

Bourns® Sensors & Controls

Model EM14 Brochure



Bourns® Model EM14 Product Description

Bourns® Model EM14 is a self-contained rotary optical encoder. It produces a 2-bit incremental quadrature signal, which is suitable for digital systems where both magnitude and direction of adjustment must be provided. The EM14 14 mm optical encoder is ideal for use as a digital panel control in human-to-machine interface (HMI) applications where long rotational life, reliability, and small package size are essential.

The EM14 Series encoder converts rotary input into electrical signals, which can be used by microprocessors without A/D conversion. Bourns encoder output signals are square wave digital pulses, which do not require additional external debounce circuitry. Both features make it possible to significantly reduce the memory overhead, wiring and interconnects required by other types of control devices.

EM14 optical encoders offer a useful rotational life of 1 million cycles (100,000 cycles with detent), making them ideal for extended service applications. The 14 mm square package is compact and well suited for applications where the available space is limited. The splash-proof shaft seal makes this device suitable for applications where occasional moisture may be encountered. The addition of detents gives the device the ergonomic feel of a standard contacting encoder with the reliability and long life of a non-contacting encoder. The optional momentary push switch can be utilized as a menu select function or an “on/off” function. For easy mounting, the EM14 comes standard with a front panel mount bushing and hardware.

The EM14 Optical Encoder is a “lead free” product in compliance with Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances (RoHS) in electrical and electronic equipment.



How Optical Encoders Work

Optical encoders utilize a light source, I/C receiver or ASIC, and a code disk to generate the digital signal as shown in Figure 1. Light passing through slots in the code disk is detected by the ASIC and translated into a digital pulse output signal. Since an optical encoder does not have a mechanical contacting wiper, the device has an extremely long useful life. The custom ASIC designed by Bourns delivers a signal essentially free of noise and distortion.

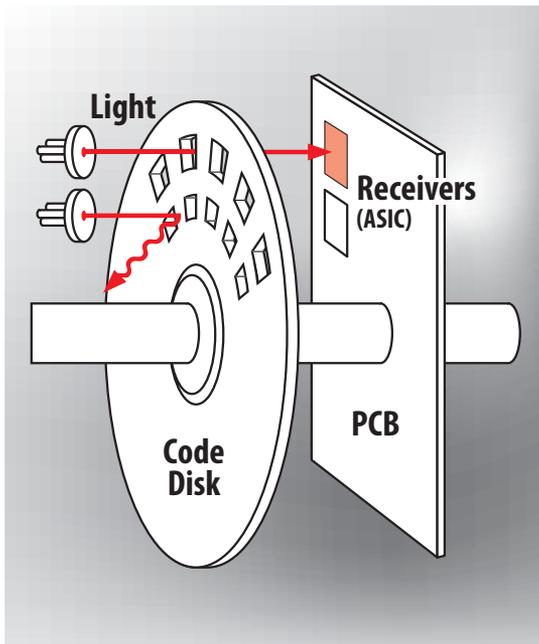


Figure 1

The Quadrature Output Table in Figure 2 shows the standard electrical signal produced by the EM14 Series optical encoder. Channel A is shown leading Channel B by 90 electrical degrees with clockwise shaft rotation.

Conversely, Channel B leads Channel A by 90 electrical degrees with counter-clockwise shaft rotation. Output voltages are compatible with

HCMOS, CMOS and TTL systems. Up to 64 quadrature output cycles per shaft revolution are available in this compact 14 mm package.

The electrical block diagram in Figure 3 provides the designer with a functional overview of the EM14. This design has a very low power consumption of only 26 mA, making it suitable for use in battery-operated applications. The ASIC also has a very high switching rate of 200 ns, which produces the clean switching signal and distortion free output.

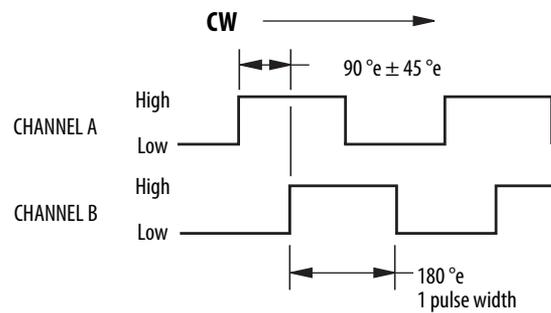


Figure 2

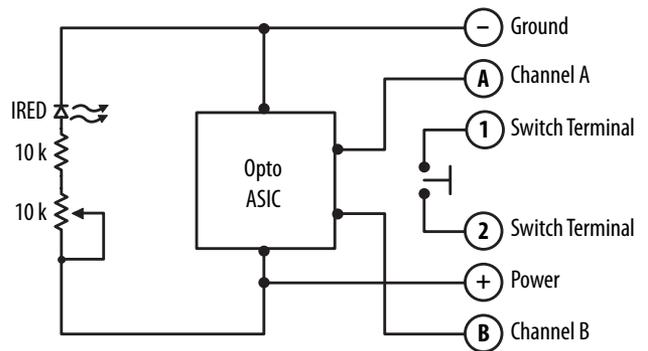


Figure 3

Typical Interface Circuits

Optical encoders can be used to create an absolute output that is the digital equivalent to the output from a potentiometer. However, absolute optical encoders with moderate-to-high resolutions are generally cost prohibitive. As a result, most encoders are of the incremental variety.

