Precision Digital Presents

The Fundamentals of Pulse Inputs

PRECISION DIGITAL

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Agenda, Objectives, & Takeaways

Understand the theory and definitions behind pulse signals

Become familiar with the specifications that describe pulse signals

Pros and Cons of pulse signals

Put it all together with real world applications

Getting to know you

- Where are you located?
- What is your industry?
- What is your level of expertise?

Theory, Terms & Definitions

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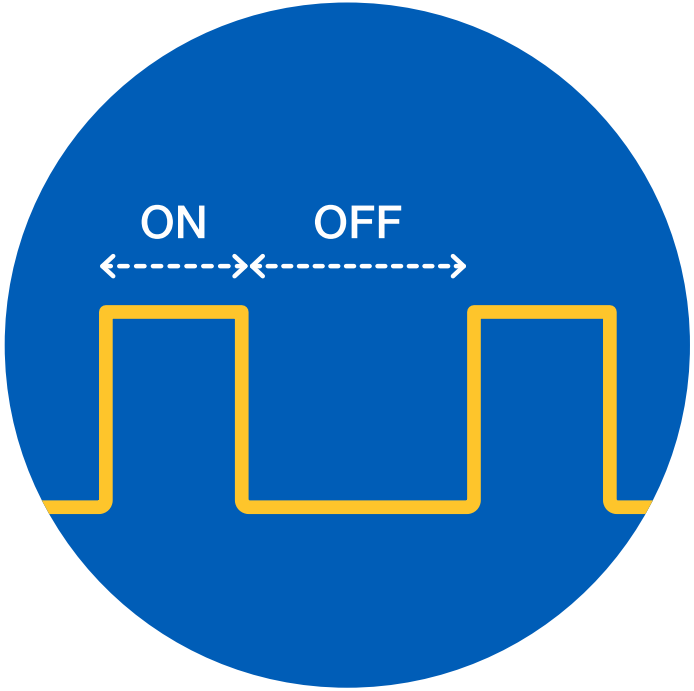
What is a pulse signal?

- A “pulse” process signal is a two-wire signal that at any given moment is in an ON or OFF state.
- The number of ON voltage “pulses”, and their speed, are the key to determining the process variable.
- Unlike a 4-20 mA signal, a pulse signal is always either ON or OFF at a point in time. The ON/OFF states change very quickly, and the ON state can be very short (i.e. 0.1 ms)



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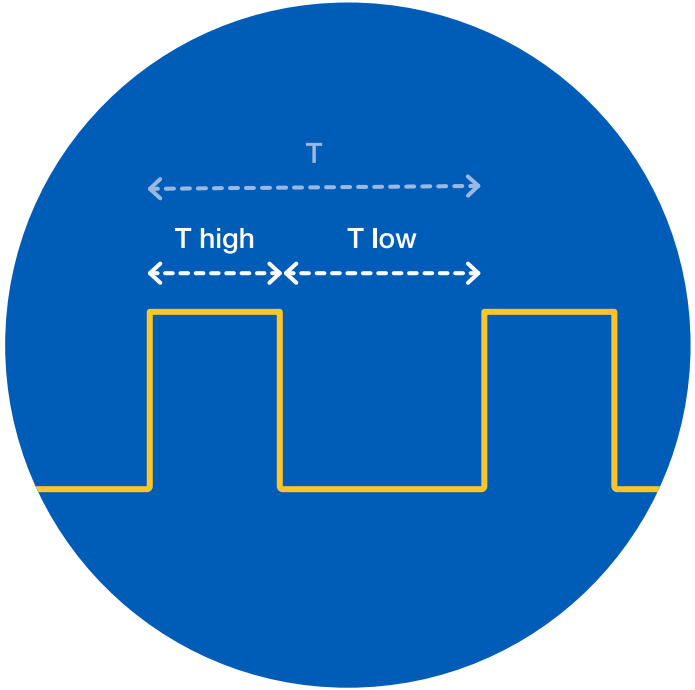
Looking at a ideal pulse signal



