is what is manipulated in order to control tension; but if too much leeway is given in brake selection, and a high-capacity brake is selected, then the output at small coil diameters could fall below the range of safe control. In general, the gain setting is constant, and has no relation to coil diameter. Thus when the coil is small, there is a tendency for the loop gain to increase, and for instability to result.

Nireco reduces control instability (hunting) by using a tension controller with a constant loop-gain circuit that eliminates changes in loop gain due to changes in coil diameter.

### ● Increased Stability through Proportion + Integral Calculation

There is some distance between the rewinding reel and tension sensor, and a certain amount of time to transmit tension waves between them is unavoidable. In other words, there is a slight but real amount of waste, and in addition, noise is generated in relation to the coil rpm. Consequently, stable control using integral (I) analysis alone is not feasible. Additionally, brake input changes in accordance with coil diameter, and so the offset with proportional (P) calculation alone is too large to use. Nireco tension controllers therefore employ Proportion + Integral (PI) calculation for stable tension control.





## FEATURES

### ■ Constant loop-gain circuit gives superior responsivity and stability

Control circuit calculations are carried out by both proportional and integral operations to give rapid, precise responses. Exponential operations are used to maintain a constant loop gain regardless of variations in diameter. Therefore loop gain is always maintained at the right level, with high responsivity but no hunting. This system is extraordinarily effective when used with splicers, high-speed presses and in situations with high roll diameter ratios.

### ■ Easy to use, simple to control

Given start and stop contacts, the system can be controlled automatically. Anyone can operate it just by setting a target tension value. A sequencer is built in that gives an output value corresponding to the diameter when the systems stops.

### ■ Tension indication available

In addition to total tension, tension for a single side can also be sensed.

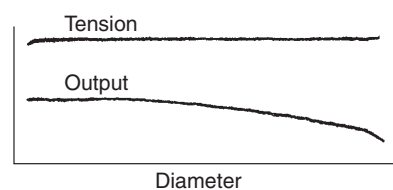
### ■ Taper tension during unwinding can be set

### ■ Tension can be set from an external source

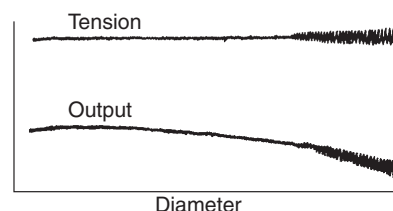
### ■ The system can be applied to various actuators

Pneumatic brakes, pneumatic clutches, pneumatic motors, electromagnetic brakes, electromagnetic clutches, torque motors, electromagnetic coupling motors etc.

Tension Controller with constant loop gain circuit



Previous tension controllers



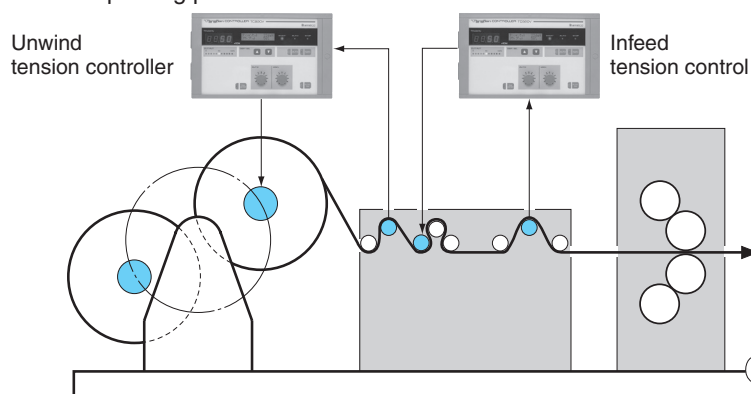
### ■ Tension control is possible for unwinding, winding and intermediate (infeed-outfeed) situations

### ■ Various installation methods are accommodated to suit the operator's position

Panel mounted, floor mounted, and wall mounted .

## SAMPLE APPLICATION

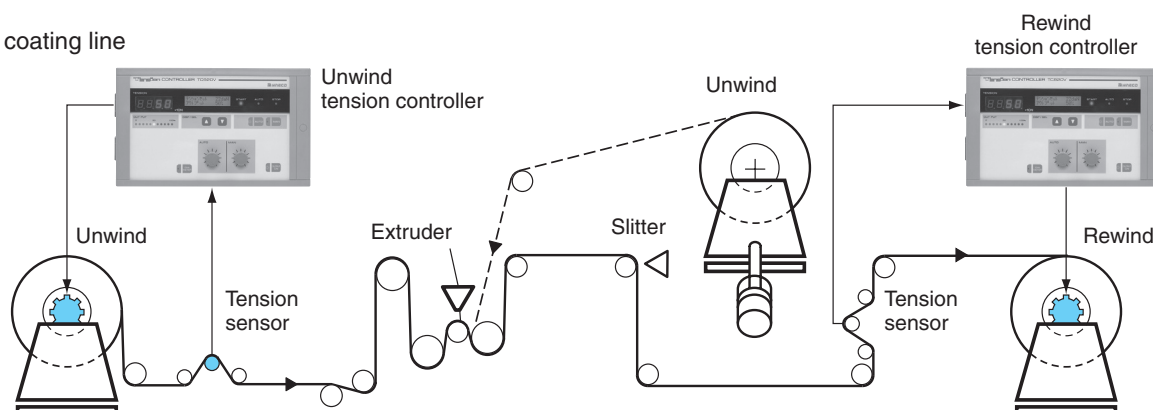
### Web-fed offset printing press

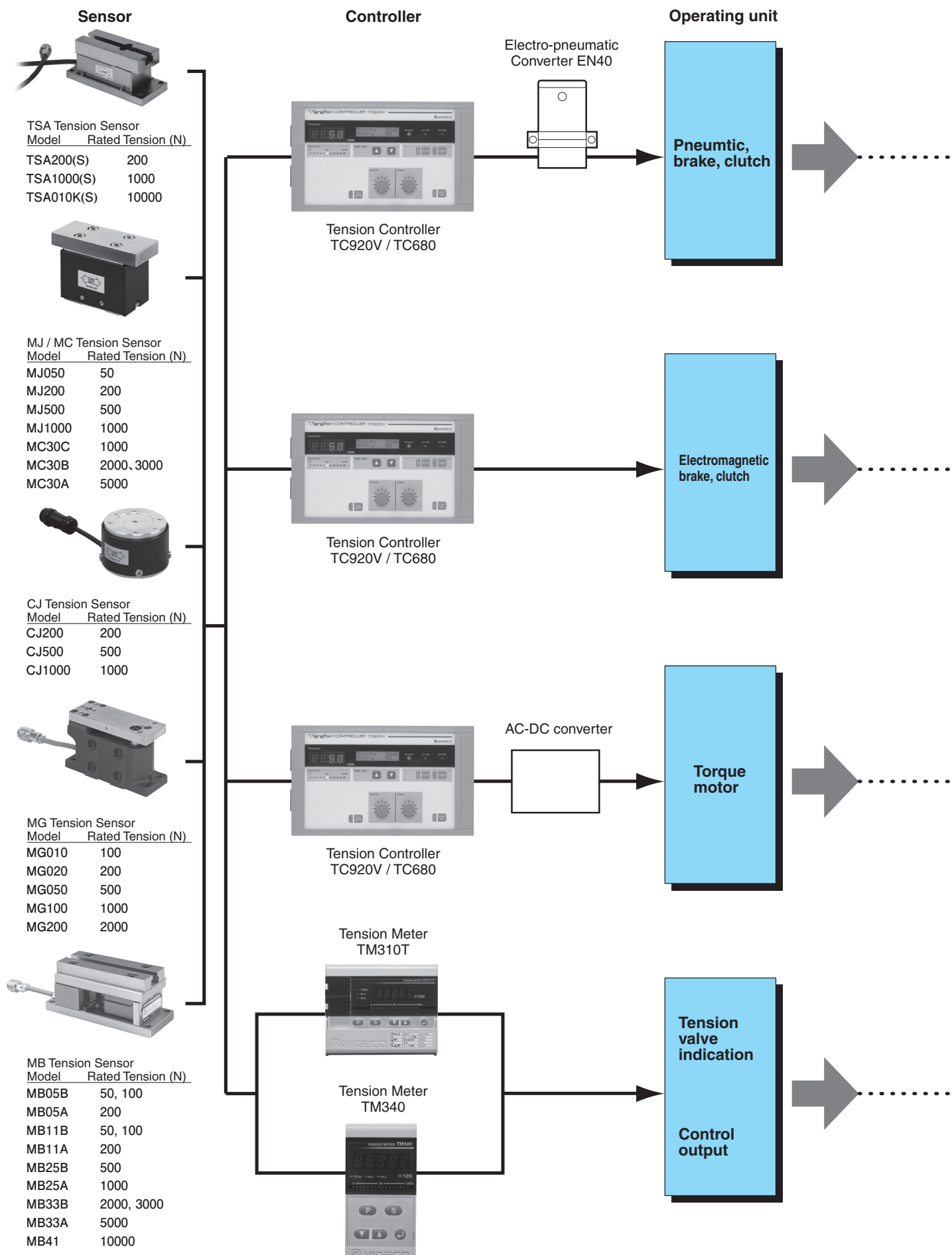


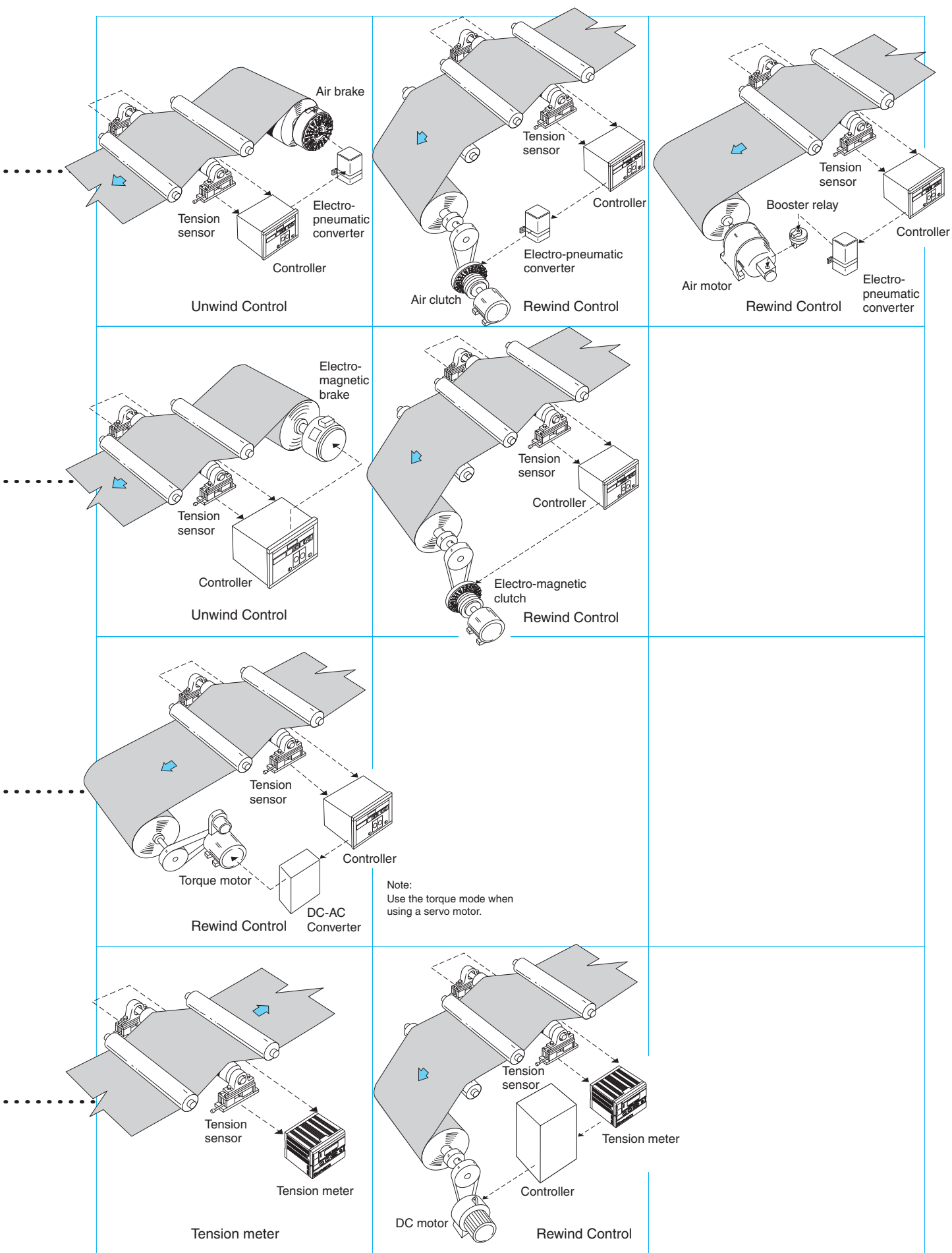
### Tension Control Applications

1. Web-fed offset printing
2. Web-fed rotogravure press
3. Business form printing press
4. Slitter
5. Coater
6. Laminator
7. Winder
8. Cutter
9. Calender
10. Corrugator

### Plastic coating line







## TSA TENSION SENSOR

TSA200(S), TSA1000(S), TSA010K(S)

The TSA tension sensor is a high-performance unit that uses a strain gauge system. The sensor has a high spring rigidity, high resonant frequency, and very little displacement even at high tension levels. This means that the TSA tension sensor is ideal not only in the tension control of paper and PET film, but also for applications in industries that manufacture highly functional films, low-stretch webs and high-value-added products. Nireco also offers an intrinsically safe explosion-proof TSA tension sensor that can be installed in hazardous locations where the atmosphere is explosive.

### FEATURES

#### High spring rigidity

The sensor's high spring rigidity means that its resonance is high, which makes it ideal for high-speed lines.

#### Little displacement under loads

As there is very little displacement under load, the TSA sensor is well suited to thin web lines, such as film and foil.

#### Excellent performance

The sensor's strain gauge system yields superior linearity and hysteresis.

#### Mounting compatibility

The TSA has the same external dimensions as the earlier MB tension sensor, making retrofitting simple.

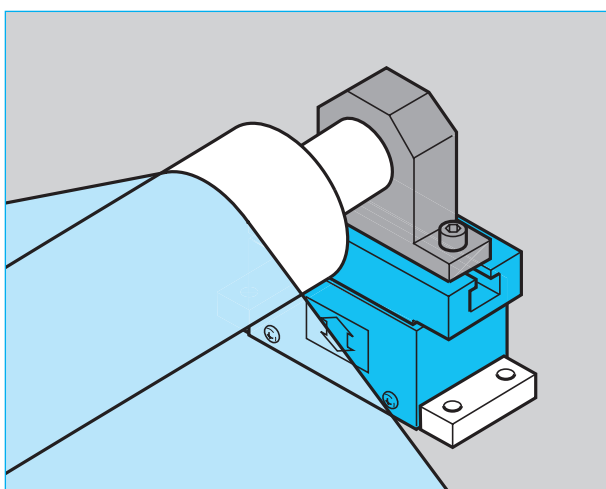
\* Cabling will need to be converted or replaced.

\* May not be possible for all models.

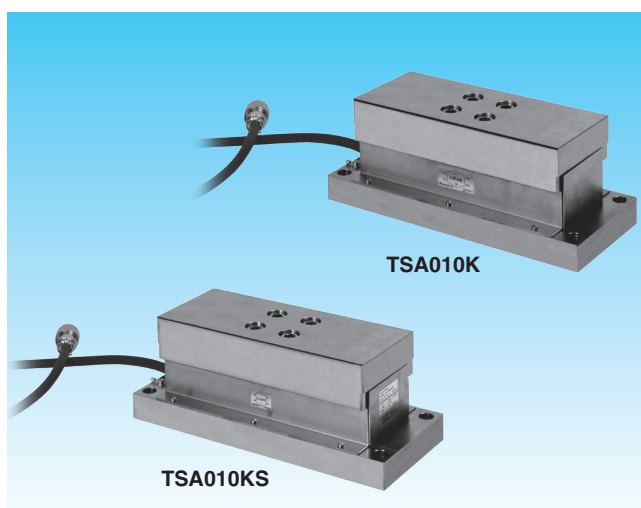
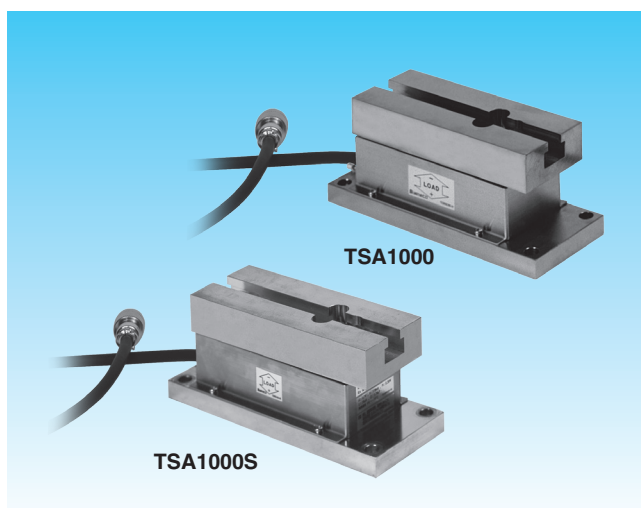
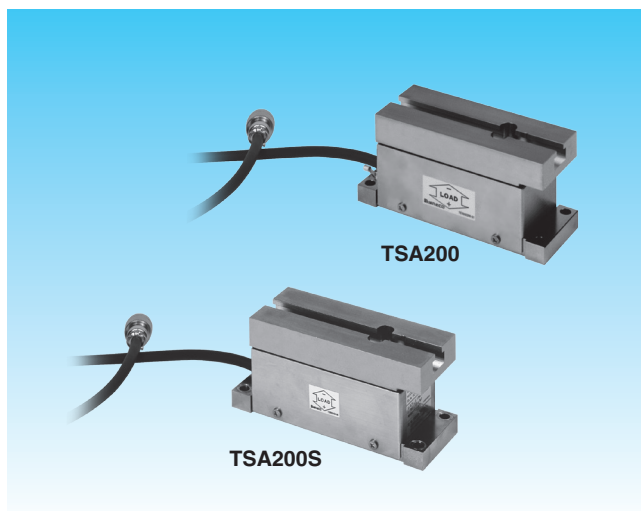
### Intrinsically safe explosion-proof model

#### Information about "intrinsically safe explosion-proof"

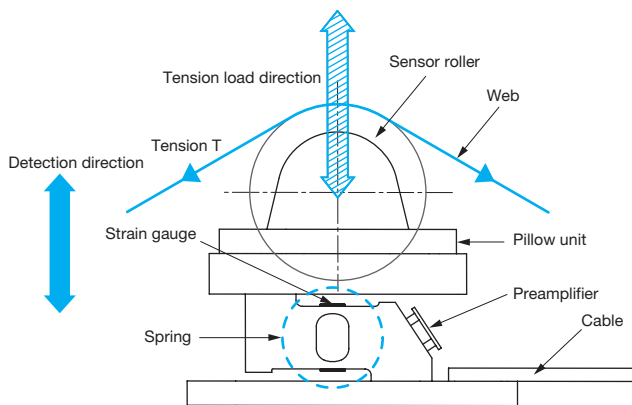
The intrinsically safe TSA tension sensor is installed in hazardous locations where there is the risk of flammable or explosive gas or steam. The tension controller, tension display and power supply are located in a non-hazardous location where there is no hazardous gas or steam. A safety barrier is installed between the tension sensor and these other devices, to maintain a state of safety.



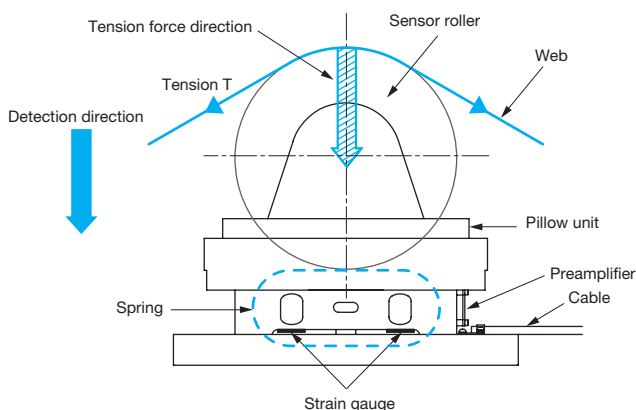
Example of tension sensor installation



## Operating principle and structure



For the TSA200, TSA1000, TSA200S and TSA1000S

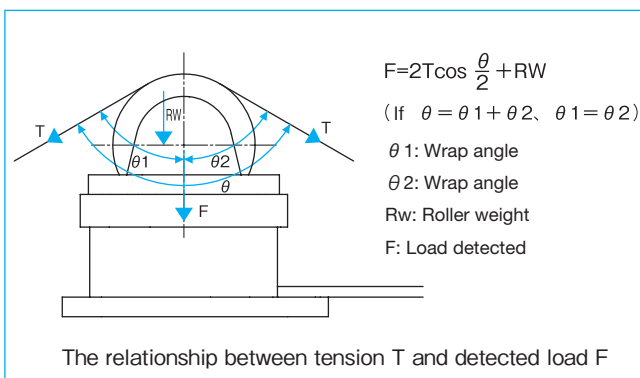


For the TSA010K and TSA010KS

TSA tension sensors detect the component forces of the tension via upper and lower springs arranged in parallel. The springs have strain gauges, and the component force of the tension is converted into an electrical signal that is proportional to the tension load. The diagram above shows the structure of the tension sensor.

Tension (T) is applied to the sensor roller. The resultant force acts as a load (F), and the parallel springs are deflected slightly. As the springs deflect, the strain gauge detects the deflection and converts this into an electric voltage signal that is proportional to the deflection. The strain gauge's signals are amplified by a preamplifier, which then sends them to a tension controller or a tension meter.

The relationship between tension T and detected load F, when the mounting is as shown in the diagram below, can be represented by the following equation.



## Specifications (Standard model)

Model		TSA200 (MB11)	TSA1000 (MB25)	TSA010K (MB33, MB41)
Rated tension(N)	※1	200	1000	10000
Permissible roller load(N)	※1	200	1000	7000
Permissible overload (10-times rated load) (N)	※1 ※2	2000	10000	100000
Roller displacement(μm/N)		0.3	0.05	0.005
Spring constant(N/mm)		3333	20000	200000
Resonant frequency(Hz)	※3	91.0	99.6	108.1
Output voltage of the sensor alone(mV)		± 420 ± 63mV/100N	± 370 ± 55mV/500N	± 535 ± 80mV/5000N
Response time(msec)	※4	0.5 or less		
Mass (kg)		1.4	3.6	16
Tension direction		Forward and reverse accepted		Only forward accepted. Detection in reverse direction not possible.
Mounting angle		360° - any angle possible		
Power supply voltage		± 15VDC( + 15V/50mA, - 15V/10mA)		
Ambient temperature and humidity range in which the sensor can operate		0 ~ + 50°C, 35 ~ 85% RH no condensation		
Operating principle		Strain gauge detection		
IP protection rating		IP30		

\*1. The rated tension, permissible roller load and permissible overload are figures for when detection is carried out on both sides. If detection is to be on one side only, then the values above will be halved.

\*2. The allowable overload indicates the permitted force applied in the direction of the tension.

\*3. The resonant frequency is that for when there is detection on both sides and the roller is at its maximum loading.

\*4. The response time is the figure when the change in tension is 1/10th that of the rated tension.

## Specifications (Intrinsically safe explosion-proof model)

Model		TSA200S (MB11S)	TSA1000S (MB25S)	TSA010KS (MB33S, MB41S)
Rated tension(N)	※1	200	1000	10000
Permissible roller load(N)	※1	200	1000	7000
Permissible overload (10-times rated load) (N)	※1 ※2	2000	10000	100000
Roller displacement(μm/N)		0.3	0.05	0.005
Spring constant(N/mm)		3333	20000	200000
Resonant frequency(Hz)	※3	91.0	99.6	108.1
Voltage output for a single rated load (mV) + 1.5 V DC (standard)		± 350 ± 52.5mV/100N	± 315 ± 47mV/500N	± 460 ± 68mV/5000N
Response time(msec)	※4	0.5 or less		
Mass (kg)		1.4	3.6	16
Tension direction		Forward and reverse accepted		Only forward accepted. Detection in reverse direction not possible.
Mounting angle		360° - any angle possible		
Power supply voltage	※5	+ 6VDC/20mA		
Ambient temperature and humidity range in which the sensor can operate		0 ~ + 50°C, 35 ~ 85% RH no condensation		
Operating principle		Strain gauge detection		
IP protection rating		IP30		
Explosion-protected mark	※6	Ex ia II C T4 X		

\*1. The rated tension, permissible roller load and permissible overload are figures for when detection is carried out on both sides. If detection is to be on one side only, then the values above will be halved.

\*2. The allowable overload indicates the permitted force applied in the direction of the tension.

\*3. The resonant frequency is that for when there is detection on both sides and the roller is at its maximum loading.

\*4. The response time is the figure when the change in tension is 1/10th that of the rated tension.

\*5. The power supply voltage indicates the voltage input to the safety barrier.

\*6. Caution indicated by an "X" mark: Do not allow the tension sensor to be subjected to impacts or friction as there is the risk that it may ignite.

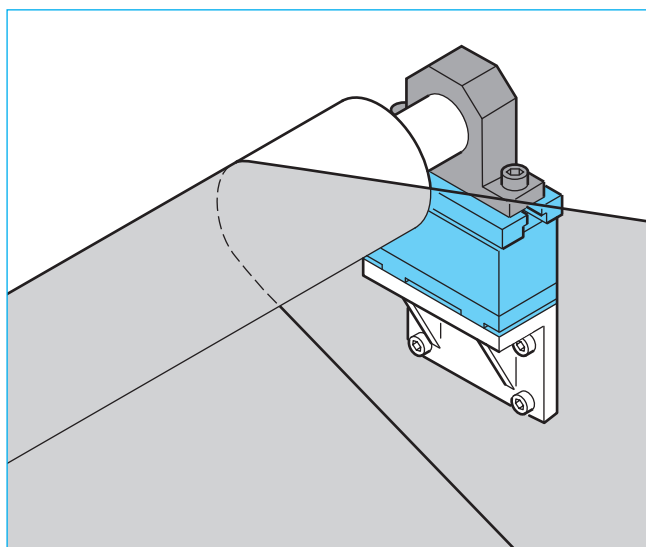
# MJ TENSION SENSOR

MJ050, MJ200, MJ500, MJ1000

The MJ tension sensor is the ideal high-performance tension sensor for producing sophisticated plastic films. It is essential for tension control of sophisticated plastic films used in leading-edge industries, including flat-screen TVs, rechargeable batteries, thin and light solar cells, and organic EL lighting, which is expected to become the next generation of lighting.

## FEATURES

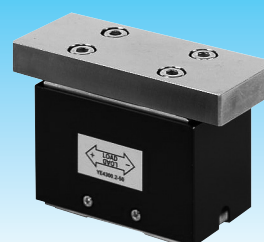
- The high spring-steel rigidity of the MJ tension sensor provides a high resonance point, making it ideal for high-speed lines.
- The load displacement of the MJ tension sensor is extremely low, making it effective for thin web lines (i.e., film, foil, etc.).
- The stainless version has an IP66-compliant protective housing that can handle being splashed with water when cleaning a production line.
- The use of a mono-block structure provides outstanding linearity and hysteresis.
- The MJ sensor is compact but highly robust.



MJ Tension Sensor



MJ050



MJ200



IP66 Drip-proof and dust-proof (optional)

## SPECIFICATIONS

	Model	MJ050	MJ200	MJ500	MJ1000
	Diagram number	MD0000320	MD0000330	MD0000340	MD0000350
*1	Rated tension (N)	50	200	500	1000
*1,4	Maximum roll load (N)	200	200	500	1000
*1,4,5	Maximum overload	700	2000	5000	10000
	Roll displacement (μm·N)	0.36	0.12	0.05	0.03
*2	Resonance frequency (Hz)	105.0	143.8	140.9	128.6
*3	Frequency response (Hz)	300			
	Main unit mass (kg)	0.9		1.7	
	Direction of resultant tension force	Forward or reverse			
	Mounting angle	Any desired angle			
	Supply voltage	±15VDC ±1V (+15V/50mA, -15V/10mA)			
	Ambient temperature/humidity	0 to +50°C, 35 to 85%RH (No condensation permitted)			
	IP Protection Rating	IP30			

Note \*1. The figures for rated tension, maximum roll load, and maximum overload are for double-sided detection. For single-sided detection the above figures should be halved.

\*2. The resonance frequency figures are for the tension load during double-sided detection and at maximum roll load.

\*3. The frequency response figure is with respect to a change of 1/10 in the rated tension.

\*4. For the MJ050, the maximum roll load is not equal to the rated tension (double-sided load). The maximum roll load is 200 N. Consequently, the maximum overload = the rated tension × 10 + the maximum roll load.

\*5. The maximum overload represents the maximum value of the force exerted in the direction of the resultant force.



# CJ TENSION SENSOR

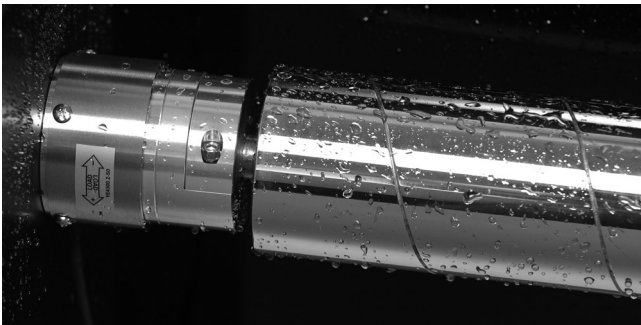
CJ200, CJ500, CJ1000

The CJ sensor is essential for tension control of sophisticated plastic films used in leading-edge industries, including flat-screen TVs, rechargeable batteries, thin and light solar cells, and organic EL lighting which is expected to become the next generation of lighting.

The CJ series of tension sensors are bearing-type sensors, so they can easily be installed on existing lines.

## FEATURES

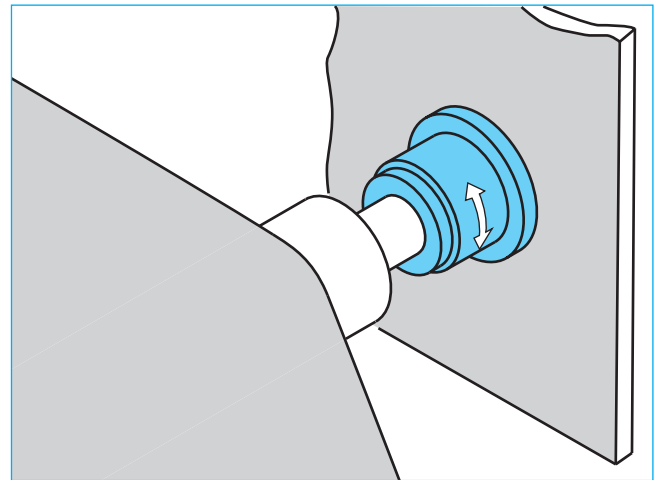
- The CJ tension sensor has excellent dynamics, and its high spring-steel rigidity provides a high resonance point, making it ideal for high-speed lines.
- The load displacement of the MJ tension sensor is extremely low, making it effective for thin web lines (i.e., film, foil, etc.).
- The stainless version has an IP66-compliant protective housing that can handle being splashed with water when cleaning a production line.
- The use of a mono-block structure provides outstanding linearity and hysteresis.
- Because the bearing unit and sensor are integrated, the sensor has a low profile and requires minimal installation space, enabling it to easily be installed even in confined spaces.