Incremental encoders produce a 2-channel quadrature signal providing enough information to allow a digital processor to determine both magnitude and direction of adjustment. By means of logic circuitry shown

in Figure 4a and 4b, a system's counter can be incremented "up" or "down" depending on the direction of the encoder's shaft rotation. With the capacity to control direction of adjustment as well as magnitude, the incremental encoder can be used in almost any control or position sensing application. If necessary, rise/fall times can be reduced using the inverters shown in Figure 4c. However, it should be remembered that an incremental encoder is only a circuit adjusting device and is not capable of producing or retaining absolute position information.

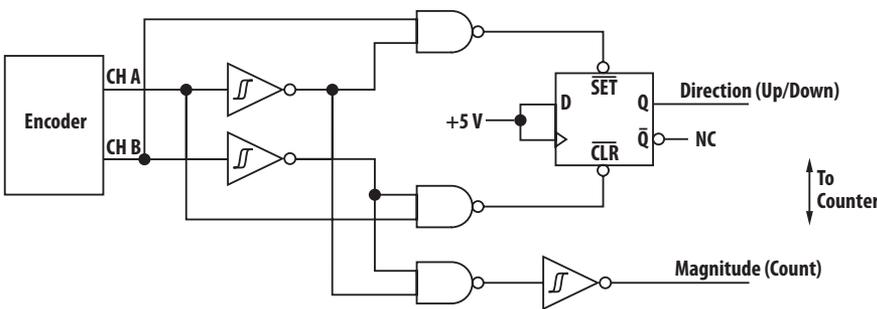


Figure 4a: Typical circuit for producing direction (up/down) and magnitude (count) signals.

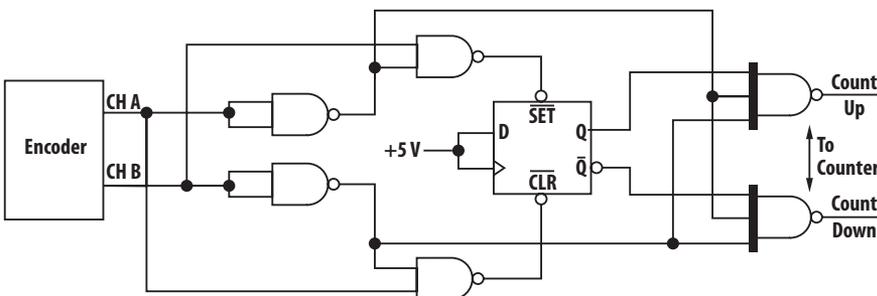


Figure 4b: Typical circuit for producing count up and count down signal.

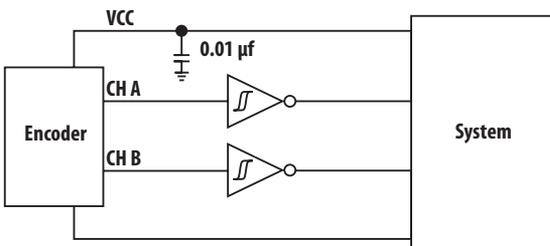


Figure 4c: Suggested method for reducing signal rise/fall times.

Applications

The Bourns® EM14 Optical Encoder may be used as a manual input device for digitally controlled equipment such as:

- **Professional Audio**

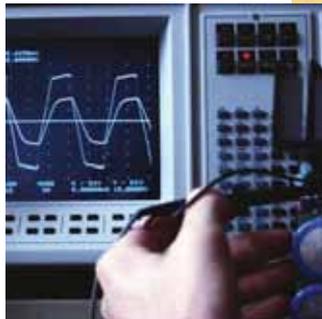
- Studio mixing consoles
- Broadcast consoles
- Signal processing equipment
- Guitar amplifiers
- Keyboard controllers
- Digital drums



- **Medical Instrumentation***
 - Sonogram controls
 - X-ray controls
 - Ultrasound
 - Patient monitoring
 - Motorized bed controls
 - Motorized dental chair controls

- **Test and Measurement**

- Environmental chamber controls
- Oscilloscopes
- Frequency analyzers
- Amplifiers



- **Industrial Equipment**
 - Motor speed controls
 - Equipment positioning controls
 - Automated processing controls
 - Industrial joystick controls

- **Avionics**

- Air traffic controls
- Simulator controls
- Cockpit controls



- **Other Applications**
 - Welder controls
 - Security camera position
 - Liquid dispensing controls

*Excluding critical life support.

