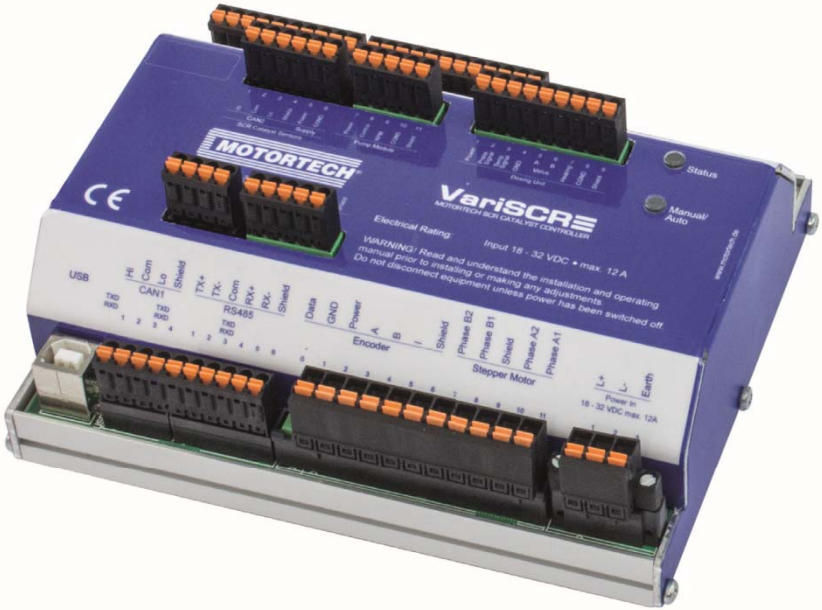
MOTORTECH

# VariSCR – NOx Emission Controller

## Operating Manual




P/N 01.50.025 – EN | Rev. 06/2020

VariSCR
MOTORTECH NOx EMISSION CONTROLLER

Original instructions

# Table of Contents

# Table of Contents

# Table of Contents

# 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.


**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 |
| CPU | Central Processing Unit | | |
| CSV | Comma-separated Values | | Text file for storage or exchange of structured data |
| DC | Direct Current | | |
| EMC | Electromagnetic Compatibility | | Compatibility of electrical or electronic equipment items with their surroundings |
| ESD | Electrostatic Discharge | | |
| LED | Light Emitting Diode | | Light emitting electronic semiconductor |
| MAP | Manifold Absolute Pressure | | |
| MAT | Manifold Air Temperature | | |
| MICT | MOTORTECH Integrated Configuration Tool | | Configuration software for MOTORTECH control units |

# 1 General Information

| Abb. | Term | Description | Explanation |
|---|---|---|---|
| SCR | Selective Catalytic Reduction | | Technology for the reduction of nitrogen oxides in exhaust gases |
| USB | Universal Serial Bus | | Serial connection system to link a computer to external devices |

# 2 Safety Instructions

## 2.1 General Safety Instructions

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.
- Avoid all activities that can impair the function of the equipment.
- Operate the equipment only while it is in proper condition.
- Investigate all changes that occur during operation of the gas engine or electronic engine control.
- 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 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 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.

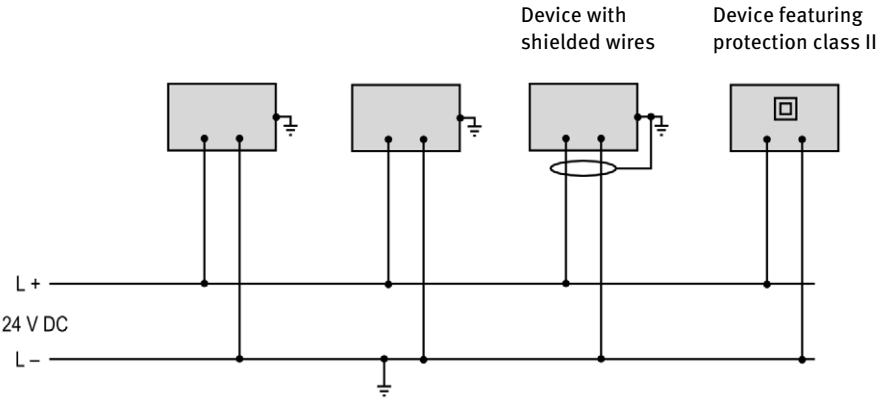
## 2.3 Information on Electric Isolation

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

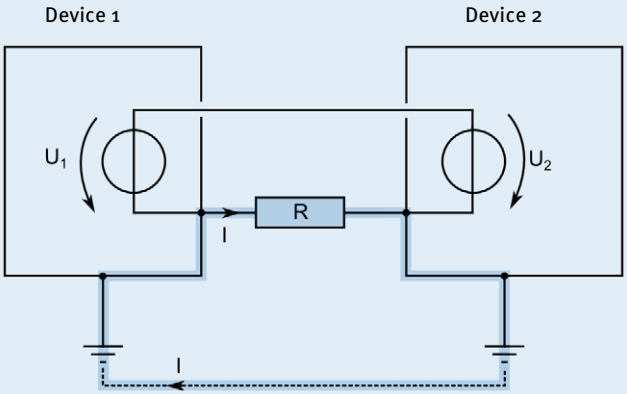



NOTICE

**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.




Ground loop

# 2 Safety Instructions

## 2.4 Special Safety Instructions for the Device


**Explosion hazard!**

Do not disconnect any connectors while the system is live. If the system is located in a hazardous area, there is a risk of explosion.


**Explosion hazard!**

Only use the $NO_x$ sensor for measurement in non-explosive gas mixtures, as explosive gas mixtures can ignite on the hot sensing element. Especially in the case of engine malfunction, make sure that no unburned gas mixture enters the exhaust pipe.


**Operational safety!**

All screws of the connectors must be adequately tightened.


**Operational safety!**

The proper functioning of the device is only guaranteed if the device is operated within the permissible supply voltage range. Therefore, use a power supply in accordance with the specifications in the operating manual.


**Risk of injury!**

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

The VariSCR emission controller must not be electrically connected to circuits which carry dangerously high voltages or which could lead to a single failure.

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 dangerous voltages or could carry in the event of a failure.
- All currently applicable standards and regulations must be taken into account.


**Risk of burning!**

The surfaces of the system may heat up to high temperatures. Ensure good heat transfer through ventilation when installing in the control cabinet.


**Risk of burning!**

There is a risk of burns when touching the sensing element of the $NO_x$ sensor because the sensing element becomes hot during operation. Therefore, note the following points:

- Therefore, install the sensing element on the exhaust pipe at a suitable location where people at the plant cannot be burned by it, or attach a protective grid around the sensing element to prevent contact with the sensing element.
- The sensing element must have cooled down sufficiently at the end of operation before you can touch the sensing element again.


**Danger of damage to health!**

If AdBlue® evaporates, harmful gases can be produced. Therefore, avoid contact of AdBlue® with hot surfaces (e.g. on the catalytic converter). Furthermore, when working with AdBlue®, observe the applicable safety regulations.


**Danger of interference with radio reception!**

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

## 2.5 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 $NO_x$ emission controller VariSCR is a component of an exhaust aftertreatment system based on an SCR catalytic converter. The emission controller evaluates the signals from sensors and controls the AdBlue® injection into the catalytic converter according to the parameters determined. The signals from the MAP and MAT sensors and the $NO_x$ sensor upstream of the catalytic converter are used for feed forward control. The signal from the $NO_x$ sensor after the catalytic converter then enables the system to be regulated more precisely.

