Applications

A speed response switch indicates motion, speed and assists in the control of rotating machinery.

If you need to know whether or not a shaft is rotating, running at an acceptable speed or which way it is rotating, consider using a speed responsive switch. Such a device can remotely indicate shaft motion and direction and activate control circuits at adjustable selected speeds. Numerous safety, sequencing, and interlocking control functions can be performed automatically with these versatile units.

Many automatic machine control actions are based on rotary shaft speed. Often a particular shaft speed and/or direction of rotation is important. For example:

1. In certain portions of a machine cycle, motion of any kind is unwanted.
2. Rotation in the wrong direction must be prevented.
3. A particular shaft speed marks the beginning of a dangerous overspeed or underspeed condition.
4. Sequential operations must take place at definite rotary speeds.

Where sensing and/or control of rotary speed is required, speed responsive switches are often the best choice. These rugged reliable components open or close electrical contacts at pre-set adjustable rotary speeds, in one or both directions of rotation. The contact operations can effect a variety of automatic indicating and control actions. A number of proved industrial applications for these units are listed below:

### Industrial Uses

**Electric Motors**
- Indicate rotation and/or direction of rotation.
- Plugging and anti-plugging or preventing overspeed.
- Provide speed governing and adjustable speed action for motors.

**Materials Handling Equipment**
- Indicate slowdown or stoppage of rotating shafts on rotary feeders, conveyors, bucket elevators, and other material handling equipment.
- Operate emergency braking equipment on cranes, hoists, etc.

**Production Equipment**
- Disconnect or stop drive if speed drops below normal due to a machine jam or other type of overload.
- Energize electromagnetic clutches and brakes at preset speeds.
- Indicate number of equipment starts and stops (with counter).
- Interlock equipment actions.
- Prevent accelerations, slowdowns and reversals of mixers and centrifuges.
- Provide overspeed and underspeed protection for machines and processes.
- Shift gears automatically (machine tool transmissions).
- Remotely indicate faulty operations of any rotating parts.

### General Uses

**Plugging**
A common use for a speed responsive switch is in plugging an electric motor. (Rapidly stopping an electrical motor by applying reverse power through a reversing contactor). Plugging increases the number of machine operations per unit of time by reducing the stopping time of the motor and the machine it drives. When used for plugging, a speed responsive switch acts with a magnetic control to allow reverse power to be applied to a rotating motor. The power is automatically removed by the switch when the motor approaches zero speed, to prevent undesirable reversing.

**Anti-Plugging**
Anti-plugging is used to prevent the application of reverse power to a motor operating above a preset speed. One area is in equipment with high inertia loads, where plugging from full speed in either direction could cause motor or equipment damage. A speed responsive switch used for anti-plugging will not allow a motor to be plugged until it has decelerated to a predetermined safe speed.

**Material Handling Interlocking & Sequencing**
Another useful application area for speed responsive switches is in bulk material handling systems. The illustration on the next page shows the various functions of speed responsive switches.

Switch “A” senses rotary feeder shaft motion. Slowing or stopping of the feeder shaft indicates a malfunction such as a jammed feeder or a plugged outlet. The speed responsive switch is set to open the drive motor circuit at some feeder shaft speed below normal.

**Switch “B”** monitors the speed of the elevator boot pulley, it senses a belt break or overload, or malfunction of the boot pulley.

All the speed responsive switches in this application can be interlocked so that slowing or stopping of one unit in the system will automatically shut down the whole system. This will prevent the pile-up of material in or on malfunctioning units.

**Additional Features**
A useful safety feature of some speed responsive switches is a magnetic lockout coil. This prevents false starting of a motor in a plugging circuit if an operator turns the motor by hand. The coil is connected across two motor starter terminals. Operation of the speed responsive switch is prevented unless electrical power is applied to the lockout coil.

**Other Typical Applications**
Speed responsive switches can be used in many other interlocking applications. For example – in a rotary kiln dryer, action must be taken immediately if the dryer stops turning. A speed responsive switch can sense dryer stoppage and turn off the heat. A similar application calls for a speed responsive switch to shut off the gas burner if a blower fails. Computers and expensive electronic equipment can also be shut down if a blower fails.

Manual and automatic reset features are also available. One application for a manual reset button is in unattended pumping stations. If a speed responsive switch shuts down a pump drive because of improper speed, a signal will be sent to a central control station. The pump drive cannot be restarted, however, until a repairman visits the remote station and operates the manual reset button, which forces repair of the fault causing the shutdown.
Specific Applications

Series 2200

Machine Tools — Euclid Type PR Series can be used to increase production as a zero-speed plugging switch with normally open contacts incorporated with a magnetic reverse panel to bring AC motors to a quick stop.

Motion Interlocking — such as on conveyors and machine tools, where a centrifugal switch is driven by the main conveyor at a location near the junction with a feeder conveyor. The normally open centrifugal switch contacts are connected in series with the control circuits of the magnetic controllers for the motors driving the feeder conveyors. If the main conveyor accidentally stops, the centrifugal switch driven by that conveyor will automatically stop the motors driving the feeder conveyors, preventing material from being piled up on the stalled conveyor by the feeder conveyors.

Series 2210

Euclid Type C switches provide overspeed & underspeed protection and precision speed sensing with repeatable accuracy to indicate slipping or broken conveyor belts, preventing material pileup; prevent overspeed or underspeed of motors, generators, fans & pumps; control starting of diesel engines; prevent damage to rotating industrial machinery; maintain speeds increase or decrease from safe values; for plugging applications to assure quick & safestops; sequential control of functions at specific speeds.

Series 2220

With Production Equipment — Euclid Type F switches may be incorporated to stop motor drives in case of machine jams or overloads; energize electromagnetic clutches and brakes; indicate (with a counter) equipment starts and stops; prevent slow-downs and reversals of mixers and centrifuges; provide reversal or unwanted motion protection for compressors, pumps, electric motors, test equipment; automatically shift gears on machine tools and power transmissions; indicate motion or broken shaft for stamping presses.

