

SENSING & SWITCHING SOLUTIONS FOR CNC MACHINES

Application Brief

Honeywell

Computer Numerical Control (CNC) machines are automated machining systems that use programmed commands to control cutting tools with high precision.

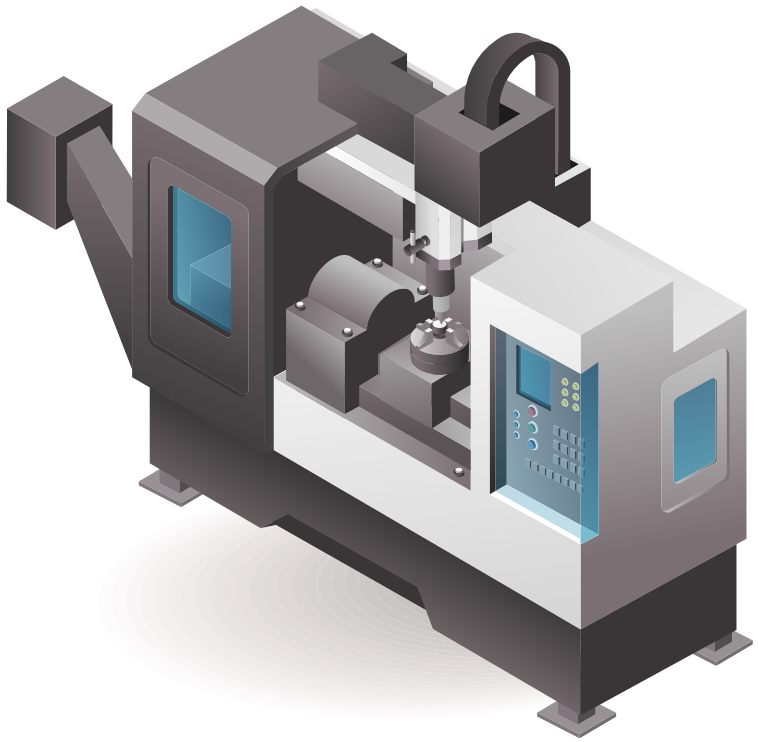
BACKGROUND

They have revolutionized modern manufacturing by enabling highly precise, automated machining processes, and have become essential in manufacturing industries such as aerospace, automotive, and metal fabrication.

Key Functions of CNC Machines

1. **Automated Precision Machining:** CNC machines execute programmed instructions with minimal deviation, ensuring precise cuts, drilling, and shaping
2. **Multi-Axis Movement:** Machines operate on multiple axes (e.g., 3-axis, 5-axis) to create intricate geometries and detailed designs
3. **Repeatability and Efficiency:** CNC systems allow manufacturers to produce large batches of identical components with high repeatability and minimal error
4. **Flexibility in Material Processing:** These machines handle various materials, including metals, plastics, and composites, adapting to different industrial applications
5. **Integration with CAD/CAM Software:** CNC machines interpret digital models from CAD (Computer-Aided Design) and CAM (Computer-Aided Manufacturing) software to execute precise machining tasks
6. **Safety and Automation:** Built-in safety features and automated control systems reduce the risk of operator errors and workplace hazards

To maintain accuracy, reliability, consistent quality, enhanced productivity, and safety, CNC machines require highly accurate and reliable sensors and switches. Honeywell has engineered sensors and switches to enhance CNC machine performance.





SOLUTIONS – POSITION AND SAFETY MONITORING

Limit Switches

Limit switches are crucial for detecting the position of various machine components and ensuring safety during operations. They may be used to detect the end positions of machine axes, preventing over-travel, and ensuring safety by stopping motion when limits are reached.

Limit switches serve as essential safety components in CNC machines by defining the operational boundaries of the machine's moving parts. They prevent unintended movement beyond the designated workspace, protecting both the equipment and the operator. Without limit switches, CNC machines would be at risk of mechanical damage due to over-travel, which could result in costly repairs and downtime. Additionally, these switches contribute to precision by ensuring that each axis stops at the correct position as programmed, maintaining consistency in machining operations.

