Frequency / Pulse Devices & Applications
Agenda

• Sensor/Instrument Types
  Magnetic Pickup
  Photoelectric, Proximity, Capacitive
  Turbine Flow Meter
  Tachometers

• Applications

• Output Signal Measurement

• Acromag Interface Solutions
Magnetic Pickup

A magnetic pickup is essentially a coil wound around a permanent magnet. This creates a magnetic field around the Mag Pickup. An iron object moving past the sensing area changes the air gap which varies the magnetic field strength. An AC voltage output is developed.

magnetic flux - the lines of force surrounding a permanent magnet
Magnetic Pickup Applications

- **Engine RPM** - aircraft, automobiles, boats, buses, trucks, rail vehicles
- **Motor RPM** - drills, grinders, lathes, automatic screw machines
- **Material Handling** - food, textile, paper, printing, pharmaceutical
- **Industrial Equipment** - pumps, blowers, mixers, exhaust, ventilating fans
- **Vehicle control** - cruise control, antilock braking, speed sensitive steering
- **Flow measurement** - turbine flow meters
Magnetic Pickup Output
# Photoelectric / Inductive / Capacitive

These sensors are selected based upon the object material and distance.

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Typical Distances</th>
<th>Material</th>
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</thead>
<tbody>
<tr>
<td>Photoelectric</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diffuse</td>
<td>1” to 18”</td>
<td>Non-transparent</td>
</tr>
<tr>
<td>Retro-reflective</td>
<td>1 ft to 6 ft</td>
<td>Non-transparent</td>
</tr>
<tr>
<td>Thru-beam</td>
<td>2 ft to 20 ft</td>
<td>Non-transparent</td>
</tr>
<tr>
<td>Inductive Proximity</td>
<td>1/16” to 1“</td>
<td>Metal</td>
</tr>
<tr>
<td>Capacitive Proximity</td>
<td>1/16” to 1”</td>
<td>Non-Metal</td>
</tr>
</tbody>
</table>
Photoelectric

Photo eyes use a light sensitive element to detect objects and are made up of a light source and a receiver.

**Diffuse** - The light source and receiver are in one unit and the light is reflected off an object.

**Retro-reflective** - The light source and receiver are in one unit and the light is reflected off a reflector. An object is detected when it interrupts the light beam.

**Thru-beam** - The light source and receiver are in separate units. An object is detected when it interrupts the light beam.
Inductive Proximity

Power is applied to this prox sensor and a coil generates a high frequency magnetic field. The presence of a metallic object in the sensing area causes a change in oscillation amplitude. The rise or fall of the amplitude is detected by a threshold circuit that switches the sensor output.
Capacitive Proximity

This sensor generates an electrostatic field that reacts to changes in capacitance caused when an object enters this field. The capacitive coupling developed between the object and the sensor activates an oscillation circuit. This is detected by a threshold circuit that switches the sensor output.
Photoelectric / Inductive / Capacitive Applications

- **Material Handling** - production, packaging, storage
- **Conveyors** - detection, position, sorting
- **Automation** - inspection, assembly, counting, level
- **Manufacturing systems** - printing, machinery
- **Materials processing** - plastic molding, metal working
- **Process industries** - food & beverage, pharmaceutical
These sensors can be DC or AC powered. The DC powered is most common and generally have unipolar square wave outputs. If switched continuously, a pulse train is generated.

Common DC outputs:
- Open Collector - Circuit drives low or high. Requires load resistor.
- Powered - Circuit drives low and high.
- Namur - Changing resistance circuit. Requires amplifier to switch.
Turbine Flow Meters

A turbine flow meter measures both liquid and gas. It has a rotor that turns at a speed that is proportional to the flow velocity. A magnetic pickup is mounted above the rotor. The sensor generates a pulse each time a rotor blade passes by. Outputs can represent a frequency (rate) or pulse (to totalize).
Tachometers

Rotational Speed Detection of:
• Engine Speed
• Dynamometers
• Rolling Mills
• Fan speed in Wind Turbines
• Rotating machinery
• Vibration monitoring
Acromag Solutions - Frequency / Pulse Inputs

**TT Series**
Windows programming via USB

**Model TT239-0600**
4-20mA Sink or Source Loop Powered Output

**Model TT339-0700**
V, I Outputs
Bipolar: ±10V, ±20mA Redundant Power
Programming Acromag TT Transmitters

Convert RPM to Frequency: (mpu, max engine speed is 2400 RPM, 120 tooth gear)

\[ 2400 \text{ R/M} \times \frac{1 \text{M}}{60 \text{ sec}} \times 120 \text{ teeth (pulses)} = 4800 \text{ Hz (pulses/sec)} \]

I/O Configuration

Scale the I/O: 
- Input: 0 to 4800 Hz
- Output: 4 to 20mA

Threshold: select Bipolar or Unipolar

Load Resistor: Pull up, Pull down, Disabled

Cutoff: Choose minimum input frequency for output to go to zero level

Debounce: The amount of time after a rising edge before the input is measured
Input Signal Averaging

These 2 features act together to create a moving average filter:
- **Sampling:** The number of samples that are averaged (125 max)
- **Output update:** The amount of time for each sample (5 Sec max)

Example:
- 100 samples
- 10 mSec output update

Input is averaged for 1 Sec (100 x .010 Sec)

The output is updated every 10 mSec based on a 1 Sec moving average of the input.
Pulse Width Modulated Inputs

Duty Cycle: \[ \frac{\text{On Time}}{\text{Total Time}} \times 100 \]

Ex: 1 to 99% input
4 to 20 mA output

Monitoring Pulsed Laser Applications include cutting and welding in:

- Automotive production
- Medical device technology
- Micro-processing of materials
- Tool and mold fabrication
- Electrical systems & electronics
TT Series Performance

Maximum Amplitude: $\pm 170VDC$ or $120VRMS$

Minimum Pulse Width: 2 - 10 microSec
(Based on max frequency input)

Freq. Duty Cycle: 1% Min to 99% Max

Scaling: Any range from 0 to 100K Hz
Can be 59.5 Hz to 61.5 Hz
Can be reverse acting

Operating Temp: -40°C to +80°C

Vibration: 25G Shock, 4G Vibration

Approvals: CE, UL, cUL, Class 1 Div 2
**TT Series Outputs**

**Model TT239-0600**
4-20mA Sink or Source
Loop Powered Output

**Model TT339-0700**
Voltage and Current Outputs
Can do Bipolar Outputs: ±10V, ±20mA

**Local Power Supply w/ Sourced Output**

**Loop-Powered w/ Sinking Output**

**Redundant Power**
Make the USB connection to a laptop running on battery power with no other devices connected. Or, an USB Isolator should be used to prevent potential ground loops between:

- A grounded PC and transmitter’s input circuit
- Multiple USB connected instruments
Acromag 841T-1500

- Pulse Inputs - To Count/Totalize
- Frequency Inputs - For Rate of Speed

Analogue output

Relay alarm output
Acromag 989EN-4016

- 16 DIO - 8 inputs can Count/Totalize pulses
- Ethernet Modbus TCP/IP communications

Input

- 32 bit counters - @ 4.3 billion counts
- Count up or down
- Up to 150 Hz
- Non-volatile memory
Summary

With Knowledge of your application:

1. Choose appropriate sensors
2. Understand sensor outputs
3. Select Signal Conditioner
4. Program / Configure
5. Consult Operating Manual for proper wiring and grounding
6. Verify
Thank you!

- Questions?
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