



EasyNO_x – NO_x Monitoring

Operating Manual



Original instructions

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Read through this operating manual carefully before use and become familiar with the product. Installation and start-up should not be carried out before reading and understanding this document. Keep this manual readily available so that you can reference it as needed.

1.1 What Is the Purpose of this Operating Manual?

This manual serves as an aid for the installation and operation of the product and supports the technical staff with all operating and maintenance tasks to be performed. Furthermore, this manual is aimed at preventing dangers to life and health of the user and third parties.

1.2 Who Is this Operating Manual Targeted to?

The operating manual provides a code of conduct for personnel tasked with the setup, operation, maintenance, and repair of gas engines. A certain level of technical knowledge with respect to the operation of gas engines and basic knowledge of electronic ignition systems are necessary. Persons who are only authorized to operate the gas engine shall be trained by the operating company and shall be expressly instructed concerning potential hazards.

1.3 Which Symbols Are Used in the Operating Manual?

The following symbols are used in this manual and must be observed:



Example

This symbol indicates examples, which point out necessary handling steps and techniques. In addition, you receive additional information from the examples, which will increase your knowledge.



Notice

This symbol indicates important notices for the user. Follow these. In addition, this symbol is used for overviews that give you a summary of the necessary work steps.



Warning

This symbol indicates warnings for possible risks of property damage or risks to health. Read these warning notices carefully and take the mentioned precautionary measures.

1 General Information



Danger

This symbol indicates warnings for danger to life, especially due to high voltage. Read these warning notices carefully and take the mentioned precautionary measures.

1.4 Which Abbreviations/Acronyms Are Used in the Operating Manual?

In the operating manual or the user interface, the following abbreviations/acronyms are used.

| Abb. | Term | Description | Explanation |
|---------|---|----------------------------------|---|
| AC | Alternating Current | | |
| CAN bus | Controller Area Network bus | Bus for control devices/networks | Asynchronous serial connection system for linking control units |
| CE | Conformité Européenne | Conformity with EU directives | Mark based on EU legislation for certain products in conjunction with product safety |
| CiA® | CAN in Automation | | Users' and manufacturers' group standardizing CAN protocols |
| CSV | Comma-separated Values | Data separated by comma | Text file for storage or exchange of structured data |
| DC | Direct Current | | |
| DIP | Dual In-Line Package | | Housing form for electronic components with two rows of connections for push-fit assembly |
| DIS | Draft International Standard | | Draft ISO standard |
| ECU | Electronic Control Unit | | Electronic module for control and regulation |
| ESD | Electrostatic Discharge | | |
| HMI | Human-Machine Interface | | Interface between a human and a machine or a computer |
| IEC | International Electrotechnical Commission | | International organization for standardization in the field of electrical engineering and electronics |
| I/O | Input/Output | | Communication of an information system with the outside world |

| Abb. | Term | Description | Explanation |
|-----------|--|---|---|
| ISO | International Organization for Standardization | | |
| LED | Light Emitting Diode | | Light emitting electronic semiconductor |
| LSS | Layer Setting Services | | Service for configuration of node ID and bit rate in a CAN-open® network |
| MAP | Manifold Absolute Pressure | | |
| MMC | Multimedia Card | | Digital storage medium |
| NMT | Network Management | | |
| PRAK | PIN Reset Authorization Key | Key for resetting all PINs | Key that resets all PINs of the EasyNO _x . |
| PRRK | PIN Reset Request Key | Key for applying for a PIN reset key | Key with which the key for resetting all EasyNO _x PINs can be requested. |
| SAE | Society of Automotive Engineers | | International organization for standardization in the field of mobility technology |
| SD card | Secure Digital card | Secure digital data storage card | Digital storage medium |
| SDHC card | Secure Digital High-Capacity card | Secure, high-capacity digital memory card | Digital storage medium |
| USB | Universal Serial Bus | | Serial connection system to link a computer to external devices |
| UTC | Coordinated Universal Time | | |

2 Safety Instructions

2.1 General Safety Instructions

The following safety instructions must be followed in the area in which the device is operated:



High voltage! Danger to life!

While the engine is running, there is danger to life through high voltage particularly in the area of the ignition system. The following parts should therefore not be touched or removed unless explicitly stated otherwise:

- Ignition coils and caps
- Wires of the high voltage circuit
- In- and output wiring of the ignition controller
- Pickups and their wiring



Danger to persons with implanted cardiac devices!

Electromagnetic impulses in the wiring of the ignition system may exceed the permissible limits of active implanted cardiac devices such as pace-makers or defibrillators. Persons with cardiac devices must therefore not be present in the vicinity of the ignition system being operated. Mark the operating location of the ignition system with the corresponding standardized warning symbol.

MOTORTECH equipment is manufactured as state of the art and therefore safe and reliable to operate. Nevertheless, the equipment can cause risks or damage can occur if the following instructions are not complied with:

- The gas engine must only be operated by trained and authorized personnel.
- Observe all safety instructions of the system and all safety instructions of the system operator.
- Operate the equipment only within the parameters specified in the technical data.
- Use the equipment correctly and for its intended use only.
- Never apply force.
- For all work such as installation, conversion, adaptation, maintenance, and repair, all equipment must be disconnected from the mains and secured against unintentional reactivation.
- Perform only such maintenance and repair work as is described in the operating manual, and follow the instructions given while working.
- Only use spare parts supplied by MOTORTECH for the maintenance of the device.
- Further work must only be performed by personnel authorized by MOTORTECH. Non-compliance with the instructions will void any warranties for the proper function of the equipment as well as the responsibility for the validity of the certifications.
- Safety devices must not be dismantled or disabled.
- Avoid all activities that can impair the function of the equipment.
- Operate the equipment only while it is in proper condition.

- Investigate all changes detected while operating the gas engine or ignition system.
- Ensure compliance with all laws, directives, and regulations applicable to the operation of your system, including such not expressly stated herein.
- If the system is not entirely tight and sealed, gas may escape and result in explosion hazard. The inhalation of gas can also lead to death or severe health damages. Therefore, upon completion of all assembly works, always check the system's tightness.
- Always ensure adequate ventilation of the engine compartment.
- Ensure a safe position at the gas engine.
- There is a risk of burning on hot surfaces. Allow the gas engine to cool down before starting any work.
- Personal protective equipment (PPE), e.g. safety shoes and gloves, must be worn during all work on the gas engine.
- Noise from the system can cause permanent or temporary damage to your hearing. Wear suitable hearing protection at the system.
- Your behavior can reduce possible residual risks to a minimum. Observe responsible handling of the gas engine and the gas-carrying system.

2.2 Electrostatic Discharge Hazards

Electronic equipment is sensitive to static electricity. To protect these components from damage caused by static electricity, special precautions must be taken to minimize or prevent electrostatic discharge.

Observe these safety precautions while you work with the equipment or in its vicinity.

- Before performing maintenance or repair work, ensure that the static electricity inherent to your body is discharged.
- Do not wear clothing made from synthetic materials to prevent static electricity from building up. Your clothing should therefore be made of cotton or cotton mix materials.
- Keep plastics such as vinyl and Styrofoam materials as far away from the equipment and the work environment as possible.
- Do not remove the circuit boards from the housing of the device.

2.3 Information on Electric Isolation

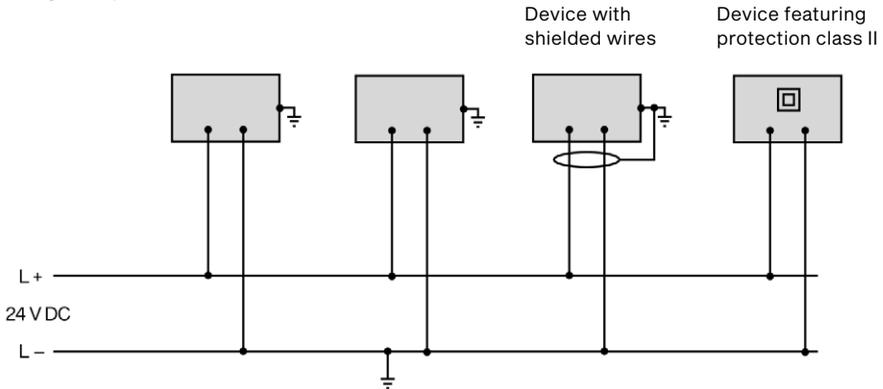
If ground and earth potential are not properly isolated, the following problems as well as others can occur:

- Electromagnetic interferences (e.g. ground loops)
- Signal corruption (e.g. of the analog voltage signal)
- Unwanted leakage currents

Therefore, earth potential and the negative pole of the power supply of all devices in the electric assembly that provide the option, should be connected separately. If possible, the negative pole of the power supply should only be connected to earth potential at one point in the entire system.

2 Safety Instructions

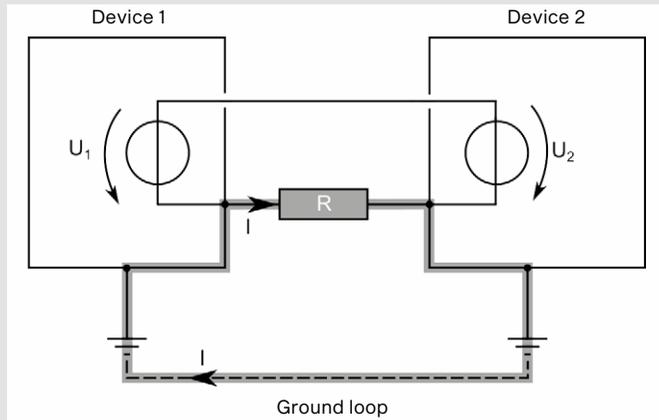
Wiring Example



Occurrence of ground loops

The devices shown in the following image do not feature the possibility to connect the earth potential and the negative pole of the power supply separated from each other. How ground loops are created.

A ground loop is a ground connection of an electric wiring assembly that is closed as a loop. Due to impedance (resistance $R > 0$) of the loop, low-frequency interference currents can lead to an unwanted voltage drop in the signal path.



2.4 Special Safety Instructions for the EasyNO_x



Explosion hazard!

The following operations may only be executed providing the environment is classified as non-explosive:

- Establishing and terminating communications via EasyNO_x interfaces and connections.
- Inserting and removing memory cards.



Risk of destruction and injury!

The EasyNO_x is an electrically operated device, and there is the risk of electrostatic discharges. Therefore, never operate the device without the appropriate grounding, to prevent injuries and damage.



Risk of injury!

The EasyNO_x is designed for operation in circuits with **protected extra-low voltage (PELV)**. The voltages in these circuits must not exceed 50 V AC or 75 V DC.

The EasyNO_x must not be electrically connected to circuits which carry dangerously high voltages or which could do so if a single fault occurs.

Therefore, the following conditions, among others, must be fulfilled:

- The power supply may only be provided from power supply units with safe electrical isolation or from batteries.
- Relays with safe isolation must be used for coupling to circuits that carry or in the event of a failure could carry dangerous voltage.
- All currently applicable standards and regulations must be taken into account.



Operational safety!

The EasyNO_x and the software are not designed for safety-critical applications. The analog and binary inputs and outputs of the EasyNO_x system must not be used for safety-critical purposes.

2 Safety Instructions



Risk of destruction!

When using the EasyNO_x, observe the following points:

- Do not let the device fall.
- The device must not come into contact with water and other liquids.
- Do not operate the device in direct sunlight, near heat sources or in humid environments.
- Only operate the device in accordance with the technical specifications.

Disregard of these guidelines can lead to the destruction of the device.



Risk of damage and malfunctions!

Safe operation is no longer guaranteed in the following cases:

- The EasyNO_x shows visible damage.
- The display remains dark or shows unusual patterns for a longer period of time.
- The screen saver does not turn off when touching the display.
- The EasyNO_x does not react after a restart.

The EasyNO_x must then be turned off and must not be used any longer.



Risk of destruction!

The surface of the touchscreen is sensitive to pointed and sharp-edged objects. Therefore handle the touchscreen carefully. Pixel errors due to improper handling are excluded from the warranty.

2.5 Special Safety Instructions for Use as NO_x Monitor



Explosion hazard!

In the event of a malfunction, ignitable sparks may be generated in the EasyNO_x system. Comply with all locally applicable explosion protection regulations and ensure that no explosive gases form in the system area.



Risk of suffocation! Risk of poisoning!

Leaks in the exhaust pipe can cause exhaust gases to escape and people in the system room can suffocate or be poisoned. After mounting the sensors, check the tightness of the exhaust pipe.



Risk of burning!

There is a risk of burns when touching the sensing elements of the NO_x sensor and the thermocouples because the sensing elements become hot during operation. Therefore, observe the following:

- Install the sensing elements on the exhaust pipe at suitable locations so that people at the plant cannot be burned by them, or install an appropriate protection around the sensing elements that prevents contact with them.
- The sensing elements must have cooled down sufficiently after switching off or disconnecting the power supply before you can touch the sensing elements again.



Risk of destruction and injury!

The CAN bus/NO_x sensor module is an electrically operated device, and there is the risk of electrostatic discharges. Therefore, never operate the device without the appropriate grounding, to prevent injuries and damage.



Operational safety!

The NO_x monitoring devices, including the EasyNO_x, must be operated with closed housings. Otherwise, proper functioning of the devices and compliance with the protection classes cannot be guaranteed.

When the system is powered off, the housings may only be opened for wiring and configuration. When the housing is open, make sure that no moisture forms in the housing.

2 Safety Instructions



Operational safety!

To prevent sparking and short circuits that can cause electric shock and serious damage to the connected equipment, always switch off the power supply to the EasyNO_x system before disconnecting the electrical connections in the EasyNO_x system.



Danger of interference with radio reception!

The CAN bus/NO_x sensor-module is not intended for use in residential areas and cannot ensure adequate protection of radio reception in such environments.

2.6 Special Safety Instructions on NO_x Sensor P/N 56.03.003



Explosion hazard!

Only use the NO_x sensor for measurement in non-explosive gas mixtures, as explosive gas mixtures can ignite at the hot sensing element. Especially in the event of an engine malfunction, make sure that no unburned gas mixture enters the exhaust pipe. Also comply with all locally applicable explosion protection regulations.



Operational safety!

Proper functioning of the NO_x sensor is only guaranteed if the sensing element does not overheat at the mounting location. Avoid accumulated heat at the sensing element and ensure sufficient ventilation of the sensing element by ambient air.



Operational safety!

To ensure proper functioning of the NO_x sensor throughout its service life, be sure to observe the following:

- The probe must not come into contact with condensation water, other liquid components such as oil and grease, or sealants.
- Contamination in the exhaust gas, e.g. due to corrosion or material escaping from the catalytic converter, must be avoided.
- The sensor and its electronics must not be painted or otherwise coated.
- Do not open the cover of the evaluation unit's connector.



Operational safety!

The NO_x sensor must not be used any further under any circumstances if it is damaged or the sensing element of the NO_x sensor has been mechanically shocked (e.g. by dropping it on the floor or impacts on the sensing element). In these cases, contact MOTORTECH for sensor replacement (see *Customer Service Information* on page 134).



Operational safety!

The sensing element may be mounted a maximum of one time. The electrical connection to the NO_x sensor's evaluation unit may be established and disconnected a maximum of 20 times. After that, proper functioning of the sensor can no longer be guaranteed.

2.7 Proper Storage

CAN Bus/NO_x Sensor Module

Keep the storage period of the CAN bus/NO_x sensor module as short as possible and unpack the CAN bus/NO_x sensor module no earlier than directly before mounting (see section *Proper Transport* on page 18). For storage, observe the mechanical specifications of the CAN bus/NO_x sensor module (see section *Mechanical Data* on page 31). In the vicinity of the NO_x sensor, no easily evaporating organic materials or silicone-organic materials may be stored.

2 Safety Instructions

2.8 Proper Transport

EasyNO_x

Let the EasyNO_x remain in its original packaging until it reaches its place of use. After unpacking, secure the EasyNO_x housing against falling over, dropping, and slipping.

CAN Bus/NO_x Sensor Module

Let the CAN bus/NO_x sensor module and in particular the sensing element of the NO_x sensor remain in their original packaging until they reach their place of use.

After unpacking, take care not to twist the wires in the connection cable between the sensing element and the evaluation unit of the NO_x sensor P/N 56.03.003 when carrying the CAN bus/NO_x sensor module. Do not wrap the connection cable of the NO_x sensor around the CAN bus/NO_x sensor module under any circumstances. Wrap the connection cable separately from the module, and maintain the minimum bending radius of 20 mm (0.79") as well as the minimum distance of the first bend of 30 mm (1.18") on both ends of the connection cable.

The protective cap of the NO_x sensor's sensing element is designed to prevent dirt and dust from entering the sensing element. Do not remove the protective cap from the sensing element until you are instructed to do so in the EasyNO_x operating manual (see section *Mounting the Sensing Element of NO_x Sensor P/N 56.03.003* on page 52).

2.9 Proper Disposal

For the proper disposal of MOTORTECH equipment, observe the information provided at www.motortech.de.

3.1 Functional Description

The NO_x monitor of the EasyNO_x monitors the exhaust gases of stationary gas-powered lean-burn engines in industrial environments. The measurement data is provided by a connected CAN bus/NO_x sensor module. Up to two thermocouples can be connected to the CAN bus/NO_x sensor module and are additionally used to measure the exhaust gas temperature near the catalytic converter and to detect the dew point for the NO_x sensor of the CAN bus/NO_x sensor module. The EasyNO_x can be connected to up to two CAN bus/NO_x sensor modules via the CAN bus interface CAN2 and thus monitor up to two engines.

Using the I/O communication module BPlus specially available from MOTORTECH and I/O modules supporting device profile CiA® 401 or CiA® 404, the EasyNO_x can be expanded with physical analog and binary inputs and outputs, to which different functions depending on the application can be assigned, thus enabling communication with a master control. Up to three I/O modules including up to two I/O communication modules BPlus can be connected to the EasyNO_x via the CAN bus interface CAN1.

Additionally, the EasyNO_x can start up to three devices that are not directly supported by it, but to which it is connected via the CAN bus interface CAN1, and monitor their connection status.

The NO_x monitor is fully configurable via the EasyNO_x. A USB port allows recorded data and reports to be saved to a USB flash drive. Simultaneously, the EasyNO_x can integrate a maximum of two NO_x monitors, three I/O modules including a maximum of two I/O communication modules BPlus, and three devices that are not directly supported by it.

3 Intended Use

3.2 Applications



Danger of interference with radio reception!

The CAN bus/NO_x sensor-module is not intended for use in residential areas and cannot ensure adequate protection of radio reception in such environments.

The EasyNO_x is designed for use in a non-hazardous area and may only be operated with the devices specified for this purpose. The EasyNO_x does not support safety-critical applications.

In conjunction with NO_x sensor P/N 56.03.003, the NO_x monitor of the EasyNO_x is designed for use with stationary gas-powered lean-burn engines in industrial environments, which are equipped with exhaust gas cleaning and whose exhaust gases have an oxygen content $\geq 1\text{ vol}\%$.

The NO_x sensor P/N 56.03.003 of the CAN bus/NO_x sensor module is suited for exhaust gases that are free of ammonia. The NO_x sensor may only be used mounted in an exhaust pipe for measurements in non-explosive gas mixtures.

In exhaust gas lines equipped with an oxidizing catalytic converter, the NO_x monitor of the EasyNO_x can be used for qualitative monitoring and documentation of nitrogen oxide emissions in accordance with the 44th Ordinance Implementing the Federal Immission Control Act (BImSchV) and the standard sheet VDMA 6299:2019-09.

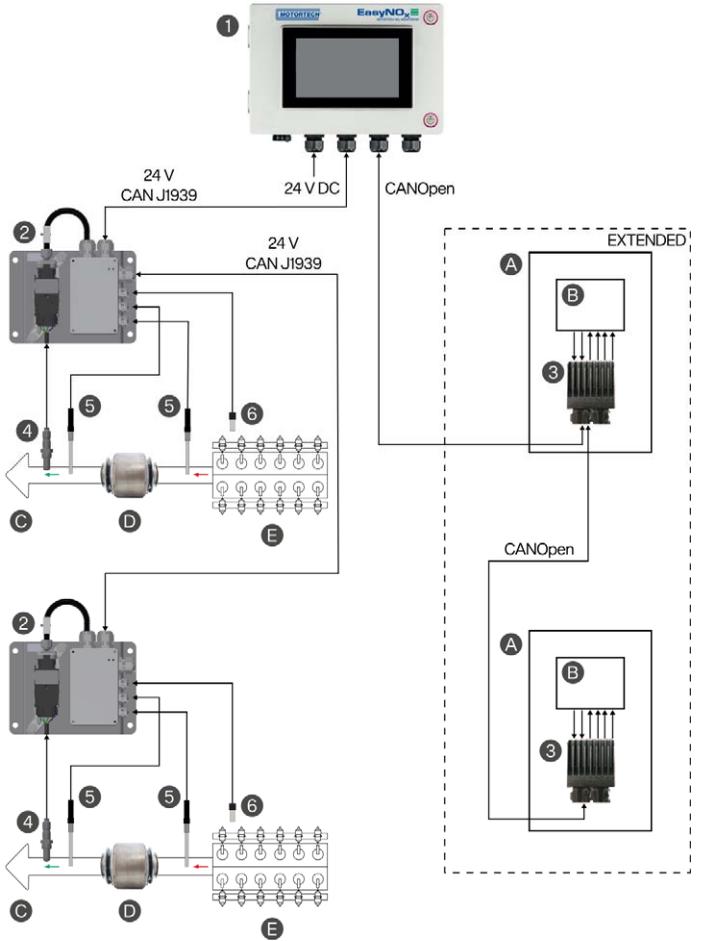
The NO_x monitor of the EasyNO_x can be used with two CAN bus/NO_x sensor modules to monitor two engines that are located in the same room in close proximity.

As per EN 55011, the EasyNO_x HMI module in housing is equipment of Group 1 and Class B. As per EN 55011, the CAN bus/NO_x sensor module is equipment of Group 1 and Class A.

Any use other than the one described in the operating manual shall be considered improper use and will result in the voiding of all warranties.

3 Intended Use

System Overview NO_x Monitoring (Example)



- ① EasyNO_x
- ② CAN bus/NO_x sensor module
- ③ I/O communication module BPlus
- ④ NO_x sensor
- ⑤ Thermocouple
- ⑥ Pressure sensor

- Ⓐ Control cabinet
- Ⓑ Master control
- Ⓒ Exhaust gas line
- Ⓓ Catalytic converter
- Ⓔ Engine

4 Product Description

4.1 Technical Data

4.1.1 EasyNO_x

4.1.1.1 Certifications

The EasyNO_x HMI module in housing is certified as follows: CE

The EU Declaration of Conformity can be obtained on request from your MOTORTECH contact person (see section *Customer Service Information* on page 134).

4.1.1.2 Mechanical Data



Compliance with protection class

The specified protection class is only guaranteed if all external cables are wired according to their specifications, all cable glands and screw openings are tightly closed, and the door is closed as specified.

The EasyNO_x has the following mechanical characteristics.

| Feature | Value |
|-------------------------------------|---|
| Dimensions | 305.6 mm x 230 mm x 86 mm (12.04" x 9.06" x 3.39") (length x width x height) |
| Weight | 3.5 kg (7.8 lbs) |
| Shape of device | See section <i>Overview Drawings</i> on page 27 |
| Mechanical environmental conditions | Protection: IP 66 |
| Climatic environmental conditions | Operation: 0 °C to +50 °C (+32 °F to +122 °F) Housing closed: 5 % to 90 % humidity without condensation Condensation must be prevented by suitable measures Housing open: 5 % to 50 % humidity without condensation at +40 °C (+104 °F) 5 % to 90 % humidity without condensation at +20 °C (+68 °F) Storage: –20 °C to +70 °C (–4 °F to +158 °F) 30 % to 70 % humidity without condensation Up to 3,000 m (9,842') above sea level |

4.1.1.3 Warning Notices on the Device

Information Text on Memory Card Slot of EasyNO_x

To preserve data integrity, do not remove memory card!

Warning Symbol on Memory Card Slot of EasyNO_x



Warning

4.1.1.4 Product Identification – Labeling on the Device

EasyNO_x

On the outside of the housing

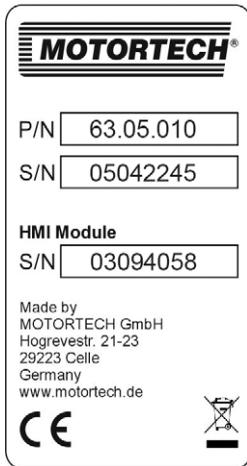


Illustration example

| Abb. | Meaning |
|------|---|
| P/N | Part number of the EasyNO _x |
| S/N | Serial number of the EasyNO _x and under <i>HMI Module</i> the serial number of the EasyNO _x HMI module installed in the housing |

4 Product Description

EasyNO_x HMI Module

Rear side



Illustration example

| Abb. | Meaning |
|------|--|
| P/N | Part number of the EasyNO _x HMI module |
| A/N | Arrangement number of the EasyNO _x HMI module |
| S/N | Serial number of the EasyNO _x HMI module |

4.1.1.5 Electrical Data

The EasyNO_x has the following electrical characteristics:

| Feature | Value |
|--------------------------|---|
| Power consumption | Without CAN bus/NO _x sensor module: <ul style="list-style-type: none"> – 5.3 W typical, max. 22.8 W With up to two CAN bus/NO _x sensor modules with NO _x sensor P/N 56.03.003: <ul style="list-style-type: none"> – Max. 100 W in measuring operation – During heating up to 176 W for a short period |
| Power supply | Nominal voltage: 24 V DC Operating voltage: <ul style="list-style-type: none"> – Without CAN bus/NO_x sensor module: 9 V DC to 32 V DC – With CAN bus/NO_x sensor module: 16 V DC to 32 V DC |
| Required current | Without CAN bus/NO _x sensor module: <ul style="list-style-type: none"> – Max. 1.5 A With up to two CAN bus/NO _x sensor modules with NO _x sensor P/N 56.03.003: <ul style="list-style-type: none"> – Max. 4.7 A in measuring operation – During heating up to 7.9 A for a short period |
| Real-time clock accuracy | ± 30 ppm at 25 °C (77 °F) |
| Internal backup battery | Non-rechargeable lithium manganese dioxide portable battery CR1220, 3 V, 35 mAh Service life: approx. 8 years (depending on application) |

4.1.1.6 Display

The EasyNO_x display has the following features:

| Feature | Value |
|------------------------|----------------------------------|
| Screen diagonal | 178 mm (7") |
| Resolution | 800 x 480 pixels |
| Color depth | 18 bit (262,144 colors) |
| Brightness | 400 cd/m ² typical |
| Viewing angle | 50°, 70°, 70°, 70° (UDRL) |
| Touch technology | Projected capacitive multi touch |
| Backlight service life | 50,000 hours typical |

4 Product Description

4.1.1.7 Interfaces

The EasyNO_x has the following interfaces:

USB Interface

- Compatible with USB 2.0
- Data rate: 480 Mbit/s (Host)
- Suitable for USB flash drives formatted with FAT (FAT12, FAT16, FAT32)

CAN Bus Interfaces

- Quantity: 2
- Galvanically separated
- Network protocol: CANopen® (CAN1), SAE J1939 (CAN2)
- As per ISO/DIS 11898
- Transmission rate: 250 kbit/s
- Max. cable length 250 m (820')
- The CAN bus interfaces of the EasyNO_x are exclusively intended for communication with devices that are supported by the EasyNO_x.