To ensure the system functions properly, the temperature at the dosing valve is monitored and, if necessary, it is cooled or heated. In addition, the emission controller offers the following monitoring functions:

- Monitoring of pressure and speed of the AdBlue® pump
- Monitoring of the exhaust temperature before and after the catalytic converter
- Monitoring of the $NO_x$ sensors and temperature sensors function

The emission controller is configured using a connected computer. The software used for this purpose is also used to display current system data and error messages.

## 3.2 Applications

The full functionality of the VariSCR emission controller can only be guaranteed if the components of the MOTORTECH SCR system are used, consisting of:

- SCR catalytic converter
- $NO_x$ sensors
- Temperature sensors
- Pump module
- Dosing unit
- MOTORTECH cable harnesses including MAT sensor PT100 and MAP sensor

Other required components (not included):

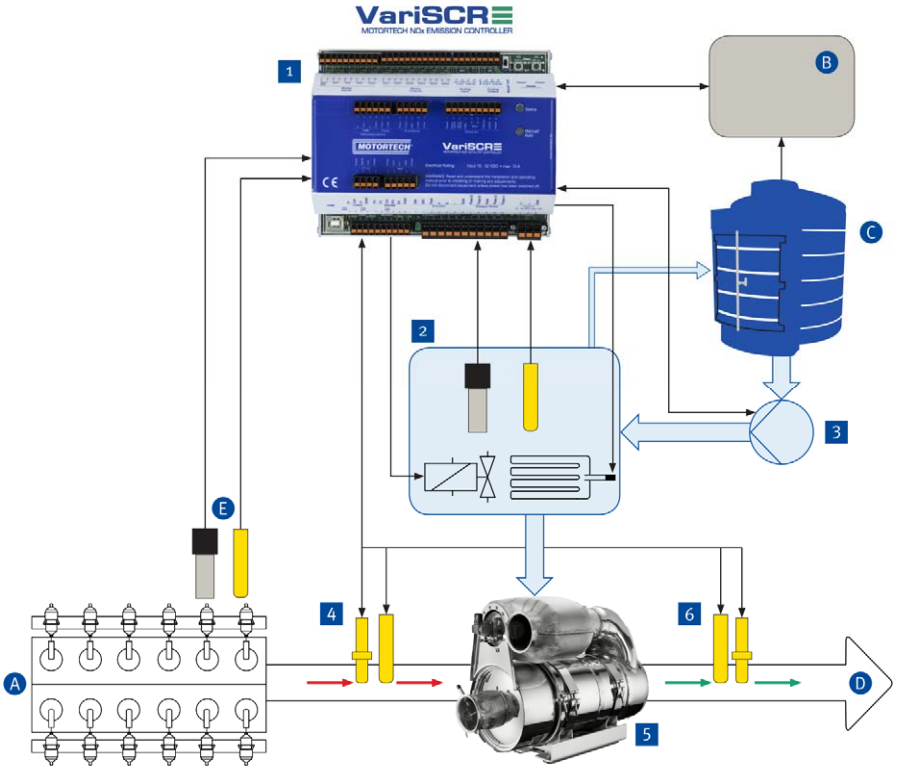
- Urea tank including level sensor and piping
- Master Generator & CHP Control System

Two SCR systems are generally required for V-engines.

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

# 3 Intended Use

## System Overview (Example)




1. NOx Emission controller VariSCR
2. Dosing unit (incl. pressure and temperature sensor, dosing valve and heating)
3. Pump module
4. NOx and temperature sensor before the SCR catalytic converter
5. SCR catalytic converter
6. NOx and temperature sensor after of the SCR catalytic converter

A. Engine
B. Master Generator & CHP Control System
C. AdBlue® tank
D. Exhaust tract
E. MAP and MAT sensor

# 4 Product Description

## 4.1 Technical Data

### 4.1.1 Certifications

The emission controller VariSCR is certified according to the following directives:

CE

EMC Directive 2014/30/EU

- EN 61326-1:2013 – Electrical equipment for measurement, control and laboratory use. EMC requirements. General requirements
- EN 55011:2009 + A1:2010 – Industrial, scientific and medical equipment. Radio-frequency disturbance characteristics. Limits and methods of measurement
  - Group 1, Class A

RoHS Directive 2011/65/EU

The EU Declaration of Conformity can be found as a PDF file on the storage device enclosed with the device.

### 4.1.2 Mechanical Data

The VariSCR emission controller has the following mechanical characteristics:

| Feature | Value |
|---|---|
| Dimensions | 160 mm x 126 mm x 61 mm (6.30" x 4.96" x 2.40")<br>(length x width x height) |
| Weight | 766 g (1.7 lbs) |
| Shape of device | See chapter *Overview Drawings* on page 22 |
| Mechanical environmental conditions | Protection: IP20 |
| Climatic environmental conditions | –20 °C to +60 °C (–4 °F to +140 °F)<br>Max. 85 % humidity without condensation<br>up to 3,000 m (9,842') above sea level |

### 4.1.3 Warning Notices on the Device

Top of Device

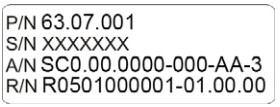
WARNING! Read and understand the installation and operating manual prior to installing or making any adjustments. Do not disconnect equipment unless power has been switched off.

# 4 Product Description

## 4.1.4 Product Identification – Labeling on the Device

You find the numbers required for unique product identification on the label on the side of the device:

- Part number of the emission controller (P/N)
- Serial number of the emission controller (S/N)
- Arrangement number of the emission controller (A/N)
- Revision number of the emission controller indicating its precise construction status (R/N)




(Exemplary representation)

## 4.1.5 Electrical Data

The VariSCR emission controller has the following electrical characteristics:

| Feature | Value |
|---|---|
| Power consumption | Max. 180 W |
| Power supply | Nominal voltage: 24 V DC<br>Operating voltage: 18 V DC to 32 V DC |
| Required current | Max. 10 A |

### Electrical Data for Inputs and Outputs

The inputs and outputs of the emission controller have the following electrical data:

| Inputs and outputs | Values/characteristics |
|---|---|
| Binary inputs | – Input voltage up to 32 V DC<br>– Input current at least 5 mA for high level (approx. 12 mA at 24 V DC)<br>– galvanically isolated (rated insulation voltage: max. 70 V DC)<br><br>When the reset signal is given, the high level must be present at the relevant input for at least 50 ms before it is possible to initiate the reset. |
| Binary outputs | – Inactive: output is high-impedance<br>– Active: output is low-impedance<br>– Switching voltage: max. 32 V<br>– Current: max. 100 mA<br>– Max. voltage drop at 100 mA: 2.5 V<br>– galvanically isolated (rated insulation voltage: max. 70 V DC) |
| Analog voltage input | – Permissible voltage: 0 V to 10 V<br>– Input resistance: 12.4 kΩ |
| Analog current input | – Permissible current: 0 mA to 20 mA<br>– Max. difference in potential relative to device ground: +3.5 V<br>– Input resistance: max. 25 Ω |
| Analog voltage output | – Output voltage: 0 V to 10 V<br>– Working resistance: min. 500 Ω |
| Analog current output | – Output current: 0 mA to 20 mA<br>– Working resistance: max. 500 Ω |

### Electrical Data for Connection of the Pump Module

The connections of the pump module have the following electrical data:

| Feature | Value |
|---|---|
| Power supply for the pump | 18 V DC to 32 V DC; max. 1.5 A |

# 4 Product Description

| Feature | Value |
|---|---|
| Output for control signal for pump speed | – Open collector<br>– Voltage: 18 V DC to 32 V DC<br>– PWM: 100 Hz<br>– Current: Max. 30 mA |
| Input for feedback signal for pump speed | – NPN with pull-up resistor 12 kΩ<br>– Input voltage up to 32 V DC<br>– Frequency: 0 Hz to 500 Hz (square wave signal) |

