EasyNOₓ – NOₓ Monitoring

Operating Manual

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❚ 1 General Information

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
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
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
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
EMC	Electromagnetic Compatibility		Compatibility of electrical or electronic equipment items with their surroundings
ESD	Electrostatic Discharge		
HMI	Human-Machine Interface		Interface between a human and a machine or a computer
I/O	Input/Output		Communication of an information system with the outside world

1 General Information

Abb.	Term	Description	Explanation
ISO	International Organization for Standardization		
LED	Light Emitting Diode		Light emitting electronic semi-conductor
MAP	Manifold Absolute Pressure		
MMC	Multimedia Card		Digital storage medium
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.
RoHS	Restriction of Hazardous Substances		
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 pacemakers!

Electromagnetic impulses in the wiring of the ignition system may exceed the permissible limits of pacemakers. Persons with pacemakers 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 this 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 dismounted or disabled.

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– 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 as possible.

– Do not remove the circuit boards from the housing of the device.

▌2 Safety Instructions

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.

Wiring Example
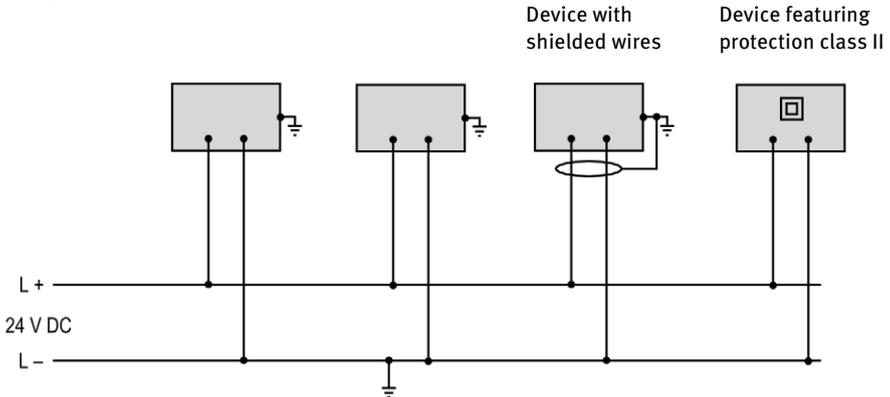
Occurrence of ground loops

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.

Device 1   Device 2

Ground loop
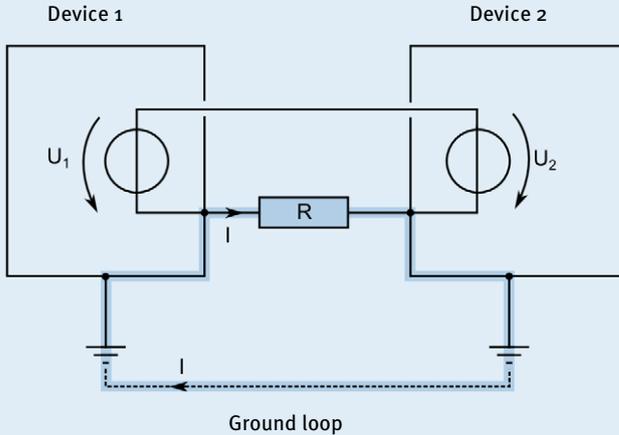
▌2 Safety Instructions

2.4 Special Safety Instructions

2.4.1 EasyNO$_x$ System

Explosion hazard!

In the event of a malfunction, ignitable sparks may be generated in the EasyNO$_x$ system. Therefore, take appropriate measures to ensure that no explosive gases are formed 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, note the following points:

–   Install the sensing elements on the exhaust pipe at suitable locations at which 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 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 devices of the EasyNO$_x$ system 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.

Operational safety!

To prevent arcing or 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.

Operational safety!

The EasyNO$_x$ and the software are not designed for safety-critical applications. The 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.

Danger of interference with radio reception!

The EasyNO$_x$ system is not intended for use in residential areas and cannot ensure adequate protection of radio reception in such environments.

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2.4.2 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.

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 133).

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 Safety Instructions

2.5 Proper Storage

Keep the storage period of the CAN bus/NOx sensor module as short as possible and unpack the CAN bus/NOx 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/NOx sensor module (see section *Mechanical Data* on page 22). In the vicinity of the NOx sensor, no easily evaporating organic materials or silicone-organic materials may be stored.

2.6 Proper Transport

Let the EasyNOx system and in particular the sensing element of the NOx sensor remain in their original packaging until they reach their place of use.

After unpacking, secure the EasyNOx housing against falling over, dropping, and slipping.

After unpacking, take care not to twist the wires in the connection cable between the sensing element and the evaluation unit of the NOx sensor P/N 56.03.003 when carrying the CAN bus/NOx sensor module. Do not wrap the connection cable of the NOx sensor around the CAN bus/NOx 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 NOx 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 within this operating manual (see section *Mounting the Sensing Element of NOx Sensor P/N 56.03.003* on page 49).

2.7 Proper Disposal

After the expiration of its service life, MOTORTECH equipment can be disposed of with other commercial waste, or it may be returned to MOTORTECH. We will ensure its environmentally friendly disposal.

▌ 3 Intended Use

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.

The optionally available I/O communication module provides the EasyNO$_x$ with analog and binary inputs and outputs to which, depending on the application, various functions can be assigned and which in this way enable communication with a master control. Up to two I/O communication modules can be connected to the EasyNO$_x$ via the CAN bus interface CAN1.

Additionally, the EasyNO$_x$ can start a device that is not directly supported by it, but to which it is connected via the CAN bus interface CAN1, and monitor its connection status.

The NO$_x$ monitor and the I/O communication module are 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 up to two NO$_x$ monitors and up to two I/O communication modules.

▌ 3 Intended Use

3.2 Applications

> **⚠ WARNING**
>
> **Danger of interference with radio reception!**
>
> The EasyNO$_x$ system is not intended for use in residential areas and cannot ensure adequate protection of radio reception in such environments.

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 ≥ 1 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.

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.

As per EN 55011, the EasyNO$_x$ NO$_x$ monitoring 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.

System Overview (Example)

① EasyNOₓ	Ⓐ Control cabinet
② CAN bus/NOₓ sensor module	Ⓑ Master control
③ I/O communication module	Ⓒ Exhaust gas line
④ NOₓ sensor	Ⓓ Catalytic converter
⑤ Thermocouple	Ⓔ Engine
⑥ Manifold pressure sensor	

■ 4 Product Description

4.1 Technical Data

4.1.1 Certifications

The EasyNO$_x$ NO$_x$ monitoring 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 133).

4.1.2 Mechanical Data

> **Compliance with protection class**
>
> The specified protection classes are only guaranteed if all external cables are wired according to their specifications, all cable glands and screw openings are tightly closed, and all covers are closed or mounted 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 *Overview Drawings* on page 32
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 Product Description

The CAN bus/NOx sensor module with NOx 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 *Overview Drawings* on page 32
Mechanical environmental conditions	Protection: IP 66 with mating plug connected to evaluation unit of NOx 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 NOx 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 *Overview Drawings* on page 32
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

The optional I/O communication module 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 *Overview Drawings* on page 32
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

4.1.3 Product Identification – Labeling on the Device

EasyNO$_x$

On the outside of the housing

Abb.	Meaning
P/N	Part number of the EasyNO$_x$
S/N	Serial number of the EasyNO$_x$ and under *HMI Module* the serial number of the EasyNO$_x$ HMI module installed in the housing

EasyNO$_x$ HMI Module

Rear side

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 Product Description

CAN Bus/NOx Sensor Module

MOTORTECH®
P/N 63.05.015
S/N 05042268
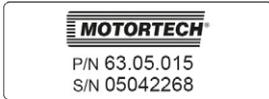
Abb.	Meaning
P/N	Part number of the CAN bus/NOx sensor module
S/N	Serial number of the CAN bus/NOx sensor module

CAN Bus Module
On the outside of the housing

MOTORTECH®
P/N 06.72.099
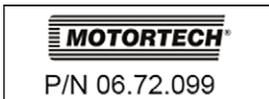
Abb.	Meaning
P/N	Part number of the CAN bus module

NOx 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 NOx sensor (P/N)

– Serial number of the NOx sensor (S/N)

MOTORTECH® NOx-Sensor
24V
P/N 56.03.003
S/N 080752409181
MOTORTECH GmbH
29223 Celle
Hogrevestr. 21-23
www.motortech.de
CE

MOTORTECH

I/O Communication Module (optional)
On the bottom side of the top hat rail spring clip

MOTORTECH®
P/N 63.05.014-01
S/N 05042922

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

4.1.4 Electrical Data
The EasyNOx has the following electrical characteristics:

Feature	Value
Power consumption	Without CAN bus/NOx sensor module: – 5.3 W typical, max. 22.8 W With up to two CAN bus/NOx sensor modules with NOx sensor P/N 56.03.003: – 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: 16 V DC to 32 V DC
Required current	Without CAN bus/NOx sensor module: – Max. 1.5 A With up to two CAN bus/NOx sensor modules with NOx sensor P/N 56.03.003: – 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 Service life: approx. 8 years (depending on application)

▌4 Product Description

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 °C to +1,200 °C (−328 °F to +2,192 °F)
	Measurement resolution: 0.1 K
	Measuring accuracy: ± 0.1 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 NOx sensor P/N 56.03.003 has the following characteristics:

Feature	Value
Measuring range nitrogen oxide (NOx)	0 ppm to 3,012 ppm
Measuring accuracy nitric oxide (NO)	See table 1, valid measured values from $O_2 \geq 1$ 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 NOx measurement	Ammonia (NH_3) typ. 110 %
Sensitivity NOx 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 $O_2 \geq 1$ 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 (O_2)

Measurement	Gas composition	Measuring accuracy	
		New	Aged
0 %	N_2 with 1 % H_2O	± 0.2 % abs	± 0.3 % abs
8.29 %	8.29 % O_2 in N_2; 0 % H_2O	± 6 % rel	± 8 % rel
12 %	12 % O_2 in N_2; 0 % H_2O	± 6 % rel	± 8 % rel
20.95 %	20.95 % O_2 in N_2; 0 % H_2O	± 6 % rel	± 8 % rel

▍4 Product Description

The optional I/O communication module 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

4.1.5 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/m² typical
Viewing angle	50°, 70° ,70°, 70° (UDRL)
Touch technology	Projected capacitive multi touch
Backlight service life	50,000 hours typical

4.1.6 Interfaces

The EasyNO$_x$ has the following interfaces:

USB Interface
– Compatible with USB 2.0

– Data rate: 480 Mbit/s (Host)

CAN Bus Interfaces
– Quantity: 2

– Network protocol: CANopen® (CAN1), SAE J1939 (CAN2)

– As per ISO/DIS 11898

– Transmission rate: 250 kbit/s

– Max. wire 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$_x$.

WARNING

Operational safety!

The memory card must remain inserted in the EasyNO$_x$ if you use its NO$_x$ monitor. Otherwise you will lose access to the recorded NO$_x$ monitoring data. If the memory card requires mandatory replacement, contact your MOTORTECH contact person (see *Customer Service Information* on page 133).