Series 2243

Conveyor Manufacturers — use it to indicate jammed screw conveyors; slipping or broken belts; very low speed sequencing.

Machine Manufacturers — utilize the Euclid Type D switch in determining time in seconds or even fractions of a second to stop motion of a press or machine for protection to personnel or indexing machines so that proper and exact holes are punched accurately. Sequential control of functions at specific speeds is a natural application; prevent damage to rotating industrial machinery when speed increases or decreases from safe standards; shift linkages on engine lathes.

Series 2260

On Production Equipment — The Euclid Type E Switch can be used to stop drive equipment in cases of jam or motor drive slowdowns due to severe overload condition; can energize or control electromagnetic brake circuitry to provide consistently accurate stops; prevent inadvertent drive reversals of mixers, pumps, and winches; provide overspeed or underspeed protection and/or indication; indicate and prevent improper sequence of gear or speed changes; can indicate “lost rotary cam limit switch” speed on stamping or welding presses.

Series 2210

Euclid Type C switches provide overspeed & underspeed protection and precision speed sensing with repeatable accuracy to indicate slipping or broken conveyor belts, preventing material pileup; prevent overspeed or underspeed of motors, generators, fans & pumps; control starting of diesel engines; prevent damage to rotating industrial machinery; maintain speeds increase or decrease from safe values; for plugging applications to assure quick & safestops; sequential control of functions at specific speeds.

Choosing a Speed Switch

The first step in selecting a speed responsive switch is to determine what it must do electrically in response to shaft rotation. Points that should be resolved include:

1. What contact configurations (SPST, SPDT, etc.) are required?
2. Are snap-action or butt-type contacts needed? Snap-action contacts are more sensitive when speed changes in the control zone are slow. Butt-type contacts are satisfactory for rapid speed changing conditions.
3. Is direction sensing required? This suggests the use of a speed responsive switch that can detect direction of operation, and requires no change-over for direction of rotation.
4. Is the contact speed adjustment range satisfactory?
5. Is the maximum running speed for direction of rotation.
6. Will contact rating (current, voltage, etc.) be imposed on a speed responsive switch?
7. Have special electrical features (magnetic lockout coil, manual or automatic reset, etc.) been specified?
8. The operating environment should be checked and a suitable enclosure specified for the switch.
9. Operating temperature ratings should be considered in selecting a speed responsive switch.
10. Specify surface (standard) or flange mounting enclosures.

Where a separate switch is to be used to be driven by a motor or a machine shaft, the use of a flexible coupling is recommended. End thrust should never be imposed on a speed responsive switch and speed increasers are available to change the operating range of a switch. Direct rigid connections and chain drives are not recommended.

Directional vs. Non-Directional Switches

Directional switches are units that sense the direction in which the shaft is rotating by means of operating only one of two isolated circuits for a given direction of shaft rotation. Non-directional switches do not sense the direction their shaft is rotating. The same circuits operate in either direction of shaft rotation.

The table at the right shows which switches are directional and non-directional.
Features

Series 2200
Euclid Type PR Series are pilot circuit switches with contacts that are opened or closed by means of centrifugal force. The contacts are therefore responsive to changes in speed so that these switches can be used for plugging, overspeed or underspeed protection, non-plugging, and for motion interlocking.

- MSHA Approved XB, XC, XD, &XE Series
- Mill Construction, Cast Iron Frame and End Plates
- NEMA Style Enclosures for Indoor, Outdoor & Hazardous Applications
- Directional or Non-Directional Contacts
- Silver-To-Silver Contacts
- Easy Accessibility to Contacts and Flyweight Assy
- Permanently Lubricated Precision Bearings
- Surface or Flange Mounting
- 5/8" Stainless Steel Shaft
- Optional Rear Shaft Extension, Manual Reset Contacts
- AC and DC Slow Break-Butt Type or Snap-Action Precision Switch

Series 2210
Type C Speed Responsive switches assure maximum protection of material handling systems and rotating equipment. They provide overspeed and underspeed protection with precise speed sensing. These switches have excellent repetitive accuracy and are basically unaffected by temperature variations.

- NEMA Type Enclosures for Indoor, Outdoor & Hazardous Environment
- Rugged Construction
- Contacts Easily Adjustable While Running
- High Speed Operation to 4700 RPM
- Low Speed Operation from 10 RPM
- Snap-Action Contacts or Pneumatic Air Valve
- Oversize Low Friction Bearings
- Surface or Flange Mounting
- 5/8" Input Stainless Steel Shaft

Series 2220
The Euclid Type F speed responsive switch is a low speed, pilot circuit device designed to sense rotation of production or materials handling equipment and provide an electrical interlocking signal with other mechanical or electrical devices. The Type F switch as a stop motion indicator assures safe and proper sequential operation of rotating equipment.

- NEMA Type Enclosures for Indoor, Outdoor and Hazardous Applications
- Rugged Construction
- Contacts Easily Adjustable While Running
- Low Speed Operation from 0.8 RPM
- Snap-Action Contacts, SPDT Operation in Either Direction
- Oversize Permanently Lubricated Bearings
- Surface or Flange Mounting
- 5/8" Input Shaft

Series 2223
Euclid Type D Speed Responsive Switches are highly precise, non-directional, solid state, low speed responsive devices for industrial applications. The unique light chopping network “digitally controlled” output relay can easily be adjusted to open or close an electric circuit at speeds as low as .6 RPM. Type D switches provide precise speed sensing and sequential control with high repetitive accuracy.

