FREQUENTLY ASKED QUESTIONS

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ACCURACY: Accuracy of most Midori position sensors are specified as "Independent Linearity". What does this mean and what other parameters are used to specify the accuracy?

Accuracy of a sensor output is described by comparing it against a given theoretical line and the maximum allowable difference (error) between them is stated in % of total output range.

Mathematical expression of the theoretical line is described as:

$$Y = aX + B$$

Y = output in volt, current or % of total input voltage (% of total output current range for case of current output type).

a = slope of the theoretical line (volts/°, %/°, mA/°)

X = shaft position in degree (in mm for linear type)

b = the output value when the shaft position is at "0°"position.

The most popular method adopted in the sensor industry is "**Independent Linearity**" which defines output error against a theoretical line chosen for each sensor being examined. "**a**" and "**b**" of the theoretical line may be adjusted for each sensor being examined to yield the minimum error along the full scale range.

"**Absolute Linearity**", on the other hand, requires a pre-determined fixed reference line ("**a**" and "**b**" held constant) for all sensors being examined.

"**Zero Based Linearity**" method is used for a sensor in which its output response at "0°"position is significant for its intended application. In Midori product line, **Zero Based Linearity** is used predominantly on inclinometers to specify the output accuracy since the output signal indicates how many degrees the sensor is tilted from the zero degree position. The theoretical line is required to cross (0°, **b**) point for all sensors being examined, but "**a**" can be adjusted on individual sensor being examined to yield the minimum error along the full scale range.

CENTER TAP: Is center tap available in Green Pots? If so, how does one specify it?

Yes, the center tap is available by special request. It is specified with the standard product model number followed with "**A Tap**" or "**B Tap**".

Example: CPP-45B 5k A Tap

"**A Tap**" is recommended for application where near zero degree shorting width (less than a tenth of a degree) is required. However, one should note that there are up to a few hundred ohms of resistance between the tapped point and a termination point (solder terminal or lead), which may affect the performance in the intended application unless appropriate measures are taken.

On the other hand, "**B Tap**" has 1° to 5° shorting width but with practically negligible resistance between the tapped point and the terminal.

IP RATING: What is "**IP** rating?

IP (Ingress protection) rating is an internationally recognized rating system specifying the level of protection on products or enclosures against solid objects and liquids.

The IP number consists of three digits. The first digit represents a protection level against solid objects, the second digit-liquids, the third digit-mechanical impact.

The higher the number, the better the protection. The third digit is often omitted.

On Midori specification sheets, the IP rating is used for defining the level of the SEAL COMPLIANCE parameter.

The following are the definitions of the first and second digit number:

Value	**First Digit**	**Second Digit**
0	No protection	No protection
1	Protected against solid objects over 50 mm e.g. hands, large tools.	Protected against vertically falling drop of water.
2	Protected against solid objects over 12 mm e.g. hands, large tools.	Protected against direct sprays of water up to 15° from vertical.
3	Protected against solid objects over 2.5 mm e.g. wire, small tools.	Protected against direct sprays of water up to 60° from vertical.
4	Protected against solid objects over 1.0 mm e.g. wire, small tools.	Protected against water sprayed from any direction. Limited ingress permitted.
5	Limited protection against dust ingress (no harmful deposit).	Protected against low pressure water jet sprayed from any direction. Limited ingress permitted.
6	Totally protected against dust ingress.	Protected against high pressure water jet from any direction. Limited ingress permitted.
7		Protection against immersion between 15cm and 1M.

Example: Model CPP-45RBN
SEAL COMPLIANCE: IP55 (Dust and water proof).

MAGNETIC FIELD, EFFECT OF: What is the effect of an external magnetic field on a Blue Pot and Orange Pot?

Since **Blue Pot** and **Orange Pot** work on effect Hall Effect principle and magnets are used to vary resistance or voltage on the sensor element output, an external magnetic field may influence the performance of the sensors, but the effect depends on the sensor's orientation relative to the external magnetic field and the magnetic field intensity.

Flux density of less than 100 gauss around the sensor should not affect the output level.

If the sensor must be installed in an area where a high magnetic field exists, it is highly recommended that the sensor is tested for output stability and repeatability in the actual operating environment. Because of casing of sensing element/magnet and awareness of the product nature by users, there haves been no application problem reported on this subject since the introduction of the **Blue Pot** and the **Orange Pot**.

OUTPUT CONFIGURATION: What types of output configurations are available in Midori products?

There are three basic output configurations: **Voltage**, **Ratiometric** (voltage) and **Current**.

Voltage: Full scale output voltage range is fixed as long as the input voltage stays within the specified range. Example: Model CP-2UK-V1
The output voltage varies 0 to 5 V for -40° to +40° shaft position, at the input voltage of 6 Vdc to 10Vdc.