### Electrical Data for Connection of the Dosing Unit

The connections of the dosing unit have the following electrical data:

| Feature | Value |
|---|---|
| Power supply of the integrated sensors | 5 V DC; max. 30 mA |
| Analog voltage input for AdBlue® pressure | – Permissible voltage: 0 V DC to 4.5 V DC<br>– Measuring range: 0 bar to +19.5 bar abs. (0 psi to +282.8 psi abs.)<br>– Measuring tolerance: 2 % of measured value |
| Analog voltage input for AdBlue® temperature | – Permissible voltage: 3.3 V DC to 0.5 V DC<br>– Measuring range: –50 °C to +150 °C (–58 °F to +302 °F)<br>– Measuring tolerance:<br>+/–4 °C (in the range 0 °C to +90 °C)<br>+/–7.2 °F (in the range +32 °F to +194 °F) |
| Connection for the dosing valve | PWM: 5 kHz, 18 V to 32 V; max. 1 A |
| Connection for the heating resistor | Power supply: 18 V DC to 32 V DC; max. 2 A |

### Electrical Data of the Connections for the Sensors on the Catalytic Converter

The connections of the sensors have the following electrical data:

| Feature | Value |
|---|---|
| Power supply of the sensors | 18 V DC to 32 V DC; max. 1.5 A |

### Electrical Data of the Connections for the MAP and MAT Sensor

The connections of the sensors have the following electrical data:

| Feature | Value |
|---|---|
| Input for the MAP sensor | – Permissible current: 4 mA to 20 mA<br>– Measuring range: 0 bar to 3 bar (0 psi to 43.5 psi)<br>– Measuring tolerance: 4 % of measured value<br>– Common mode offset voltage at I in +/I in - against GND: 0 V DC to 3 V DC<br>– Power supply of the sensor: 15 V DC to 25 V DC; max. 30 A load |
| Input for the MAT sensor | – Sensor type: PT100<br>– Power supply: 2 mA<br>– Three-wire technology<br>– Measuring range: –50 °C to +150 °C (–58 °F to +302 °F)<br>– Measuring tolerance:<br>+/–1.5 °C(in the range –20 °C to +120 °C)<br>+/–2.7 °F (in the range –4 °F to +248 °F) |

## 4.1.6 Interfaces

### USB

– Compatible with USB 1.1 and USB 2.0

– The connector *type B* is only suitable for temporary data exchange and not for a permanent connection.

### CAN Bus 2.0B Interface

– As per ISO 11898, up to 1 Mbit/s

– Transient-proof (automotive classification)

– Max. 110 participants

### Modbus Interface

– RS485 standard

– Max. 32 participants

– Full duplex (4-pole) or half duplex (2-pole)

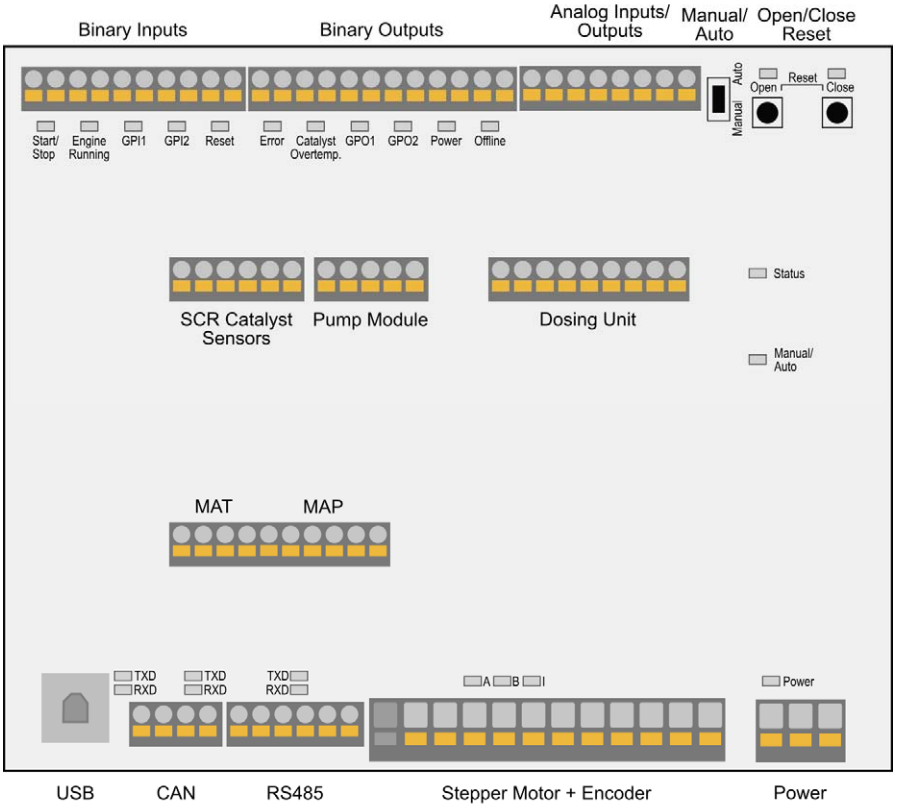
# 4 Product Description

**Field bus protocols**

No emission-specific values are currently available in the field bus protocols.

## 4.1.7 Overview Drawings

### Ports/Connections and LEDs



| Designation | Function |
|---|---|
| Binary Inputs | Binary inputs are available for a reset and a start/stop signal. The *Engine Running* input can be used to enable the optional mixture control (see *Wiring – Binary Inputs* on page 36). |
| Binary Outputs | The binary outputs signal the status of the emission controller and the SCR catalytic converter (see *Wiring – Binary Outputs* on page 37). |
| Analog Inputs/ Outputs | The analog inputs and outputs can be used for the optional mixture control. |
| Manual/Auto (switch) | Switch for changing between manual and automatic operation (see *Manual and Automatic Operation* on page 45) |
| Open/Close; Reset | An error can be reset by simultaneously pressing the *Open* and *Close* buttons. |
| SCR Catalyst Sensors | Connection of the NOx sensors and the temperature sensors before and after the catalytic converter via CAN bus |
| Pump Module | Connection of the pump module |
| Dosing Unit | Connection of the dosing unit |
| MAT | Connection of the temperature sensor |
| MAP | Connection pressure sensor |
| Status | The LED flashes:<br>– green: The emission controller works without errors.<br>– Orange: A warning occurred.<br>– red: An error occurred.<br>You can find details about status signaling in the following information box.<br>For additional information on warnings and errors, read section *Runtime Data – Message Log* on page 87. |
| Manual/Auto (LED) | The LED lights up:<br>– green: The emission controller is in automatic mode and is controlled by the master control.<br>– Orange: The emission controller is in manual mode. |
| USB | Port for data transmission to the PC. Data transmission is signaled by the blinking LEDs *TXD* and *RXD* (*TXD*=Data are being sent, *RXD*=Data are being received). |

# 4 Product Description

| Designation | Function |
|---|---|
| CAN | Connection for communication with a master control via CAN bus. Data transmission is signaled by the blinking LEDs *TXD* and *RXD* (*TXD*=Data are being sent, *RXD*=Data are being received). |
| RS485 | Port for communication via Modbus with superordinate control devices. Data transmission is signaled by the blinking LEDs *TXD* and *RXD* (*TXD*=Data are being sent, *RXD*=Data are being received). |
| Stepper Motor + Encoder | The connections are currently not in use. |
| Power | Connection for the supply voltage (see *Wiring – Power Supply* on page 28). This LED lights up if the supply voltage is available. |


**Status signaling**

The status of the VariSCR emission controller is signaled via the LED *Status*.

