User Manual: NexBot Vision SD312-015 1500N Single-Axis Force Sensor

SKU: NXB-SNS-SD312-015 | Version: 1.0 | Brand: NexBot Robotics

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1. Safety Information

READ ALL SAFETY INSTRUCTIONS BEFORE OPERATION. Failure to follow safety procedures may result in serious injury or equipment damage.

DANGER: Hazardous voltage. Disconnect and lock out all power sources before installation, service, or repair. Failure to do so can result in severe injury or death.

WARNING: Never exceed the sensor's maximum rated load of 1500N. Overloading can cause permanent damage, leading to inaccurate readings or complete failure.

WARNING: Improper mounting can lead to sensor detachment during operation, creating a projectile hazard and causing severe equipment damage. Always use the specified bolt size and torque values.

CAUTION: This device contains components sensitive to electrostatic discharge (ESD). Always wear a grounded anti-static wrist strap when handling or making connections to the sensor.

NOTICE: For optimal performance and accuracy, the sensor must be allowed to acclimate to the ambient operating temperature before use. A zeroing (tare) procedure should be performed before starting critical tasks.

2. Product Overview

The NexBot Vision SD312-015 is a high-performance single-axis force sensor designed to provide precise, real-time force feedback for demanding industrial automation applications. This sensor enables robots to perform tasks that require a delicate touch or consistent pressure, such as polishing, grinding, deburring, and force-limited assembly. By integrating this sensor into your robotic cell, you can significantly improve process consistency, enhance product quality, and reduce defects caused by uncontrolled force application. Key features of the SD312-015 include its robust construction and high accuracy. The housing is machined from durable 17-4PH stainless steel, providing an IP67 rating for protection against dust and water ingress, ensuring reliable operation in harsh manufacturing environments. The sensor is engineered for a nominal capacity of 1500 N, making it suitable for a wide range of medium-force tasks. A critical benefit is its substantial overload protection of up to 500% of its nominal capacity, which safeguards the sensor against damage from unexpected impacts or programming errors, thereby minimizing downtime and replacement costs. Integration is streamlined through its native EtherCAT communication protocol, allowing for high-speed, low-latency data transmission directly to the robot controller. This facilitates advanced force control strategies and real-time process adjustments. The compact form factor and standard mounting interface simplify installation on a variety of end-of-arm tooling (EOAT) and robot wrists. The SD312-015 sensor is an essential component for automating complex material removal and assembly processes where force control is paramount for achieving the desired outcome.

3. Getting Started

1. Product Overview

The NexBot Vision SD312-015 is a single-axis force sensor designed for high-precision industrial applications. It measures compression and tension forces along its primary axis up to 1500N, providing real-time feedback over an EtherCAT network to a NexBot robot controller or other compatible master device.

2. Principle of Operation

The sensor utilizes strain gauge technology to detect minute deflections in its stainless steel structure caused by applied force. These deflections are converted into a calibrated digital signal by the internal electronics, which is then transmitted over the high-speed EtherCAT protocol for use in force-guided robotic operations.

3. System Integration

The SD312-015 is designed to be mounted between a robot arm flange and an end-effector. It functions as an EtherCAT slave device, integrating seamlessly into a standard industrial control network. The sensor requires a stable 24VDC power supply and is configured using the NexBot Integrated Control Environment (NICE) software.

4. Operation

Reading Force Data

Once integrated, force data is broadcast as a process data object (PDO) over the EtherCAT network. This data can be mapped to variables within your robot program

to monitor or control operations in real-time. The primary output is a signed integer representing the measured force in the configured units.

> **Tip:** For high-frequency applications, ensure your EtherCAT cycle time is configured appropriately to match the sensor's update rate for the most responsive performance.

Performing a Tare (Zeroing)

A tare operation sets the current force reading to zero. This is critical for negating the weight of the attached tool and ensuring measurements reflect only the process forces. The tare function can be triggered via a command in the robot program or through the NICE software interface.

> **Tip:** Perform a tare procedure after tool changes or significant temperature shifts to maintain the highest level of accuracy.

Implementing Force Control

The sensor's feedback enables advanced force control modes. In applications like deburring or polishing, the robot's path can be adjusted dynamically to maintain a constant contact force, compensating for part variability and tool wear. This is configured using the force control function blocks within the NexBot programming environment.

