LS30 Rotary Encoder Switch Debounce/Noise-Rejection IC

General Description

The LogiSwitch LS30 Rotary Encoder Switch Debounce IC utilizes LogiSwitch NoBounce™ Technology to debounce inherently noisy mechanical rotary encoders. The LS30 generates a clean Pulse (P) signal to indicate the end of a click cycle and the Direction (D) signal to indicate the rotation direction. There is also a Switch In (SI) and a corresponding debounced Switch Out (SO) in the case that the rotary encoder includes a pushbutton switch.

When using LogiSwitch LS30 integrated circuits (ICs), no pull-up resistors are required on the inputs or outputs because these elements are included inside the device.

Features

- Eliminates switch bounce.
- Utilizes LogiSwitch adaptive NoBounce Technology.
- Bounce-free P output indicates successful completion of a "click" cycle.
- Bounce-free D output reflects the rotational direction.
- Debounced pushbutton output
- LS30 + mechanical encoder less than half the cost of an equivalent optical encoder.
- No external components required (excluding optional decoupling capacitors).
- Low impedance 25mA totem pole outputs.
- PDIP or SOIP package options

Also, no external components (like resistors and capacitors to implement RC filters) are required on the A, B, or SWI inputs.

It is recommended (although not mandatory) that a 0.1μF capacitor is connected between the power and ground pins (as close to the pins as possible) to compensate for any problems in the power supply. Also, it is suggested that a 0.01μF capacitor is connected between the power and ground pins (as close to the pins as possible) to filter any high-frequency noise, such as electromagnetic interference from other equipment.

Device Information

Part Number	Package	Size Information
LS30-P	PDIP (8)	Plastic DIP 300 mil
LS30-S	SOIC (8)	Narrow SOIC 150 mil

Pin Description LS30

Pin	Name	Function
1	VDD	+2.3 V to +5.5 V Supply Voltage
2	A	Normally Open Switch Input A
3	B	Normally Open Switch Input B
4	SWI	Normally Open Pushbutton Switch Input
5	SWO	Normally High Pushbutton Switch Output 2
6	D	Direction Output (Powers Up Low)
7	P	Pulse Output (Powers Up Low)
8	VSS	Ground Reference (Switch Common)

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2.3V to 5.5V

0.01µF

Recommended

0.1µF

Pin 1

Pin 8

VDD   GND

From Rotary Encoder

A ——— A   P ——— Pulse

B ——— B   D ——— Direction

SW_In ——— SWI   SWO ——— SW_Out

To Microcontroller

LS30

Anticlockwise (B leads A) — Click Click

Clockwise (A leads B) — Click Click Click

Anticlockwise (B leads A) — Click

A

B

t_{pr}

P

t_{dr}

t_{pw}

D
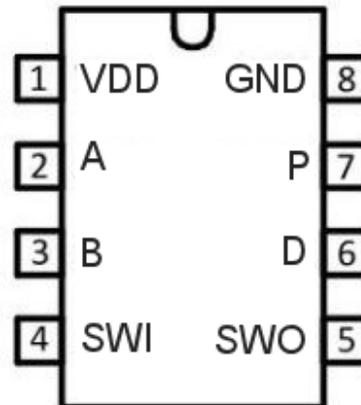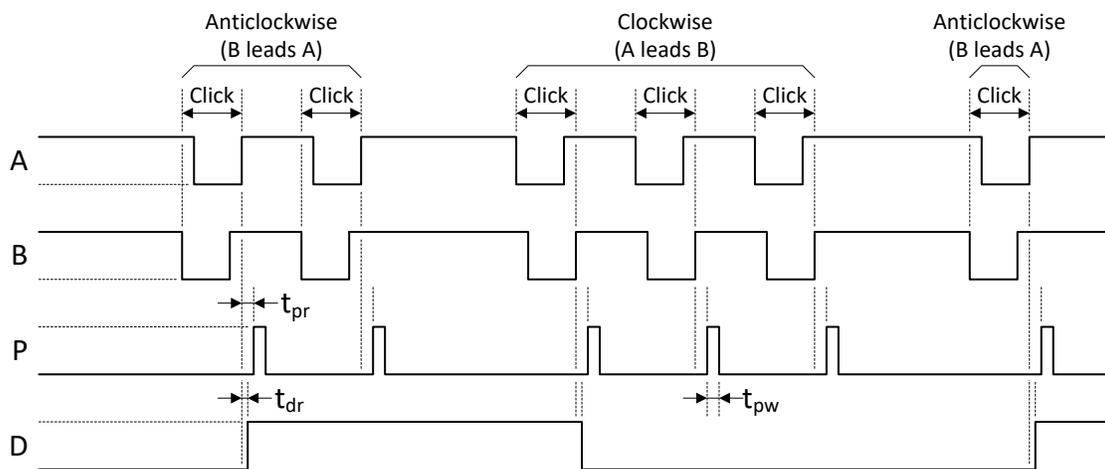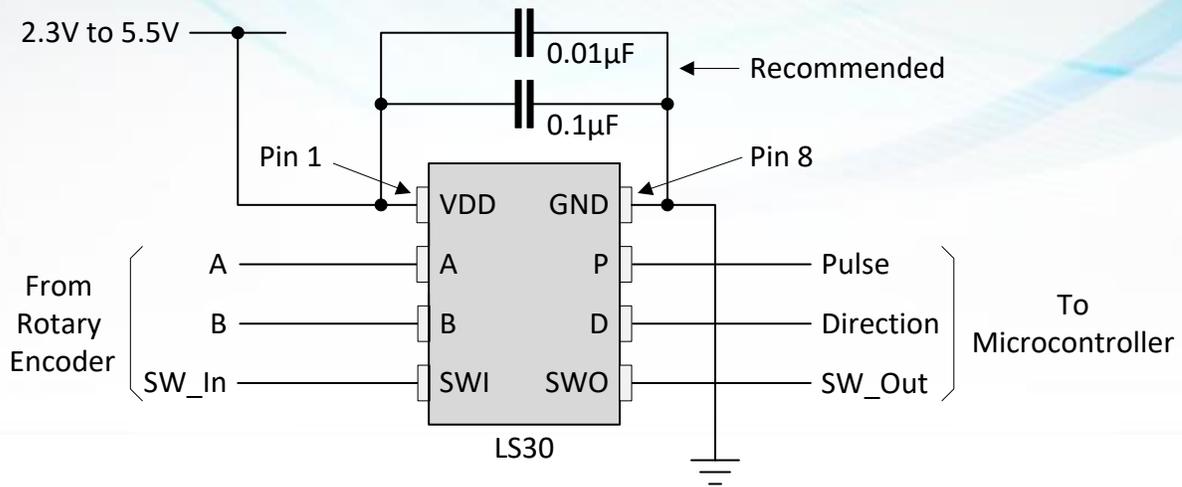
The LS30 is intended for use with incremental rotary encoders (quadrature encoding). The LS30 will work with all forms of these encoders, including mechanical, optical, capacitive, and magnetic implementations.

