Application Note

Enhancing the Performance and Flexibility of Studio Mixing Consoles with Bourns® Rotary Optical and Magnetic Encoders

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Advancements in computer and component technology have created a genesis in professional audio equipment, allowing studio mixing consoles to offer increased functionality in similar or smaller overall footprints. A collection of faders, rotary controls, and switches provide a layout for processing sound, including audio mixing, signal routing, blending effects, manipulating tracks, and combining multiple digital and analog audio input sources. The experience is enhanced with rotary optical encoders and magnetic encoders, providing a programmable means of customizing controls to adjust various audio characteristic adjustments, and interfacing with on-screen menus.

How Rotary Optical Encoders Work

Optical encoders utilize a light source (InfraRed Emitting Diode or IRED), code disk, and detector/receiver (Application Specific Integrated Circuit or ASIC), as shown in figure 1, to generate the digital output signal. Light passing through slots in the code disk is detected by a custom ASIC with a switching rate as low as 200 ns and translated into a digital output pulse essentially free of noise and distortion. Since an optical encoder does not have a mechanical contact wiper, wear is only limited by the shaft/bearing interface. Magnitude and direction of adjustment are provided by the 2-bit incremental quadrature output signals.

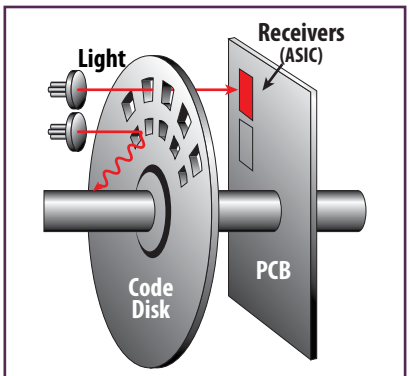

Figure 1 | *Optical Encoder*

Bourns® Model EN 22 mm Optical Encoder is available with resolution of up to 256 PPR and optional ball bearings for extended life of up to 200 million rotational cycles. Splash-proof shaft seals are available on some versions for moisture concerns. Other available product capabilities include custom shaft and bushing lengths, and cable/connector options.

Bourns® Model EM14 14 mm Optical Encoder is available with resolution of up to 64 PPR and an optional momentary push switch. This rotary encoder is available with detents and flatted or slotted shaft styles. A splash-proof shaft seal is standard on this model. Cable and connector options are also available.

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How Rotary Magnetic Encoders Work

Magnetic encoders utilize a Hall effect Application Specific Standard Product (ASSP) capable of producing four distinct output waveforms. The encoder produces a sinusoidal signal by rotation of a magnet in close proximity to the ASSP as shown in figure 2. The signal is then converted to the desired output waveform as factory preprogrammed to produce a quadrature, direction/step, pulse-width modulated, or absolute signal output. Similar to the optical encoder, the magnetic encoder does not have a mechanical contact wiper, so wear is only limited by the shaft/bearing interface.

Bourns® Model EMS22 22 mm Magnetic Encoder is available with resolutions of up to 256 PPR for 2-bit quadrature, 512 PPR for step/direction, and 1024 position for pulse-width modulated or absolute signal outputs. Optional ball bearings are available for extended life of up to 100 million shaft revolutions. Splash-proof shaft seals are available on some versions for moisture concerns. Other available product capabilities include custom shaft and bushing lengths, and cable/connector options.

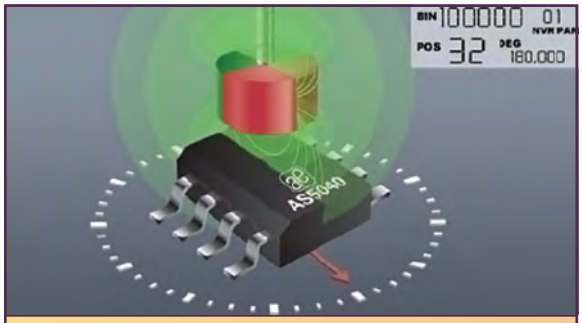

Figure 2 | *Magnetic Encoder*

Functions of a Rotary Encoder in a Studio Console

Rotary optical encoders are ideal for individual channel attenuation level, EQ, pan, auxiliary level, input level, and custom assignable controls in studio mixing consoles. Jog shuttle control, possible with these encoders, allows scrolling of menu options and searching for specific points within audio files for editing. An optional momentary push switch can be utilized for menu selection, power, or activation/deactivation functions. These functions allow digital mixing consoles to incorporate greater functionality and flexibility without increasing the number of controls on a panel.

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Typical Interface Circuits in Studio Mixing Consoles

Generally, the output of the encoder is fed through logic circuitry to trigger a system's counter. In turn, the counter triggers a function in the preprogrammed microprocessor to perform a specific function, whether panning from one channel to another, setting a specific tone on an EQ, or setting a level input/output. Rotation of the encoder triggers a response from the preprogrammed microprocessor depending on the direction and degree of rotation. The electrical block diagrams in figures 3 through 5 below provide typical digital circuits used with optical and magnetic encoders.