Operational safety!

The EasyNO_x is delivered with an SDHC card, which is inserted in the HMI module and is required for recording data. To ensure the integrity of the data recorded on it, the SDHC card under any circumstances must not be removed or replaced. Similarly, the recorded data from the NO_x monitor must not be used with another HMI module.

If the SDHC card requires mandatory replacement (e.g. due to a defect), contact your MOTORTECH contact person (see *Customer Service Information* on page 134).

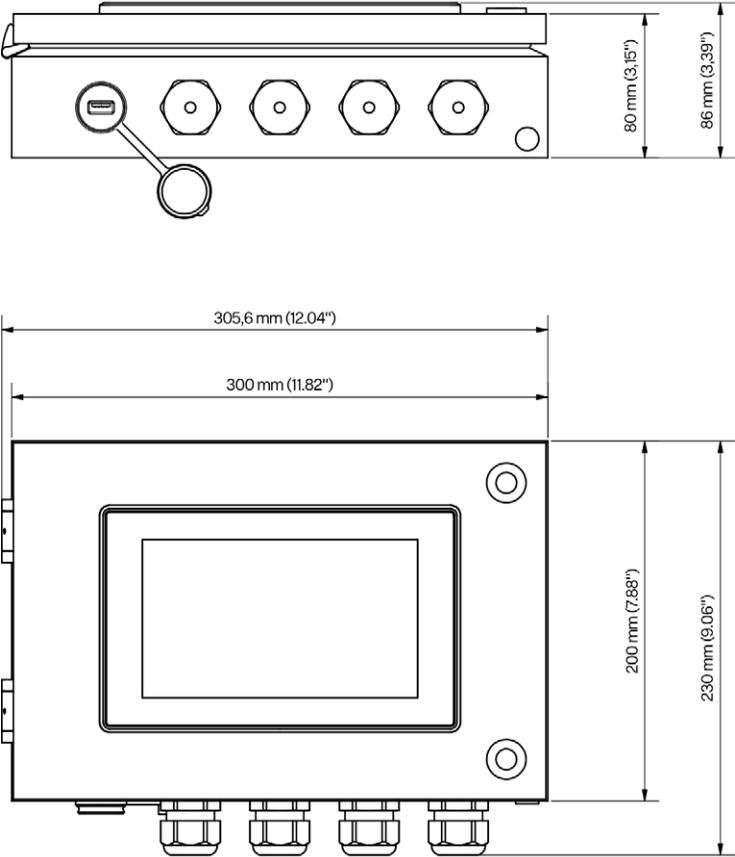
Memory Card Slot

- Supported memory card types: SDHC, SD, MMC
- Formatting: FAT (FAT12, FAT16, FAT32)

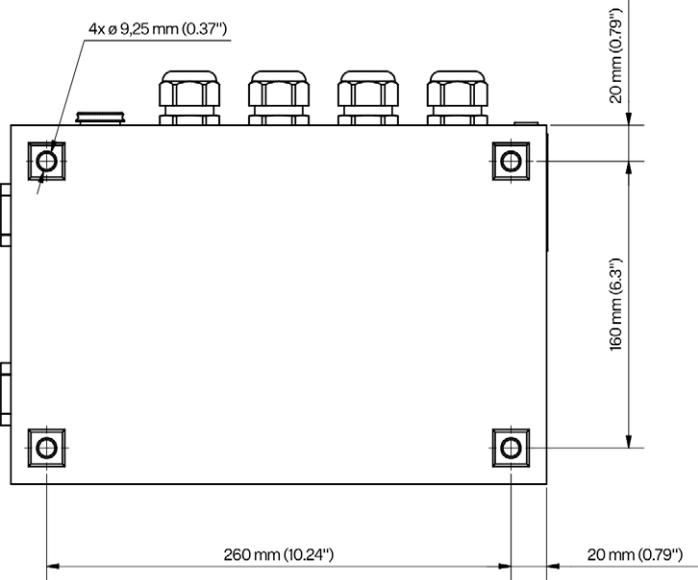
4 Product Description

4.1.1.8 Overview Drawings

Dimensions



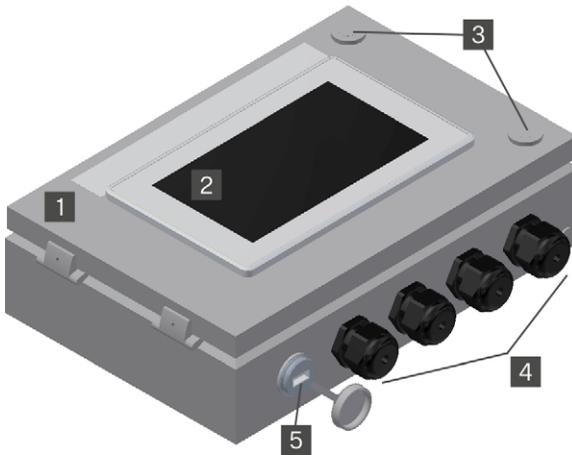
4 Product Description



4 Product Description

MOTORTECH®

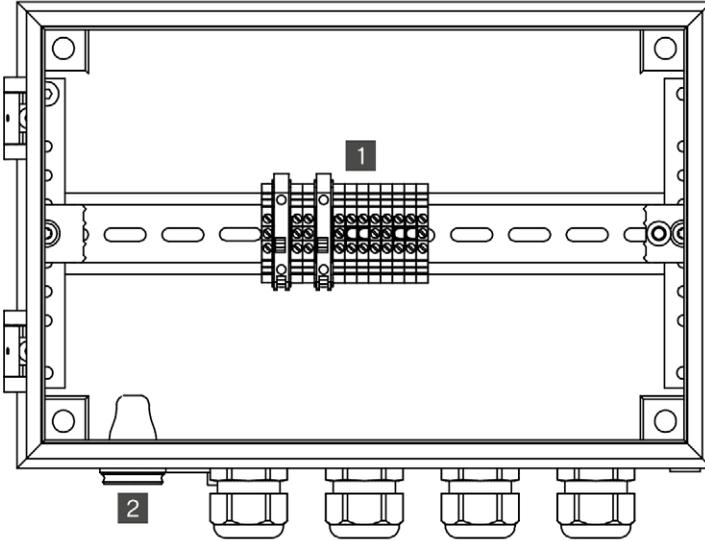
Components



| Pos. | Description |
|------|------------------------------|
| 1 | Housing door |
| 2 | Touchscreen |
| 3 | Housing door lock |
| 4 | Cable glands |
| 5 | USB port with protective cap |

4 Product Description

4.1.1.9 Connections



| Pos. | Description |
|------|--|
| 1 | Terminal blocks (see section <i>Wiring</i> on page 61) |
| 2 | USB port |

4.1.2 CAN Bus/NO_x Sensor Module

4.1.2.1 Certifications

The CAN bus/NO_x sensor module is certified as follows: CE

The EU Declaration of Conformity can be obtained on request from your MOTORTECH contact person (see section *Customer Service Information* on page 134).

4.1.2.2 Mechanical Data



Compliance with protection class

The specified protection class is only guaranteed if all external cables are wired according to their specifications, all cable glands and screw openings are tightly closed, and the cover is closed as specified.

The CAN bus/NO_x sensor module with NO_x sensor P/N 56.03.003 has the following mechanical characteristics:

| Feature | Value |
|-------------------------------------|---|
| Dimensions | Length x width mounting plate: 206.5 mm x 150 mm (8.13" x 5.91") Height mounting plate with CAN bus module: 82 mm (3.23") |
| Weight | 1.53 kg (3.4 lbs) |
| Shape of device | See section <i>Overview Drawings</i> on page 36 |
| Mechanical environmental conditions | Protection: IP 66 with mating plug connected to evaluation unit of NO _x sensor P/N 56.03.003 and sensing element mounted in suitable welding boss from MOTORTECH |
| Climatic environmental conditions | Operation: –40 °C to +85 °C (–40 °F to +185 °F) 5 % to 90 % humidity without condensation with closed housing Storage: –40 °C to +75 °C (–40 °F to +167 °F) 30 % to 60 % humidity without condensation with closed housing Max. 18 months Up to 2,000 m (6,561') above sea level |

4 Product Description

The sensing element of the NO_x sensor P/N 56.03.003 has the following mechanical characteristics:

| Feature | Value |
|-------------------------------------|---|
| Dimensions | Length of probe: 24 mm (0.95") Length of sensing element: 83.3 mm (3.28") Length of connection cable: 980 mm (38.58") |
| Shape of device | See section <i>Overview Drawings</i> on page 36 |
| Mechanical environmental conditions | Protection: IP 6K9K with mating plug connected to evaluation unit and sensing element mounted in suitable welding boss from MOTORTECH |
| Climatic environmental conditions | Exhaust gas temperature range: –40 °C to +850 °C (–40 °F to +1,562 °F) Operating temperature hexagon nut: –40 °C to +500 °C (–40 °F to +932 °F) Operating temperature sensing element grommet and connection cable: –40 °C to +170 °C (–40 °F to +338 °F) Operating pressure range: 600 mbar abs to 1,500 mbar abs |
| Mounting cycles | Max. 1 |
| Service life | 8,000 operating hours with ambient temperature max. +90 °C (+194 °F) at evaluation unit |

4.1.2.3 Product Identification – Labeling on the Device

CAN Bus/NO_x Sensor Module

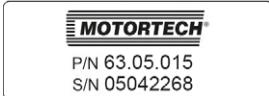


Illustration example

| Abb. | Meaning |
|------|--|
| P/N | Part number of the CAN bus/NO _x sensor module |
| S/N | Serial number of the CAN bus/NO _x sensor module |

4 Product Description

CAN Bus Module

On the outside of the housing



Illustration example

| Abb. | Meaning |
|------|---------|
|------|---------|

| | |
|-----|-----------------------------------|
| P/N | Part number of the CAN bus module |
|-----|-----------------------------------|

NO_x Sensor P/N 56.03.003

The numbers required for unique product identification are on the top side of the evaluation unit:

- Part number of the NO_x sensor (P/N)
- Serial number of the NO_x sensor (S/N)



Illustration example

4 Product Description

4.1.2.4 Electrical Data

The measuring inputs of the CAN bus module have the following electrical data:

| Feature | Value |
|-----------------------|---|
| Resolution | 16 bit |
| Thermocouple inputs | Quantity: 2 Suitable for thermocouples of type K, class 1 as per IEC 584 With cold junction compensation Measuring range: $-200\text{ }^{\circ}\text{C}$ to $+1,200\text{ }^{\circ}\text{C}$ ($-328\text{ }^{\circ}\text{F}$ to $+2,192\text{ }^{\circ}\text{F}$) Measurement resolution: 0.1 K Measuring accuracy: $\pm 0.1\text{ K}$ Sampling rate: 100 Hz per input The measuring point of the thermocouple must be insulated from the housing. |
| Analog current inputs | Quantity: 2 Permissible current: max. 22 mA Current range for measured values: 4 mA to 20 mA Measurement resolution: 0.001 mA Measuring accuracy: 0.01% FS Sampling rate: 200 Hz per input |
| Period CAN message | 200 ms |

The measuring probe of the NO_x sensor P/N 56.03.003 has the following characteristics:

| Feature | Value |
|---|--|
| Measuring range nitrogen oxide (NO _x) | 0 ppm to 3,012 ppm |
| Measuring accuracy nitric oxide (NO) | See table 1, valid measured values from O ₂ $\geq 1\text{ vol}\%$ |
| Response time nitric oxide (NO) | t_{10-90} : max. 1,800 ms at exhaust gas velocity 10 m/s |
| Light-off time nitric oxide (NO) | Max. 80 s after dew point release |
| Cross sensitivity NO _x measurement | Ammonia (NH ₃) typ. 110 % |
| Sensitivity NO _x measurement | Nitrogen dioxide (NO ₂) typ. 85 % |
| Measuring range oxygen (O ₂) | 0 % to 20.95 % |
| Measuring accuracy oxygen (O ₂) | See table 2 |
| Response time oxygen (O ₂) | t_{10-90} : max. 800 ms at exhaust gas velocity 11 m/s |
| Light-off time oxygen (O ₂) | Max. 45 s after dew point release |
| Exhaust gas velocity | 10 m/s to 100 m/s |

Table 1: Measuring accuracy nitric oxide (NO)

| Measurement | Measuring accuracy at O ₂ ≥ 1 vol% | |
|-------------|---|--------------|
| | New | Aged |
| 0 ppm | ± 8 ppm abs | ± 10 ppm abs |
| 90 ppm | ± 10 ppm abs | ± 12 ppm abs |
| 1,500 ppm | ± 8 % rel | ± 10 % rel |

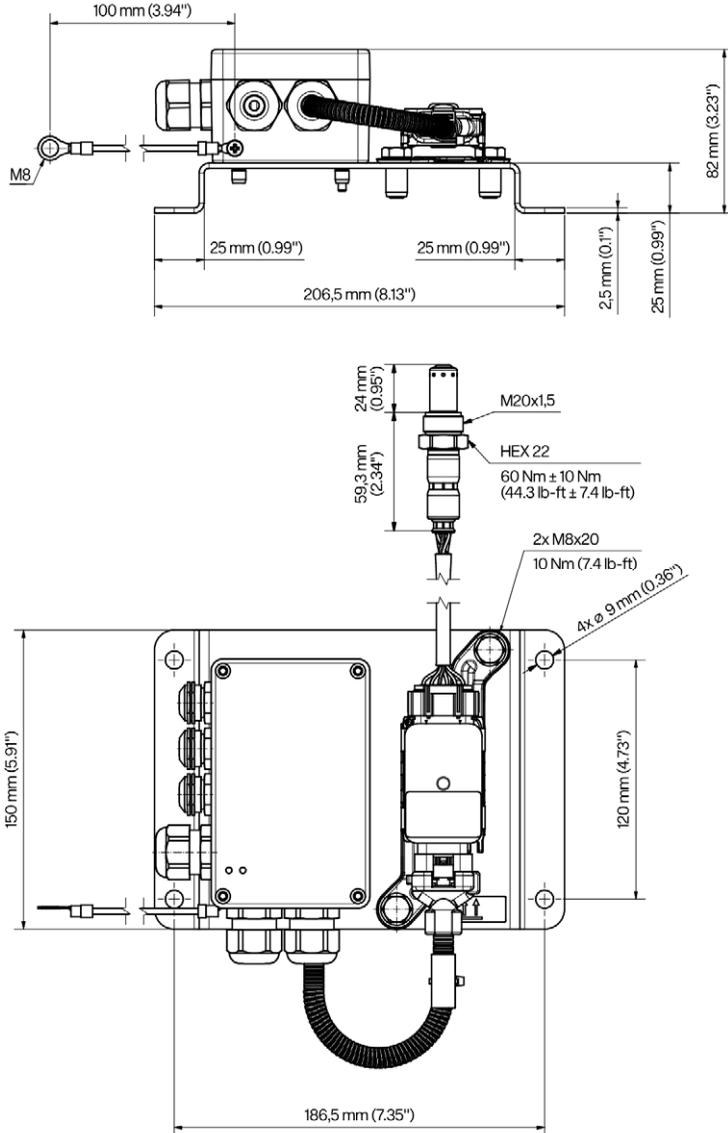
Table 2: Measuring accuracy oxygen (O₂)

| Measurement | Gas composition | Measuring accuracy | |
|-------------|---|--------------------|-------------|
| | | New | Aged |
| 0 % | N ₂ with 1 % H ₂ O | ± 0.2 % abs | ± 0.3 % abs |
| 8.29 % | 8.29 % O ₂ in N ₂ ; 0 % H ₂ O | ± 6 % rel | ± 8 % rel |
| 12 % | 12 % O ₂ in N ₂ ; 0 % H ₂ O | ± 6 % rel | ± 8 % rel |
| 20.95 % | 20.95 % O ₂ in N ₂ ; 0 % H ₂ O | ± 6 % rel | ± 8 % rel |

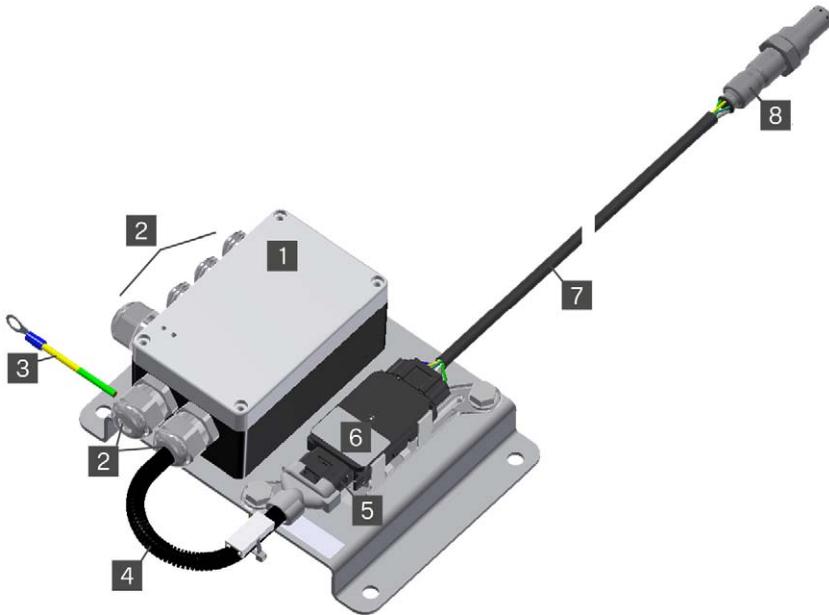
4 Product Description

4.1.2.5 Overview Drawings

Dimensions



Components

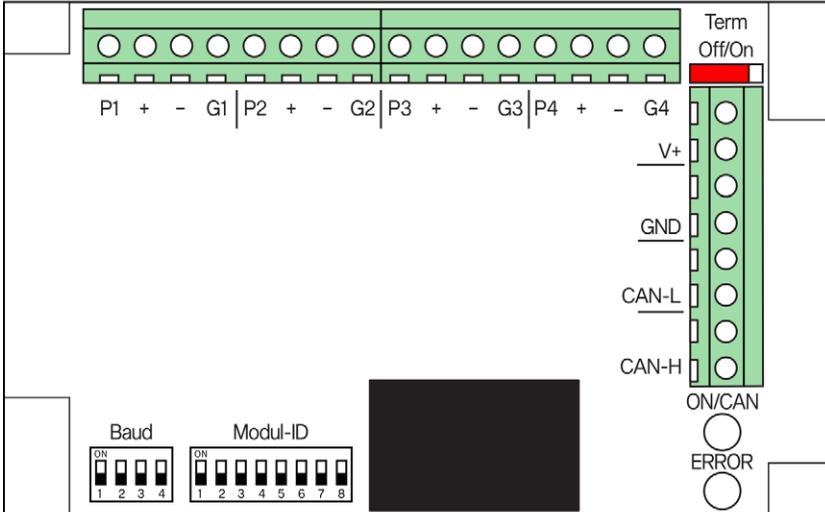


| Pos. | Description |
|------|---|
| 1 | CAN bus module |
| 2 | Cable glands |
| 3 | Grounding cable |
| 4 | Connection cable CAN bus module to evaluation unit |
| 5 | Evaluation unit connector |
| 6 | Evaluation unit of NO _x sensor P/N 56.03.003 |
| 7 | Connection cable evaluation unit to sensing element |
| 8 | Sensing element of NO _x sensor P/N 56.03.003 |

4 Product Description

4.1.2.6 Connections and LEDs

CAN Bus Module



| Designation | Function |
|------------------------------|---|
| P1, +, -, G1 P2, +, -, G2 | Measurement connections for the thermocouples |
| P3, +, -, G3 | Analog input for a manifold pressure or load signal |
| P4, +, -, G4 | Optional analog current input, whose input current can be displayed in the NO _x monitor of the EasyNO _x (see section <i>Overview</i> on page 102). |
| Term Off/On | Slide switch for CAN bus termination |
| V+, GND | Connection for the supply voltage and for looping through the supply voltage |
| CAN-L, CAN-H | Port for communication via the CAN bus |
| ON/CAN | The LED indicates the J1939 status of the CAN bus module: <ul style="list-style-type: none"> Green: The CAN bus module is in "Error Active" state. Glowing green, 4 times flashing red: The CAN bus module is in "Error Passive" state. Red: The CAN bus module is either in "Bus Off" state or there is an error regarding the set bit rate or node ID. |

| Designation | Function |
|-------------|---|
| ERROR | <p>The LED indicates the device status of the CAN bus module:</p> <ul style="list-style-type: none"> – Green: The CAN bus module works flawlessly. – Flashes red repeatedly 1 time long and 1 time short: The bit rate is set incorrectly. – Flashes red repeatedly 1 time long and 2 times short: The node ID is set incorrectly. – Flashing steadily red: an unsuitable sensor or no sensor connected |
| Modul-ID | DIP switches for setting the node ID of the CAN bus module (see section <i>Node ID CAN Bus Module</i> on page 67) |
| Baud | DIP switches for setting the bit rate of the CAN bus module (see section <i>Bit Rate CAN Bus Module</i> on page 68) |

The wiring and configuration of the CAN bus module is described in section *CAN Bus/NO_x Sensor Module* on page 63.

4.1.3 I/O Communication Module BPlus (Optional)

4.1.3.1 Certifications

The I/O communication module BPlus is certified as follows: CE

The EU Declaration of Conformity can be requested from your MOTORTECH contact person (see section *Customer Service Information* on page 134) if required.

4.1.3.2 Mechanical Data

The I/O communication module BPlus has the following mechanical characteristics:

| Feature | Value |
|-------------------------------------|--|
| Dimensions | Without wiring: 100 mm x 97 mm x 48 mm (3.94" x 3.82" x 1.89") (length x width x height) |
| Weight | Without harnesses: 320 g (0.71 lbs) |
| Shape of device | See section <i>Overview Drawings</i> on page 41 |
| Mechanical environmental conditions | Protection: IP20 |
| Climatic environmental conditions | –40 °C to +85 °C (–40 °F to +185 °F) Max. 85% humidity without condensation Up to 2,000 m (6,561') above sea level |

4 Product Description

4.1.3.3 Product Identification – Labeling on the Device

The numbers required for unique product identification are on the bottom side of the top hat rail spring clip:

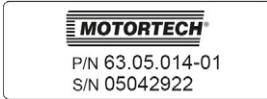


Illustration example

| Abb. | Meaning |
|------|---|
| P/N | Part number of the I/O communication module |
| S/N | Serial number of I/O communication module |

4.1.3.4 Electrical Data

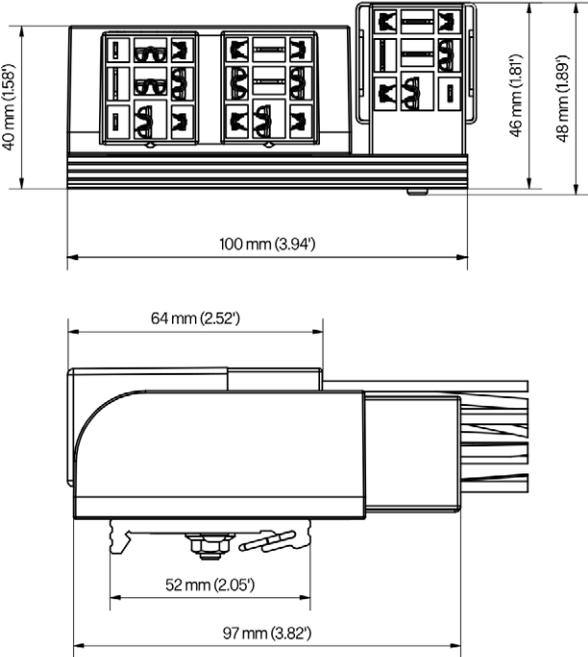
The I/O communication module BPlus has the following electrical characteristics:

| Feature | Value |
|-------------------|---|
| Power consumption | 0.72 W with unloaded outputs |
| Power supply | Nominal voltage: 24 V DC Operating voltage: 8 V DC to 32 V DC |
| Required current | 30 mA at 24 V and with unloaded outputs |
| Binary input | Low level: 0 V High level: corresponds to supply voltage Safe low level at 24 V: 0 V to 12 V Safe high level at 24 V: 14 V to 24 V |
| Binary outputs | Quantity: 3 Plus/ground switching Low level: 0 V High level: corresponds to supply voltage |
| Analog input | Current range for measured values: 4 mA to 20 mA |
| Analog output | Output current: 4 mA to 20 mA |

4 Product Description

4.1.3.5 Overview Drawings

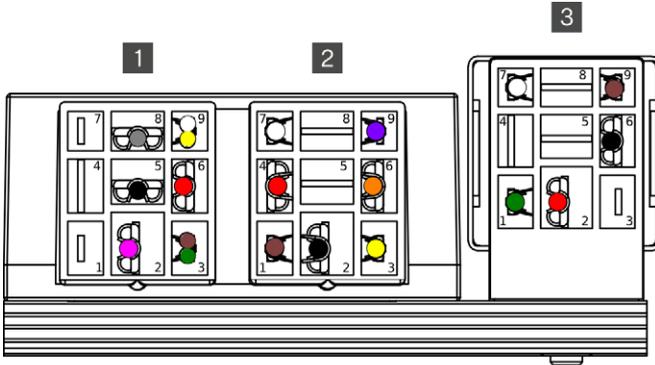
Dimensions



4 Product Description

4.1.3.6 Assignment

The I/O communication module BPlus is designed for wiring via a terminal strip in the control cabinet. The contacts and wires of the module are assigned as follows:



Relay connector left **1**

| Contact | Wire color | Assignment | Function |
|---------|------------|--------------|--|
| 1 | – | – | Not used |
| 2 | Pink | Binary input | Function configurable (see <i>Binary Inputs</i> on page 124) |
| 3 | Brown | CAN Lo | CAN connection to the previous device in the CANopen® network |
| | Green | CAN Lo | CAN connection to the following device in the CANopen® network or connection of the terminating resistor |
| 4 | – | – | Not used |
| 5 | Black | L – | Supply voltage for I/O communication module BPlus (8 V DC to 32 V DC, nominal voltage 24 V DC) |
| 6 | Red | L + | |
| 7 | – | – | Not used |
| 8 | Gray | Analog input | Function configurable (see <i>Analog Inputs</i> on page 126) |
| 9 | White | CAN Hi | CAN connection to the previous device in the CANopen® network |
| | Yellow | CAN Hi | CAN connection to the following device in the CANopen® network or connection of the terminating resistor |

Relay connector center ²

| Contact | Wire color | Assignment | Function |
|---------|------------|-----------------|---|
| 1 | Brown | CAN Lo | Internal CAN connection to the right I/O module |
| 2 | Black | L – | Pass-through of the supply voltage to the right I/O module |
| 3 | Yellow | Binary output 3 | Function configurable (see <i>Binary Outputs</i> on page 125) |
| 4 | Red | L + | Pass-through of the supply voltage to the right I/O module |
| 5 | – | – | Not used |
| 6 | Orange | Binary output 2 | Function configurable (see <i>Binary Outputs</i> on page 125) |
| 7 | White | CAN Hi | Internal CAN connection to the right I/O module |
| 8 | – | – | Not used |
| 9 | Purple | Binary output 1 | Function configurable (see <i>Binary Outputs</i> on page 125) |

Relay connector right ³

| Contact | Wire color | Assignment | Function |
|---------|------------|---------------|---|
| 1 | Green | Analog output | Function configurable (see <i>Analog Outputs</i> on page 127) |
| 2 | Red | L + | Supply voltage for right I/O module |
| 3 | – | – | Not used |
| 4 | – | – | Not used |
| 5 | – | – | Not used |
| 6 | Black | L – | Supply voltage for right I/O module |
| 7 | White | CAN Hi | Internal CAN connection to left I/O module |
| 8 | – | – | Not used |
| 9 | Brown | CAN Lo | Internal CAN connection to left I/O module |

5 Functions

5.1 NO_x Monitoring

In the following sections, the NO_x monitoring functions of the EasyNO_x are described. To use the NO_x monitoring in the EasyNO_x, the EasyNO_x must be connected to a suitable CAN bus/NO_x sensor module from MOTORTECH.