Ratiometric: Output voltage range varies proportional to the input voltage. Example: Model CP-2UTX
The output voltage varies from approximately 35% to 65 % of the input voltage for -45° to +45° shaft position, at the input voltage below the maximum allowable input voltage (10 Vdc for CP-2UTX).

Output of all standard Green Pots (conductive plastic potentiometers) and wire wound potentiometers are **ratiometric** since those are true voltage dividers where the output varies from 0 to 100% of input voltage for the full electrical angle.

Current: Sensor supplies 4 mA to 20 mA current signal to low load resistance, typically a few hundred ohms, for a specified electrical angle range. This configuration is adopted in application where the load is in a remote location requiring lengthy wiring. Adopting this configuration eliminates output error caused by voltage loss on the lengthy wires. Example: Model CP-2UK-A
The output current varies 4 mA to 20 mA for -45° to +45° shaft position as long as the input voltage is between 20 Vdc to 28 Vdc.

PRODUCT TYPE, CHOICE OF: Based on what criteria shouldone choose a Blue, Green or an Orange Pot?

When a position sensor is required to operate for many operating cycles, up to several hundred million cycles and/or being subjected to vibration constantly, one should choose contactless sensors **Blue Pots** or **Orange Pots**. However, the range of electrical angles is limited to 90° (except some **Blue Pot** are available for up to 300°). The maximum operating cycles would vary depending on the type of shaft bearing used on the sensors.

Then, what are the characteristics distinguishing a **Blue Pot** and **Orange Pot**?

	Blue Pot:	**Orange Pot:**
Input Voltage (Vin):	0 to 10 Vdc	5 ±0.5 Vdc
Output Sensitivity:	0.3 %Vin/1° Typ.	4.5 %Vin/1° Typ.

Output Noise:	No noise	2 mVp-p Typ.
Operating Current:	Vin / 15 kOhms Typ.	8 mA typ.
Independent Linearity:	±1.5 %FS	± 1.5 %
Temperature Effect: (-30°C to +100°C)	±8 %FS S	±2.5% FS

As described above, the **Blue Pot** excels in the output smoothness (no noise) and resolution, and is flexible in choosing input voltage. However, the **Orange Pot** is superior in output sensitivity and temperature characteristics to the **Blue Pot**. These different characteristics are due to the **Blue Pot** being a passive device where output is simply a junction of two Hall elements (magneto resistors) connected in series, and the **Orange Pot** being an active electronic sensor made of a CMOS monolithic circuitry integrating a Hall element and amplifiers, temperature compensation and signal condition circuits. Both the **Blue Pot** and **Orange Pot** are available in compact body size, Ø16 X 14 mm.

When higher accuracy, superior temperature characteristics, high resolution and wider electrical angles are required in position sensing application, the **Green Pot** is the best choice. Independent linearity of ±1% to ±0.02% is available. However, operating cycles are limited to 10 million cycles and body size is relatively large, Ø22 X 12 mm to Ø62 X 28, depending on the accuracy requirements.

RESISTANCE VALUE, CHOICE OF: How should the resistance value of a Green Pot (conductive plastic potentiometer) or wire-wound potentiometer be selected?

Choice of resistance value is determined by considering three factors: **resolution**, **power consumption** and **output impedance**. The following are brief explanations of those factors which may influence choosing the value of a potentiometer, assuming the potentiometer is used as a "voltage divider" with constant input voltage.

Resolution: On **Green Pot**, the resistive element surface is, inherently smooth enough to offer excellent resolution. Therefore, the resistance value is practically irrelevant to the resolution. However, on a wire,wound potentiometer, the resolution will depend on its resistance value. The higher the resistance value is, the better the resolution. For exact specification, refer to the specification sheet or contact Midori America.

Power Consumption, Output Impedance: The choice of resistance value will largely depend on the interface circuitry that a potentiometer is connected to. If, for example, input impedance of the circuit is to have 10 meg Ohms (Input impedance of 10 meg Ohms or larger is not uncommon in interface circuitry of modern control equipment) and a potentiometer with a value of a 20 k Ohms is connected to it, it will produce only 0.02% maximum error (maximum output impedance of potentiometer is one fourth of the total resistance. For the case of 20 k Ohms potentiometer, the maximum output impedance is 5 k Ohms). If one attempts to further reduce the error by choosing a lower total resistance potentiometer (1 k Ohms as an example), the output error at input of the interface circuit would be reduced to 0.001%, however, power dissipation (current consumption) of the potentiometer would be increased by twenty fold which might not be desirable nor allowable.

In summary, when selecting the resistance value, one should always be knowledgeable about the output load impedance (input impedance of the interface circuit), the power rating of the potentiometer and available current for the potentiometer.

SOLDERING TEMPERATURE: Soldering a lead to a terminal, what wire size should be used and what should the soldering iron tip temperature set to?

Wire size should be 23 AWG or smaller. The iron tip temperature should be set at no higher than 300°C, and the heat should applied for no longer than 5 seconds to avoid damage of the internal construction.