- Sharp ON (high) and OFF (low) voltage transitions
- Only 2 states, ON and OFF
- V_{OFF} = 0 V
- V_{ON} = 5+ V
- *Definitions:*
  - *Amplitude* is the height, or voltage level of the signal
  - T = *Period* of the Pulse Signal, the time for one ON/OFF cycle
  - *Frequency* is the number of ON/OFF cycles per second

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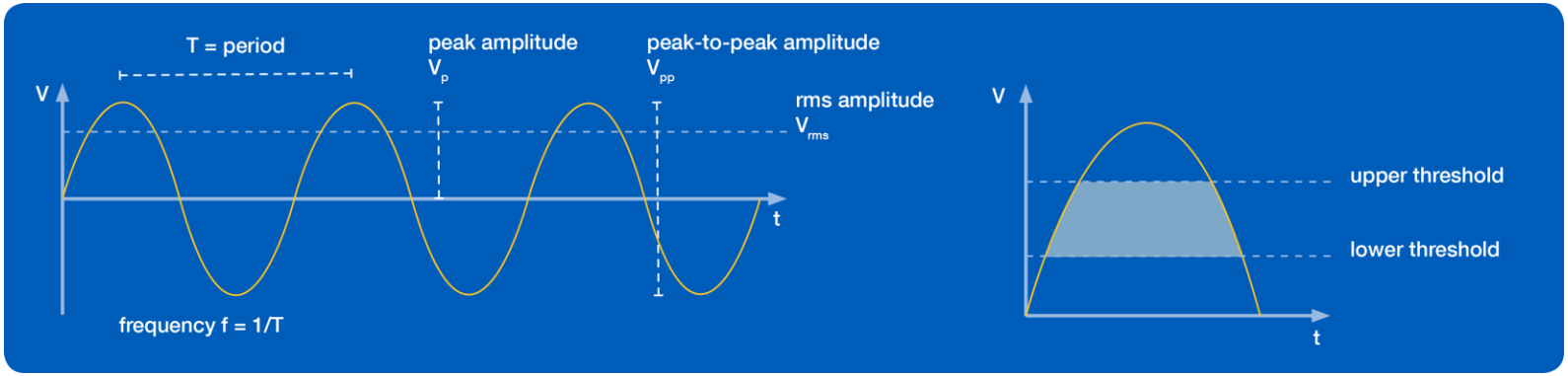
Other pulse signal waveforms



- Any type of waveform can be a pulse output, not just a square wave
- **Example:**
  Magnetic coil pickup flowmeter outputs generate a sine wave. The pulse is considered high or low when it passes the threshold voltage specified in the meter specifications.

For a PD6830 flow totalizer:
HI/LOW Thresholds

Setting	Low (V)	High (V)
Normal	1.2	2.0
Low	0.2	1.2

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How is the pulse generated?

- There are a number of pulse output flow meters that can generate pulses. Each is a unique technology.
- Some common flow meter types are positive displacement or turbine technology, where the design requires that for every liquid gallon pushed through the pipe, X pulses will be generated.
- Note that many other forms of pulse output meter technologies can also be used. The following are just some common examples.

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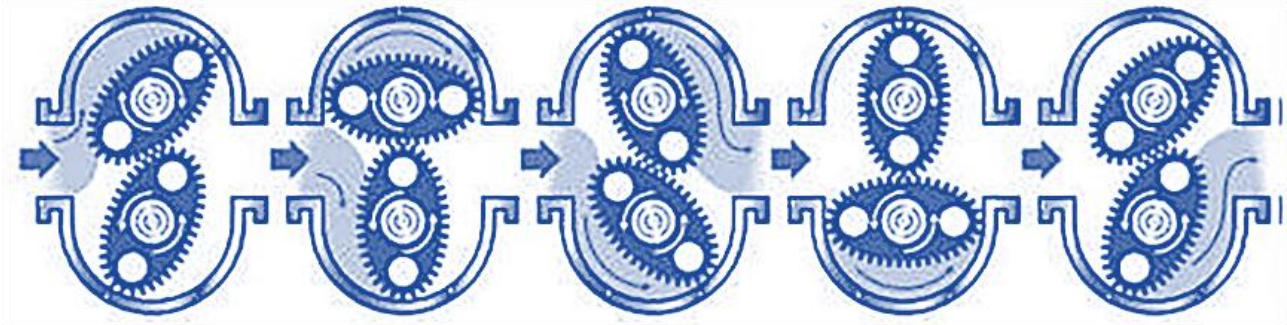
Positive displacement meters



- Operation of these units consists of separating liquids into accurately measured increments and moving them on. Each segment is counted by a connecting register (the device that counts and often displays pulses). Because every increment represents a discrete volume, positive-displacement units are popular for automatic batching and accounting applications.