5.1.1 Measured Value Display and Measured Value Output

The NO_x monitoring of the EasyNO_x displays the following measured values for up to two engines:

- The current nitrogen oxide concentration reading from the connected NO_x sensor in ppm
- The current oxygen concentration reading from the connected NO_x sensor in vol. %
- The current nitrogen oxide reading converted according to VDMA 6299:2019-09 in mg/Nm³ (for further details see section *Conversion of Nitrogen Oxide Readings* on page 44)
- The provisional daily average of nitrogen oxide readings determined in normal operation in mg/Nm³

The NO_x monitoring calculates the nitrogen oxide daily average from valid readings of the NO_x sensor in normal operation, provided that the dew point of the NO_x sensor has been reached at the catalyst outlet for at least 5 minutes.

In conjunction with the optionally available I/O communication module BPlus or a suitable I/O module supporting device profile CiA[®] 401 or CiA[®] 404, the current nitrogen oxide reading converted according to VDMA 6299:2019-09 or the provisional daily average can additionally be output to a master control via an analog output.

5.1.2 Conversion of Nitrogen Oxide Readings

The readings from the connected NO_x sensor are converted according to VDMA 6299:2019-09 in the NO_x monitor of the EasyNO_x.

At first, the oxygen content measured in wet exhaust gas is converted to dry exhaust gas:

$$O_{2,dr} = \frac{O_{2,w}}{1 - \left(0.1966 - 0.8953 \cdot \frac{O_{2,w}}{100}\right)}$$

In this context, the NO_x monitor of the EasyNO_x does not regard oxygen readings for wet exhaust gas, which lead to oxygen contents in the dry exhaust gas of over 20 %.

In the next step, the measured nitrogen oxide value is corrected by sensor- and plant-specific NO₂ correction factors:

$$NO_{x,w-c} = NO_{x,w} \cdot (1 - K) + NO_{x,w} \cdot \left(\frac{K}{K_{NO_2}}\right)$$

Following that, this NO₂-corrected nitrogen oxide value measured in wet exhaust gas is converted to dry exhaust gas:

$$NO_{x,dr} = \frac{NO_{x,w-c}}{1 - \left(0.1966 - 0.8953 \cdot \frac{O_{2,w}}{100}\right)}$$

Then the volume-based nitrogen oxide measured value is converted to a mass-based value in mg/Nm³:

$$\text{NO}_{x,\text{dr-mg}} = 2.053 \cdot \text{NO}_{x,\text{dr}}$$

In the last step, the mass-based nitrogen oxide measured value is converted to a reference oxygen content of $O_r = 5\%$:

$$\text{NO}_{x,r} = \frac{21 - O_r}{21 - O_{2,\text{dr}}} \cdot \text{NO}_{x,\text{dr-mg}}$$

| Variable | Meaning |
|-----------------------------|---|
| K | NO ₂ /NO _x ratio of the exhaust gas as a constant (see section <i>Determining the NO₂/NO_x Ratio</i> on page 57) |
| K _{NO₂} | Sensor-specific NO ₂ correction factor as a constant (see section <i>Sensor</i> on page 117) |
| NO _{x,r} | Nitrogen oxide measured value converted to reference oxygen content and based on mass and dry exhaust gas in mg/Nm ³ |
| NO _{x,w} | Nitrogen oxide value of the NO _x sensor measured wet in ppm |
| NO _{x,w-c} | NO ₂ -corrected nitrogen oxide measured value related to wet exhaust gas in ppm |
| NO _{x,dr} | Nitrogen oxide measured value related to dry exhaust gas in ppm |
| NO _{x,dr-mg} | Mass-based nitrogen oxide measured value related to dry exhaust gas in mg/Nm ³ |
| O _r | Reference oxygen |
| O _{2,dr} | Oxygen measured value of the NO _x sensor calculated on dry exhaust gas in vol. % |
| O _{2,w} | Oxygen value of the NO _x sensor measured wet in vol. % |

5.1.3 Limit Monitoring

For the nitrogen oxide daily average, you define a level limit that must not be exceeded and a warning threshold that indicates that the daily average is approaching the level limit. To use the NO_x monitoring in accordance with standard sheet VDMA 6299:2019-09, the daily average at which an alarm should be triggered must be specified as level limit. If the final nitrogen oxide daily average exceeds the specified level limit, the detected normal operation hours of the day are added to the failure hour counter of the ongoing calendar year to the second.

The limit monitoring can be configured in the *NO_x Setup* view (see section *Preferences* on page 112).

5.1.4 Failure Hour Counter

The failure hour counter of the NO_x monitoring registers the time to the second that the nitrogen oxide daily average has been above the configured level limit so far in a running calendar year. The detected normal operation hours of a day are added to this failure hour counter to the second if the final nitrogen oxide daily average exceeds the configured level limit (also see section *Limit Monitoring* on page 45).

5 Functions

For this failure hour counter, you specify a time limit in the NO_x monitoring that must not be exceeded and a warning threshold that indicates that the failure hour counter is approaching the time limit.

You can configure the normal operation detection in the *NO_x Setup* view (see section *Preferences* on page 112).

The change of day is firmly preset to 00:00:00 hrs Central European Time (CET) or UTC+1. At the beginning of a new calendar year, the failure hour counter is automatically reset to 0 hours.

5.1.5 Exhaust Gas Temperature Monitoring

The exhaust gas temperature monitoring of the NO_x monitor is used for monitoring catalytic converter operation and also as dew point detection for the NO_x sensor (see section *Dew Point Detection* on page 46), and it is designed for thermocouples of type K. For up to two measuring points, you define a temperature threshold respectively, that must not be exceeded. If the exhaust gas temperature is to be monitored both before and after the catalytic converter, you can also define the permissible temperature difference range of the exhaust gas between the catalyst inlet and catalyst outlet.

You can configure the exhaust gas temperature monitoring in the *NO_x Setup* view (see section *Preferences* on page 112).

5.1.6 Dew Point Detection

For the dew point detection of the NO_x sensor, the temperature in the exhaust pipe at the catalyst outlet is used, which is measured by the NO_x monitor to monitor the exhaust gas temperature (see section *Exhaust Gas Temperature Monitoring* on page 46). The dew point detection threshold is firmly predefined in the NO_x monitor.

For engines with two catalytic converters in split exhaust gas lines, the exhaust gas temperature at the catalyst outlet must be measured in both exhaust gas lines for NO_x sensor dew point detection.

The status of the dew point detection is displayed in the *NO_x Monitoring* view of the EasyNO_x (see section *Overview* on page 102).

5.1.7 Normal Operation Detection

For detecting normal operation, the NO_x monitor can evaluate the analog load signal of a master control connected to the CAN bus module of the EasyNO_x system, to the optional I/O communication module BPlus, or to a suitable I/O module with device profile CiA® 401 or CiA® 404. Alternatively, the NO_x monitor can use the manifold pressure as an indicator for the engine load. For this purpose, a pressure sensor can be connected directly to the CAN bus module of the EasyNO_x system or alternatively the signal of a pressure sensor can be forwarded to the CAN bus module via the control cabinet. The threshold for normal operation detection can be configured.

In conjunction with the optional I/O communication module BPlus or a suitable I/O module with device profile CiA® 401 or CiA® 404, there is also the option that a master control indicates normal operation via the binary input of the I/O module (see section *Binary Inputs* on page 124).

The status of the normal operation detection is displayed in the *NO_x Monitoring* view of the EasyNO_x (see section *Overview* on page 102). You can configure the normal operation detection in the *NO_x Setup* view (see section *Preferences* on page 112).

5.1.8 Daily Log

Every 10 seconds, the NO_x monitor of the EasyNO_x saves a complete record of all relevant measured values, timers, and status values to a daily log on the memory card inserted in the EasyNO_x. Selected measured values of the daily logs can be visualized in the *NO_x History* view of the NO_x monitor (see section *History* on page 106). Via the USB interface of the EasyNO_x, each daily log can be exported as a CSV file to a USB flash drive (see section *Export* on page 110).

5.1.9 Annual Log

For each calendar year, the NO_x monitor of the EasyNO_x summarizes the relevant measured values and timers of all measurement days in an annual log. This annual log is stored on the memory card inserted in the EasyNO_x and contains the following information:

- Measured values: average, minimum value, maximum value, and standard deviation related to the measurement day
- Timers: daily value related to the measurement day and total value related to the calendar year

Note that in the annual log, the daily averages for nitrogen oxide (*NO_x [ppm]*) and oxygen (*O₂ [%]*) include all valid readings from the day, including those outside of normal operation.

Via the USB interface of the EasyNO_x, each annual log can be exported as a CSV file to a USB flash drive (see section *Export* on page 110).

5.1.10 Logbook

In a logbook, the NO_x monitor of the EasyNO_x logs emission-related events. Additionally, custom entries can be made in this logbook (see section *Logbook* on page 108). The logbook can be exported to a USB flash drive as part of the NO_x monitoring report (see section *NO_x Monitoring Report* on page 48). You can maintain the logbook in accordance with standard sheet VDMA 6299: 2019-09.

5 Functions

5.1.11 NO_x Monitoring Report

For each calendar year for which the NO_x monitor has values, the EasyNO_x can generate a NO_x monitoring report as a PDF file if needed and export it to a USB flash drive (see section *Export* on page 110). This NO_x monitoring report contains the following information:

NO_x Monitoring Report 2023

Printed: 20 Feb 2024 11:11

Engine 1

Operator: Company
Contact: Jane Doe
Street: 5 Main Street
Postal Code, City: E1 7DP London
Site: CWP
Engine Serial Number: 140253

Summary

Operating Hours: 7954 h
NO_x Failure Hours: 333 h
Operating Days: 340
NO_x Failure Days: 14 (4.1 %)
Temp. Failure Hours: 30 h
NO_x Average: 403.0 mg/Nm³
O₂ Average: 5.53 %

Hourly Limit 400

Report limit: 400 for twelve consecutive months. See 44th BImSchV (2017-01). The sums may differ from the summary displayed value in the device.

| Month | Sum |
|-------|------|
| 2023 | 1172 |
| 2022 | 1172 |
| 2021 | 1172 |
| 2020 | 1172 |
| 2019 | 1172 |
| 2018 | 1172 |
| 2017 | 1172 |
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5.2 I/O Communication Module BPlus

The optional I/O communication module BPlus available from MOTORTECH provides the EasyNO_x with the following inputs and outputs:

- One analog input
- One analog output
- One binary input
- Three binary outputs

Depending on the application, these inputs and outputs can be linked to different functions, for example for the input and output of measured values or for signalling warnings, errors, or certain operating states from or to a master control. Up to two I/O communication modules BPlus can be connected to the EasyNO_x via the CAN bus interface CAN1.

A description of the functions and views of an added I/O communication module BPlus can be found in the section *I/O Communication Module BPlus, I/O Module (CiA401, CiA404)* on page 119.

5.3 I/O Module (Device Profile CiA® 401/404)

The EasyNO_x can use analog and binary inputs and outputs from I/O modules that support the device profile CiA® 401 or 404 and that are connected to the EasyNO_x via the CAN interface CAN1. The number of available analog and binary inputs and outputs depends on the I/O module to which the EasyNO_x is connected.

Depending on the application, the inputs and outputs can be linked to different functions, for example for the input and output of measured values or for signalling warnings and errors or certain operating states from or to a master control.

Up to three supported I/O modules can be connected to the EasyNO_x via the CAN bus interface CAN1. Of these, a maximum of two modules can be the I/O communication modules from BPlus (see section *I/O Communication Module BPlus* on page 49), which are specially available from MOTORTECH.

For more information on the functions and views of an added I/O module, read the section *I/O Communication Module BPlus, I/O Module (CiA401, CiA404)* on page 119 .

5.4 Generic Device

The EasyNO_x can integrate up to three devices that it does not support directly, but to which it is connected via the CAN bus interface CAN1 (for example a protocol converter), as a so-called generic device each. Generic devices are started along with the EasyNO_x, and their connection status is monitored by the EasyNO_x. Generic devices are not displayed in the start menu, but their connection status is visualized in the menu bar of the EasyNO_x and logged in the *Event Log* view. For more information on the generic devices, see section *Generic Device* on page 128.

6 Installation Instruction

6.1 Unpacking

Before unpacking, observe the instructions in section *Proper Transport* on page 18.

To prevent condensation from forming in the sensing element of the supplied NO_x sensor P/N 56.03.003, you should avoid any temperature shocks when opening the packaging. Before opening, allow the shipping unit to adjust to the mounting temperature, and after having opened it, avoid temperature changes. The supplied NO_x sensor must not be taken out of its packaging in polluted air and under bad weather conditions (e.g. oil, water, snow, dust, sand, smoke).

Unpack the components of the EasyNO_x system without damaging them and ensure that the operating manual is always within reach of the device and easily accessible. Do not remove the protective cap from the sensing element until you are instructed to do so within this operating manual (see section *Mounting the Sensing Element of NO_x Sensor P/N 56.03.003* on page 52). Check the contents for completeness and verify that the equipment meets your application requirements.

Scope of Supply

The scope of supply of the EasyNO_x includes:

- EasyNO_x incl. housing and inserted SDHC card 16 GB
- Sealing plugs for EasyNO_x housing (4x)
- Sealing insert for cable gland M25 of EasyNO_x housing, 3x \varnothing 7 mm (2x)
- Sealing insert pin for sealing insert opening \varnothing 7 mm (6x)
- Wire end ferrules
- Up to two CAN bus/NO_x sensor modules pre-mounted on a mounting plate, each including
 - Sealing insert pin for cable gland M16, \varnothing 9 mm
 - Sealing insert pin for cable gland M12, \varnothing 7 mm (2x)
 - Welding boss for NO_x sensor
 - Locking screw for welding boss
- USB flash drive with EasyNO_x operating manual and handling guidelines for MOTORTECH NO_x sensors
- Safety instructions for the EasyNO_x
- EXTENDED package: up to two I/O communication modules BPlus

Optional accessories:

- CAN bus hybrid cable for connecting the CAN bus modules to the EasyNO_x and to the power supply
- Sheath thermocouples with suitable compression fitting
- Pressure sensor

6.2 Installation of the EasyNO_x

The EasyNO_x is typically mounted on the wall in the control room at a suitable accessible location. If there is no control room, the EasyNO_x can also be mounted in the engine room, but not in the immediate vicinity of the engine in order to protect it from high temperatures and vibrations. The installation location must be selected in such a way that there is sufficient space for maintenance and repair work and that the EasyNO_x can be operated without problems. The mechanical specifications of the EasyNO_x must always be complied with (see section *Mechanical Data* on page 22). The EasyNO_x is not suited for outdoor installation.

For wall mounting, always use the four screw openings on the back of the EasyNO_x housing (see section *Overview Drawings* on page 27). Ensure that the wall has sufficient load-bearing capacity and use fasteners that are suitable for wall mounting. In order to ensure the IP protection class of the EasyNO_x, carry out the fastening in such a way that the screw openings are sufficiently sealed.



Sealing plugs for screw openings

To ensure that the IP protection class of the EasyNO_x is also guaranteed during storage or transport, you can close the four screw openings with the supplied sealing plugs if required.

6.3 Mounting of CAN Bus/NO_x Sensor Module

The CAN bus/NO_x sensor modules are to be installed at a suitable location in direct proximity to the engine, but not on the engine. When selecting the mounting locations, pay attention to the maximum available cable lengths and specifications of the individual connection cables. Also comply with the specifications for laying the connection cable between the sensing element and the evaluation unit of the NO_x sensor P/N 56.03.003 from the section *Laying the Connection Cable* on page 55.

Also observe the mechanical specifications of the CAN bus/NO_x sensor module (see section *Mechanical Data* on page 22). Also ensure that the J1939 network, to which the EasyNO_x and the CAN bus/NO_x sensor modules are connected, complies with the maximum cable length of 250 m (820').

The CAN bus/NO_x sensor module is mounted via the screw openings on the mounting plate (see section *Overview Drawings* on page 36). Use suitable fasteners and make sure that the load-bearing capacity is sufficient at the mounting location.

6 Installation Instruction

6.4 Mounting the Sensing Element of NO_x Sensor P/N 56.03.003



Risk of suffocation! Risk of poisoning!

Leaks in the exhaust pipe can cause exhaust gases to escape and people in the system room can suffocate or be poisoned. After mounting the sensors, check the tightness of the exhaust pipe.



Operational safety!

To safely mount the NO_x sensor, be sure to observe the following:

- To protect the NO_x sensor and yourself, wear ESD-compliant work gloves. To protect the NO_x sensor against electrostatic discharge, also comply with IEC 61340-5-1 and IEC TR 61340-5-2 in their respective valid versions.
- Under no circumstances touch the probe of the sensing element while mounting.



Operational safety!

The NO_x sensor must not be used any further under any circumstances if it is damaged or the sensing element of the NO_x sensor has been mechanically shocked (e.g. by dropping it on the floor or impacts on the sensing element). In these cases, contact MOTORTECH for sensor replacement (see *Customer Service Information* on page 134).



Operational safety!

Proper functioning of the NO_x sensor is only guaranteed if the sensing element does not overheat at the mounting location. Avoid accumulated heat at the sensing element and ensure sufficient ventilation of the sensing element by ambient air.



Operational safety!

The sensing element may be mounted a maximum of one time. The electrical connection to the NO_x sensor's evaluation unit may be established and disconnected a maximum of 20 times. After that, proper functioning of the sensor can no longer be guaranteed.



SCR catalytic converter: no monitoring in accordance with VDMA 6299:2019-09

The NO_x monitor of the EasyNO_x does not evaluate the dosing release of the urea solution in an SCR catalytic converter. Thus, the NO_x monitor of the EasyNO_x is not suited for monitoring SCR catalytic converters in accordance with the standard sheet VDMA 6299:2019-09.

The following sections describe the mounting of the sensing element of the NO_x sensor from the CAN bus/NO_x sensor module.

6.4.1 Mounting Position of Sensing Element

The possible mounting positions of the sensing element depend on the catalytic converter type used:

- Oxidizing catalytic converter: Select a suitable position between the exhaust gas turbocharger and the exhaust gas heat exchanger before or after the catalytic converter. For engines with two catalytic converters in split exhaust gas lines, select a suitable position before or after the split exhaust gas lines.
- SCR catalytic converter: Select a suitable position after the catalytic converter.

Ensure that there is a sufficient distance between the sensing element and the exhaust gas turbocharger. Normally this distance should be at least 1 meter (3.3').

The NO_x sensor is only suited for measurement when mounted in an exhaust pipe.

The mounting position of the sensing element must be defined in such a way that no condensation water is able to collect in the protective tube of the sensing element.

A pipe connected to the exhaust system (e.g. for changing the gas mass flow or gas pressure) must not be located in the environment of the sensing element.

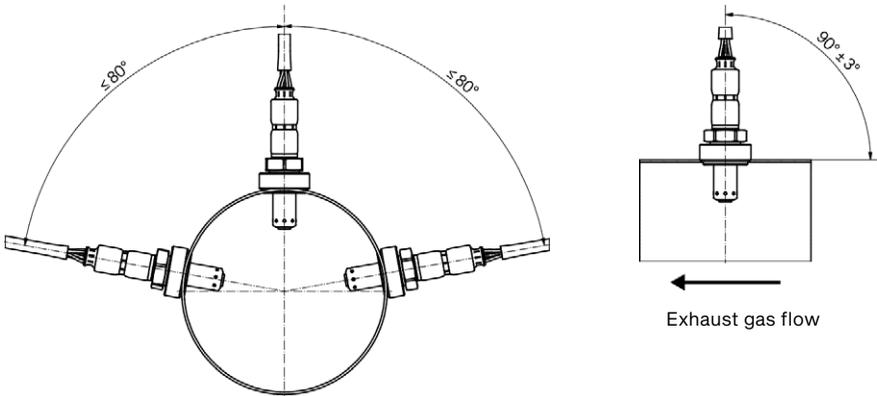
If the intake pipe is located near the sensing element, the distance between the sensing element and the intake pipe must be chosen in a way that condensed liquid droplets will not stream back to the sensing element due to gas pulsation.

When mounting the sensing element after the catalytic converter, make sure that no material escapes from the catalytic converter.

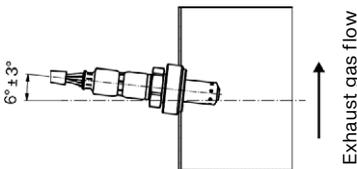
6 Installation Instruction

The possible tilt angles of the sensing element depend on the course of the exhaust pipe. Mounting in a vertical exhaust pipe is not recommended by MOTORTECH.

Tilt angles horizontal exhaust pipe



Tilt angles vertical exhaust pipe

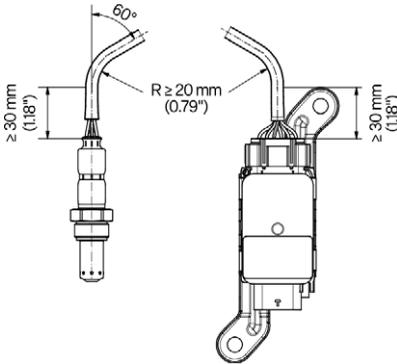


The sensing element heats up as soon as the NO_x sensor is powered. Therefore, the sensing element must be installed on the exhaust pipe at a suitable location at which people at the plant cannot be burned by it, or an appropriate protection must be installed around the sensing element that prevents contact with it.

Make sure that the sensing element of the NO_x sensor does not overheat at the mounting location. Avoid accumulated heat at the sensing element and ensure sufficient ventilation of the sensing element by ambient air. Also comply with the specified temperature limits (see section *Mechanical Data* on page 22).

6.4.2 Laying the Connection Cable

To ensure proper functioning of the connection cable between the sensing element and the evaluation unit, the minimum bending radius of the connection cable of 20 mm (0.79") must be adhered to at the mounting position and the first bend of the connection cable must maintain a minimum distance of 30 mm (1.18") on each end. In addition, the angle of the cable outlet at the sensing element grommet must not exceed 60° and there must be no pull on the connection cable.



Also, it must be possible to lay the connection cable in such a way that it is not affected by heat-conducting or heat-radiating components.

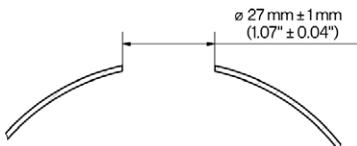
6.4.3 Mounting the Sensing Element

Make sure that the engine is switched off while mounting and that the EasyNO_x system is not live. Also make sure that the exhaust pipe has cooled down sufficiently and that there are no exhaust gases in the exhaust pipe.

The sensing element of the NO_x sensor is screwed into the exhaust pipe via the supplied stainless steel welding boss (material number 1.4301) from MOTORTECH. The supplied locking screw is used for closing the welding boss if you no longer want to use the opening or close it temporarily, and as a welding aid for the welding boss.

Proceed as follows:

1. At the selected mounting position in the exhaust pipe, drill a hole with a diameter of 27 mm ± 1 mm (1.07" ± 0.04") into the exhaust pipe.

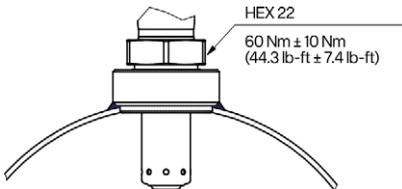


6 Installation Instruction

2. Screw the supplied locking screw into the supplied welding boss and weld the stainless steel welding boss (material number 1.4301) into this hole with a suitable welding filler.



3. At the mounting position of the sensing element, determine the NO_2/NO_x ratio (correction factor K) in the exhaust gas with a suitable calibrated exhaust gas analyzer. More information on this is available in the section *Determining the NO_2/NO_x Ratio* on page 57.
4. Remove the protective cap from the probe of the sensing element. Do not pull on the connection cable, but hold the sensing element only by its metal body.
5. Check whether the thread of the sensing element is sufficiently greased. If necessary, re-grease only the thread of the sensing element with a small amount of high temperature grease (Optimol Paste MF from Castrol® or Never Seez Regular Grade from Bostik®, recommendation $40 \text{ mg} \pm 10 \text{ mg}$). Also make sure that no dirt, dust, or grease gets deposited in or on the probe while mounting.
6. Insert the sensing element into the welding boss and screw the sensing element into the welding boss via its hexagon nut by hand first. The outgoing wires must not twist in the process. Therefore counter the sensing element with your hand.
7. Then tighten the sensing element over its hexagon nut using a calibrated torque tool with a torque of $60 \text{ Nm} \pm 10 \text{ Nm}$ ($44.3 \text{ lb-ft} \pm 7.4 \text{ lb-ft}$).



8. Then lay the connection cable between the sensing element and the evaluation unit of the NO_x sensor. When doing so, comply with the specifications in the section *Laying the Connection Cable* on page 55.
 - ▶ The sensing element of the NO_x sensor is mounted.
9. Later, when configuring the Easy NO_x , enter the NO_2/NO_x ratio determined above in the *NO_x Setup* view of the respective NO_x monitor (see section *Preferences* on page 112).
10. Also, when configuring the Easy NO_x , enter the sensor-specific factor $K\text{NO}_2$ for the corrective calculation of the NO_2 sensitivity in the *NO_x Setup* view of the respective NO_x monitor (see section *Preferences* on page 112). For the correction factor, refer to the entry *NO_2 Gain* in the *NO_x Sensor* view of the respective NO_x monitor (see section *Sensor* on page 117).

6.5 Determining the NO₂/NO_x Ratio

When the NO_x sensor is mounted for the first time at the installation location and each time the NO_x sensor is replaced, the NO₂/NO_x ratio (correction factor K) in the exhaust gas must be determined at the mounting position of the sensing element. Use a suitable calibrated exhaust gas analyzer and determine the concentration of nitrogen dioxide (NO₂) and nitrogen oxide (NO_x) at the sensing element's mounting position. The correction factor K results from the following equation:

$$K = \frac{NO_2}{NO_x}$$

When configuring the EasyNO_x, enter this value in the NO_x Setup view of the respective NO_x monitor (see section *Preferences* on page 112).

Always determine the NO₂/NO_x ratio before screwing the sensing element in for the first time and avoid repeatedly screwing the sensing element in and out. Also follow the instructions in the section *Mounting the Sensing Element of NO_x Sensor P/N 56.03.003* on page 52 when mounting the NO_x sensor for the first time and the instructions in the section *Replacing the NO_x Sensor* on page 136 when replacing the NO_x sensor.

6.6 Installation Locations of Thermocouples



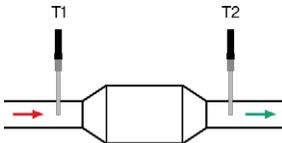
Risk of suffocation! Risk of poisoning!