Beyond safety, limit switches also support automation and efficiency in CNC machines. They act as reference points for homing sequences, which are crucial when initializing the machine before operation. During power cycles or after tool changes, CNC machines rely on limit switches to recalibrate and establish accurate starting positions. Furthermore, limit switches are integrated into emergency stop systems, immediately halting operations in case of a malfunction. By facilitating accurate positioning, enhancing safety, and contributing to seamless automation, limit switches play a vital role in maintaining optimal performance in CNC machining.

Specifically, here are some functions Honeywell MICRO SWITCH Limit Switches perform in CNC machines.

MICRO SWITCH 914CE Compact Limit Switches – may be used to detect end-of-travel positions for machine axes and moving parts. In a CNC milling machine, a 914CE Series limit switch installed at the end of an axis detects when the cutting tool reaches the programmed endpoint, preventing over-travel and mechanical damage.



MICRO SWITCH 914CE Compact Limit Switch

Features

- Rugged, miniature construction means minimal real estate on equipment
- NEMA 1, 2, 3, 3R, 4, 6, 6P, 12 (boot seal), 13, and IP66/67/68 environmental sealing
- Pre-leaded (UL cable) or supplied with a M12 four-pin connector
- Wide selection of actuators and cable length variations with side and bottom exit cable/connector options
- Well suited for up to 10 million actuation cycles (Up to 5 million actuation cycles for wobble actuators)

MICRO SWITCH NGC Compact Limit Switches – The NGC Series switch may be installed at specific points along the machine's axis, such as the end of travel or a predefined position, to accurately detect the location of moving parts like the spindle or carriage. For safety, the limit switch can be integrated into the machine's emergency stop system. If an abnormal condition arises—such as the machine exceeding its travel limits or a malfunction—the limit switch can trigger a shutdown, halting the operation to prevent damage to both the machine and the operator. This dual-purpose use of the MICRO SWITCH NGC compact limit switch enhances both the accuracy and safety of CNC machine operations.



MICRO SWITCH NGC Compact Limit Switch

Features

- Highly configurable
- Snap-action, positive-break contacts (SPDT, DPDT)
- Silver alloy and gold-plated contact options
- UL, CE, cUL, and CCC approvals
- Conforms to IEC 60947-5-1, IEC 61373, EN45545-2 (metal variants with M12 connectors only)
- NEMA 1, 4, 12, 13; IP67 sealing
- Metal and plastic housing options

Honeywell GLS Series Limit Switches – are often used in emergency stop systems and door interlocks. In a CNC lathe, a GLC Series limit switch installed on the machine door prevents operation when the door is open, ensuring operator safety.



MICRO SWITCH GLS Compact Limit Switch

Features

- Designed to EN50047 standard
- Metal housing or double-insulated plastic housing for indoor and outdoor applications
- Wide range of actuator heads and levers
- Heads can be positioned at 90° increments for design flexibility. Side rotary actuator heads can be factory set for CW, CCW, or CW and CCW actuation
- Certified for global applications: CE, UKCA, UL, CSA, CCC

SOLUTIONS - POSITION AND SAFETY MONITORING

Basic Switches

Honeywell MICRO SWITCH basic switches are important for the operation and safety of CNC machines by serving as positioning and homing switches, as well as emergency stop triggers. These highly reliable and durable switches help detect the position of moving components, ensuring that the machine operates within its programmed parameters. In CNC applications, MICRO SWITCHES are commonly placed at the end of travel limits for axes to prevent overtravel, protecting both the machine and the workpiece. Their fast response time and high cycle life make them ideal for continuous industrial use, ensuring that CNC equipment runs efficiently with minimal downtime.

Additionally, MICRO SWITCH basic switches are often used in tool change mechanisms and safety interlocks within CNC machines. They can detect when a tool has been properly seated or whether a machine guard is securely closed before allowing operation, reducing the risk of accidents and equipment damage. Their rugged designs also make them well-suited for harsh industrial environments, where exposure to coolants, metal shavings, and vibrations is common. By integrating these precision switches into CNC systems, manufacturers can enhance automation, maintain operational accuracy, and improve overall machine longevity.