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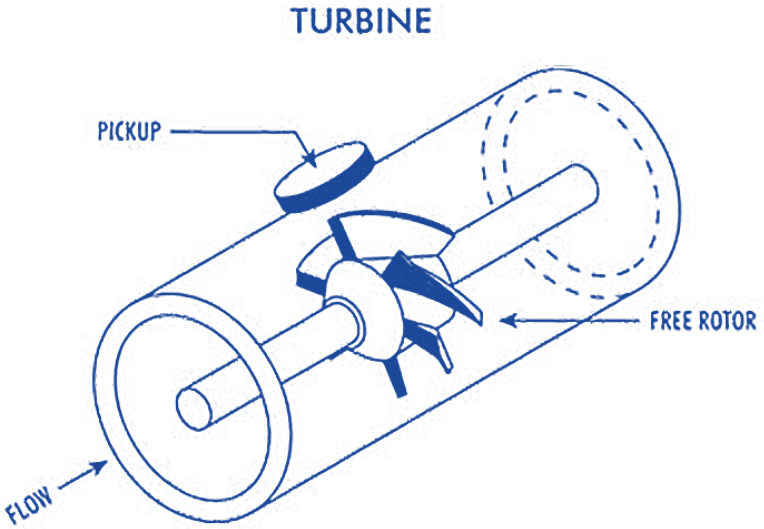
Turbine Meters

- Turbine meters have found widespread use for accurate liquid measurement applications. The unit consists of a multiple-bladed rotor mounted with a pipe, perpendicular to the liquid flow. The rotor spins as the liquid passes through the blades. The rotational speed is a direct function of flow rate and can be sensed by magnetic pickup, photoelectric cell, or gears.



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Common Pulse Generating Device Characteristics

- One Pulse equals a specific value (volume, distance, speed, etc.)
- Often generated by rotating equipment
- Requires little or no power
- Usually connected to a register/meter, which will count and interpret pulses, often display the relevant process variable, and may retransmit the pulses as an easier to work with signal.

Specifications

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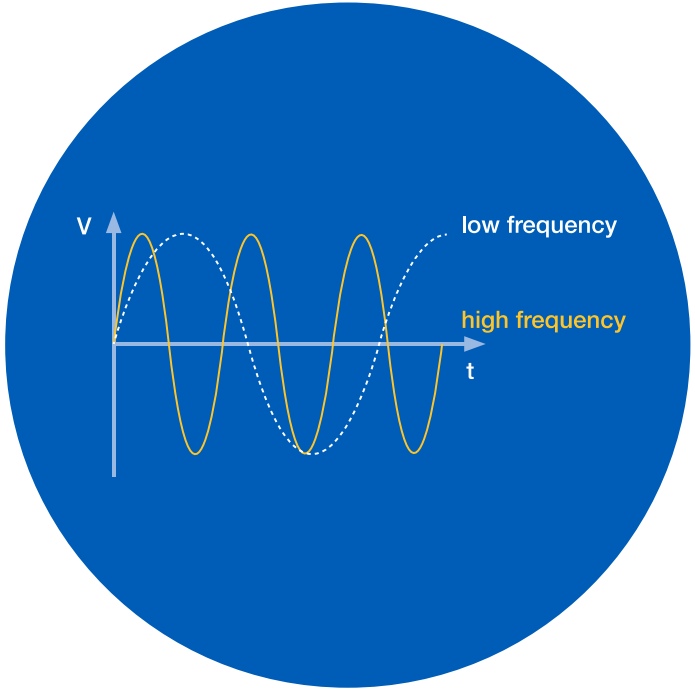
Maximum frequency



- The maximum frequency (speed) the pulses can run at.
  - Measured in Hz (or kHz), this is how many pulses/second the device is capable of handling.
  - Very fast speeds, such as 30 kHz is not uncommon.
- A device may have different maximum frequencies based on the type of pulse.