Memory Card Slots
– Supported memory card types: SDHC, SD, MMC

4 Product Description

4.1.7 Overview Drawings

4.1.7.1 Dimensions

EasyNO$_x$

4x ø 9,25 mm (0.37")

20 mm (0.79")

160 mm (6.3")

260 mm (10.24")

20 mm (0.79")
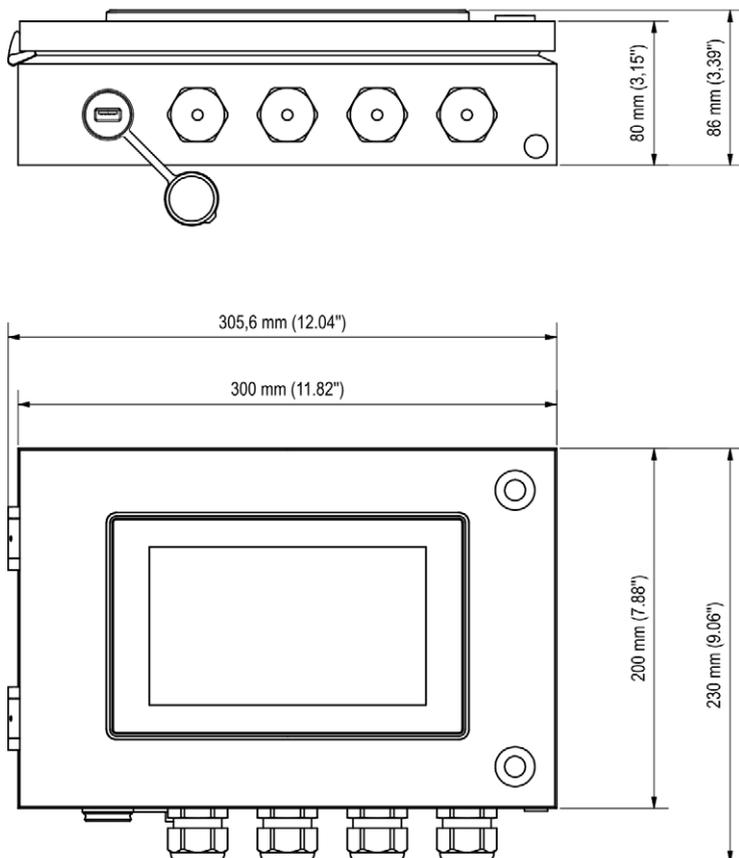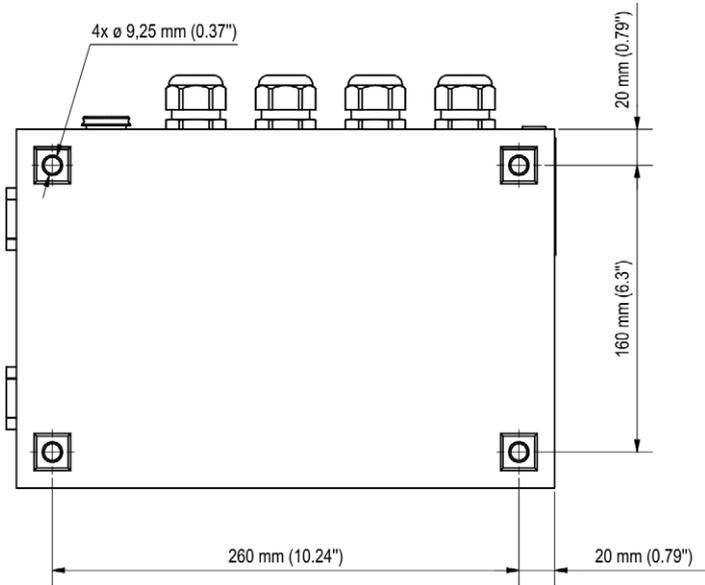
▌ 4 Product Description

CAN Bus/NOx Sensor Module P/N 63.05.015
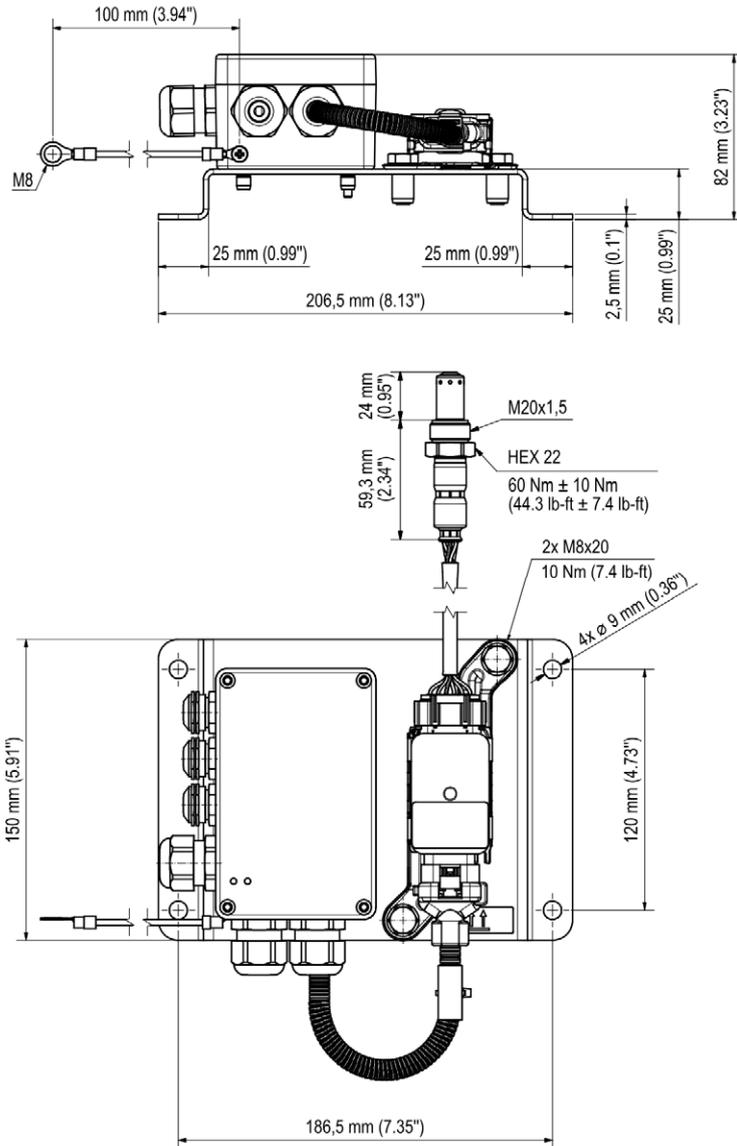
▌4 Product Description

I/O Communication Module (Optional)
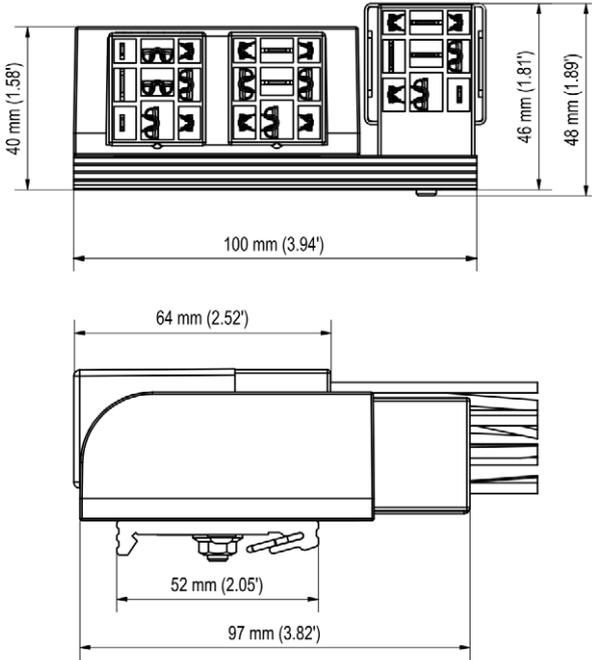
▌4 Product Description

4.1.7.2 Components

EasyNO$_x$
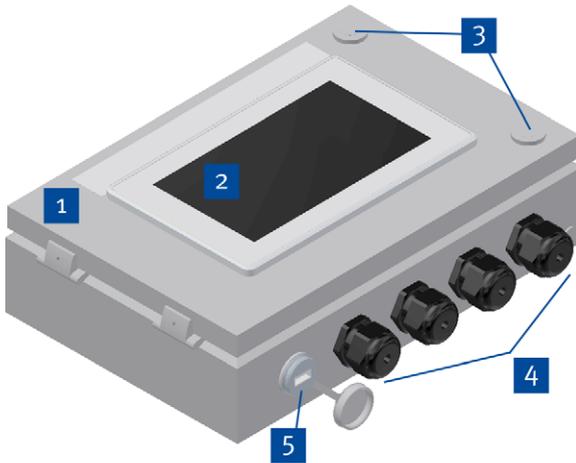
Pos.	Description
1	Housing door
2	Touchscreen
3	Housing door lock
4	Cable glands
5	USB port with protective cap

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CAN Bus/NOx Sensor Module P/N 63.05.015
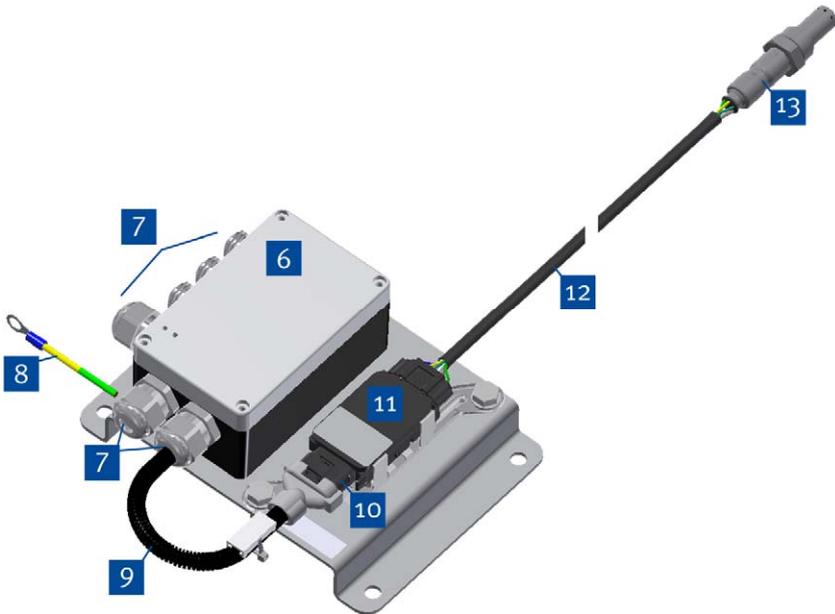
Pos.	Description
6	CAN bus module
7	Cable glands
8	Grounding cable
9	Connection cable CAN bus module to evaluation unit
10	Evaluation unit connector
11	Evaluation unit of NOx sensor P/N 56.03.003
12	Connection cable evaluation unit to sensing element
13	Sensing element of NOx sensor P/N 56.03.003

4 Product Description

4.1.8 Ports/Connections and LEDs

EasyNO$_x$
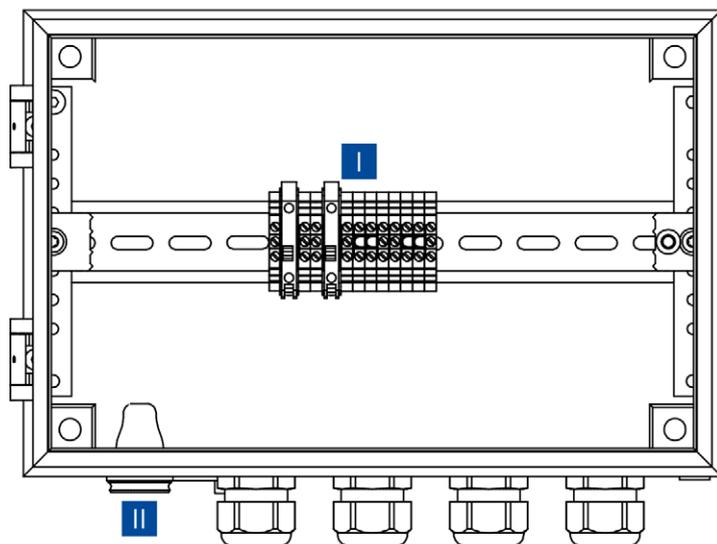
Pos.	Description
I	Terminal blocks (see section *Wiring* on page 58)
II	USB port

MOTORTECH

CAN Bus Module

Designation	Function
P1, +, −, G1 P2, +, −, G2	Measurement connections for the thermocouples
P3, +, −, G3	Analog input for a charging pressure or load signal
P4, +, −, G4	Optional analog current input, whose input current can be displayed in the NO_x monitor of the EasyNOx (see section *Overview* on page 100).
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: – 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.