The LS30 powers up with the P (Pulse) output low and the D (Direction) output low (thereby indicating a default direction of clockwise). A high-going pulse on the P output indicates that a rotational "click" has occurred. A 0 on the D output indicates clockwise rotation; a 1 on the D output indicates anticlockwise rotation.

The default states of the A and B inputs from the rotary encoder are high (11). A clockwise "click" of the encoder causes the A and B outputs to go through the sequence 11 (start), 01, 00, 10, 11 (end), with A leading B.

An anticlockwise "click" of the encoder causes the A and B outputs to go through the sequence 11 (start), 10, 00, 01, 11 (end), with B leading A.

The P and D outputs respond at the end of a click cycle. Assuming the direction of rotation is changing, then the D (Direction) output changes first followed by the P (Pulse) output.

Once the D output has been set to indicate clockwise or anticlockwise rotation, it will remain in this state until the user starts to rotate the encoder in the opposite direction.

A positive-going edge on the P signal can be used as an interrupt to the microcontroller. The corresponding interrupt service routine (ISR) can then check the state of the D signal. Alternatively, the program can simply poll the P signal waiting for it to change (the width of the pulses on the P signal are 5ms).

The A and B signals shown in the diagram above do not reflect any noise or switch bounce. In the case of mechanical rotary encoders, there can be a substantial amount of switch bounce on these. The amount of switch bounce can increase as a function of rotational speed and the age of the device. The LS30 addresses any switch bounce on the A and B inputs and generates clean signals on the P and D outputs.

The SWO (Switch Output) signal is a debounced version of the SWI (Switch Input) signal from the pushbutton switch on the encoder. The output follows the input 20ms after the final bounce (this signal behaves like one of the channels on an LS18 device; see the LS18 datasheet for more details).

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LS30 Operating Conditions

Parameter	Min	Typ	Max	Units	Comments
Operating Temperature	-40		+85	°C	
t_{bnc} Bounce Time	0	~1		ms	Dependent on the switch
t_{cltm} Clean Time	18.2	20.0	21.0	ms	-40°C -+85°C Vdd 2.5V – 5.5V
t_{dbnc} Debounce Time	$t_{bnc} + t_{cltm}$				

Electrical Specifications

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Operating Voltage Range	Vcc		2.5		5.5	V
Supply Current	Icc	Vcc = 3.0 V, All Inputs Open		1.0	1.6	mA
Input Pull-up Current per Pin	Ipu		25	100	200	µA

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Supply current	Icc	Vcc = 3.0V, All Inputs Open		1	1.6	mA
Input Pull-up Current per Pin - Switch Closed	Ipu		25	100	200	uA
Debounce Time	t_{dbnc}	Vcc = 2.5V to 5.5V		21		ms
Output Pin Drive Current	Iout	Source or Sink			25	mA