# OMRON

# High-speed Analog Input Unit

## NX Series NX-HAD401/402

**Analog inspection without PC**

- PLC systems can acquire analog data at high speeds
- Easy system configuration and maintenance

# High-speed analog inspection with PLC system
## —No special devices and no PC required

Improving quality in parts inspections requires as detailed analog data as possible. Most automotive and other manufactu[...]
special measuring devices such as data loggers for measurements.
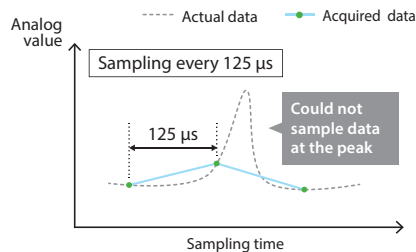Being among the first to work on IoT at manufacturing sites, Omron now offers the High-speed Analog Input Unit that car[...]
easily acquire synchronized analog data. It will help you improve quality.

## Reliable

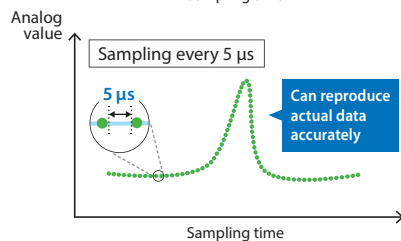### Industry's fastest*1 sampling speed of 5 μs to catch every minute change

**Conventional PLC**

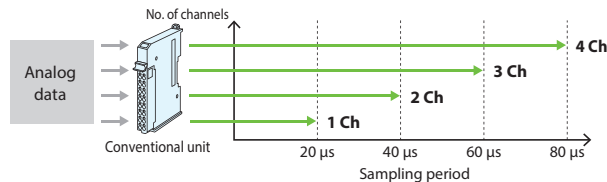Some data could not be obtained when an error occurred

**NX-HAD**

Sampling **as fast as every 5 μs** catches all changes in behavior

Analog value
---- Actual data   •— Acquired data

Sampling every 125 μs

125 μs

Could not sample data at the peak

Sampling time

Analog value

Sampling every 5 μs

5 μs

Can reproduce actual data accurately

Sampling time

### Industry's fastest sampling speed*1: Same speed*2 regardless of the number of channels

**Conventional PLC**

Sampling period becomes longer as data is obtained from multiple channels

No. of channels

Analog data

Conventional unit

4 Ch
3 Ch
2 Ch
1 Ch

20 μs   40 μs   60 μs   80 μs
Sampling period

**NX-HAD**

**Achieves high-speed sampling every 5μs from 4 channels** at the same time

No. of channels

Analog data

NX-HAD

4 Ch
3 Ch
2 Ch
1 Ch

5 μs   20 μs   40 μs   60 μs   80 μs
Sampling period
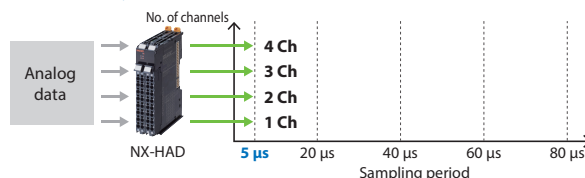
*1. Based on Omron's surveys as of January 2018.   *2. When using 4 channels.

## Precise

### Fully insulated channels to obtain precise data witho[...]

**Conventional PLC**

Mutual interference occurred between channels

**NX-HAD**

**Precise data** can be obtained from multiple channels

### Easy comparative analysis o[...] synchronously from multipl[...]

**Conventional PLC**

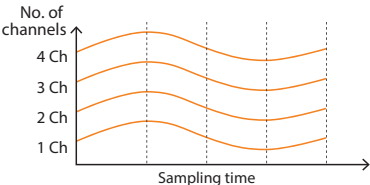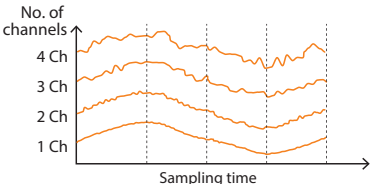Difficult to compare data obtained at different times