MICRO SWITCH V7 Basic Switches – A Honeywell MICRO SWITCH V7 basic switch can be installed in a CNC machine to indicate the vertical travel of the router (Z-axis) by acting as a limit switch or homing sensor. This switch would be mounted on the machine's Z-axis assembly, positioned to detect the movement of the router as it moves up and down. The actuator lever or plunger of the V7 switch would be aligned so that it makes contact with a mechanical stop or the router carriage at a specific position, triggering the switch to send an electrical signal to the CNC controller. To ensure reliable operation, the V7 switch would typically be installed at the upper and/or lower travel limits of the router, preventing overtravel that could damage the machine or workpiece.



MICRO SWITCH V7 Basic Switch

Features

- High strength thermoplastic housing, glass-filled PCT high-performance polyester
- Single pole double throw (SPDT): 3 terminals; single pole single throw normally closed (SPST-NC) 2 terminals; or single pole single throw normally open (SPST-NO) 2 terminals
- Wide range of electrical ratings from logic level (less than 0.1 A) up to 25 A power duty rated
- Pin plunger actuated or wide assortment of factory assembled integral lever options

Large basic switches can be effectively used in the foot pedal of a CNC machine to provide a durable and responsive control interface for machine operators. These switches act as the primary sensing component within the pedal mechanism, detecting when the operator presses or releases the pedal. The large basic switch ensures reliable actuation with minimal effort, providing tactile feedback to the operator while handling high-frequency usage in industrial environments.



MICRO SWITCH BZ Large Basic Switch

MICRO SWITCH BZ Large Basic Switches – A MICRO SWITCH BZ switch may be installed inside the pedal housing, positioned to actuate when the operator presses down on the pedal. It is mounted on a stable internal bracket, aligned so that the pedal's movement directly engages the switch actuator, such as a plunger or lever-type mechanism. When the operator applies pressure to the pedal, the switch is triggered, sending an electrical signal to the CNC machine to perform the assigned function, such as starting a spindle, engaging a clamp, or executing a programmed operation.

Features

- Switch styles; momentary plunger, manual reset plunger, make-beforebreak contacts, sequential contacts, double break contacts, split contacts
- Standard package size 49,3 L × 17,5 W × 24,1 H mm [1.94 × 0.69 × 0.93 in]
- Mounts on standard 25,4 mm centers [1.00 in] or threaded plunger bushing
- Wide selection of integral
- Fine silver contacts, silver-alloy contacts or gold-alloy contacts
- Electrical connection options; solder terminals, screw terminals or quickconnect terminals
- Optional sealed plunger and cover

SOLUTIONS – TOOL AND WORKPIECE POSITIONING

Position Sensors

Position sensors are critical in CNC machines for tracking and maintaining precise control over tool and workpiece positioning. These sensors ensure that the cutting tool moves along the programmed path with exact accuracy, preventing deviations that could lead to defects in the final product. They work by continuously monitoring the position of machine components and providing feedback to the control system, allowing for real-time adjustments. This level of precision is essential for high-tolerance applications, such as aerospace and medical device manufacturing, where even minor errors can result in costly rework or product failure.

In addition to improving machining accuracy, position sensors contribute to automation and efficiency in CNC operations. They enable features such as automatic tool changers, robotic part loading, and adaptive control strategies that optimize machining parameters based on real-time feedback. Position sensors also play a key role in predictive maintenance by detecting misalignments or wear in machine components before they lead to failures. By enhancing accuracy, efficiency, and machine longevity, position sensors are indispensable components in modern CNC systems, ensuring seamless operation and high-quality production.

Honeywell SMART Position Sensor, SPS Series (Linear Configuration) – used for non-contact linear position sensing of cutting tools and workpieces. In a CNC router, the SMART Position Sensor monitors the vertical position of the spindle to ensure correct cutting depth.



SMART Position Sensor, SPS Series (Linear Configuration)

Features

- Non-contact design reduces wear and tear, improving reliability and durability, and minimizing downtime
- No moving parts within the sensor that makes the sensor more resistant to vibration, shock, and extreme temperatures
- Electronics on board allow for flexible packaging and component compatibility with existing systems
- Self-diagnostics feature can reduce equipment downtime by providing predictive maintenance input
- IP67 and IP69K sealing allows use in many harsh applications.