- Flashing **green**: Error-free operation
- Flashing **orange**: Warning
  Warnings can be acknowledged by simultaneous pressing of buttons *Open* and *Close* (in manual mode) or by the external reset signal.
  Warnings can for example be caused by:
  - Overload of the device
  - Overtemperature or over current error confirmed by MICT.
- Flashing **red**: Error
  Errors can be acknowledged by simultaneous pressing of buttons *Open* and *Close* or by the external reset signal. Errors can for example be caused by:
  - Overtemperature
  - Low voltage
  - Over current
- Alternate flashing of **red** and **green**:
  The supply voltage for the device was too low during start up.

# 5 Installation Instructions

## 5.1 Installation Instructions

Unpack the emission controller without damaging it and ensure that the operating manual is always within reach of the device and easily accessible. Installation locations where strong vibrations or ambient temperatures of below –20 °C (–4 °F) or above +60 °C (+140 °F) are present are not permissible and result in the warranty being voided.


**Risk of destruction!**

The device must not be installed directly on or at the engine, as vibration and heat may cause damage to electronic components.


**Risk of destruction!**

Make sure that the device is not covered and ensure sufficient circulation of air.

### Scope of Supply

The scope of supply of the VariSCR emission controller consists of the following components:

- $NO_x$ Emission controller VariSCR
- Storage device (USB flash drive or CD-ROM) including configuration software MICT
- USB cable
- Operating manual

### Installation of the VariSCR Emission Controller

1. Install the VariSCR Emission Controller on a horizontal DIN rail in the control cabinet.
2. When installing all other components of the exhaust aftertreatment system, observe the specifications and instructions of the respective manufacturers.

# 6 Wiring


**Risk of destruction!**

The VariSCR emission controller contains separate circuits. If these are connected, this can cause damage to the device. Please adhere to the following points:

- The *GND* connections must not be connected to each other.
- The *GND* connections must not be used for the supply (24 V DC).
- The *GND* connections may only be connected to the respective components (sensors, etc.).


**Risk of damage to the device!**

Incorrectly installed wiring can cause damage to the device. Please adhere to the following points:

- Do not disconnect connectors under load. This can cause an arc.
- Use the prescribed wire cross sections and suitable wire end ferrules.


**Wiring of components**

If you are not using wiring harnesses manufactured by MOTORTECH, carry out the wiring according to the following specifications:

- Power supply:
  3-wire cable, min. conductor cross-section 1.5 mm², max. cable length 15 m (49')
  If the cable length is longer, a respective larger cross-section must be selected.
- Pump:
  4-wire, shielded cable, min. conductor cross-section 1.5 mm², max. cable length 15 m (49')
- Dosing unit: Valve and heater:
  4-wire, shielded cable, min. conductor cross-section 1.0 mm², max. cable length 15 m (49')
- Dosing unit: Sensor signals (Press., Temp.):
  4-wire, shielded cable, min. conductor cross-section 0.2 mm², max. cable length 15 m (49')
- MAT sensor:
  3-wire cable, min. conductor cross-section 0.2 mm², max. cable length 15 m (49')
- MAP sensor:
  2-wire cable, min. conductor cross-section 0.2 mm², max. cable length 15 m (49')
- Binary inputs and outputs:
  multicore cable, min. conductor cross-section 0.2 mm², max. cable length 30 m (98')
- Analog inputs and outputs:
  multicore, shielded cable, min. conductor cross-section 0.2 mm², max. cable length 30 m (98')
- CAN bus:
  4-wire, shielded bus cable, twisted in pairs, min. conductor cross-section 0.34 mm², max. cable length 250 m (820') at 250 kbit/s
- Modbus:
  6-wire, shielded bus cable, twisted in pairs, min. conductor cross-section 0.25 mm², max. cable length 250 m (820')

# 6 Wiring

## 6.1 Wiring – Power Supply


**Risk of injury!**

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

The VariSCR emission controller must not be electrically connected to circuits which carry dangerously high voltages or which could lead to a single failure.

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 dangerous voltages or could carry in the event of a failure.
- All currently applicable standards and regulations must be taken into account.


**Risk of injury!**

When the power supply to the VariSCR emission controller is established, the connected pump builds up the pressure. If the AdBlue® pipe system is not completely closed at this time, AdBlue® may leak and cause injury (e.g. splashing into the eyes).

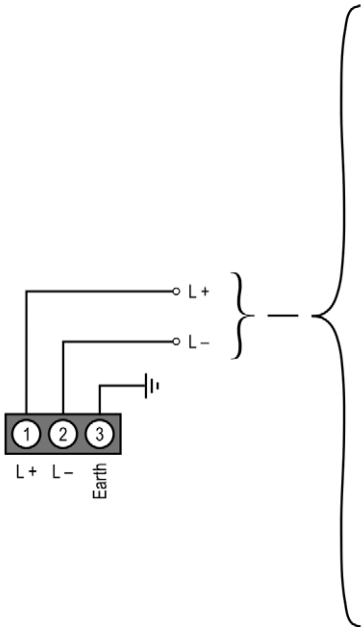

**Operational safety!**

The proper functioning of the device is only guaranteed if the device is operated within the permissible supply voltage range. Therefore, use a power supply in accordance with the specifications in the operating manual.

The power supply is wired using the 3-pole connector. In order to comply with the EMC requirements, it is necessary that the earth connection (Earth) is established with a cable that is routed separately from the negative pole (L –) and as short as possible. In addition to overcurrent protection, the power supply of the emission controller shall be equipped with a disconnecting device (e.g. by using a fuse switch disconnector).

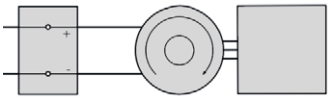
# 6 Wiring

L ≙ 18 V DC to 32 V DC (nominal voltage: 24 V DC)

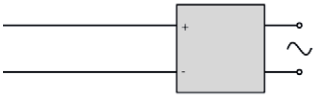



**Variations**

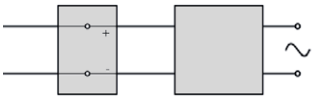
1 Battery Generator Control unit



2 Power supply



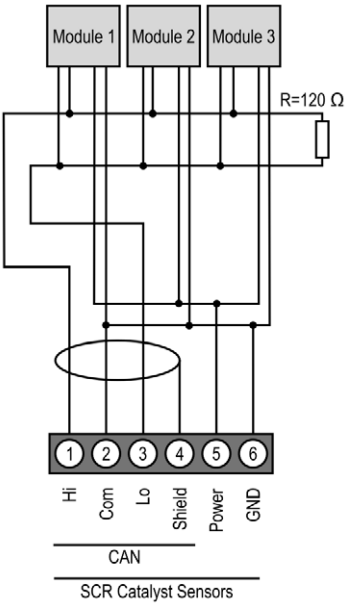
3 Battery Charger



# 6 Wiring

## 6.2 Wiring – Sensors on the SCR Catalytic Converter

The sensors before and after the SCR catalytic converter are connected via CAN bus. The pump module is wired using the 6-pole connector in the device cover. To meet EMC requirements, install the control units of the NOx sensors and the control unit of the two temperature sensors on an earthed metal plate.




| Module | Sensors |
|---|---|
| 1 | NOx sensor before the catalytic converter |
| 2 | NOx sensor after the catalytic converter |
| 3 | Temperature sensors before and after the catalytic converter |

The modules can be wired in any order. The sensors are permanently connected to the CAN modules.

| Pin | Designation | | Function |
|---|---|---|---|
| 1 | SCR Catalyst Sensors | CAN Hi | Connection of the CAN bus which integrates the NOx sensors and the temperature sensors before and after the catalytic converter. |
| 2 | | CAN Com | |
| 3 | | CAN Lo | |
| 4 | | CAN Shield | |
| 5 | | Power | Power supply of the sensors |
| 6 | | GND | |


**Wiring of the sensors on the SCR catalytic converter via CAN**

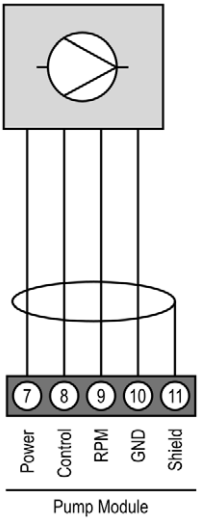
When wiring the sensors to the SCR catalytic converter via CAN, observe the following notes:

- Each bus end must be fitted with a terminating resistor of 120 Ω (see drawing).
- The maximum wire length is 250 m (820') depending on the bit rate.
- The stub lines to the sensors should be a maximum of 30 cm (11.81") long.
- Only use cables that are specified by the manufacturer for use in the CAN bus.