IP66 Drip-proof and dust-proof (optional)



CJ Tension Sensor



CJ Tension Sensor

## SPECIFICATIONS

	Model	CJ200	CJ500	CJ1000
	Diagram number	MD0000360	MD0000370	MD0000380
	Diagram number with adapter unit	MD0000450	MD0000460	MD0000470
*1	Rated tension (N)	200	500	1000
*1	Maximum roll load (N)	200	500	1000
*1,5	Maximum overload	2000	5000	10000
	Roll displacement (μm·N)	0.12	0.06	0.035
*2	Resonance frequency (Hz)	143.8	128.6	119.1
*3	Frequency response (Hz)	300		
*4	Main unit mass (kg)	1.0 (1.6)		
	Direction of resultant tension force	Forward or reverse		
	Mounting angle	Any desired angle		
	Supply voltage	±15VDC ±1V (+15V/50mA, -15V/10 mA)		
	Ambient temperature/humidity	0 to +50°C, 35 to 85%RH (No condensation permitted)		
	IP Protection Rating	IP30		

Note

- \*1. The figures for rated tension, maximum roll load, and maximum overload are for double-sided detection.
- \*2. The resonance frequency figures are for the tension load during double-sided detection and at maximum roll load.
- \*3. The frequency response figure is with respect to a change of 1/10 in the rated tension.
- \*4. The figure in parenthesis is the mass including the adapter unit.
- \*5. The maximum overload represents the maximum value of the force exerted in the direction of the resultant force.

# MB TENSION SENSOR

MB05, MB11, MB25, MB33, MB41

The MB Tension Sensor was designed to be used with a tension controller or tension meter. It supports a wide range of products, with any tension range. The MB Tension Sensor has long been a strong seller, since sales were launched 20 years ago.

## FEATURES

### Proven Track Record and Reliability

Without bearings or similar mechanical contacts, and employing a non-contact detection method using a differential transformer, the MB Tension Sensor is highly responsive with low hysteresis. The compact size also requires little space for installation.

### Easy to Install

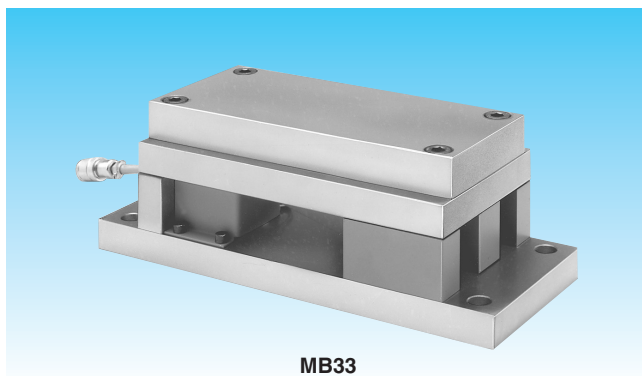
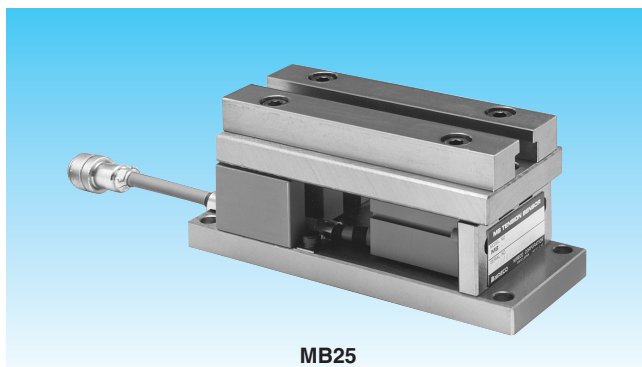
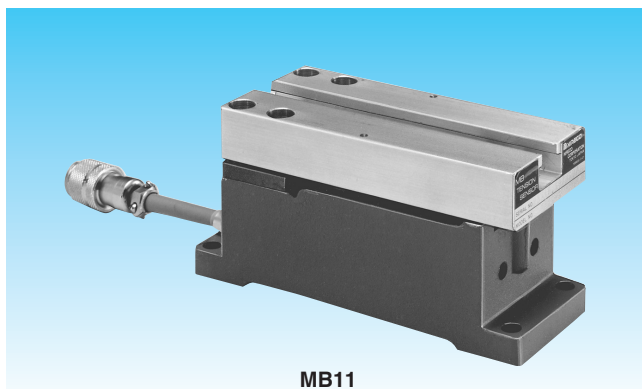
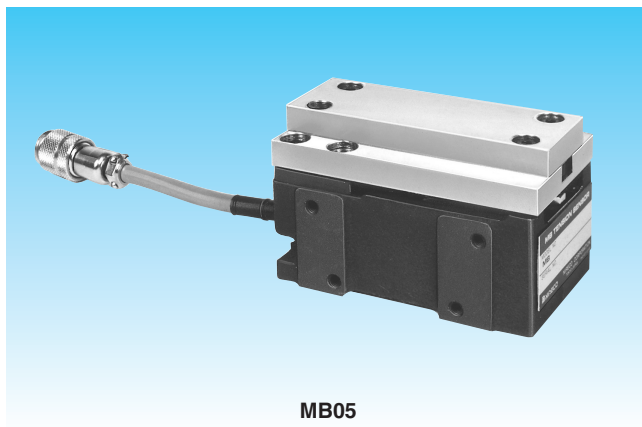
The MB 05, 11, and 25 can be installed at any angle.

### Wide Selection of Sensors

- ① Full range available, from low tension (100 N full scale) to high tension (10,000 N full scale)
- ② All sensors have intrinsically safe construction.

### Overload Resistant

The durable construction provides resistance to momentary overloads.



MB Tension Sensor

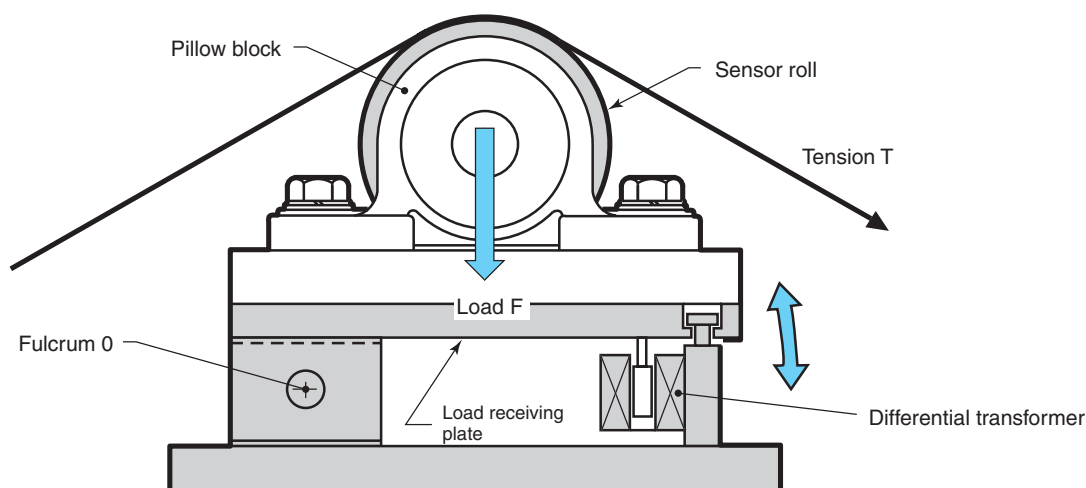
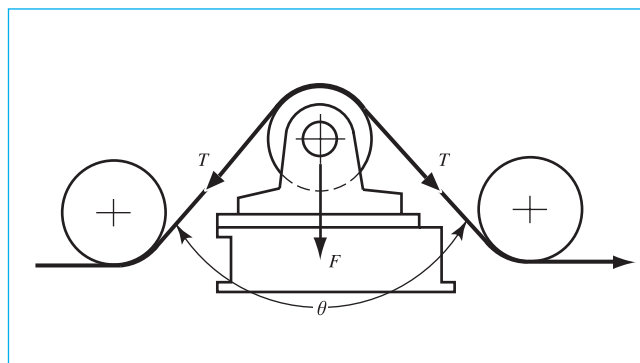
## PRINCIPLE AND CONSTRUCTION

To measure the tension, attach a MB tension sensor to 3 rollers arranged in a triangle (see figure at right). The relation between the tension "T" and the load "F" is expressed by the following equation.

$$F = 2 T \cos \frac{\theta}{2} + R_w \dots\dots\dots (1)$$

$$\therefore T = \frac{F - R_w}{2 \cos \frac{\theta}{2}} \dots\dots\dots (2)$$

$\theta$  : Wrap angle  
 $R_w$  : Roll weight



Structure of MB Tension Sensor (this drawing shows model MB25)

The figure above shows the structure of the MB tension sensor. When the web tension increases, the resultant force F of the tension acts downward on the pillow block on which the roll is mounted. Due to this load, a very small rotation occurs, starting from the fulcrum O. Since this fulcrum has a spring action, the rotary displacement is proportional to the resultant force F. This displacement is very small at the roll, and reaches a maximum at the core which is remotest from point O. This mechanical displacement is converted into an electrical value proportional to the displacement of the differential transformer.

Since the displacement due to deflection of the fulcrum is proportional to the load, the electrical value produced is substantially proportional to the tension ( $\propto$  load). Thus, the fulcrum and differential transformer determine sensor performance. Therefore, the fulcrum is machined by cutting, and its material excels in spring action (hysteresis and strength), while stress is at a sufficiently low value. The differential transformer also has a high oscillation frequency, and the temperature characteristics are excellent.

## SPECIFICATIONS

Model	MB05B	MB05A	MB11B	MB11A	MB25B	MB25A	MB33B	MB33A	MB41
Rated tension (N)	100	200	100	200	500	1000	3000	5000	10000
Roll displacement (μm=N)	2.42	1.20	2.80	1.38	0.47	0.22	0.086	0.057	0.023
Allowable roll mass (kg)	10	20	10	20	50	100	300	350	700
Allowable overload (N)	Ten times rated load								
Unit mass (kg)	1.5		0.8		3.4		16.1		24
Tension resultant direction	Forward or reverse possible						Forward only (reverse impossible)		
Mounting angle	Any desired angle								
Supply voltage	DC +6V								
Ambient temperature	-10 ~ +60°C								

- Note
- Figures for rated tension and allowable roll mass are for double-sided detection. For single detection the above figures should be halved.
  - A 5m cable with connectors for connection to an amplifier is supplied.
  - MB05, MB11 and MB25 can be wall mounted with a bracket. If the unit is equipped with a bracket, "-W" is added to the end of its model name. e.g. MB11B-W.
  - Sensors with inherently intrinsic safety construction are also available. "S" is added to the end of the corresponding model name. e.g. MB11BS.

# MG TENSION SENSOR

MG010, MG020, MG050, MG100, MG200

The MG Tension Sensor was designed to be used with a tension controller or tension meter. It features compact and rigid construction, high accuracy, reduced temperature drift and high response.

## FEATURES

- With excellent temperature characteristics, the compact size saves space as well.
- Additionally, non-contact detection using a differential transformer yields improved precision.

## PRINCIPLE AND CONSTRUCTION

When web tension is applied to the MG tension sensor, the movable core of the differential transformer moves about the spring fulcrum 0. That change in core position causes the differential transformer to vary the electrical signal.

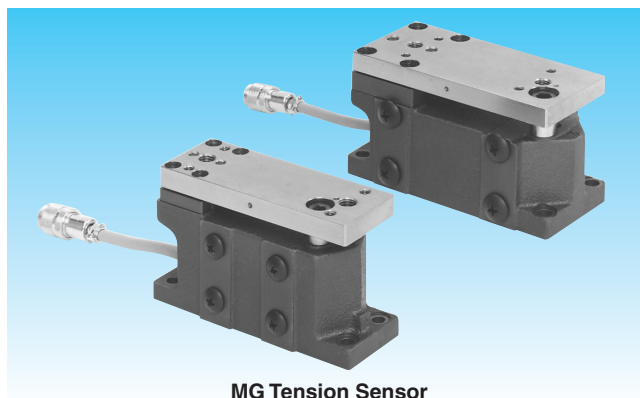
Figure 1 shows the structure of the MG Tension Sensor. When web tension (T) is applied to the sensor roller, load (F) of tension acts downward on the load bearing plate. Due to this load, the load bearing plate rotates minutely about the fulcrum point 0. The torque generated bends the spring fulcrum.

This small displacement of the load bearing plate reaches a maximum at the opposite side of fulcrum point 0, where the core of the differential transformer is installed. The mechanical displacement of the core is converted into an electrical signal by the differential transformer, using the change in mutual inductance. The signal is sent to a tension controller or a tension meter. The relationship between tension (T) and load (F) in the structure, as shown in Figure at right is expressed by the following equation.

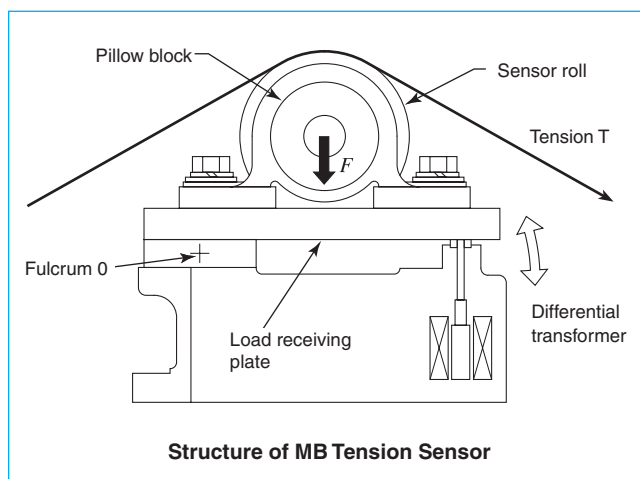
$$F = 2 T \cos \frac{\theta}{2} + R_w \dots\dots\dots (1)$$

$$\therefore T = \frac{F - R_w}{2 \cos \frac{\theta}{2}} \dots\dots\dots (2)$$

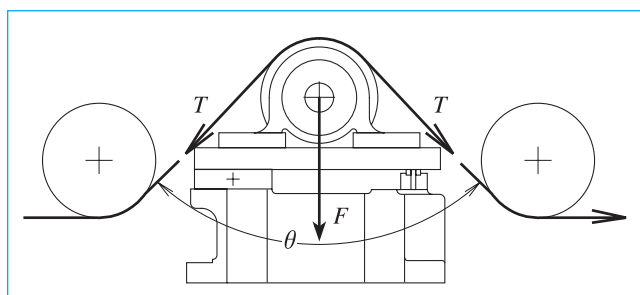
When:  
 $\theta$  : Wrap angle  
 $R_w$  : Roll mass



MG Tension Sensor



Structure of MB Tension Sensor



## SPECIFICATIONS

Model	MG010	MG020	MG050	MG100	MG200
Rated tension (N)	100	200	500	1000	2000
Roll displacement (μm=N)	2.63	1.23	0.48	0.20	0.11
Allowable roll mass (kg)	10	20	50	100	200
Allowable overload (N)	Ten times rated load				
Unit mass (kg)	1.5			2.6	
Tension resultant direction	Forward or reverse possible			Forward only (reverse impossible)	
Mounting angle	Any desired angle				
Supply voltage	DC +6V				
Ambient temperature	-5 ~ +50°C				
Applicable bearings	UCP201 ~ 204 *UCP205 may also be employed when optional pillow-mounting brackets (MD0177.0-22P) are used.			UCP201 ~ 204 *UCP205 and UCP206 may also be optional pillow-employed when optional pillow mounting brackets (MD0178.0-12P) are used.	

Note 1. Figures for rated tension and allowable roll mass are for double-sided detection. For single detection the above figures should be halved.  
 2. A 5m cable with connectors for connection to an amplifier is supplied.

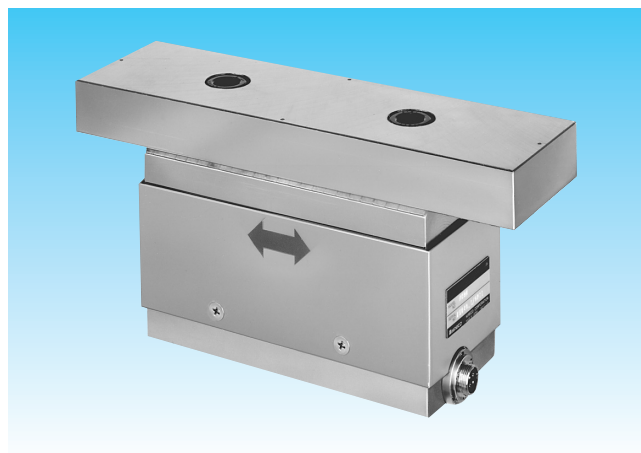
# MC TENSION SENSOR

MC30

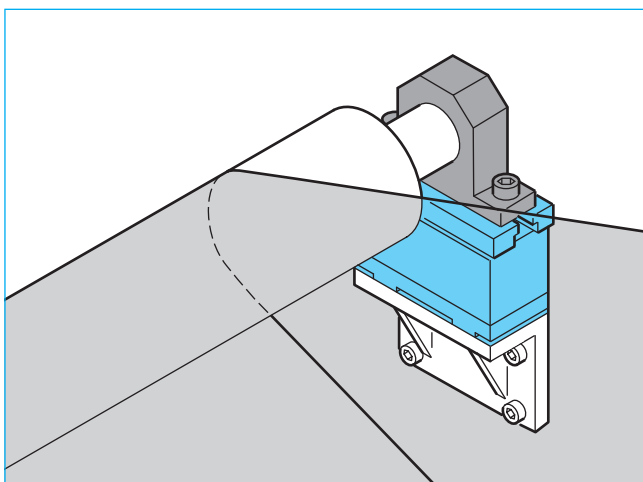
The MC tension sensor is a force converter designed especially for tension controllers or tension meters. It is a high-precision instrument suited to high-speed lines.

## FEATURES

This tension sensor has a high spring stiffness and therefore a high resonance frequency, which makes it ideal for high-speed lines. Since there is very little displacement under loads, it is particularly useful for sensing deflection in thin webs (films and aluminum foil, etc.). The sensor's simple, monoblock construction makes it more accurate, and gives it an excellent hysteresis and linearity. A stopper protects it against overloading.



MC30



MC30 Tension sensor

## SPECIFICATIONS

Model		MC30C	MC30B	MC30A
Rated tension (N)		1000	3000	5000
Roll displacement ( $\mu\text{m}/\text{N}$ )		0.024	0.011	0.0064
Allowable roll weight (kg)	Mounting angle : 360° Any desired angle	100	300	500
	Mounting angle : When Horizontal or reverse mounting	1500	2000	3000
Allowable overload (N)		Ten times rated load		
Unit weight (kg)		17		
Tension resultant direction		Forward or reverse possible		
Mounting angle		360° Any desired angle		
Supply voltage		DC $\pm$ 15V		
Ambient temperature		0 to +50°C		

Note 1. Figures for rated tension and allowable roll weight are for double-sided detection. For single detection the above figures should be halved.  
2. A 5m cable with connectors for connection to an amplifier is supplied.

# TENSION CONTROLLER TC920V

The TC920V Tension Controller can be used with a wide range of web manufacturing and treatment processes to automatically control the tension of a moving web to a constant value. Digital calculation allows a wider range of functions than previous products, but the controller can still be operated in the intuitive style of an analog device. This controller combines stable and precise tension control with excellent cost performance.

## FEATURES

- Control knobs for frequently-used operations**  
Control knobs are used for tension settings and manual settings to give a familiar feel.
- Clear display**  
A four-digit LED display is used for quick and easy checking and an LCD display for more extensive information.
- Simple zero and span adjustment on installation**  
Automatic adjustment functions make adjustment a simple process.  
Tension control is conducted with the start contact only.  
The system automatically outputs pre-output on startup, and slack-prevention output on stop.
- Excellent responsivity and stability**  
Proportional and integral action are augmented by our renowned fixed loop gain calculation.
- Connection with a wide range of tension sensors**  
Can be connected to the following wide range of Nireco sensors: MB, MG, MC, CD, MJ, CJ, TSA, and intrinsically safe TSA sensors

## SPECIFICATIONS

Power supply voltage	100 to 240V AC 50/60Hz
Power consumption	300VA(Entry current 60A typ (20ms))
Current capacity	1.5A (200V)
Mass	6 kg
Environment	<ul style="list-style-type: none"> <li>Operating ambient temperature 0 to +50°C</li> <li>Operating ambient humidity 35 to 85%RH (no condensation)</li> <li>Vibration resistance 3.5mm, 1G, 3 to 150Hz, 3 directions (for one hour)</li> <li>Power source noise 2kV, normal mode, pulse width of common mode 50 nS, 1 uS (depends on the noise simulator)</li> <li>Operating ambient atmosphere Place free from water droplets, inflammable gas, corrosive gas, corrosive gas, and dust</li> </ul>
Rated tension	10 to 10000N
Tension sensors that can be connected to the TC920V	MB, MG, MC, CD, MJ, CJ, TSA, and intrinsically safe TSA tension sensors.
Output	Output for measurement External setting power supply Power supply for external setting
Output	Tension value voltage output (0 to 10VFS (1 mA or less)) Current output for tension value meter (0 to 1mA/FS)
Output	0 to 10V (1 mA or less), 4 to 20mA (470Ω or less) 0 to 24V (4A or less)
Output	10V(30 mA or less)
Contact output	Zero tension output Minimum diameter output Automatic control output
Contact output	Number of outputs, 3 (DC30V 0.2A, AC200V 0.2A)
Input	Sensor input MB/MG/Intrinsically safe TSA tension sensor (connected to terminal Nos. 13 to 20) MC/CD/MJ/CJ/TSA tension sensor (connected to terminal Nos. 33 to 40)
Analog input	External tension setting External manual output setting
Analog input	Number of inputs, 2 (0 to 5V, input resistance 100kΩ)
Analog input	Analog diameter (for Taper and Start level) New shaft diameter (for paper splicing) External start level setting External taper ratio setting
Analog input	Number of inputs, 4 (0 to 10V, input resistance 100kΩ)
Contact input	Automatic contact Memory reset contact Acceleration/deceleration contact Paper splicing contact Output ON contact Emergency stop contact or external automatic/manual selection, acceleration contact Measurement diameter reset contact Measurement diameter hold contact
Contact input	Number of inputs, 8 (12V DC, 12mA)
Input for Pulse oscillator and gate oscillator	12V DC
For speed and diameter measurement	



Tension Controller TC920V

- Free choice of actuators**  
Electromagnetic brakes and clutches, pneumatic brakes and clutches and torque motors can be used.
- Compatible with automatic paper splicing**  
The new/old spindle switching signal produces paper splicing preset output for paper splicing with little variability.
- Diameter measurement function**  
An encoder or other suitable sensor can be connected to measure roll diameter.

## TABLE OF MODELS

MODEL	TC920V	AP	MB11B	W	D	1A
TC920V	No					
AP						
TC920V	Standard type					
TC920V	With fixed power (12 V DC, 2 A)					
TC920V	50, 100N					
TC920V	200N					
TC920V	50, 100N					
TC920V	200N					
TC920V	500N					
TC920V	1kN					
TC920V	2, 3kN					
TC920V	5kN					
TC920V	10kN					
TC920V	100N					
TC920V	200N					
TC920V	500N					
TC920V	1kN					
TC920V	2kN					
TC920V	1kN					
TC920V	100, 200N					
TC920V	0.5, 1kN					
TC920V	1kN					
TC920V	2, 3kN					
TC920V	5kN					
TC920V	200N					
TC920V	500N					
TC920V	1kN					
TC920V	50N					
TC920V	200N					
TC920V	500N					
TC920V	1kN					
TC920V	200N					
TC920V	1kN					
TC920V	200N					
TC920V	1kN					
TC920V	Intrinsically safe explosion-proof model					
TC920V	TSA Tension Sensor					
TC920V	No					
TC920V	Yes					
TC920V	No					
TC920V	Yes					
TC920V	Bilateral sensing					
TC920V	Unilateral sensing: total sensing by one sensor					
TC920V	EN40-1A					
TC920V	EN40-1B					
TC920V	TB800					
TC920V	TB820					
TC920V	BB100					
TC920V	No					

Models, MB05, MB11, MB25 are equipped with wall mounting brackets



## FUNCTION

### Loop Gain Correction Circuit Provides Excellent Responsiveness and Stability

#### Tension Signal Converter

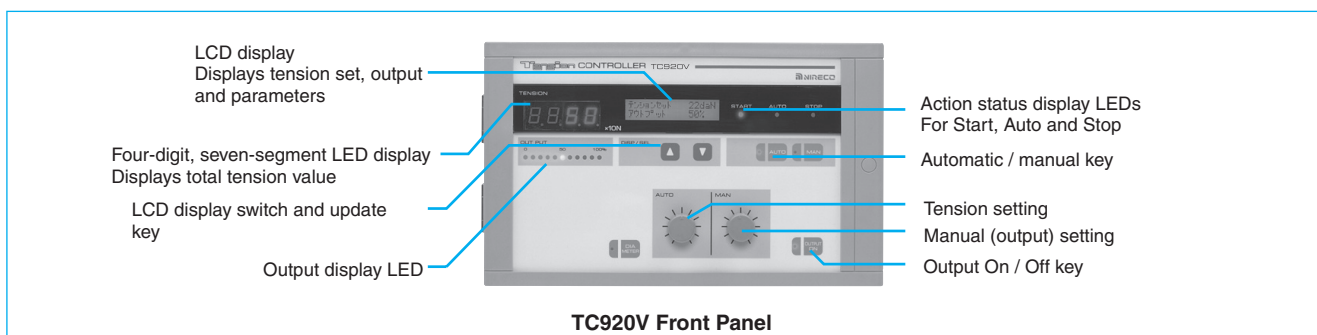
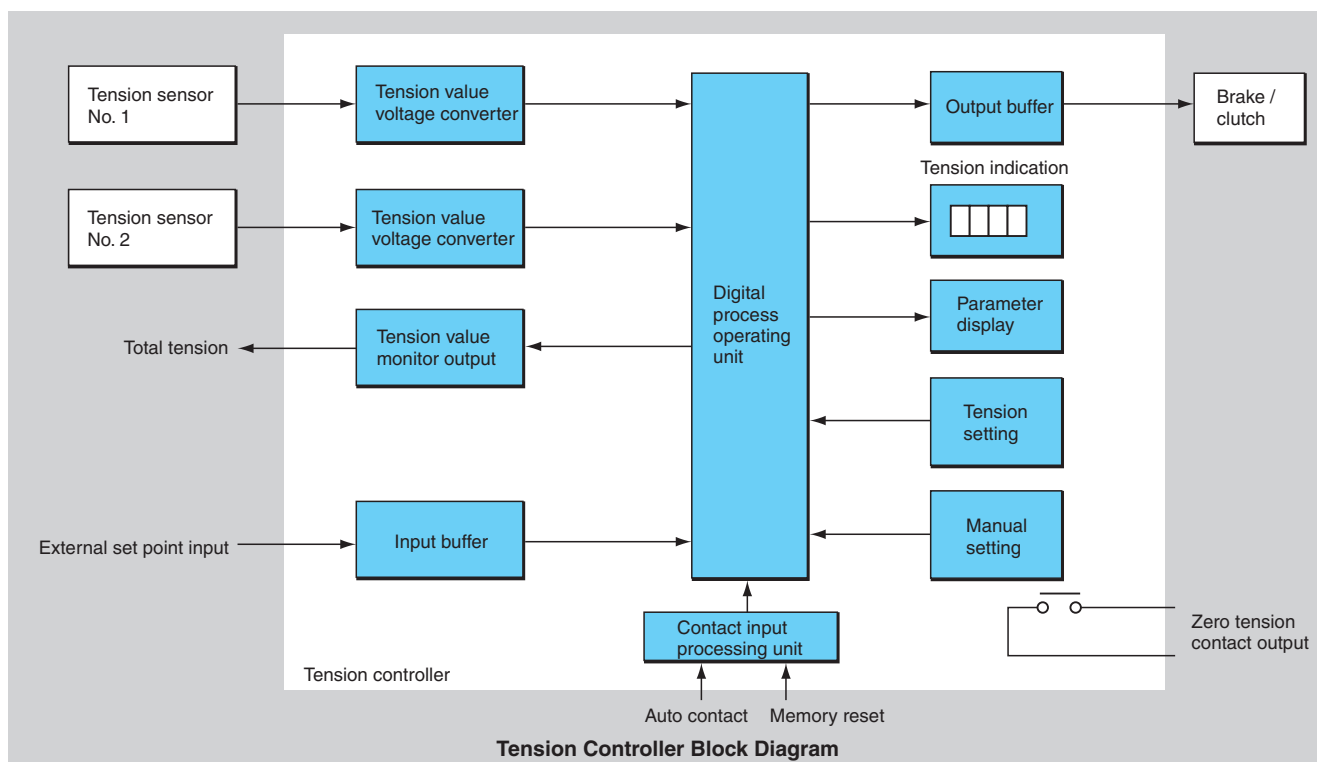
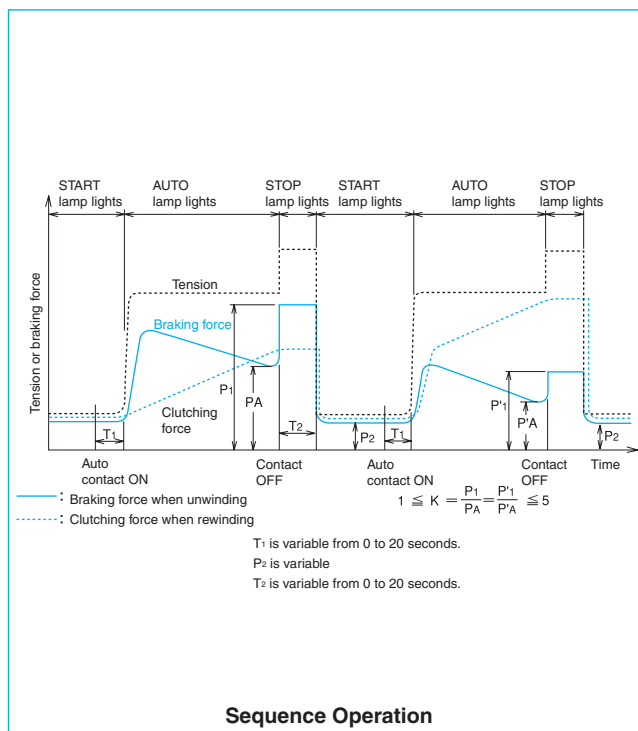
Digitally display the sum or product of the No. 1 and No. 2 tension sensor tensions.

#### Control Calculator

A control calculator compares the tension signal from the tension display with the target tension, and reduces any variation. Additionally, the ever-popular constant loop-gain control delivers superb control stability and responsiveness, regardless of coil diameter.