**NX-HAD**

**Precise data** can be obtained from multiple channels

Furthermore, the Time-Stamp function in EtherCAT® ensures accurate synchronization between units
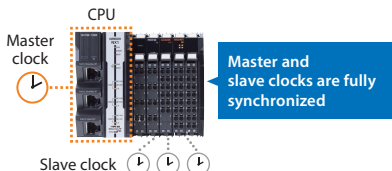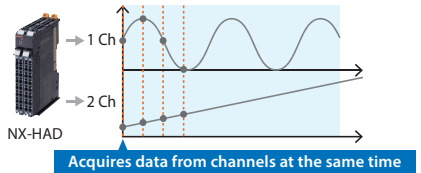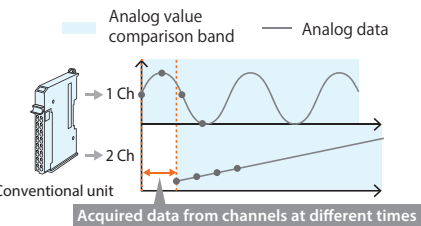
NX102-1200

OMRON NX1

PF0730  AD3208

HAD401

## Easy

**Simple system configuration ideal for global manufacturing**

...urers are using PC and

...n reliably, precisely, and

**...ut noise**

No. of channels

4 Ch
3 Ch
2 Ch
1 Ch

Sampling time

No. of channels

4 Ch
3 Ch
2 Ch
1 Ch

Sampling time

**...f data obtained ...e channels**

Analog value comparison band — Analog data

1 Ch

2 Ch

Conventional unit

**Acquired data from channels at different times**

1 Ch

2 Ch

NX-HAD

**Acquires data from channels at the same time**

CPU

Master clock

**Master and slave clocks are fully synchronized**
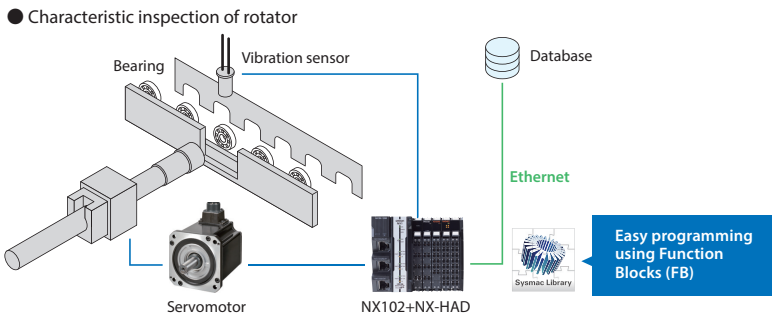
Slave clock

### Conventional system

- Special measuring devices don't have flexibility in configuration
- PC requires programming skills in C
- Difficult to change programs concealed in dedicated controllers
- Some technical skills are required to configure PC that is connected to database

● Characteristic inspection of rotator

Bearing
Vibration sensor
Database
Ethernet
**Complicated program**
PC
PC board
Servomotor
PLC
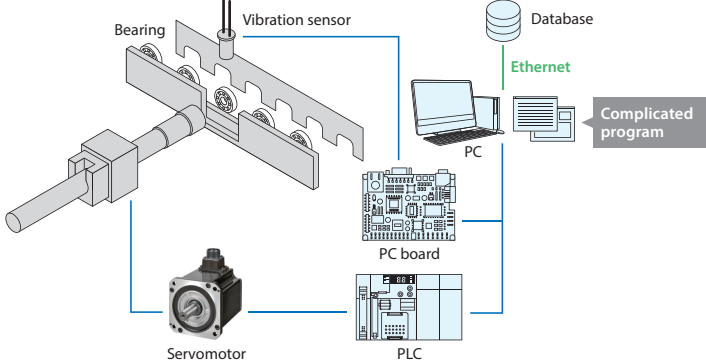
### NX-HAD

- PLC system **reduces initial costs**
- **Programs can be created without any special knowledge** of PC
- **Programs can be changed** for additional inspection items
- Database connection controller*3 brings **IoT** into manufacturing sites **without connecting PC**

● Characteristic inspection of rotator

Bearing
Vibration sensor
Database
Ethernet
**Easy programming using Function Blocks (FB)**
Sysmac Library
Servomotor
NX102+NX-HAD

*3. When using the NJ/NX Machine Automation Controller Database Connection CPU Unit or the Industrial PC Platform NY IPC Machine Controller.