Leaks in the exhaust pipe can cause exhaust gases to escape and people in the system room can suffocate or be poisoned. After mounting the sensors, check the tightness of the exhaust pipe.

To monitor catalyst operation and to detect the dew point for the NO_x sensor, it is necessary to install a thermocouple in the exhaust pipe at the catalyst outlet at a suitable location. Only use type K thermocouples with the measuring point insulated from the housing. When installing the thermocouples, follow the manufacturer's instructions and ensure that the thermocouples are positioned centrally in the exhaust pipe.

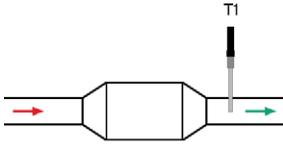
The following layouts are supported by the EasyNO_x:

- Before and after catalytic converter (*Before & After Cat*)
In this arrangement, mount the thermocouples at equal distances before and after the catalytic converter.

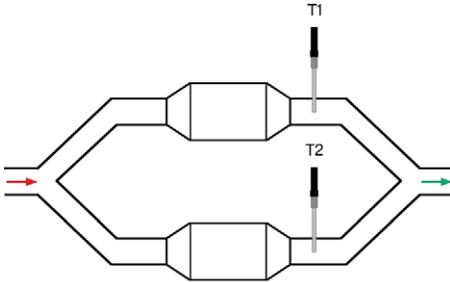


6 Installation Instruction

- After catalytic converter (*One After Cat*)



- In two exhaust gas lines after catalytic converter (*Two After Cat*)
The measured values of both thermocouples are used to detect the dew point for the NO_x sensor.



6.7 Installation Location of Pressure Sensor



Risk of suffocation! Risk of poisoning!

Leaks in the exhaust pipe can cause exhaust gases to escape and people in the system room can suffocate or be poisoned. After mounting the sensors, check the tightness of the exhaust pipe.

If you want to use the manifold pressure as engine load indicator for normal operation detection and use for this purpose the NO_x monitoring mode *MAP Naturally Aspirated* or *MAP Turbo* in the EasyNO_x (see section *Preferences* on page 112), a pressure sensor 4–20 mA is required.

Install the pressure sensor on the intake side of the engine after the throttle. The installation location must have adequate mechanical strength and must not exceed the specified temperature ranges. Observe the tightening torques as specified by the manufacturer. Comply with the pertinent regulations for wiring. Upon completion of the assembly works, check the system's tightness.

The pressure sensor can be connected directly to the CAN bus module. Alternatively, its signal can be routed to the CAN bus module via the control cabinet. For more information, read the section *Wiring of Pressure Sensor, Pressure Signal, Load Signal* on page 65.

6.8 Determining Manifold Pressure for Normal Operation Detection

This step is mandatory if you want to use the manifold pressure as engine load indicator for normal operation detection and use for this purpose the NO_x monitoring mode *MAP Naturally Aspirated* or *MAP Turbo* in the EasyNO_x (see section *Preferences* on page 112). In that case, you need to determine the manifold pressure that indicates the start of normal operation on the intake side of your engine (for example 30 % nominal load as per VDMA 6299:2019-09 or nominal load as per the engine manufacturer's specifications). In the case of a naturally aspirated engine, this manifold pressure must then be undercut, in the case of a turbocharged engine it must be exceeded.

6.9 Mounting of I/O Communication Module BPlus



Assignment of the modules to the engines

Set up your EasyNO_x system in such a way that the first NO_x monitor of the EasyNO_x monitors the first engine and the second NO_x monitor of the EasyNO_x monitors the second engine. Ensure the correct configuration of the EasyNO_x components (CAN bus module, NO_x sensor, I/O communication module BPlus).

In the optional I/O communication modules BPlus, the node IDs are unchangeably pre-configured. The MOTORTECH part number (P/N) tells you which node ID is configured in the respective I/O communication module.

| Part number | Node ID |
|------------------|-----------|
| P/N 63.05.014-01 | 10 (0x0A) |
| P/N 63.05.014-02 | 11 (0x0B) |

MOTORTECH recommends that you wire and configure the I/O communication module BPlus with node ID 10 for use with the first NO_x monitor of the EasyNO_x and the I/O communication module BPlus with node ID 11 for use with the second NO_x monitor of the EasyNO_x.

Accordingly, mount the I/O communication module with the appropriate part number onto a horizontal top hat rail in the control cabinet of the respective engine. In doing so, observe that the CANopen® network to which the EasyNO_x and the I/O communication modules BPlus are connected must comply with the maximum cable length of 250 m (820').

6.10 Mounting of I/O Module (Device Profile CiA® 401/404)

For mounting the I/O modules supporting device profile CiA® 401 or CiA® 404, read the manufacturer's documentation accompanying the product.

7 Wiring and Configuration

7.1 EasyNO_x

The following sections describe the wiring of the EasyNO_x. The EasyNO_x must be wired without voltage.

7.1.1 Opening and Closing of Housing



Operational safety!

The NO_x monitoring devices, including the EasyNO_x, must be operated with closed housings. Otherwise, proper functioning of the devices and compliance with the protection classes cannot be guaranteed.

When the system is powered off, the housings may only be opened for wiring and configuration. When the housing is open, make sure that no moisture forms in the housing.

To wire the EasyNO_x, you must open the door of the EasyNO_x housing. In order to be able to open the door, use a suitable slotted screwdriver or a screwdriver T25 to turn both locks on the right side of the housing door (see position ④ in the subsection *Components* of the section *Overview Drawings* on page 27) to the open position. Having finished the work in the housing, close the door of the EasyNO_x housing and turn the locks on the right side of the housing door to the closed position.

Closed position
(long slot on top)



Open position
(long slot to the left)



7.1.2 Wiring



Risk of injury!

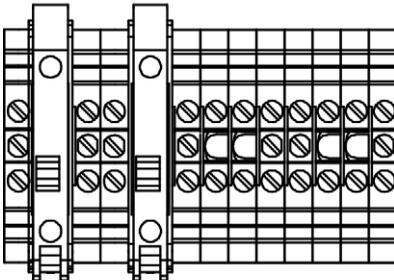
The EasyNO_x is designed for operation in circuits with **protected extra-low voltage (PELV)**. The voltages in these circuits must not exceed 50 V AC or 75 V DC.

The EasyNO_x must not be electrically connected to circuits which carry dangerously high voltages or which could do so if a single fault occurs.

Therefore, the following conditions, among others, must be fulfilled:

- The power supply may only be provided from power supply units with safe electrical isolation or from batteries.
- Relays with safe isolation must be used for coupling to circuits that carry or in the event of a failure could carry dangerous voltage.
- All currently applicable standards and regulations must be taken into account.

Do the wiring as follows:



| | | | | | | | | | | | | |
|--|-----|--------------------------|-----|-----|-----------------|----|----|---------------|-----|----|----|--------|
| Earth | L + | L - | L - | L + | Shield | Lo | Hi | Com | Com | Hi | Lo | Shield |
| Power in 24 V _{DC} max. 10 A | | Power out max. 8 A | | | CAN1 CANopen | | | CAN2 J1939 | | | | |

| Designation | | Function |
|--------------------------------|--------------------|--|
| Power in 24 V _{DC} | Earth, L +, L - | Terminals for the power supply of the EasyNO _x system (16 V DC to 32 V DC, nominal voltage 24 V DC) |
| Power out | L -, L + | Terminals for passing through the supply voltage to the first CAN bus/NO _x sensor module (e.g. via the CAN bus hybrid cable from MOTORTECH) |

7 Wiring and Configuration

| Designation | | Function |
|-----------------|------------------------|---|
| CAN1 CANopen | Shield, Lo, Hi, Com | Terminals of the CAN bus interface CAN1 (protocol CANopen®) for connection to the devices in the CANopen® network including I/O communication modules BPlus and the I/O modules supporting device profile CiA® 401 or CiA® 404 (see <i>Wiring CANopen® Network (CAN1)</i> on page 68) |
| CAN2 J1939 | Com, Hi, Lo, Shield | Terminals of the CAN bus interface CAN2 (protocol J1939) for connection to the first CAN bus/NO _x sensor module (e.g. via the CAN bus hybrid cable from MOTORTECH) |

Use suitable wire end ferrules for each wire that you place on a terminal.

Use a three-core round cable with a minimum cross section of 1.5 mm² to connect the EasyNO_x system to the power supply. The earth of the EasyNO_x system must be connected to the earth of the system.

For CAN bus wiring, only use shielded CAN cables in compliance with the standards ISO 11898-2 and CiA® 303-1. Connect the shields to the appropriate terminals (*Shield*).

Unless you use the CAN bus hybrid cable from MOTORTECH, the CAN and power supply cables to the CAN bus/NO_x sensor modules must be routed in parallel.

The power supply cables to the CAN bus/NO_x sensor modules should have a minimum wire cross-section of 1.5 mm². Depending on the total cable length of both power supply cables and the number of CAN bus/NO_x sensor modules connected, provide sufficient supply voltage to the EasyNO_x. Possible wire cross-sections and total cable lengths depending on the supply voltage can be found in the following tables.

Wire cross-section 1.5 mm²

| Total cable length | Minimum supply voltage | |
|--------------------|------------------------|-----------|
| | 1 module | 2 modules |
| 25 m (82') | 18 V DC | 20 V DC |
| 50 m (164') | 20 V DC | 24 V DC |

Wire cross-section 2.5 mm²

| Total cable length | Minimum supply voltage | |
|--------------------|------------------------|-----------|
| | 1 module | 2 modules |
| 25 m (82') | 17.3 V DC | 18.5 V DC |
| 50 m (164') | 18.5 V DC | 21 V DC |

Insert the supplied sealing inserts and sealing insert pins into the cable glands through which you do not feed any cables. Close all cable glands with a tightening torque of 8 Nm (5.9 lb-ft).

Close the door of the EasyNO_x housing after wiring the EasyNO_x and turn the locks of the door to the closed position (see section *Opening and Closing of Housing* on page 60).

7.2 CAN Bus/NO_x Sensor Module

The following sections describe the wiring and configuration of the CAN bus/NO_x sensor module. The CAN bus/NO_x sensor module must be wired without voltage.

7.2.1 Opening and Closing of Module



Operational safety!

The NO_x monitoring devices, including the EasyNO_x, must be operated with closed housings. Otherwise, proper functioning of the devices and compliance with the protection classes cannot be guaranteed.

When the system is powered off, the housings may only be opened for wiring and configuration. When the housing is open, make sure that no moisture forms in the housing.

To wire and configure the CAN bus module and the NO_x sensor, you have to open the housing cover of the CAN bus module. To do so, loosen the four cover screws on the top with a suitable screwdriver and then remove the housing cover. Regard that the cover screws are captively connected to the housing cover.

After wiring and configuration, put the housing cover back onto the CAN bus module and firmly tighten the four cover screws with a suitable screwdriver until stop so that the CAN bus module is securely closed again.

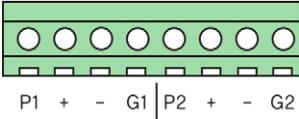
7.2.2 Grounding

The grounding cable (see position **3** in subsection *Components* of the section *Overview Drawings* on page 36) of the CAN bus/NO_x sensor module must be connected to the earth of the system.

7 Wiring and Configuration

7.2.3 Wiring of Thermocouples

All cables must be fed through a cable gland at a suitable position of the CAN bus module. Use suitable wire end ferrules for each wire that you place on a terminal.



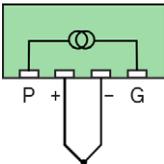
Connect the first thermocouple to input 1. Optionally, connect the second thermocouple to input 2 (see section *Installation Locations of Thermocouples* on page 57). Depending on the layout, connect the thermocouples as follows:

| Layout | Input 1 (T1) | Input 2 (T2) |
|---|---|--|
| Before and after catalytic converter (<i>Before & After Cat</i>) | Before catalytic converter | After catalytic converter |
| After catalytic converter (<i>One After Cat</i>) | After catalytic converter | – |
| In two exhaust gas lines after catalytic converter (<i>Two After Cat</i>) | First exhaust gas line: after catalytic converter | Second exhaust gas line: after catalytic converter |

If you do not use input 2, bridge this input with a jumper between the terminals + and -. This prevents the measuring circuit from being disturbed by interfering radiation.

Only use thermocouples with shielded leads. When connecting, make sure that the terminal designation corresponds to the polarity of the thermocouples.

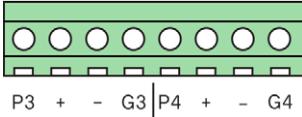
Connect the thermocouples as follows:



Connect the shields of the thermocouple leads with the cable glands. Do not lay the shields inside the CAN bus module.

7.2.4 Wiring of Pressure Sensor, Pressure Signal, Load Signal

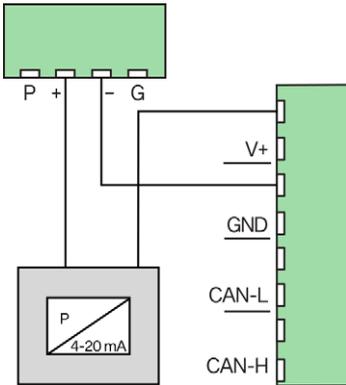
All cables must be fed through a cable gland at a suitable position of the CAN bus module. Use suitable wire end ferrules for each wire that you place on a terminal.



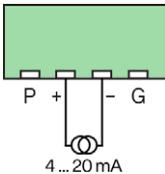
Depending on the intended NO_x monitoring mode (see *Preferences* on page 112), connect a pressure sensor 4–20 mA, a pressure signal 4–20 mA, or a load signal 4–20 mA to input 3. You can optionally connect another 4–20 mA signal to input 4, whose current value is displayed in the EasyNO_x in the *NO_x Monitoring* view. Note that the large cable gland at the long side of the CAN bus module is not available for input 4 if you connect a second CAN bus module to this module (see section *Wiring of Power Supply and CAN Bus* on page 66).

Connect the shields of the wires with the cable glands. Do not lay the shields inside the CAN bus module. No bridges may be set between the measurement inputs.

Connect a pressure sensor as shown in the following illustration. The wire cross-section of the power supply cable from the pressure sensor should be at least 0.5 mm². For smaller wire cross-sections, ensure that the cable is appropriately fused.



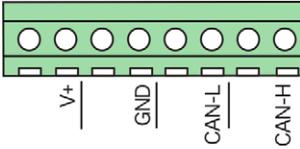
Connect active signal sources 4–20 mA (pressure signal, load signal) as shown in the following illustration. Use shielded wires for connecting active signals 4–20 mA.



7 Wiring and Configuration

7.2.5 Wiring of Power Supply and CAN Bus

All cables must be fed through a cable gland at a suitable position of the CAN bus module. Use suitable wire end ferrules for each wire that you place on a terminal.



| Designation | Function |
|--------------|--|
| V+, GND | Terminals for the supply voltage coming from the EasyNO _x or from the first CAN bus module and for passing through the supply voltage to the NO _x sensor and optionally to a second CAN bus module |
| CAN-L, CAN-H | Terminals for the CAN cable coming from the EasyNO _x or from the first CAN bus module and for passing through the CAN signal to the NO _x sensor and optionally to a second CAN bus module |

Note that each terminal is available twofold. If more than one wire has to be connected to a terminal, use suitable double wire end ferrules for a safe connection (not included in scope of supply). Use these terminals to connect the CAN bus module to the supply voltage and the CAN cable from the EasyNO_x or the first CAN bus module. Use a shielded CAN cable in compliance with the standards ISO 11898-2 and CiA® 303-1. Connect the shield of the CAN cable with the cable glands. Do not lay the shield inside the CAN bus module.

To pass through the supply voltage and the CAN signal, connect the NO_x sensor and, if needed, a second CAN bus module to these terminals. The CAN cable to the second CAN bus module must be shielded and comply with the standards ISO 11898-2 and CiA® 303-1. Unless you use the CAN bus hybrid cable from MOTORTECH, the CAN and power supply cable to the second CAN bus module must be routed in parallel.

The connection cable from the CAN bus module to the evaluation unit of the NO_x sensor is assigned as follows:

| Color | Assignment |
|--------|---|
| White | L + |
| Brown | L - |
| Green | CAN Lo |
| Yellow | CAN Hi |
| Gray | Node ID of the NO _x sensor (see section <i>Node ID NO_x Sensor</i> on page 67) |

To avoid coupling of interference signals, make sure that the CAN lines are not laid over the signal lines when wiring.

If you connect a second CAN bus module to the first CAN bus module, pass the power supply and CAN cable to the second CAN bus module through the large cable gland at the long side of the CAN bus module on the right.

7.2.6 Closing of Cable Glands

Insert the supplied sealing inserts and sealing insert pins into the cable glands through which you do not feed any cables. Close the large M16 cable glands with a tightening torque of 3 Nm (2.2 lb-ft) and the small M12 cable glands with a tightening torque of 1.2 Nm (0.9 lb-ft).

7.2.7 CAN Bus Termination

The CAN bus module is the last device in the J1939 network and must be terminated. If you use two CAN bus modules, terminate only the last CAN bus module in the J1939 network. To do so, set the *Term* switch to the desired position using a fine screwdriver.

Termination off

Term

Off/On



Termination on

Term

Off/On



7.2.8 Node ID NO_x Sensor



Assignment of the modules to the engines

Set up your EasyNO_x system in such a way that the first NO_x monitor of the EasyNO_x monitors the first engine and the second NO_x monitor of the EasyNO_x monitors the second engine. Ensure the correct configuration of the EasyNO_x components (CAN bus module, NO_x sensor, I/O communication module BPlus).

For communication with the EasyNO_x via the CAN bus, the correct node ID must be set for the NO_x sensor. Set the node ID of the NO_x sensor using the grey wire of the harness to the NO_x sensor as follows.

- First NO_x monitor (NO_x:1): Put the grey wire on the GND terminal.
- Second NO_x monitor (NO_x:2): Do not connect the grey wire.

7.2.9 Node ID CAN Bus Module

For communication with the EasyNO_x via the CAN bus, the correct node ID be set on the CAN bus module. Set the node ID of the CAN bus module via the DIP switches *Modul-ID* as follows:

| CAN bus module | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| First NO _x monitor (NO _x :1) | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| Second NO _x monitor (NO _x :2) | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |

7 Wiring and Configuration

7.2.10 Bit Rate CAN Bus Module

Set the bit rate of the CAN bus module to 250 kbit/s via the DIP switches *Baud*:

| 1 | 2 | 3 | 4 |
|---|---|---|---|
| 0 | 1 | 1 | 1 |

7.2.11 Device Setup EasyNO_x

For each CAN bus/NO_x sensor module you use, add a NO_x monitor (display name *NO_x*) in the *Device Setup* view of the EasyNO_x (see section *Adding a Device* on page 83). Set up your EasyNO_x system in such a way that the first NO_x monitor (*NO_x:1*) monitors the first engine and the second NO_x monitor (*NO_x:2*) monitors the second engine.

7.3 Wiring CANopen® Network (CAN1)

The CAN bus interface CAN1 of the EasyNO_x connects the EasyNO_x to a CANopen® network. Via this CANopen® network, you connect the EasyNO_x to the following devices:

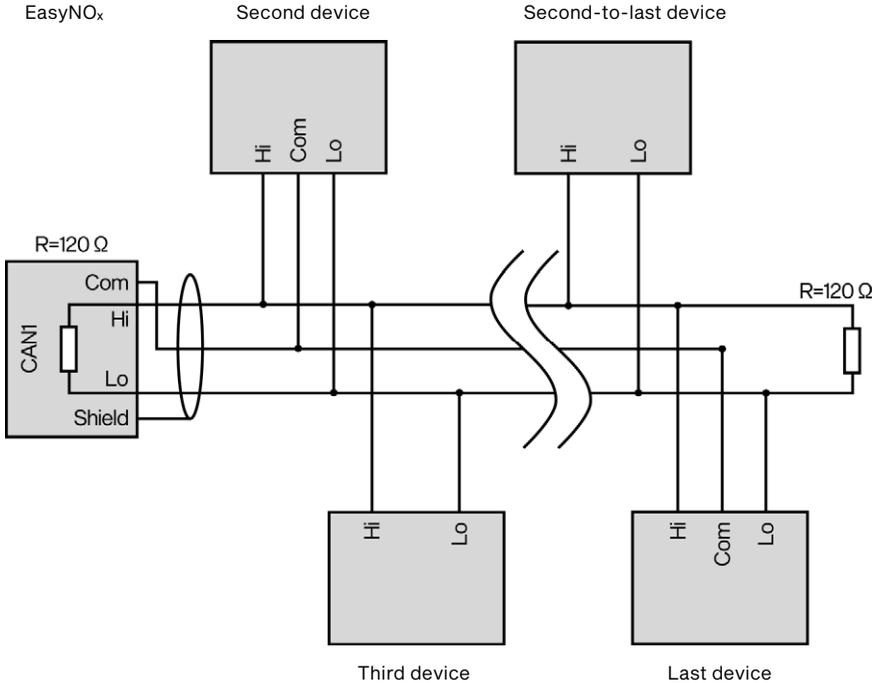
- I/O communication module BPlus
- I/O module (device profile CiA® 401 or CiA® 404)
- Generic device

Observe the device restrictions in the section *Adding a Device* on page 83.

The EasyNO_x functions as NMT manager in the CANopen® network.

The wiring of the CAN bus requires three conductors (CAN Hi, CAN Lo, and CAN Com). The conductors for CAN Hi and CAN Lo must be twisted wires. At a bit rate of 250 kbit/s, the bus may only have a maximum cable length of 250 m (820') and must be terminated at both ends by a terminating resistor of 120 Ω between the CAN Hi and CAN Lo conductors to prevent reflections. Only use shielded CAN cables in compliance with the standards ISO 11898-2 and CiA® 303-1.

The EasyNO_x has a built-in 120 Ω terminating resistor and must therefore be the first or last device in the CANopen® network. The following diagram shows as an example the wiring of the EasyNO_x with other devices:



Common mode voltage in CAN bus

If the CAN bus contains devices with CAN bus interfaces that are not isolated from the power supply (i.e. the I/O communication module BPlus available from MOTORTECH or the NO_x sensor from the CAN bus/NO_x sensor module), error-free communication of the devices in the CAN bus is only guaranteed if the voltage levels of the signal lines CAN Hi and CAN Lo are within the range of -2 V to +7 V. If this common mode voltage range is not maintained, use a CAN bus insulator (available from MOTORTECH as accessory) for potential isolation between the interfaces.

7 Wiring and Configuration



CAN bus wiring

Note the following when connecting the CAN bus:

- Each bus end must be fitted with a terminating resistor of 120 Ω (see drawing).
- The maximum cable length depends on the bit rate:

| Bit rate | Maximum cable length | Maximum length of a stub | Maximum length of all stubs |
|------------|----------------------|--------------------------|-----------------------------|
| 1 Mbit/s | 25 m (82') | 1.5 m (5') | 7.5 m (25') |
| 800 kbit/s | 50 m (164') | 2.5 m (8') | 12.5 m (41') |
| 500 kbit/s | 100 m (328') | 5.5 m (18') | 27.5 m (90') |
| 250 kbit/s | 250 m (820') | 11 m (36') | 55 m (180') |
| 125 kbit/s | 500 m (1,640') | 22 m (72') | 110 m (360') |
| 50 kbit/s | 1,000 m (3,280') | 55 m (180') | 275 m (902') |

- Only use cables that are specified by the manufacturer for use in the CAN bus.
- Comply with the standards ISO 11898-1 and CiA® 303-1.

The EasyNO_x is delivered with a bit rate set to 250 kbit/s.

7.4 I/O Communication Module BPlus

The following sections describe the wiring and configuration of the optional I/O communication module BPlus.

The I/O communication module BPlus is designed for wiring via a terminal strip in the control cabinet. The I/O communication module must be wired without voltage.

7.4.1 Wiring of Power Supply

The I/O communication module BPlus must be supplied with power via the control cabinet of the respective engine. Connect the black wire L – and the red wire L + of the left relay connector (see position **1** in the section *Assignment* on page 42) to the power supply via a terminal strip in the control cabinet.

To ensure error-free device communication in the CAN bus, make sure that the potential difference between the voltage supply grounds of the I/O communication modules BPlus and the EasyNO_x is as small as possible.

7.4.2 CAN Bus Wiring, CAN Bus Termination



Common mode voltage in CAN bus

If the CAN bus contains devices with CAN bus interfaces that are not isolated from the power supply (i.e. the I/O communication module BPlus available from MOTORTECH or the NO_x sensor from the CAN bus/NO_x sensor module), error-free communication of the devices in the CAN bus is only guaranteed if the voltage levels of the signal lines CAN Hi and CAN Lo are within the range of -2 V to +7 V. If this common mode voltage range is not maintained, use a CAN bus insulator (available from MOTORTECH as accessory) for potential isolation between the interfaces.

For wiring, use a terminal strip in the control cabinet. On the left relay connector of the I/O communication module BPlus (see position **1** in section *Assignment* on page 42), the white wire CAN Hi and the brown wire CAN Lo are used for the CAN connection to the previous device in the CANopen® network. Use the yellow wire CAN Hi and the green wire CAN Lo of the left relay connector to connect the I/O communication module to the following device in the CANopen® network. If the I/O communication module is the last device in the CANopen® network, connect the supplied 120 Ω terminating resistor to these wires.

Reference ground of the CAN bus interface of the I/O communication module BPlus is the supply voltage ground.

On the EasyNO_x side, connect the shield of the CAN cable to the *Shield* terminal in the EasyNO_x. On the module side, connect the shield of the CAN cable to the earth of the control cabinet for each I/O communication module BPlus. Connect the shields of the CAN cables of all devices in the CAN bus with each other.

7 Wiring and Configuration

7.4.3 Wiring of Inputs and Outputs



Operational safety!

The EasyNO_x and the software are not designed for safety-critical applications. The analog and binary inputs and outputs of the EasyNO_x system must not be used for safety-critical purposes.

Wire the binary and analog inputs and outputs of the I/O communication module BPlus via a terminal strip in the control cabinet as needed. For further details on the assignment of the relay connectors, refer to the section *Assignment* on page 42.

| Relay connector | Wire color | Assignment |
|-----------------|------------|-----------------|
| Left | Pink | Binary input |
| | Gray | Analog input |
| Center | Yellow | Binary output 3 |
| | Orange | Binary output 2 |
| | Purple | Binary output 1 |
| Right | Green | Analog output |

Note that, in the EasyNO_x, you must assign the desired function to the wired inputs and outputs of the I/O communication module BPlus before you can use them (see section *Preferences* on page 123). To do so, the respective BPlus module must have been added as a device in the EasyNO_x (see following section *Device Setup EasyNO_x* on page 72).

Reference ground of the analog and binary inputs and outputs of the I/O communication module BPlus is the supply voltage ground.

7.4.4 Device Setup EasyNO_x

For each I/O communication module BPlus you use, add a *BPlus* device in the *Device Setup* view of the EasyNO_x (see section *Adding a Device* on page 83).

MOTORTECH recommends that you wire and configure the I/O communication module with node ID 10 (MOTORTECH part number P/N 63.05.014-01) for use with the first NO_x monitor of the EasyNO_x and the I/O communication module with node ID 11 (MOTORTECH part number P/N 63.05.014-02) for use with the second NO_x monitor of the EasyNO_x.