# 6 Wiring

## 6.3 Wiring – Pump Module

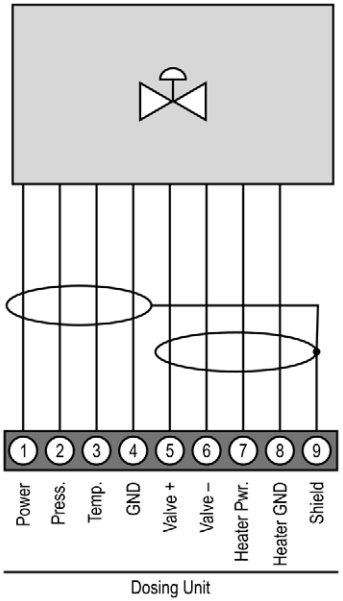
The pump module is wired using the 5-pole connector in the device cover.




| Pin | Designation | | Function |
|---|---|---|---|
| 7 | Pump Module | Power | Power supply of the pump module |
| 8 | | Control | Control signal for the pump |
| 9 | | RPM | Feedback signal pump speed |
| 10 | | GND | Ground of the pump module |
| 11 | | Shield | Shield |

## 6.4 Wiring – Dosing Unit

The dosing unit is wired using the 9-pole connector in the device cover.




| Pin | Designation | | Function |
|---|---|---|---|
| 1 | Dosing Unit | Power | Power supply of the dosing unit |
| 2 | | Press. | Pressure signal |
| 3 | | Temp. | Temperature signal |
| 4 | | GND | Ground of the dosing unit |
| 5 | | Valve + | Control signal for the dosing valve |
| 6 | | Valve – | |
| 7 | | Heater Pwr. | Control signal for the heating of the dosing unit |
| 8 | | Heater GND | |
| 9 | | Shield | Shield |

# 6 Wiring

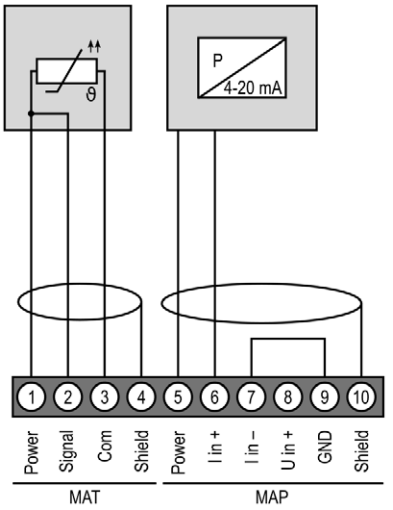

**Risk of destruction!**

The VariSCR emission controller contains separate circuits. If these are connected, this can cause damage to the device. Please adhere to the following points:

- The *GND* connections must not be connected to each other.
- The *GND* connections must not be used for the supply (24 V DC).
- The *GND* connections may only be connected to the respective components (sensors, etc.).

## 6.5 Wiring – MAT and MAP Sensor

The MAT and MAP sensors are wired via the 10-pole connector in the device cover. The wiring of the MAT sensor is carried out in a three-wire circuit. To meet EMC requirements, install the MAP and MAT sensors so that the sensor housings have a conductive connection to ground/earth.

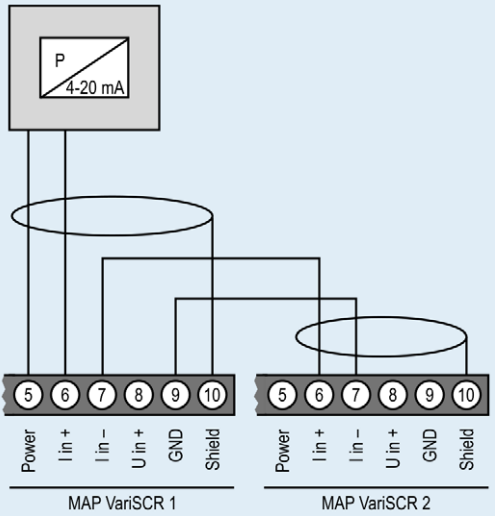


| Pin | Designation | | Function |
|---|---|---|---|
| 1 | MAT | Power | Current source for the temperature sensor |
| 2 | | Signal | Input for the temperature sensor signal |
| 3 | | Com | Common return |
| 4 | | Shield | Shield temperature sensor |
| 5 | MAP | Power | Power supply for the pressure sensor |
| 6 | | I in + | Current input for the pressure sensor signal |
| 7 | | I in – | |
| 8 | | U in + | Voltage input; not currently used |
| 9 | | GND | Ground of the pressure sensor |
| 10 | | Shield | Shield of the pressure sensor |

EXAMPLE

**MAP sensor wiring for V-engines**

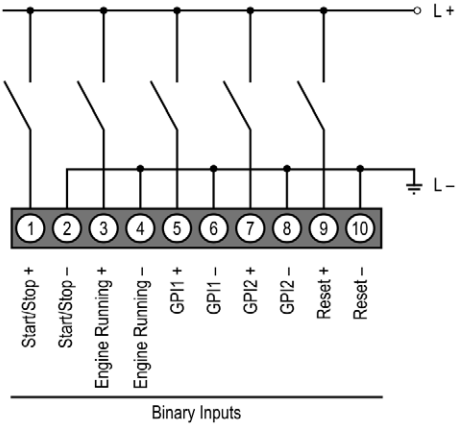
If two VariSCR emission controllers and only one MAP sensor are used for a V-engine, the wiring must be carried out as follows:



# 6 Wiring

## 6.6 Wiring – Binary Inputs

The binary inputs are wired using the 10-pole connector. The inputs can be switched both on the operating voltage side and on the ground side.
L = 5 V DC to 32 V DC

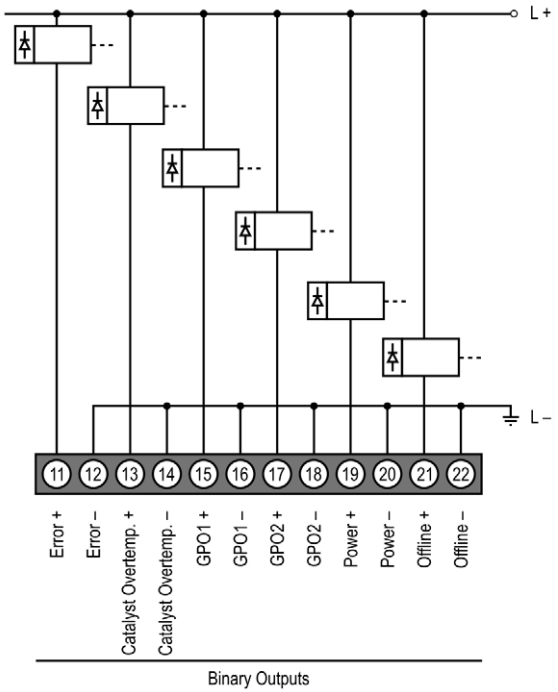



| Pin | Designation | | Function |
|---|---|---|---|
| 1<br>2 | | Start/Stop +<br>Start/Stop – | The binary input controls the release of the emission controller. When the high level is applied, the emission controller switches to the active operation mode. At engine standstill, the stop level (low level) must be applied in order to switch off the emission controller respectively to stop the injection of AdBlue®. |
| 3<br>4 | Binary Inputs | Engine Running +<br>Engine Running – | The binary input controls the release of the optional mixture control. |
| 5<br>6 | | GPI1 +<br>GPI1 – | Not currently used. |
| 7<br>8 | | GPI2 +<br>GPI2 – | Not currently used. |
| 9<br>10 | | Reset +<br>Reset – | If a high level is applied for at least 50 ms, the device exits the error mode and the emission controller is reset. |

## 6.7 Wiring – Binary Outputs

The binary outputs are wired using the 12-pole connector. The outputs can switch both the operating voltage and the ground.