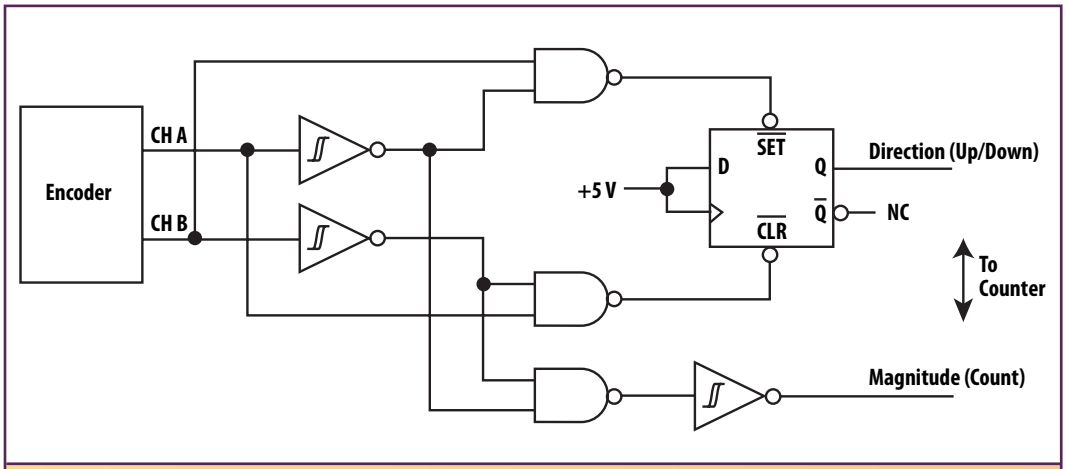

Figure 3 | *Typical circuit for producing direction (up/down) and magnitude (count)*

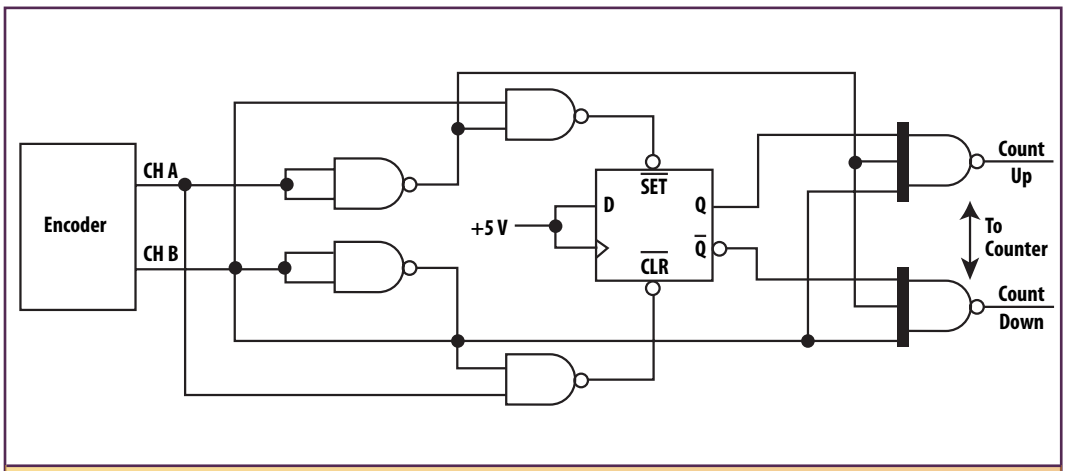

Figure 4 | *Typical circuit for producing count up and count down signals*

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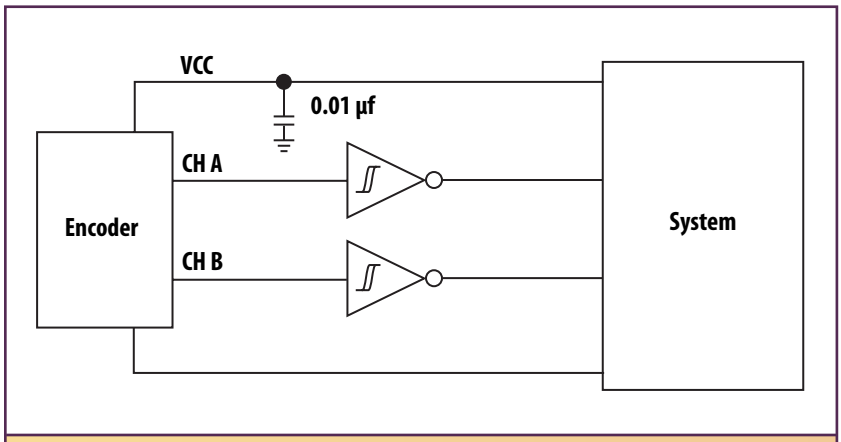

Figure 5 | *Suggested method for reducing signal rise/fall times*

Using Filters with Optical and Magnetic Encoders

Bourns® Optical and Magnetic Encoders do not require the use of filters. The custom ASIC utilized in the optical encoder has built-in signal filtration and provides a clean output signal. The austriamicrosystems® ASIC utilized in the magnetic encoder also provides a clean output signal. However, if the equipment is to be used in an area where there is constant low level vibration, Schmitt triggers devices should be used to prevent false triggering of the encoders. Software filters can also be utilized with similar results.

Advantages of Using Rotary Encoders in a Studio Console

Studio mixing consoles using rotary optical and magnetic encoders have an advantage over those with potentiometers in terms of memory overhead, wiring, and program speed. Utilizing encoders makes it possible to significantly reduce the memory overhead, wiring and interconnects required for flexible functionality. Designed for use in dynamic applications such as studio mixing consoles, Bourns® rotary optical and magnetic encoders provide the durability, flexibility, and functionality that audio professionals desire.

For further technical support and for complete pro audio solutions, please visit

www.bourns.com/proaudio

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