# High-speed Analog Input Unit

## Ordering Information

| Product name | Analog input section | | | | | Trigger input section | | Model |
|---|---|---|---|---|---|---|---|---|
| | Number of points | Input range | Resolution | Input method | Conversion time | Number of points | Internal I/O common | |
| High-speed Analog Input Unit | 4 points | Voltage:<br>• -10 to 10 V (-32000～32000)<br>• -5 to 5 V (-32000～32000)<br>• 0 to 10 V (0～32000)<br>• 0 to 5 V (0～32000)<br>• 1 to 5 V (0～32000)<br>Current:<br>• 0 to 20 mA (0～32000)<br>• 4 to 20 mA (0～32000) | • Input range of -10 to 10 V or -5 to 5 V 1/64000 (full scale)<br><br>• Other input range 1/32000 (full scale) | Differential input | 5 μs/4 Ch | 4 points | NPN | NX-HAD401 |
| | | | | | | 4 points | PNP | NX-HAD402 |

## Combination Table

| Model | Unit version | |
|---|---|---|
| | CPU Unit or Industrial PC | EtherCAT® Coupler Unit |
| NX-HAD401　Ver.1.0<br><br>NX-HAD402　Ver.1.0 | NX701-□□□□　Ver.1.18 or later | NX-ECC203　Ver.1.0 or later |
| | NX102-□□□□　Ver.1.30 or later | |
| | NJ501-□□□□　Ver.1.18 or later | |
| | NJ301-□□□□　Ver.1.18 or later | |
| | NJ101-□□□□　Ver.1.18 or later | |
| | NX1P2-□□□□□□(1)　Ver.1.18 or later | |
| | NY5□□-1　Ver.1.18 or later | |

# Collection of software functional components Sysmac Library

Please download it from following URL and install to Sysmac Studio.
**http://www.ia.omron.com/sysmac_library/**

## Ordering Information

| Product | Features | Model |
|---|---|---|
| High-Speed Analog Inspection Library | The High-speed Analog Inspection Library records analog input values acquired by the NX series High-speed Analog Input Units in time. This library provides functions required for product inspections during production processes, including calculation of feature values (e.g., maximum, minimum, and mean), comparison with master data, and data file storage. | SYSMAC-XR016 |

## Function Block (FB) Specifications

| Name | FB name | Description |
|---|---|---|
| Device Output Data Binding | DeviceVariableToArray_*** | Reads analog input values of one task period from the NX High-speed Analog Input Unit, and joins them into a single array variable. |
| Scale Transformation for NX-series High-speed Analog Input Unit | ScaleTrans_HAD | Performs scale transformation of data from the NX High-speed Analog Input Unit. |
| Upper/lower Alarm for NX-series High-speed Analog Input Unit | LimitAlarm_HAD | Monitors input data from the NX-series High-speed Analog Input Unit and issues alarms in terms of the top upper limit, upper limit, lower limit, and bottom lower limit. |
| Trigger Control | TrigControl | Generates trigger information, which allows the DataRecorder FB to start data logging. |
| Data Recorder | DataRecorder | Joins specified elements of array data into a single array variable every task period, and creates log data in chronological order. |
| Upper and Lower Limit Test | LimitTest | Checks whether each element value in the data array is within the allowable range of the test standard data. |
| Feature Values Calculation | CalcFeatureValues | Calculates the mean, standard deviation, skewness, kurtosis, maximum value, and minimum value for the test target data array. |
| Log Data CSV File Write | LogDataToCSV | Outputs the log data created in the DataRecorder FB as a CSV file (*.csv) to an SD memory card. |
| Log Data CSV File Read-Out | CSVToLogData | Reads out the log data recorded in the SD memory card from a CSV file to the LogData[] array variables as the test standard data for the LimitTest FB. |

# Function Block (FBs)* in the High-Speed Analog Inspection Libraryreduce programming time and allow PLC systems to be used for analog inspection machines

* The Sysmac Library is a collection of software functional components that can be used in programs for the NJ/NX Machine Automation Controllers or Industrial PC Platform NY IPC Machine Controller. Please download it from following URL and install to Automation Software Sysmac Studio.
http://www.ia.omron.com/sysmac_library/


Sysmac Library

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## Collect: Data Recorder FB

Joins acquired analog data into a single array variable and creates log data in chronological order.