7.5 I/O Module (Device Profile CiA[®] 401/404)

For the wiring and configuration of the I/O modules supporting device profile CiA[®] 401 or CiA[®] 404, read the manufacturer's documentation accompanying the product.

General functions and setting options for the EasyNO_x are described in this chapter. You can find information on the menus of added devices in chapter *Devices* on page 100.



Notice

In this manual, the screenshots and buttons are displayed in day mode. You can find out how to toggle between day and night mode in the section *Start Menu* on page 76.

8.1 Switching on and off the Device

The device is switched on by connection to the power supply and switched off by interrupting the power supply.

8 General Operation

8.2 Navigation

The EasyNO_x has a touchscreen, which can be operated directly with the finger or a stylus pen suitable for capacitive touchscreens (not included in scope of supply). The screen comprises the following areas:



Title Area **1**

The name of the current view is displayed in the title area of the EasyNO_x. If you are in a device menu, the device and its node ID set in the EasyNO_x are additionally displayed for certain devices. In the NO_x monitor views, a custom name is additionally displayed instead of the device and the node ID (see section *Preferences* on page 112).

By tapping on the logo in the upper left corner, you can display detailed information about the EasyNO_x, in an information window, regardless of the selected view. If a USB flash drive with the folder *temp* created in its root directory is inserted in the EasyNO_x, tapping on the logo also creates a screenshot of the current view. An information text in the title bar of the information window informs you about the successfully created screenshot.

In certain views you can access additional views via the buttons  and .

Menu Bar **2**

The menu bar on the right-hand side of the screen is always displayed. There is more information in the section *Menu Bar* on page 75.

Main Window **3**

In the main window, the EasyNO_x is configured, and the device menus of added devices are shown.

8.3 Menu Bar

The menu bar is always displayed and offers the following options and information:

| Symbol | Function |
|--|--|
|  <p>Start</p> | <p>With the <i>Start</i> button you reach the <i>Start Menu</i>. There is more information in the section <i>Start Menu</i> on page 76.</p> |
|  <p>Back</p> | <p>With the <i>Back</i> button you reach the next higher operating level of the EasyNO_x.</p> |
|  <p>Tooltip</p> | <p>Information on the buttons and functions can be displayed in pop-up windows. Proceed as follows:</p> <ol style="list-style-type: none"> In the menu bar, tap the <i>Tooltip</i> button. <ul style="list-style-type: none"> The <i>Tooltip</i> button is now activated and framed light blue. Tap a button or an area of the display. <ul style="list-style-type: none"> A pop-up window with information opens. The <i>Tooltip</i> button is deactivated. Tap the screen at any location to close the pop-up window. <p>To get information about other buttons and areas, the <i>Tooltip</i> button must be reactivated.</p> |
|  <p>Alert</p> | <p>The <i>Alert</i> button in the menu bar can display two states:</p> <ul style="list-style-type: none"> If the button is grayed, there are no new messages. The button is activated when messages are present. <p>By tapping the activated button, you acknowledge messages and open the <i>Event Log</i> view.</p> <ul style="list-style-type: none"> The filter of the <i>Event Log</i> view is automatically set so that only messages of devices that have reported alarms, warnings, or errors are displayed. The <i>Alert</i> button is grayed out. In the <i>Start Menu</i>, devices which had a yellow frame now get a turquoise frame again. |
|  <p>Service</p> | <p>This button informs about the status of the access control:</p> <ul style="list-style-type: none"> <i>Operator, Service, Master</i>: The corresponding access level is set. <i>Locked</i>: The <i>Read Only</i> access level is set. <i>Disabled</i>: The access control is disabled. <p>By tapping this button, you can access the <i>Access Control</i> view. There is more information in the section <i>Access Control</i> on page 92.</p> |

8 General Operation

| Symbol | Function |
|--|--|
|  10:49 | <p>Status information of added devices is shown in the lowest field of the menu bar.</p> <p>The communication status symbol provides information on the following states:</p> <ul style="list-style-type: none">  There is a connection to all added devices.  The connection is not established to all added devices.  No other device is connected. <p>The system time is displayed at the very bottom.</p> <p>If you tap the button for the connection status, the <i>Event Log</i> view opens. There is more information in the section <i>Event Log</i> on page 98.</p> |

8.4 Start Menu

The *Start Menu* will be displayed after the EasyNOx has started. You can access the *Start Menu* any time via the *Start* button in the menu bar.



You have the following options in the *Start Menu*:

Devices

With this button you open the *Device Setup* view, in which you can add new devices and edit device settings. There is more information in the section *Devices* on page 79.

Display

With this button, you open the *Display Configuration* view. Among other things, you can set the language and system time of the EasyNO_x and activate a screen saver. There is more information in the section *Display* on page 87.

Connection

With this button, you open the *Communication Setup* view. You can change the node ID and the bit rate of the EasyNO_x, and of all LSS-capable devices to which the EasyNO_x is connected via the CAN bus interface CAN1. There is more information in the section *Connection* on page 90.

Night Mode/Day Mode

With this button, you can change the display colors to ensure legibility under various lighting conditions.



Recordings

With this button, you open the *Recorded Files* view. The EasyNO_x currently does not support devices that allow the recording of trend data in the *Device Setup* view.

Help

This button opens the operating manual of the EasyNO_x. There is more information in the section *Help* on page 99.

8 General Operation

Added Devices

The buttons of added devices each contain a device icon, the device name, and for some devices the node ID configured in the EasyNO_x or a sequential number. The frames of the buttons can take different colors.



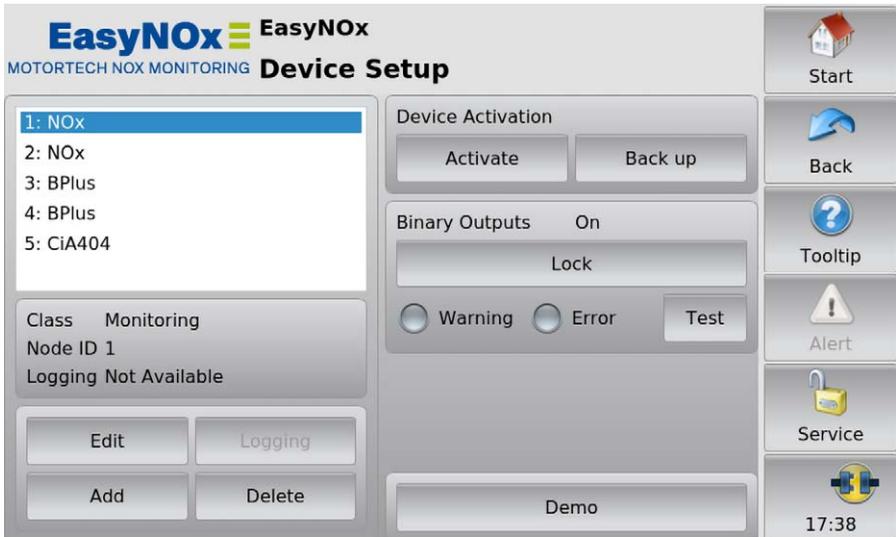
The frames of the device buttons have the following meaning:

- Turquoise: There are no errors.
- Yellow: There are one or more messages for the device. Acknowledge the messages via the *Alert* button (see section *Menu Bar* on page 75).
- Purple: The device is not activated (see section *Device Activation* on page 81).
- Red: The device is not connected. Check the connection and connection settings.

Tapping on a device opens the *Main Menu* of the particular device. For information on how to configure devices, see section *Devices* on page 100.

8.4.1 Devices

The *Devices* button in the *Start Menu* opens the *Device Setup* view.



The *Device Setup* view provides the following options:

- [List of Added Devices](#)
In this field, all added devices are listed.
- [Edit](#)
With the button you can edit the settings of certain devices. You can find more information in the section *Editing a Device* on page 85.
- [Logging](#)
With the button, you can select for certain devices whether data of the device should be recorded on the memory card inserted in the EasyNO_x. The EasyNO_x currently does not support devices that optionally allow the recording of trend data. For an added NO_x monitor, the recording of data on the memory card inserted in the EasyNO_x is firmly preset and cannot be deactivated.
- [Add](#)
With the button you open the dialog *Add Device*. You can find more information in the section *Adding a Device* on page 83.
- [Delete](#)
Tap this button to delete an added device. You can find more information in the section *Deleting a Device* on page 86.

8 General Operation

– Device Activation

The EasyNO_x HMI modules are activated differently ex works. In certain cases, you can activate additional devices in the EasyNO_x with software dongles from MOTORTECH. There is more information in the section *Device Activation* on page 81. With the *Back up* button, you can save all device activations to a USB flash drive (e.g. before software updates). A device-specific software dongle is stored on the USB flash drive for each activated device, including those activated ex works. If necessary, you can re-activate the devices with these software dongles.

– Binary Outputs

The EasyNO_x provides the binary outputs *Warning* and *Error* virtually via the CAN bus interface CAN1. In order to use them in the CAN bus, they must be activated in the EasyNO_x. Additionally, they can each be connected to a physical binary output of an optional I/O module (see section *Binary Outputs* on page 125). Observing the following safety instructions, you can use the *Unlock* button to activate the binary outputs *Warning* and *Error* and the *Lock* button to deactivate them. The status displays *Warning* and *Error* indicate the switching status of these binary outputs.



Operational safety!

The EasyNO_x and the software are not designed for safety-critical applications. The analog and binary inputs and outputs of the EasyNO_x system must not be used for safety-critical purposes.

– Test

For test purposes, you can switch the binary outputs *Warning* and *Error*, which the EasyNO_x provides virtually via the CAN bus interface CAN1, on and off. To do so, use the *Test* button to open the *Binary Output Test* window. In this window, you can switch the binary outputs while observing the following safety instructions and thereby test the behavior of the devices that are connected to these binary outputs.



Operational safety!

Testing the outputs affects the connected devices. Before performing tests, make sure that switching the outputs will not result in hazards or damage.

– Demo

To access the device-specific pages for demonstration or pre-configuration without the device being connected, you can activate and deactivate the demo mode by tapping the button while observing the following safety instructions. The demo mode is indicated in the information bar in the logo by the text *DEMO MODE*.



Operational safety!

The demo mode is not a normal operating state of the EasyNO_x. In combination with other devices the EasyNO_x must not be operated in demo mode.

8.4.1.1 Device Activation



Device activations of the NO_x monitor packages

In an NO_x monitor package of the EasyNO_x for two engines, both NO_x monitors have been activated in the EasyNO_x ex works.

If you purchase a second engine extension package for a package of the EasyNO_x supporting one engine, a software dongle is included with this extension package. This software dongle activates the second NO_x monitor in the EasyNO_x.

For certain devices, activation is required in order to add and use them in the EasyNO_x. You can add activated devices to the device configuration of your EasyNO_x in the *Device Setup* view (see section *Adding a Device* on page 83).

The EasyNO_x HMI modules are activated differently ex works (e.g. in a package of the EasyNO_x for two engines, the first and second NO_x monitor). In certain cases, you may retrofit additional devices by purchasing one or more software dongles from your MOTORTECH contact person (see *Customer Service Information* on page 134). With these software dongles, you then activate the respective devices in your EasyNO_x. After activation, you can add the devices to the device configuration of your EasyNO_x.

Software dongles are tied to the respective EasyNO_x via the serial number. For retrofitting your EasyNO_x with a software dongle, you need to specify its serial number. You can find the serial number on the device label of your EasyNO_x (see section *Product Identification – Labeling on the Device* on page 23) or display it in the EasyNO_x in the *Display Information* view (see section *Display* on page 87).

If you have received a software dongle from MOTORTECH, proceed as follows to activate the respective device in the EasyNO_x:

1. The EasyNO_x reads software dongles from a USB flash drive inserted in the EasyNO_x. Therefore, ensure that the desired software dongle from MOTORTECH is on a USB flash drive.
2. Insert the USB flash drive with the desired software dongle into your EasyNO_x.

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3. In the *Device Setup* view in the area *Device Activation*, tap *Activate*.
 - ▶ The storage locations available are displayed in a window.
4. Navigate to the desired software dongle with the file extension *.usd* and select it.
5. Tap *Enter*.
 - ▶ The device is activated.
 - ▶ You can add the device in the EasyNO_x (see *Adding a Device* on page 83) and use it.



Activating multiple devices

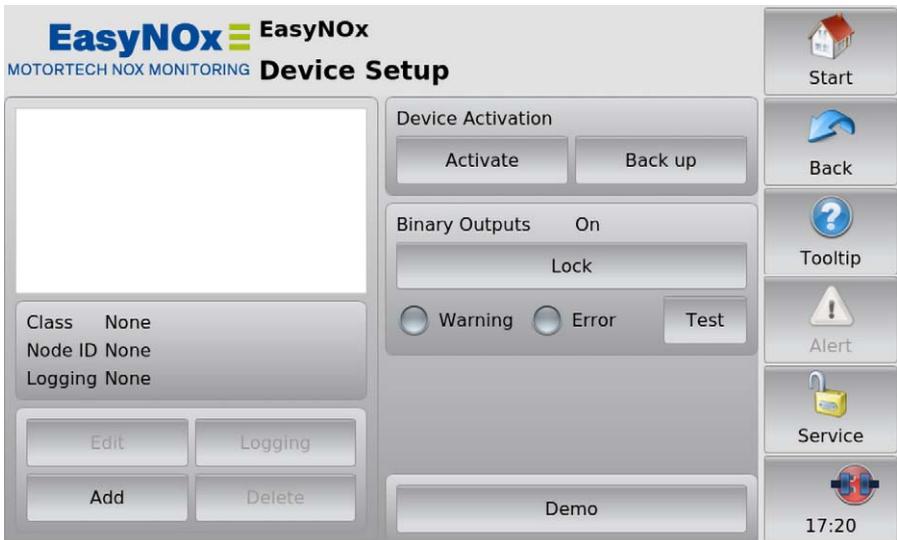
If you have multiple software dongles for device activation, you can alternatively copy the software dongles into one folder on the USB flash drive. Then mark this folder in the device activation selection window so that the EasyNO_x reads all the software dongles that are in this folder.

8.4.1.2 Adding a Device



Maximum number of added devices

Simultaneously, the EasyNO_x can integrate a maximum of two NO_x monitors, three I/O modules including a maximum of two I/O communication modules BPlus, and up to three generic devices.



To add a device, proceed as follows:

1. In the *Device Setup* view, tap the *Add* button.
 - ▶ The dialog *Add Device* opens.

8 General Operation

2. Select the device. For information on the *Generic* device, read the section *Generic Device* on page 128.



This symbol next to a device indicates this device has been activated at least once. You can add the device multiple times until the maximum number of activated devices of this type is reached. In certain cases, you can retrofit additional devices (see section *Device Activation* on page 81).



This symbol next to a device indicates that no activation is required for the device. The device can be added to the device configuration if its maximum number has not been exceeded.



This symbol next to a device indicates that the device has not been activated and cannot be added to the device configuration. In certain cases, you can retrofit additional devices (see section *Device Activation* on page 81).

3. Where available, use the arrow keys to set the node ID of the device to be added. The node ID entered must correspond to the node ID of the device.
4. Confirm your entry via the *Save* button.
 - ▶ The dialog is closed, and you are returned to the *Device Setup* view. The device is displayed in the list of added devices with device class and node ID or sequential number.



5. To add more devices, repeat steps 1 to 4.

6. When you tap *Start* in the menu bar, the added devices are displayed in the *Start Menu* with node ID or sequential number (NO_x monitor only).



8.4.1.3 Editing a Device

You can edit the settings of certain devices. Proceed as follows:

1. In the *Device Setup* view, select the device whose settings you want to change from the list of added devices.
2. Tap the *Edit* button.
 - ▶ The dialog for editing devices opens.
3. Set the device and, where applicable, the node ID.
4. Tap *Save*.
 - ▶ The dialog is closed.
 - ▶ The device is displayed with changed settings in the *Device Setup* view and in the *Start Menu*.

8 General Operation

8.4.1.4 Deleting a Device



Deleting the NO_x monitor

An added NO_x monitor can only be deleted if the mode of the respective NO_x monitor is set to *Off* and thus NO_x monitoring is deactivated (see section *Preferences* on page 112).

Further, the first NO_x monitor (display name *NO_x:1*) cannot be deleted prior to the second NO_x monitor (display name *NO_x:2*).

If you want to delete both NO_x monitors, you must first delete the second NO_x monitor.

If you only want to use the second NO_x monitor, set the mode of the first NO_x monitor to *Off*.

To delete an added device, proceed as follows:

1. In the *Device Setup* view, select the device you want to delete from the list of added devices.
2. Tap *Delete*.
 - ▶ The device is no longer displayed in the *Device Setup* view and in the *Start Menu*.

8.4.2 Display

The *Display* button in the *Start Menu* opens the following views:

- *Display Configuration*
- *Display Information*

The  and  buttons allow you to switch between the views. The views are described as follows.

Display Configuration



You have the following options:

- **Language**
Select the desired system language.
- **Temperature Unit**
Select, whether temperatures in the EasyNO_x are to be displayed in °C or in °F. Recordings are also created in the units selected. This setting has no effect on the NO_x monitor. In the NO_x monitor, all temperatures are displayed and recorded in °C.
- **Screen Saver**
Tap *Settings* to configure the screen saver. When the screen saver has been activated, the display is darkened and switched off after a specified time (*Power Save* option). In addition, the EasyNO_x is placed on the access level *Read Only* (displayed status *Locked* in the menu bar). By touching the display, a running screen saver is stopped.
- **Pop-ups**
Activate or deactivate pop-ups with information for the user. Important pop-ups, e.g. with information on errors, are always displayed. Pop-ups which e.g. provide information on successful actions can be deactivated.

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- **Revert Changes**
Tap *Revert Changes* to restore the last saved configuration state. Date and time are not reset.
- **Time Zone**
Tap *Set* to set the time zone.
- **Date, Time**
Tap *Set* to set the system time and date. Your configuration options depend on the access level you are logged in to (see section *Access Control* on page 92).
- **Configuration**
You have the following options:

- **Save**
Save the configuration of your EasyNO_x to a USB flash drive inserted in the EasyNO_x. One file is created each for the configuration of the EasyNO_x, for all added NO_x monitors, and for each configured I/O module. This enables you to easily restore the configuration of your EasyNO_x or transfer it to another EasyNO_x using a USB flash drive. With the I/O module, the configuration of deleted devices is also saved so that it is also available on another EasyNO_x if you add the device with an identical node ID to the device configuration. The following configuration files are saved:

| File | Content |
|-------------------|--|
| Configuration.xml | General configuration of the EasyNO _x including the list of added devices from the <i>Device Configuration</i> view |
| nox_config.json | Configuration of all added NO _x monitors in the EasyNO _x |
| Dev401_xxx.json | Configuration of an I/O communication module BPlus or an I/O module supporting device profile CiA® 401 with node ID xxx |
| Dev404_xxx.json | Configuration of an I/O module supporting device profile CiA® 404 with node ID xxx |

- **Load**
Load a configuration of your EasyNO_x stored on a USB flash drive. For this, select the desired configuration files via the displayed context menu.
- **PDF File**
Save a PDF document with information on the configuration of your EasyNO_x to a USB flash drive.
- **Service**
Creates a service report in English as a PDF document on a USB flash drive. In addition to the configuration information, this service report also contains information on memory usage and a list of events. To receive the best possible support, send the service report to your MOTORTECH contact person (see *Customer Service Information* on page 134) for service requests.
- **Reboot**
With the *Reboot* button, you carry out a reboot of your EasyNO_x. Unsaved settings will get lost, and databases will be closed!

Display Information

In the *Display Information* view, you can find the following information:

- Display ID
- MOTORTECH serial number
- Arrangement number
- Board support package version
- Software version of your EasyNO_x

The screenshot displays the 'EasyNOx Display Information' interface. At the top left, the logo 'EasyNOx' is shown next to 'MOTORTECH NOX MONITORING'. The title 'Display Information' is centered at the top. Below the title, there are five rows of data, each with a label on the left and a value in a white input field on the right:

| | |
|-----------------------|----------------------|
| Display ID | 02509571 |
| MOTORTECH S/N | 01234567 |
| Arrangement Number | PV4.00.0000-200-AA-B |
| Board Support Package | rocko-7.0-0 |
| Software | 2.0.0 |

On the right side of the screen, there is a vertical navigation bar with the following elements from top to bottom:

- A 'Start' button with a house icon.
- A 'Back' button with a blue arrow icon.
- A 'Tooltip' button with a question mark icon.
- An 'Alert' button with a warning triangle icon.
- A 'Service' button with a padlock icon.
- A clock showing the time '10:49'.

In demo mode (see section *Devices* on page 79), data on the Ethernet connection of the EasyNO_x is additionally displayed for service purposes. The Ethernet interface of the EasyNO_x is intended exclusively to be used by MOTORTECH service.

8 General Operation

8.4.3 Connection

The *Connection* button in the *Start Menu* opens the *Communication Setup* view.



Bit rate settings in the CAN bus

For communication via the CAN bus, it is mandatory that all connected devices use the same bit rate.

If the EasyNO_x is connected to a CANOpen® network via the CAN bus interface CAN1, you can make the following settings for this network in the *Communication Setup* view:

EasyNO_x

Changing Node ID

The factory setting for the node ID on your EasyNO_x is 66. Change the node ID as follows:

1. You can set a node ID for your EasyNO_x in the *EasyNO_x* area using the arrow keys.
2. Tap *Save* to confirm the setting of the node-ID.
 - ▶ The node ID of the EasyNO_x is changed.

The changed node ID will be discarded if you tap *Reset* before saving or leave the *Communication Setup* view without saving.

Changing Bit Rate

Change the bit rate of the EasyNO_x as follows:

1. Select the desired bit rate in the *EasyNO_x* area.
2. Tap *Save*.
 - ▶ The bit rate of the EasyNO_x is changed.

The changed bit rate will be discarded if you tap *Reset* before saving or leave the *Communication Setup* view without saving.

Other Devices

If supported by the respective device, you can use LSS commands to change the node ID and the bit rate of devices in the CAN bus on CAN1.



LSS commands: Disconnect all other devices from the CAN bus!

When sending LSS commands, all devices connected to the CAN bus via CAN1 are addressed. In order to change the bit rate or the node ID of the desired device only, no other devices may be connected to the EasyNO_x via CAN1.



LSS commands: Use identical bit rates!

LSS commands can only be received from another device in the CAN bus if the LSS manager (here: EasyNO_x) is set to the bit rate of the other device. If necessary, set the corresponding bit rate in the EasyNO_x before sending the LSS command.

Changing Node ID

You can change the node ID of another device in the CANopen® network as follows:

1. Make sure that the current bit rate of the other device is set in the EasyNO_x.
2. Make sure that there is only the other device connected to the EasyNO_x via CAN1.
3. Set the node ID that the other device is to be given in the *LSS Commands* area.
4. Tap *Send Command*.
 - ▶ The node ID of the other device is changed.
5. If you have changed the bit rate of the EasyNO_x in step 1, set the EasyNO_x back to the previous bit rate in the *EasyNO_x* area, if required.

8 General Operation

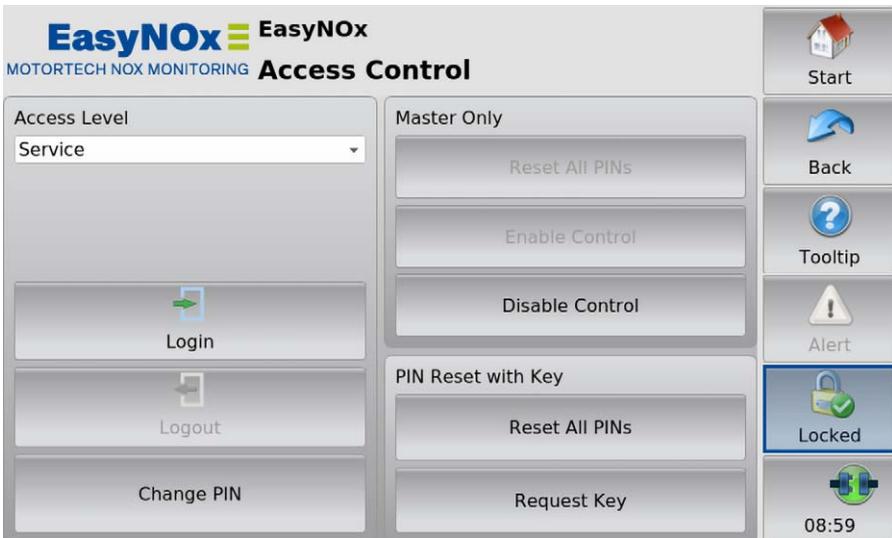
Changing Bit Rate

You can change the bit rate of another device in the CANopen® network as follows:

1. Make sure that the current bit rate of the other device is set in the EasyNO_x.
2. Make sure that there is only the other device connected to the EasyNO_x via CAN1.
3. Make sure that the current node ID of the other device is set in the *LSS Commands* area. Otherwise, it will be changed accordingly when the LSS command is sent.
4. Select the bit rate that the other device is to be given.
5. Tap *Send Command*.
 - ▶ The bit rate and the node ID of the other device are changed.
6. If you have changed the bit rate of the EasyNO_x in step 1, set the EasyNO_x back to the previous bit rate in the *EasyNO_x* area, if required.

8.5 Access Control

The access control can be accessed in the menu bar via the highlighted button. Depending on the current setting, the button is labeled *Disabled*, *Locked*, *Operator*, *Service*, or *Master*.



The access control of the EasyNO_x serves to protect sensitive data and functions. When access control is disabled, there are no restrictions with the exception of the NO_x monitor views. With enabled access control (see section *Enabling/Disabling Access Control* on page 94), four access levels with different rights are available (see table below). Note that the NO_x monitor views can only be opened when access control is enabled, and you need at least the rights of the access level Operator to open these views.

| Access level | Rights |
|--|--|
| Read Only (displayed status in the menu bar: <i>Locked</i>) | <ul style="list-style-type: none"> – Switching between day and night mode – Activating and deactivating pop-ups |
| Operator | <ul style="list-style-type: none"> – Read Only rights – Access to NO_x monitor – Exporting daily log, annual log, and NO_x monitoring report to a USB flash drive – Display configuration |
| Service | <ul style="list-style-type: none"> – Operator rights – Changing preferences of the following devices: <ul style="list-style-type: none"> – NO_x monitor – I/O communication module BPlus – I/O module (device profile CiA® 401/404) – Device setup – Activating devices – Changing the node ID and the bit rate of the EasyNO_x |
| Master | <ul style="list-style-type: none"> – Service rights – Setting system time and system date – Enabling/disabling access control – Resetting all PINs – Sending LSS commands |



Access to locked functions

If you would like to access a function with enabled access control, which exceeds your currently set rights, you will be prompted to enter the PIN for the access level required in a dialog window. The required access level is displayed in the header of the dialog window respectively (e.g. *Enter Operator PIN*).

8 General Operation

8.5.1 Enabling/Disabling Access Control



Access control in as-delivered state

In as-delivered state, the access control is not enabled, and all PINs are set to 0000. After enabling the access control, assign an individual PIN for each access level including *Master* (see *Changing the PIN* on page 96).