▌4 Product Description

Designation	Function
ERROR	The LED indicates the device status of the CAN bus module:
	– 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 *Node ID CAN Bus Module* on page 66)
Baud	DIP switches for setting the bit rate of the CAN bus module (see section *Bit Rate CAN Bus Module* on page 66)

The wiring and configuration of the CAN bus module is described in section *CAN Bus/NOₓ Sensor Module* on page 61.

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.%

– In normal operation, the current nitrogen oxide reading converted according to VDMA 6299:2019-09 in mg/Nm^3 (for further details, see section *Conversion of Nitrogen Oxide Readings* on page 41)

– The provisional daily average of nitrogen oxide readings in mg/Nm^3

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, 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:

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

In the next step, the measured nitrogen oxide value is corrected by sensor- and plant-specific NO$_2$ correction factors:

$$NO_{X,w-c} = NO_{X,w} \cdot (1 - K) + NO_{X,w} \cdot \left(\frac{K}{K_{NO2}}\right)$$

Following that, this NO$_2$-corrected nitrogen oxide value measured in wet exhaust gas is converted to dry exhaust gas:

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

5 Functions

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

$$NO_{X,dr-mg} = 2.053 \cdot NO_{X,dr}$$

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

$$NO_{X,r} = \frac{21 - O_r}{21 - O_{2,dr}} \cdot NO_{X,dr-mg}$$

Variable	Meaning
K	NO₂/NOₓ ratio of the exhaust gas as a constant (see section *Determining the NO₂/NOₓ Ratio* on page 54)
K_{NO_2}	Sensor-specific NO₂ correction factor as a constant (see section *Sensor* on page 118)
$NO_{X,r}$	Nitrogen oxide measured value converted to reference oxygen content and based on mass and dry exhaust gas in mg/Nm³
$NO_{X,w}$	Nitrogen oxide value of the NOₓ sensor measured wet in ppm
$NO_{X,w-c}$	NO₂-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/Nm³
O_r	Reference oxygen
$O_{2,dr}$	Oxygen measured value of the NOₓ sensor calculated on dry exhaust gas in vol.%
$O_{2,w}$	Oxygen value of the NOₓ 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 level that indicates that the daily average is approaching the level limit. To use the NOₓ 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 *NOₓ 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 42).

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$_x$ monitoring 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 43), 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 43). 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 100).

◢ 5 Functions

5.1.7 Normal Operation Detection

For detecting normal operation, the NO$_x$ monitor can evaluate the load signal of a master control connected to the CAN bus module of the EasyNO$_x$ system or to the optional I/O communication module. Alternatively, the NO$_x$ monitor can use the absolute charging pressure as an indicator for the engine load. For this purpose, a manifold pressure sensor can be connected directly to the CAN bus module of the EasyNO$_x$ system or alternatively the signal of a manifold 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, there is also the option that a master control indicates normal operation via the binary input of the I/O communication 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 Easy-NO$_x$ (see section *Overview* on page 100). 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

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 45). You can maintain the logbook in accordance with standard sheet VDMA 6299:2019-09.

5.1.11 NOx Monitoring Report

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

Pos.	Description
I	Name of the monitored engine
II	Operator information
III	Annual summary
IV	Time limit for twelve consecutive months as per 44th BImSchV § 20 (4)
V	Configuration of the respective NOx monitor
VI	Logbook of the respective NOx monitor
VII	Daily values of the respective NOx monitor
VIII	Miscellaneous data on the EasyNOx

Exceedances of the time limit within twelve consecutive months are highlighted in red in the *Sum* column of the time limit overview IV.

▌ 5 Functions

5.2 I/O Communication Module

The optionally available I/O communication module (e.g. as part of the EXTENDED package of the EasyNO$_x$) provides the EasyNO$_x$ with analog and binary inputs and outputs. Depending on the application, these inputs and outputs can be assigned differently, for example for the input and output of measured values or for signaling warnings, errors, or certain operating states from or to a master control. Up to two I/O communication modules can be connected to the EasyNO$_x$ via the CAN bus interface CAN1.

For more information on the I/O communication module, read the section *I/O Communication Module* on page 121.

5.3 Generic Device

The EasyNO$_x$ can integrate a device 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. The generic device is started along with the EasyNO$_x$ and its connection status is monitored by the EasyNO$_x$. The generic device is not displayed in the start menu, but its 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 device, see section *Generic Device* on page 128.

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 49). 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 ⌀7 mm (2x)

– Sealing insert pin for sealing insert opening ⌀7 mm (6x)

– Up to two CAN bus/NO$_x$ sensor modules pre-mounted on a mounting plate, each including

    – Sealing insert pin for cable gland M16, ⌀9 mm

    – Sealing insert pin for cable gland M12, ⌀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

– EXTENDED package: up to two I/O communication modules

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

– Manifold pressure sensor

❚ 6 Installation Instruction

6.2 Mounting of 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 device 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 *Dimensions* on page 32). 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 52.

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 wire length of 250 m (820').

The CAN bus/NO$_x$ sensor module is mounted via the screw openings on the mounting plate (see section *Dimensions* on page 32). Use suitable fasteners and make sure that the load-bearing capacity is sufficient at the mounting location.

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

⚠ WARNING

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.

⚠ WARNING

Operational safety!

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

– To protect the NOx sensor and yourself, wear ESD-compliant work gloves. To protect the NOx 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.

⚠ WARNING

Operational safety!

The NOx sensor must not be used any further under any circumstances if it is damaged or the sensing element of the NOx 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 133).

⚠ WARNING

Operational safety!

Proper functioning of the NOx 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.

⚠ WARNING

Operational safety!

The sensing element may be mounted a maximum of one time. The electrical connection to the NOx 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.

❚ 6 Installation Instruction

> **SCR catalytic converter: No monitoring in accordance with VDMA 6299:2019-09**
>
> The NOₓ monitor of the EasyNOₓ does not evaluate the dosing release of the urea solution in an SCR catalytic converter. Thus, the NOₓ monitor of the EasyNOₓ 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 NOₓ sensor from the CAN bus/NOₓ 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 NOₓ 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.

In systems with urea injection, if the sensing element is to be mounted near the injection point, the sensing element should be mounted prior to the injection point, and it should be ensured that no urea flows back to the sensing element.

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

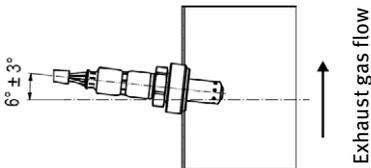# ▌ 6 Installation Instruction

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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

Exhaust gas flow
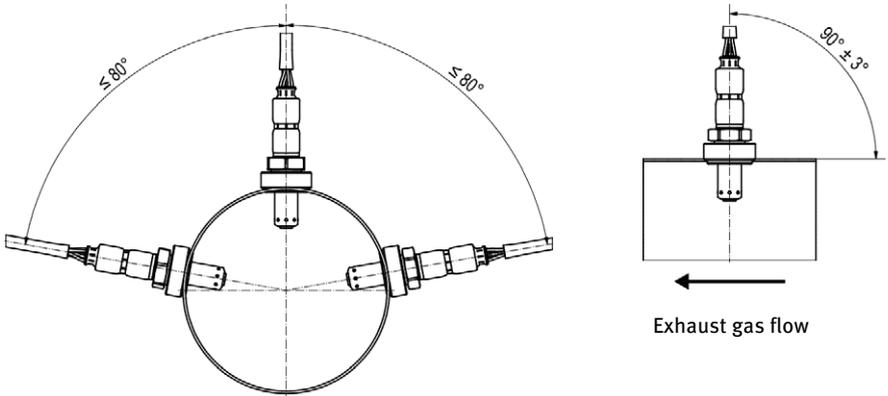
Tilt angles vertical exhaust pipe

Exhaust gas flow

The sensing element heats up as soon as the NOₓ 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 NOₓ 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 Installation Instruction

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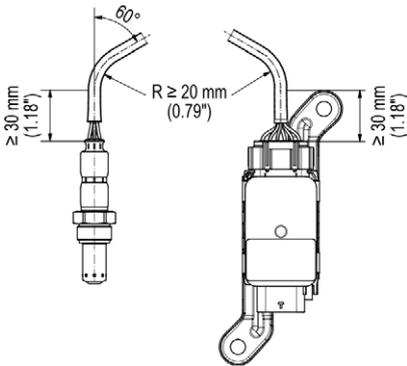
Also, it must be possible to lay the connection cable in such a way that it is not affected by heat-conducting or heat-radiating components.

6.4.3 Mounting the Sensing Element

Make sure that the engine is switched off while mounting and that the EasyNOx 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 NOx 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.

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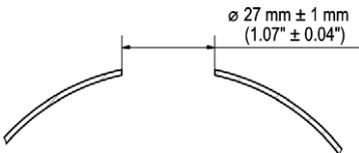
2. Screw the supplied locking screw into the supplied welding boss and weld the stainless steel welding boss (material number 1.4301) into this hole with a suitable welding filler.

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 54.

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 mg ± 10 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 Nm ± 10 Nm (44.3 lb-ft ± 7.4 lb-ft).
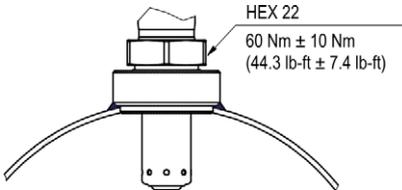
8. Then lay the connection cable between the sensing element and the evaluation unit of the NO_x sensor. When doing so, comply with the specifications in the section *Laying the Connection Cable* on page 52.

    ‣ The sensing element of the NO_x sensor is mounted.

9. Later, when configuring the EasyNOₓ, 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 EasyNOₓ, enter the sensor-specific factor *KNO_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 118).

❚ 6 Installation Instruction

6.5 Determining the NO₂/NOₓ Ratio

When the NOₓ sensor is mounted for the first time at the installation location and each time the NOₓ sensor is replaced, the NO₂/NOₓ 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 (NO_2) 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 EasyNOₓ, enter this value in the *NOₓ Setup* view of the respective NOₓ monitor (see section *Preferences* on page 112).

Always determine the NO₂/NOₓ 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 NOₓ Sensor P/N 56.03.003* on page 49 when mounting the NOₓ sensor for the first time and the instructions in the section *Replacing the NOₓ Sensor* on page 136 when replacing the NOₓ sensor.
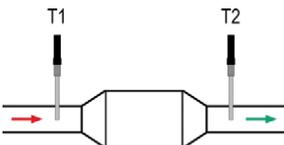
6.6 Installation Locations of Thermocouples

> **⚠ WARNING**
>
> **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 NOₓ 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.
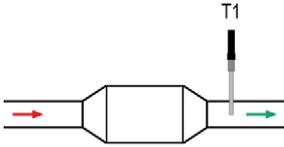
The following layouts are supported by the EasyNOₓ:

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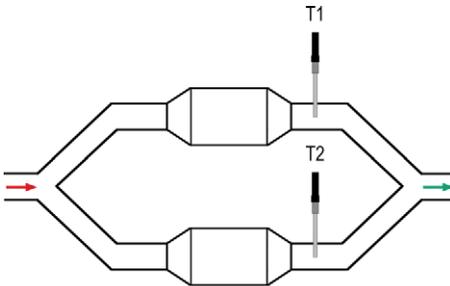
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–   After catalytic converter (*One After Cat*)

–   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 NOx
    sensor.

6.7 Installation Location of Manifold Pressure Sensor

> **WARNING**
>
> **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 absolute charging pressure as engine load indicator for normal operation detection and for this purpose use the NOx monitoring mode *MAP Naturally Aspirated* or *MAP Turbo* in the EasyNOx (see section *Preferences* on page 112), a manifold pressure sensor (absolute pressure sensor) 4–20 mA is required.

Install the manifold 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 manifold 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 Manifold Pressure Sensor, MAP Signal, Load Signal* on page 63.