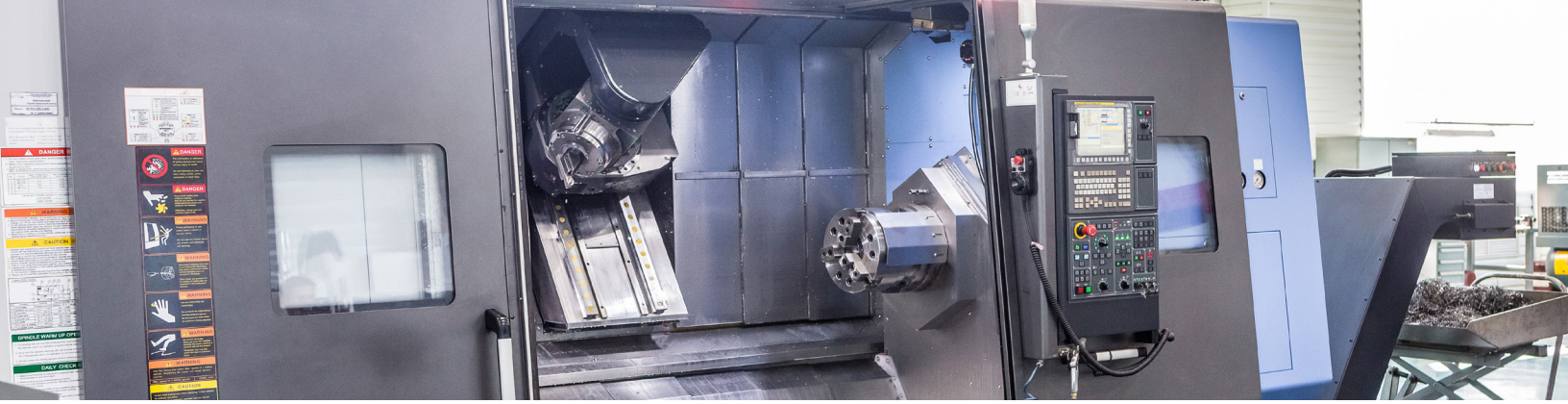
Honeywell VF401 Hall-Effect Position Sensor – designed for detecting rotary position of CNC spindles and servo motors. In a CNC turning center, this sensor provides spindle position feedback for precision threading operations.



VF401 Hall-effect Position Sensor

Features

- Robust design operating from -40 °C to 150 °C [-40 °F to 302 °F] can withstand short durations up to 175 °C [347 °F
- Not damaged by reverse polarity voltages when customer supplied sense resistor is installed, enhancing protection
- Patented MR bridge optimized for stable sensing of 20- to 50-pole pair ring magnets with improved insensitivity to runout, tilt and twist
- 2-wire digital current output simplifies wiring and interfacing which can reduce total system cost



SOLUTIONS – HYDRAULIC AND PNEUMATIC SYSTEM MONITORING

Pressure Switches

Pressure switches are essential in CNC machinery for monitoring and controlling hydraulic and pneumatic systems, ensuring that critical components operate within specified pressure ranges. These switches play a key role in maintaining proper fluid pressure levels in hydraulic actuators, lubrication systems, and pneumatic tool changers. If pressure deviates beyond acceptable limits, pressure switches send alerts or trigger automatic shutdowns to prevent equipment damage and ensure operational safety. By maintaining consistent pressure, these switches help optimize machine performance, preventing issues such as inadequate lubrication, improper tool engagement, or hydraulic failure.

Beyond system protection, pressure switches contribute to process efficiency and reliability in CNC machining. They enable real-time pressure adjustments, allowing machines to adapt dynamically to different machining conditions. For instance, in coolant delivery systems, pressure switches help regulate fluid flow, ensuring optimal cooling during high-speed cutting operations. Additionally, these switches support predictive maintenance by detecting abnormal pressure fluctuations that may indicate potential leaks or component wear. By integrating pressure switches, CNC machines can achieve higher levels of precision, reduced downtime, and extended equipment lifespan.