- Precise Speed Sensing
- Low Speed Operation from 0.6 RPM
- High Running Speed to 3600 RPM
- NEMA & CEMA Type 4 Encl.
- Silicon Solid State Components, Integrated Circuits, Transient Voltage Protection
- Digital Controlled Output Relay
- LED Light Chopping Disc and Cell Assembly
- Oversize Bearing, Rugged Enclosure, Double Shaft Seals with Lubrication Fitting
- Adjustable Differential

Series 2260
The Bulletin 2260 Type E Speed Responsive Switch is a medium speed pilot circuit device designed to precisely and rapidly sense rotational speed of production and materials handling equipment. The sensor provides an electrical interlocking signal to associated electromechanical devices. The use of the Type E Switch as a "Stop-Motion" indicator can assist in assuring safe and consistently proper sequential operation of rotating equipment.

- Medium Actuation Speed Range 3 – 300 RPM
- Output Actuation Speed Adjustable While In Motion
- NEMA 13 Enclosures, Dust-tight and Oil-tight Indoor
- Relay Contact Output - SPDT
- Oversize Bearings and Shaft Support
- Surface/Flange Mounting
- Non-directional or Directional Sensing
- 5/8" Stainless Steel Shaft

Series 2310
The 2310 Non-Contact Speed Responsive Switch is a self-contained solid state device capable of sensing the presence of metal without physical contact. This high-density tubular package senses metal targets in a nominal 10 mm (.4") sensing distance from the sensing head for targets of a typical size, 30 mm (1.2") square by 1.5mm (.06") thick.

- Solid State Speed-Sensing Device
- Self-Containing Control Adjustments and Diagnostics
- Ease of Installation
- Maintenance Free
- Automatic Reset Each Cycle
- High Impact Housing
- Available in models for Low DC Voltage Three Wire Applications or AC Voltage Two Wire in Line Applications

Select specific model to match speed requirements.
### Summary of Features

<table>
<thead>
<tr>
<th>Series 2200</th>
<th>Series 2210</th>
<th>Series 2220</th>
<th>Series 2243</th>
<th>Series 2260</th>
<th>Series 2310</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of Mechanism</strong></td>
<td><strong>Mechanical Centrifugal Force</strong></td>
<td><strong>Mechanical Centrifugal Force</strong></td>
<td><strong>Mechanical Centrifugal Force</strong></td>
<td><strong>Electronic</strong></td>
<td><strong>Non-Contact Sensing</strong></td>
</tr>
<tr>
<td>Operating Range (ascending trip)</td>
<td>80 – 2500 RPM</td>
<td>10 – 3700 RPM*</td>
<td>1 – 90 RPM*</td>
<td>- .- 300 RPM</td>
<td>3 – 300 RPM</td>
</tr>
<tr>
<td>Operating Range (descending trip)</td>
<td>85 – 2450 RPM</td>
<td>9 – 3500 RPM*</td>
<td>1 – 59 RPM*</td>
<td>.37 – 240 RPM</td>
<td>2.25 – 225 RPM</td>
</tr>
<tr>
<td>Max Bounding Speed</td>
<td>3600 RPM</td>
<td>5000 RPM*</td>
<td>2000 RPM*</td>
<td>3600 RPM</td>
<td>3600 RPM</td>
</tr>
<tr>
<td>Adjustment</td>
<td>Field Adjustable</td>
<td>Field Adjustable</td>
<td>Field Adjustable</td>
<td>Field Adjustable</td>
<td>Field Adjustable</td>
</tr>
<tr>
<td>Repeatability</td>
<td>1%</td>
<td>1%</td>
<td>12%</td>
<td>12%</td>
<td>12%</td>
</tr>
<tr>
<td>Rotation Sensing</td>
<td>Directional &amp; Non-Directional</td>
<td>Non-Directional</td>
<td>Non-Directional</td>
<td>Directional</td>
<td>Non-Directional</td>
</tr>
<tr>
<td>Voltage</td>
<td>AC or DC</td>
<td>AC or DC</td>
<td>AC only</td>
<td>AC only</td>
<td>AC only</td>
</tr>
<tr>
<td>Current Rating (continuous)</td>
<td>15 amps (max.) @ 105/60V AC</td>
<td>10 amps (max.) @ 105/60V AC</td>
<td>3 amps (max.) @ 120V AC</td>
<td>5 amps (max.) @ 120/240V AC</td>
<td>7 amps (max.) @ 120/240V AC</td>
</tr>
<tr>
<td>Interrupting Ratings</td>
<td>3 amps 120V AC @ 35% P.F.</td>
<td>3 amps 120V AC @ 35% P.F.</td>
<td>1.5 amps 120V AC @ 35% P.F.</td>
<td>2 amps 120/240V AC @ 35% P.F.</td>
<td>2.5 amps 120V AC @ 45% P.F.</td>
</tr>
<tr>
<td>Input Voltage</td>
<td>120/240/480V AC or 125/240V DC</td>
<td>120/240/480V AC or 125/240V DC</td>
<td>120/240V AC</td>
<td>115V AC @ 10% to 15%</td>
<td>115V AC @ 10%</td>
</tr>
<tr>
<td>Ambient Temperature</td>
<td>60°F to 250°F (-50°C to 121°C)</td>
<td>60°F to 250°F (-50°C to 121°C)</td>
<td>60°F to 250°F (-50°C to 121°C)</td>
<td>32°F to 195°F (0°C to 79°C)</td>
<td>0°F to 138°F (-18°F to 59°C)</td>
</tr>
<tr>
<td>Enclosure</td>
<td>Cast Iron End Plates &amp; Frame with Steel Wrap Cover</td>
<td>Cast Iron End Plates &amp; Frame with Steel Wrap Cover</td>
<td>Cast Iron End Plates &amp; Frame with Steel Wrap Cover</td>
<td>Cast Aluminum</td>
<td>Cast and Drawn Aluminum</td>
</tr>
<tr>
<td>NEMA Ratings</td>
<td>3R, 4, 7, 9 &amp; 10</td>
<td>4, 7, 9, 10 &amp; 13</td>
<td>4, 7, 9 &amp; 13</td>
<td>4</td>
<td>13</td>
</tr>
<tr>
<td>Mounting Configurations</td>
<td>Surface or Flange</td>
<td>Surface or Flange</td>
<td>Single/Double Gear Clusters</td>
<td>Surface or Flange</td>
<td>Single/Double Gear Clusters</td>
</tr>
<tr>
<td>Max Overhung Lead</td>
<td>60 lbs @ 3600 RPM</td>
<td>34 lbs @ 3600 RPM</td>
<td>20 lbs @ 3600 RPM</td>
<td>10 lbs @ 3600 RPM</td>
<td>10 lbs @ 3600 RPM</td>
</tr>
<tr>
<td>Max End Thrust</td>
<td>25 lbs @ 3600 RPM</td>
<td>10 lbs @ 3600 RPM</td>
<td>10 lbs @ 3600 RPM</td>
<td>10 lbs @ 3600 RPM</td>
<td>10 lbs @ 3600 RPM</td>
</tr>
</tbody>
</table>