#### Output Amp

When the magnetic brake/clutch on the final control element is used, the power of the control signal is increased, and output at 0 to 24 V (4A). When the air brake/clutch is used, 4 to 20 mA is output to the electro-pneumatic converter. When a torque motor is used, a 0 to 10 V (2mA) voltage signal is output to the motor driver.

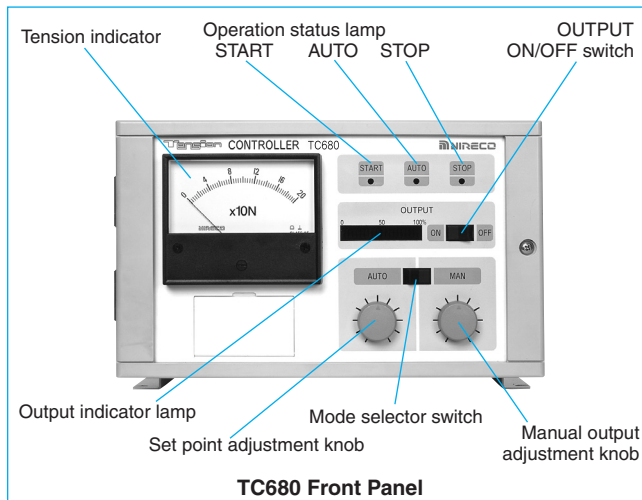


# TENSION CONTROLLER TC680A/D

This analog tension controller was designed for easy-to-use, safe control and ease of operation. This intuitive controller, with its simple functionality, is easy for anyone to use.



Tension Controller TC680 A



TC680 Front Panel

## FEATURES

### Excellent Responsiveness via Constant Loop Gain Circuit

The control circuit uses Proportional + Integral calculation, providing fast response and high accuracy. Additionally indexed calculation is used to maintain a constant loop gain, regardless of changes in diameter. This maintains high responsiveness without hunting, maintaining appropriate loop gain at all times.

### Easy to Use and Operate

The unit can be controlled automatically as long as you have an automatic machine contact. Consequently, the controller is easy for anyone to use, as long as a tension value is set. When stopped, a sequence allows the stopped output value corresponding to the diameter to be obtained.

### Tension Display

It is possible to find the total tension, as well as the tension on just one side. Select an analog or digital display to suit your preferences.

### Wide Range of Applications

Fits the final control elements of a large number of applications, including air brakes/clutches, air motors, electro-magnetic brakes/clutches, torque motors, and magnetic coupling motors. Select the installation method to suit the location, from panel-mounted, stand-alone, or mounted.

### Connection with a wide range of tension sensors

Can be connected to the following wide range of Nireco sensors: MB, MG, MC, CD, MJ, CJ, TSA, and intrinsically safe TSA sensors

### CE Compliant

CE marking compliant product

## TABLE OF MODELS

MODEL						
TC680	A	05	MB11B	W	D	1A
TC680						
	A					
	D					
		05				
		10				
		20				
		50				
		100				
		200				
		300				
		500				
		1000				
			MB05B			
			MB05A			
			MB11B			
			MB11A			
			MB25B			
			MB25A			
			MB33B			
			MB33A			
			MB41			
			MG010			
			MG020			
			MG050			
			MG100			
			MG200			
			CD20			
			MC05			
			MC20			
			MC30C			
			MC30B			
			MC30A			
			CJ200			
			CJ500			
			CJ1000			
			MJ050			
			MJ200			
			MJ500			
			MJ1000			
			TSA200			
			TSA1000			
			TSA200S			
			TSA1000S			
			No			
			W			
			No			
			W			
				D		
				S		

#### NOTES:

- The digital display makes no distinction for the maximum scale.
- Models MB05, MB11, MB25 are equipped with wall mounting brackets.

## FUNCTION

### ① Tension Indicator

This section amplifies the signals from the No. 1 and No. 2 sensors of the MB Tension Sensor and adds them for display at the tension indicator. The amplified signals are also then fed to the PI control section.

### ② PI Control Section and Exponential Operation

The signal output from the adder section is compared with the "set" signal. If there is a deviation between these two signals, the PI section performs operations to reduce the deviation. These operations are both P (proportional) and I (integral). Integral action eliminates "offset" (Target value and detected value should not match), providing the exceptional stability of the system. The function of exponential operation is to maintain the loop gain constant, regardless of changes in web roll diameter. Therefore, better response and stability can be maintained.

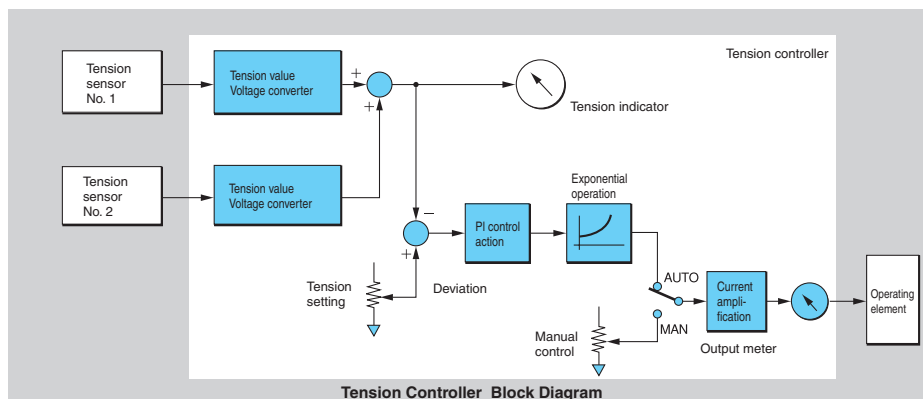
### ③ Sequence Operation

This operation applies proper timing to the controller operation by START and STOP timers. The start timer is used to

set the proper waiting time (variable between 0 to 20 seconds) on start for the machine operation to enter into automatic operation. The stop timer is used to determine the duration of the stopping break (variable between 0 to 20 seconds) in proportion to the coil diameter on stopping of the machine.

#### ④ Current Amplifier Section

When the actuator used is an electromagnetic clutch or brake, the output signal current is amplified (0-4A) before it is transmitted. When a pneumatic brake or clutch is used, the output of 4-20mA is converted into an electro-pneumatic air pressure of amplified flow for transmission to the clutch or brake.



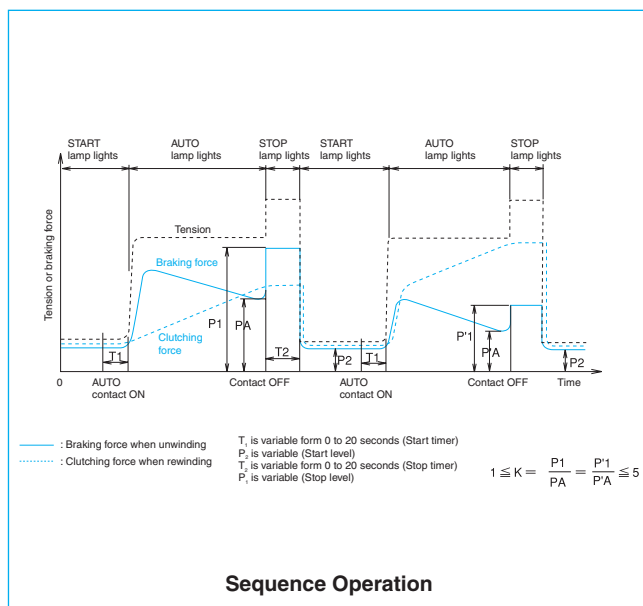
## SPECIFICATIONS

Power voltage		AC100 to 240V 50/60Hz
Power consumption		320VA (Rush current 60A (200V))
Over voltage category		II
Current capacity		1.6A (200V)
Mass		5 kg
Environment	Ambient temp.	0 to +50 °C
	Ambient hum.	35 to 85% RH or less (no condensation)
	Vibration	3.5 mm, 1G, 3 to 150 Hz, 3 directions (1 hour)
	Power noise	2,000 Vp-p, normal mode, common mode 50 nS, 1 uS
	Atmosphere	No liquid water or flammable or corrosive gas, with low dust levels
Air pollution degree		2
Rated tension		50, 100, 200, 500, 1000, 2000, 3000, 5000, 10000 N (The scale of the rated tension display is changed to show the various tensions.)
Connectable Tension Sensors		MB/MG tension sensor or MC/CD/MJ/CJ/TSA/Intrinsically safe TSA tension sensor
Output	Control Output	0 to 10V (max.5mA), 4 to 20mA 0 to 24V (max.4A)
	Display Output	0 to 10V (max.1mA), 0 to 1mA
	Recorder Output	0 to 10V (max.1mA)
	External Tension Setting Power	10V (max.5mA)
	Contact Output	No. outputs: 1 (30 V DC; 0.2A) Zero tension
Input	Sensor Input	Shared pins MB/MG/Intrinsically safe TSA tension sensor(connect to pins 1 to 4 & 17 to 20) MC/CD/MJ/CJ/TSA tension sensor (connect to pins 3 to 6 & 19 to 22)
	External Tension Setting Input	0 to 10V, input resistance 20 kΩ
	Contact Input	Auto contact (12 V DC; 10 mA)

## ■ SEQUENTIAL OPERATION

Tension controllers of the TC series incorporate a sequence circuit which allows for automatic control via start and stop contact signals from the machine.

As shown in the sequence operation diagram, when the machine is stopped, the maximum brake force P1 (break force proportional to the roller diameter) is applied for several seconds (T2). Following this, the large unwinding roller stops on the spot and brake force becomes the minimum (P2) and thereby waits for restarting of operation. When the machine starts, automatic operation is established in several seconds (T1).



# TENSION METER TM340

Our new TM340 tension meter is compatible with Nireco's entire line-up of tension sensors (MB, MG, MC, CD, MJ, CJ, TSA, Intrinsically safe TSA ) and displays their tension readings.

The display range is from 0 to 10 kN (1,000 x 10 N). The tension signal output (0 to 10 V (0 to 5 V), or 4 to 20 mA) can be output to a sequencer, indicator, recorder or other device. By using the new communications function (RS485), the tension meter can be linked to a PC or other receiver, so that the operating state of the equipment can be monitored remotely.

## GENERAL

The Tension Meter TM340 quantitatively measures the tension of a running web in manufacturing and processing lines of webs such as film, textile and rubber.

Nireco tension sensors that have good accuracy and responsiveness are used. These sensors electronically measure the tiny changes that vary in proportion to the web tension. The TM340 tension meter then adds and amplifies the sensor signals and indicates the tension.

## FEATURES

### Enhanced operability through digital processing

When initializing, various parameters can be set via a dialogue system.

### Auto-zero control function

Zeroing the sensor can be done at the touch of a button.

### Correction functions

Auto-zero, auto-span and other adjustment functions can easily be made.

### Communication function

The TM340's communication function (RS-485) enables connection to a PC to allow remote monitoring.



Tension Meter TM340

## SPECIFICATIONS

Power source voltage	TM340 DC : DC24V (*1) TM340 AC : AC100 to 240V 50/60Hz
Power consumption	25VA
Ambient temperature operating range	0 to +50 °C
Ambient humidity	80% or less (no condensation)
Sensor power supply	+6V, ±15V
Input	2 inputs: Any Nireco sensor from the MB, MG, MC, CD, TO, MJ, CJ, TSA, Intrinsically safe TSA series
Output	Voltage output: 4 outputs: for control(*2), for recording (No. 1, No. 2, Total) Current outputs: 2 outputs.. for control(*2) and for an indicator
Warning output	2 tension upper limits or left and right tension comparisons, lower limit warning outputs
Communications function	RS485 (2 line half duplex, 9600 bps independent protocol)(Transmit the tension value to host)
Installation	Panel mounting
External dimensions	(W)48×(H)96×(D)150
Mass	0.4kg

Note 1: CE: DC specifications only

Note 2: When using an output for the controller, only one output can be selected: either voltage output or current output.

# TENSION METER TM310T

Tension meter TM310T is compatible with Nireco's entire line-up of tension sensors (MB, MG, MC, CD, MJ, CJ, TSA, Intrinsically safe TSA) and displays their tension readings.

The display range is from 0 to 10 kN (1,000 x 10 N). The tension signal output (0 to 10 V (0 to 5 V), or 4 to 20 mA) can be output to a sequencer, indicator, recorder or other device.

## GENERAL

The Tension Meter TM310T quantitatively measures the tension of a running web in manufacturing and processing lines of webs such as film, textile and rubber.

Nireco tension sensors that have good accuracy and responsiveness are used. These sensors electronically measure the tiny changes that vary in proportion to the web tension. The TM310T tension meter then adds and amplifies the sensor signals and indicates the tension.

## FEATURES

- **Enhanced operability through digital processing**  
When initializing, various parameters can be set via a dialogue system.
- **Auto-zero control function**  
Zeroing the sensor can be done at the touch of a button.
- **Correction functions**  
Auto-zero, auto-span and other adjustment functions can easily be made.
- **Communications function**  
The TM310T's communication function (RS-485) enables connection to a PC to allow remote monitoring.



Tension Meter TM310T

## SPECIFICATIONS

Power source voltage	TM310T DC : DC24V TM310T AC : AC100 to 240V 50/60Hz
Power consumption	25VA
Ambient temperature operating range	0 to +50 °C
Ambient humidity	80% or less (no condensation)
Sensor power supply	+6V, ±15V
Input	Any Nireco sensor from the MB, MG, MC, CD, TO, MJ, CJ, TSA, Intrinsically safe TSA series
Output	Voltage output: 4 outputs: for control(*1), for recording (No. 1, No. 2, Total) Current outputs: 2 outputs.. for control(*1) (4 to 20 mA) and for an indicator (1 mA)
Warning output	2 tension upper limits or left and right tension comparisons, lower limit warning outputs
Telecommunications function	RS485 (2 line half duplex, 9600 bps independent protocol)
Installation	Attached to the DIN rail
External dimensions	(W)110×(H)90×(D)70.5
Mass	1.2kg

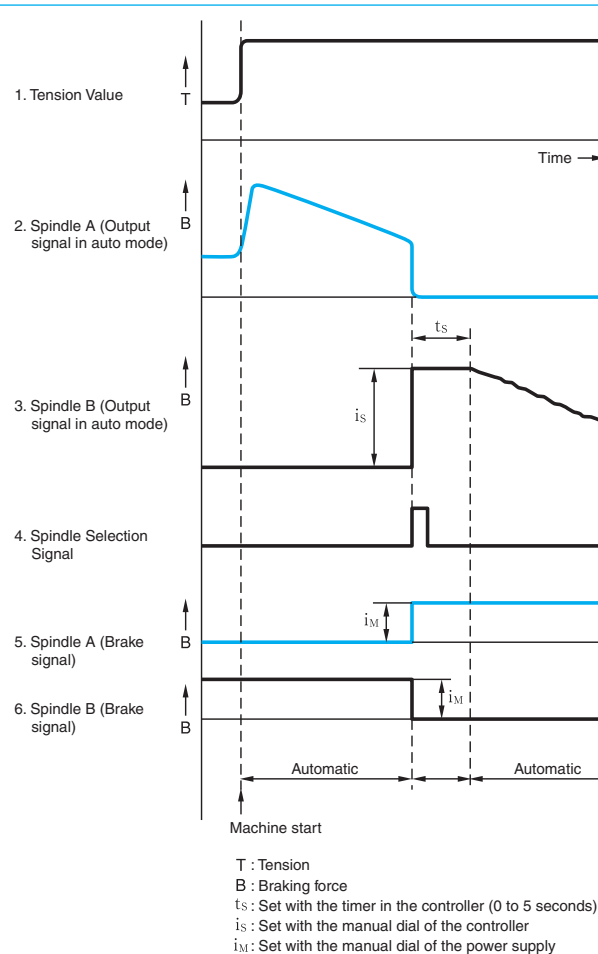
Note 1: When using an output for the controller, only one output can be selected: either voltage output or current output.

# AUTOMATIC PASTER TENSION CONTROLLER TC920V

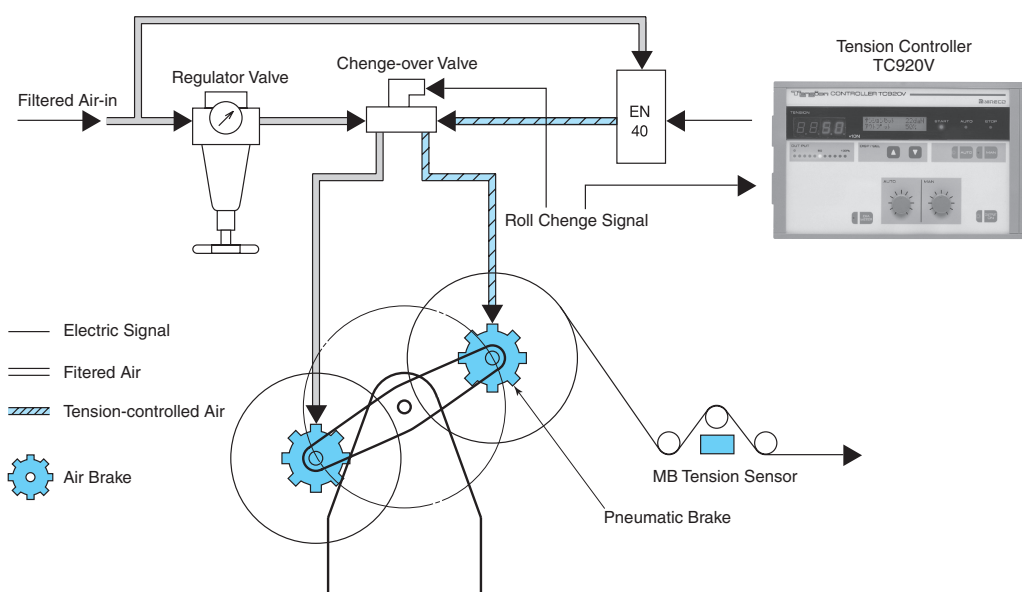
This tension controller is equipped with a function which eliminates tension value changes due to base paper mass during automatic splicing, enabling trouble-free high-speed splicing.

## GENERAL

This section describes the air-brake method of operation. The controller's output signal is sent to the air brake of the rewinding reel via EN40 (see Auto Booster Configuration drawing). When splicing, a reel-change signal is sent to the controller and switching valve, automatically initiating a sequence to switch the controller output to the new reel, and at the same time bringing the old reel to a fast halt by applying the halt brake via air pressure from the pressure-relief valve. The torque level of the new reel is uniquely set by the tension setting and initial rewind diameter. Note that a bumpless circuit is employed for smooth splicing.



Automatic Paster Sequence Action Diagram



Automatic Paster configuration diagram



# OPEN LOOP TENSION CONTROL SYSTEM

TCD030

The TCD030 is a controller for controlling the tension of a web at the unwinder or winder, without using a tension sensor. The roll diameter is calculated by using a signal from a gate generator mounted on the winding/unwinding reel, and a control signal corresponding to the change in the roll diameter is delivered.

## GENERAL

### Non-contact detection of roll diameter

The roll diameter is detected without any contact being made using a gate generator attached to a winding/unwinding reel. Therefore, the material is not exposed to damage.

### Easy to operate

It is operated just by setting the roll radius and the web thickness.

### Stop output circuit incorporated

A stop output signal is generated when stopping an unwinder. The reel is stopped without slackening the web.

### Applicable to various brakes/clutches

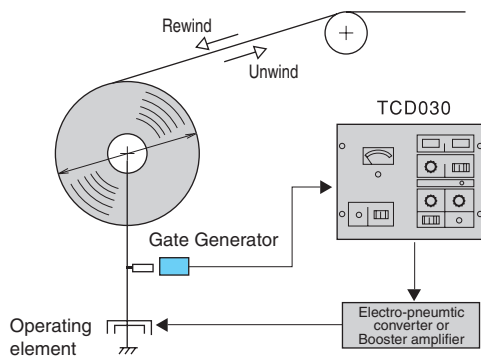
It is available with voltages of 0 to 10V and currents of 4 to 20 mA for control outputs. Combined with a converter, it can control an electromagnetic brake/clutch or an air brake/clutch.

### Applicable to very thin webs as well as to very thick webs

The web is available in thicknesses of 1  $\mu$ m to 9.99 mm.



Tension Controller TCD030



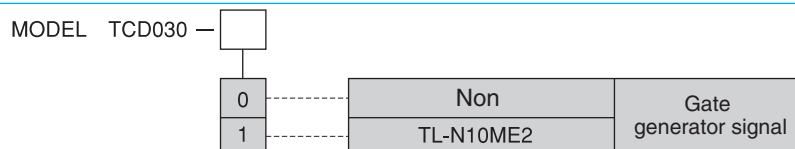
Combination of brake/clutch and converter

Brake/clutch	Converter	Reference position
Air brake/clutch	Electro-pneumatic converter: EN40	P.26 to P.28, P.48 to P.50
Electromagnetic brake/clutch	Booster amplifier: TB800 or TB820	P.29, P.51

## FEATURES

Radius setting	Radius: 1 to 999 mm (internal setting)
Thickness settings	0.01 to 9.99 mm or 1 to 999 mm
Control output	0 to 10V (5 mA) and 4 to 20mA DC
Gate generator input	"0": 0 to 1 V or less (10 mA) "1": 10 to 12 V 12 V system rectangular wave; one pulse per revolution of a winding/unwinding reel
Contact input	Start signal and stop signal Contact switching capacity: 15 V DC, 30 mA or more.
Power supply	100/110/200/220 V AC 10%, 50/60Hz
Power consumption	5VA
Ambient temperature	0 to +50°C
Mass	1.7kg

## MODELS CODE

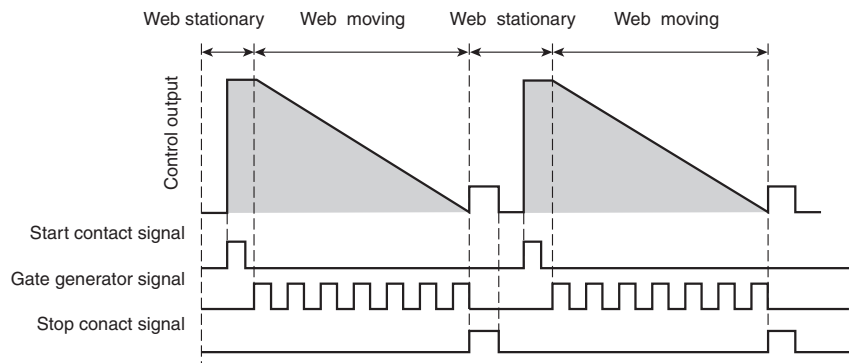


Note: An electro-pneumatic converter and a booster amplifier are not in the model code. Order them separately.

## Function

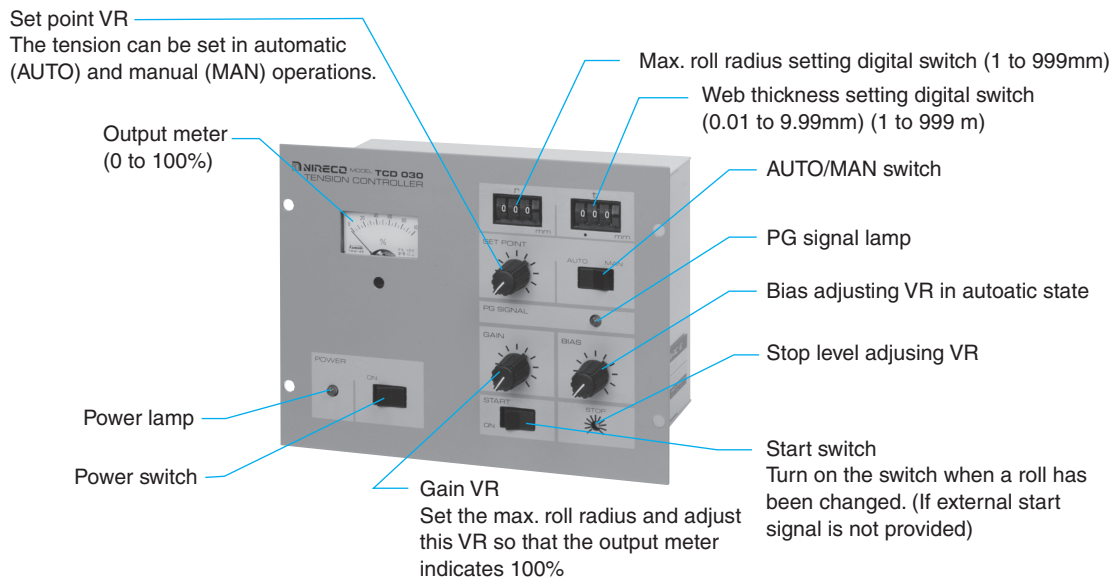
### SEQUENCE CONTROL

The TCD030 automatically controls web tension using start signal and a stop signal for the machine. When no start signal is supplied externally, turn on the START switch at the front panel with the timing shown in the figure to the right. The same sequence operation can be activated. However, the stop signal must be entered externally.



Sequence diagram (example of unwinding)

### FRONT PANEL



Front panel of TCD030

# OPEN LOOP TENSION CONTROL SYSTEM TCD050

The TCD050 is a controller for controlling the tension of a web at the unwinder or winder, without using a tension sensor. The roll diameter is calculated by using signals from two generators mounted on the winding/unwinding reel, and a control signal corresponding to the change in the roll diameter is delivered.

## GENERAL

### The roll diameter can be measured

The roll diameter is indicated on the indicator while a signal of 0 to 5 V is issued. The TCD050 can be used for other applications such as external taper signals for a closed-loop controller.

### Not necessary to use gears

The roll diameter is calibrated internally. It is not necessary to use gears between the measure roll and the pulse generator.

### The sequence control makes operation easy

Since a stop signal that is proportional to the roll diameter is output when the line stops, the web is prevented from slackening.

The re-start level allows smooth re-starting because the stop level immediately before the line stops is stored. In addition, the start level can be set manually with the manual VR by resetting this stored stop level with the reset contact.

### Applicable to various brakes/clutches

The control output is available at a voltage of 0 to 10 V and a current of 4 to 20 mA. Using them, the TCD050 can control an electromagnetic brake/clutch and an air brake/clutch.

### Taper tension can be controlled

In addition to the constant tension control, the taper tension can be controlled.



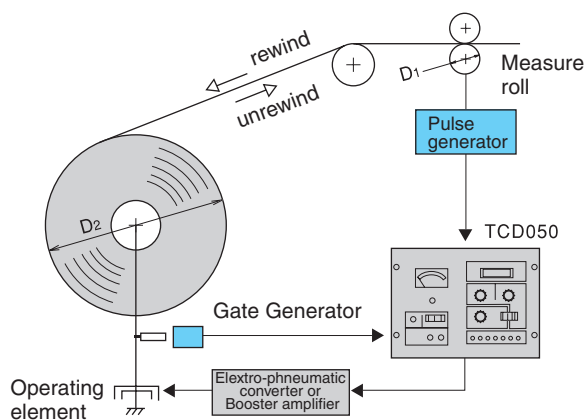
Tension Controller TCD050

### Compact unit

This compact unit can be panel-mounted. It can be easily installed in the control panel.

### Non-contact detecting system

The non-contact detecting system allows the TCD050 to measure the roll diameter without causing any damage. In addition, it is not necessary to make a roll space for attaching a sensor, which is required with other control systems.



In the figure to the left, the tension value can be obtained from the following formula (1).

$$T = \frac{2\tau}{D_2} \quad (1)$$

T : Tension;  $\tau$  : Brake/clutch torque;  $D_2$  : Roll diameter

Constant tension control is available by measuring the roll diameter ( $D_2$ ) and controlling the brake/clutch torque corresponding to the roll diameter. The roll diameter can be obtained from the following formula (2).

$$D_2 = D_1 \frac{P_n}{P} \quad (2)$$

P : No. of pulses generated by the pulse generator per revolution of the measuring roll.

$P_n$  : No. of pulses generated by the pulse generator per revolution of the roll.

$D_1$  and  $P$  are known constants. The roll diameter  $D_2$  can be obtained by counting  $P_n$ .

Combination of brake/clutch and converter

Brake/clutch	Converter	Reference position
Air brake/clutch	Electro-pneumatic converter: EN40	P.26 to P.28, P.48 to P.50
Electromagnetic brake/clutch	Booster amplifier: TB800 or TB820	P.29, P.51

## SPECIFICATIONS

Maximum roll diameter		500, 1000, 1500 mm
Outputs	Control output	0 to 10 V (5mA) and 4 to 20 mA DC
	Roll diameter output	0 to 5 V (2mA) /maximum diameter
	Power supply of pulse generator	12 V DC. 150 mA 15 V DC. 150 mA
Inputs	Gate generator and pulse generator inputs	"0": 0 to 1 V or less (10 mA) "1": 10 to 12 V 12V system rectangular wave; one pulse per revolution of a winding/unwinding reel.
Contact input		Reset signal, stop signal and output hold signal Contact switching capacity: 15 V DC, 30 mA or more.
Mass		2.6 kg
Power supply		100/110/200/220 V. 50/60Hz
Power consumption		5 VA
Ambient temperature		0 to +50 °C

## MODEL CODE

TCD050-  -

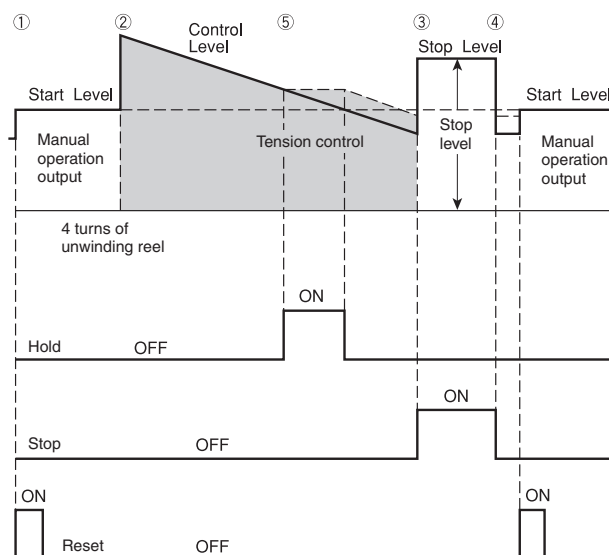
05			500mm	Maximum roll diameter
10			1000mm	
15			1500mm	
	00		Not provided	Pulse generator
	11		No. of pulses 100P/rev*1	
	12		No. of pulses 200P/rev*2	
	20		With wheel	
		0	Not provided	Gate genrator
		1	TL-N10 ME2	

Notes. 1. An electro-pneumatic converter and booster amplifier are not included in the model code. Order them separately.  
2. A maximum roll diameter of more than 1500 mm is available.  
3.\*1 : For a measure roll diameter of 0 to 150 mm.  
\*2 : For a measure roll diameter of 151 to 250 mm. In this case, the measure roll is coupled directly to the encoder.

## SEQUENCE CONTROL

The TCD050 automatically controls web tension using a reset contact signal and a stop contact signal for the machine. The sequence is as follows.

- ① The reset (RESET) contact is made to reduce roll slip at the same time when the machine starts, and the output becomes the start level that has already been set with the manual VR.
- ② The output becomes the control level to control the tension after the winding/unwinding reel has rotated four turns.
- ③ The output becomes the stop level when the stop (STOP) contact is made at the same time as the machine stops.
- ④ The output becomes the level immediately before the machine stops by turning off the stop contact after the roll has stopped.
- ⑤ If you want to maintain that output during operation, make the hold (HOLD) contact.