❚ 6 Installation Instruction

6.8 Determining Charging Pressure for Normal Operation Detection

This step is mandatory if you want to use the absolute charging pressure as engine load indicator for normal operation detection and for this purpose use 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 charging 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 charging pressure must then be undercut, in the case of a turbocharged engine it must be exceeded.

6.9 Mounting of I/O Communication Module

> **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).

In the optional I/O communication modules, the node IDs are unchangeably pre-configured. The MOTORTECH part number (P/N) tells you which node ID is configured in the 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 with node ID 10 for use with the first NO_x monitor of the EasyNO$_x$ and the I/O communication module 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 on 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 are connected must comply with the maximum wire length of 250 m (820').

7.1 EasyNOₓ

The following sections describe the wiring of the EasyNO$_x$.

7.1.1 Opening and Closing of Housing

> **Operational safety!**
>
> The devices of the EasyNO$_x$ system 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$_x$ or to change the memory card of 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 ❸ in the section *Components* on page 36) 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 Wiring and Configuration

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:
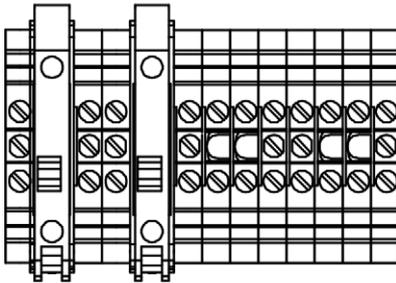
Earth	L +	L –	L –	L +	Shield	Lo	Hi	Com	Com	Hi	Lo	Shield
Power in 24 V⎓ max. 10 A		Power out max. 8 A			CAN1 CANopen				CAN2 J1939			

Designation		Function
Power in 24 V ⎓	Earth, L +, L −	Terminals for the power supply of the EasyNOx 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/NOx sensor module (e.g. via the CAN bus hybrid cable from MOTORTECH)
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 the optional I/O communication modules (see *CAN Bus Wiring CAN1* on page 67)
CAN2 J1939	Com, Hi, Lo, Shield	Terminals of the CAN bus interface CAN2 (protocol J1939) for connection to the first CAN bus/NOx sensor module (e.g. via the CAN bus hybrid cable from MOTORTECH)

Use suitable wire end ferrules (not supplied) 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 EasyNOx system to the power supply. The earth of the EasyNOx system must be connected to the earth of the system.

Only use shielded CAN cables for CAN bus wiring, and 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/NOx sensor modules must be routed in parallel.

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

Cable 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

▌ 7 Wiring and Configuration

Cable 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).

Unless you want to exchange the memory card as well, 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 57).

7.1.3 Replacement of Memory Card

> **WARNING**
>
> **Operational safety!**
>
> The memory card must remain inserted in the EasyNO$_x$ if you use its NO$_x$ monitor. Otherwise you will lose access to the recorded NO$_x$ monitoring data. If the memory card requires mandatory replacement, contact your MOTORTECH contact person (see *Customer Service Information* on page 133).

If necessary, you can replace the supplied memory card with another supported memory card (see section *Interfaces* on page 31). When inserting your memory card, make sure that it is not write-protected by an accidentally flipped write-protect switch. Also note that if you replace the memory card, you will lose access to the previously recorded NO$_x$ monitoring data.

Unless you additionally want to wire the EasyNO$_x$, close the housing door after having replaced the memory card and turn the locks of the door to the closed position (see section *Opening and Closing of Housing* on page 57).

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7.2 CAN Bus/NOₓ Sensor Module

The following sections describe the wiring and configuration of the CAN bus/NO$_x$ sensor module.

7.2.1 Opening and Closing of Module

> **Operational safety!**
>
> The devices of the EasyNO$_x$ system 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 8 in section *Components* 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.
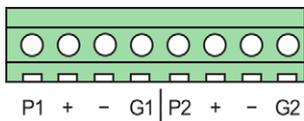

Connect the first thermocouple to input 1. Optionally, connect the second thermocouple to input 2 (see section *Installation Locations of Thermocouples* on page 54). Depending on the layout, connect the thermocouples as follows:

Layout	Input 1 (T_1)	Input 2 (T_2)
Before and after catalytic converter (*Before & After Cat*)	Before catalytic converter	After catalytic converter
After catalytic converter (*One After Cat*)	After catalytic converter	–
In two exhaust gas lines after catalytic converter (*Two After Cat*)	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.
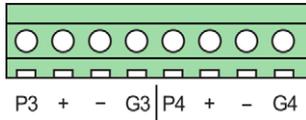
Connect the thermocouples as follows:
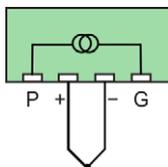
Connect the shields of the thermocouple leads with the cable glands. Do not lay the shields inside the CAN bus module.

7.2.4 Wiring of Manifold Pressure Sensor, MAP Signal, Load Signal
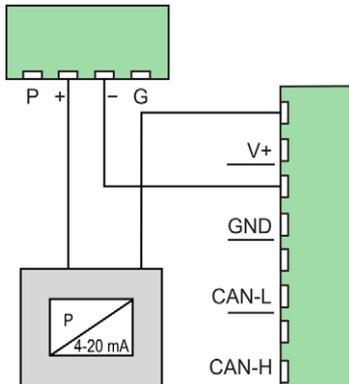
All cables must be fed through a cable gland at a suitable position of the CAN bus module. Use suitable wire end ferrules for each wire that you place on a terminal.


Depending on the intended NO_x monitoring mode (see *Preferences* on page 112), connect a manifold pressure sensor 4–20 mA, a MAP 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 on the right 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 64).

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 manifold pressure sensor as shown in the following illustration. The cable cross-section of the power supply cable from the manifold pressure sensor should be at least 0.5 mm². For smaller cable cross-sections, ensure that the cable is suitably protected.


Connect active signal sources 4–20 mA (MAP signal, load signal) as shown in the following illustration. Use shielded wires for connecting active signals 4–20 mA.
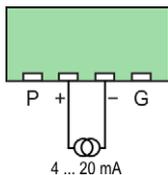
❚ 7 Wiring and Configuration

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.
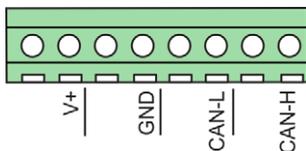
Designation	Function
V+, GND	Terminals for the supply voltage coming from the Easy-NO$_x$ or from the first CAN bus module and for passing through the supply voltage to the NO$_x$ sensor and optionally to a second CAN bus module
CAN-L, CAN-H	Terminals for the CAN cable coming from the EasyNO$_x$ or from 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. 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. 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 *Node ID NO$_x$ Sensor* on page 65)

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   Termination on

Term   Term
Off/On   Off/On

7.2.8 Node ID NO$_x$ Sensor

NOTICE	**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).

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 (*NOx:1*): Put the grey wire on the *GND* terminal.

– Second NO$_x$ monitor (*NOx:2*): Do not connect the grey wire.

7 Wiring and Configuration

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 (*NOx:1*)	0	0	0	0	0	0	1	0
Second NO$_x$ monitor (*NOx:2*)	1	0	0	0	0	0	1	0

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 *NOx*) in the *Device Setup* view of the EasyNO$_x$ (see section *Adding a Device* on page 82). Set up your EasyNO$_x$ system in such a way that the first NO$_x$ monitor (*NOx:1*) monitors the first engine and the second NO$_x$ monitor (*NOx:2*) monitors the second engine.

7.3 CAN Bus Wiring CAN1

The CAN bus interface CAN1 of the EasyNO$_x$ connects the EasyNO$_x$ to a CANopen® network. This CANopen® network is used to connect the EasyNO$_x$ to an optional I/O communication module and other devices supported by the EasyNO$_x$. The EasyNO$_x$ functions as NMT master 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 wire 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. Use shielded CAN cables only.

The EasyNO$_x$ has a built-in 120 Ω terminating resistor and must therefore be the first device in the CANopen® network. The following diagram shows as an example the wiring of the EasyNO$_x$ with four other devices:
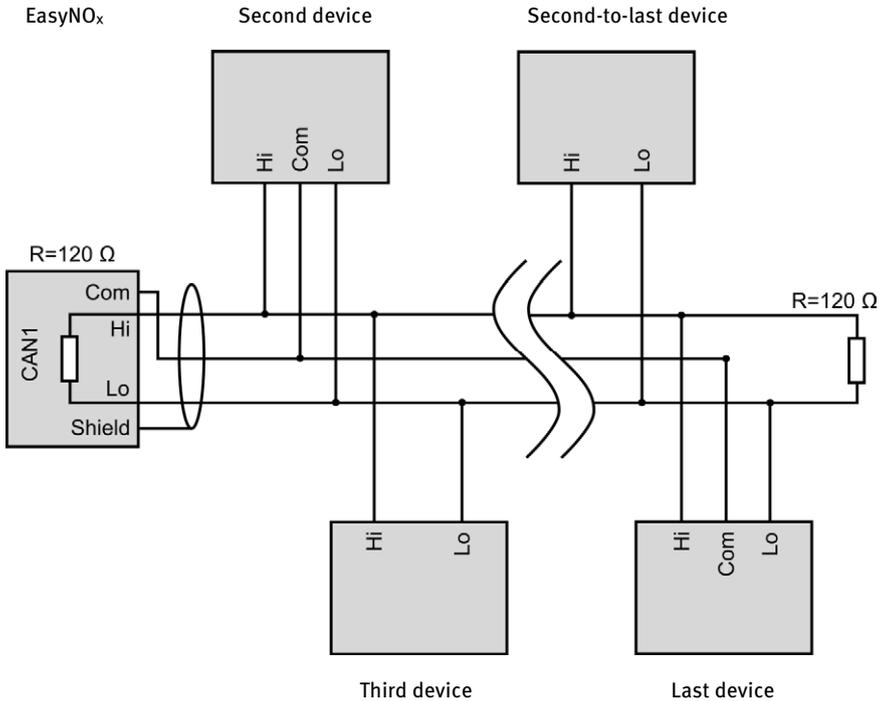
❚ 7 Wiring and Configuration

Common mode voltage in CAN bus

Error-free communication of the devices on 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.

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 wire length depends on the bit rate:

Bit rate	Maximum wire 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.
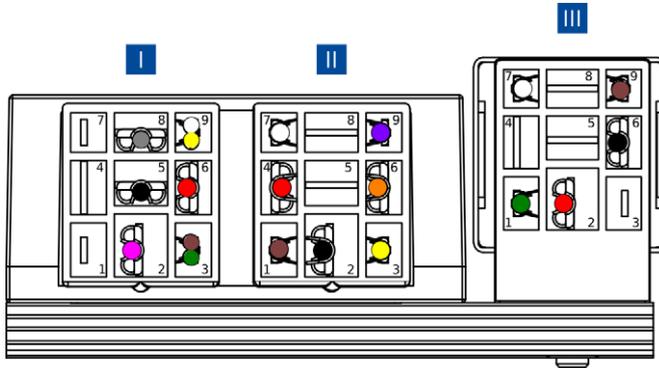
The EasyNO$_x$ is delivered with a bit rate set to 250 kbit/s.

7.4 I/O Communication Module

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

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7.4.1 Assignment

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

I Relay connector left

Contact	Wire color	Assignment	Function
1	–	–	Not used
2	Pink	Binary input	Function configurable (see *Binary Inputs* 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 (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 *Analog Inputs* 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

▌ 7 Wiring and Configuration

II Relay connector center

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 *Binary Outputs* 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 *Binary Outputs* 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 *Binary Outputs* on page 125)

III Relay connector right

Contact	Wire color	Assignment	Function
1	Green	Analog output	Function configurable (see *Analog Outputs* 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

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7.4.2 Wiring of Power Supply

The I/O communication module is designed for wiring via a terminal strip in the control cabinet. The I/O communication module must be supplied with power via the control cabinet of the respective engine. For this purpose, use the wires L– and L+ of the left relay connector ▮.

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 and the EasyNOx is as small as possible.