* Internal gear clusters available to reduce standard operating/running speed range.

### Operating Principles

A speed responsive switch consists of three major elements: an input member, a speed sensor and an output member.

- **Input member**: a shaft, a motor or a machine being controlled.
- **Speed sensor**: a switch that controls starting, overspeed, and underspeed of a machine or process.
- **Output member**: a switch that operates a pair of contacts that either open or close as directed by the speed sensor.

### Electronic Motion Detection

Hubbell offers three electronic models – Series 2243, 2260 & 2310. Both Series 2243 and 2260 use a light chopping disc that is mounted directly on the input shaft. When the shaft is rotated, the disc segments interrupt an IR light beam between a solid state LED light source and a light sensitive cell. A specific number of light pulses are produced for each revolution of the shaft. The pulses are counted by the digital circuitry, actuating an output relay at a set point.

### Calculating Response Time for Series 2243/2260

#### Ascending Response Time

- **Input Shaft Speed (rpm)**
- **C** = 0.015 (Series 2243) & 0.013 (Series 2260)

#### Descending Response Time

- **Descending Set Point (rpm)**
- **C** = 0.010 (Series 2243) & 0.006 (Series 2260)
Building a Catalog Number

One of the most difficult procedures for any complex and thorough product line such as Hubbell’s speed switches, is determining the catalog number for the switch you need for your application. We have been able to simplify this.

Catalog numbers for mechanical speed switches (Series 2200, 2210, 2230) are comprised of three basic parts (shown on adjacent page) – the type of switch, the enclosure or NEMA rating required for the switch and the options available.

The catalog number for the switch is made up of a variety of letters and numbers. They are usually dictated by the application the switch will be used for.

Catalog numbers for electronic speed switches (Series 2243, 2260, 2310) are much simpler due to their single unit/single function construction.

How to Build the Catalog Number

Series 2200

Determine the type of contacts you want for your speed switch. The table shows the type of contacts available. Under each group of contact types, the switches are listed by the maximum running speed. Once determining the correct area of the table for the maximum running speed, select the switch with the contact adjustment range required. The catalog number is shown to the right.

Next determine what type of housing your application requires and add the appropriate suffix to the catalog number. To determine the options available read further across the column. If you require flange mounting or manual reset buttons and those options are available replace the “x” in the catalog number with the appropriate letter. You now have a complete catalog number.

If you do not require any of these options, simply remove the “x” from the completed catalog number, leaving the enclosure NEMA rating.

For speed switch pricing, see the companion Speed Switch Price List.

Series 2243

Determine whether you need over-speed or under-speed protection, the shaft diameter, and your rpm requirements. Using the table on page 16, you can then select the proper catalog number.

For speed switch pricing, see the companion Speed Switch Price List.

How to Build the Catalog Number

Series 2210/2220

Determine the type of contacts you want for your speed switch. The table shows the type of contacts available. Under each group of contact types, the switches are listed by the maximum running speed. Once determining the correct area of the table for the maximum running speed, select the switch with the contact adjustment range required. The catalog number is shown to the right.

Next determine what type of housing your application requires and add the appropriate suffix to the catalog number. The standard enclosure is NEMA 1 gasketed and several options are available. Add the appropriate suffix for these options to complete the catalog number.

For speed switch pricing, see the companion Speed Switch Price List.

Series 2260

Determine whether you need direction-al or non-directional contacts, type of mounting, and your rpm requirements. Using the table on page 16, you can then locate the proper catalog number.

For speed switch pricing, see the companion Speed Switch Price List.

Series 2310

Determine whether you need normally open or closed contacts, whether your electrical circuit is AC or DC, and if DC whether your electrical design requires load sinking (NPNI) or load sourcing (PVPN); the housing material preferred, and your rpm requirements. Using the table on page 16, you can then select the proper catalog number.

For speed switch pricing, see the companion Speed Switch Price List.

Ordering Example

You need a speed responsive switch for overspeed detection. The switch needs to operate at 2100 rpm on increasing speed, be flange mounted to the motor with a manual reset feature. One NC contact for a 110V AC pilot circuit is required and the contact needs to operate in either direction.