LE Series Pressure Switch

Honeywell LE & 5000 Series Pressure Switches – used for monitoring pressure pneumatic systems. In a CNC plasma cutter, an LE Series switch monitors air pressure for optimal cutting performance. In addition, within a CNC press brake, a 5000 Series switch ensures that hydraulic pressure remains within safe operating limits to prevent damage to machine components.

Features

- Pressure switching set point range: 3.5 psi to 150 psi
- Proof pressures up to 500 psi
- Burst pressures up to 4000 psi
- Life cycle rating up to 1 million
- IP67 sealing rating
- More than 15 pressure port options and over 30 electrical terminations
- Plated steel, brass or stainless steel options



5000 Series Pressure Switch

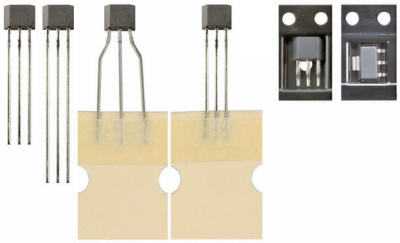
SOLUTIONS – SPEED AND POSITION DETECTION

Hall-effect Sensor ICs

Hall-effect sensor ICs play a crucial role in CNC machines by providing contactless and highly reliable position sensing. These sensors detect changes in magnetic fields to determine the position and movement of machine components, offering precise feedback for motion control. They are commonly used in spindle speed monitoring, axis positioning, and detecting tool presence. Since Hall-effect sensors operate without physical contact, they experience less wear and have a longer lifespan compared to mechanical sensors, making them ideal for high-precision and high-speed CNC applications.

Another key benefit of Hall-effect sensors in CNC machines is their resistance to environmental factors such as dust, vibration, and temperature variations. This makes them particularly useful in harsh manufacturing environments where traditional sensors may fail. Additionally, these sensors contribute to automation by enabling precise homing sequences and ensuring accurate tool positioning, which enhances overall machine efficiency. By integrating Hall-effect sensors, CNC machines achieve improved reliability, reduced maintenance, and greater precision in machining operations.

Honeywell SS441A Hall-Effect Sensor – incorporated as a home switch or proximity sensor in CNC machines. In a CNC machining center, the SS441A sensor detects tool position when resetting the machine after a power cycle.



SS441A Hall-effect Sensor

Features

- Digital current sinking output Quad-Hall design virtually eliminates mechanical stress effects
- Temperature compensated magnetics
- Operate/release points can be customized
- High output current capability

SOLUTIONS – MAIN CONTROL PANEL

MICRO SWITCH Toggle and Pushbutton Switches

Toggle switches and pushbutton switches on the main control panel of a CNC machine serve as essential user interface components, allowing operators to manually control various machine functions. Toggle switches are commonly used for power control, enabling or disabling machine operations, and activating key functions such as coolant flow, spindle operation, or emergency stop modes. Their durable design ensures reliability in industrial environments, where quick and definitive actuation is required for operational efficiency and safety.

Pushbutton switches, on the other hand, facilitate momentary or sustained control actions, such as starting or stopping machining cycles, tool changes, or resetting alarms. These switches provide an intuitive interface for operators, allowing rapid interaction with machine controls without the need for complex programming. Pushbuttons often include features like LED indicators to signal machine status, helping improve workflow visibility and reducing errors. Together, toggle switches and pushbutton switches enhance the ease of use, safety, and operational control of CNC machines, ensuring efficient and reliable machine operation.



MICRO SWITCH NT Toggle Switches – Many CNC machines use an NT toggle switch to manually turn the coolant flow on or off. The coolant is essential for dissipating heat generated during machining, reducing tool wear, and improving surface finish. The toggle switch provides a simple and reliable way for the operator to enable or disable coolant flow based on machining needs.

Features

- Sealed to NEMA 3, 3R, 4, 13 and IP67/IP68 for global use
- Suitable for applications in many demanding outdoor environments, where the panels are subjected to vibration from equipment, temperature extremes, dust, splashing water, and/or hose directed water
- UL recognized, File E12252, Vol. 1, Section 44, CSA certified, UKCA and CE certified for global use
- Spring-loaded actuating mechanism provides excellent tactile feedback



MICRO SWITCH NT Toggle Switch

MICRO SWITCH AML Pushbutton Switches – A MICRO SWITCH AML pushbutton can start and stop the CNC machine's operation, allowing the operator to begin or halt machining tasks. A pushbutton switch configuration provides the operator with a clear, reliable means to control the machine's active or idle state, ensuring both operational efficiency and safety.

