PULSE-WIDTH MODULATION (PWM) MODE

Bourns® EMS22 NON-CONTACTING ENCODER SERIES

TECHNICAL NOTE

Introduction

Technological advancements in the semiconductor industry have created a broad use of electronically controlled systems. This developing technology promotes the need for sensors that operate in the digital realm, and can handle harsh environments where extreme levels of temperature, moisture and particles are present.

For many system manufacturers, there is a need to utilize components that can operate in Pulse-Width Modulation (PWM) output modes. The advantage of PWM compared to traditional analog readings is that it eliminates the need for an Analog-to-Digital converter and has better noise immunity. The Bourns® Model EMS22 Non-Contacting Rotary Magnetic Encoder Series has this capability. The following information will assist in understanding the output form and expectations in PWM Mode.

Pulse-Width Modulation (PWM) Output

The Model EMS22P provides a PWM output with a duty cycle proportional to the measured angle and can be calculated with the following formula:

$$Position = \frac{t_{on} * 1025}{(t_{on} + t_{off})} - 1$$

The PWM frequency is internally trimmed to an accuracy of ±5 % (±10 % over full temperature range). This tolerance can be cancelled by measuring the complete duty cycle as shown above.

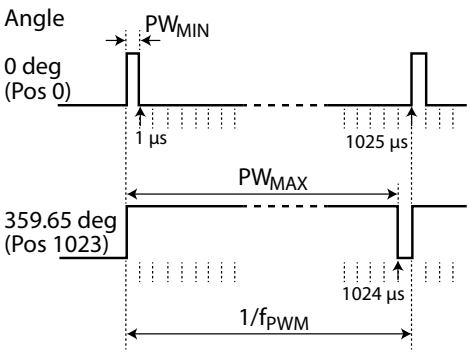

Figure 1 | *Minimum and Maximum Pulse-Width of PWM Signals (source: austriamicrosystems AG)*

Table 1 | *PWM Signal Parameters*

Parameter	Symbol	Typical	Unit	Note
PWM frequency	f_{PWM}	0.9756 kHz	kHz	Signal period: 1025 µs
Min. pulse width	PW_{MIN}	1 kHz	µs	Position: 0 degrees Angle: 0 degrees
Max. pulse width	PW_{MAX}	1024 kHz	µs	Position: 1023 degrees Angle: 359.65 degrees

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Pulse-Width Modulation (PWM) Output *(Continued)*

Measuring the complete duty cycle to compensate for PWM frequency variation from part to part or over the temperature range will eliminate the measuring error because the position ratio is calculated on $1/f_{PWM}$ as shown with the following formula:

$$Position = \frac{t_{on}}{{}^{1}/_{f_{PWM}} - \left(\frac{{}^{1}/_{f_{PWM}}}{1025}\right)} \%$$

Table 2 | *PWM Signal Parameters*

Parameter	Symbol	Typical	Unit	Note
Min. pulse width	PW_{MIN}	1 kHz	0.10 %	Position: 0 degrees Angle: 0 degrees
Max. pulse width	PW_{MAX}	1024 kHz	100.00 %	Position: 1023 degrees Angle: 359.65 degrees

Conclusion

The Bourns® EMS22 Non-Contacting Encoder Series has the capability to operate in the digital realm with Pulse-Width Modulation (PWM) modes. These encoders can handle designated harsh environments where extreme levels of temperature, moisture and particles are present with no effect on performance characteristics. Design engineers with constraints such as cost, space, circuit complexity and resolution will appreciate the unique features and benefits of the Bourns® Model EMS22 Non-Contacting Magnetic Encoder Series.

The EMS22 non-contacting encoder is ideal for use in harsh environments where extreme levels of temperature, moisture and particles are present. The outstanding performance of this device is attributed to the non-contacting technology and superior performance of the austriamicrosystems* AS5040 Hall Effect ASSP. In addition, this product is sealed to IP** 65 with an optional upgrade to IP 67.

* Pulses per Revolution

** Ingression Protection

For more information on the Bourns® EMS22 Rotary Magnetic Encoder Series, please visit

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