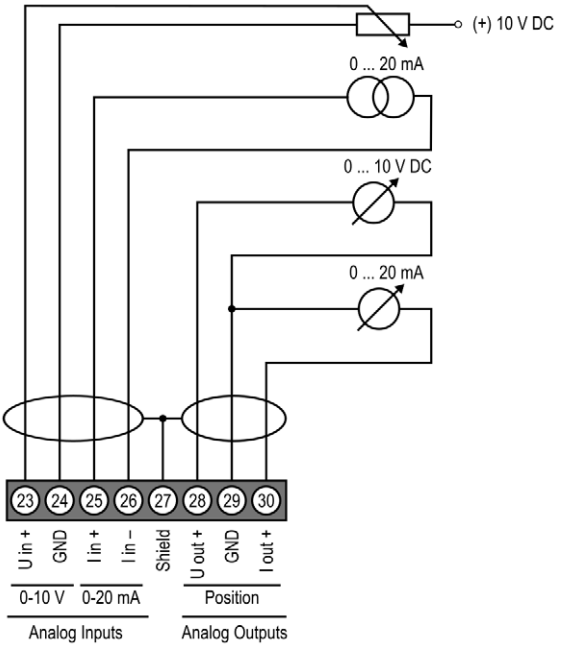
L = 5 V DC to 32 V DC; max. 100 mA



| Pin | Designation | | Function |
|---|---|---|---|
| 11<br>12 | | Error +<br>Error – | The output is low impedance if an error has occurred. Serious damages can occur. The engine should be switched off by the master control. To exit the error state, the error needs to be acknowledged (refer to *Acknowledging Faults* on page 107). |
| 13<br>14 | Binary Outputs | Catalyst Overtemp. +<br>Catalyst Overtemp. – | The output is low impedance if a too high exhaust gas temperature has been measured before or after the catalytic converter. |
| 15<br>16 | | GPO1 +<br>GPO1 – | – |
| 17<br>18 | | GPO2 +<br>GPO2 – | – |
| 19<br>20 | | Power +<br>Power – | The output is low impedance when the supply voltage is present and the emission controller is ready for operation. |
| 21<br>22 | | Offline +<br>Offline – | The output has a low impedance if the VariSCR emission controller is in a state in which the SCR control does not yet function or only functions to a limited extent (e.g. if the catalyst temperature is too low). |

## 6.8 Wiring – Analog Inputs and Outputs

The analog inputs and outputs are wired using the 8-pole plug.




| Pin | Designation | | Function |
|---|---|---|---|
| 23 | Analog Inputs | 0-10 V U in + | currently without function |
| 24 | | 0-10 V GND | |
| 25 | | 0-20 mA I in + | currently without function |
| 26 | | 0-20 mA I in – | |
| 27 | Shield | | Shield |
| 28 | Analog Outputs | Position U out + | Voltage and current output with shared ground. |
| 29 | | Position GND | |
| 30 | | Position I out + | |

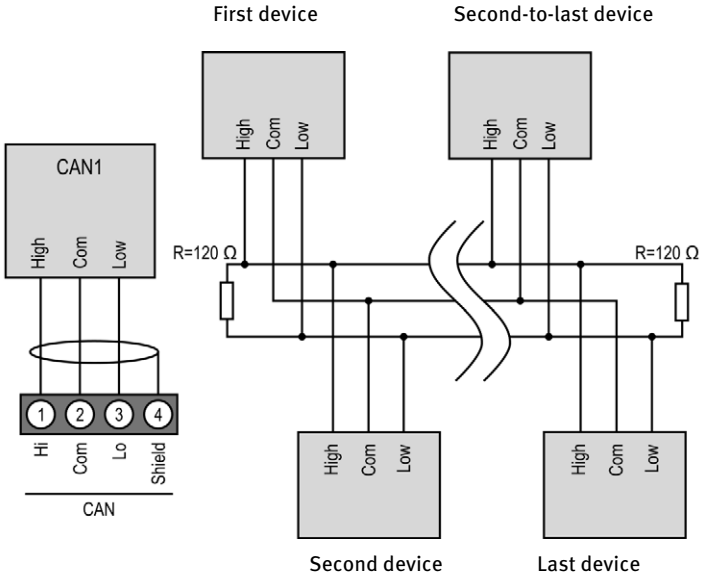
# 6 Wiring

**Unused inputs and outputs**

Please note that the terminals for the analog inputs and outputs not selected in the MICT must remain unoccupied.

## 6.9 Wiring – CAN Bus

The wiring of the CAN bus interface for communication with other devices is done via the 4-pole connector.




**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.


**Field bus protocols**

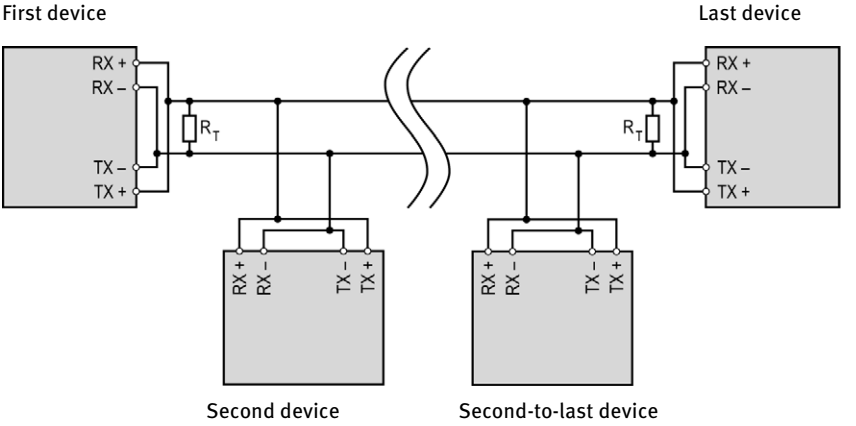
No emission-specific values are currently available in the field bus protocols.

# 6 Wiring

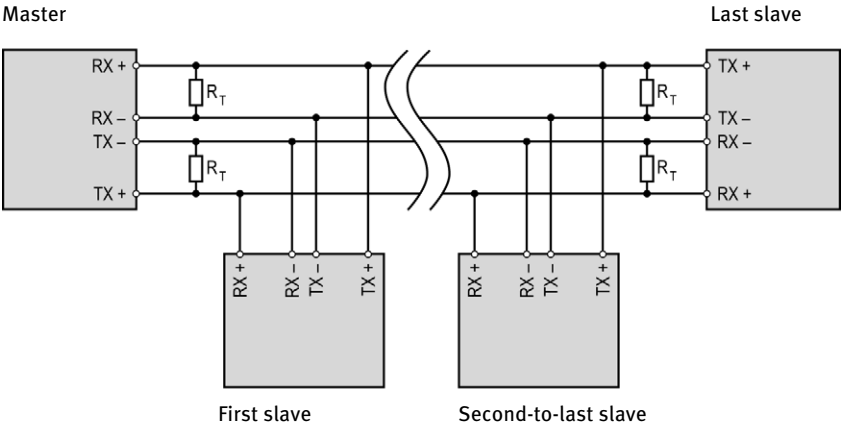
## 6.10 Wiring – Modbus (RS485)

The Modbus can be wired as half duplex or full duplex, and twisted cables must be used. With both variants the load resistance $R_T$ is the characteristic impedance of the cable.