## Sequence control

Current roll diameter during unwinding or winding is indicated.

### Power Switch

Power lamp

PG signal lamp



- Output indicator
  - The control output is indicated as 0 to 100%

- Taper VR

- Set point VR
- For setting tension

- AUTO/MAN switch

- Manual operation switch

- Mechanical loss correcting VR

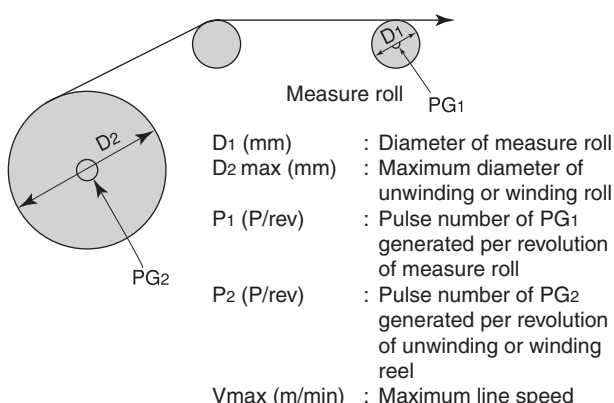
## Re-adjusting VR

- Stop level adjusting VR

### Front pannel of TCD050

## SELECTING THE NUMBER OF PULSES

The number of pulses is selected as follows in the configuration shown in the figure below.



Find the number of pulses generated per revolution of the pulse generator. (The pulse generator should rotate one turn for one revolution of the measure roll.)

- Select  $P_1$  so that  $D_1/P_1$  can be close to 1.

$$0.5 < \frac{D_1}{P_1} < 1.5 \dots \dots \dots (1)$$

- Check if the controller can count the number of pulses. When the full scale of the diameter is 1500:

$$\frac{D_2 \text{ max}}{D_1} \times P_1 \leq 2000 \dots \dots \dots (2)$$

When the full scale of the diameter is 1000:

$$\frac{D_2 \text{ max}}{D_1} \times P_1 \leq 1500 \dots \dots \dots (3)$$

When the full scale of the diameter is 500.

$$\frac{D_2 \text{ max}}{D_1} \times P_1 \leq 1000 \dots \dots \dots (4)$$

- Make sure that the frequency  $f_1$  of the pulses generated by the pulse generator at the maximum speed is less than 8 kHz of the maximum response frequency of the TCD050 to  $PG_1$ .

$$f_1 = \frac{V_{\text{max}}}{\pi D_1} \times \frac{1000}{60} \times P_1 \leq 8 \text{ [kHz]} \dots \dots \dots (5)$$

Ex.) If the case of  $D_1=175$  mm,  $D_2\text{max}=1000$  mm,  $V_{\text{max}}=800\text{m/min}$ , and  $P_2=1\text{p/rev}$ , install the gate generator to generate one pulse per revolution of the unwinding reel, and find  $P_1$ .

For formula (1), when  $P_1$  is 200:

$$\frac{175}{200} = 0.875$$

From formula (3),

$$\frac{1000}{175} \times 200 \div 1143 \leq 1500$$

From formula (5),

$$f_1 = \frac{800}{3.14 \times 175} \times \frac{1000}{60} \times 200 \div 4853 \leq 8000$$

From the above results, the number of pulses per revolution of the pulse generator can be determined to be 200 (P/rev) if the pulse generator is directly coupled to the measure roll.

## TENSION SYSTEM WITH INTRINSICALLY SAFE CONSTRUCTION TENSION SYSTEM

A tension system with intrinsic anti-explosion construction should be used in factories where gravure rotary presses, coaters, laminators and other devices use solvents and there is a danger of explosion.

### GENERAL

The system locates the MB Tension Sensors, brakes and clutches in the danger area and the tension controller in a risk-free area, separated by a Zener barrier.

Name	Model	Notes	Reference position
TSA Tension Sensor	TSA***S		P.6 to 7
MB Tension Sensor	MB***.S		P.10 to 11
Tension Meter		Standard specification model	P.18 to 19
Tension Controller		Standard specification model	P.14 to 17
Electro-pneumatic Converter	EN40-**S		P.26 to 28
Zener barrier box		For MB Tension Sensor	P.48
		For TSA Tension Sensor	P.33
		For Electro-pneumatic converter	P.50

	TSA Tension Sensor	MB Tension Sensor	Electro-pneumatic converter
Inspection pass number	No.TC20121	No.T39500	No.C16096
Explosion grade and flammability	EX ia2 II C T4 X	1G3	IIBT4



Zener Barrier Box

## ELECTRO-PNEUMATIC CONVERTER

EN40

When the air brake or air clutch is used to control tension, the tension controller output current signals are converted into pneumatic signals by the electro-pneumatic converter.



Electro-pneumatic Converter EN40

### OVERVIEW

The EN40 electro-pneumatic converter uses the characteristics of moving coils and nozzle flappers to convert electrical input signals into air pressure signals.

The EN40 produces air pressure output signals that have excellent linearity and frequency characteristics. The built-in volume booster means that the EN40 can supply various pneumatic devices with the necessary air volume and pressure. Through remote control, the range of application of the EN40 to industrial pneumatic equipment can be widened.

### Features

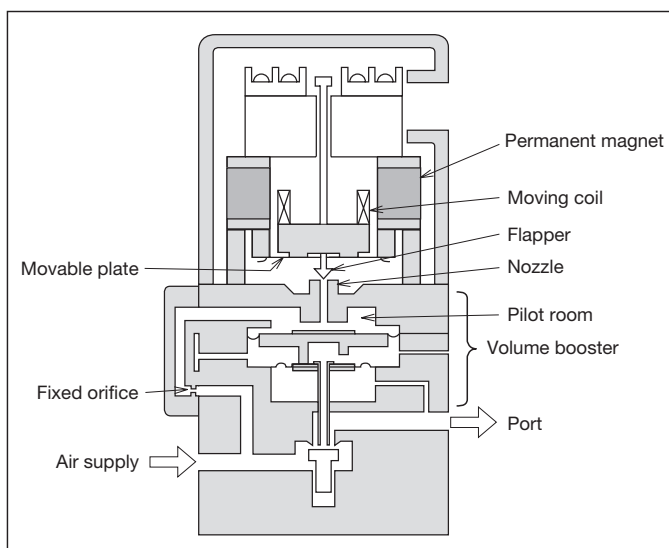
- **Enables the remote operation of pneumatic equipment**  
Pneumatic equipment can be operated remotely because their control signals are sent as electrical signals.
- **Excellent linearity and frequency response**  
The air pressure is proportional to the electric current, enabling various kinds of industrial pneumatic devices to be operated.
- **Built-in volume booster**  
The EN40 has an internal volume booster that has excellent flow characteristics, enabling the direct control of ordinary industrial pneumatic devices.
- **Compact and can be fitted with a manifold**  
The EN40 is small and is designed to take up very little space. A manifold can be fitted.
- **Even if the source pressure changes, the output is hardly affected at all**  
In the standard model, if the source pressure changes by 0.1 MPa, the output air pressure variation will be within 3%. This variation is even less with the pilot stabilizer model.
- **A high-quality plastic resin is used for the case and construction**  
A plastic resin with excellent strength and environmental durability (resistant to chemicals and weather) is used.

### OPERATING PRINCIPLE

The Electro-Pneumatic Converter Model EN40 converts a current signal into a proportional pneumatic output and incorporates a volume booster to assure the flow-rate and the pneumatic pressure required by pneumatic industrial equipment. The mechanism which converts a current signal into the corresponding pneumatic signal consists of a nozzle-flapper and moving coil that can move freely in the magnetic field. The moving coil is coupled with the flapper via the moving plate so that the gap between the nozzle and the flapper varies.

The current through the moving coil causes a downward force that is proportional to the current, reducing the gap between the nozzle and the flapper, and raising the nozzle back pressure.

The force which the flapper receives from the nozzle back pressure is balanced by the force of the moving coil at a certain flapper displacement. The nozzle back pressure is proportional to the current. The flow-rate and pneumatic pressure are amplified with a volume booster and are fed to the operating unit.





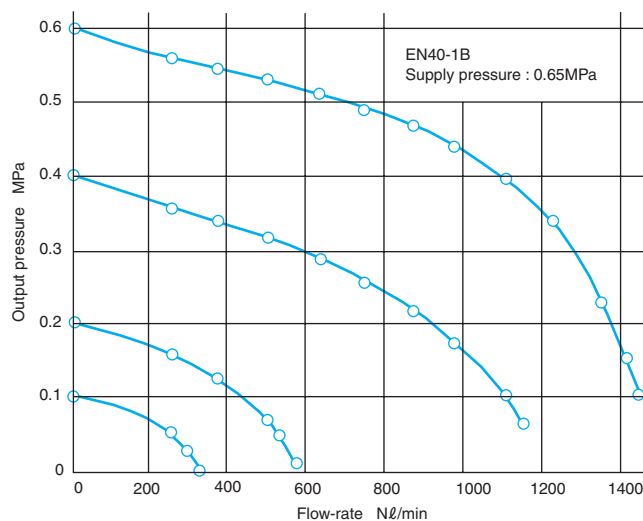
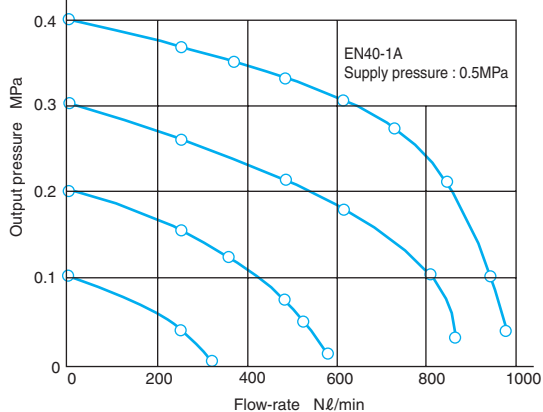
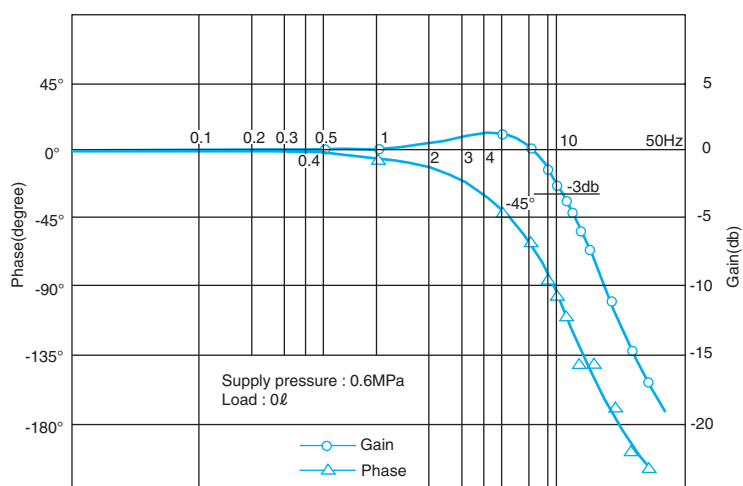
## SPECIFICATIONS

MODEL		EN40-1A-V	EN40-1B-V	EN40-2B-V	EN40-5B-V	EN40-6C-V	EN40-1AS-V	EN40-1BS-V	EN40-2BS-V	EN40-5BS-V	EN40-6CS-V
Input current	mA DC	4 to 20	4 to 20	10 to 50	0 to 16	0 to 20	4 to 20	4 to 20	10 to 50	0 to 16	0 to 20
Output pressure †	MPa	0 to 0.4	0 to 0.6	0 to 0.6	0 to 0.6	0 to 0.5	0 to 0.4	0 to 0.6	0 to 0.6	0 to 0.6	0 to 0.5
Supply air pressure	MPa	0.5	0.7	0.7	0.7	0.6	0.5	0.7	0.7	0.7	0.6
Air consumption *	Nℓ/min	9	12	12	12	10.5	9	12	12	12	10.5
Max. flow rate	Nℓ/min	1000	1400	1400	1400	1200	1000	1400	1400	1400	1200
Hysteresis	MPa	0.005 (1.25%)	0.007 (1.2%)	0.007 (1.2%)	0.007 (1.2%)	0.006 (1.2%)	0.005 (1.25%)	0.007 (1.2%)	0.007 (1.2%)	0.007 (1.2%)	0.006 (1.2%)
Frequency response	-3dB/10Hz, -45°/5Hz						-3dB/10Hz, -45°/5Hz				
Linearity : ±1% Load resistance (input impedance) : 450Ω max.	Material : High-density plastic foam(PBT) Appearance : Black Installation : Wall, floor or manifold mounting Ambient temperature : 0 to +60 Mass : 2.5kg						Body, case and cover material: conductive plastic resin (PBT, VC210) approval number: No. C16096 Gas or steam explosion class and ignition group: II BT4 Appearance : Black Installation : Wall, floor or manifold mounting Ambient temperature : 0 to +60 Mass : 2.5kg				

Notes. 1. Use a constant-current power supply for the input.

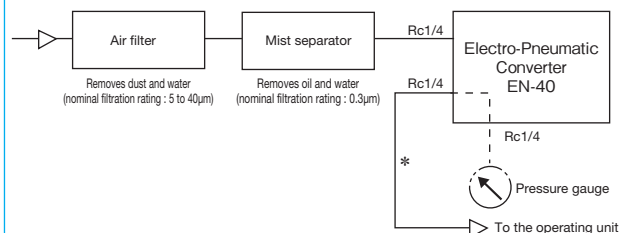
2. An asterisk (\*) mark indicates values at the maximum output pressure.

3. †: At output pressures of 0.01 MPa or lower, there is no linearity with respect to the input.



## PIPING DIAGRAM

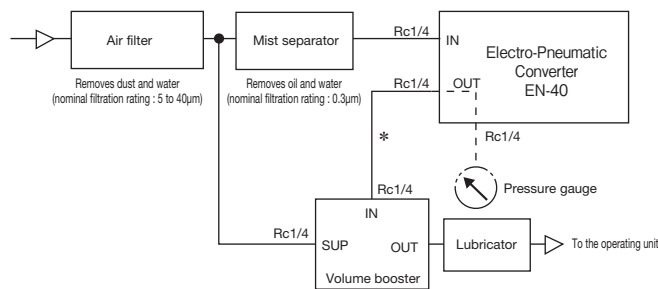
1) When the load does not require lubricant



Notes)

1. The air filter, mist separator, volume booster and lubricator should be prepared by the customer.
2. Be sure to flush out pipes laid for the air circuit.
3. The pipe length marked \* must be less than  $\phi 6 \times 1t \times 10m$

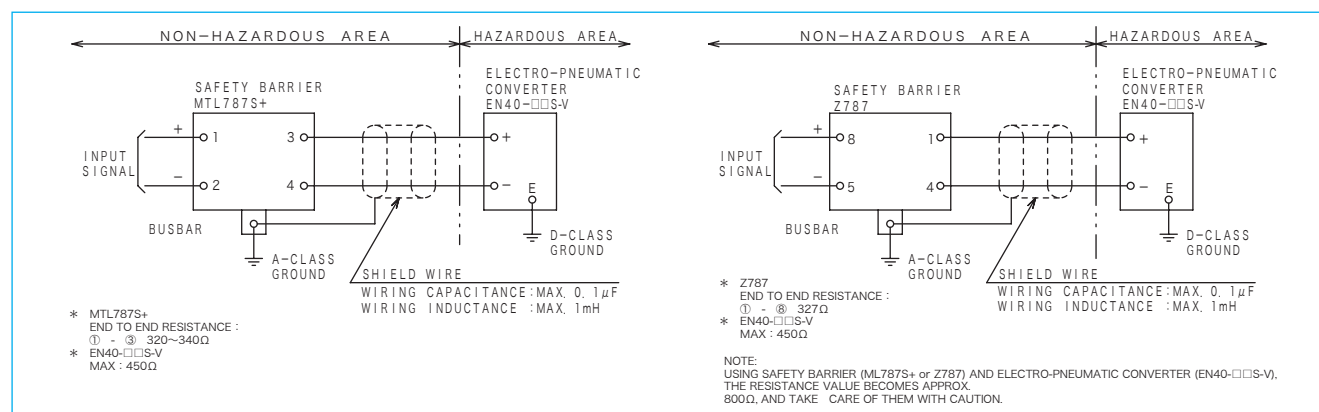
2) When the load requires lubricant



## PIPING DIAGRAM Intrinsically safe explosion-proof Electro-pneumatic converter EN40-□□S

If you plan to install an electro-pneumatic converter in an environment where there is a risk of flammable or explosive gas or steam, please use our intrinsically safe explosion-proof model.

If you do so, please install the power supply in the non-hazardous location and ensure safety by using a safety barrier to electrically isolate the converter.



## MP setter

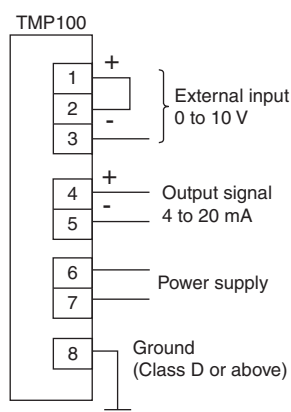
TMP100

The TMP100 MP setter is used to manually control the power supply to the electro-pneumatic converter, and can be used to manually operate various models of pneumatic operating units.

### FEATURES

- In combination with a Zener barrier, the TMP100 can control intrinsically safe explosion-proof electro-pneumatic converters.
- Can be used as a voltage-current converter.
- Can be used to manually control the power supply to other devices in the range of 4 to 20 mA.

Output signal	4 to 20 mA DC, Max. load 1 k $\Omega$
External input	0 to 10V DC
Source	100, 110, 200, 220 V AC, 50/60 Hz, 22 VA
Mass	1 kg
Ambient temperature	0 to +50°C



Note: If using an external voltage input, open (1) and (2), and connect to (1) and (3).

External wiring



MP setter TMP100

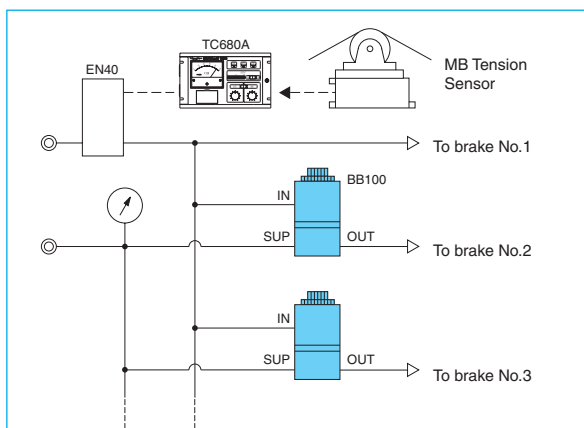
# BIASED BOOSTER

BB100

When the diameter of each paper roll of a machine with multiple paper feeds is nearly equal, as shown in the figure below, installing a tension control system using a bias-equipped BB100 booster will greatly reduce the cost of instrumentation.

## SPECIFICATIONS

Bias volume (air pressure)	-100 to + 250 kPa
Ambient temperature	0 to + 50 °C
Mass	0.8 kg
Air consumption	3 Nℓ /min
Dimensions	φ60 × 133 mm
Connection opening	R1/4



BB100

# BOOSTER AMPLIFIER

TB800, TB820

The Booster Amplifier is capable of amplifying the control signal of the tension controller into signals necessary for operating the electromagnetic and clutch.

## GENERAL

The TB800 booster amp amplifies the 0 to 10-V control signal output of the tension controller to a maximum of 6 A. Although the TB820 is used with the same purpose as the TB800, the TB820 has attenuation, bias, and AUTO/MAN operational features.

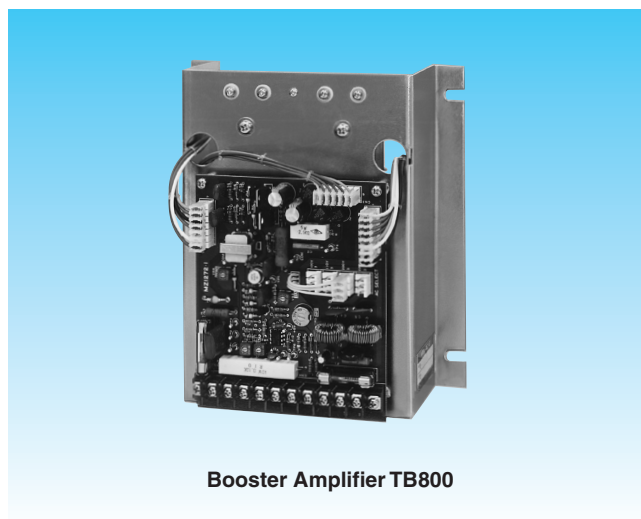
## FEATURES

Booster Amplifier TB800 (Current output type)

Input	0 to 10 V DC
Output	0 to 24V DC (6A)
Power supply	100V, 110V, 200V, 220V AC, 50/60 Hz
Power consumption	200 VA
Ambient temperature	0 to + 50 °C
Mass	5.3 kg
Size	187 (W) × 210 (H) × 110 (D) mm

Booster Amplifier TB820 (Voltage output type)

Input	0 to 8 V DC
Output	0 to 24 V DC (max. 6A)
Power supply	100V, 115V, 200V, 220V AC, 50/60 Hz
Power consumption	350 VA
Ambient temperature	0 to + 50 °C
Mass	7.7 kg
Size	230 (W) × 157 (H) × 240 (D) mm



Booster Amplifier TB800



Booster Amplifier TB820

# PULSE GENERATORS

LEC-**\*\*B-G12F**, L-1200A (SPL)

These are encoder-type pulse generators which measure the travelling length of the web. Two measuring systems are available: one system where the number of revolutions of the shaft of measure roll is measured, and the other system where the web travelling length is measured directly on the measure roll.

## Pulse Generator (Rotary Encoder)

### GENERAL

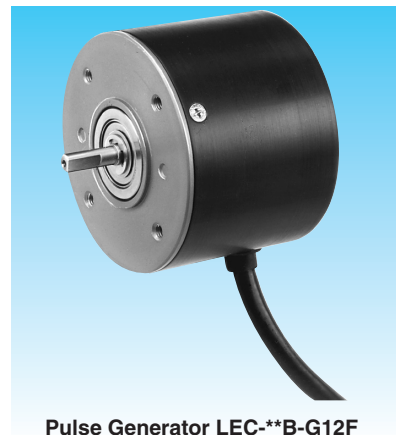
The pulse generator measures the web travel length, attached to the measure roll. Select the one that meets the following specifications.

### SPECIFICATIONS

Power supply voltage	12V DC $\pm$ 10% or 15V DC $\pm$ 10%
Current consumption	150 mA or less
Output signal	High: 10V or more, Low: 1 V or less (10mA)
Response frequency	10 kHz or more
Ambient temperature	-10 °C to +60 °C
Mass	350 g

### Model examples of pulse generators

No. of pulses	Model
100 P/rev.	LEC-10B-G12F
200 P/rev.	LEC-20B-G12F



Pulse Generator LEC-**\*\*B-G12F**

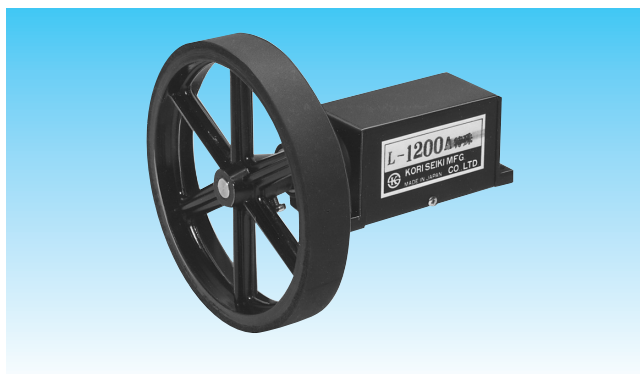
## Pulse Generator (with wheel)

### GENERAL

The pulse generator with a wheel measures the travelling volume of the web on the measure roll.

### SPECIFICATIONS

No. of pulses output	100 P/R
Power supply voltage	4.5 to 13 V DC
Current consumption	20 mA
Output impedance	2k $\Omega$
Max. torque	0.05 N/cm
Max. speed	3000 m/min.
Ambient temperature	-10 °C to +50 °C
Mass	250 g



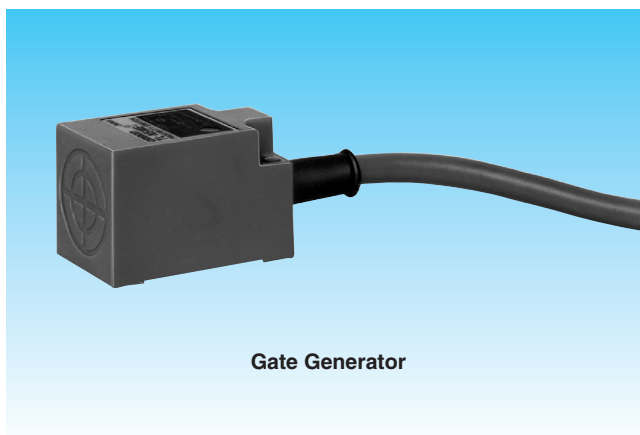
Pulse Generator L-1200A (SPL)

# GATE GENERATOR (proximity switch)

The gate generator generates pulses for measuring the roll radius.

### SPECIFICATIONS

Power supply voltage	10V DC to 30 V DC
Current consumption	10 mA or less
Output signal	High: 10V or more, Low: 1 V or less (10mA)
Response frequency	500 kHz or more



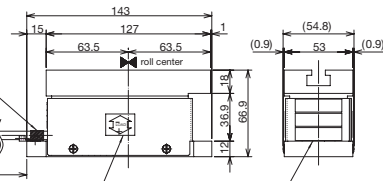
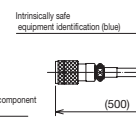
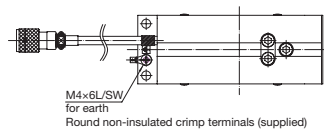
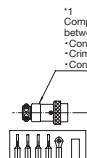
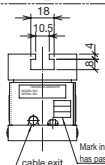
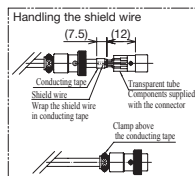
Gate Generator

**TSA Tension Sensor TSA200    Dwg. No. MD0001710 EA**

**TSA Tension Sensor TSA1000 Dwg. No. MD0001720 EA**

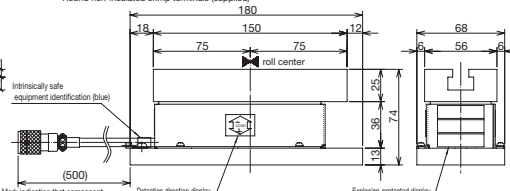
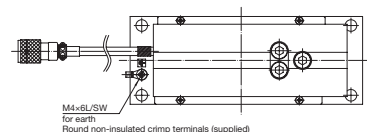
**TSA Tension Sensor TSA010K Dwg. No. MD0001730 EA**

## Ancillary Devices ■ 31



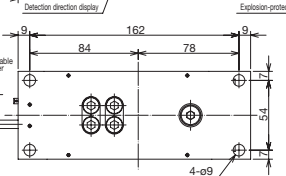
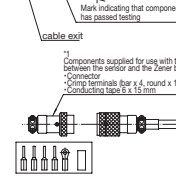
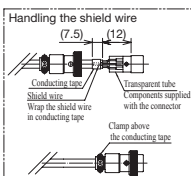
Note)  
Please refer to the Instruction  
Manual for cautions concerning  
the supplied components.

**TSA Tension Sensor TSA200S Dwg. No. MD0002660 EA**



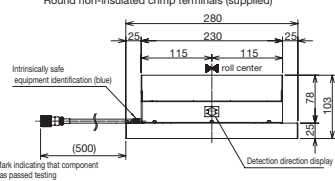
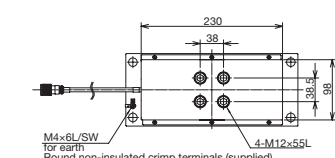
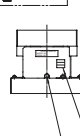
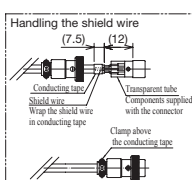
Note)  
Please refer to the Instruction  
Manual for cautions concerning  
the supplied components.

**TSA Tension Sensor TSA1000S Dwg. No. MD0002670 EA**



Note)  
Please refer to the Instruction  
Manual for cautions concerning  
the supplied components.

**TSA Tension Sensor TSA1000S Dwg. No. MD0002670 EA**

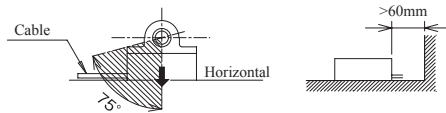


Note)  
Please refer to the Instruction  
Manual for cautions concerning  
the supplied components.

**TSA Tension Sensor TSA010KS Dwg. No. MD0002680 EA**

## • Installation method TSA010K, TSA010KS

Specifications  
Rated tension : 10000N (when detecting both sides)  
Tolerable roll mass : 700kg (when detecting both sides)  
Operating temperature range : 0-50°C  
Detector mass : 16kg  
Range of tolerable resultant tension for detection  
Based on where the cable is ensured the direction of  
the resultant tension is within the range indicated  
by the slanted lines in the diagram below.

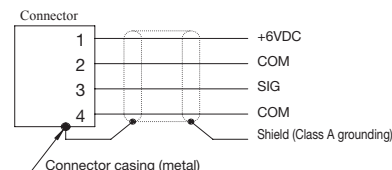


Mounting angle : 360°  
The mounting face should be flat (flatness < 0.05°). Also, thoroughly clean both sides of the mounting face (i.e., the sensor and machine sides).  
Leave a gap of at least 60mm on the cable side when mounting.

## \*1. Information about the cable between the sensor and the Zener barrier

- Use the supplied connector and crimp terminals.
- Use a 4-core shielded cable that is AWG22 or greater. Refer to the following table (figure) when wiring the connector.
- Be sure to connect the shield wire to the connector.
- The sensor's internal inductance will be 39  $\mu$ H, and its internal capacitance will be 1.78  $\mu$ F.  
The inductance and capacitance of the cable will include these values above. When you select the Zener barrier, check that these figures are within the barrier's rated values.

Connector pin numbers	Use
1	+6VDC
2	COM
3	SIG
4	COM



Caution:  
Select a cable whose total length will not exceed 50 meters from the sensor via the Zener barrier to the controller or meter.

Explosion-protected mark Ex ia II C T4 X  
"X" mark = Do not allow the tension sensor to be subjected to impacts or friction as there is the risk that it may ignite.

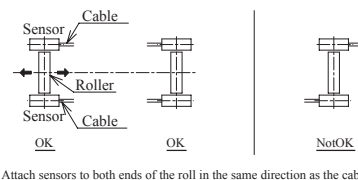
Hazardous locations where the tension sensor can be used  
Special Hazardous Locations,  
Class 1 Hazardous Locations,  
Class 2 Hazardous Locations.

Range of hazardous gas or steam in which the tension sensor can be used  
Equipment group : II C temperature class : T4.