7.4.3 CAN Bus Wiring, CAN Bus Termination

The I/O communication module is designed for wiring via a terminal strip in the control cabinet.

> **i NOTICE**
>
> **Common mode voltage in CAN bus**
>
> Error-free communication of the devices on 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.

On the left relay connector ▮ of the I/O communication module, 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 is the supply voltage ground.

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

7.4.4 Wiring of Inputs and Outputs

The I/O communication module is designed for wiring via a terminal strip in the control cabinet.

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

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

7.4.5 Device Setup EasyNO$_x$

For each I/O communication module you use, add an I/O communication module (display name *BPlus*) in the *Device Setup* view of the EasyNO$_x$ (see section *Adding a Device* on page 82).

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 Easy-NO$_x$ 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$_x$.

8 General Operation

General functions and setting options for the EasyNOx are described in this chapter. You can find information on the menus of added devices in chapter *Devices* on page 98.

> **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 77.

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:
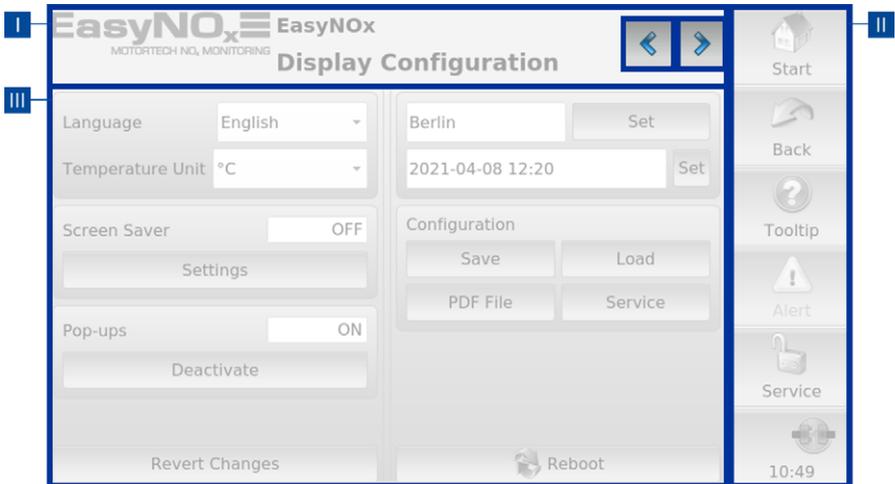
▮I Title Area

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. Simultaneously, tapping on the logo also creates a screenshot of the current view, provided that a USB flash drive is inserted in the EasyNO$_x$, which has the folder *temp* in its root directory. 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 ► .

▮II Menu Bar

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.

▮III Main Window

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

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8.3 Menu Bar

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

Symbol	Function
Start	With the *Start* button you reach the *Start Menu*. There is more information in the section *Start Menu* on page 77.
Back	With the *Back* button you reach the next higher operating level of the EasyNO$_x$.
Tooltip	Information on the buttons and functions can be displayed in pop-up windows. Proceed as follows: 1. In the menu bar, tap the *Tooltip* button. ► The *Tooltip* button is now activated and framed light blue. 2. Tap a button or an area of the display. ► A pop-up window with information opens. ► The *Tooltip* button is deactivated. 3. Tap the screen at any location to close the pop-up window. To get information about other buttons and areas, the *Tooltip* button must be reactivated.
Alert	The *Alert* button in the menu bar can display two states: – If the button is grayed, there are no messages. – The button is activated when messages are present. To acknowledge messages, tap the activated button. ► The *Event Log* view opens. The filter is automatically set so that only messages of devices that have reported alarms, warnings, and errors are displayed. ► The *Alert* button is grayed out. ► In the *Start Menu*, devices which had a yellow frame now get a green frame again.

▌ 8 General Operation

Symbol	Function
Service	This button informs about the status of the access control: – *Operator*, *Service*, *Master*: The corresponding access level is set. – *Locked*: The *Read Only* access level is set. – *Disabled*: The access control is disabled. By tapping this button, you can access the *Access Control* view. There is more information in the section *Access Control* on page 90.
10:49	Status information of added devices is shown in the lowest field of the menu bar. The communication status symbol provides information on the following states: There is a connection to all added devices. The connection is not established to all added devices. No other device is connected. The system time is displayed at the very bottom. If you tap the button for the connection status, the *Event Log* view opens. There is more information in the section *Event Log* on page 96.

8.4 Start Menu

The *Start Menu* will be displayed after the EasyNO$_x$ 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 85.

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 the devices to which the EasyNO$_x$ is connected via the CAN bus interface CAN1. There is more information in the section *Connection* on page 89.

▮ 8 General Operation

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 97.

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.
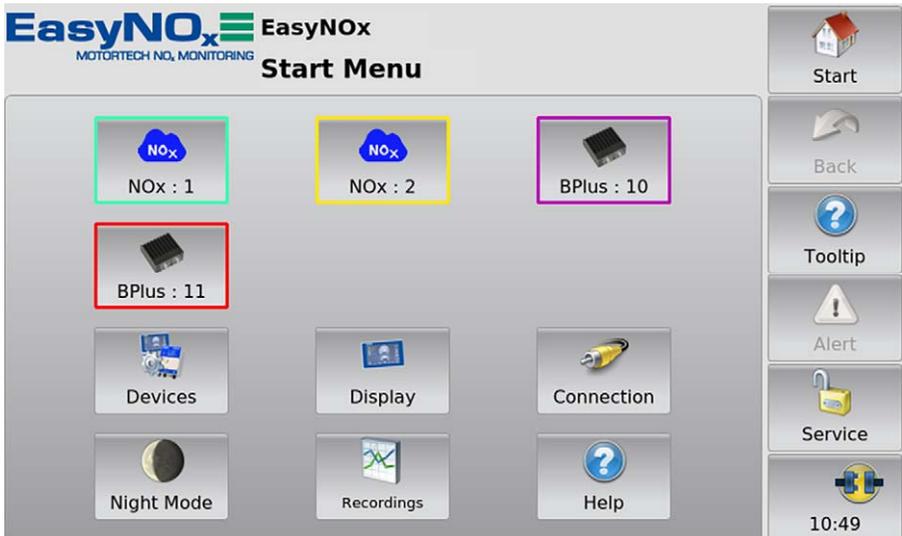
The frames of the device buttons have the following meaning:

– Green: 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 98.

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. If you tap a device, the class, the node ID or sequence number (depending on the device), and the device logging status are displayed below.

– Edit
With the button you open the *Edit Device* dialog. You can find more information in the section *Editing a Device* on page 85.

❚ 8 General Operation

– 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 82.

– Delete

Tap this button to delete an added device. You can find more information in the section *Deleting a Device* on page 85.

– Device Activation

As a rule, all devices with which you have purchased the EasyNO$_x$ are activated ex works. 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

In this area, use the *Unlock* button to activate the binary outputs *Warning* and *Error* of the EasyNO$_x$. Use the *Lock* button to deactivate them. In order to use the activated binary outputs *Warning* and *Error* with other devices, they must each be linked to a binary output of the optionally available I/O communication module (see section *Binary Outputs* on page 125). The status displays *Warning* and *Error* indicate the switching status of these binary outputs. Additionally, you can switch the binary outputs *Warning* and *Error* on and off for testing purposes. To do so, use the *Test* button to open the *Binary Output Test* window. In this window, you can switch the binary outputs and thereby test the behavior of the devices that are connected to the binary outputs. The NO$_x$ monitor of the EasyNO$_x$ indicates exceedances of the provisional daily average via the binary outputs *Warning* and *Error* (see section *Overview* on page 100).

> **Operational safety!**
>
> The EasyNO$_x$ and the software are not designed for safety-critical applications. The binary inputs and outputs of the EasyNO$_x$ system must not be used for safety-critical purposes.

> **Operational safety!**
>
> Testing the binary outputs affects the connected devices. Before performing tests, make sure that switching the binary 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. 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 activation of EasyNO$_x$ packages**
>
> In an EasyNO$_x$ package 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 an EasyNO$_x$ package supporting one engine, a software dongle is included with this extension package. This software dongle activates the second NO$_x$ monitor of 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 82).

All devices with which you have purchased the EasyNO$_x$ are normally activated ex works (e.g. the first and second NO$_x$ monitor in an EasyNO$_x$ package for two engines). You can retrofit additional devices by purchasing a software dongle from your MOTORTECH contact person (see *Customer Service Information* on page 133). With this software dongle, you then activate the respective device in your EasyNO$_x$. After activation, you can add the device to the device configuration of your EasyNO$_x$.

▍ 8 General Operation

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 25) or display it in the EasyNO$_x$ in the *Display Information* view (see section *Display* on page 85).

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 from MOTORTECH into your EasyNO$_x$.

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 82) and use it.

> **ℹ NOTICE**
>
> **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

> **ℹ NOTICE**
>
> **Maximum number of added devices**
>
> Simultaneously, a maximum of two NO$_x$ monitors, two I/O communication modules, and one generic device can be integrated in the EasyNO$_x$.

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To add a device, proceed as follows:

1. In the *Device Setup* view, tap the *Add* button.

    ▸ The dialog *Add Device* opens.

    🔑✅ 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. For additional devices you need an activation (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 (see section *Device Activation* on page 81). The device cannot be added to the device configuration.

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

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.

▋8 General Operation

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 (*BPlus*) or sequential number (*NOx*).
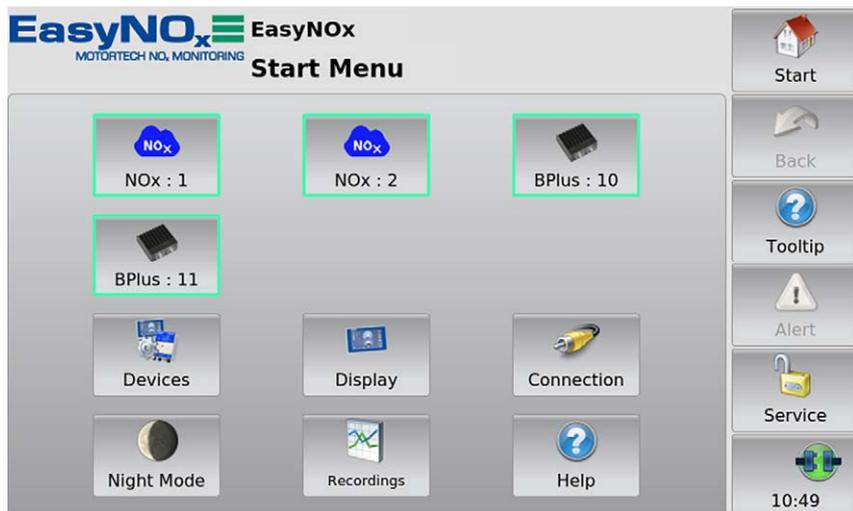
8.4.1.3 Editing a Device

In order to edit the settings for a device, 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*.

8.4.1.4 Deleting a Device

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.

▮ 8 General Operation

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) or a slide show starts. 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.

– **Revert Changes**
  Tap *Revert Changes* to restore the status of the last stored configuration. Date and time are not reset.

– **Time Zone**
  Tap *Set* to set the time zone.

❚ 8 General Operation

– 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 90).

– Configuration
You have the following options:

– Save
Save the configuration of your EasyNO$_x$ to a USB flash drive. This enables you to easily restore the configuration of your device or transfer it to other devices. The following configuration files are saved:

File	Content
Configuration.xml	General configuration of the EasyNO$_x$ including the list of added devices from the *Device Configuration* view
nox_config.json	Configuration of all added NO$_x$ monitors in the EasyNO$_x$
Dev401_xx.json	Configuration of an added I/O communication module (display name *BPlus*) with node ID xx

– 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 133) 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!

8 General Operation

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$_x$

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.

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8.4.3 Connection

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

In this view, settings can be made within the CANopen® network to which the EasyNO$_x$ is connected via the CAN bus interface CAN1.