EM14 vs EN Series Encoder

Bourns® EM14

- Up to 64 PPR
- Switch Option
- Detent Option
- 14 mm Square Package
- Metal Shaft Standard
- Metal Bushing Standard
- Ball Bearings Not Available
- HMI* Only
- Low Cost



Bourns® EN Series

- Up to 256 PPR
- Switch Not Available
- Detent Not Available
- 16 mm x 22 mm Package
- Metal Shaft Standard
- Metal Bushing Standard
- Ball Bearing Option
- HMI or MMI**
- High Cost



*HMI: Human-to-machine interface

**MMI: Machine-to-machine interface

Features	Benefits
• 2 channel quadrature output	• Provides clean digital signal
• Custom ASIC design	• No debounce filter required, TTL/CMOS/HCMOS compatible
• Bushing mount	• HMI applications
• Optical design	• High reliability/long life
• Low current draw	• Excellent for battery applications
• Optional push switch	• Control for on/off or menu driven applications
• Optional detents	• Good ergonomic feel
• Shaft splash seal	• Protects from moisture ingress
• Lead free	• Environmentally friendly

Modification Capabilities and Value Added Solutions

The EM14 Rotary Optical Encoder can be customized to suit your customer's application and design needs. Capabilities to develop custom solutions and modifications include:

- **Bushing** - Special lengths and thread pitch can be accommodated.
- **Shaft** - Special lengths, flats, slots or plain shaft can be provided. Custom holes, notches, or grooves can also be accommodated.
- **Resolution** - Custom resolutions between 8 PPR and 64 PPR can be provided.
- **Marking** - Customer part number or other designation can be marked on the part.
- **Mounting Brackets** - Custom mounting brackets can be designed to suit the customer's application.
- **Cable/Connector** - Custom cable harness of specified length and end connector can be provided.
- **Hardware** - Additional hardware or custom size hardware is available on request.



Competitive Comparison

Bourns® EM14	Grayhill 62A	Agilent HRPG
• Up to 64 PPR	• Up to 8 PPR	• Up to 32 PPR
• Switch Option	• Switch Option	• Switch N/A
• Detent Option	• Detent Option	• Detent Option
• 14 mm Square Package	• 12.5 mm x 19 mm Package	• 16 mm x 20 mm Package
• Metal Shaft Standard	• Metal Shaft Standard	• Metal Shaft Standard
• Metal Bushing Standard	• Metal Bushing Standard	• Metal Bushing Standard
• Splash Seal	• Splash Seal Not Available	• Splash Seal Not Available
• Lead Free	• Lead Free Not Available	• Lead Free Not Available
• Low Cost	• Low Cost	• High Cost





Worldwide Sales Offices

Country	Phone	Fax
Benelux:	+31-70-3004333	+31-70-3004345
Brazil:	+55 11 5505 0601	+55 11 5505 4370
China:	+86-21-64821250	+86-21-64821249
France:	+33-254-735151	+33-254-735156
Germany:	+49-69-80078212	+49-69-80078299
Hong Kong:	+852-2411 5599	+852-2412 3611
Ireland:	+44-1276-691087	+44-1276-691088
Italy:	+39-02-38900041	+39-02-38900042
Japan:	+81-49-269 3204	+81-49-269 3297
Singapore:	+65-63461933	+65-63461911
Switzerland:	+41-41-7685555	+41-41-7685510
Taiwan:	+886-2-25624117	+886-2-25624116
UK:	+44-1276-691087	+44-1276-691088
USA:	+1-951-781-5500	+1-951-781-5700
Non-Listed European Countries:	+41 (0)41 768 5555	+41 (0)41 768 5510

Technical Assistance

Region	Phone	Fax
Asia-Pacific:	+886 2 25624117	+886 2 25624116
Europe:	+41 (0)41 768 5555	+41 (0)41 768 5510
North America:	+1-951-781-5500	+1-951-781-5700

www.bourns.com

Bourns' products are available through an extensive network of manufacturer's representatives, agents and distributors. To obtain technical applications assistance, a quotation, or to place an order, contact a Bourns representative in your area.

Specifications subject to change without notice. Actual performance in specific customer applications may differ due to the influence of other variables. Customers should verify actual device performance in their specific applications.



Sensors & Controls

"Bourns" is a registered trademark of Bourns, Inc. in the U.S. and other countries.

COPYRIGHT © 2004, BOURNS, INC. • LITHO IN U.S.A. • DP 09/04 • 25M/SC0415