Features

- Pushbuttons, paddles, rockers, key-actuated, and indicators within AML Series for coordinated panel appearance
- Pushbuttons, paddles, and rockers furnished lighted or unlighted
- Available with momentary or alternate action (push-on and push-off)
- Two or three positions and maintained or momentary action
- One-, two-, or four-poles with double throw available for most switches



MICRO SWITCH AML Pushbutton

SOLUTIONS – TEMPERATURE MONITORING

Temperature Sensors

Monitoring Spindle Temperature – CNC machines often use high-speed spindles that can generate significant heat during operation. Monitoring spindle temperature is crucial to prevent overheating, which can lead to spindle wear or failure Temperature sensors, like thermistors or RTDs, can be placed near the spindle motor or the spindle itself. If temperatures exceed safe operational limits, the system can alert operators or automatically slow down or halt processes to prevent damage.

Cooling System Regulation – Many CNC machines utilize coolant systems to manage heat generated during machining. Temperature sensors help regulate the heating and cooling processes. Sensors can be installed in coolant lines or the liquid reservoir to monitor coolant temperature. If the coolant becomes too hot, the system can activate pumps or adjust flow rates to maintain optimal temperatures.

Tool Temperature Monitoring – The temperature of cutting tools can influence their lifespan and performance. Excessive heat can lead to tool wear, affecting machining accuracy. Sensors can be placed near tools or in tool holders to provide real-time data on tool temperature. Monitoring this data allows for adjustments in machining parameters (like feed rate or spindle speed) to optimize tool life and part quality.

Material Temperature Sensing – Certain materials can experience dimensional changes with temperature fluctuations, affecting the machining process. Temperature sensors can be used to monitor material temperatures, especially during operations involving heat-sensitive materials. This helps maintain dimensional accuracy and consistency in finished parts.

Control Systems Integration – Integrating temperature data into CNC control systems can enhance overall machine operation. Temperature sensors can feed data into the CNC software, allowing it to make live adjustments to parameters based on thermal conditions. This integration can lead to improved precision and quality in machining outcomes.

Safety and Alarm Systems –Safety is paramount in CNC operations. Temperature sensors can help in preventing dangerous situations. Sensors can be linked to alarm systems. If an abnormal temperature is detected (e.g., overheating of electrical components), alarms can be triggered, and emergency shutdowns can be initiated to protect operators and equipment.

Process Optimization – Continuous monitoring of temperatures can provide insights into optimizing machining processes for better performance and quality. Analyzing temperature data over time can help identify trends that allow for process adjustments, such as optimizing cutting parameters to reduce wear and improve surface finish on machined parts.

Overall, temperature sensors contribute significantly to the efficiency and reliability of CNC machines, enabling manufacturers to maintain high standards of quality, safety, and durability in their machining operations.



500 Series Temperature Sensors – Temperature sensors play a critical role in the operation of CNC machines by monitoring temperature in various components, ensuring safety, enhancing operational efficiency, and extending the life of the equipment.

Features

- Air/gas, surface, immersion and liquid level
- NTC type output
- Enhanced sensitivity, reliability, accuracy, stability/low drift
- Small package size
- Easy to install
- Wide operating temperature range



500 Series Temperature Sensors

CONCLUSION

Honeywell sensors and switches play key roles in CNC machine automation by enhancing safety, precision, and efficiency. Whether monitoring axis travel with limit switches, ensuring correct tool positioning with position sensors, or maintaining hydraulic pressure with pressure switches, these components contribute to the reliable operation of CNC equipment. By integrating Honeywell high-quality solutions, manufacturers can achieve improved productivity and reduced downtime in CNC machining processes.



⚠WARNING IMPROPER INSTALLATION

- Consult with local safety agencies and their requirements when designing a machine control link, interface and all control elements that affect safety.
- Strictly adhere to all installation instructions.

Failure to comply with these instructions could result in death or serious injury.

WARRANTY/REMEDY

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