❚ 8 General Operation

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*.
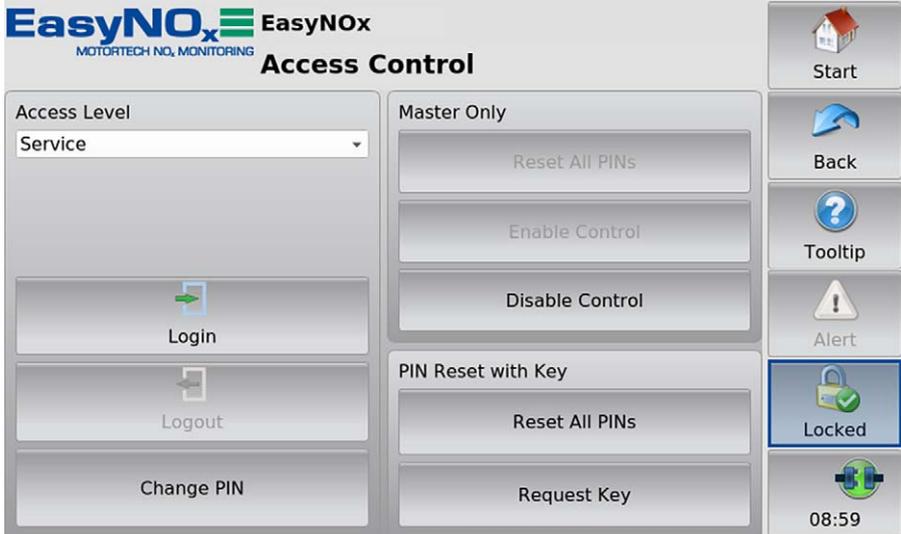
The access control of the EasyNO$_x$ serves to protect sensitive data and functions. When access control is disabled, there are no restrictions with the exception of the NO$_x$ monitor views. With enabled access control (see section *Enabling/Disabling Access Control* on page 92), four access levels 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: *Locked*)	– Switch between day and night mode – Activate and deactivate pop-ups
Operator	– Read Only rights – Access to NO$_x$ monitor – Export daily log, annual log, and NO$_x$ monitoring report to a USB flash drive – Display configuration

Access level	Rights

Service	– Operator rights
	– Change settings of the following devices:
	    – NO$_x$ monitor
	    – I/O Communication Module
	– Complete display configuration
	– Activate devices

Master	– Service rights – Set system time and system date – Enable/Disable access control – Reset all PINs – Firmware Update

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.

▌ 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 94).

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 93.

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 94).

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 the disable 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*:

❚ 8 General Operation

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.

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 93).

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 93).

2. In the area *Master Only*, tap on *Reset All PINs*.

    ▸   All PINs are reset to the value *0000*.

<table>
<tr>
<td>

i

NOTICE
</td>
<td>

Assign new PINs!

After resetting the PINs, new PINs must be assigned to all access levels to guarantee maximum security.
</td>
</tr>
</table>

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.

    ▸   Send the new PIN Reset Request Key (*New PRRK*) 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 the USB flash drive containing the MOTORTECH key 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 EasyNO$_x$.

Date	Time	ID	Device	Message
2020-10-20	09:33:31	67	EasyNOx	Access control enabled.
2020-10-20	09:33:31	1	NOx	No enable input defined.
2020-10-20	09:33:31	502	NOx	Access control not active.
2020-10-20	09:33:31	67	EasyNOx	Started 1.4.1
2020-10-20	09:30:43	67	EasyNOx	Demo mode switched on
2020-10-20	09:30:42	67	EasyNOx	Access level set to Service.
2020-10-20	09:28:03	67	EasyNOx	Access control enabled.
2020-10-20	09:28:03	1	NOx	No enable input defined.
2020-10-20	09:28:03	502	NOx	Access control not active.
2020-10-20	09:28:03	67	EasyNOx	Started 1.4.1
2020-10-19	13:39:58	67	EasyNOx	Demo mode switched on
2020-10-19	13:39:55	67	EasyNOx	Access level set to Service.
2020-10-19	13:39:18	67	EasyNOx	Access control enabled.
2020-10-19	13:39:18	1	NOx	No enable input defined.
2020-10-19	13:39:18	502	NOx	Access control not active.

Buttons: Start, Back, Tooltip, Alert, Service, 11:23

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. A maximum of 1,000 messages are displayed and stored by the EasyNO$_x$. 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.

8 General Operation

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 EasyNOₓ 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 the respective 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 EasyNOₓ as follows:

– *Help* button in *Start Menu*

– *Help* button in the *NOₓ Main Menu* view of an added NOₓ monitor

– *Help* button in the *Main Menu* of an added I/O communication 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 EasyNOx.

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 NOx Monitor

> **NOx monitor: enable access control**
>
> The views of the NOx 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 90.

> **Automatic exit from NOx monitor**
>
> If you do not make any entries for 6 minutes or the screen saver switches on, the views of the NOx 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 NOx monitor.

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9.1.1 Main Menu

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

The main menu has the following buttons:

- **Overview**
  The button provides information about the current status of the NOx monitoring and provides access to the current trend of measured values. There is more information in the section *Overview* on page 100.

- **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 NOx monitor. There is more information in the section *Logbook* on page 108.

- **Export**
  The button provides access to the export function of the NOx monitor, which allows you to export the daily and annual logs logged by the NOx monitor as well as the NOx 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 NOx monitor. There is more information in the section *Preferences* on page 112.

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- Operator
  Use the button to specify the operator information for the NO monitoring report of the NOx monitor. The information specified here applies to both NOx monitors of the EasyNOx. There is more information in the section *Operator* on page 117.

- Sensor
  The button gives you access to the status information from the NOx sensor of the connected CAN bus/NOx sensor module. There is more information in the section *Sensor* on page 118.

- Help
  This button opens the operating manual of the EasyNOx. There is more information in the section *Help* on page 97.

9.1.2 Overview

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

- *NOx Monitoring*

- *NOx Trends*

The ◁ and ▷ buttons allow you to switch between the views.

The views are described as follows.

NOx monitor

This view displays the current status of the NOx monitor. The view varies depending on the set NOx monitoring mode. The various parameters of the NOx monitor can be set in the *NOx 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 NOx 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 NOx monitor of the EasyNOx signals the threshold exceedance correspondingly via the binary outputs *Warning* and *Error*.

– Red: The provisional daily average currently exceeds the configured level limit. The NOx monitor has switched the binary output *Error*.

– Yellow: The provisional daily average currently exceeds the configured warning level. The NOx monitor has switched the binary output *Warning*.

– Gray: The provisional daily average currently does not exceed any of the configured thresholds. The NOx monitor has not switched any of the binary outputs.

– 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 EasyNOx (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.

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- 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 41)
  - 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

- T1, T2
 Display of the currently measured exhaust gas temperature at the designated measuring points (see section *Installation Locations of Thermocouples* on page 54). *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 charging 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.

– NOx

Display of the current nitrogen oxide reading from the connected NOx 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 NOx sensor. If the background of the entry is purple, the measured value is not transmitted via the CAN bus.

– Op

Shows the normal operation hours registered so far by the NOx 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

Failure hour counter, which shows the number of hours that the daily average of the NOx concentration has been above the configured level limit in the current calendar year so far (see section *Failure Hour Counter* on page 43). 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 level of the failure hour counter is exceeded.

- White (day mode) or black (night mode): None of the configured thresholds is exceeded.

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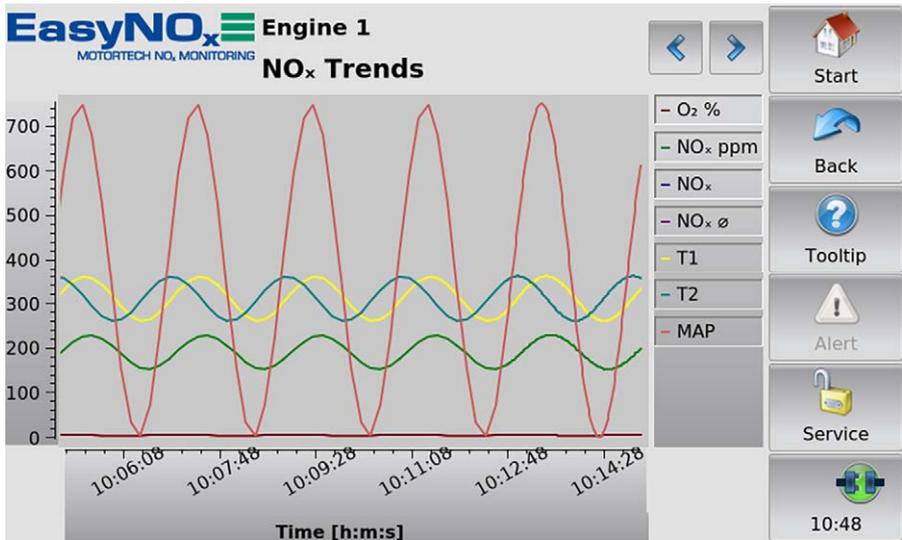
In the *NOx Trends* view, you get information about the current trend of the measured values and the provisional nitrogen oxide daily average for the last 10 minutes. You can hide or show individual trends by using the legend.

The following trends are displayed:

– O₂ %
  Trend of the oxygen reading from the connected NOx sensor

– NOx ppm
  Trend of the nitrogen oxide reading from the connected NOx sensor

– NOx
  Trend of the nitrogen oxide reading converted according to VDMA 6299:2019-09 (see section *Conversion of Nitrogen Oxide Readings* on page 41) in mg/Nm³

– NOx 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 54)

– MAP / Load / ---

The displayed trend depends on the selected monitoring mode. *MAP* displays the trend of the measured charging pressure in the NOx monitoring modes *MAP Naturally Aspirated* and *MAP Turbo*, *Load* the trend of the signalled load in the NOx monitoring modes *Load on CAN Module* and *Load via CANopen*. Three dashes (---) appear in the NOx monitoring modes *Off, Recording Only*, and *Start/Stop via CANopen*, and no trend is displayed.

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9.1.3 History

The *History* button in the main menu of an added NOx monitor opens the *NOx History* view.
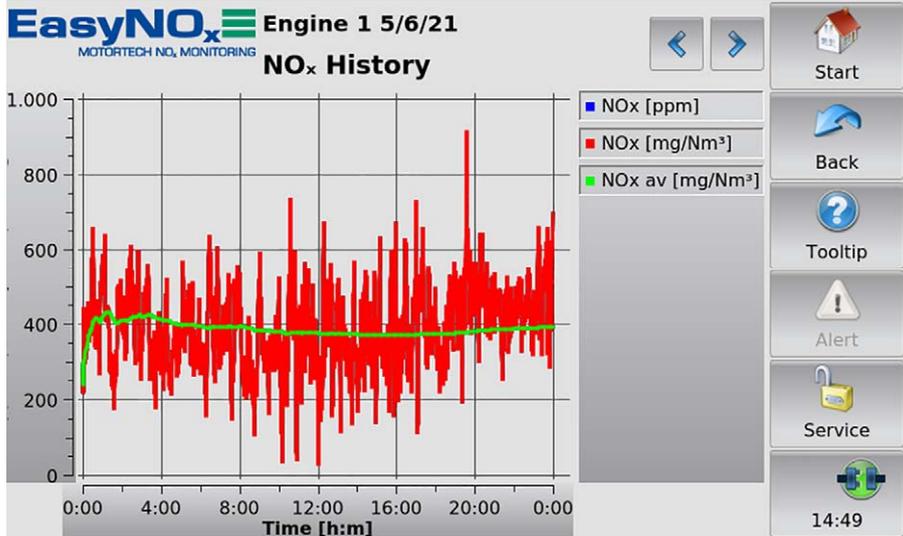
In this view, you can display the trends of selected measured values for each day from the daily logs.

The and buttons allow you to switch between the days.