### Wiring Half Duplex

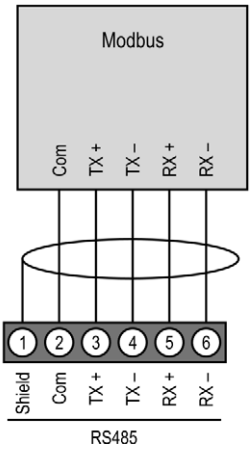



### Wiring Full Duplex



### Connection to VariSCR emission controller

The Modbus is wired using the 6-pole connector.




**Field bus protocols**

No emission-specific values are currently available in the field bus protocols.

# 7 Functions

## 7.1 NOx Emission Control

The emission regulation is carried out in two steps:

### Feed Forward Control

The required AdBlue® injection quantity is calculated from the measured values of the $NO_x$ sensor before of the catalytic converter, the MAP and MAT sensors and the exhaust gas temperature. The calculation is carried out with the aid of a map table with up to eight points. This can be configured via the MICT (see *Exhaust Control – SCR – Feed Forward Control* on page 70).

### Adjustment

Based on the measured value of the $NO_x$ sensor after the catalytic converter, a digital PID controller adjusts the configured emission value. By changing the opening time of the dosing valve, the AdBlue® injection quantity is adjusted until the corresponding $NO_x$ value is reached.

The range of the PID controller is limited by the parameters of the map table of the feed forward control, thus overdosing is avoided. The emission value and the settings for the PID controller can be configured in the MICT (see *Exhaust Control – SCR – Dosing Valve* on page 69).

## 7.2 Pump Self Test

The pump self test checks whether the pump speed and pump pressure are within the minimum and maximum values specified in the configuration. Two types of pump self test are performed automatically by the VariSCR emission controller:

- Initial Self Test
  The initial self test is performed automatically after starting the emission controller and after each error acknowledgment. In addition, the initial self test can be started manually by the user via the menu command *Device -› Pump check*.
- Continuous Self Test
  The continuous self test is performed permanently during operation of the emission controller.

The parameters for the pump self test are defined on the corresponding configuration page in the MICT. Refer to the section *Exhaust Control – SCR – Pump Self Test* on page 67.

## 7.3 Control of the Pressure of the Pump

The pressure of the pump is adjusted by a digital PID controller which reacts to the pressure signal of the dosing unit. The actual pressure is set by regulating the pump speed. The target pressure and the settings of the PID controller can be configured in the MICT. Refer to the section *Exhaust Control – SCR – Pump Setup* on page 66.

## 7.4 Cooling of the Dosing Valve

If the temperature at the dosing valve is too high, AdBlue® is pumped through the dosing unit by the pump in order to cool the valve and thus ensure functionality. The AdBlue® returns via an internal bypass line from the dosing unit to the tank.

The cooling circuit remains active until the emission controller is disconnected from the power supply, even if the device has been switched off via the start/stop input.

The temperature values at which the pump is switched on and off for cooling the dosing valve can be configured in the MICT. Refer to the section *Exhaust Control – SCR – Pump Setup* on page 66.

## 7.5 Protection against Freezing of the Dosing Valve

To protect the dosing valve from too low temperatures, the temperature sensor of the dosing unit is analyzed. If the temperature falls below the minimum temperature, the heating of the dosing unit is switched on.

Protection against freezing is ensured until the emission controller is disconnected from the power supply, even if the device has been switched off via the start/stop input.

The temperature values at which the heating of the dosing valve is switched on and off can be configured in the MICT. Refer to the section *Exhaust Control – SCR – Dosing Valve* on page 69.

## 7.6 Manual and Automatic Operation

The VariSCR emission controller can be operated in two modes:

- Manual operation
- Automatic operation

Manual and automatic operation can be switched via the *Manual/Auto* switch or via the MICT. In this case, the MICT overwrites the switch position on the device. Switching via the *Manual/Auto* switch can be disabled by a setting in the MICT. If the status LEDs *Manual* or *Auto* are lighted up, this indicates the operation mode the emission controller is currently in.

The emission controller must be in manual mode to download a configuration from the MICT to the device. In automatic operation, the MICT can only be used to display the data and to create log files.


**Risk of destruction!**

In manual operation, the signals of the master control are not analyzed. If you make any adjustments in the manual mode with the gas engine running, make sure that these settings do not endanger the correct operation of the gas engine.

# 7 Functions

When switching to automatic operation, emission control starts immediately. In manual operation, the pump and dosing valve can be controlled via the MICT, for example to vent the pump.

## 7.7 Access Control

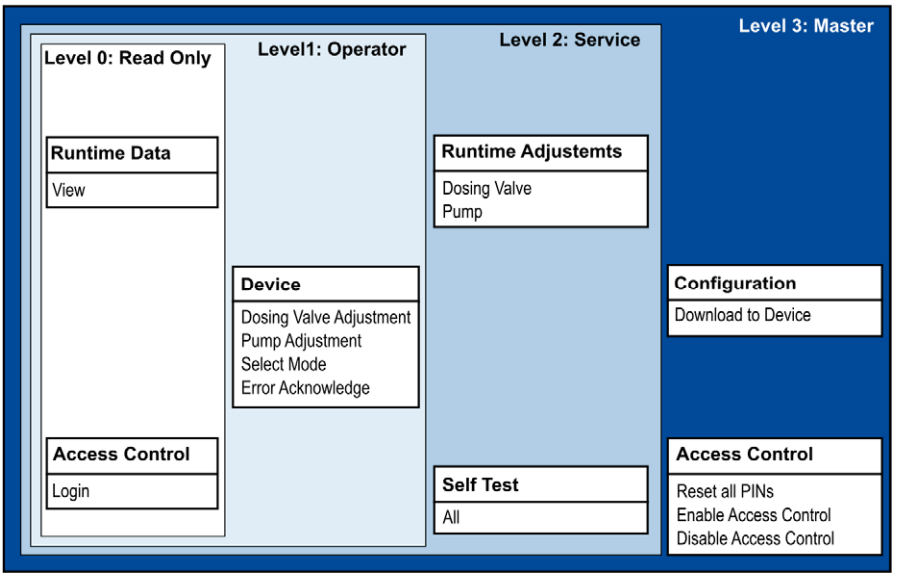
You can protect the VariSCR emission controller against unauthorized access by establishing the access control in the MICT. The access control has four operating levels, three of which can be secured with different PINs. As a default setting, the access control is not activated. If the access control for the emission controller is activated, it is independent from the access levels that control authorizations within the MICT.

EXAMPLE

**Access Control**

A user is logged in to the *Advanced Service* access level on the MICT. He changes a configuration and would like to download the change to the VariSCR emission controller. Although he has the full authorization set in the MICT, he is prompted to log in with the PIN for the *Level 3 (Master)*. This ensures that it is not possible for any user with an MICT and the generally valid password to change the configuration of your emission controller.