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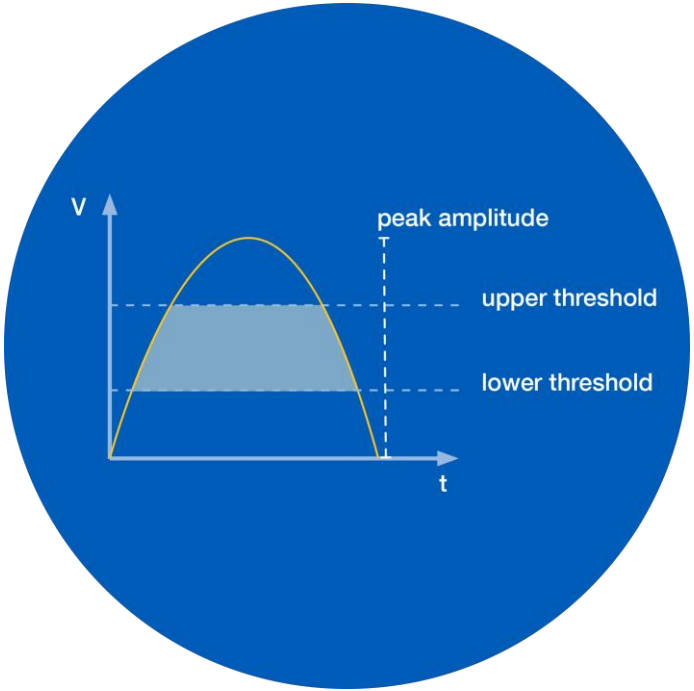
Voltage Peak and Threshold

- The pulse receiver must be able to pick up the voltage range generated by the pulse generator.
- Pulse Amplitude
  - The voltage levels of the generated pulses
- Voltage Threshold
  - The high and low voltage levels that equate to a HI or LOW at the pulse reciever
- On Magnetic Pickup Meters, Low Voltage Sensitivity is Critical
  - Mag pickup technology flow meters may provide a very low (ie: 20 mV_{P-P}) output sine wave pulse.
  - The amplitude (height/peak) of the pulse is determined by the flow rate; low flow makes low pulse amplitudes.



Getting to know you

- What is your primary application?

Questions?

- Please enter your questions in the ‘Questions’ chat window.

Pros & Cons

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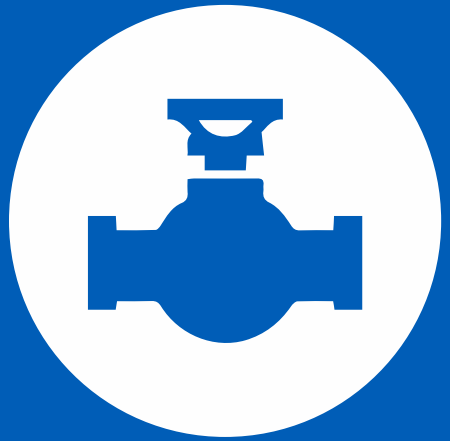
Pros and cons of pulse signals

Pros

- Direct measurement; highly accurate
- Could have good noise immunity
- No power required
- Low cost

Cons

- Devices must be compatible
- Could be susceptible to noise
- Complexity
- Signal run distance limited