Safety maintenance rating  
Max. allowable voltage of intrinsically safe circuit : 8.7V,  
Max. allowable current of intrinsically safe circuit : 178mA,  
Max. allowable power of intrinsically safe circuit : 0.39W,  
Internal inductance : 39 $\mu$ H,  
Internal capacitance : 1.78 $\mu$ F,  
Ambient temperature : 0°C~+50°C.

Details are contained in the Instruction Manual (QJ4123-E).  
Be sure to refer to the Instruction Manual before using.

This product is an intrinsically safe explosion-proof construction product approved by the Technology Institution of Industrial Safety of Japan. Therefore, outside of Japan, steps will need to be taken to ensure that this product meets the requirements of explosion-protection standards in the country or territory in which it is to be used.





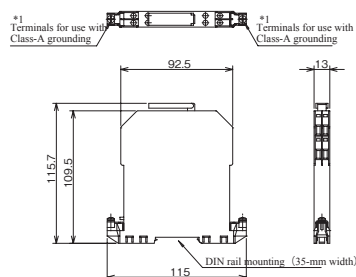
**Zener barrier box (for dual-sided detection)**  
for intrinsically safe explosion-proof TSA tension sensor  
Dwg. No. MK0001110-EA

**Name:** Intrinsically safe explosion-proof Zener barrier (TIS compatible)  
**Type:** Z961  
**Manufacturer:** PEPPERL & FUCHS  
**Specifications:** [EEx ia] IIC  
 Um=AC250V 50/60Hz, DC250V  
 Ambient temperature 60°C  
**Safety barrier rating:** Intrinsically safe circuit maximum voltage 8.7 V  
 Intrinsically safe circuit maximum current 178 mA  
 Intrinsically safe circuit maximum power 0.39 W  
 Intrinsically safe circuit allowable inductance 1.1 mH  
 Intrinsically safe circuit allowable capacitance 4.5 nF

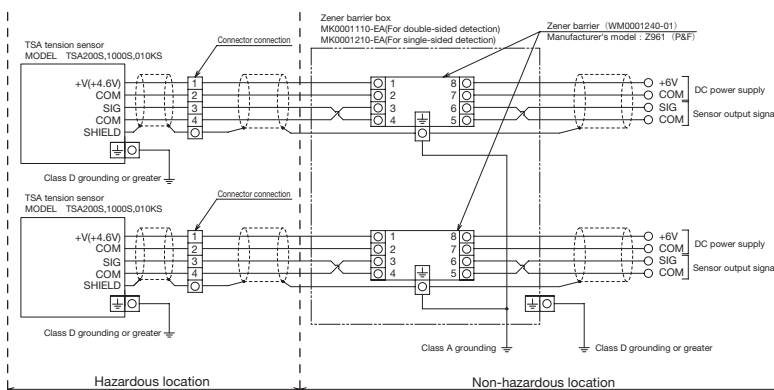
Note 1: Terminals for use with Class-A grounding are electrically connected to the DIN rail mounting brackets. Be careful when installing these terminals.

Note 2: For usage details, be sure to refer to the manufacturer's instruction manual.

Intrinsically safe circuit side (non-safe side)	Non-intrinsically safe circuit side (safe side)
Terminal number: 1, 2, 3, 4	Terminal number: 5, 6, 7, 8

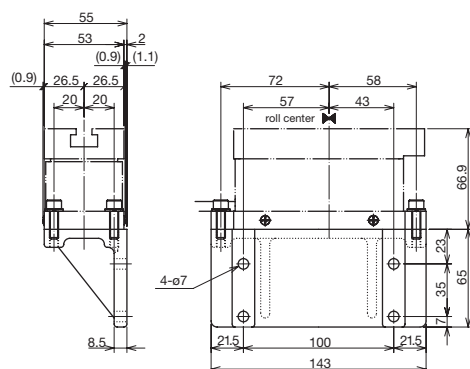


**Intrinsically safe explosion-proof Zener barrier Z961 (PEPPERL+FUCHS)**  
Dwg. No. WM0001240-01

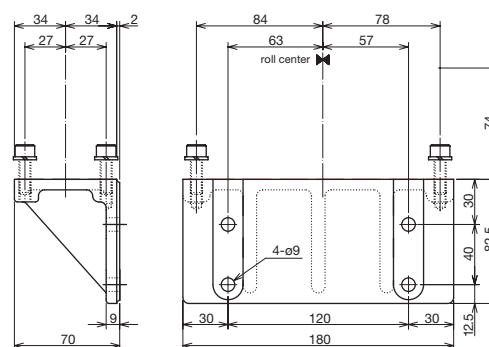


- **Notes:**
  - For single-sided detection, there will be one tension sensor-Zener barrier set.
  - The wiring for a single set will be unchanged. Install the wiring for a single set.
- **Explosion-protected mark**
  - Ex ia IIC T4 X
  - "X" mark = Do not allow the tension sensor to be subjected to impacts or friction as there is the risk that it may ignite.
- **Hazardous locations where the tension sensor can be used**
  - Special Hazardous Locations, Class 1 Hazardous Locations, Class 2 Hazardous Locations.
- **Range of hazardous gas or steam in which the tension sensor can be used**
  - Equipment group : IIC temperature class : T4.
- **Safety maintenance rating**
  - Max. allowable voltage of intrinsically safe circuit : 8.7V, Max. allowable current of intrinsically safe circuit : 178mA,
  - Max. allowable power of intrinsically safe circuit : 0.39W, Internal inductance : 39μH, Internal capacitance : 1.78μF,
  - Ambient temperature : 0°C~+50°C.
- **Details**
  - are contained in the Instruction Manual (QJ4123-E). Be sure to refer to the Instruction Manual before using.
  - This product is an intrinsically safe explosion-proof construction product approved by the Technology Institute of Industrial Safety of Japan. Therefore, outside of Japan, steps will need to be taken to ensure that this product meets the requirements of explosion-protection standards in the country or territory in which it is to be used.

Zener barrier box (for the intrinsically safe explosion-proof TSA tension sensor)  
Dwg No. RM0000470-EC



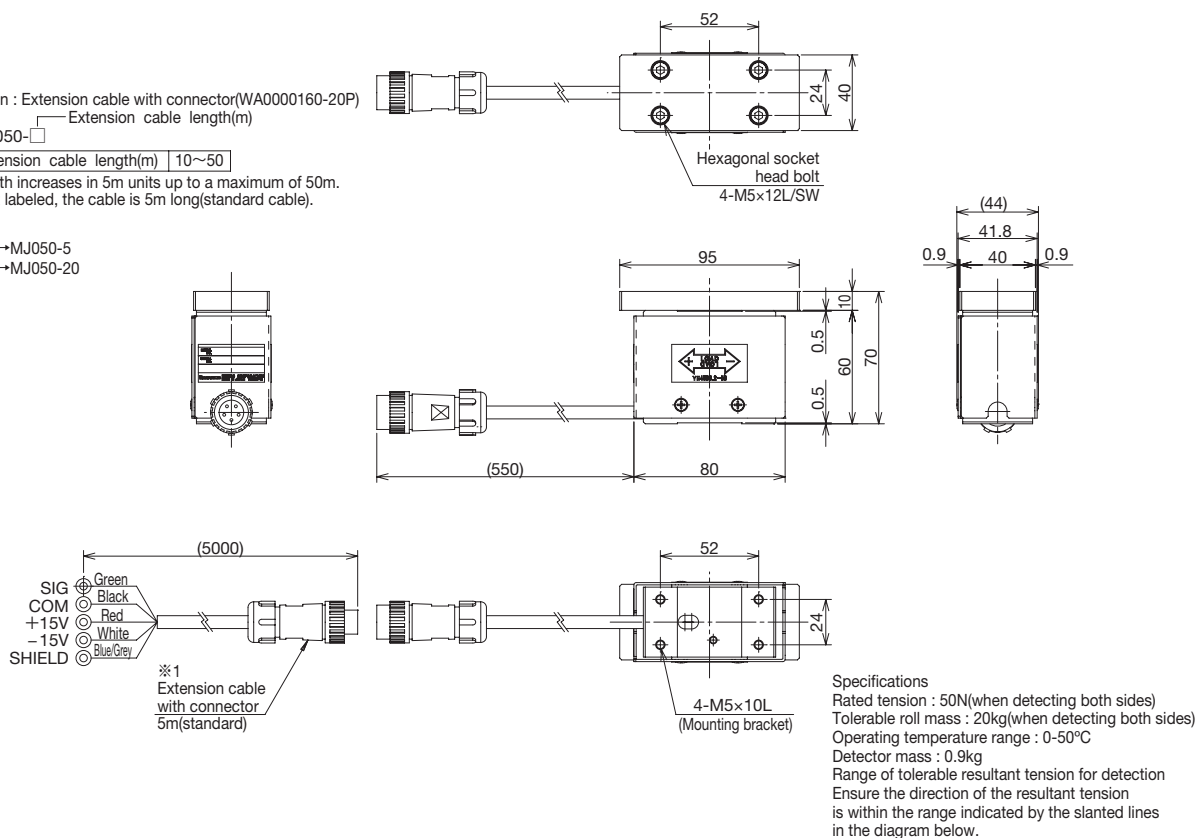
**MB11, TSA200 wall-mounting bracket Dwg. No. MW1520.0-95P**



**MB25.TSA1000 wall-mounting bracket Dwg. No. MW1521.0-95P**

※1  
Option : Extension cable with connector(WA0000160-20P)  
Extension cable length(m)  
MJ050-□  
Extension cable length(m) 10~50  
Length increases in 5m units up to a maximum of 50m.  
If not labeled, the cable is 5m long(standard cable).

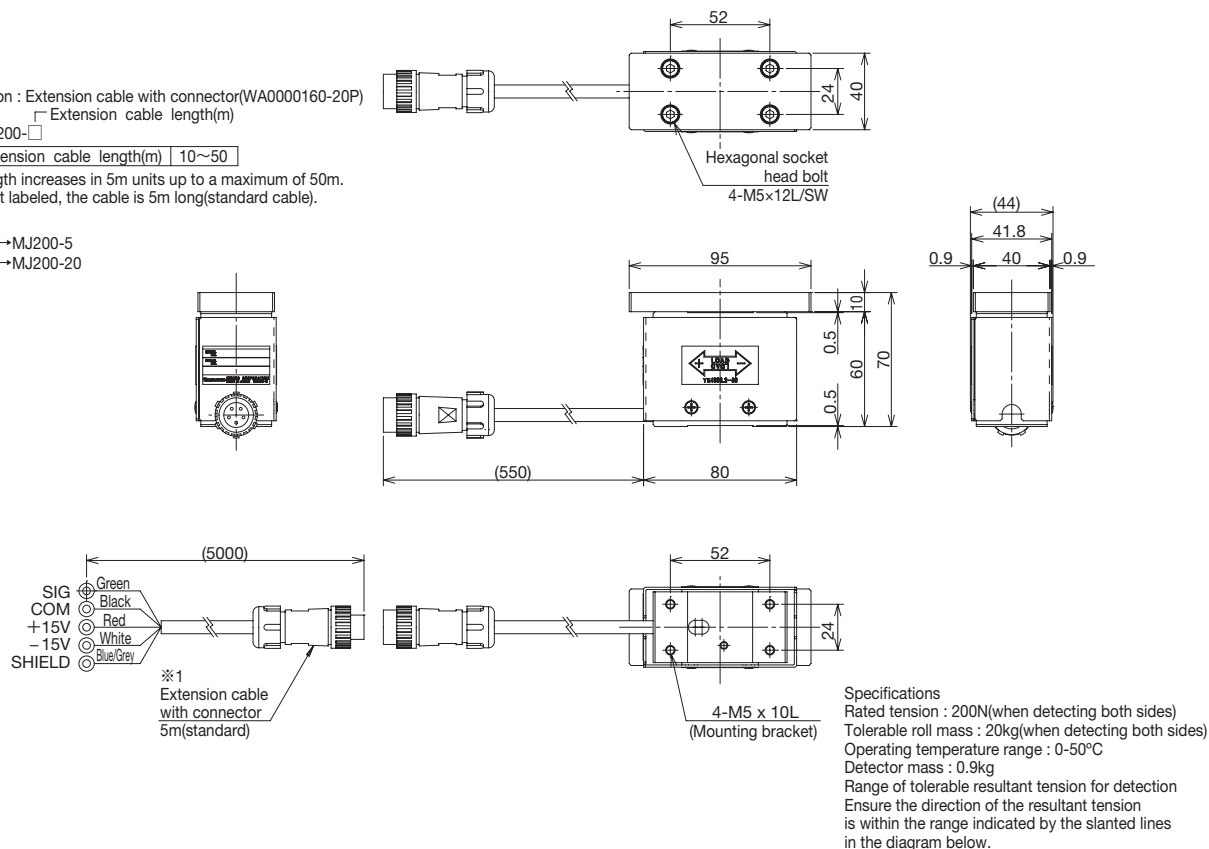
EX.  
5m→MJ050-5  
20m→MJ050-20



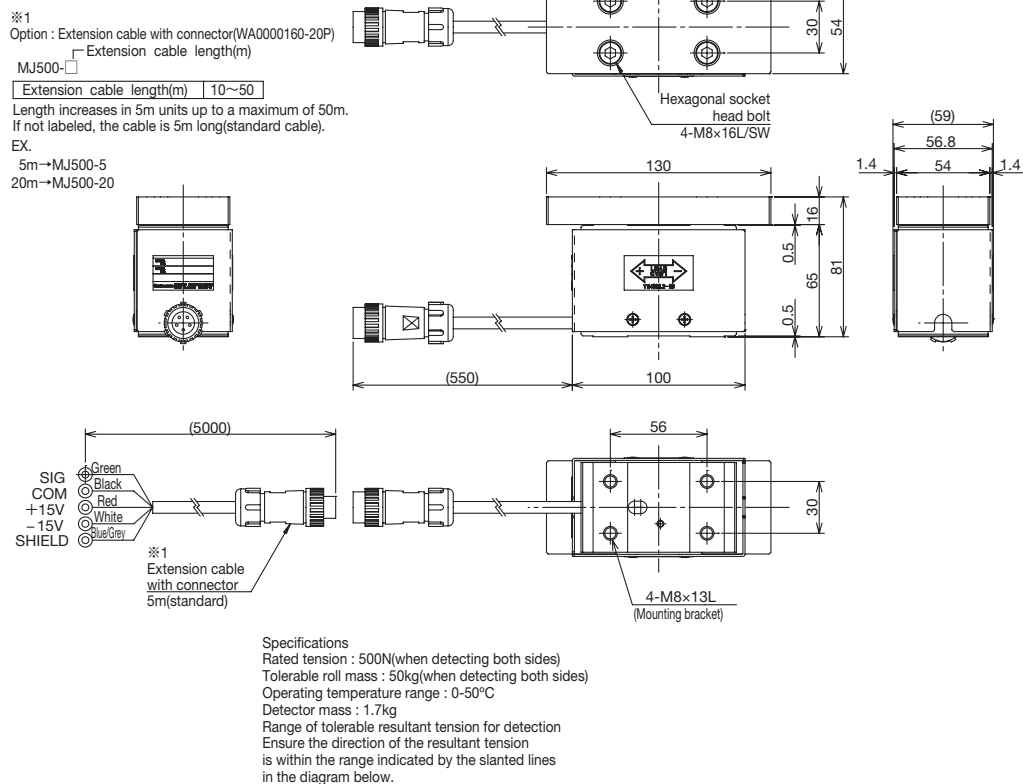
MJ Tension Sensor MJ050-□ Dwg. No. MD0000320-EA

※1  
Option : Extension cable with connector(WA0000160-20P)  
Extension cable length(m)  
MJ200-□  
Extension cable length(m) 10~50  
Length increases in 5m units up to a maximum of 50m.  
If not labeled, the cable is 5m long(standard cable).

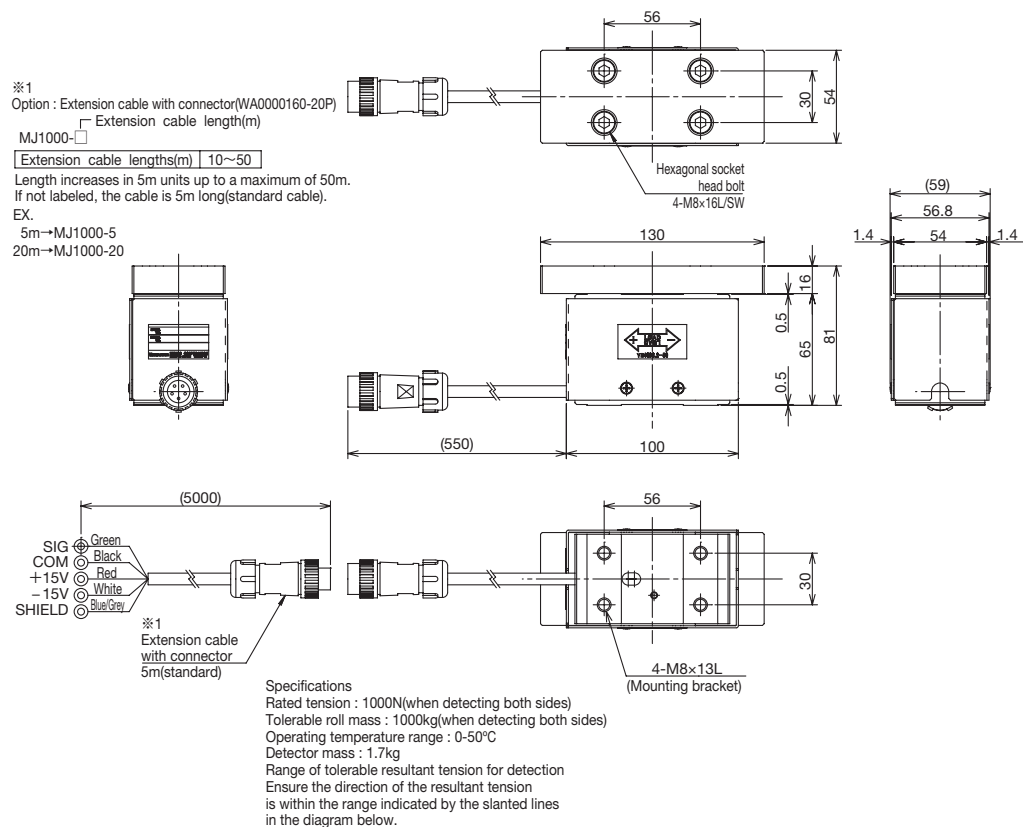
EX.  
5m→MJ200-5  
20m→MJ200-20



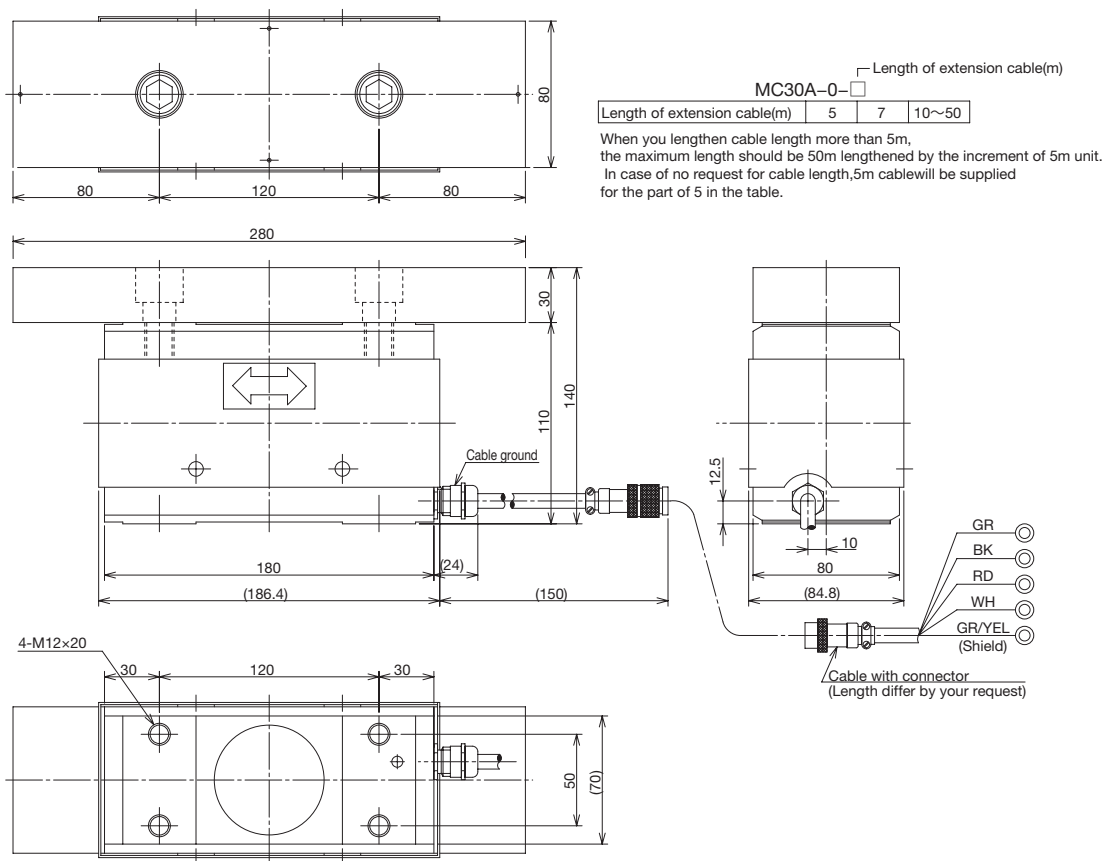
MJ Tension Sensor MJ200-□ Dwg. No. MD0000330-EA



MJ Tension Sensor MJ500-□ Dwg. No. MD0000340-EA

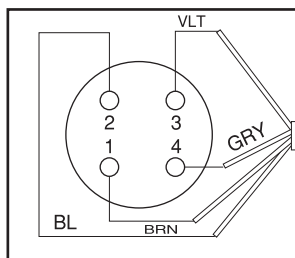


MJ Tension Sensor MJ1000-□ Dwg. No. MD0000350-EA

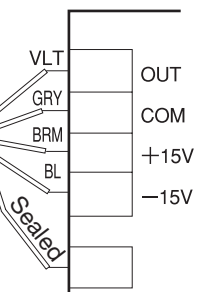


MC Tension Sensor MC30A Dwg. No. MK3183.0-EA

#### MC/CD Tension sensor No.1

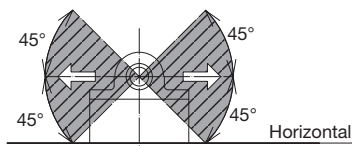


#### Tension controller



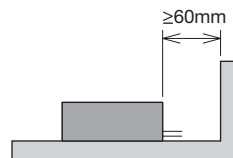
Wiring of MC tension sensor

1. Range of tolerable resultant tension for detection Ensure the direction of the resultant tension is within the range indicated by the slanted lines in the diagram below.

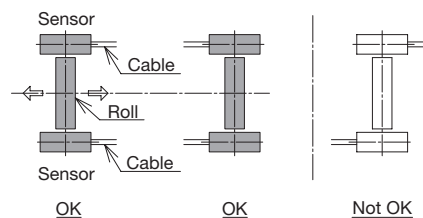


2. The mounting face should be flat. (flatness  $\leq 0.05^\circ$ ) Also thoroughly clean both sides of the mounting face (i.e., the sensor and machine sides.)

3. Leave a gap of at least 60mm on the cable side when mounting



4. Attach sensors to both ends of the roll in the same direction as the cables



5. Switch the signal polarity with respect to the forward-reverse load using the controller or at the meter.

6. Install the MJ tension sensor at a place free of vibration.

Mounting of MJ/MC Tension Sensor

※1  
Model  
CJ200-□-N  
└ OP: Extension cable length with connector(m)  
(WA0000160-20P)

Extension cable lengths(m) 10~50

Length increases in 5m units up to a maximum of 50m.  
If not labeled, the cable is 5m long(standard cable).

EX.

5m→CJ200-5-N  
20m→CJ200-20-N

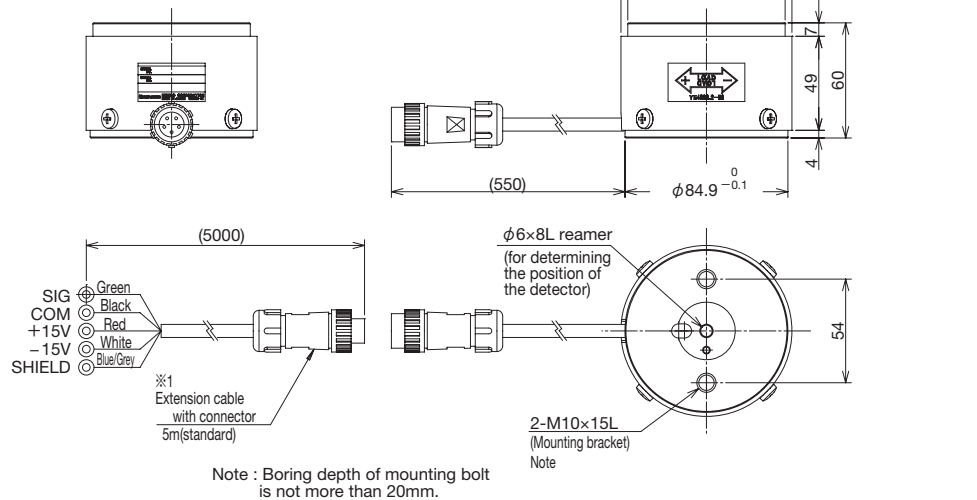
Specifications

Rated tension : 200N(when detecting both sides)

Tolerable roll mass : 20kg(when detecting both sides)

Operating temperature range : 0-50°C

Detector mass : 1kg



CJ Tension Sensor CJ200-□-N Dwg. No. MD0000360-EA

※1  
Model  
CJ500-□-N  
└ OP: Extension cable length with connector(m)  
(WA0000160-20P)

Extension cable lengths(m) 10~50

Length increases in 5m units up to a maximum of 50m.  
If not labeled, the cable is 5m long(standard cable).

EX.

5m→CJ500-5-N  
20m→CJ500-20-N

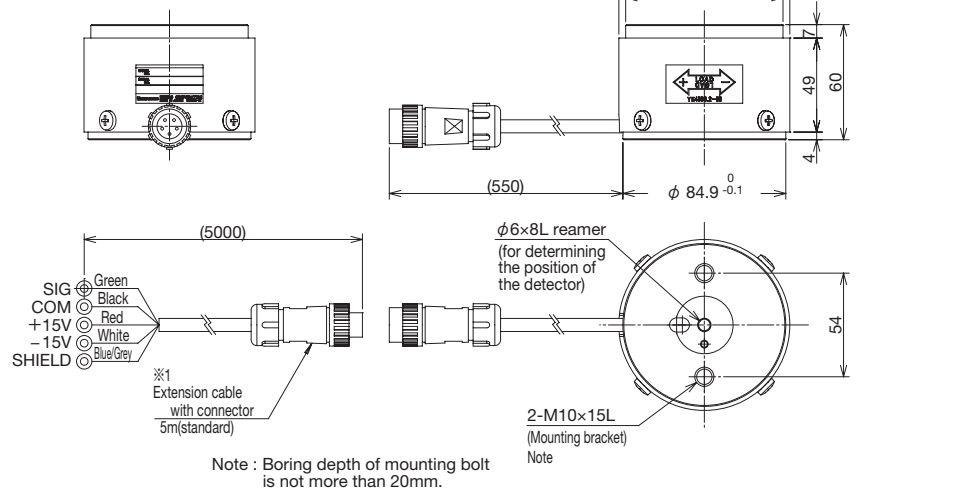
Specifications

Rated tension : 500N(when detecting both sides)

Tolerable roll mass : 50kg(when detecting both sides)

Operating temperature range : 0-50°C

Detector mass : 1kg



CJ Tension Sensor CJ500-□-N Dwg. No. MD0000370-EA

※1

Model

CJ1000-□-N

OP: Extension cable length with connector(m)  
(WA0000160-20P)

Extension cable lengths(m) 10~50

Length increases in 5m units up to a maximum of 50m.  
If not labeled, the cable is 5m long (standard cable).

EX.