Enabling Access Control

Enable the access control for all access levels as follows:

1. Tap the *Enable Control* button.
 - ▶ You are prompted to enter the PIN for the access level *Master*.
2. Enter the PIN for the access level *Master* and tap *OK*.
 - ▶ Access control for all access levels is enabled.
 - ▶ You are logged in as *Master*.
 - ▶ The *Logout* button is activated.
 - ▶ The *Disable Control* button is activated.

If necessary, you can log in to a different access level. Refer to the section *Logging in and Logging out* on page 95.

Disabling Access Control



Disabling access control

If the access control is not to be used for a longer period of time, we recommend that you write down the Master PIN or reset all PINs to 0000 before disabling the access control. A renewed enabling of the access control is only permitted with the Master PIN. If you have forgotten the Master PIN, you must contact MOTORTECH for a reset of all PINs (see *Resetting the PINs* on page 96).

Disable the access control for all access levels as follows:

1. Tap the *Disable Control* button.
 - ▶ You are prompted to enter the PIN for the access level *Master*.
2. Enter the PIN for the access level *Master* and tap *OK*.
 - ▶ The *Disabling Access Control* dialog window appears.

3. Observe the note in the *Disabling Access Control* dialog window. If you are certain that you want to disable the access control, answer the displayed question by tapping **Yes**.
 - ▶ Access control for all access levels is disabled.
 - ▶ In the menu bar the condition *Disabled* is displayed.
 - ▶ The buttons *Login* and *Logout* are deactivated.
 - ▶ The *Enable Control* button is activated.

8.5.2 Logging in and Logging out

With enabled access control, you can log in to the access levels *Operator*, *Service* and *Master*.

Logging in

Log in to the desired access level as follows:

1. From the drop-down list under *Access Level*, select the desired access level (*Operator*, *Service*, or *Master*).
2. Tap the *Login* button.
 - ▶ You will be prompted to enter the corresponding PIN.
3. Enter the PIN and tap **OK**.
 - ▶ You have now logged in to the desired access level and can use the associated functions.
 - ▶ The access level set is displayed in the menu bar.

Logging out



Automatic logout

You are automatically logged out of the access levels *Operator*, *Service*, or *Master*,

- if you have not entered anything for six minutes.
- if for six minutes only functions of lower access levels are used.
- if the screen saver is switched on.

The EasyNO_x is then placed on the access level *Read Only* with the displayed status *Locked*.

There are two options for logging out manually from the access levels *Operator*, *Service*, or *Master*:

Option 1:

Leave the currently set access level with the *Logout* button in the *Access Control* view.

- ▶ In the menu bar, the condition *Locked* is displayed.
- ▶ The set access level is *Read Only*.
- ▶ The *Logout* button is deactivated.
- ▶ The *Login* button is activated.

8 General Operation

Option 2:

1. From the drop-down list under *Access Level* in the *Access Control* view, select a different access level (*Operator*, *Service*, or *Master*).
2. Tap the *Login* button.
 - ▶ You will be prompted to enter the corresponding PIN.
3. Enter the PIN and tap *OK*.
 - ▶ You have now logged in to the desired access level and can use the associated functions.
 - ▶ The access level set is displayed in the menu bar.

8.5.3 Changing the PIN

Change the PIN of the access levels *Operator*, *Service*, or *Master* as follows:

1. Log in to the access level (*Operator*, *Service*, or *Master*) whose PIN you want to change (see section *Logging in and Logging out* on page 95).
2. Tap the *Change PIN* button.
 - ▶ You are prompted to enter a new PIN for the active access level.
3. Enter the new four-digit PIN and tap *OK*.
4. In the *Confirm new PIN* field, re-enter the new four-digit PIN and tap *OK*.
 - ▶ The PIN of the active access level was changed.

8.5.4 Resetting the PINs

Forgotten Operator PIN / Service PIN

If you have forgotten the PIN of the access levels *Operator* or *Service*, contact the Master. The latter can reset all PINs to the value 0000 as described in the following. Afterwards, new PINs must be assigned to all access levels.

Resetting All PINs

The authorization for the access level *Master* allows you to reset the PINs of all access levels:

1. Log in to the access level *Master* (see section *Logging in and Logging out* on page 95).
2. In the area *Master Only*, tap on *Reset All PINs*.
 - ▶ All PINs are reset to the value 0000.



Assign new PINs!

After resetting the PINs, new PINs must be assigned to all access levels to guarantee maximum security.

Master PIN Forgotten

If you have forgotten the Master PIN, you must apply for a PIN Reset Authorization Key from MOTORTECH. With this key, you can reset all PINs without authorization for the access level *Master*.

Requesting Key

Request the key from MOTORTECH as follows:

1. Tap the *Request Key* button.
 - ▶ A dialog window with the new and actual PIN Reset Request Key opens.
 - ▶ Write down the new PIN Reset Request Key (*New PRRK*) and send it to your MOTORTECH contact person.
2. Tap the *Confirm* button.
 - ▶ MOTORTECH sends you a PIN Reset Authorization Key based on *New PRRK*. Note that the PIN Reset Authorization Key is only valid for a limited period of time.

Entering Key

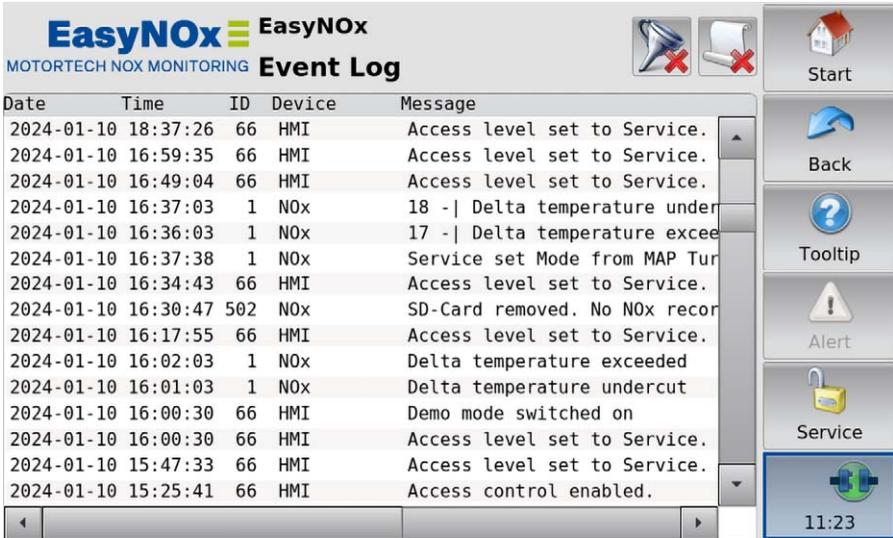
Enter the key from MOTORTECH in your EasyNO_x as follows:

1. Insert a USB flash drive on which the MOTORTECH key is stored into your EasyNO_x.
2. In the area *PIN Reset with Key*, tap the button *Reset All PINs*.
 - ▶ The storage locations available are displayed in a window.
3. Navigate to the desired PIN Reset Authorization Key (file extension *.prak*) and select it.
4. Tap the *Enter* button.
 - ▶ All PINs are reset to the value 0000.

8 General Operation

8.6 Event Log

If you tap on the status information field in the menu bar (see marking), the *Event Log* view opens. In this view you get messages concerning the EasyNOx.



| Date | Time | ID | Device | Message |
|------------|----------|-----|--------|-------------------------------|
| 2024-01-10 | 18:37:26 | 66 | HMI | Access level set to Service. |
| 2024-01-10 | 16:59:35 | 66 | HMI | Access level set to Service. |
| 2024-01-10 | 16:49:04 | 66 | HMI | Access level set to Service. |
| 2024-01-10 | 16:37:03 | 1 | NOx | 18 - Delta temperature under |
| 2024-01-10 | 16:36:03 | 1 | NOx | 17 - Delta temperature excee |
| 2024-01-10 | 16:37:38 | 1 | NOx | Service set Mode from MAP Tur |
| 2024-01-10 | 16:34:43 | 66 | HMI | Access level set to Service. |
| 2024-01-10 | 16:30:47 | 502 | NOx | SD-Card removed. No NOx recor |
| 2024-01-10 | 16:17:55 | 66 | HMI | Access level set to Service. |
| 2024-01-10 | 16:02:03 | 1 | NOx | Delta temperature exceeded |
| 2024-01-10 | 16:01:03 | 1 | NOx | Delta temperature undercut |
| 2024-01-10 | 16:00:30 | 66 | HMI | Demo mode switched on |
| 2024-01-10 | 16:00:30 | 66 | HMI | Access level set to Service. |
| 2024-01-10 | 15:47:33 | 66 | HMI | Access level set to Service. |
| 2024-01-10 | 15:25:41 | 66 | HMI | Access control enabled. |

The following data is displayed: date (YYYY-MM-DD) and time (hh:mm:ss) of the entry, node ID or internal sequential number of the device, device name, and the accompanying message. The abbreviation *HMI* represents the EasyNOx. A maximum of 1,000 messages are displayed and stored. Older messages are deleted.

In the title area, two buttons are displayed. The symbols on the buttons change depending on their setting and are described in the following.

Filter Button

The button's appearance has the following meaning:



No filters are active. All entries are displayed.



Filters are active. Only certain entries are displayed.

To set or change filters, tap the *Filter* button. The *Filter Settings* dialog window appears. Select time and node IDs of the entries you want to display. If you select none of the listed node IDs, the entries of all listed node IDs are displayed. Confirm your selection with *OK*. Tap *Clear* to reset the filters.

Automatic Scrolling Button

The button's appearance has the following meaning:



Automatic scrolling is inactive.



Automatic scrolling is active.

To activate and deactivate automatic scrolling, tap the *Automatic Scrolling* button. When the function is activated, the EasyNO_x scrolls automatically to newly registered entries.

You have the following options for navigating in the list:

- Tap in the list and drag the displayed list section in the desired direction.
- Double-tap in a border area of the list (top, bottom, left, right) to jump to the end of that border area.
- Tap and hold in a border area of the list (top, bottom, left, right) to scroll in the desired direction.
- Move one of the scroll bars to scroll in the desired direction.

8.7 Help

You can access the operating manual of the EasyNO_x as follows:

- *Help* button in *Start Menu*
- *Help* button in the *NO_x Main Menu* view of an added NO_x monitor
- *Help* button in the *Main Menu* of an added I/O communication module BPlus or I/O module

In the browser, tap on the appropriate links, and then use the bars on the right side of the screen to scroll and the buttons for navigation:

- **Start**
Use this button to go to the first page of the operating manual.
- **Back**
Use this button to go to the previously displayed page of the operating manual.
- **Close**
Use this button to exit the Help menu.

9 Devices

This chapter describes the device menus of the devices that can be added in the EasyNO_x.

Information about adding devices can be found in the section *Devices* on page 79.

You can access the device menus of added devices via the corresponding buttons in the *Start Menu*.

9.1 NO_x Monitoring



NO_x monitor: enable access control

The views of the NO_x monitor can only be opened when access control is enabled. In order to open these views, you need at least the rights of the access level *Operator*. For more information, read the section *Access Control* on page 92.



Automatic exit from NO_x monitor

If you do not make any entries for 6 minutes or the screen saver switches on, the views of the NO_x monitor are automatically exited, and the access level is set to *Read Only* (displayed state in the menu bar *Locked*).

This section describes the functions and views of an added NO_x monitor.

9.1.1 Main Menu

The main menu of an added NO_x monitor can be opened in the start menu via the NO_x button.



The main menu has the following buttons:

- [Overview](#)
The button provides information about the current status of the NO_x monitor and provides access to the current trend of measured values. There is more information in the section *Overview* on page 102.
- [History](#)
The button can be used to display the trends of selected measured values for each day from the daily logs. There is more information in the section *History* on page 106.
- [Logbook](#)
The button provides access to the logbook of the NO_x monitor. There is more information in the section *Logbook* on page 108.
- [Export](#)
The button provides access to the export function of the NO_x monitor, which allows you to export the daily and annual logs logged by the NO_x monitor as well as the NO_x monitoring report including the logbook to a USB flash drive. There is more information in the section *Export* on page 110.
- [Preferences](#)
The button provides access to the settings of the NO_x monitor. There is more information in the section *Preferences* on page 112.
- [Operator](#)
Use the button to specify the operator information for the NO monitoring report of the NO_x monitor. The information specified here applies to both NO_x monitors of the EasyNO_x. There is more information in the section *Operator* on page 116.

9 Devices

- **Sensor**
The button gives you access to the status information from the NO_x sensor of the connected CAN bus/NO_x sensor module. There is more information in the section *Sensor* on page 117.
- **Help**
This button opens the operating manual of the EasyNO_x. There is more information in the section *Help* on page 99.

9.1.2 Overview

The *Overview* button in the main menu of an added NO_x monitor opens the following views:

- *NO_x Monitoring*
- *NO_x Trends*

The  and  buttons allow you to switch between the views.

The views are described as follows.

NO_x Monitoring



This view displays the current status of the NO_x monitor. The view varies depending on the set NO_x monitoring mode. The various parameters of the NO_x monitor can be set in the *NO_x Setup* view (see section *Preferences* on page 112). If one of the entries shows the value A, the value is outside of the specified range.

The following information is provided:

- **Dew Point**
The blue status display shows that the temperature in the exhaust pipe at the catalyst outlet is above the dew point of the NO_x sensor. For thermocouple layout *Two After Cat* (see *Preferences* on page 112), this condition must be met in both exhaust gas lines.
- **Normal Operation**
The green status display shows that normal operation is detected.
- **24h Average**
This entry shows the provisional daily average of the nitrogen oxide readings since 00:00:00 hrs CET (UTC+1) of the current day converted according to VDMA 6299:2019-09. If the entry is grayed, the conditions for averaging are not met.
- **Trend**
The status display indicates that the provisional daily average of the nitrogen oxide concentration exceeds certain thresholds. In parallel, the NO_x monitor signals the threshold exceedance correspondingly via the binary outputs *Warning* and *Error* of the EasyNO_x (see section *Devices* on page 79).
 - Red: The provisional daily average currently exceeds the configured level limit. The NO_x monitor has switched the binary output *Error* of the EasyNO_x.
 - Yellow: The provisional daily average currently exceeds the configured warning threshold. The NO_x monitor has switched the binary output *Warning* of the EasyNO_x.
 - Gray: The provisional daily average currently does not exceed any of the configured thresholds. The binary outputs *Warning* and *Error* of the EasyNO_x are not switched by the NO_x monitor.
- **Δ Temperature**
This entry shows the current temperature difference of the exhaust gas between the catalyst inlet and outlet. The entry is available if the layout *Before & After Cat* is set for exhaust gas temperature monitoring in the EasyNO_x (see section *Preferences* on page 112). The temperature at the catalyst inlet is subtracted from the temperature at the catalyst outlet. The background colors of the entry have the following meaning:
 - Red: The configured temperature difference maximum is exceeded.
 - Blue: The configured temperature difference minimum is undercut.
 - White (day mode) or black (night mode): The current temperature difference is within the configured permissible range.
- **Nitrogen Oxide Reading Display (Analog)**
 - Red pointer
During normal operation display of the current nitrogen oxide reading converted according to VDMA 6299:2019-09 (see section *Conversion of Nitrogen Oxide Readings* on page 44)
 - Blue pointer
Display of the provisional daily average of the nitrogen oxide readings since 00:00:00 hrs CET (UTC+1) of the current day converted according to VDMA 6299:2019-09 as soon as valid nitrogen oxide readings are available in normal operation.
- **Nitrogen Oxide Reading Display (Digital)**
In normal operation display of the current nitrogen oxide reading converted according to VDMA 6299:2019-09

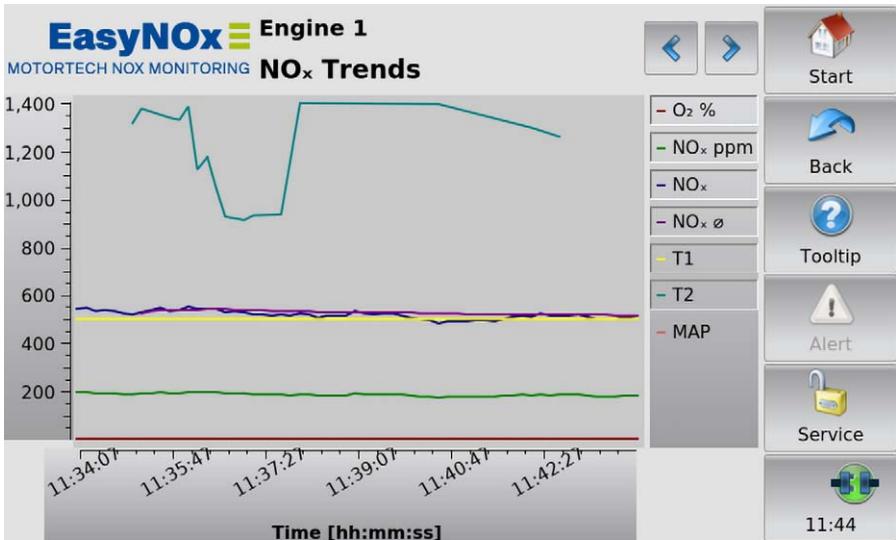
9 Devices

- **T1, T2**
Display of the currently measured exhaust gas temperature at the designated measuring points (see section *Installation Locations of Thermocouples* on page 57). *T2* is not available if the layout *One After Cat* is set for exhaust gas temperature monitoring in the EasyNO_x (see section *Preferences* on page 112). The background colors of the entry have the following meaning:
 - Red: The configured overtemperature has been exceeded at the respective measuring point.
 - White (day mode) or black (night mode): The currently measured exhaust gas temperature is below the configured overtemperature at the respective measuring point.
 - Purple: The measured value is not transmitted via the CAN bus.
- **MAP / Load / In 3**
The displayed entry depends on the selected monitoring mode. If the background of the respective entry is purple, the measured value is not transmitted via the CAN bus.
 - **MAP**
This entry is displayed in the NO_x monitoring modes *MAP Naturally Aspirated* and *MAP Turbo* and shows the current manifold pressure measured via input 3 of the respective CAN bus module.
 - **Load**
This entry is displayed in the NO_x monitoring modes *Load on CAN Module* and *Load via CANopen* and shows the current load signalled via the respective analog input.
 - **In 3**
This entry is displayed in the NO_x monitoring modes *Off*, *Recording Only*, and *Start/Stop via CANopen* and shows the current input current at input 3 of the respective CAN bus module.
- **In 4**
This entry shows the current input current at input 4 of the respective CAN bus module. If the background of the entry is purple, the measured value is not transmitted via the CAN bus.
- **NO_x**
Display of the current nitrogen oxide reading from the connected NO_x sensor. If the background of the entry is purple, the measured value is not transmitted via the CAN bus.
- **O₂**
Displays the current oxygen reading from the connected NO_x sensor. If the background of the entry is purple, the measured value is not transmitted via the CAN bus.
- **Op**
Displays the normal operation hours registered so far by the NO_x monitor for the current calendar year. The normal operation hours are registered to the second and rounded down to the hour in the display.

- Alm (Alarm)

Failure hour counter, which shows the number of hours that the daily average of the NO_x concentration has been above the configured level limit in the current calendar year so far (see section *Failure Hour Counter* on page 45). The failure hours are registered to the second and rounded down to the hour in the display. The background colors of the entry have the following meaning:

- Red: The configured time limit of the failure hour counter is exceeded.
- Yellow: The configured warning threshold of the failure hour counter is exceeded.
- White (day mode) or black (night mode): None of the configured thresholds is exceeded.

NO_x Trends

In the NO_x Trends view, you get information about the current trend of the measured values and the provisional nitrogen oxide daily average for the last 10 minutes. You can hide or show individual trends by using the legend.

The following trends are displayed:

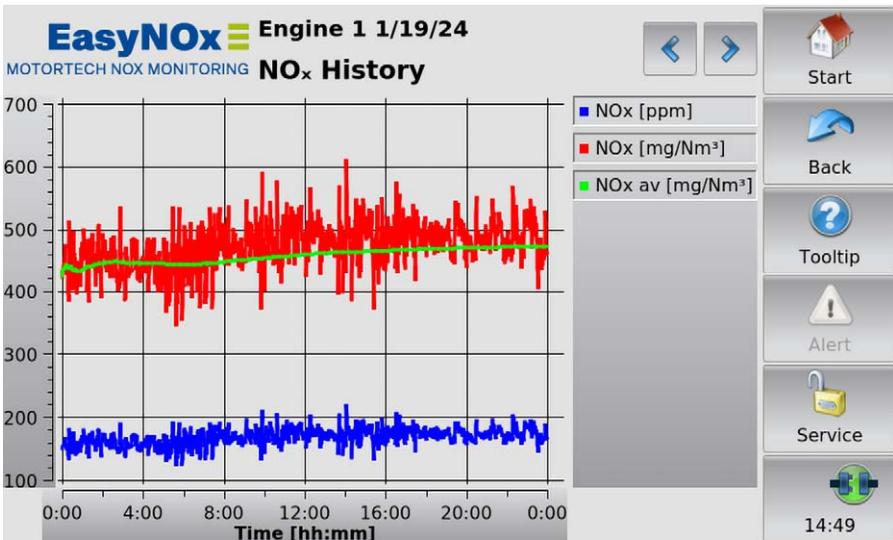
- O₂ %
Trend of the oxygen reading from the connected NO_x sensor
- NO_x ppm
Trend of the nitrogen oxide reading from the connected NO_x sensor
- NO_x
Trend of the nitrogen oxide reading converted according to VDMA 6299:2019-09 (see section *Conversion of Nitrogen Oxide Readings* on page 44) in mg/Nm³

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- **NO_x ø**
Trend of the provisional daily average of the nitrogen oxide readings since 00:00:00 hrs CET (UTC+1) of the current day converted according to VDMA 6299:2019-09 in mg/Nm³
- **T1, T2**
Trend of the measured exhaust gas temperatures at the designated measuring points (see section *Installation Locations of Thermocouples* on page 57)
- **MAP / Load / ---**
The displayed trend depends on the selected monitoring mode. *MAP* displays the trend of the measured manifold pressure in the NO_x monitoring modes *MAP Naturally Aspirated* and *MAP Turbo*, *Load* the trend of the signalled load in the NO_x monitoring modes *Load on CAN Module* and *Load via CANopen*. Three dashes (---) appear in the NO_x monitoring modes *Off*, *Recording Only*, and *Start/Stop via CANopen*, and no trend is displayed.

9.1.3 History

The *History* button in the main menu of an added NO_x monitor opens the *NO_x History* view.



In this view, you can display the trends of selected measured values for each day from the daily logs.

The  and  buttons allow you to switch between the days.

You can hide or show individual trends in the view by using the legend.

Three parameter groups are available. Tap into the trend graph to select the desired group.

Depending on the selected parameter group, the following trends are displayed:

| Parameter group | Parameters | Description |
|-----------------|--|--|
| NO _x | NO _x [ppm] | Daily trend of the nitrogen oxide reading from the connected NO _x sensor |
| | NO _x [mg/Nm ³] | Daily trend of the nitrogen oxide reading converted according to VDMA 6299:2019-09 (see <i>Conversion of Nitrogen Oxide Readings</i> on page 44) |
| | NO _x av [mg/Nm ³] | Daily trend of the provisional daily average of the nitrogen oxide readings converted according to VDMA 6299:2019-09 |
| Temperature | T1 [°C] | Daily trend of the measured exhaust gas temperature at measuring point T1 (see <i>Installation Locations of Thermocouples</i> on page 57) |
| | T2 [°C] | Daily trend of the measured exhaust gas temperature at measuring point T2 |
| Current | In3 [mA] | Daily trend of the measured input current at input 3 of the respective CAN bus module |
| | In4 [mA] | Daily trend of the measured input current at input 4 of the respective CAN bus module |

9 Devices

9.1.4 Logbook

The *Logbook* button in the main menu of an added NO_x monitor opens the *Logbook* view. In the logbook, the EasyNO_x logs events from the respective NO_x monitor. You can also create custom entries in the logbook. The logbook can be maintained in accordance with standard sheet VDMA 6299:2019-09.

| Date | Time | Category | Message |
|------------|----------|-------------|------------------------------------|
| 2024-01-26 | 11:54:17 | ALARM | Delta temperature exceeded |
| 2024-01-26 | 11:54:17 | ALARM | Temperature 2 exceeded |
| 2024-01-26 | 11:54:11 | ALARM | Delta temperature undercut |
| 2024-01-26 | 11:54:07 | ALARM | Delta temperature exceeded |
| 2024-01-26 | 11:54:07 | ALARM | Temperature 2 exceeded |
| 2024-01-26 | 11:54:05 | ALARM | Temperature 2 undercut |
| 2024-01-26 | 11:53:35 | ALARM | Delta temperature undercut |
| 2024-01-26 | 11:53:31 | ALARM | Delta temperature exceeded |
| 2024-01-26 | 11:53:31 | ALARM | Temperature 2 exceeded |
| 2024-01-26 | 11:52:17 | CONFIGURATI | Service set NOx Warning from 500 t |
| 2024-01-26 | 11:30:56 | CONFIGURATI | Service set Sensor Layout from Bef |
| 2024-01-26 | 11:30:54 | CONFIGURATI | Service set Mode Limit from 800 to |
| 2024-01-26 | 11:30:52 | CONFIGURATI | Service set Mode from MAP Naturall |
| 2024-01-26 | 11:30:52 | CONFIGURATI | Service set Scaling Max. from 3007 |
| 2024-01-26 | 11:30:42 | CONFIGURATI | Service set Mode Limit from 1400 t |

For each entry the date (YYYY-MM-DD), time (hh:mm:ss), category, and the related message are displayed. Note that this view is continuously updated and displays at most the last 1,000 entries, although the logbook may contain more entries. To display older entries, you can filter the period to be displayed (see section *Filter Button* below).

In the title area, three buttons are displayed. The symbols on the middle and right button change depending on their settings. The buttons are described as follows.

Custom Entry Button

To add custom entries to the logbook, tap the following button:



The dialog window *Add Entry to Logbook* appears.

First, specify the creator of the logbook entry under *Name/Organization*. Then under *Measure*, use the drop-down list to select the type of measure (e.g. Service, Faults, Maintenance) the logbook entry is. The selection made here determines the available entries under *Event*. Then under *Event*, select the relevant event from the drop-down list (e.g. Regular engine maintenance performed, Engine/generator/cooling defective). If necessary, you can enter additional information about the logbook entry under *Description*. To save your logbook entry, tap on *OK*. To discard the logbook entry, tap on *Cancel*.



Events with lock icon

Events marked with a lock icon  cannot be entered in the logbook with the rights of your access level. If you select such an event, you will be prompted to log in to the required access level.

Filter Button

The button's appearance has the following meaning:



No filters are active. Continuously updated, the last 1,000 entries are displayed.



Filters are active. Up to 1,000 entries are displayed according to the set filters.

To filter the logbook entries, tap the *Filter* button. The dialog window *Logbook Filter* appears.

Select the period and the categories of the entries to be displayed. Regard any dialog messages that you may get when setting the filters. Confirm your selection with *OK*.

Automatic Scrolling Button

The button's appearance has the following meaning:



Automatic scrolling is inactive.



Automatic scrolling is active.

To activate and deactivate automatic scrolling, tap the *Automatic Scrolling* button. When the function is activated, the EasyNO_x scrolls automatically to newly registered entries.