| TimeStamp | | CH1 | CH2 | CH3 |
|---|---|---|---|---|
| 375539985418 | 0 | 24 | 36 | 3 |
| 375540005418 | 20 | 21 | 14 | 0 |
| 375540025418 | 40 | 30 | 34 | 10 |
| 375540045418 | 60 | 12 | 8 | -4 |
| 375540065418 | 80 | 8 | 0 | -6 |
| 375540085418 | 100 | 6 | 18 | -3 |
| 375540105418 | 120 | 0 | 30 | -2 |
| 375540125418 | 140 | 1 | 35 | 6 |
| 375540145418 | 160 | -4 | 13 | 4 |
| 375540165418 | 180 | -6 | 23 | 1 |
| 375540185418 | 200 | -1 | 18 | 9 |
| 375540205418 | 220 | -10 | 2 | -1 |
| 375540225418 | 240 | -12 | 13 | -3 |
| 375540245418 | 260 | -8 | 30 | 0 |

← Measured data
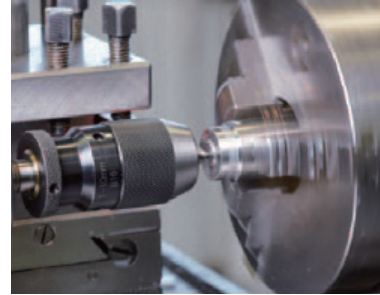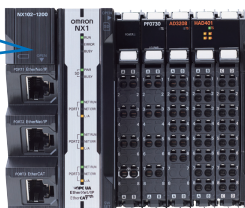


<Machine condition inspection>
In order to perform predictive maintenance of a machine, all control data is acquired, and data during normal operation is compared with data during abnormal operation.

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## Calculate: Feature Values Calculation FB

Calculates not only maximum values, minimum values, and other feature values but also standard deviations used for analog inspections.



Measured value

Analog data

Maximum value

Minimum value

Time
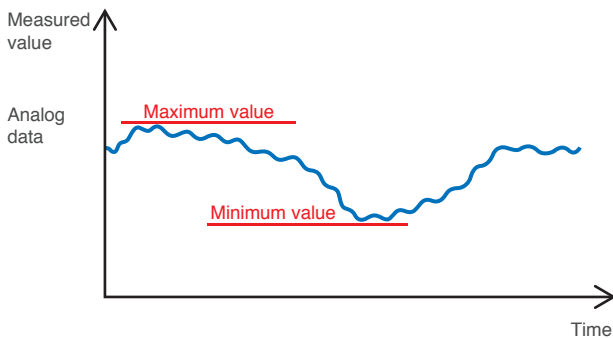


<Characteristic inspection of rotator>
Rotators (e.g., motors and bearings) are inspected whether future values including maximum and minimum rotation speeds satisfy the specifications.

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## Judge: Upper and Lower Limit Test FB

Checks whether measured values are within the allowable range of the test standard data. The measurement data of good products can be set as test standard data, and the allowable range can be set as desired.



Measured value

- - - Allowable range
——— Measured value

Time
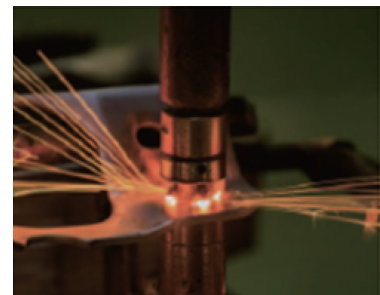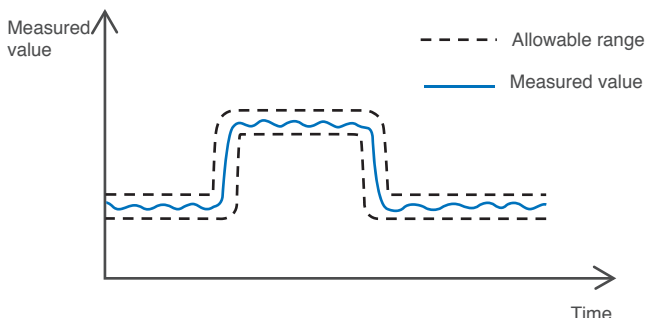


<Welding quality inspection>
Welding voltage and current values are measured, and the waveforms are monitored to check if welding failure occurred.
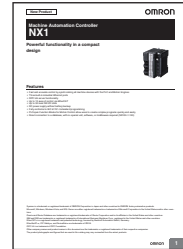
Powerful functionality in a compact design
Machine Automation Controller

# NX1

The NX1 in combination with the high-speed analog unit can control quality through high-speed inspections and collect information while at the same time providing high-speed, high-precision control.

**NX1 Catalog**
P129

**NX1 Datasheet**
P130

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