5m→CJ1000-5-N

20m→CJ1000-20-N

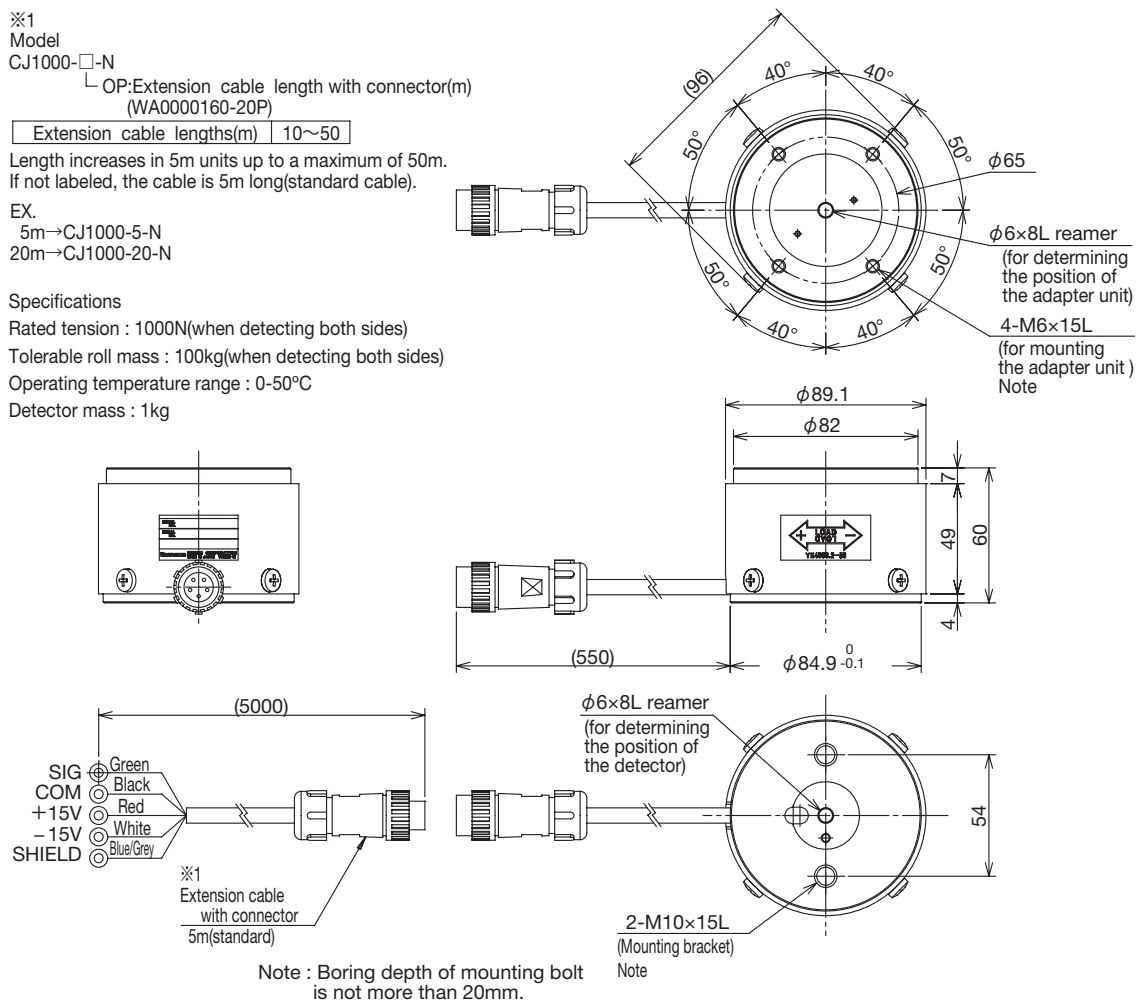
Specifications

Rated tension : 1000N (when detecting both sides)

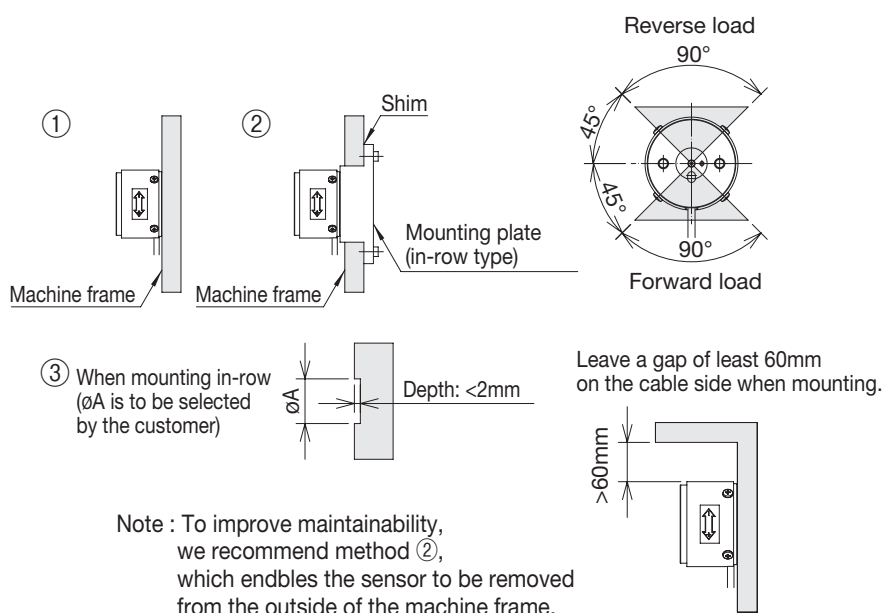
Tolerable roll mass : 100kg (when detecting both sides)

Operating temperature range : 0-50°C

Detector mass : 1kg

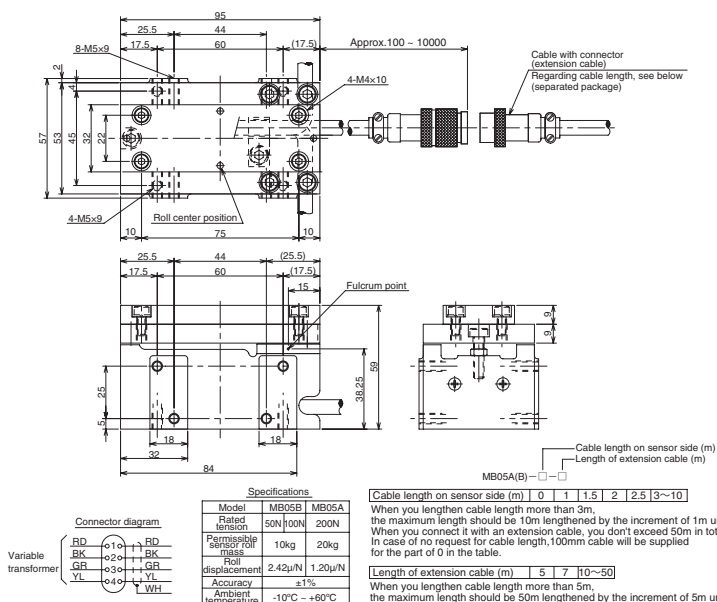


CJ Tension Sensor CJ1000-□-N Dwg. No. MD0000380-EA

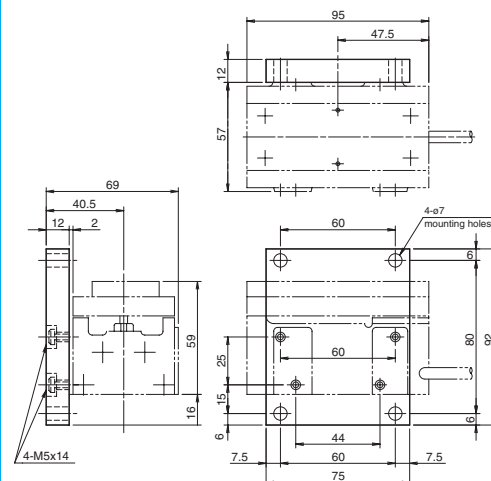


Example with CJ tension sensor mounted

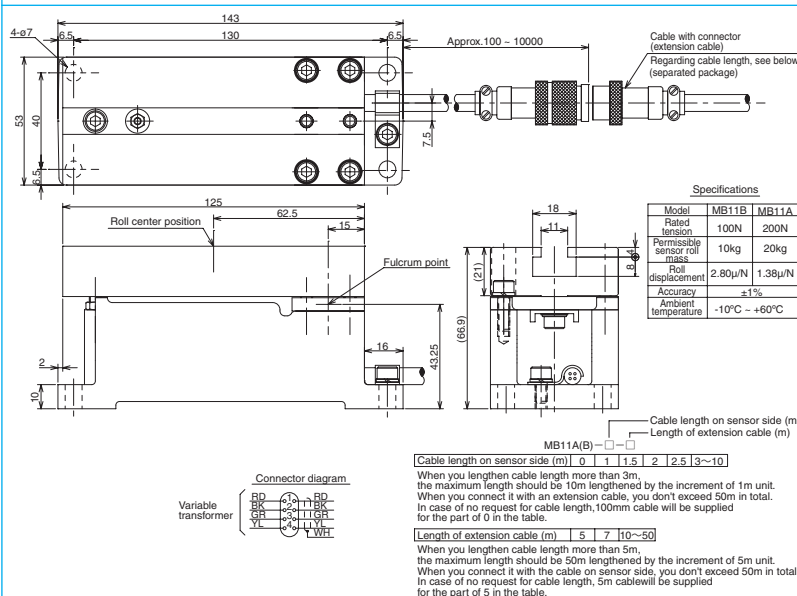




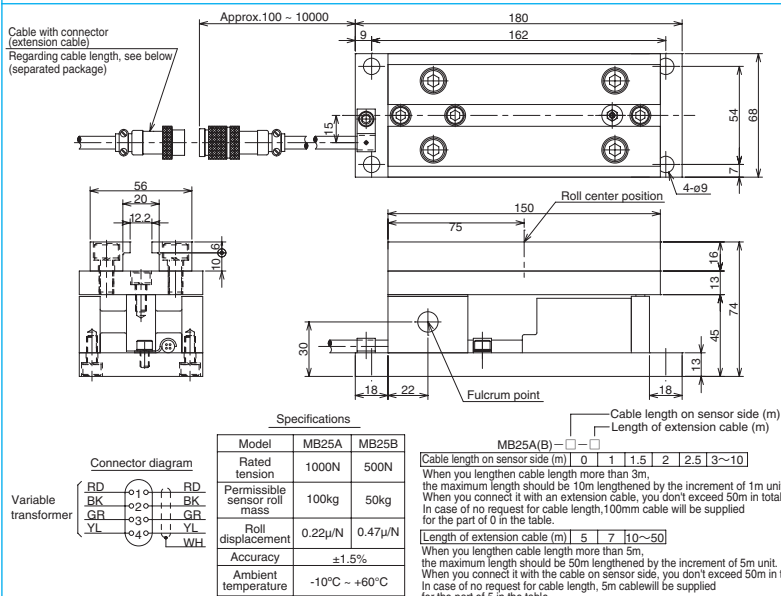
MB Tension Sensor MB05 Dwg. No. MW1519.0-EA



Wall Mounting Bracket for MB05 Dwg. No. MW1519.0-90P



MB Tension Sensor MB11 Dwg. No. MW1520.0-EA

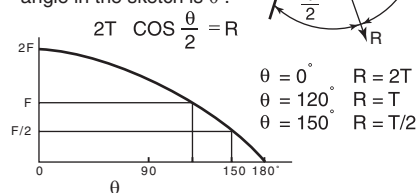


MB Tension Sensor MB25 Dwg. No. MW1521.0-EA

## MOUNTING OF MB TENSION SENSOR (1) A. MB05, B11, and MB25

### 1. Web wrap angle

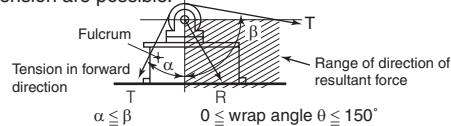
The resultant force R at tension T is as follows assuming that the wrap angle in the sketch is  $\theta$ :



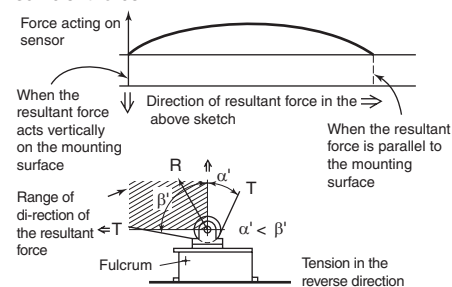
Thus, at a wrap angle  $\theta = 0^\circ$ , resultant force R is twice as much as the tension; at  $120^\circ$  it is equal to the tension; and at  $150^\circ$ , it is half of the tension.

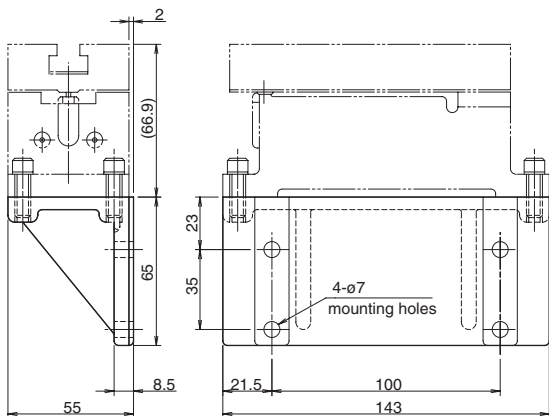
### 2. Web application and wrap angle

Both forward direction tension and reverse direction tension are possible.

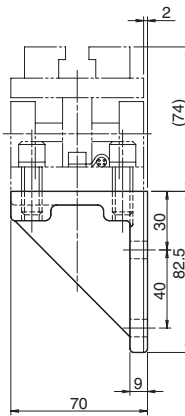


The force acting on the sensor is the moment of rotation around the fulcrum, i.e., the arrow "↓" and "→" indicate the minimum force acting on the sensor. Therefore, the intermediate portion acts as a sufficient force.

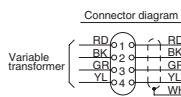
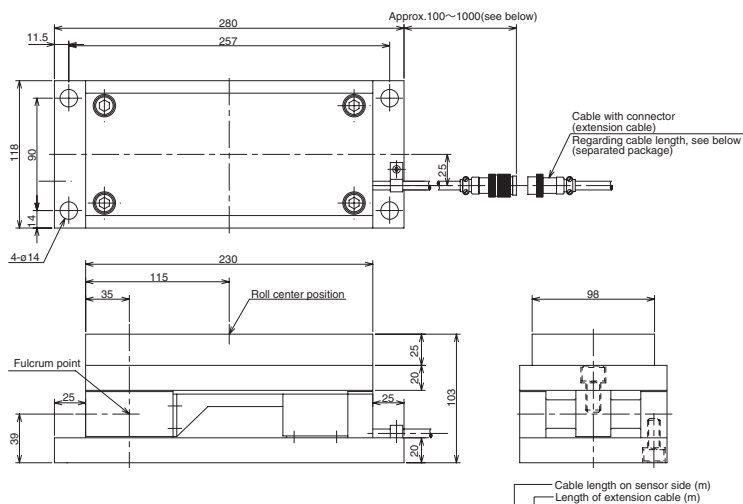




Wall Mounting Bracket for MB11 Dwg. No. MW1520.0-95P



Wall Mounting Bracket for MB25 Dwg. No. MW1521.0-95P



Specifications		
Model	MB33B	MB33A
Rated sensor roll mass	2000N/3000N	5000N
Permissible sensor roll mass	300kg	350kg
Roll displacement	0.086μN	0.057μN
Accuracy	±1.75%	
Ambient temperature	-10 ~ +60°C	

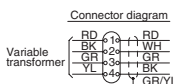
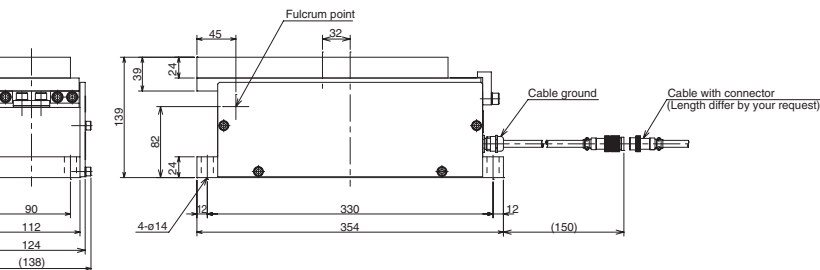
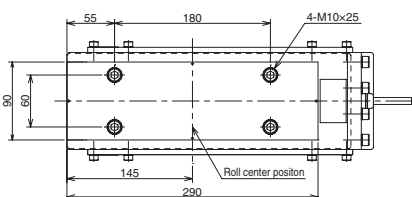
Cable length on sensor side (m) 0 1 1.5 2 2.5 3~10

When you lengthen cable length more than 3m, the maximum length should be 10m lengthened by the increment of 1m unit. When you connect it with an extension cable, you don't exceed 50m in total. In case of no request for cable length, 100mm cable will be supplied for the part of 0 in the table.

Length of extension cable (m) 1 5 7 10~50

When you lengthen cable length more than 5m, the maximum length should be 50m lengthened by the increment of 5m unit. When you connect it with the cable on sensor side, you don't exceed 50m in total. In case of no request for cable length, 5m cable will be supplied for the part of 5 in the table.

MB Tension Sensor MB33 Dwg. No. MW1522.0-EA



Specifications		
Model	MB41	
Rated tension	10kN	
Permissible sensor roll mass	700kg	
Roll displacement	0.023μN	
Accuracy	±1.75%	
Ambient temperature	-10 ~ +60°C	

Length of extension cable (m) 1 5 7 10~50

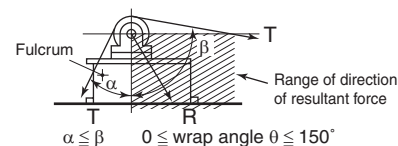
When you lengthen cable length more than 5m, the maximum length should be 50m lengthened by the increment of 5m unit. When you connect it with the cable on sensor side, you don't exceed 50m in total. In case of no request for cable length, 5m cable will be supplied for the part of 5 in the table.

MB Tension Sensor MB41 Dwg. No. MW1507.2-EA

## MOUNTING OF MB TENSION SENSOR (2) B. MB33, MB41

### 1. Web application and wrap angle

Tension in forward direction only is possible.

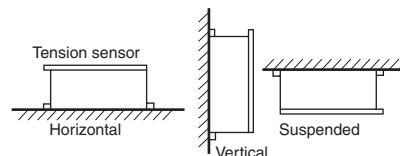


Notes:

- In the case of the rated tension 2000N of the MB33, set the wrap angle ( $\theta$ ) to not more than 120 degrees.
- Mount the sensor directly on the machine frame. Its action is not guaranteed if a wall mounting bracket is used.

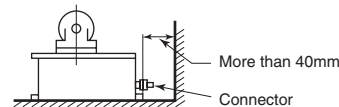
### C. Common

- The sensor can be installed at any angle.



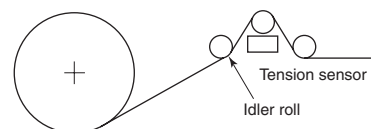
- The flatness of the mounting face should be 5/100mm or less.

- Provide a space of more than 40mm for the connector as illustrated.



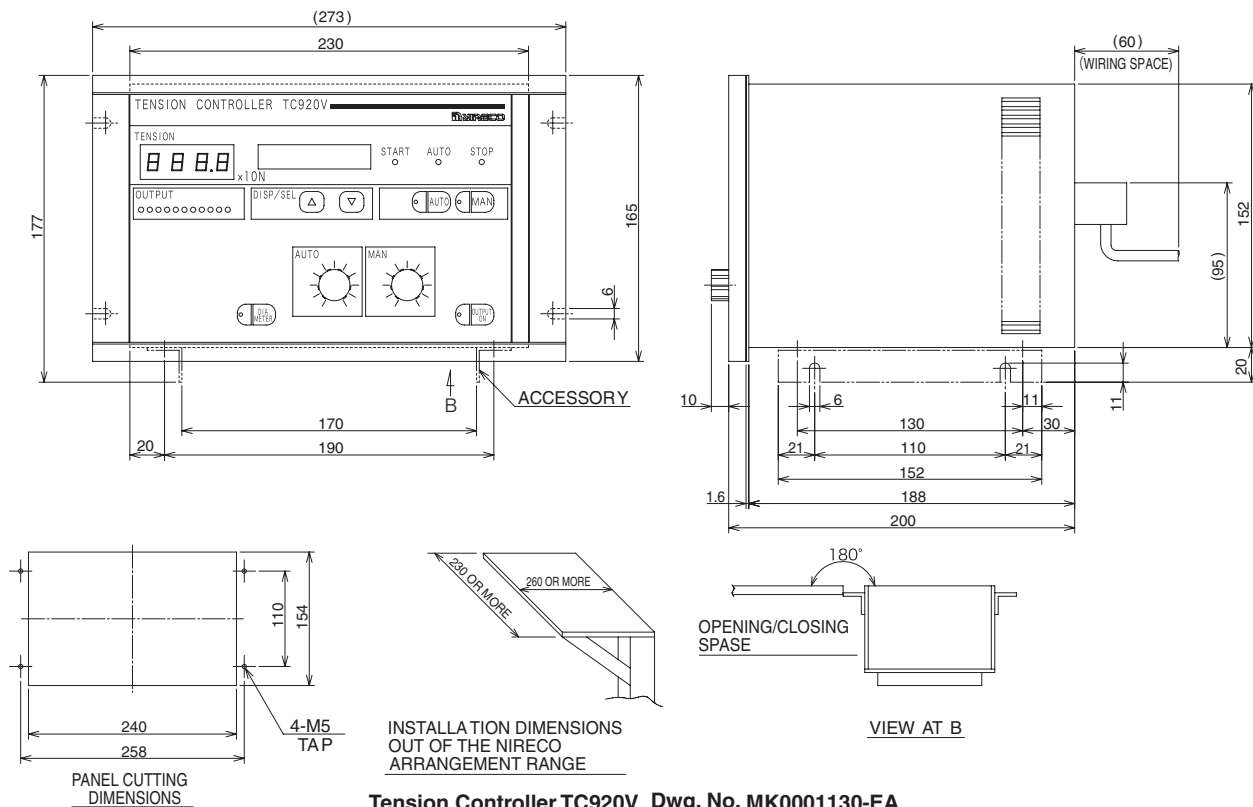
- The quality of the detecting roll balance should conform to JIS B 0905 Grade 1 which is explained in the relevant instruction manual.

- Insert the idler roll into winding or unwinding reel. This is to keep the web wrap angle with respect to the sensor constant. Conditions for the idler roll are as follows:
  - Use two or three rolls or less.
  - Use rolls with a low mechanical friction. In particular, when the tension is less than 100N, observe conditions (1) and (2) strictly.

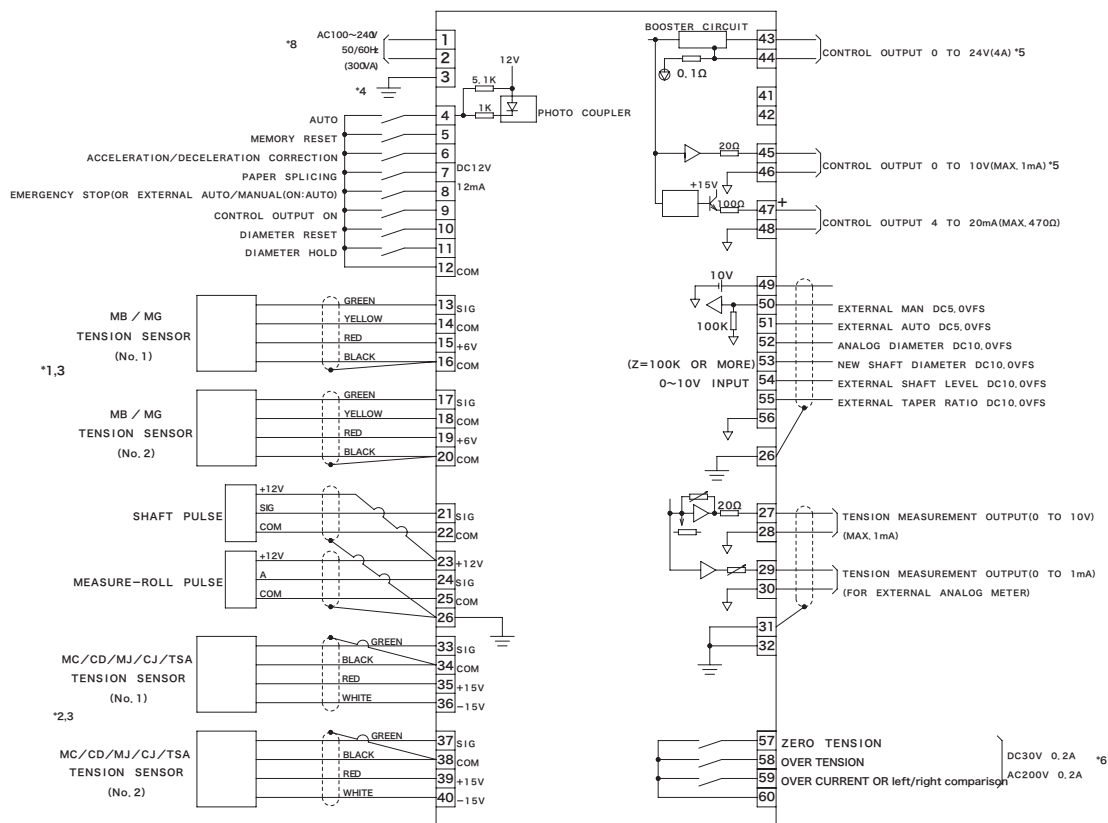


- Install the MB tension sensor in a place free of vibration.





Tension Controller TC920V Dwg. No. MK0001130-EA



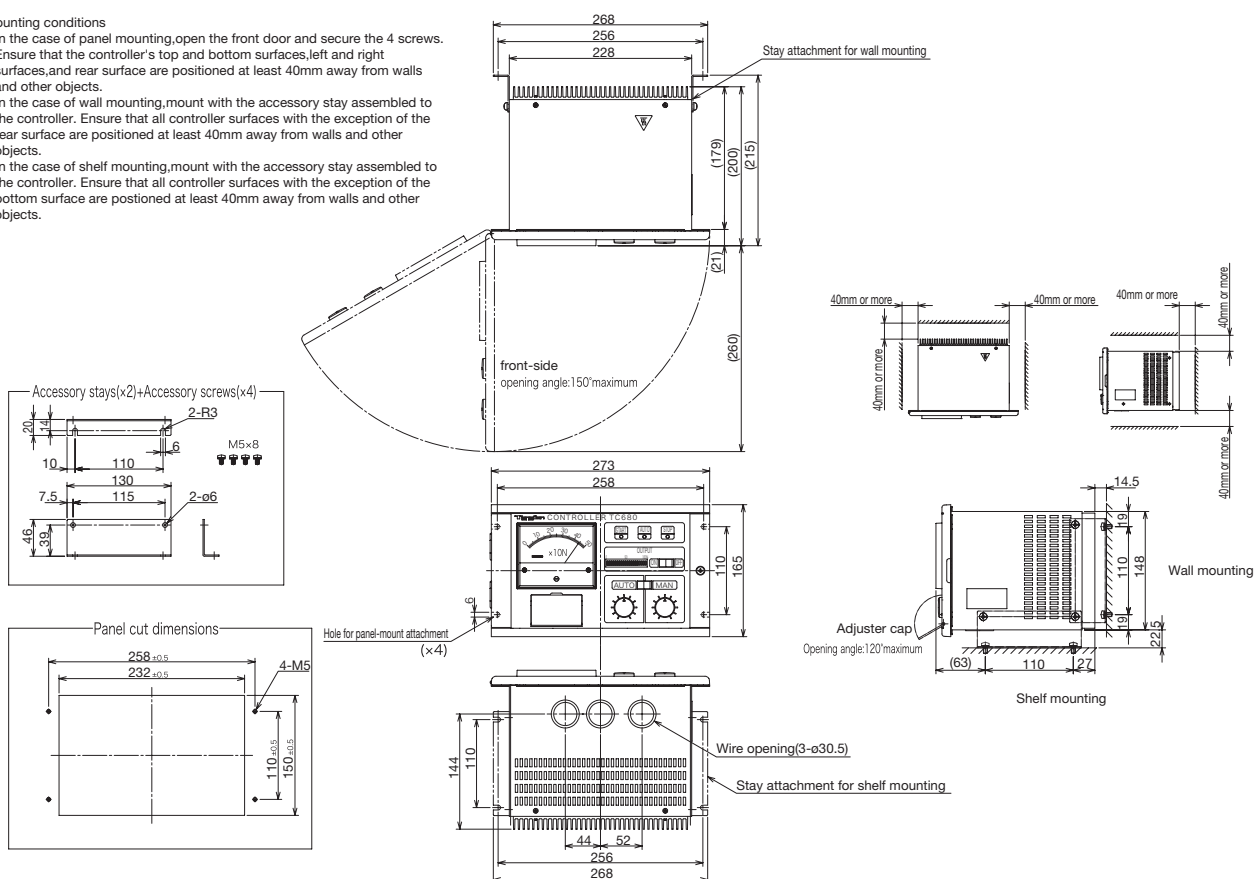
NOTES.

- 1.SHORT CIRCUIT TERMINALS 13 AND 17.  
WHEN USE A SINGLE MB/MG TENSION SENSOR.
- 2.SHORT CIRCUIT TERMINALS 33 AND 37.  
WHEN USE A SINGLE MC/CD/MJ/CJ/TSA TENSION SENSOR.
- 3.CAN NOT USE THE MB/MG TENSION SENSOR AND  
MC/CD/MJ/CJ/TSA TENSION SENSOR AT SAME TIME.
- 4.BE SURE TO GROUND TERMINAL No.3.(D-CLASS GROUND)
- 5.DONT SHORT ACROSS OUTPUT TERMINALS.
- 6.USE A SPARK KILLER FOR REACTANCE LOAD.
- 7.DONT SHORT CIRCUIT EARTH AND COMMON.
- 8.WHEN USE A CIRCUIT BREAKER FOR POWER SUPPLY OF TC920V.  
USE A 5A OR MORE SPECIFICATION OF CIRCUIT BREAKER.

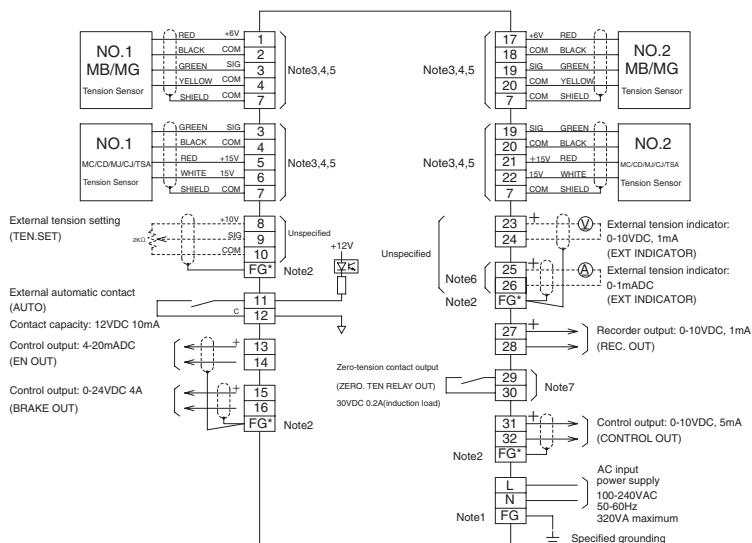
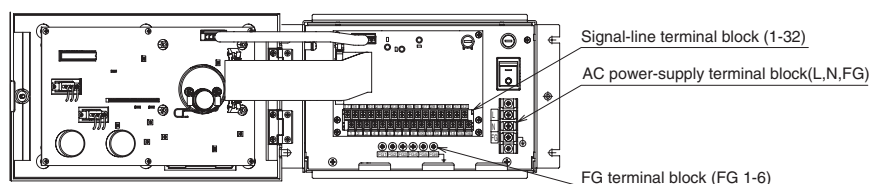
External Wiring Diagram Dwg. No. MK0001130-EC

## Mounting conditions

1. In the case of panel mounting, open the front door and secure the 4 screws. Ensure that the controller's top and bottom surfaces, left and right surfaces, and rear surface are positioned at least 40mm away from walls and other objects.
2. In the case of wall mounting, mount with the accessory stay assembled to the controller. Ensure that all controller surfaces with the exception of the rear surface are positioned at least 40mm away from walls and other objects.
3. In the case of shelf mounting, mount with the accessory stay assembled to the controller. Ensure that all controller surfaces with the exception of the bottom surface are positioned at least 40mm away from walls and other objects.