9 Devices

You have the following options for navigating in the list:

- Tap in the list and drag the displayed list section in the desired direction.
- Double-tap in a border area of the list (top, bottom, left, right) to jump to the end of that border area.
- Tap and hold in a border area of the list (top, bottom, left, right) to scroll in the desired direction.
- Move one of the scroll bars to scroll in the desired direction.

9.1.5 Export

The *Export* button in the main menu of an added NO_x monitor opens the *NO_x Export* view.

EasyNOx Engine 1
MOTORTECH NO_x MONITORING **NO_x Export**

| | | | | | | |
|----------|----------|----------|----------|----------|----------|---------|
| 2/21/23 | 6/13/23 | 6/14/23 | 6/15/23 | 6/28/23 | 7/5/23 | 7/10/23 |
| 7/12/23 | 7/26/23 | 7/27/23 | 8/1/23 | 8/3/23 | 8/4/23 | 8/14/23 |
| 8/22/23 | 9/8/23 | 9/25/23 | 9/26/23 | 10/4/23 | 10/5/23 | 10/6/23 |
| 10/9/23 | 10/11/23 | 10/12/23 | 10/15/23 | 10/18/23 | 10/22/23 | |
| 10/23/23 | 10/24/23 | 10/25/23 | 10/26/23 | 10/27/23 | 11/6/23 | |
| 11/10/23 | 11/16/23 | 11/17/23 | 11/22/23 | 11/23/23 | 11/27/23 | |
| 11/28/23 | 11/30/23 | 12/1/23 | 12/4/23 | 12/6/23 | 12/7/23 | 12/8/23 |
| 12/12/23 | 12/21/23 | 2023 | | | | |

Copy CSV Export Report Up Abort

0%

Start
Back
Tooltip
Alert
Service
12:15

From this view, you can copy daily and annual logs of the NO_x monitor (see section *Daily Log* on page 47 and section *Annual Log* on page 47) and the NO_x monitoring report including the logbook (see section *NO_x Monitoring Report* on page 48) to a USB flash drive inserted in the EasyNO_x.

The file overview shows you the logs available on the device. Move the scroll bar to scroll up or down when necessary. Select the desired calendar year via the respective year number in blue letters. Select the desired daily log via the respective date in black letters. Select the annual log via the year number in green letters.

When copying to the USB flash drive, the progress bar below the buttons shows the copying progress and other information about the copying process.

You have the following options:

- **Copy**
This function is available for service purposes and creates a 1:1 copy of the desired log on the USB flash drive. This 1:1 copy cannot be read or processed by other devices.

- **CSV Export**
Mark the desired log (daily or annual) and use the button to create a copy of the log as a CSV file on the USB flash drive. On a PC, the CSV file can be opened with an editor, for example, or further processed with a spreadsheet. The CSV file is saved in the following format:
 - Character set: UTF-8
 - Separator: Tab
 - Decimal separator: Dot
- **Report**
Use this button to create a NO_x monitoring report for the selected calendar year as a PDF file on the USB flash drive. This monitoring report also includes the logbook along with other summarizing information. The operator information contained in the NO_x monitoring report can be specified in the *Information on Operator* view (see section *Operator* on page 116).
- **Up**
Use this button to return to the calendar year selection in the file overview.
- **Abort**
Use this button to cancel an ongoing copying process to the USB flash drive.

With the rights of the access level *Master*, the EasyNO_x additionally displays the following button in this view:



Loss of your NO_x monitor's data integrity!

The functions available via the *More* button are designed exclusively for service purposes and may only be triggered by MOTORTECH service or upon instruction from MOTORTECH. If you do not observe this notice, you risk the data integrity of your NO_x monitor. In such a case, contact your MOTORTECH contact person (see *Customer Service Information* on page 134).

The functions available via this button may only be triggered by MOTORTECH service or upon instruction from MOTORTECH. In addition, observe the preceding notice.

9 Devices

9.1.6 Preferences

The *Preferences* button in the main menu of an added NO_x monitor opens the NO_x Setup view.

EasyNOx **Engine 1**
MOTORTECH NO_x MONITORING **NO_x Setup**

Mode: MAP Naturally Aspir

Scaling Min.: 0 mbar

Scaling Max.: 3000 mbar

MAP <: 800 mbar

K: 0.2

KNO₂: 0.8

Level Limit: 600 mg/Nm³

Level Warning: 500 mg/Nm³

Time Limit: 400 h

Time Warning: 350 h

Name: Engine 1

Serial Number: 140253

Layout: Before & After

Overtemperature 1: 580 °C

Undertemperature 1: 250 °C

Overtemperature 2: 590 °C

Undertemperature 2: 250 °C

Min. Δ Temperature: -20 K

Max. Δ Temperature: 20 K

Output NO_x Min.: 100 mg/Nm³

Output NO_x Max.: 1005 mg/Nm³

Start

Back

Tooltip

Alert

Service

10:46

Note that changes in this view are not saved and applied by the NO_x monitor until you exit the view. Also note that you can only edit the NO_x monitoring parameters after you have entered the serial number of the engine to be monitored under *Serial Number*.

You can make the following settings:

- **Mode**
Use the drop-down list to set the NO_x monitoring mode:
 - **Off**
NO_x monitoring is disabled. The nitrogen oxide and oxygen readings from the NO_x sensor are not recorded. This mode must be set in the respective NO_x monitor if you want to delete it from the device configuration (see section *Deleting a Device* on page 86).
 - **Recording Only**
The nitrogen oxide and oxygen readings from the NO_x sensor are recorded, but NO_x monitoring is deactivated.
 - **MAP Naturally Aspirated**
For normal operation detection of the NO_x monitor, the manifold pressure of a naturally aspirated engine serves as an indicator for the engine load. For this purpose, a pressure sensor must be connected to input 3 of the respective CAN bus module (see *Wiring of Pressure Sensor, Pressure Signal, Load Signal* on page 65).
 - **MAP Turbo**
For normal operation detection of the NO_x monitor, the manifold pressure of a turbo engine serves as an indicator for the engine load. For this purpose, a pressure sensor must be connected to input 3 of the respective CAN bus module (see *Wiring of Pressure Sensor, Pressure Signal, Load Signal* on page 65).

- **Load on CAN Module**
The NO_x monitor detects normal operation by means of the load signal connected to input 3 of the respective CAN bus module (see *Wiring of Pressure Sensor, Pressure Signal, Load Signal* on page 65).
- **Load via CANopen**
The NO_x monitor detects normal operation by means of the load signal connected to the analog input of the I/O communication module BPlus or an I/O module. For this purpose, the function *Load Input for NO_x* must be assigned to the analog input of the respective I/O module (see *Analog Inputs* on page 126).
- **Start/Stop via CANopen**
The NO_x monitor receives the normal operation release from the master control via a binary signal connected to the binary input of the I/O communication module BPlus or an I/O module. For this purpose, the function *Normal Operation Release for NO_x* must be assigned to the binary input of the respective I/O communication module (see *Binary Inputs* on page 124).
- **Scaling Min., Scaling Max.**
Via these entries you can specify the measuring value range of the pressure sensor in the NO_x monitoring modes *MAP Naturally Aspirated* and *MAP Turbo*. Under *Scaling Min.*, enter the measured value of the sensor at 4 mA and under *Scaling Max.* at 20 mA. The values in-between are interpolated linearly.
- **MAP < / MAP > / Last / ---**
The entry displayed at this point depends on the set NO_x monitoring mode:
 - **MAP <**
In the NO_x monitoring mode *MAP Naturally Aspirated* you set the manifold pressure which must be undercut for normal operation detection (see *Determining Manifold Pressure for Normal Operation Detection* on page 59).
 - **MAP >**
In the NO_x monitoring mode *MAP Turbo*, you set the manifold pressure which must be exceeded for normal operation detection (see *Determining Manifold Pressure for Normal Operation Detection* on page 59).
 - **Load**
In the NO_x monitoring modes *Load on CAN Module* and *Load via CANopen*, you specify the load that indicates the beginning of normal operation of your engine (for example 30 % nominal load as per VDMA 6299:2019-09 or as per the engine manufacturer's specifications).
 - **---**
In NO_x monitoring modes *Off* and *Recording Only*, normal operation detection is disabled. In the NO_x monitoring mode *Start/Stop via CANopen*, the NO_x monitor receives the normal operation release from the master control.
- **K**
Enter the NO₂/NO_x ratio of the exhaust gas from your system. The NO₂/NO_x ratio must be determined at the mounting position of the NO_x sensor's sensing element before start-up of NO_x monitoring and each time the NO_x sensor is replaced. More information on this is available in the section *Determining the NO₂/ NO_x Ratio* on page 57.

9 Devices

- **KNO₂**
Enter the factor for the corrective calculation of the NO_x sensor's NO₂ sensitivity. For the correction factor, refer to the entry *NO₂ Gain* in the *NO_x Sensor* view (see section *Sensor* on page 117).
- **Level Limit**
Enter the daily average of the NO_x concentration, which must not be exceeded under any circumstances. To use the NO_x monitoring of the EasyNO_x in accordance with standard sheet VDMA 6299:2019-09, enter here the daily average at which an alarm should be triggered. If the daily average exceeds the level limit at the end of a day, the detected normal operation hours are added to the failure hour counter of the ongoing calendar year to the second. The change of day is firmly preset to 00:00:00 hrs Central European Time (CET) or UTC+1.
- **Level Warning**
Below the configured *Level Limit*, specify a daily average of the NO_x concentration above which the EasyNO_x will issue a warning. The *Level Warning* daily average serves to indicate that the daily average is approaching the configured level limit. As a warning threshold, you can specify your currently valid plant-specific limit value.
- **Time Limit**
For the failure hour counter of the NO_x monitor, specify the number of hours that the NO_x concentration may exceed the configured level limit as a maximum within one calendar year. If this number of hours is exceeded, the EasyNO_x indicates this in the *NO_x Monitoring* view via a red status display in the failure hour counter *Alm*.
- **Time Warning**
For the failure hour counter of the NO_x monitor, specify a warning threshold to indicate that the failure hour counter is approaching the configured *Time Limit*. If this warning threshold is exceeded, the EasyNO_x indicates this in the *NO_x Monitoring* view via a yellow status display in the failure hour counter *Alm*.
- **Name**
Enter a custom name for the engine to be monitored. This name is displayed in the title area in all views of the respective NO_x monitor.
- **Serial Number**
Enter the serial number of the engine to be monitored. This field is mandatory.
- **Layout**
Use the drop-down list to set the layout of the thermocouples (see *Installation Locations of Thermocouples* on page 57):
 - **Before & After Cat**
One thermocouple respectively measures the exhaust gas temperature before and after the catalytic converter.
 - **One After Cat**
One thermocouple measures the exhaust gas temperature after the catalytic converter.
 - **Two After Cat**
In engines with two exhaust gas lines, one thermocouple after each catalytic converter measures the exhaust gas temperature.
- **Overtemperature 1 / 2**
Specify respectively the exhaust gas temperature which must not be exceeded in the exhaust pipe at the corresponding measuring point (1 = T1, 2 = T2).

- **Undertemperature 1 / 2**
Specify respectively the exhaust gas temperature which must not be undercut in the exhaust pipe at the corresponding measuring point (1= T1, 2= T2).
- **Min. Δ Temperature, Max. Δ Temperature**
If you have selected the layout *Before & After Cat* for exhaust gas temperature monitoring, you must also specify the permissible temperature difference range of the exhaust gas between the catalyst inlet and outlet. A positive temperature difference stands for a correspondingly higher temperature at the outlet compared to the inlet. A negative temperature difference stands for a correspondingly lower temperature at the outlet compared to the inlet.
- **Output NO_x Min., Output NO_x Max.**
Specify the value range that is output by the EasyNO_x at an analog output for the currently measured nitrogen oxide reading (assigned function *Actual NO_x from NOx1 / NOx2*) and for the provisional daily average (assigned function *Average NO_x from NOx1 / NOx2*).

With the rights of the access level *Master*, the EasyNO_x additionally displays the following drop-down list in the title area of this view:

Simulation Off ▾



Risk of burning! Risk of destruction!

The simulation function of the NO_x monitor must always be set to *Simulation Off*, otherwise there is a risk of people getting burned on components of the plant or components of your system being destroyed.



Loss of your NO_x monitor's data integrity!

The simulation function of the NO_x monitor must always be set to *Simulation Off*. In case of a deviating setting, the NO_x monitor loses its data integrity! In such a case, contact your MOTORTECH contact person (see *Customer Service Information* on page 134) immediately.

This list field is protected by a special PIN, allows a simulation of the NO_x monitor, and may only be changed by MOTORTECH service. In addition, observe the preceding notices.

9 Devices

9.1.7 Operator

The *Operator* button in the main menu of an added NO_x monitor opens the *Information on Operator* view.

| EasyNO _x  Engine 1 | |  |
|--|--|---|
| MOTORTECH NO _x MONITORING | | Start |
| Owner/Operator | <input type="text" value="Company"/> |  |
| Contact | <input type="text" value="Jane Doe"/> | Back |
| Street | <input type="text" value="5 Main Street"/> |  |
| Postal Code | <input type="text" value="E1 7DP"/> | Tooltip |
| City | <input type="text" value="London"/> |  |
| Site | <input type="text" value="CHP"/> | Alert |
| | |  |
| | | Service |
| | |  |
| | | 10:24 |

In this view, specify the information about the operator of the NO_x monitor. The operator information stored here is valid for both NO_x monitors of the EasyNO_x and is included correspondingly in the NO_x monitoring report, which can be exported to a USB flash drive using the export function of the respective NO_x monitor (see section *Export* on page 110).

9.1.8 Sensor

The *Sensor* button in the main menu of an added NO_x monitor opens the NO_x Sensor view.

| EasyNOx  Engine 1 | | MOTORTECH NOx MONITORING NO _x Sensor P/N 56.03.003 | | Start  | |
|--|---------------------------|---|--------|---|--|
| NO _x [ppm] | 185 | Heater Ratio | 0 | Back  | |
| OK | OK | NO _x Gain [%] | 0 | Tooltip  | |
| O ₂ [%] | 5.47 | NO _x Offset [ppm] | 0 | Alert  | |
| OK | OK | Operating Hours | 252 10 | Service  | |
| Heater | Auto | O ₂ p Gain [%/bar] | 0.51 | 10:24  | |
| OK | OK | NO _x p Gain [%/bar] | 0.1 | | |
| Power | OK | NO ₂ Gain | 0.85 | | |
| Diagnosis | Not Activ | NH ₃ Gain | 1.1 | | |
| Software | Z597 99 01 | Self-Diagnosis | 255 | | |
| ECU ID | 2267220397 0000002135 24V | | | | |

In this view, status information from the NO_x sensor of the connected CAN bus/NO_x sensor module is displayed. The type of NO_x sensor (P/N 56.03.003 or P/N 56.03.002) is retrieved when the view is called up and is displayed in the name of the view. If one of the entries shows the value A, the value is outside of the specified range.

The following information is provided:

- **NO_x [ppm]**
In the field to the right of the entry, the current nitrogen oxide reading is displayed. The left field below the entry displays whether the current reading is valid, there is an error, there is no connection to the NO_x sensor, or the NO_x sensor has not yet determined a measured value (for example, if the dew point has not yet been reached). In case of an error, an error message or an error code is displayed in the right field below the entry.
- **O₂ [%]**
In the field to the right of the entry, the current oxygen reading is displayed. The left field below the entry displays whether the current reading is valid, there is an error, there is no connection to the NO_x sensor, or the NO_x sensor has not yet determined a measured value (for example, if the dew point has not yet been reached). In case of an error, an error message or an error code is displayed in the right field below the entry.
- **Heater**
In the field to the right of the entry, the current mode of the sensing element heater of the NO_x sensor is displayed. The left field below the entry displays whether the sensing element is at operating temperature, there is an error, there is no connection to the NO_x sensor, or the status is not available. In case of an error, an error message or an error code is displayed in the right field below the entry.

9 Devices

- **Power**
Display of the current status of the supply voltage applied to the NO_x sensor.
- **Diagnosis**
Display of the current status of the NO_x sensor's self-diagnosis
- **Software**
Display of the software identification data of the NO_x sensor
- **ECU ID**
Display of the ECU identification data of the NO_x sensor consisting of ECU part number, ECU serial number, and ECU voltage type
- **Heater Ratio**
With NO_x sensor P/N 56.03.002, this entry displays the current heater ratio of the resistance heater that is embedded in the sensing element of the NO_x sensor. This value is not determined by NO_x sensor P/N 56.03.003.
- **NO_x Gain [%]**
Display of the current NO_x gain of the new part deviation
- **NO_x Offset [ppm]**
Display of the current NO_x offset of the new part deviation
- **Operating Hours**
Display of the total operating hours of the NO_x sensor, counted from dew point release. Observe that the NO_x sensor must be replaced when its service life has been reached. For more information on this, refer to the section *Replacing the NO_x Sensor* on page 136.
- **O₂ p Gain [%/bar] / $\alpha(\lambda)$ [bar]**
The displayed entry depends on the connected NO_x sensor.
 - NO_x sensor P/N 56.03.003: **O₂ p Gain [%/bar]**
Display of O₂ correction factor
 - NO_x sensor P/N 56.03.002: **$\alpha(\lambda)$ [bar]**
Display of the pressure correction constant of the linear lambda signal
- **NO_x p Gain [%/bar] / $\alpha(\text{NO}_x)$ [bar]**
The displayed entry depends on the connected NO_x sensor.
 - NO_x sensor P/N 56.03.003: **NO_x p Gain [%/bar]**
Display of NO_x correction factor
 - NO_x sensor P/N 56.03.002: **$\alpha(\text{NO}_x)$ [bar]**
Display of the pressure correction constant of the NO_x signal
- **NO₂ Gain**
Display of the factor for the corrective calculation of the NO₂ sensitivity. Enter the value displayed here in the NO_x Setup view as NO₂ correction factor in the entry KNO₂ (see section *Preferences* on page 112).
- **NH₃ Gain**
Display of the factor for the corrective calculation of the NH₃ sensitivity
- **Self-Diagnosis**
Final result of the NO_x sensor's self-diagnosis displayed as a ratio to the reference value defined by the manufacturer

9.2 I/O Communication Module BPlus, I/O Module (CiA401, CiA404)

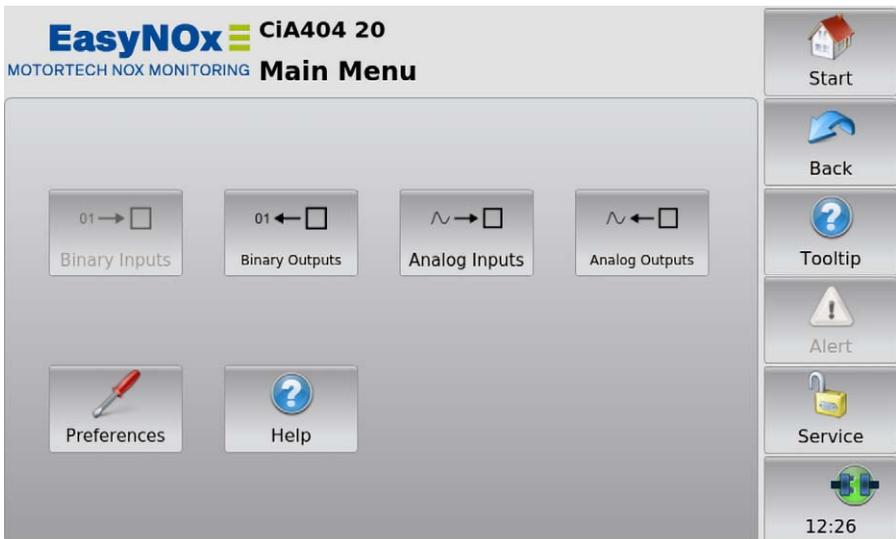
This section uses the example of an I/O module supporting device profile CiA® 404 to describe the functions and views of the I/O communication module BPlus specially available from MOTORTECH and of an I/O module supporting device profile CiA® 401.

The number of available analog and binary inputs and outputs depends on the respective I/O module to which the EasyNO_x is connected via the CAN bus interface CAN1. For the I/O communication module BPlus, you can find this information in the section *I/O Communication Module BPlus* on page 49.

Also observe the node ID that is set for the module in the EasyNO_x and displayed behind the device name in the module's views. It must match the node ID of the respective module.

9.2.1 Main Menu

The main menu of an added I/O communication module BPlus or I/O module supporting device profile CiA® 401 or CiA® 404 can be opened in the *Start Menu* via the respective button (*BPlus*, *CiA401*, or *CiA404*).



If a specific input or output type is not available with the I/O module, the respective button is grayed out.

The main menu has the following buttons:

- **Binary Inputs**
The button opens the *Binary Inputs* view. In this view, a green status display in the *Status* column shows that the corresponding binary input in the *Channel* column is closed (see illustration example binary outputs below). In the *Function* column, the view displays the function that you have assigned to the channel. For an explanation of the function and for assigning the channel a function, read the section *Binary Inputs* on page 124.

9 Devices

– Binary Outputs

The button opens the *Binary Outputs* view. In this view, a green status display in the *Status* column shows that the corresponding binary output in the *Channel* column is switched. In the *Function* column, the view displays the function that you have assigned to the channel. For an explanation of the function and for assigning the channel a function, read the section *Binary Outputs* on page 125. You can switch binary outputs that are not linked to any function (displayed as ---) for test purposes (see section *Testing of Outputs* on page 121).

Illustration example binary outputs

| Channel | Status | Linked to Function | Test |
|---------|--------|-----------------------------|--------------------------|
| 1 | | Cat. Temperature Error NOx1 | |
| 2 | | NOx Exceedance NOx1 | |
| 3 | | --- | <input type="checkbox"/> |

– Analog Inputs

The button opens the *Analog Inputs* view. In this view, the incoming signal that is present at the corresponding analog input in the *Channel* column is displayed in the *Value* column (see illustration example analog outputs below). In the *Function* column, the view displays the function that you have assigned to the channel. For an explanation of the function and for assigning the channel a function, read the section *Analog Inputs* on page 126. If an I/O module supporting device profile CiA® 404 is configured and connected to the EasyNO_x, the EasyNO_x displays the respective value in the *Value* column with unit. With the I/O communication module BPlus and with an I/O module supporting device profile CiA® 401, the EasyNO_x displays the respective raw value.

– Analog Outputs

The button opens the *Analog Outputs* view. In this view, the outgoing signal that is output by the I/O module at the corresponding analog output in the *Channel* column is displayed in the *Value* column. In the *Function* column, the view displays the function that you have assigned to the channel. For an explanation of the function and for assigning the channel a function, read the section *Analog Outputs* on page 127. If an I/O module supporting device profile CiA® 404 is configured and connected to the EasyNO_x, the EasyNO_x displays the respective value in the *Value* column with unit. With the I/O communication module BPlus and with an I/O module supporting device profile CiA® 401, the EasyNO_x displays the respective raw value. You can assign values to analog outputs that are not linked to any function (displayed as ---) for test purposes (see section *Testing of Outputs* on page 121).

Illustration example analog outputs

| Channel | Value | Function | Test |
|---------|------------------------------------|------------------------------------|--------------------------|
| 1 | <input type="text" value="4.800"/> | V Actual NO _x from NOx1 | |
| 2 | <input type="text" value="0.000"/> | V --- | <input type="checkbox"/> |

– Preferences

This button provides access to the settings of the added I/O module. There is more information in the section *Preferences* on page 123.

- [Help](#)
This button opens the operating manual of the EasyNO_x. There is more information in the section *Help* on page 99.

9.2.1.1 Testing of Outputs



Operational safety!

The EasyNO_x and the software are not designed for safety-critical applications. The analog and binary inputs and outputs of the EasyNO_x system must not be used for safety-critical purposes.



Operational safety!

Testing the outputs affects the connected devices. Before performing tests, make sure that switching the outputs will not result in hazards or damage.

Analog outputs to which no function is assigned can be used to output values for test purposes. Binary outputs to which no function is assigned can be switched for test purposes. This allows you to test the behavior of devices connected to these outputs.

Start Testing

If you want to test an output, proceed as follows:

1. For the respective output, tap on the empty rectangle in the *Test* column.
 - ▶ A black dot appears in the rectangle.



- ▶ The field *Test Off* at the bottom left of the respective view is empty.
 - ▶ If another output has been tested before, this test is ended, the value of the respective output is reset, and the black dot in the respective rectangle is deleted.
2. Test the output.
 - Binary output: Tap the *Toggle* button to switch the output on and off. A turquoise frame around the *Toggle* button indicates that the output to be tested is switched.



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- Analog output: Use the slider to set the desired analog test value.



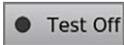
End Testing

You have two options to end the test of an output.

Option 1:

Tap on the field *Test Off*.

- ▶ A black dot appears in the *Test Off* field.



- ▶ The test of the respective output is ended, its value is reset and the black dot in the *Test* column is deleted for the respective output.

Option 2:

Exit the view using the *Back* button in the menu bar.

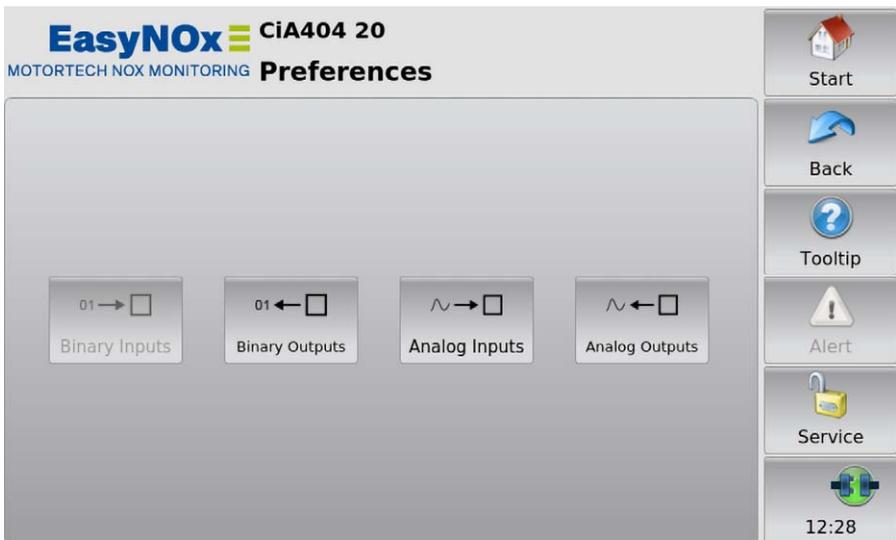
- ▶ The test of the respective output is ended and its value reset.

9.2.2 Preferences

**Operational safety!**

The EasyNO_x and the software are not designed for safety-critical applications. The analog and binary inputs and outputs of the EasyNO_x system must not be used for safety-critical purposes.

The *Preferences* button in the *Main Menu* of an added I/O communication module BPlus or I/O module supporting device profile CiA® 401 or CiA® 404 opens the *Preferences* view.



If a specific input or output type is not available with the I/O module, the respective button is grayed out.

The *Preferences* view contains the following buttons:

- **Binary Inputs**
Use the button to open a view in which you can link the binary inputs of the respective I/O module to a function of the EasyNO_x. There is more information in the section *Binary Inputs* on page 124.
- **Binary Outputs**
Use the button to open a view in which you can link the binary outputs of the respective I/O module with a function of the EasyNO_x. There is more information in the section *Binary Outputs* on page 125.