The switch you select is the Series 2210. The catalog number for the switch to meet these requirements is built as shown in the four steps on the next page.
Selection Guides

Type 2200

<table>
<thead>
<tr>
<th>Application</th>
<th>Maximum Running Speed (RPM)</th>
<th>Contact Adjustment Range°</th>
<th>Max. RPM (RPM)</th>
<th>Contact Options</th>
<th>Catalog Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Snap Action – Precision Switch Type Non-Directional Contacts – AC Voltage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overspeed or underspeed protection</td>
<td>1800</td>
<td>80</td>
<td>65</td>
<td>170</td>
<td>156</td>
</tr>
<tr>
<td>2000</td>
<td>105</td>
<td>85</td>
<td>200</td>
<td>170</td>
<td>2200-PRS-025-11</td>
</tr>
<tr>
<td>3600</td>
<td>140</td>
<td>105</td>
<td>320</td>
<td>280</td>
<td>2200-PRS-025-21</td>
</tr>
<tr>
<td>3600</td>
<td>230</td>
<td>190</td>
<td>680</td>
<td>620</td>
<td>2200-PRS-025-22</td>
</tr>
<tr>
<td>3600</td>
<td>750</td>
<td>650</td>
<td>2550</td>
<td>2450</td>
<td>2200-PRS-025-42</td>
</tr>
</tbody>
</table>

Type 2210

<table>
<thead>
<tr>
<th>Application</th>
<th>Maximum Running Speed (RPM)</th>
<th>Contact Adjustment Range°</th>
<th>Max. RPM (RPM)</th>
<th>Contact Options</th>
<th>Catalog Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Snap Action – Precision Switch Type Non-Directional Contacts – AC Voltage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overspeed or underspeed protection</td>
<td>2200-142CCxSS</td>
<td>4,7,9,13</td>
<td>M,MM</td>
<td>9,10</td>
<td></td>
</tr>
<tr>
<td>Overspeed or underspeed protection</td>
<td>2200-132CCxS</td>
<td>4,7,9,10,13</td>
<td>F,9,10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overspeed or underspeed protection</td>
<td>2200-132CCxS</td>
<td>4,7,9,10,13</td>
<td>F,9,10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overspeed or underspeed protection</td>
<td>2200-132CCxS</td>
<td>4,7,9,10,13</td>
<td>F,9,10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overspeed or underspeed protection</td>
<td>2200-142CCxS</td>
<td>4,7,9,10,13</td>
<td>F,9,10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Optional Feature

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>WP</td>
<td>Weatherproof – NEMA 2P</td>
</tr>
<tr>
<td>W</td>
<td>Watertight – NEMA 4</td>
</tr>
<tr>
<td>XD</td>
<td>NEMA 7 Explosion Proof Class 1, Group D</td>
</tr>
<tr>
<td>XBP</td>
<td>NEMA 9 Explosion Proof Class 2, Group E, F, or G</td>
</tr>
<tr>
<td>XD/XC/2X/3X</td>
<td>NEMA 10 Explosion Proof MSHA Approved</td>
</tr>
<tr>
<td>F</td>
<td>Flange Mounting (NEMA 1 switches only)</td>
</tr>
<tr>
<td>E</td>
<td>Rear Shaft Extension – 3000′ x 1.25′ (NEMA 1 switches only)</td>
</tr>
</tbody>
</table>

When selecting options for the Series 2210 switches, first determine which switch your application requires from the table above. Then from the table left determine which type of housing you require. If the switch you selected is NEMA 1, then determine if the additional options of flange mounting and rear shaft extension are necessary.

When selecting options for the Series 2200, first determine which switch your application requires from the table above. Then from the table left determine which type and mounting configuration you require. The only mounting configurations available for most switches are – “surface mounting” or “flange mounting”. The standard configuration is “surface mounting”. If the switch you selected has AC SPST contacts, you can additionally select whether you want single or double manual reset buttons. NEMA 4 Flange mounting is not available.

See page 16 for all footnotes and general notes. Contact Factory For Optional Features Not Shown.
### Selection Guides

#### Type 2220

<table>
<thead>
<tr>
<th>Application</th>
<th>Maximum Running Speed</th>
<th>Contact Adjustment Range</th>
<th>Contact Speed</th>
<th>Min. RPM</th>
<th>Max. RPM</th>
<th>Min. RPM</th>
<th>Max. RPM</th>
<th>Left Hand</th>
<th>Right Hand</th>
<th>Catalog Number</th>
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<td>F 9</td>
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</tbody>
</table>

#### Optional Feature

- **F**: Flange mounting

When selecting options for the Series 2220 switches, first determine which switch your application requires from the table on this page. Then determine which type housing and mounting configuration you require. The only mounting configurations available for most switches are – “surface mounting” or “flange mounting”. The standard configuration is “surface mounting”.

---

**See page 16 for all footnotes and general notes. Contact Factory For Optional Features Not Shown.**

---

### Series 2243

<table>
<thead>
<tr>
<th>% of Shaft Catalog Number</th>
<th>% of Shaft Catalog Number</th>
<th>Maximum Running Speed</th>
<th>Contact Adjustment Range</th>
<th>Non-Directional Contacts</th>
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<tbody>
<tr>
<td>Under Speed Detection</td>
<td>Desc. Trip</td>
<td>Asc. Trip</td>
<td>Contact Speed</td>
<td>Asc. Trip</td>
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<tr>
<td>2243-201</td>
<td>3600</td>
<td>0.57</td>
<td>0.60 – 0.71</td>
<td>4.8</td>
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<tr>
<td>2243-202</td>
<td>3600</td>
<td>3.8</td>
<td>4.0 – 4.7</td>
<td>16.0</td>
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<td>2243-203</td>
<td>3600</td>
<td>14.3</td>
<td>15.0 – 17.8</td>
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<td>47.5</td>
<td>50.0 – 59.4</td>
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### Series 2260

<table>
<thead>
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<th>Catalog Number</th>
<th>Maximum Running Speed</th>
<th>Contact Adjustment Range</th>
<th>Non-Nip Speed</th>
<th>Mounting</th>
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### Series 2310

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<th>AC Part Number</th>
<th>Contact Speed</th>
<th>Housing</th>
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<td>48954-102</td>
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<td>NC 6 – 150</td>
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</table>

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**See page 16 for all footnotes and general notes. Contact Factory For Optional Features Not Shown.**
Notes

These notes are for pages 12 – 15.