You can hide or show individual trends 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
NOx	NOx [ppm]	Daily trend of the nitrogen oxide reading from the connected NOx sensor
	NOx [mg/Nm³]	Daily trend of the nitrogen oxide reading converted according to VDMA 6299:2019-09 (see *Conversion of Nitrogen Oxide Readings* on page 41)
	NOx av [mg/Nm³]	Daily trend of the provisional daily average of the nitrogen oxide readings converted according to VDMA 6299:2019-09

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Parameter group	Parameters	Description
Temperature	T1 [°C]	Daily trend of the measured exhaust gas temperature at measuring point T1 (see *Installation Locations of Thermocouples* on page 54)
	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

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9.1.4 Logbook

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

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.

Add Entry to Logbook	✖
Name/Organization	Company
Measure	Service ▾
Event	Regular engine maintenance performed ▾
Description	
	✔ OK ⬅ Cancel

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*.

> **ℹ NOTICE**
>
> **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.

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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 the respective 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 NOx monitor opens the *NOx Export* view.

From this view, you can copy daily and annual logs of the NOx monitor (see section *Daily Log* on page 44 and section *Annual Log* on page 44) and the NOx monitoring report including the log-book (see section *NOx Monitoring Report* on page 45) to a USB flash drive inserted in the Easy-NOx.

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.

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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 117).

– 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:
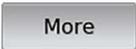
More

> **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 133).

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

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9.1.6 Preferences

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

Note that changes in this view are not saved and applied by the NOx monitor until you exit the view. Also note that you can only edit the NOx 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 NOx monitoring mode:

  – Off
    NOx monitoring is disabled. The nitrogen oxide and oxygen readings from the NOx sensor are not recorded.

  – Recording Only
    The nitrogen oxide and oxygen readings from the NOx sensor are recorded, but NOx monitoring is deactivated.

  – MAP Naturally Aspirated
    For normal operation detection of the NOx monitor, the absolute charging pressure of a naturally aspirated engine serves as an indicator for the engine load. For this purpose, a manifold pressure sensor must be connected to input 3 of the respective CAN bus module (see *Wiring of Manifold Pressure Sensor, MAP Signal, Load Signal* on page 63).

- MAP Turbo

  For normal operation detection of the NO$_X$ monitor, the absolute charging pressure of a turbo engine serves as an indicator for the engine load. For this purpose, a manifold pressure sensor must be connected to input 3 of the respective CAN bus module (see *Wiring of Manifold Pressure Sensor, MAP Signal, Load Signal* on page 63).

- 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 Manifold Pressure Sensor, MAP Signal, Load Signal* on page 63).

- Load via CANopen

  The NO$_X$ monitor detects normal operation by means of the load signal connected to the analog input of the optional I/O communication module. For this purpose, the function *Load Input for NOx* must be assigned to the analog input of the respective I/O communication 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 optional I/O communication module. For this purpose, the function *Normal Operation Release for NOx* 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 absolute manifold 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 absolute charging pressure which must be undercut for normal operation detection (see *Determining Charging Pressure for Normal Operation Detection* on page 56).

  - MAP ›

    In the NO$_X$ monitoring mode *MAP Turbo*, you set the absolute charging pressure which has to be exceeded for normal operation detection (see *Determining Charging Pressure for Normal Operation Detection* on page 56).

  - 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).

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- ---

  In NOx monitoring modes *Off* and *Recording Only*, normal operation detection is disabled. In the NOx monitoring mode *Start/Stop via CANopen*, the NOx monitor receives the normal operation release from the master control.

- K

  Enter the NO_2/NO_x ratio of the exhaust gas from your system. The NO_2/NO_x ratio must be determined at the mounting position of the NOx sensor's sensing element before start-up of NOx monitoring and each time the NOx sensor is replaced. More information on this is available in the section *Determining the NO_2/NO_x Ratio* on page 54.

- KNO_2

  Enter the factor for the corrective calculation of the NOx sensor's NO_2 sensitivity. For the correction factor, refer to the entry *NO_2 Gain* in the *NOx Sensor* view (see section *Sensor* on page 118).

- Level Limit

  Enter the daily average of the NOx concentration, which must not be exceeded under any circumstances. To use the NOx monitoring of the EasyNOx 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 NOx concentration above which the EasyNOx 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 NOx monitor, specify a time threshold that the NOx concentration may exceed the configured level limit as a maximum within one calendar year. If this time threshold is exceeded, the EasyNOx indicates this in the *NOx Monitoring* view in the failure hour counter *Alm* via a red status display.

- Time Warning

  For the failure hour counter of the NOx 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 EasyNOx indicates this in the *NOx Monitoring* view in the failure hour counter *Alm* via a yellow status display.

- 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 NOx 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 54):

  – 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.

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With the rights of the access level *Master*, the EasyNO$_x$ additionally displays the following entry in this view:

Simulation	Off (J1939) ▾

Risk of burning! Risk of destruction!

The *Simulation* entry must always be set to *Off (J1939)*, 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* entry must always be set to *Off (J1939)*. 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 133) immediately.

The *Simulation* entry is protected by a special PIN and may only be changed by MOTORTECH service. In addition, observe the preceding notices.

9.1.7 Operator

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

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

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9.1.8 Sensor

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

EasyNOx ≡ Engine 1			
NOx Sensor P/N 56.03.003			Start

NOx [ppm]		10.6	Heater Ratio	0		Zurück
OK	OK		NOx Gain [%]	0		
O₂ [%]		17.1	NOx Offset [ppm]	0		Tooltip
OK	OK		Operating Hours	455		
Heater	Auto					Alarm
OK	OK					
Power	OK		O₂ p Gain [%/bar]	0.48		Service
Diagnosis	Complete		NOx p Gain [%/bar]	0.09		
Software	Z597 99 01		NO₂ Gain	0.85		
ECU ID	2267220397 0000002135 24V		NH₃ Gain	1.1		10:24
			Self-Diagnosis	255		

In this view, status information from the NOx sensor of the connected CAN bus/NOx sensor module is displayed. The type of NOx 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:

– NOx [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 NOx sensor, or the NOx 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 NOx sensor, or the NOx 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.

– **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.

– **O_2 p Gain [%/bar] / α{λ} [bar]**
 The displayed entry depends on the connected NO_x sensor.

 – NO_x sensor P/N 56.03.003: **O_2 p Gain [%/bar]**
  Display of O_2 correction factor

 – NO_x sensor P/N 56.03.002: **α{λ} [bar]**
  Display of the pressure correction constant of the linear lambda signal

– **NO_x p Gain [%/bar] / α{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: **α{NO_x} [bar]**
  Display of the pressure correction constant of the NO_x signal

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    – **NO_2 Gain**
Display of the factor for the corrective calculation of the NO_2 sensitivity. Enter the value displayed here in the *NOx Setup* view as NO_2 correction factor in the entry *KNO₂* (see section *Preferences* on page 112).

    – **NH_3 Gain**
Display of the factor for the corrective calculation of the NH_3 sensitivity

    – **Self-Diagnosis**
Final result of the NOx sensor's self-diagnosis displayed as a ratio to the reference value defined by the manufacturer

9.2 I/O Communication Module

This section describes the functions and views of an added I/O communication module.

9.2.1 Main Menu

The main menu of an added I/O communication module can be opened in the start menu via the *BPlus* button.
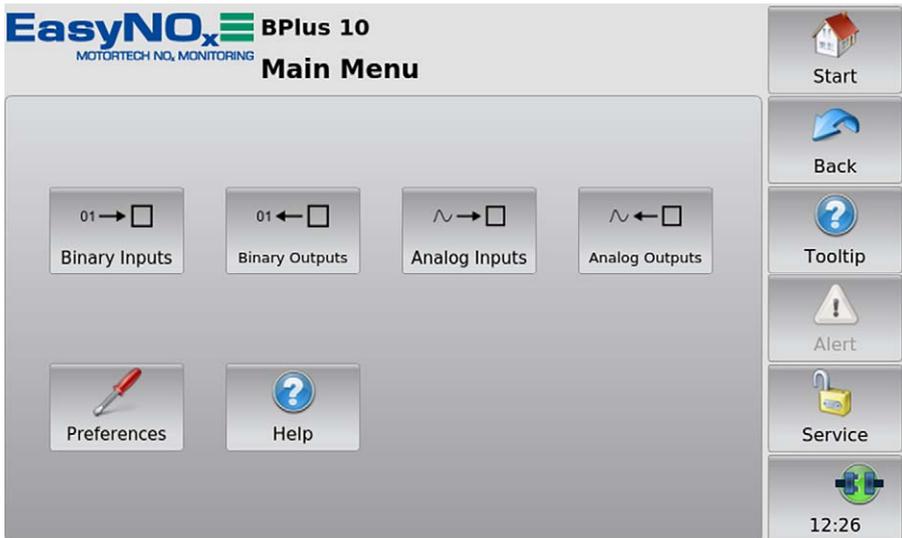
The main menu has the following buttons:

– **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 below).

– **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.

▌9 Devices

Illustration example binary inputs / outputs

– **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 as raw value in the *Value* column (see illustration example below).

– **Analog Outputs**
  The button opens the *Analog Outputs* view. In this view, the outgoing signal that is output by the I/O communication module at the corresponding analog output in the *Channel* column is displayed as raw value in the *Value* column.

Illustration example analog inputs / outputs

– **Preferences**
  The button provides access to the settings of the I/O communication 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 97.

9.2.2 Preferences

The *Preferences* button in the main menu of an added I/O communication module opens the *Preferences* view.
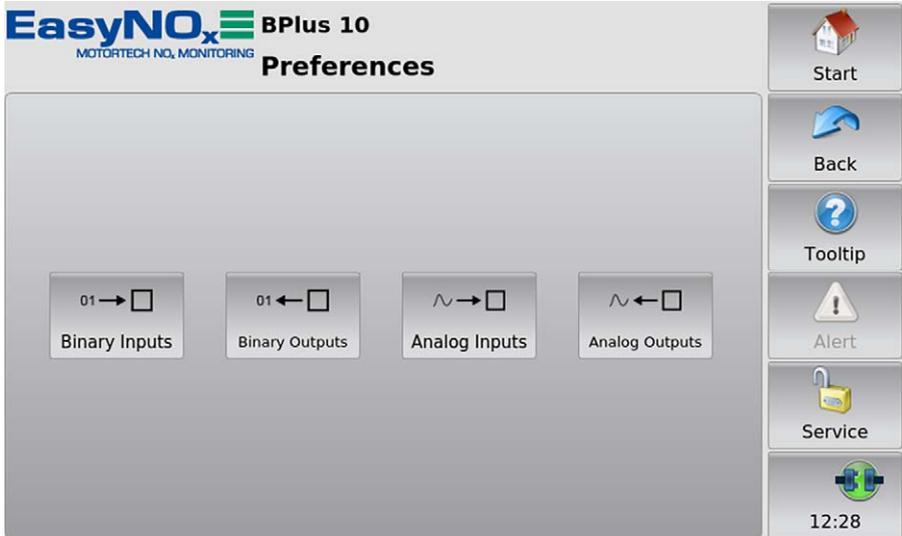
The *Preferences* view contains the following buttons:

– **Binary Inputs**
  Use the button to open a view in which you can set the function of the binary input for the re-spective I/O communication module. 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 set the function of the binary outputs for the respective I/O communication module. There is more information in the section *Binary Out-puts* on page 125.

– **Analog Inputs**
  Use the button to open a view in which you can set the function of the analog inputs for the respective I/O communication module. There is more information in the section *Analog In-puts* on page 126.

– **Analog Outputs**
  Use the button to open a view in which you can set the function of the analog outputs for the respective I/O communication module. There is more information in the section *Analog Out-puts* on page 127.

9 Devices

9.2.2.1 Binary Inputs

The *Binary Inputs* button in the *Preferences* view of an added I/O communication module opens the *Binary Inputs* view.

Note that changes in this view are not saved and applied by the I/O communication module until you exit the view. Use the drop-down list to link the binary input of the I/O communication module displayed in the *Channel* column to the following functions:

– Not Used
  The binary input is not linked to any function.