9 Devices

- [Analog Inputs](#)

Use the button to open a view in which you can link the analog inputs of the respective I/O module to a function of the EasyNO_x. There is more information in the section *Analog Inputs* on page 126.

- [Analog Outputs](#)

Use the button to open a view in which you can link the analog outputs of the respective I/O module with a function of the EasyNO_x. There is more information in the section *Analog Outputs* on page 127.

9.2.2.1 Binary Inputs

The *Binary Inputs* button in the *Preferences* view of an added I/O communication module BPlus or I/O module supporting device profile CiA® 401 or CiA® 404 opens the *Binary Inputs* view.

The screenshot displays the 'Binary Inputs' configuration interface for an EasyNO_x CiA404 20 module. The interface includes a title bar with the EasyNO_x logo and 'CiA404 20 MOTORTECH NOX MONITORING Binary Inputs'. Below the title bar is a table with two columns: 'Channel' and 'Linked to Function'. The table contains one row with '1' in the 'Channel' column and 'Normal Operation Release for NOx1' in the 'Linked to Function' column. To the right of the table is a vertical toolbar with several icons: a house icon labeled 'Start', a blue arrow icon labeled 'Back', a question mark icon labeled 'Tooltip', a warning triangle icon labeled 'Alert', a yellow padlock icon labeled 'Service', and a clock icon labeled '12:29'.

Note that changes in this view are not saved and applied by the I/O module until you exit the view. Use the drop-down list to link the I/O module's binary inputs displayed in the *Channel* column to the desired function:

- [Not Used](#)

The binary input is not linked to any function.

- [Normal Operation Release for NO_x1 / NO_x2](#)

A master control can signal to the respective NO_x monitor of the EasyNO_x via a closed binary input that the conditions for normal operation are met by the engine. In NO_x monitoring mode *Start/Stop via CANopen*, the binary input must be linked to this function.

9.2.2.2 Binary Outputs

The *Binary Outputs* button in the *Preferences* view of an added I/O communication module BPlus or I/O module supporting device profile CiA® 401 or CiA® 404 opens the *Binary Outputs* view.

EasyNOx  **CiA404 20**
 MOTORTECH NOX MONITORING **Binary Outputs**

| Channel | Linked to Function |
|---------|---------------------------------|
| 1 | Cat. Temperature Error NOx1 |
| 2 | NO _x Exceedance NOx1 |
| 3 | Not Used |

Start
 Back
 Tooltip
 Alert
 Service
 13:00

Note that changes in this view are not saved and applied by the I/O module until you exit the view. Use the drop-down list to link the I/O module's binary outputs displayed in the *Channel* column to the desired function:

- **Not Used**
The binary output is not linked to any function.
- **Error Output, Warning Output**
The binary output of the respective I/O module is assigned to the binary output *Error* or *Warning* of the EasyNO_x. If the binary outputs of the EasyNO_x are activated (see *Devices* on page 79), the EasyNO_x switches the assigned binary output of the I/O module if a corresponding monitoring function of an added device requires it.
- **Cat. Temperature Error NOx1 / NOx2**
If the respective NO_x monitor of the EasyNO_x has detected a temperature error on the respective engine at at least one of the configured exhaust gas temperature measuring points near the catalytic converter, the EasyNO_x switches the assigned binary output of the I/O module.
- **NO_x Exceedance NOx1 / NOx2**
If the provisional daily average of the nitrogen oxide concentration currently exceeds the configured level limit of the engine monitored by the respective NO_x monitor, the EasyNO_x switches the assigned binary output of the I/O module.
- **Normal Operation NOx1 / NOx2**
If, for the respective engine, normal operation has been detected by or signalled to the respective NO_x monitor of the EasyNO_x, the EasyNO_x switches the assigned binary output of the I/O module.

9 Devices

9.2.2.3 Analog Inputs

The *Analog Inputs* button in the *Preferences* view of an added I/O communication module BPlus or I/O module supporting device profile CiA® 401 or CiA® 404 opens the *Analog Inputs* view.

EasyNOx  **CiA404 20**
MOTORTECH NOx MONITORING **Analog Inputs**

| Channel | Type | Linked to Function |
|---------|-------|---------------------|
| 1 | ±10 V | Load Input for NOx1 |
| 2 | ±10 V | Load Input for NOx2 |
| 3 | ±10 V | Not Used |

Start
Back
Tooltip
Alert
Service
13:00

Note that changes in this view are not saved and applied by the I/O module until you exit the view. If an I/O module supporting device profile CiA® 404 is set and connected to the EasyNO_x, the EasyNO_x displays the analog input type (e.g. ±10 V) in the *Type* column.

Use the drop-down list to link the I/O module's analog inputs displayed in the *Channel* column to the desired function:

- **Not Used**
The analog input is not linked to any function.
- **Load Input for NO_x1 / NO_x2**
The analog input is used by the respective NO_x monitor as input for the load signal from the respective engine. In NO_x monitoring mode *Load via CANopen*, the analog input must be linked to this function.

9.2.2.4 Analog Outputs

The *Analog Outputs* button in the *Preferences* view of an added I/O communication module BPlus or I/O module supporting device profile CiA® 401 or CiA® 404 opens the *Analog Outputs* view.

EasyNOx  **CiA404 20**
MOTORTECH NOX MONITORING **Analog Outputs**

| Channel | Type | Linked to Function |
|---------|-------|--|
| 1 | ±10 V | Average NO _x from NO _x 1 |
| 2 | ±10 V | Not Used |

Start
Back
Tooltip
Alert
Service
13:00

Note that changes in this view are not saved and applied by the I/O module until you exit the view. If an I/O module supporting device profile CiA® 404 is set and connected to the EasyNO_x, the EasyNO_x displays the analog output type (e.g. ±10 V) in the *Type* column.

Use the drop-down list to link the I/O module's analog outputs displayed in the *Channel* column to the desired function:

- **Not Used**
The analog output input is not linked to any function.
- **Average NO_x from NO_x1 / NO_x2**
Output of the provisional daily average of nitrogen oxide readings converted according to VDMA 6299:2019-09 (see section *Conversion of Nitrogen Oxide Readings* on page 44) as determined by the respective NO_x monitor. For each NO_x monitor, you define the scaling of the output via the entries *Output NO_x Min.* and *Output NO_x Max.* in the *NO_x Setup* view (see section *Preferences* on page 112).
- **Actual NO_x from NO_x1 / NO_x2**
Output of the nitrogen oxide reading currently measured by the respective NO_x monitor converted according to VDMA 6299:2019-09. For each NO_x monitor, you define the scaling of the output via the entries *Output NO_x Min.* and *Output NO_x Max.* in the *NO_x Setup* view (see section *Preferences* on page 112).

9 Devices

9.3 Generic Device

You have the option of adding up to three devices that are connected to the EasyNO_x via the CAN bus interface CAN1 but not directly supported by it as a generic device (display name *Generic*). The generic device is started along with the EasyNO_x, and its connection status is monitored by the EasyNO_x.



Generic devices are not displayed in the Start Menu

Generic devices appear in the *Device Setup* view in the list of added devices (display name *Generic*). They are not displayed in the *Start Menu*.

Functions

- When a generic device is added to the device configuration, it is started if this has not already been done.
- The communication status is monitored by the EasyNO_x and is visualized in the menu bar (see section *Menu Bar* on page 75).
- Changes to the communication status are listed in the *Event Log* view (see section *Event Log* on page 98).

10.1 Start-up

Before you put the NO_x monitoring of your EasyNO_x system into operation, take note of the following:

- Make sure that the CAN bus modules, the NO_x sensors, the I/O communication modules BPlus, and the I/O modules supporting device profile CiA® 401 or CiA® 404 are mounted in line with the engines to be monitored and that they are connected to the EasyNO_x. Pay particular attention to the node IDs of the individual components. Make sure that the DIP switches of the CAN bus modules are set correctly (see section *Node ID CAN Bus Module* on page 67 and section *Bit Rate CAN Bus Module* on page 68).
- In both CAN buses, make sure that they are correctly terminated (see section *CAN Bus Termination* on page 67 and section *CAN Bus Wiring, CAN Bus Termination* on page 71).
- Make sure that the layout of the thermocouples corresponds respectively to the configuration of the NO_x monitor in the EasyNO_x (see section *Installation Locations of Thermocouples* on page 57).
- Make sure that the NO₂ correction factor (KNO₂) of the NO_x sensor is set correctly in the configuration of the respective NO_x monitor in the EasyNO_x (see section *Preferences* on page 112).
- Make sure that the NO₂/NO_x ratio determined with an exhaust gas analyzer upon mounting of the NO_x sensor is correctly set in the configuration of the respective NO_x monitor in the EasyNO_x (see section *Determining the NO₂/NO_x Ratio* on page 57).
- Make sure that the respective NO_x monitor is wired and configured to match the set mode of normal operation detection (see section *Normal Operation Detection* on page 46).
- Ensure that you have specified the operator data in the NO_x monitor (see section *Operator* on page 116).
- Before using the respective NO_x monitor, perform a test run for at least one hour.

Before you put the EasyNO_x into operation, take note of the following:

- Make sure that you have assigned PINs to all access levels of the EasyNO_x (see section *Access Control* on page 92).
- Make sure that the time zone as well as date and time are set correctly in the EasyNO_x (see section *Display* on page 87).
- Save your configuration as files and as a PDF on a USB flash drive before start-up and after each modification (see section *Display* on page 87).

10.2 Shutdown

The EasyNO_x including the CAN bus/NO_x sensor modules connected to it and the optional I/O communication modules BPlus are shut down by disconnecting them from the power supply.

10 Operation

10.3 Software Update



Risk of software damage!

The power supply must not be interrupted under any circumstances during the software update. Otherwise, this can lead to serious errors and the EasyNO_x will no longer work.



Back up data from the device and the NO_x monitor

Before updating the software, back up the activated devices (see section *Devices* on page 79) and the EasyNO_x configuration (see section *Display* on page 87).

To back up the protocols and the logbook of the NO_x monitor, remove the memory card from the EasyNO_x when the power is switched off.

The folders and files on the memory card must remain unchanged.

For each year the NO_x monitor has logs for, a folder with the corresponding year number exists on the memory card. Back up the desired year folders to a PC.

To back up logbooks, back up the desired *Logbook_x* folder (0 = first NO_x monitor, 1 = second NO_x monitor) to a PC.

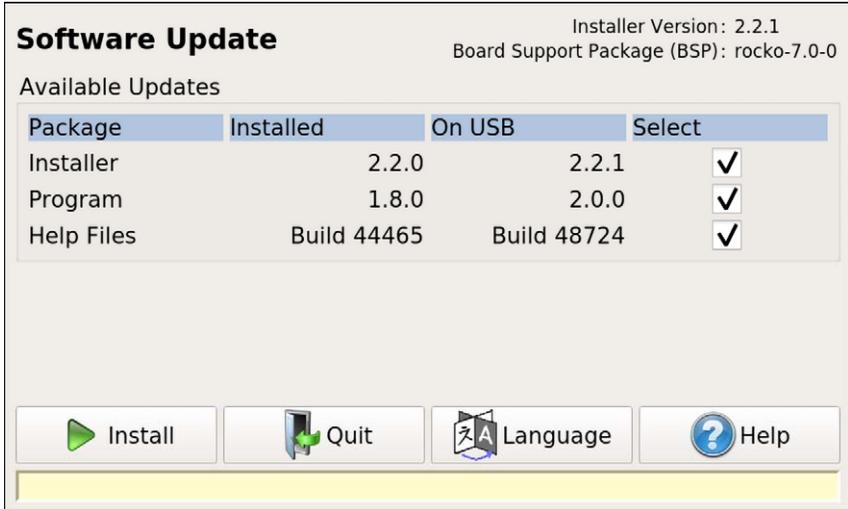
After backing up the data, first insert the memory card into the EasyNO_x before supplying the device with power. When inserting the memory card, make sure that it is not write-protected by an accidentally flipped write-protect switch.

You receive software updates for the EasyNO_x from MOTORTECH. A software update consists of several update files with signature files for verification of the update files. You need a USB flash drive to install updates. The current software version of your EasyNO_x is displayed in the *Display Information* view (see section *Display* on page 87).

Perform updates as follows:

1. Read and observe all information provided with the update (e.g. release notes, README file).
2. Make sure that the update files correspond to the board support package of your EasyNO_x. The *Display Information* view (see section *Display* on page 87) displays the installed board support package of your EasyNO_x. In the file name of the update files, you can identify the board support package by the version number after *BSP* (e.g. *rocko-7.0-0*).
3. Save the update files with the extension *.tar.bz2* and the corresponding signature files with the extension *.sha1* in the root directory of a USB flash drive.

4. Insert the USB flash drive into your running EasyNO_x.
 - ▶ After a few seconds, the standard EasyNO_x interface closes, and the installer interface opens.



5. Available update packages are displayed in the *Package* column. If necessary, tap on the *Language* button to change the language. Under *Installed* the version of the respective package installed on the EasyNO_x is displayed, under *On USB* the version to which the respective package in the EasyNO_x will be updated. As a rule, the suitable update packages are pre-selected. To change the selection if needed, activate or deactivate the checkbox under *Select* for the respective packages. To install the selected packages, tap *Install*.
 - ▶ The selected update packages are installed. After an installer update, the installation of the remaining packages must be restarted by tapping the *Install* button.
 - ▶ Certain update packages may require a restart of the EasyNO_x.
6. After installing the desired update packages, exit the installer by tapping the *Quit* button and remove the USB flash drive.
 - ▶ You can now use the EasyNO_x with the new software.

11 Errors

11.1 Possible Faults

| Fault | Possible cause | Solution |
|--|--|---|
|  The connection status symbol in the menu bar is yellow. | To at least one device there is no connection. The node ID of at least one added device is incorrect. | Establish the connection to the relevant devices. Set the correct node ID for the relevant devices. |
|  The connection status symbol in the menu bar is red. | No other device is connected. | Check the CAN bus wiring. |
| The display does not register touches at the desired position. | The display is dirty. | Clean the display (see section <i>Cleaning the Touchscreen</i> on page 135). |
| The displays on the screen are difficult to recognize. | The lighting conditions are unfavorable. | Adjust the display to the lighting conditions using the <i>Day Mode/ Night Mode</i> button in the <i>Start Menu</i> . |
| The system time is repeatedly incorrect. | The internal battery is dead. | Have the battery changed (see section <i>Battery Change</i> on page 136). |
| An added device is indicating erroneous operating data. | Node IDs in the CAN bus are incorrectly assigned. | Check the set node IDs of all devices connected to the CAN bus. |
| | The device is incorrectly wired. | Check the wiring of the device. |
| Signals do not arrive at an added I/O module (BPlus, CiA401/404) or are not received by the EasyNO _x . | The input or output is not linked to a function in the EasyNO _x . | Link the respective input or output to the desired function (see section <i>Preferences</i> on page 123). |
| | The input or output is linked to the wrong function in the EasyNO _x . | Link the respective input or output to the correct function (see section <i>Preferences</i> on page 123). |
| | The wiring is faulty. | Check the wiring, including the CAN bus wiring. For outputs, also use the test function of the EasyNO _x (see section <i>Testing of Outputs</i> on page 121). |
| Data is not getting updated. | The wiring of the CAN bus is defective. | Check the CAN bus wiring and correct any defects found. |
| | The device is not sending any data (for example if it is defective). | Check the device and fix the problems. |

| Fault | Possible cause | Solution |
|--|--|---|
|  <p>The device cannot be added, although the above symbol appears next to the device in the <i>Add Device</i> dialog.</p> | <p>The number of available activations for this device has been exceeded.</p> | <p>In certain cases, you can activate additional devices with software dongles (see section <i>Device Activation</i> on page 81).</p> |
|  <p>The symbol appears in the <i>Add Device</i> dialog next to devices.</p> | <p>This device has not been activated.</p> | <p>Activate the device with a software dongle (see section <i>Device Activation</i> on page 81).</p> |
| <p>When tapping on a device in the <i>Start Menu</i>, you get the error message "No connection to this device has been established!"</p> | <p>The wiring of the CAN bus is defective.</p> | <p>Check the CAN bus wiring and correct any defects found.</p> |
| | <p>The bit rate of the device does not correspond to the bit rate of the EasyNO_x.</p> | <p>Set the correct bit rate for the device.</p> |
| | <p>The node ID of at least one added device is incorrect.</p> | <p>Set the correct node ID for the relevant device.</p> |
| <p>The EasyNO_x does not recognize an inserted USB flash drive and cannot read data from or write data to it.</p> | <p>The formatting of the USB flash drive is not compatible with the EasyNO_x.</p> | <p>Format the USB flash drive to a compatible format (see section <i>Interfaces</i> on page 26).</p> |
| | <p>The USB flash drive is not inserted correctly in the EasyNO_x.</p> | <p>Ensure that the USB flash drive is properly inserted into the device.</p> |
| | <p>The USB flash drive is defective.</p> | <p>Use a properly working USB flash drive.</p> |

11 Errors

11.2 Customer Service Information

You can reach us during our business hours by:

Phone: +49 5141 93 99 0
Email: service@motortech.de (technical support)
sales@motortech.de (all other matters)

11.3 Returning Equipment for Repair/Inspection

To return the device for repair and inspection, first consult your MOTORTECH contact person (see *Customer Service Information* on page 134). From him you will receive all the information you need to process your order quickly and smoothly. For return shipment, also observe the instructions in the section *Instructions for Packaging the Equipment* on page 134.

11.4 Instructions for Packaging the Equipment

For return shipment, equipment should be packaged as follows:

- Use packaging material that does not damage the equipment surfaces.
- Wrap the equipment with sturdy materials and stabilize it inside the packaging.
- Use sturdy adhesive film to seal the packaging.



Document maintenance work in logbook

Note that all maintenance work on the EasyNO_x that affects its NO_x monitoring must be documented in the logbook of the respective NO_x monitor, provided that you use the logbook as defined in standard sheet VDMA 6299:2019-09.

12.1 Cleaning the Touchscreen



Risk of destruction!

Organic solvents as well as acids and alkaline solutions could damage the touchscreen. Therefore only clean the device with a soft cotton cloth and alcohol.



Risk of destruction!

Dirt affects the function of the touchscreen. Water, fingerprints, and other dirt should be removed immediately from the touchscreen and the frame to avoid spots.

To avoid spots and input problems, always remove dirt immediately. Clean the touchscreen if it reacts incorrectly when entering information.

Use a soft cotton cloth and alcohol to clean the EasyNO_x touchscreen. Do not use organic solvents. Do not use acidic or alkaline solutions.

12.2 Cleaning the NO_x Sensor

The NO_x sensor must not be cleaned with mechanical means or cleaning agents, as this may destroy the sensor or mechanically damage the labels. The NO_x sensor including its electrical connection must not come into contact with liquids.

If necessary, clean the NO_x sensor with a soft, dry cloth. If you clean the NO_x sensor when it is not mounted, make sure that the probe remains free of dirt.

12.3 Maintenance of Housing

Service the housing of the EasyNO_x at least once a year. Carry out the following work:

- Check the hinges and the cam locks of the housing door for ease of movement. Spray the hinges of the housing door with a suitable, water-free lubricant.

12 Maintenance

- Check the seal in the contact edge area for damage. If the seal in the contact edge area is damaged, contact your MOTORTECH contact person (see *Customer Service Information* on page 134).
- Check all components and surfaces for external damage. To prevent seals from being damaged by temperature-induced freezing, you can treat them with common agents such as talcum, Vaseline, or wax.
- Check the housing for traces of corrosion. Repair damage to the housing as follows:
 - Damage to small areas affecting only a part of the surface (e.g. scratches): Lightly sand off the surface at the damaged place and remove all traces of corrosion and contamination. Depending on the degree of damage, apply 2K-PUR acrylic paint with a paint stick, a brush, or a spray can.
 - Large area damage: Smooth the surface uniformly and clean it with white spirit. Then paint over the entire surface with 2K-PUR acrylic paint.

12.4 Battery Change

The internal board of the EasyNO_x has a backup battery of the type CR1220, whose service life is approximately eight years, depending on use. The backup battery is needed to ensure the integrity of the recorded monitoring data after a power supply failure. To have the battery changed, contact your MOTORTECH contact person (see *Customer Service Information* on page 134).

12.5 Replacing the NO_x Sensor

The service life of the NO_x sensor on the CAN bus/NO_x sensor module depends on the type installed:

| NO _x sensor | Service life |
|------------------------|---|
| P/N 56.03.003 | 8,000 operating hours with ambient temperature max. +90 °C (+194 °F) at evaluation unit |
| P/N 56.03.002 | 6,000 operating hours with average temperature of evaluation unit at +90 °C (+194 °F) |

After this time the NO_x sensor must be replaced. The total operating hours of the NO_x sensor are displayed in the *Sensor* view of the respective NO_x monitor (see section *Sensor* on page 117). You obtain a replacement sensor from MOTORTECH.

The replacement of the NO_x sensor is detected by the EasyNO_x and logged in the logbook of the respective NO_x monitor.

Proceed as follows to replace the NO_x sensor:

**Operational safety!**

To safely dismount the NO_x sensor, be sure to observe the following:

- To protect the NO_x sensor and yourself, wear ESD-compliant work gloves. To protect the NO_x sensor against electrostatic discharge, also comply with IEC 61340-5-1 and IEC TR 61340-5-2 in their respective valid versions.
- Under no circumstances touch the probe of the sensing element while dismantling.
- The NO_x sensor must not be live during dismantling and must have cooled down for at least 15 minutes after the voltage has been switched off. Otherwise, touching the sensing element may cause burns, the sensing element may burn, and serious damage to the connected equipment due to sparking or a short circuit may occur.

**Operational safety!**

The NO_x sensor must not be used any further under any circumstances if it is damaged or the sensing element of the NO_x sensor has been mechanically shocked (e.g. by dropping it on the floor or impacts on the sensing element). In these cases, contact MOTORTECH for sensor replacement (see *Customer Service Information* on page 134).

**Operational safety!**

Proper functioning of the NO_x sensor is only guaranteed if the sensing element does not overheat at the mounting location. Avoid accumulated heat at the sensing element and ensure sufficient ventilation of the sensing element by ambient air.

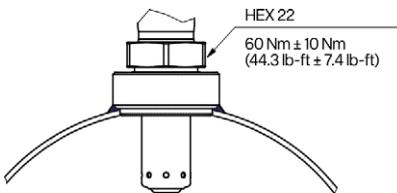
**Operational safety!**

The sensing element of the NO_x sensor P/N 56.03.003 may be mounted a maximum of one time, the sensing element of the NO_x sensor P/N 56.03.002 a maximum of two times. The electrical connection to the evaluation unit of both NO_x sensors may be established and disconnected a maximum of 20 times. After that, proper functioning of the sensor can no longer be guaranteed.

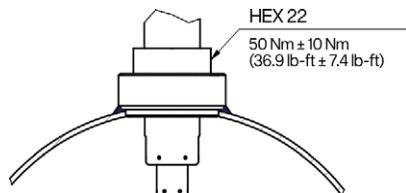
12 Maintenance

1. First ensure the following:
 - The engine must be switched off during replacement.
 - The exhaust pipe must have cooled down sufficiently and there must be no exhaust gases in the exhaust pipe.
 - The EasyNO_x system must not be live.
2. Then disconnect the connection cable to the CAN bus module from the connector of the NO_x sensor's evaluation unit.
3. Make sure that the sensing element has not been live for at least 15 minutes. Then unscrew the sensing element from the welding boss using a flare nut wrench 22 mm (0.87") with a spared corner wave profile. The outgoing wires must not twist in the process. Therefore counter the sensing element with your hand. Do not use a hammer or a flat spanner to loosen the sensing element.
4. Dismount the evaluation unit from the mounting plate of the CAN bus/NO_x sensor module by loosening the two M8x20 hexagon screws.
5. Remove the NO_x sensor.
6. At the mounting position of the sensing element, first check the NO₂/NO_x ratio (correction factor K) in the exhaust gas with a suitable calibrated exhaust gas analyzer. More information on this is available in the section *Determining the NO₂/ NO_x Ratio* on page 57.
7. Then mount the evaluation unit of the NO_x sensor onto the mounting plate of the CAN bus/NO_x sensor module using the two hexagon screws M8x20 and a tightening torque of 10 Nm (7.4 lb-ft).
8. Remove the protective cap from the probe of the new NO_x sensor's sensing element. Do not pull on the connection cable, but hold the sensing element only by its metal body.
9. Check whether the thread of the sensing element is sufficiently greased. If necessary, re-grease only the thread of the sensing element with a small amount of high temperature grease. For NO_x Sensor P/N 56.03.003, use only Optimol Paste MF from Castrol® or Never Seez Regular Grade from Bostik® with a recommended amount of 40 mg ± 10 mg.
10. Also make sure that no dirt, dust, or grease gets deposited in or on the probe during replacement.
11. Insert the sensing element into the welding boss and screw the sensing element into the welding boss via its hexagon nut by hand first. The outgoing wires must not twist in the process. Therefore counter the sensing element with your hand.
12. Then, tighten the sensing element over its hexagon nut using a calibrated torque tool with the specified torque as shown in the drawing.

P/N 56.03.003:



P/N 56.03.002:



13. Then lay the connection cable between the sensing element and the evaluation unit. In doing so, observe the following.

P/N 56.03.003:

Comply with the specifications in the section *Laying the Connection Cable* on page 55.

P/N 56.03.002:

Make sure that the minimum bending radius of the connection cable of 20 mm (0.79") is observed and that the angle of the cable outlet at the sensing element grommet is less than 15°.

14. Make sure that the five-pole connector of the NO_x sensor's evaluation unit is dry and that there are no particles or deposited grease in the connector.
15. Connect the connection cable to the CAN bus module to the five-pin connector of the evaluation unit.
 - ▶ The NO_x sensor has been replaced.
16. After you have put the EasyNO_x system back into operation, correct the NO₂/NO_x ratio determined above in the *NO_x Setup* view of the respective NO_x monitor in the entry *K* (see section *Preferences* on page 112), if necessary.
17. Also, if necessary, correct the NO₂ correction factor of the NO_x sensor in the *NO_x Setup* view of the respective NO_x monitor in the entry *KNO₂* (see section *Preferences* on page 112).
 - ▶ You can resume using the NO_x monitoring of the EasyNO_x.

12.6 Spare Parts and Accessories

For spare parts and accessories, please refer to our current Product Guide, which is available for you to download on the internet at www.motortech.de.

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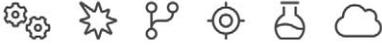
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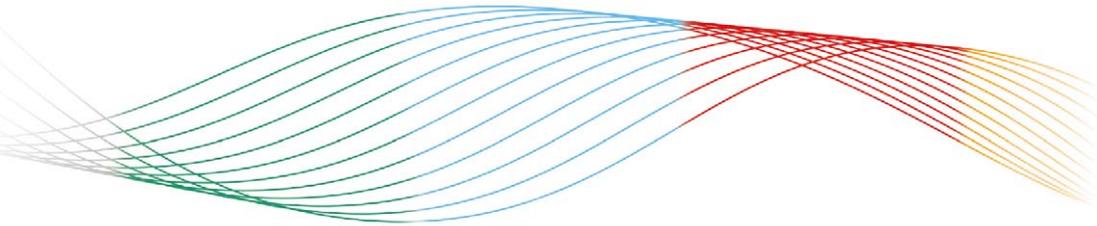
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GAS ENGINE TECHNOLOGY