Refer to Price List 2200/2300 or 1201 for pricing information.

Switch contacts may be set for either increasing speed or decreasing speed operation. However, the differential speed is nonadjustable (except for 2243 switches) and subject to mechanical tolerances.

Speed Ranges shown in the table for Series 2210/2220 are for horizontally mounted switches with contacts set for simultaneous operation. Speed Ranges shown in tables on pages 12 – 15 (except 2310) are for horizontal mounted switches. If switches are mounted vertically, consult factory. Switches are for surface mounting (except 2310) unless otherwise specified.

1. Contacts are factory set at minimum ascending and minimum descending speeds as shown. Factory speed set points above minimum are available when specified for a nominal charge.
2. Contact symbols are shown with switch at rest and viewed from the rear.
3. CW-CCW denotes shaft rotation from shaft end of switch.
4. These switches are suited for applications requiring faster than normal pickup and reset times, and are not suitable for high running speeds.
5. Relay de-energizes when descending set point is reached.
6. Relay de-energizes when ascending set point is reached.
7. Includes adapter bracket to provide for mounting in place of a Bulletin 2210 or 2220 Surface Mounting Unit.
9. Flange mounting is not available for NEMA 4 rated housing.
10. Flange mounting is not available for NEMA 7, 9 or 10 rated housings.
11. Manual Reset buttons are not available for NEMA 10 rated housings.

Flexible Couplings are available for all shaft driven speed switches and should be used to connect the switch to the driving/input shaft to compensate for minor misalignment. Several input shaft sizes are available.

Two optional vibration dampeners are available to minimize vibrations from severe applications or pulsating “dither” caused by internal combustion engines. These dampeners will extend the life of your speed switch.

Flexible Couplings

Contact Factory for Optional Features Not Shown

HUBBELL

Accessories

Dampeners & Couplings

Separate Mounted Gear Boxes

Series 2310 Accessories

Contact Factory for Optional Features Not Shown

HUBBELL

Prices for these items are located in the Accessories Section of Price List 2200/2300
Notes:
For pages 18 – 21

1. All dimensions are in inches unless noted otherwise. Available options titles are “Reset Button” – Reset Button, “5/8” Fit” – Zerk Fitting and “Cond Con” – Conduit Connection and Lock Screw.

2. The notes listed below are for size of conduit connection supplied on speed switches and appear on the tables on pages 20 & 21.
   (1) 1-1/4” x 12NF Thread .... 1/4” Ent.
   (2) 1” x 14NF Thread ....... 1/4” Ent.
   (3) 1-1/4” x 12NF Thread .... 1/2” Ent.
   (4) 1-1/4” x 12NF Thread .... 3/4” Ent.

Illustration #1
Surface Mounting Enclosure - 2200
Approx. Weight 12 lbs.
NEMA 1 Gasketed or NEMA 3R

Illustration #2
Surface Mounting Enclosure - 2200
Approx. Weight 26 lbs.
NEMA 4, 7 or 9

Illustration #3
Surface Mounting Enclosure - 2210/2220
Approx. Weight 4 lbs.
NEMA 4 or 13

Illustration #4
Surface Mounting Enclosure - 2210/2220
Approx. Weight 4.5 lbs.
NEMA 4 or 13

Illustration #5
Flange Mounting Enclosure - 2210/2220
Approx. Weight 5 lbs.
NEMA 13

Illustration #6
Surface Mounting Enclosure - 2210/2220
Approx. Weight 8.8 lbs.
NEMA 4 or 13

Illustration #7
Surface Mounting Enclosure - 2210/2220
Approx. Weight 11.5 lbs.
NEMA 7 or 9

Illustration #8
Surface Mounting Enclosure - 2243
Approx. Weight 5 lbs.
NEMA 4

Illustration #9
Surface Mounting Enclosure - 2260
Approx. Weight 4 lbs.
NEMA 13

Illustration #10
Surface Mounting Enclosure - 2310
Approx. Weight 1 lbs.
NEMA 4X or 13

Illustration #11
Flange Mounting Enclosure - 2210/2220
Approx. Weight 11.5 lbs.
NEMA 7 or 9

Illustration #12
Flange Mounting Enclosure - 2200
Approx. Weight 13.5 lbs.
NEMA 1 Gasketed

See page 20 & 21 for dimensions.
### Dimensions

**Part Number** | **NEMA Type** | **Illus. No.** | **A** | **B** | **C** | **D** | **E** | **F** | **G** | **H** | **J** | **K** | **L**
--- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | ---
-PC-xxxx-xx | 1 | 1 | 7.78 | 1.47 | 0.34 | 1.16 | 4.31 | 0.50 | 0.125 | 0.88 | 0.63 | 2.63 | 1.50
-PC-xxxx-xxF | 1 | 12 | 7.78 | 0.84 | 5.47 | 0.50 | 0.19 | 3.00 | 0.97 | 0.88 | 0.63 | 2.63 | 1.50
-xx-xxWP | 3H | 2 | 7.78 | 1.47 | 0.34 | 1.22 | 4.25 | 0.50 | 0.125 | 0.88 | 0.63 | 2.63 | 1.50
-xx-xxRP | 2 | 9.06 | 1.44 | 2.44 | 3.13 | 2.06 | 1.25 | 0.88 | 0.50 | 0.63 | 2.63 | 1.50
-xx-xxXA | 7 Class 1 | 2 | 9.06 | 1.44 | 2.44 | 3.13 | 2.06 | 1.25 | 0.88 | 0.50 | 0.63 | 2.63 | 1.50
-xx-xxXSM | 3H Class 7 | 2 | 9.06 | 1.44 | 2.44 | 3.13 | 2.06 | 1.25 | 0.88 | 0.50 | 0.63 | 2.63 | 1.50
-xx-xxXB | 10 | 2 | 9.06 | 1.44 | 2.44 | 3.13 | 2.06 | 1.25 | 0.88 | 0.50 | 0.63 | 2.63 | 1.50
-xx-xxXD | 10 | 2 | 9.06 | 1.44 | 2.44 | 3.13 | 2.06 | 1.25 | 0.88 | 0.50 | 0.63 | 2.63 | 1.50
PRSM-xxxx-x | 1 | 1 | 7.78 | 1.47 | 0.34 | 1.16 | 4.31 | 0.50 | 0.125 | 0.88 | 0.63 | 2.63 | 1.50
-xx-xxFS | 1 | 12 | 7.78 | 0.84 | 5.47 | 0.50 | 0.19 | 3.00 | 0.97 | 0.88 | 0.63 | 2.63 | 1.50