– Normal Operation Release for NOx1 / NOx2
  A master control can signal to the respective NOx monitor of the EasyNOx via a closed binary input that the conditions for normal operation are met by the engine. In NOx 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 opens the *Binary Outputs* view.

Channel	Linked to Function
1	Cat. Temperature Error NOx1 ▾
2	NOx Exceedance NOx1 ▾
3	Normal Operation NOx1 ▾

EasyNOx BPlus 10 — **Binary Outputs** (Start, Back, Tooltip, Alert, Service, 13:00)

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

– **Not Used**
   The binary output is not linked to any function.

– **Error Output, Warning Output**
   The binary output of the respective I/O communication 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 communication module if a corresponding monitoring function of the EasyNO$_x$ 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 communication 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 communication module.

❚ 9 Devices

– **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 communication module.

9.2.2.3 Analog Inputs

The *Analog Inputs* button in the *Preferences* view of an added I/O communication module opens the *Analog Inputs* view.

Note that changes in this view are not saved and applied by the I/O communication module until you exit the view. Use the drop-down list to link the analog input of the I/O communication module displayed in the *Channel* column to the following functions:

– **Not Used**
   The analog input is not linked to any function.

– **Load Input for NOx1 / NOx2**
   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 opens the *Analog Outputs* view.
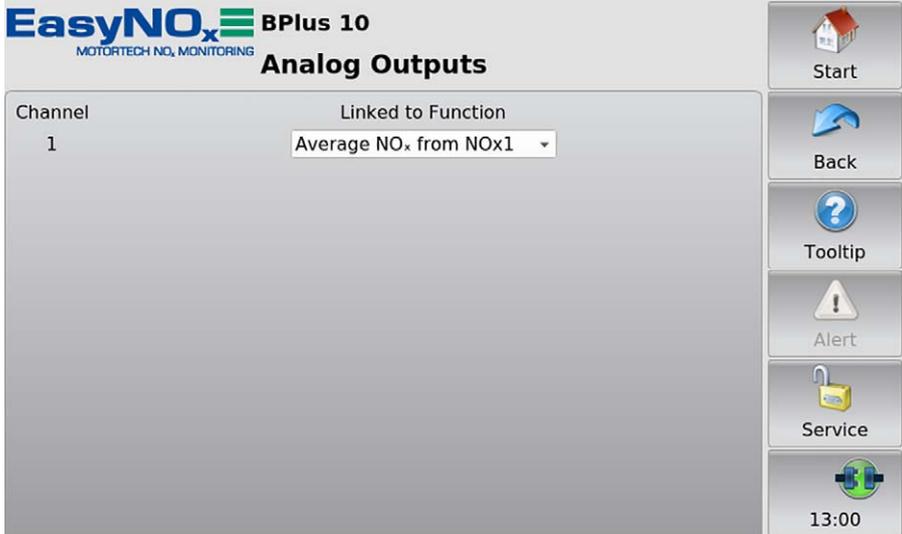
Note that changes in this view are not saved and applied by the I/O communication module until you exit the view. Use the drop-down list to link the analog output of the I/O communication module displayed in the *Channel* column to the following functions:

– Not Used
The analog output input is not linked to any function.

– Average NO$_x$ from NOx1 / NOx2
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 41) as determined by the respective NO$_x$ monitor. Scaling: 4 mA correspond to 0 mg/Nm³, 20 mA correspond to 1,000 mg/Nm³.

– Actual NO$_x$ from NOx1 / NOx2
Output of the nitrogen oxide reading currently measured by the respective NO$_x$ monitor converted according to VDMA 6299:2019-09. Scaling: 4 mA correspond to 0 mg/Nm³, 20 mA correspond to 1,000 mg/Nm³.

▌ 9 Devices

9.3 Generic Device

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

> **Generic device is not displayed in the start menu**
>
> The generic device appears in the *Device Setup* view in the list of added devices (display name *Generic*). The device is 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 96).

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, and the I/O communication modules 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 66 and section *Bit Rate CAN Bus Module* on page 66).

– In both CAN buses, make sure that they are correctly terminated (see section *CAN Bus Termination* on page 65 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 54).

– Make sure that the NO_2 correction factor (KNO_2) 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 NO_2/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 NO_2/NO_x Ratio* on page 54).

– 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 44).

– Ensure that you have specified the operator data in the NO_x monitor (see section *Operator* on page 117).

– 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 90).

– Make sure that the time zone as well as date and time are set correctly in the $EasyNO_x$ (see section *Display* on page 85).

– 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 85).

10.2 Shutdown

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

❚ 10 Operation

10.3 Software Update

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

	Back up device activations, configuration, and logs
NOTICE	Before updating the software, back up the activated devices (see section *Devices* on page 79) and the EasyNOx configuration (see section *Display* on page 85).
	To back up the logs, remove the memory card from the EasyNOx. Note that in this state, the NOx monitor of the EasyNOx will not record any data. For each year the NOx 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.

You receive software updates for the EasyNOx 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 EasyNOx is displayed in the *Display Information* view (see section *Display* on page 85).

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 EasyNOx. The *Display Information* view (see section *Display* on page 85) displays the installed board support package of your EasyNOx. 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.

Software Update

Installer Version: 2.2.0
Board Support Package (BSP): rocko-7.0-0

Available Updates

Package	Installed	On USB	Select
Installer	2.1.3	2.2.0	✔
Program	1.6.1	1.8.0	✔
Help Files	Build 44465	Build 48724	✔

▶ Install   Quit   文A Language   ? Help

---
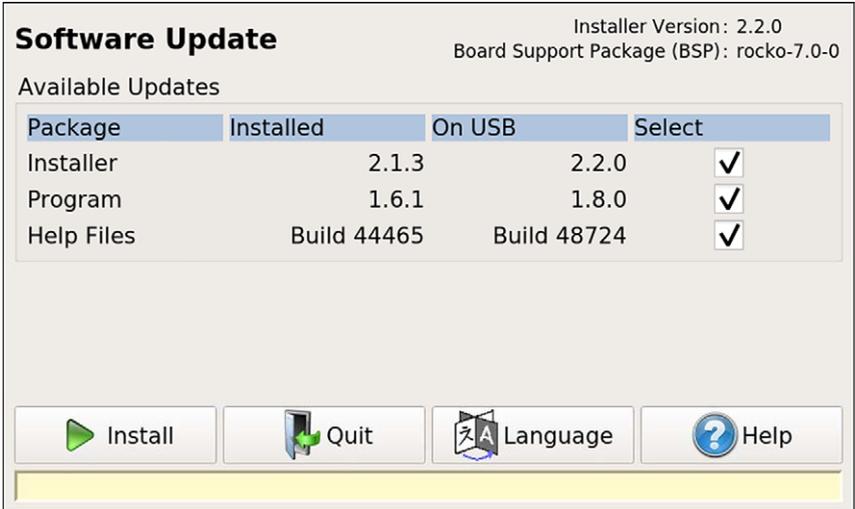
5. Available update packages are displayed in the *Package* column. If necessary, tap on the *Language* button to change the language. Under *Installed* the version of the respective package installed on the EasyNO$_x$ is displayed, under *On USB* the version to which the respective package in the EasyNO$_x$ will be updated. As a rule, the suitable update packages are preselected. 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.	Establish the connection to the relevant devices.
	The node ID of at least one added device is incorrect.	Set the correct node-ID for the relevant device.
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 *Cleaning the Touchscreen* 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 *Day Mode/ Night Mode* button in the *Start Menu*).
The system time is repeatedly incorrect.	The internal battery is dead.	Have the battery changed (see section *Battery Change* 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.
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 or the software has crashed).	Check the device and fix the problems.
The symbol appears in the *Add Device* dialog next to devices.	This device has not been activated.	Activate the device with a software dongle (see section *Device Activation* on page 81).

Fault	Possible cause	Solution
The device cannot be added, although the above symbol appears next to the device in the *Add Device* dialog.	The number of available activations for this device has been exceeded.	Activate the additional device with a software dongle (see section *Device Activation* on page 81).
When tapping on a device in the *Start Menu*, you get the error message "No connection to this device has been established!"	The wiring of the CAN bus is defective.	Check the CAN bus wiring and correct any defects found.
	The bit rate of the device does not correspond to the bit rate of the Easy-NOx.	Set the correct bit rate for the device.
	The node ID of at least one added device is incorrect.	Set the correct node-ID for the relevant device.

11.2 Customer Service Information

You can reach our customer service during business hours at the following phone and fax number, or by email:

Phone: +49 5141 93 99 0

Fax: +49 5141 93 99 99

Email: service@motortech.de

❚ 11 Errors

11.3 Returning Equipment for Repair / Inspection

To return the device for repair and inspection, obtain a return form from your MOTORTECH contact person (see *Customer Service Information* on page 133).

After you have completely filled out the return form and returned it to MOTORTECH, MOTORTECH will send you back the return form and a delivery note with RMA number specified. Enclose the return form with your device and attach the delivery note to the packaging so that it is clearly visible from the outside. This will ensure a speedy and smooth processing of your repair order.

Send the device with delivery note and return form to one of the two addresses below or to the nearest MOTORTECH representative:

MOTORTECH GmbH
Hogrevestr. 21–23
29223 Celle

Germany

Phone: +49 5141 93 99 0
Fax: +49 5141 93 99 98

www.motortech.de
motortech@motortech.de

MOTORTECH Americas, LLC
1400 Dealers Avenue, Suite A
New Orleans, LA 70123

USA

Phone: +1 504 355 4212
Fax: +1 504 355 4217

www.motortechamericas.com
info@motortechamericas.com

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.

▌ 12 Maintenance

Document maintenance work in logbook

Note that all maintenance work on the EasyNOx that affects its NOx monitoring must be documented in the logbook of the respective NOx 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 EasyNOx touchscreen. Do not use organic solvents. Do not use acidic or alkaline solutions.

12.2 Cleaning the NOx Sensor

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

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

▌ 12 Maintenance

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.

- 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 133).

- 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 133).

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 118). 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 NOx sensor:

> **Operational safety!**
>
> To safely dismount the NOx sensor, be sure to observe the following:
>
> – To protect the NOx sensor and yourself, wear ESD-compliant work gloves. To protect the NOx 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 dismounting.
>
> – The NOx sensor must not be live during dismounting 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 arcing, sparking, or short circuit may occur.

> **Operational safety!**
>
> The NOx sensor must not be used any further under any circumstances if it is damaged or the sensing element of the NOx 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 133).

> **Operational safety!**
>
> Proper functioning of the NOx 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 NOx sensor P/N 56.03.003 may be mounted a maximum of one time, the sensing element of the NOx sensor P/N 56.03.002 a maximum of two times. The electrical connection to the evaluation unit of both NOx 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 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 54.

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:
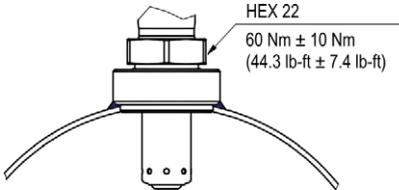
HEX 22
60 Nm ± 10 Nm
(44.3 lb-ft ± 7.4 lb-ft)

P/N 56.03.002:

HEX 22
50 Nm ± 10 Nm
(36.9 lb-ft ± 7.4 lb-ft)
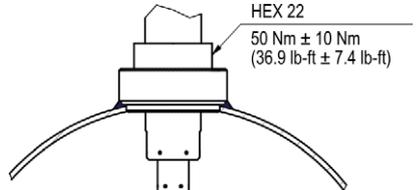
13. Then lay the connection cable between the sensing element and the evaluation unit. In doing so, observe the following.

P/N 56.03.003:
Comply with the specifications in the section *Laying the Connection Cable* on page 52.

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 EasyNOx system back into operation, correct the NO_2/NO_x ratio determined above in the *NOx 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 NO_2 correction factor of the NO_x sensor in the *NOx 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 EasyNOx.

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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GAS ENGINE TECHNOLOGY

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Spark Plugs & Accessories

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