Tension Controller Model TC680A Dwg. No. MK0001150-EA



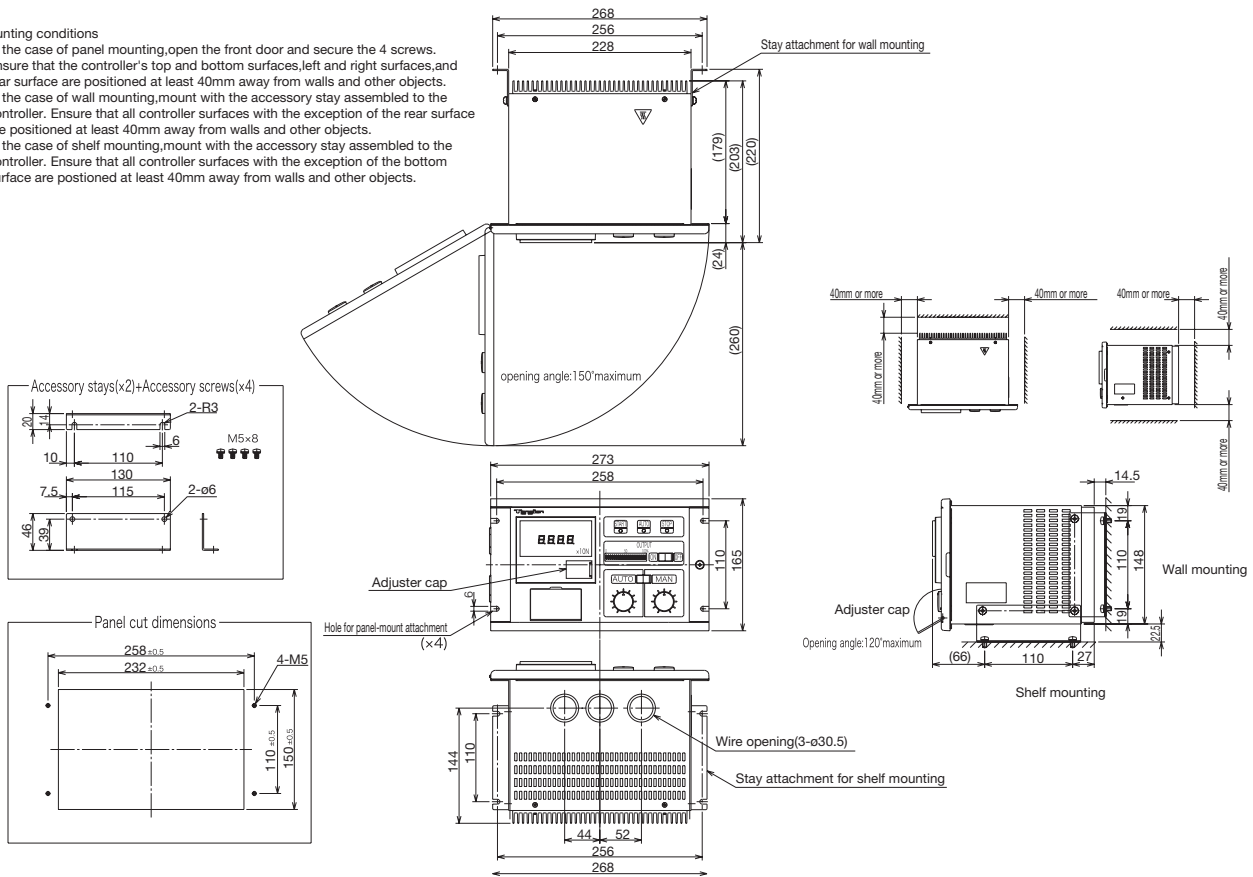
## Notes:

1. The specified grounding must be carried out for FG terminals.
2. Connect FG\* to the nearest FG terminal block (i.e., FG 1to6). (Internal connection to FG)
3. MB and MG sensors connect to terminals 1 through 4 and 17 through 20. MC, CD, MJ, CJ and TSA sensors connect to terminals 3 through 6 and 19 through 22. Cables are attached to sensors with a standard length of 5 m.
4. When using only one sensor (i.e., one side detecting, one side fixed), short terminals 3 and 19.
5. MB and MG sensors cannot be used at the same time as MC, CD, MJ, CJ and TSA sensors.
6. When connecting the external tension indicator (or ammeter), do so after first removing the shorting plate between terminals 25 and 26.
7. If connecting an L load, use a spark killer.

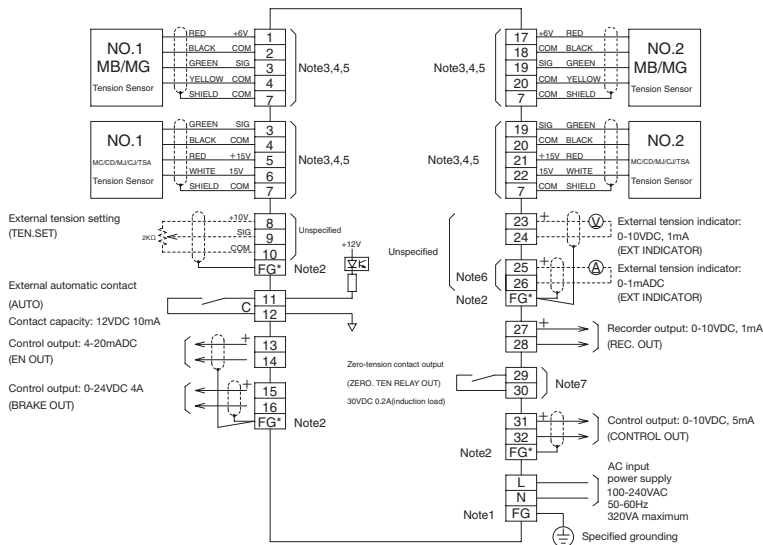
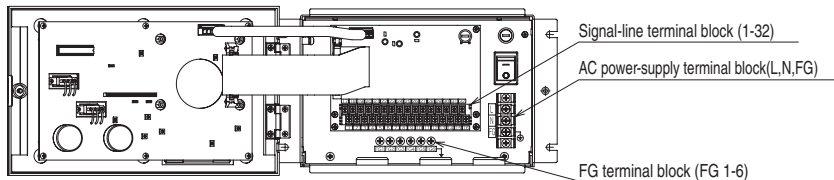
Tension Controller Model TC680A Dwg. No. MK0001150-EC

#### Mounting conditions

1. In the case of panel mounting, open the front door and secure the 4 screws. Ensure that the controller's top and bottom surfaces, left and right surfaces, and rear surface are positioned at least 40mm away from walls and other objects.
2. In the case of wall mounting, mount with the accessory stay assembled to the controller. Ensure that all controller surfaces with the exception of the rear surface are positioned at least 40mm away from walls and other objects.
3. In the case of shelf mounting, mount with the accessory stay assembled to the controller. Ensure that all controller surfaces with the exception of the bottom surface are positioned at least 40mm away from walls and other objects.



Tension Controller Model TC680D Dwg. No. MK0001140-EA



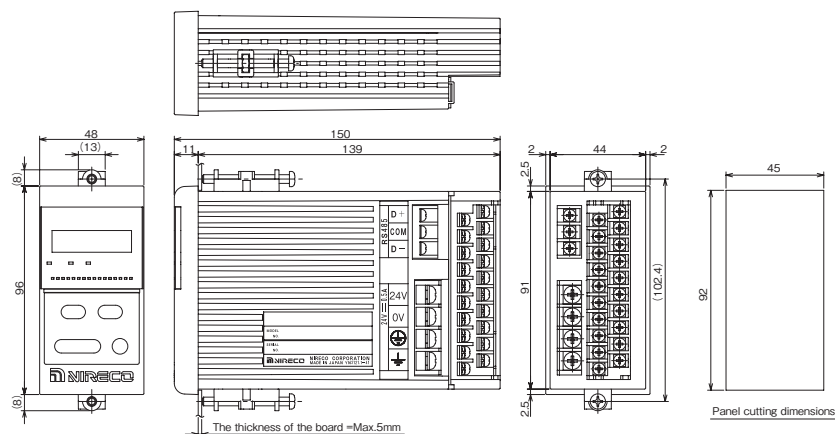
#### Notes:

1. The specified grounding must be carried out for FG terminals.
2. Connect FG\* to the nearest FG terminal block (i.e., FG 1 to 6). (Internal connection to FG)
3. MB and MG sensors connect to terminals 1 through 4 and 17 through 20. MC, CD, MJ, CJ and TSA sensors connect to terminals 3 through 6 and 19 through 22.
4. Cables are attached to sensors with a standard length of 5 m.
5. When using only one sensor (i.e., one side detecting, one side fixed), short terminals 3 and 19.
6. MB and MG sensors cannot be used at the same time as MC, CD, MJ, CJ and TSA sensors.
7. When connecting the external tension indicator (or ammeter), do so after first removing the shorting plate between terminals 25 and 26.
7. If connecting an L load, use a spark killer.

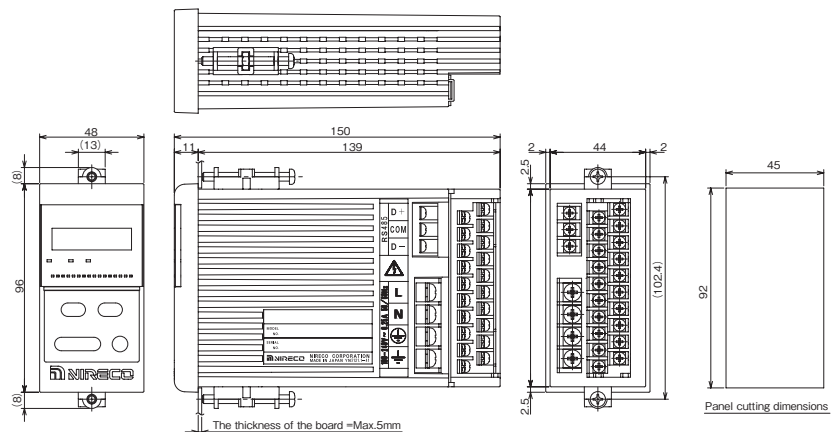
Tension Controller Model TC680D Dwg. No. MK0001140-EC



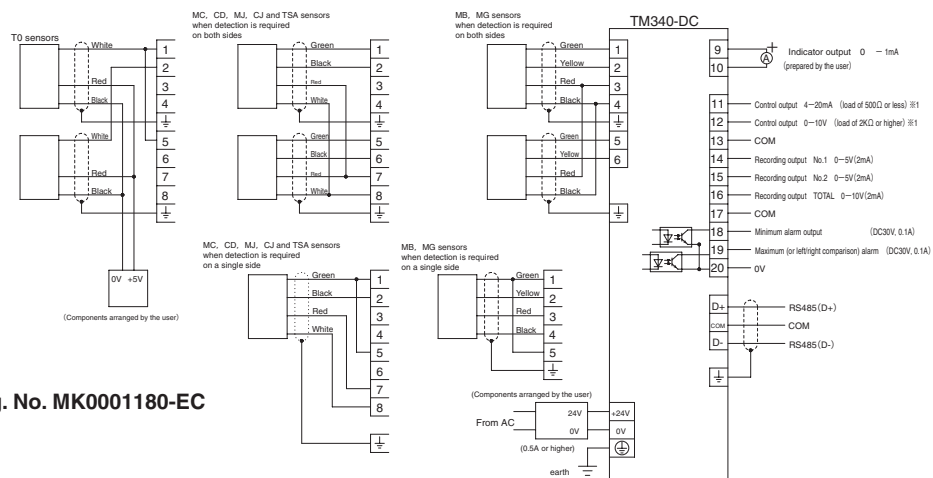
**Tension Meter TM340-DC**  
Dwg. No. MK0001180-EA



**Tension Meter TM340-AC**  
Dwg. No. MK0001190-EA

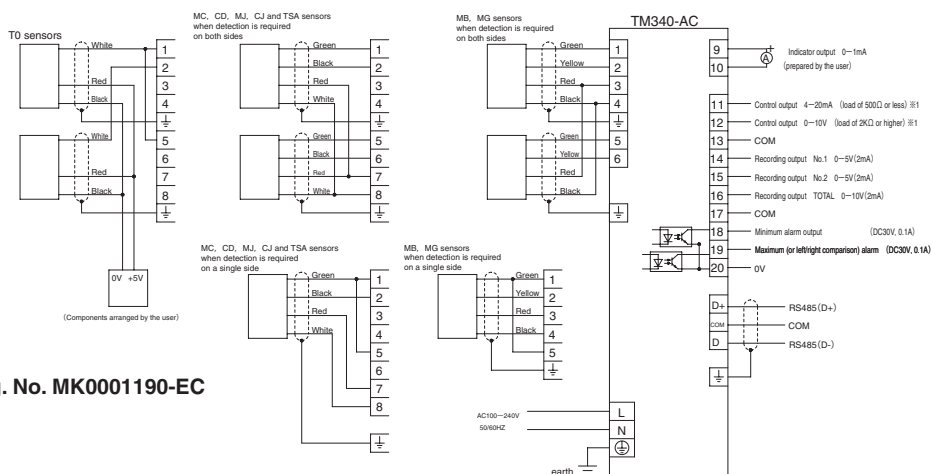


otes :  
Connect the wires as shown in the illustration when using the MB and MG sensors and when using reverse tension.  
Short-circuit terminals 1 and 5 when using the MB, MG, MC, CD, MJ, CJ and TSA sensors for single-side and single detection.  
A +5V power source is required in addition to the main power source when using TO-type sensors, and this must not be connected to the OV or tension meter's COM terminal.  
In addition, single TO sensors cannot be used. They must always be used in pairs.  
Install a noise filter if large amounts of noise are generated within the power supply.  
Ensure that the  $\Phi$  terminal is fitted with an earth without fail.  
Use DC24V for the power supply.  
Terminals marked with an asterisk(\*) cannot be used in combination.  
Do not connect anything to the terminals that are not being used.  
Signal terminals are at 1 to 20. Wire them according to the numbers on terminal block cover.  
(Ignore the numbers on terminal block itself.)  
Refer to the Instruction Manual of "TM340-\*\*\*" for further details.

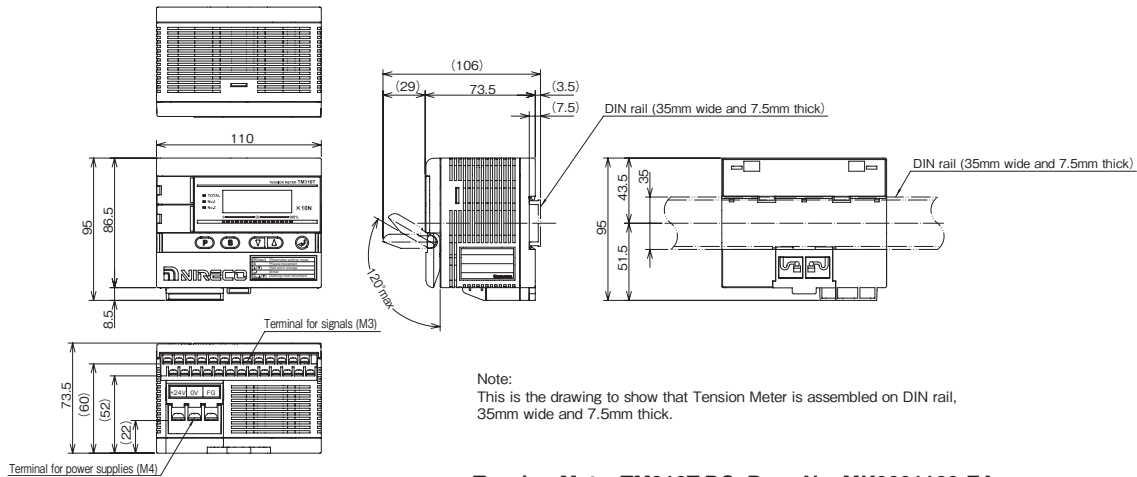


**Tension Meter TM340-DC** Dwg. No. MK0001180-EC

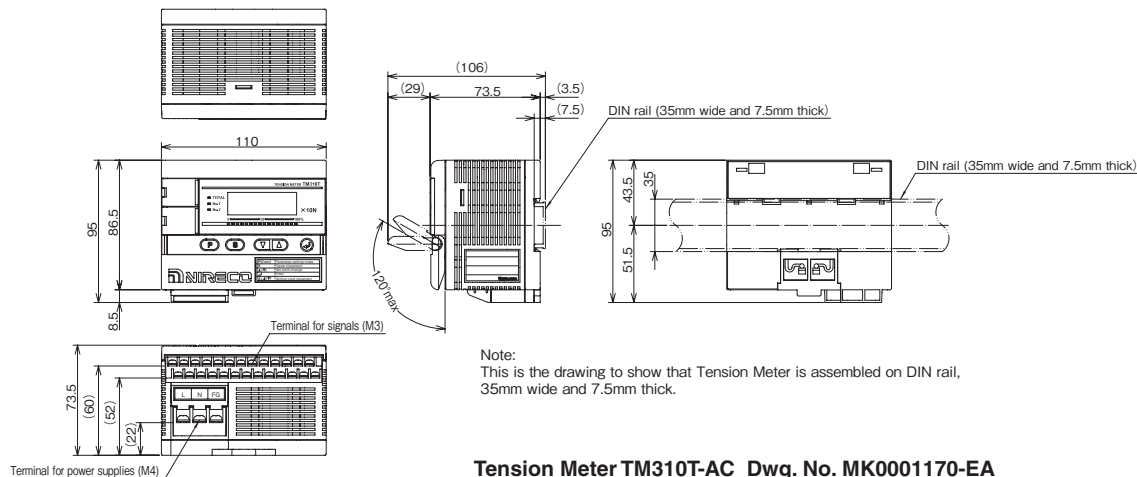
otes :  
Connect the wires as shown in the illustration when using the MB and MG sensors and when using reverse tension.  
Short-circuit terminals 1 and 5 when using the MB, MG, MC, CD, MJ, CJ and TSA sensors for single-side and single detection.  
A +5V power source is required in addition to the main power source when using TO-type sensors, and this must not be connected to the OV or tension meter's COM terminal.  
In addition, single TO sensors cannot be used. They must always be used in pairs.  
Install a noise filter if large amounts of noise are generated within the power supply.  
Ensure that the  $\Phi$  terminal is fitted with an earth without fail.  
Use DC24V for the power supply.  
Terminals marked with an asterisk(\*) cannot be used in combination.  
Do not connect anything to the terminals that are not being used.  
Signal terminals are at 1 to 20. Wire them according to the numbers on terminal block cover.  
(Ignore the numbers on terminal block itself.)  
Refer to the Instruction Manual of "TM340-\*\*\*" for further details.



**Tension Meter TM340-AC** Dwg. No. MK0001190-EC

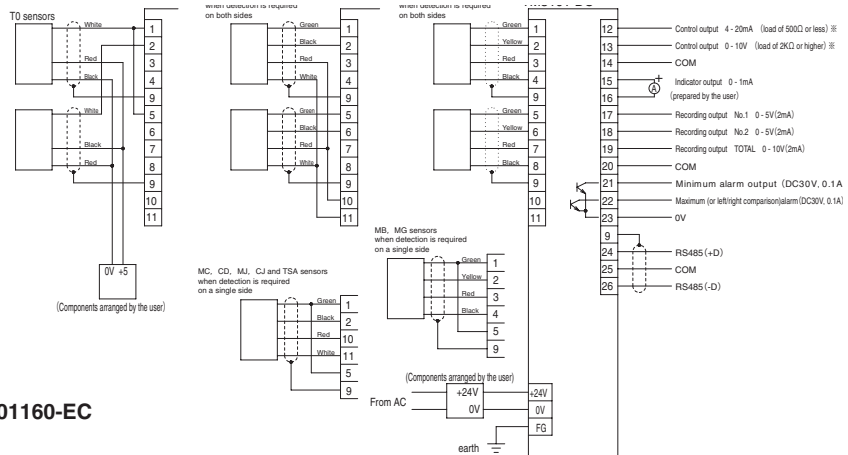


Tension Meter TM310T-DC Dwg. No. MK0001160-EA



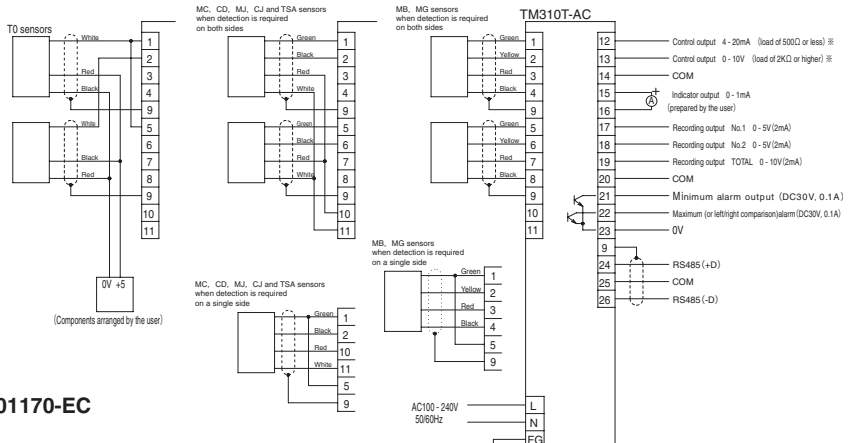
Tension Meter TM310T-AC Dwg. No. MK0001170-EA

Connect the wires as shown in the illustration when using the MB and MG sensors and when using reverse tension. Short-circuit terminals 1 and 5 when using the MB, MG, MC, CD, MJ, CJ and TSA sensors for single-side and single detection. A +5V power source is required in addition to the main power source when using TO-type sensors, and this must not be connected to the OV or tension meter's COM terminal. In addition, single TO sensors cannot be used. They must always be used in pairs. Install a noise filter if large amounts of noise are generated within the power supply. Ensure that the FG terminal is fitted with an earth without fail. Use DC24V for the power supply. Refer to the Instruction Manual for further details. Terminals marked with an asterisk (\*) cannot be used in combination. Do not connect anything to the terminals that are not being used.

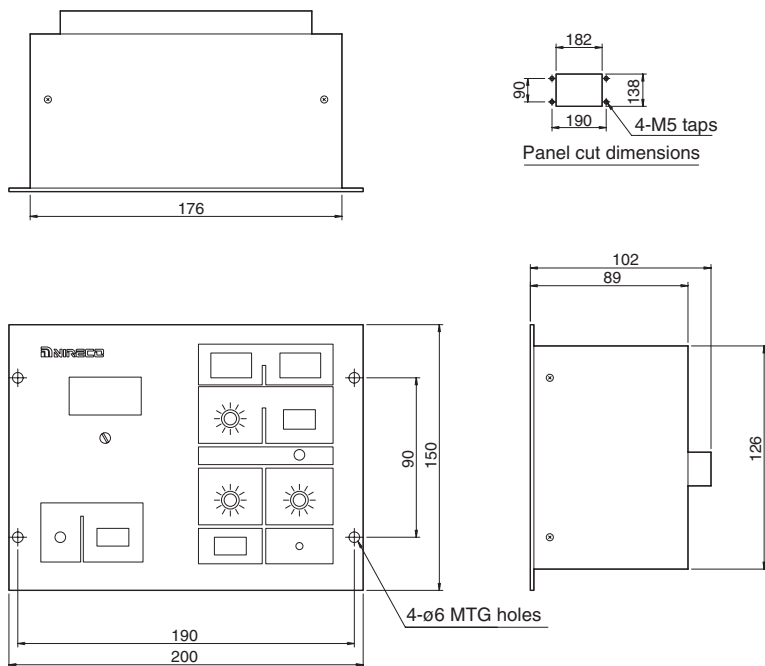


Tension Meter TM310T-DC Dwg. No. MK0001160-EC

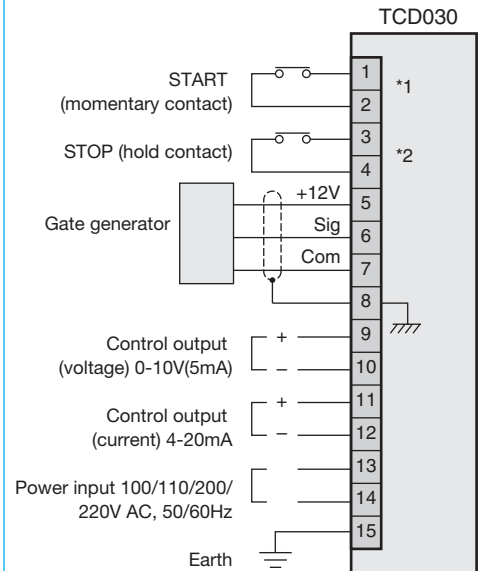
es : Connect the wires as shown in the illustration when using the MB and MG sensors and when using reverse tension. Short-circuit terminals 1 and 5 when using the MB, MG, MC, CD, MJ, CJ and TSA sensors for single-side and single detection. A +5V power source is required in addition to the main power source when using TO-type sensors, and this must not be connected to the OV or tension meter's COM terminal. In addition, single TO sensors cannot be used. They must always be used in pairs. Install a noise filter if large amounts of noise are generated within the power supply. Ensure that the FG terminal is fitted with an earth without fail. Refer to the Instruction Manual for further details. Terminals marked with an asterisk (\*) cannot be used in combination. Do not connect anything to the terminals that are not being used.



Tension Meter TM310T-AC Dwg. No. MK0001170-EC



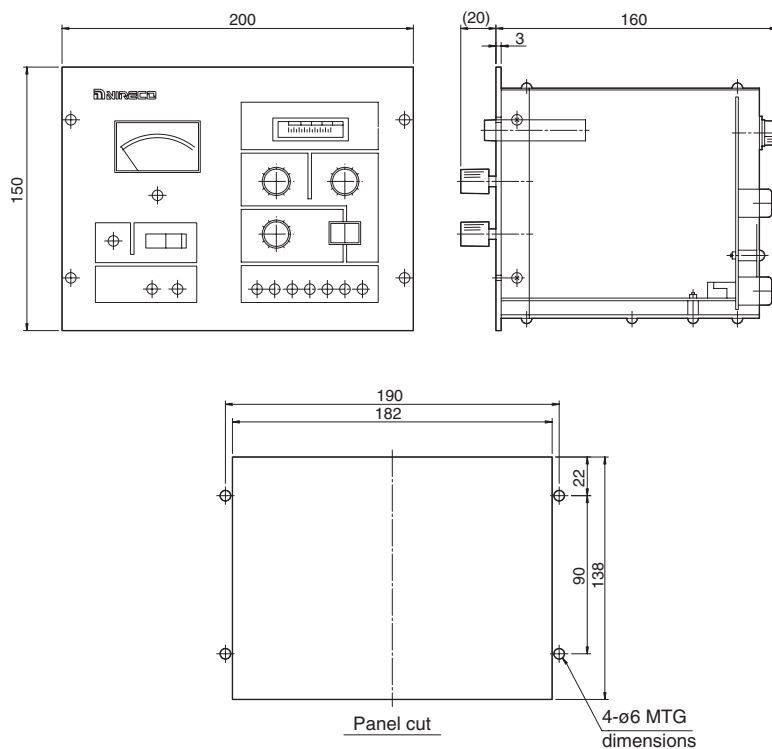
Open Loop Tension Control System TCD030 Dwg. No. MW3148.0-EA



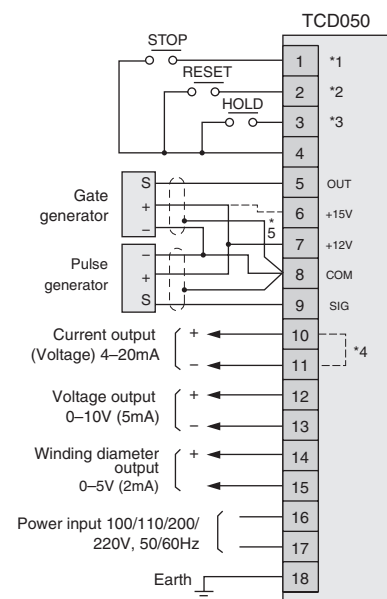
#### Notes:

- \*1 START: Make the start contact when a roll of the unwinding reel has been changed. (100 ms or more: make the contact.)
- \*2 STOP: Make the stop contact when stopping the unwinder. The stop output is provided. (The output is generated only while the contact is being made. The output will be variable from one to three times the preceding control output.)