| M | N | P | Q | R | S | T | U | V | W | X |
--- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
-PC-xxxx-xx | 1 | 1 | 7.78 | 1.47 | 0.34 | 1.16 | 4.31 | 0.50 | 0.125 | 0.88 | 0.63 | 2.63 | 1.50
-xx-xxWP | 3H | 2 | 7.78 | 1.47 | 0.34 | 1.22 | 4.25 | 0.50 | 0.125 | 0.88 | 0.63 | 2.63 | 1.50
-xx-xxRP | 2 | 9.06 | 1.44 | 2.44 | 3.13 | 2.06 | 1.25 | 0.88 | 0.50 | 0.63 | 2.63 | 1.50
-xx-xxXA | 7 Class 1 | 2 | 9.06 | 1.44 | 2.44 | 3.13 | 2.06 | 1.25 | 0.88 | 0.50 | 0.63 | 2.63 | 1.50
-xx-xxXSM | 3H Class 7 | 2 | 9.06 | 1.44 | 2.44 | 3.13 | 2.06 | 1.25 | 0.88 | 0.50 | 0.63 | 2.63 | 1.50
-xx-xxXB | 10 | 2 | 9.06 | 1.44 | 2.44 | 3.13 | 2.06 | 1.25 | 0.88 | 0.50 | 0.63 | 2.63 | 1.50
-xx-xxXD | 10 | 2 | 9.06 | 1.44 | 2.44 | 3.13 | 2.06 | 1.25 | 0.88 | 0.50 | 0.63 | 2.63 | 1.50
PRSM-xxxx-x | 1 | 1 | 7.78 | 1.47 | 0.34 | 1.16 | 4.31 | 0.50 | 0.125 | 0.88 | 0.63 | 2.63 | 1.50
-xx-xxFS | 1 | 12 | 7.78 | 0.84 | 5.47 | 0.50 | 0.19 | 3.00 | 0.97 | 0.88 | 0.63 | 2.63 | 1.50

See page 19 for notes. See page 18 & 19 for illustrations.
Series 2200

Enclosure
The frame and end plate are cast iron, accurately machined and provided with sealed and permanently lubricated precision ball bearings in which the shaft rotates. The steel shaft is hardened and ground for extreme accuracy and carries the flyweight and contact actuation assembly. Lateral motion of the flyweights is transmitted to the contact actuation assembly through a sealed and permanently lubricated precision thrust ball bearing. The heavy gauge sheet steel cover is provided with a gasket to make the enclosure semi-dust tight and oil resistant. NEMA Type I Gasketed. The cover is secured to the frame by means of the DC control circuits since the contacts are equipped with a permanent magnet blowout and are provided with one normally open and one normally closed contact. The contacts of this switch are suitable for operation at 250 volts DC maximum.

Type NPR-02B is a two circuit centrifugal switch with normally closed butt Type contacts. Type PR-023 is a two circuit switch with normally open double break Butt Type contacts. Type PR-026 is a two circuit switch with normally open double break Butt Type contacts in which one circuit is made in one direction and the other circuit is made in the opposite direction of shaft rotation. The two circuits can be isolated, if desired, by removing a short jumper.

Series 2210

Enclosure
Standard Type C centrifugal switch housings are molded of tough fiberglass reinforced polyester resin, for the flyweight compartment, and a cast aluminum housing for the contact compartment. The standard molded housings are resistant to most acids, alkalis and salt compounds.

When flange-mounting is specified, the flange and the flyweight section of the housing are precisely machined from a single aluminum casting.

NEMA Type 4 enclosures (water-tight for indoor/outdoor applications are furnished with a double shaft seal & grease fitting for lubrication and purging ensuring longer bearing life.

NEMA Type 7, 9 and 10 explosion proof enclosures are available also. These enclosures have precisely machined cast aluminum housings, either for surface or flange mounting.

Speed Adjustment

Speed points at which contacts operate are easily adjustable in the field within the standard operating range. Switches are factory set at minimum ascending speeds as listed. Other contact settings may be specified as an option. Each set of snap-action or slow-action contacts is independently adjustable from the rear while the switch is rotating. Also the speed setting of both sets of contacts can be changed at the same time by varying the tension on the main adjustment spring with the adjustment nut.

Contacts

The contact compartment provides several basic contact arrangements as required for various applications. Slow-action butt type bridging contacts for rapid speed change conditions or snap-action precision contacts for slow speed changes can be supplied. Type PR-025 is a single circuit switch with normally open double break Butt Type contacts. Type PR-026 is a two circuit switch with normally open double break Butt Type contacts in which one circuit is made in one direction and the other circuit is made in the opposite direction of shaft rotation. The two circuits can be isolated, if desired, by removing a short jumper.

Type PR-029 is a two circuit switch with normally open double break Butt Type contacts which are prevented from closing if the switch shaft or the drive to which it is connected is turned by hand.

Type PRR-025 is equipped with single-side double throw snap action contacts from which one normally open and one normally closed contact with common terminals are available. At the point of contact actuation, the normally open contact closes and the normally closed contact opens on ascending speed and visa versa on descending speed.