Setting Force Thresholds

To protect equipment and parts, you can establish force thresholds in your control software. If the measured force exceeds a predefined limit, the robot can be programmed to stop, retract, or trigger an alarm. This is essential for force-limited assembly tasks to prevent damage from misalignment or jamming.

Interpreting Status Indicators

The sensor is equipped with multi-color LEDs to provide a quick visual diagnostic. A solid green light typically indicates normal operation with an active EtherCAT link. A flashing light may indicate a configuration issue, while a red light signals a fault condition such as an overload or internal error.

> **Tip:** Refer to the full product data sheet for a detailed chart of all LED status codes and their meanings.

5. Maintenance Schedule

Interval	Task	Notes
Daily	Visually inspect the sensor housing, connectors, and cabling for any signs of physical damage, wear, or loose connections.	This check should be part of the standard pre-operation checklist for the robotic cell.
Weekly	Perform a tare procedure with the robot in a known, no-load position. Verify that the reading reliably returns to zero to check for measurement drift.	Log any significant offset for trend analysis.

Interval	Task	Notes
Monthly	Clean the sensor's exterior using a soft, lint-free cloth lightly dampened with isopropyl alcohol. Do not use abrasive cleaners or high-pressure spray.	While the sensor is IP67 rated, regular cleaning prevents buildup of contaminants that could affect thermal performance.
Quarterly	With power disconnected, verify the torque of the sensor and tool mounting bolts. Re-torque to specification if necessary.	Vibration during operation can cause bolts to loosen over time.
Annually	Inspect the full length of the power and EtherCAT cables for chafing, cracking, or damage, especially at flex points. Ensure connectors are secure and free of corrosion.	Replace any cable that shows signs of significant wear to prevent intermittent connection issues.
As Needed	If measurement accuracy is in question or after a suspected overload event, perform a full recalibration using a certified load cell and the NexBot calibration utility.	This task should be performed by a trained technician.

6. Troubleshooting

Symptom	Possible Cause	Solution
Sensor is unresponsive and status LEDs are off.	Loss of 24VDC power or reversed polarity.	Use a multimeter to verify 24VDC at the sensor's power connector. Check the power supply, fuses, and cable integrity. Confirm correct polarity.
Sensor does not appear on the EtherCAT network.	Incorrect cabling, faulty cable, or EtherCAT network configuration error.	Ensure EtherCAT cables are connected to the correct IN/OUT ports. Swap cables to rule out a faulty one. Verify the EtherCAT master configuration and ensure the correct ESI file is loaded.
Force readings are noisy or erratic.	Poor grounding, electromagnetic interference (EMI), or loose mounting.	Ensure the robot and sensor have a common, low-impedance ground. Route sensor cables away from high-power motor cables. Check the torque on all mounting bolts.
Force reading has a significant offset and does not return to zero.	The sensor requires a tare, there is an unintended mechanical preload,	Perform the tare/zeroing procedure. If the offset persists, power down and check for any obstructions or binding. If an overload is suspected, inspect the

Symptom	Possible Cause	Solution
	or the sensor was overloaded.	sensor for physical damage and perform a calibration check.
Status LED is flashing red.	Internal sensor fault or critical error.	Power cycle the sensor and the robot controller. If the fault condition persists after a restart, document the error code from the software and contact NexBot technical support for assistance.
Software reports a 'Force Overload' alarm.	The applied force has exceeded the 1500N measurement limit of the sensor.	Immediately stop the robot program. Carefully inspect the sensor, end-effector, and workpiece for damage. Revise the robot program to reduce the applied force during the operation.
Inconsistent measurements between identical tasks.	Temperature variations affecting the sensor or improper tool mounting.	Allow the system to reach a stable operating temperature before beginning precision tasks. Verify that the tool is mounted securely and that the mounting surfaces are clean.

7. Technical Specifications

Parameter	Value	Unit
Weight	0.85	kg
Material	Stainless Steel 17-4PH	
Voltage	24VDC	
IP Rating	IP67	
Country of Origin	IT	
Protocol	EtherCAT	
Dimensions	80 x 80 x 45 mm	