Open Loop Tension Control System TCD030 Wiring Diagram



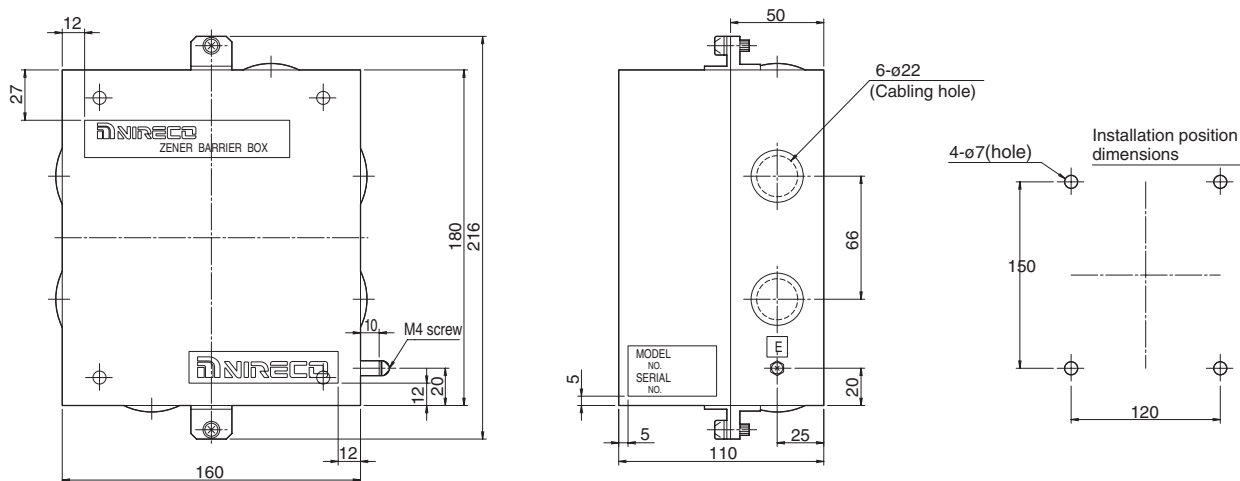
Open Loop Tension Control System TCD050 Dwg. No. MW3108.0-EA



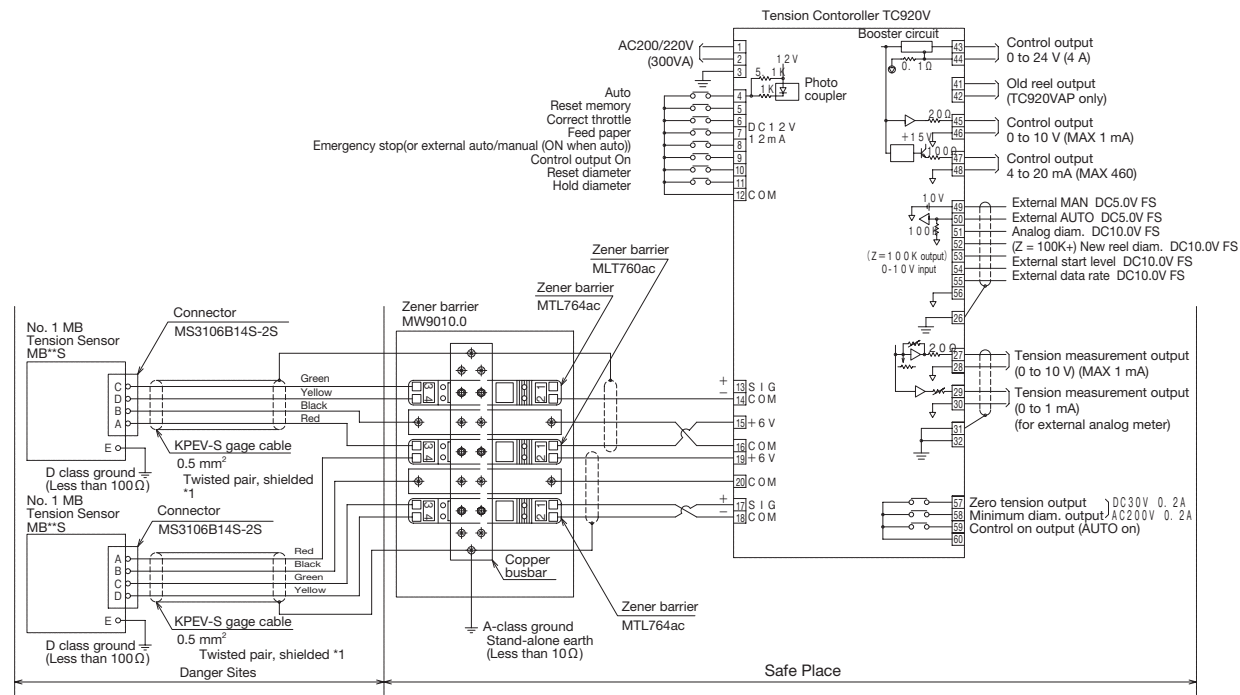
#### Notes:

- \*1 START: contact for the stop level. While this contact is being made, the output set with the SPG VR at the front panel is generated.
- \*2 RESET: contact for resetting the roll diameter. While this contact is being made, the output set with the manual VR at the front panel is generated.
- \*3 HOLD: contact for holding the output. The output is maintained while this contact is being made.
- \*4 Short-circuit the terminals when the current output (terminals 10 and 11) is not used.
- \*5 Connect to pin 6 when power voltage uses 15 V gate oscillator and pulse oscillator

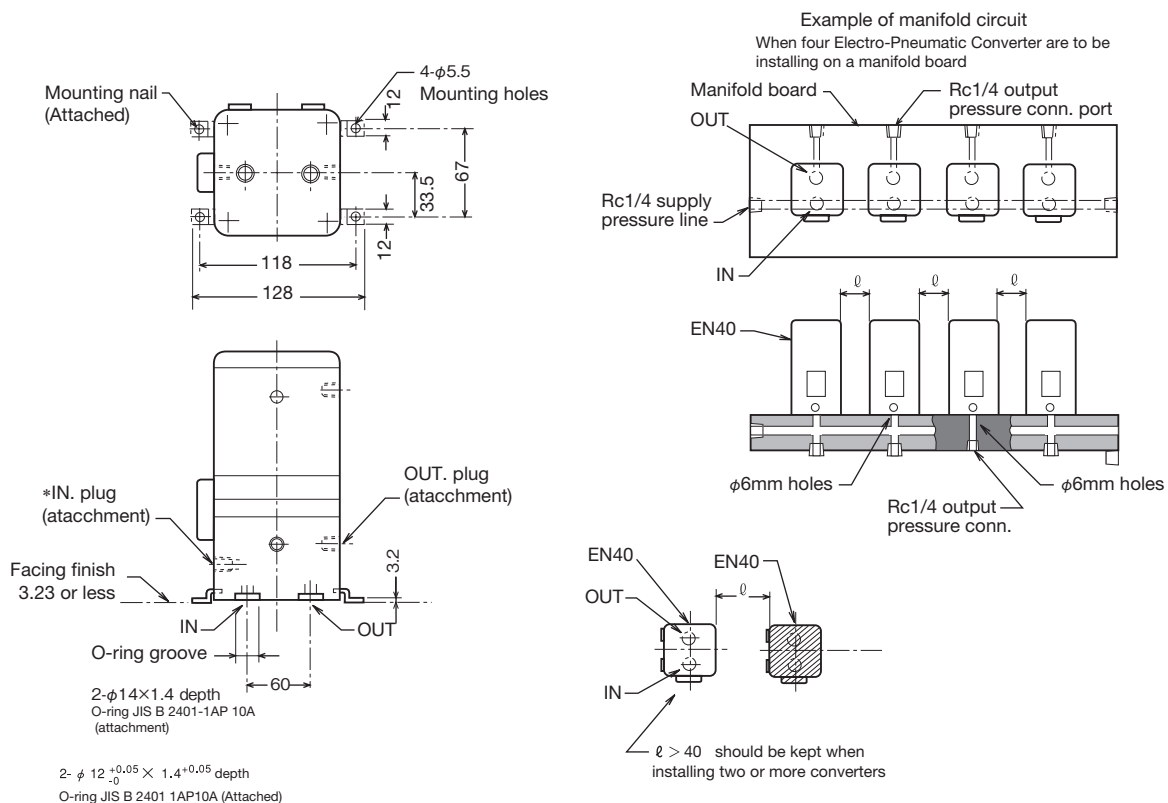
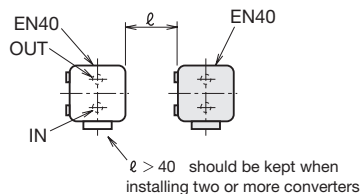
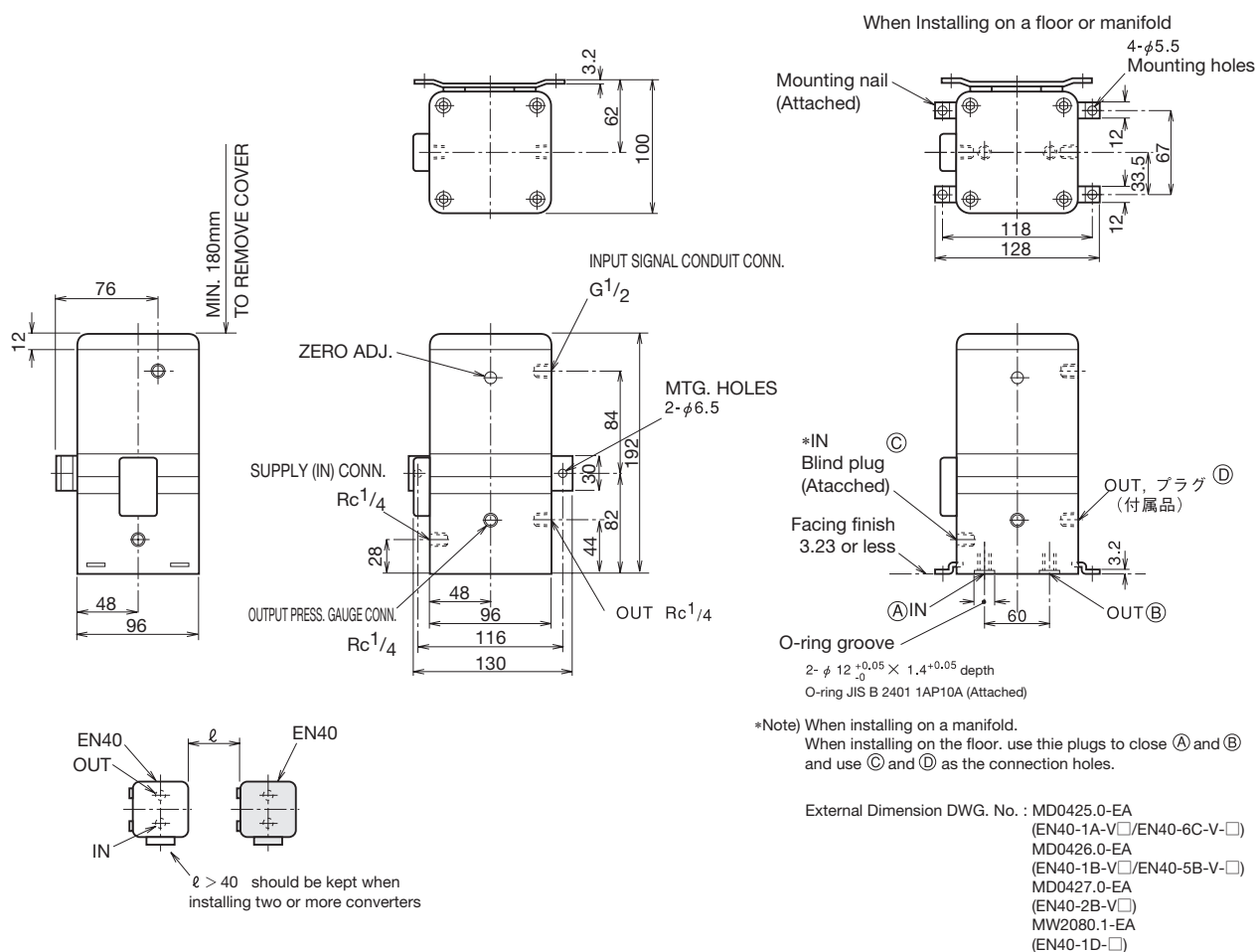
Open Loop Tension Control System TCD050 Wiring Diagram



Zener Barrier Box Dwg. No. MW9009.0-EA

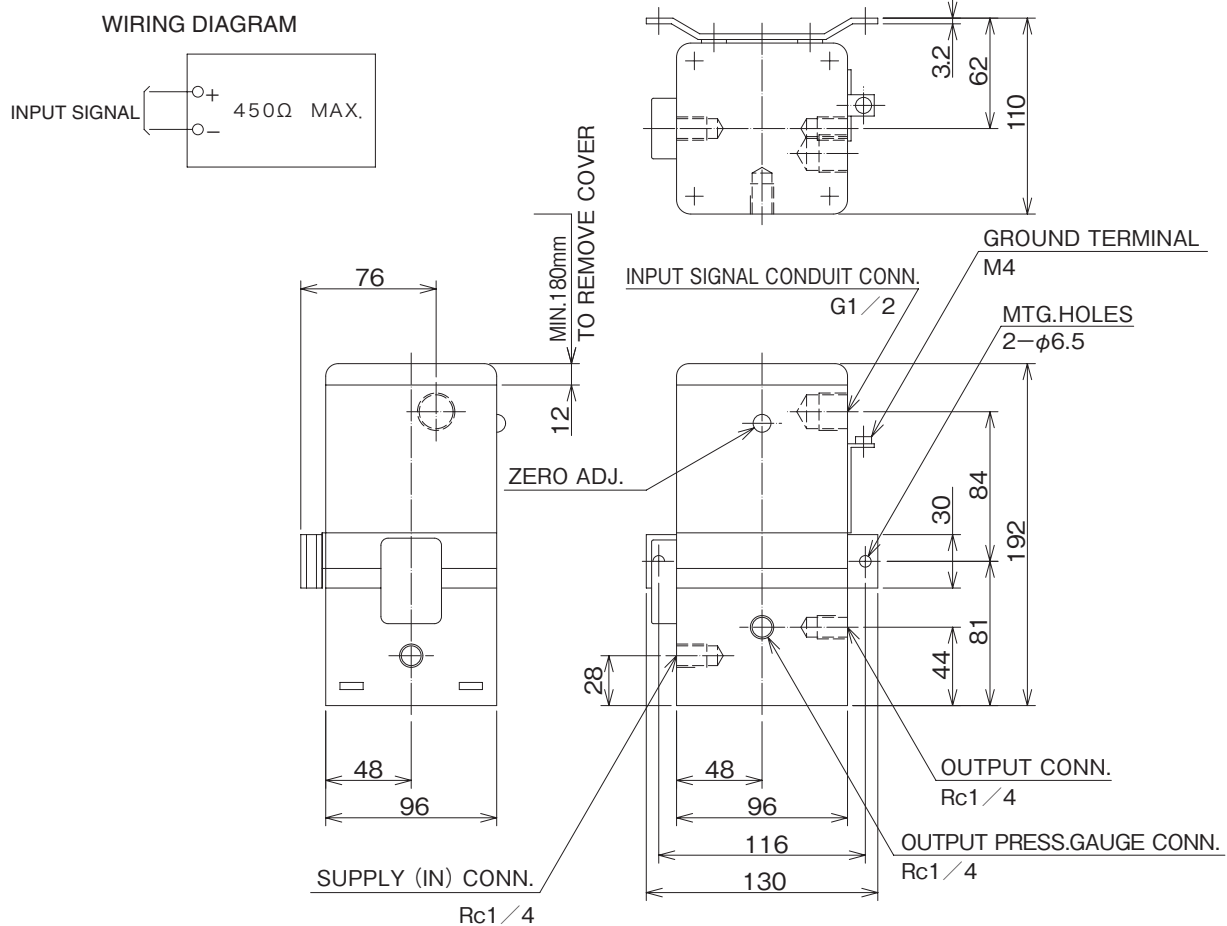


Tension Controller TC920V (with an intrinsically safe structure) wiring Diagram

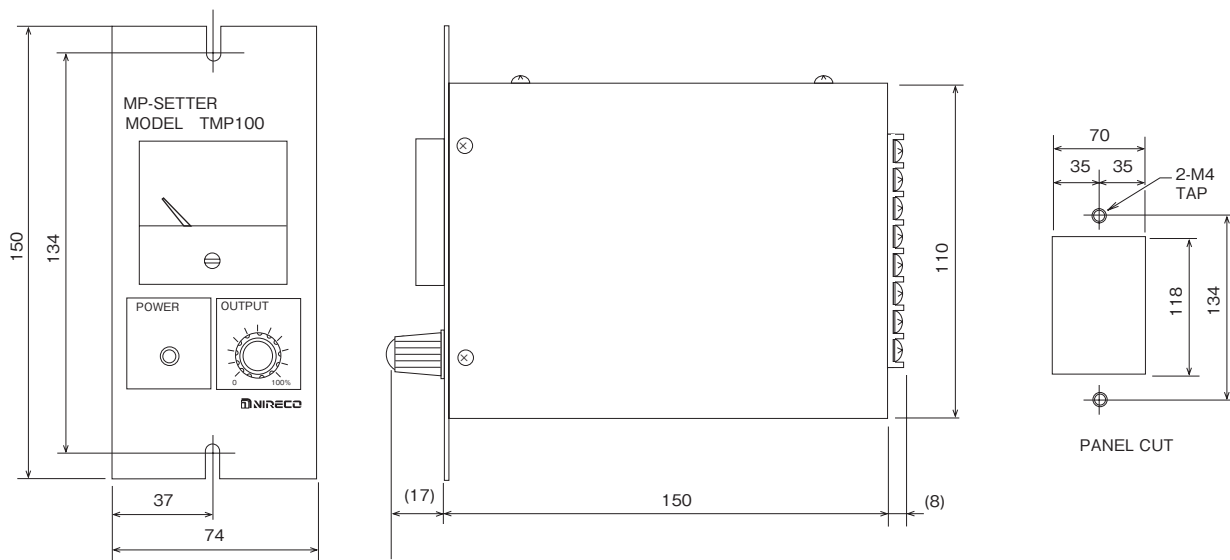


\*Note) For manifold mounting

Electro-Pneumatic Converter EN40 Floor Mounting and Manifold Mounting

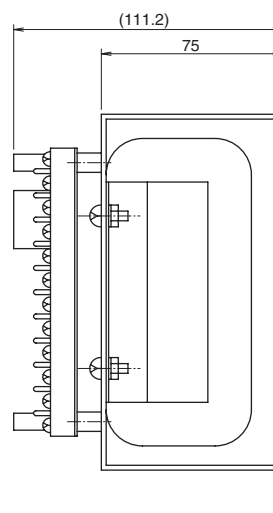
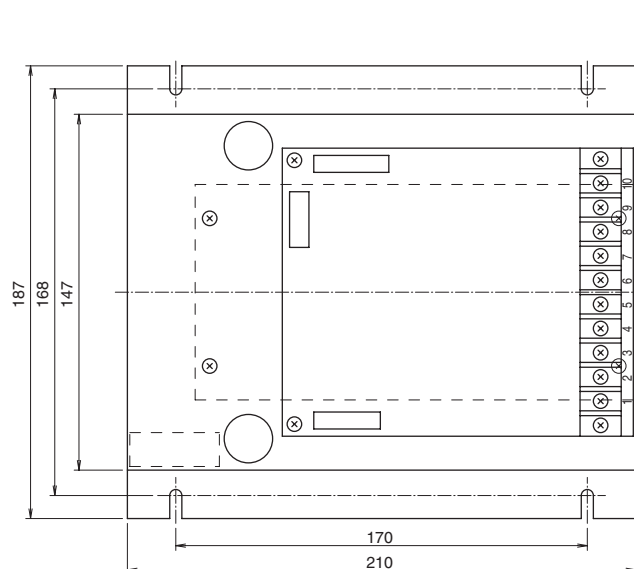


Intrinsically safe explosion-proof Electro-pneumatic Converter EN40 Dwg. No. MD0465.0-EA

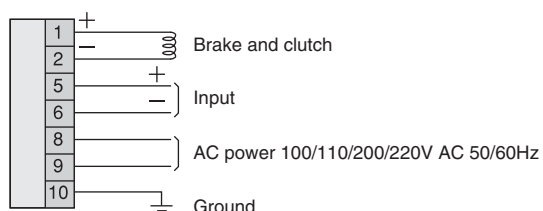


MP SETTER TMP100 Dwg. No. MW7004.1- EA

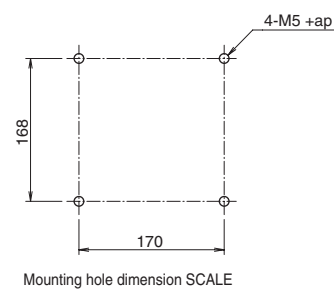




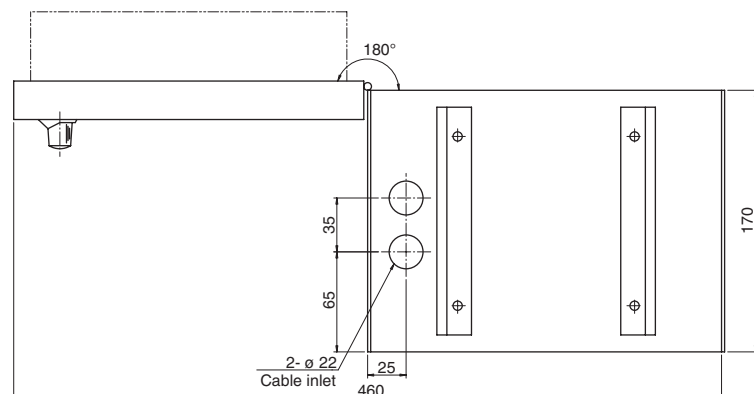
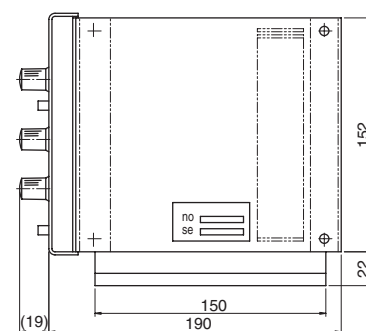
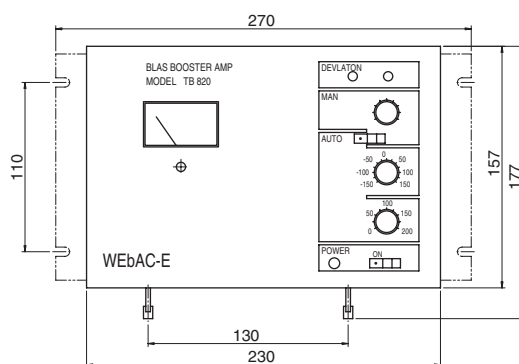
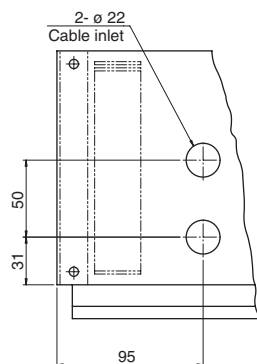
Booster amplifier TB800



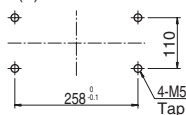
Booster Amplifier TB800 Wiring Diagram



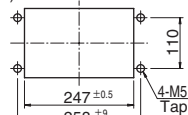
Booster Amplifier TB800 Dwg. No. MW3123.0-EA



(1) Mounting Methods  
(A) Wall mount

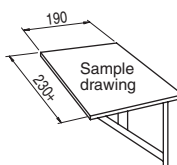


(B) Panel mount



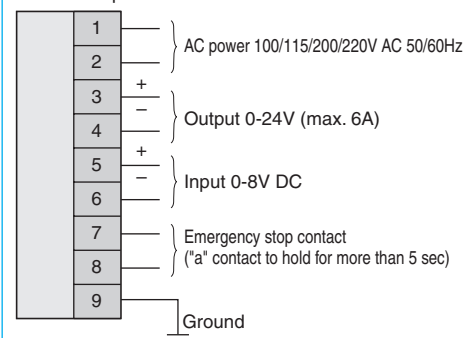
(C) Stand-alone

In this case, place on a stand as in the sample drawing  
Note:  
Not provided by Nireco

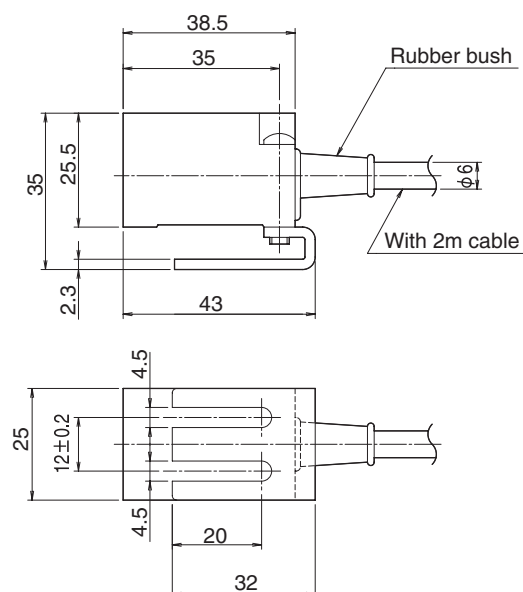
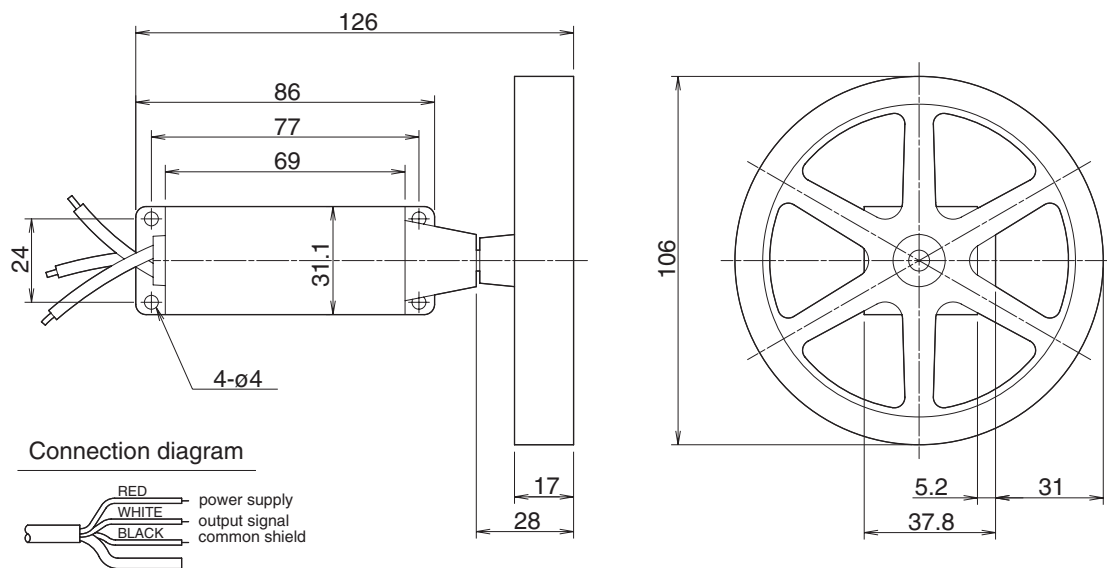
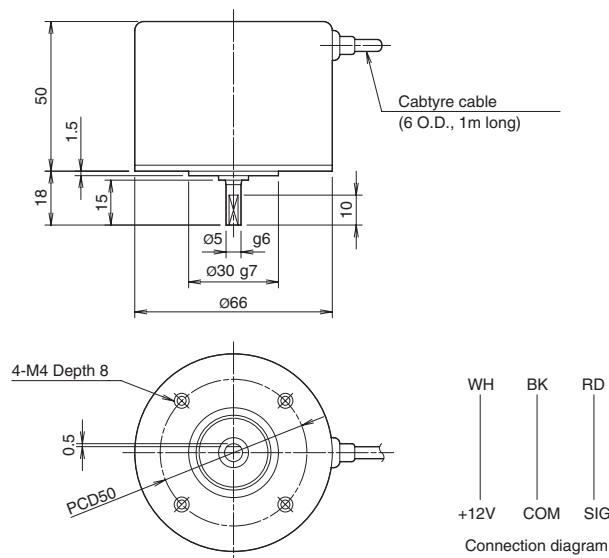


Booster Amplifier TB820 Dwg. No. MW3050.2-EA

Booster Amplifier TB820



Booster Amplifier TB820 Wiring Diagram



- Specifications
1. Power supply voltage: 12V to 24V DC
  2. Detected object: Magnetic metal  
30mm x 30mm x 1mm MIN
  3. Detecting distance: 5mm MAX

## TENSION CONTROLS QUESTIONNAIRE

Date \_\_\_\_\_

Prepared by \_\_\_\_\_

Name: \_\_\_\_\_

Company: \_\_\_\_\_

Address: \_\_\_\_\_

Phone: \_\_\_\_\_

Fax.: \_\_\_\_\_

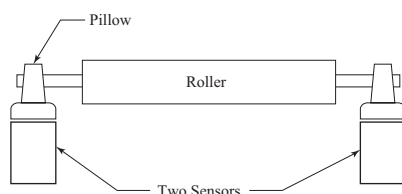
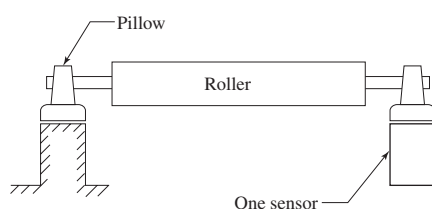
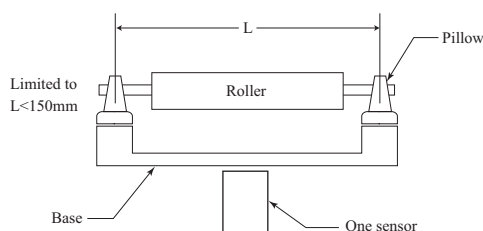
Application: \_\_\_\_\_

☐ For newly installed machine☐ For existing machine

## 1. Rated tension

- ☐ ① 50N      ☐ ④ 500N      ☐ ⑦ 3000N  
☐ ② 100N    ☐ ⑤ 1000N    ☐ ⑧ 5000N  
☐ ③ 200N    ☐ ⑥ 2000N    ☐ ⑨ 10000N

## 2. Sensing method

☐ ① Bilateral sensing☐ ② Unilateral sensing☐ ③ Total sensing by one sensor

## 3. Installation

- ☐ ① Horizontal    ☐ ② Vertical    ☐ ③ Inverse  
☐ ④ Others

## 4. Tension direction

- ☐ ① Normal    ☐ ② Reverse

## 5. Weight on sensor

Sensor roller + Two pillows + (Base) (for ③ under 2)

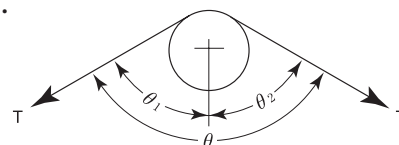
## 6. Pillow

Pillow type ( )

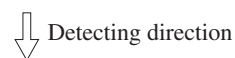
Pillow shaft center high ( )

## 7. Roller wrap angle

Wrap angle  $\theta$  should be less than  $150^\circ$ . However, for the MB33 with a rated tension of 2000N, it should be less than  $120^\circ$ .

As a general rule,  $\theta = 120^\circ$ 

is recommended



## 8. Diameter of sensor roller and max. line speed

Roller diameter ( ) mm

Max. line speed ( ) m/min

## 9. Temperature

## 10. Atmosphere (Acid, Alkaline, Flammable, Others)

## 11. Final control elements

- ☐ Electromagnetic brake    ☐ Air brake  
☐ Electromagnetic clutch    ☐ Air clutch  
☐ Electromagnetic coupling  
☐ Torque motor    ☐ Air motor

## 12. Specifications of final control elements

- ☐ Manufacturer / Model ( ) ( )  
☐ Electromagnetic brake / clutch Electric current (0 to A)  
☐ Air brake / clutch Air pressure (0 to Mpa)

## 13. Specifications of web

- a Web material ( )  
 b Web width ( )  
 c Web thickness or mass ( )  
 d Rupture stress (15 mm wide) ( )

## 14. Diameter of winding / unwinding roll

( ) mm to ( ) mm

## DETERMINING BRAKE AND CLUTCH TYPE

Always use brakes and clutches with superior induced current, air pressure and torque properties.

Determine the ones to use according to continuous slip efficiency, maximum torque and maximum and minimum revolutions. As a general guideline, the ratio of maximum torque/minimum torque for a single brake and clutch should be less than 20. Use multiple brakes or clutches if this ratio would be exceeded.

### 1. Determining

- ① Line speed :  $V_{\max} V_{\min}$  (m/min)
- ② Coil speed :  $D_{\max} D_{\min}$  (m)
- ③ Tension :  $T_{\max} T_{\min}$  (N)

### 2. For unwinding (brake)

- ① Maximum torque  

$$\tau_{\max} = \frac{1}{2 \times 10^3} T_{\max} \cdot D_{\max} \quad (\text{N} \cdot \text{m})$$
- ② Minimum torque  

$$\tau_{\min} = \frac{1}{2 \times 10^3} T_{\min} \cdot D_{\min} \quad (\text{N} \cdot \text{m})$$
- ③ Torque ratio  

$$\tau_{\max} / \tau_{\min} \quad (\text{ratio must not exceed } 20)$$
- ④ Maximum revolutions  

$$N_{\max} = \frac{V_{\max}}{\pi D_{\min}} \times 10^3 \quad (\text{rpm})$$
- ⑤ Minimum revolutions  

$$N_{\min} = \frac{V_{\min}}{\pi D_{\max}} \times 10^3 \quad (\text{rpm})$$
- ⑥ Maximum slip efficiency  

$$Q_{\max} = \frac{1}{6} T_{\max} \cdot V_{\max} \quad (\text{W})$$

### 3. For winding (clutch)

- ① Maximum torque  

$$\tau_{\max} = \frac{1}{2 \times 10^3} T_{\max} \cdot D_{\max} \quad (\text{N} \cdot \text{m})$$
- ② Minimum torque  

$$\tau_{\min} = \frac{1}{2 \times 10^3} T_{\min} \cdot D_{\min} \quad (\text{N} \cdot \text{m})$$
- ③ Torque ratio  

$$\tau_{\max} / \tau_{\min} \quad (\text{ratio must not exceed } 20)$$
- ④ Drive side maximum revolutions  

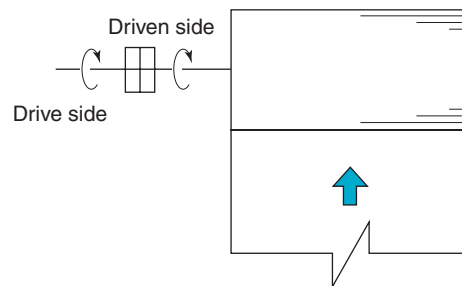
$$N_{\max} \quad (\text{rpm})$$
- ⑤ Drive side minimum revolutions  

$$N_{\min} \quad (\text{rpm})$$
- ⑥ Maximum slip efficiency  

$$Q_{\max} = \tau_{\max} (N_{\max} - n) \quad (\text{W})$$

In this case...

$$n = \frac{V_{\min}}{\pi D_{\max}} \quad (\text{rpm})$$





We reserve the right to change the specifications in this catalog without prior notice to improve and update our products.

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