Real World Applications

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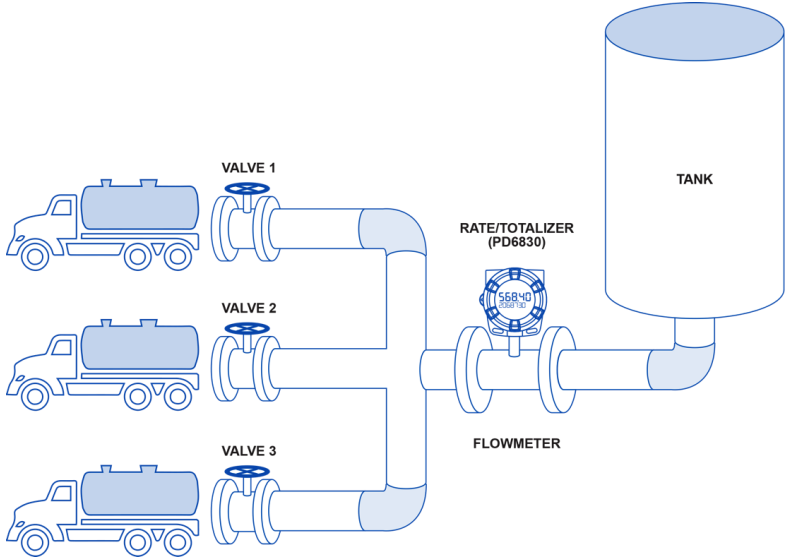
Example 1: Oil Feed Line Totalizing with Mag Pickup Flowmeter

- Oil passes through this feed line for a tanker filling station.
- Mag pickup flow meter requires no power.
- Battery powered register for flow rate display and totalization of oil.
- No external power required anywhere.
- Flow register mounted directly to the flow meter to reduce noise concerns and eliminate the need for a pre-amp or other expensive components.
- Mag pickup flowmeter required confirmation of register input specifications



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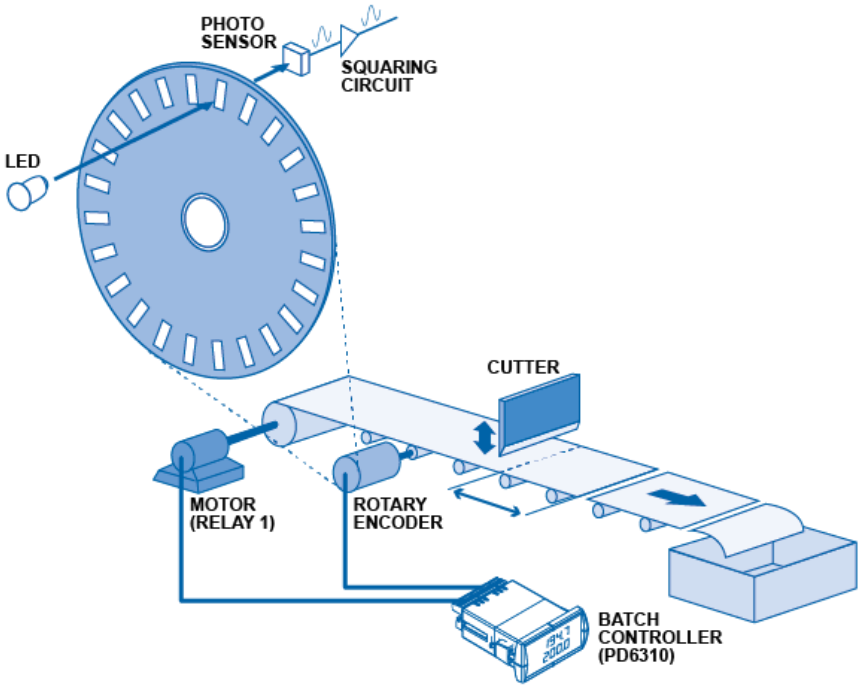
Example 2: Auto Feed for Polycarbonate Film Cutter



- Rotary encoder used to measure the length of the sheet unrolled.
- Batch controller used to feed the selected sheet length, and to act as a total feed register.
- Cutter controlled separately with safe controls and interlocks.
- Rotary encoder provides transistor output pulses.
- Batch controller with onboard transmitter supply counts pulses, and totals based on length.

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Summary

1. Gain an understanding of the theory and definitions behind pulse signals.
2. Become familiar with the specifications that describe pulse signals.
3. Pros and cons of pulse signals
4. Put it all together with real world applications.

Getting to know you

- How often do you specify digital displays?

Q & A

- Please enter your questions in the ‘Questions’ window
- Apologies if we do not get to your question today. We’ll contact you offline with a response as soon as possible.

Next Webinar – February 17

The Trouble with Ground Loops

- Learn about the infamous 4-20 mA “Ground Loop”, including what they are and how to avoid them.
- This webinar covers both true ground loops, as well as wiring issues as a result of shared commons on multiple 4-20 mA input devices.

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