Type PRD-025 is equipped with snap action contacts designed for use on DC control circuits since the contacts are equipped with a permanent magnet blowout and are provided with one normally open and one normally closed contact. The contacts of this switch are suitable for operation at 250 volts DC maximum.

Type NPR-02B is a two circuit centrifugal switch with two normally closed Butt Type contacts. In one direction of shaft rotation one contact opens while the other remains closed. In the other direction of shaft rotation the first contact remains closed while the second contact opens. This switch has been specially designed for use on high moment drives to prevent plugging.

Series 2220

Enclosure
The Type F fluid switch is supplied in a NEMA 13 industrial enclosure to resist lint, dust, seepage, external condensation and spraying of water, oil or coolant. For outdoor or indoor applications susceptible to splashing, or direct water spray, select a NEMA 4 enclosure. For hazardous locations containing explosive gas, NEMA 7, Class I, Group D should be used. NEMA 9, Class II, Group E, F or G enclosures should be used in hazardous locations containing explosive dust. This design incorporates a double shaft seal to exclude dust particles from the switch interior.

The two circuits can be isolated, if desired, by the use of either slow-action butt type bridging contacts or snap-action precision contacts. Either slow-action butt type bridging contacts for rapid speed-change conditions, or snap-action precision contacts, for slow speed changes, can be provided. One set or two sets of normally open and/or normally closed single throw contacts – each set independently adjustable – are available in the slow-action type. One set or two sets of normally open and normally closed single pole, double throw, snap-action switches are also available, with each set independently adjustable.

These two separate sets of contacts can be adjusted for operation at different speeds so that two separate operations can be controlled from one speed sensing switch. Therefore, it is possible to perform separate functions at two different speeds. A directional sensing form of the switch employs slow-action butt-type bridging contacts in normally open position only. The contact compartment houses two single pole double throw snap-action switches. Both switches can be factory-assembly assembled to operate in same direction, or one for each direction.

Series 2243

The output of the unit is provided by a single pole double throw plug-in type relay. The relay is located in the forward compartment. The relay contacts are factory wired to the terminal block in the rear compartment for easy customer connections.

On units designated for overspeed application, the relay de-energizes when set point is attained. On units designated for underspeed application, the relay de-energizes when set point is attained. The differential between ascending and descending set points is easily adjusted.

Type D Speed Responsive Switches are designed for reliable operation. In the event of component failure, the relay reverts to a de-energized position. Long life and high reliability has been designed into these devices through the use of proven integrated circuitry, precision voltage protection networks and high quality components. Silicon solid state components are used throughout to assure reliable operation over a wide temperature range.

To represent their durability, these switches are used successfully on automotive punch press applications.

Enclosure

The standard surface mounted enclosure is cast aluminum and is suitable for NEMA and CEMA Type 4.

The main compartment houses and protects the speed adjustment potentiometer, the “lightoppingding” and the chassis. The rear compartment contains the filter to exclude the input power and output relay connections. Covers for both compartments are provided with gaskets.

The Type D switch is available with either a 3⁄8” diameter shaft which has a flat for set screw securing, or a 1⁄8” diameter shaft which is supplied with a 3⁄8” square key. The shaft is supported by two large, lifetime-lubricated ball bearings for long life and low driving torque. A grease fitting and double shaft seals are provided. Application of lubricant purges the area between the seals and prevents the penetration of water and abrasive dust.

Series 2260

The Type E Switch is a unitized device containing heavy duty industrial types of sub-modules required to provide consistent, precise, and repetitively accurate responses.

The stainless steel input shaft is supported in the enclosure by two permanently sealed and lubricated ball bearings.

Speed Adjustment

The speed point at which the contacts operate is easily adjustable within the standard 3-300 rpm adjustment range. Clockwise rotation of the adjustment pot increases setting, counterclockwise rotation of the adjustment pot decreases setting.

All Type E units are factory set at the minimum ascending trip speed, 3 rpm, unless a specific setting is requested.

Series 2310

The Series 2310 speed responsive switches are available in both 3-wire low DC voltage and 2-wire series load activating AC voltage. Three (3) wire DC units operate either normally closed or normally open but transistor outputs that can be either NPN "load sinking" or PNP “load sourcing” versions. All versions...
sions of these switches are available in a plastic threaded housing or in a plastic housing with a nickel-plated brass threaded sleeve.

Easily recalibrated for “home” position, the Series 2310 permits easy resetting to compensate for belt stretching or slipping on conveyor applications, and for compensatory adjustments on variable speed operations.

In order to sense slower speeds outside the listed ranges, multiple events or actuations per revolution must be used.

Select a mounting area, keeping the Free Zone requirements of non-shielded proximity sensors in mind (see below). The target must move laterally across the face of the speed switch. Actuating distance from the target to the speed switch face is shown in the adjacent figure and table. This information provides an estimated setup distance prior to actual starting.

The speed setting within a given sensor’s range is adjustable with the 20-turn RPM adjustment potentiometer located behind the access screw. The ideal location of the speed switch is midway within this operating range.

**Series 2310 Setpoint Selection**

The Series 2310 speed adjustment ranges are shown in the graph below. The switch is settable on location with just a small screwdriver which is provided. The chart below left shows speed ranges based on single event measurements using a standard target. The speed range is directly related to the sensitivity of the switch, lateral motion and the material being sampled.

The chart below right shows the effect of lateral motion to the sensing range. Several representative factors for different materials are shown on the bottom right.

**Material Reduction Factors**

Based on a 30mm x 30mm x 1.5mm target

- Steel ......................................................... 1.0
- Stainless Steel ..................................0.7 – 0.8
- Aluminum ......................................... 0.3 – 0.5
- Brass ................................................ 0.3 – 0.4
- Copper .......................................... 0.3 – 0.4