Various functions are at your disposal on the four operating levels. The figure below illustrates this:



# 7 Functions

The following functions are available on the different levels:

- Level 0 (Read Only)
  Enables read-only access for all users.
- Level 1 (Operator)
  At this level, the user can carry out manual valve adjustment and manual pump adjustment. Beyond that, he can change the operation mode and can confirm errors.
- Level 2 (Service)
  The service can also perform runtime adjustments and run the pump self-test manually.
- Level 3 (Master)
  At this level, the master can also reset all PINs and enable or disable the access control. Moreover, only the master is authorized to download a changed configuration to the emission controller.

For information on the access levels in the MICT, refer to the section *Access Levels in the MICT* on page 49.

# 8 Settings via the MICT

MICT is an abbreviation for *MOTORTECH Integrated Configuration Tool*. Use the MICT to configure your VariSCR emission controller.

Depending on the version of the MICT you are using, the range of functions may differ from the software version shown.

## 8.1 MICT System Requirements

For the installation of the MICT, the following minimum requirements must be fulfilled:

- x86-compatible computer, at least performance class Intel Pentium 4 with 2 GHz
- 128 MB free RAM
- 250 MB free disk space
- USB interface 1.1 or higher
- Display with a resolution of at least 1440 x 900 pixels (WXGA+)
- Microsoft® Windows 7, Windows 10

## 8.2 MICT Installation

The software for the installation of the MICT is on the data storage device (USB flash dive or CD-ROM) enclosed with the VariSCR emission controller.

To install the MICT, proceed as follows:

1. Start the installation:
   - Via the menu:
     Start the file *Start.exe* on the storage device. Start the installation routine of the MICT via *Software -› Install MICT*.
   - Directly from the storage device:
     Start the installation routine of the MICT directly. It is on the storage device in the subdirectory *Installation* and for example named as follows: *MICT-2.0.0-setup.exe*.
2. Run the installation.
   Follow the instructions of the installation routine. Note that the license agreement terms must be accepted before using the MICT.
3. Install the USB driver via the menu as well or directly from the storage device.
   - Via the menu:
     *Software -› USB Drivers -› Install USB Drivers*
   - Directly from the storage device:
     Start the exe file in subdirectory *Drivers*(e.g. *CDM21226_Setup.exe*).
   - ▸ You have installed the MICT and can now connect your computer to the emission controller via the USB interface.

## 8.3 Access Levels in the MICT

You can open the MICT on your computer e.g. Via *Start -› Programs -› MOTORTECH -› MICT 2.x.x -› MICT 2.x.x.*

After opening the MICT, select the access level for which you have clearance. The access level controls the options you have at your disposal in the MICT. The password required for access can be obtained from your MOTORTECH contact person (refer to *Customer Service Information* on page 107).


The following access levels are available:

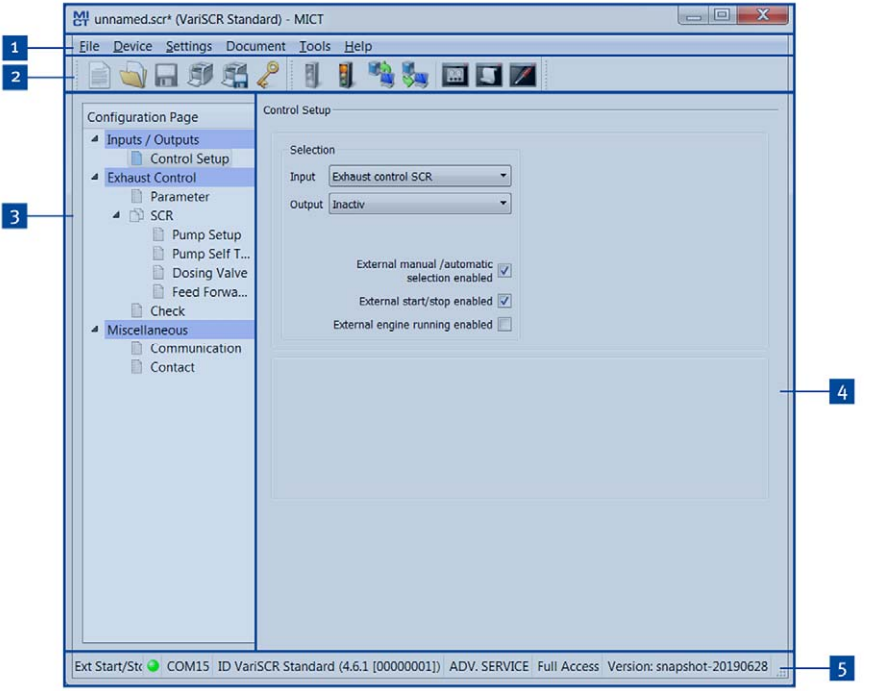
– Read Only
  On this level, the user can open a configuration and transfer it to the device. However, he cannot make changes to the configuration. The user has read-only access to all other settings.
– Customer
  This level enables the configuration of the basic functions required for operation in addition to the read-only function.
– Service
  This level includes all functions needed for maintenance.
– Advanced Service
  This level offers full access to all functions of the MICT and is enabled and accessible for specially trained personnel only.

The following sections describe the options at your disposal with the *Advanced Service* access level. If you have registered for a different level, you cannot execute all functions shown.

# 8 Settings via the MICT

## 8.4 Configuration Pages (Overview)

The configuration pages are divided into the following sections:




| Pos. | Area |
|---|---|
| 1 | Menu bar |
| 2 | Toolbar |
| 3 | Navigation bar |
| 4 | Configuration section |
| 5 | Status bar |

The functions in the menu, navigation bar, and the toolbar as well as the configuration section will be described in the following.

The status bar provides you with the following information (from left to right):

- Status display
  Indicates whether a connection is established with the device:
  - Green display: connection established
  - Red display: the connection was interrupted and is being restored
  - Gray display: the connection is not established and is not being restored
- Indication of the interface being used for the connection to the device
- Indication of the device ID
- Indication of the access level of the user in the MICT
- Indication of the operating level for the VariSCR emission controller if access control has been activated and the user has logged on with a PIN.
- Indication of the MICT program version

## 8.5 Menu Bar and Toolbar

The following functions are available to you via the symbols on the toolbar and the entries in the menu bar:

| Symbol | Menu | Function |
|---|---|---|
|  | *File -> New* | Creates a new configuration. |
|  | *File -> Open* | Opens an existing configuration. |
|  | *File -> Save /*<br>*File -> Save As* | Saves the current configuration. |
| | *File -> Recent Documents* | The last five configuration files used are offered for selection. |
| | *File -> Close* | Closes the current configuration. |
| | *File -> Open trace* | Opens a runtime data record (trace file). Refer to the section *Runtime Data* on page 76. |
| | *File -> Open pickup trace* | Opens a saved recording of pickup signals (putrace file), for example from a MOTORTECH ignition controller. Pickup signals cannot be recorded by of the VariSCR emission controller. |

# 8 Settings via the MICT

| Symbol | Menu | Function |
|---|---|---|
|  | *File -› Change Access Level* | Changes the access level for accessing the configuration data and functions. |
|  | *File -› Print* | Prints the current configuration. |
|  | *File -› Print To PDF File* | Prints the configuration to a PDF file. |
| | *File -› Print Preview* | Opens a print preview of the configuration. |
| | *File -› Quit* | Exits the MICT. |
|  | *Device -› Connect* | Connects to the device. |
|  | *Device -› Disconnect* | Cuts the connection to the device. |
|  | *Device -› Download to device* | Downloads configuration data from the computer to the device. This function can only be executed in manual mode. |
|  | *Device-› Upload from device* | Uploads configuration data from the device to the computer. |
|  | *Device -› Runtime data* | Opens the window *Runtime Data*. Refer to the section *Runtime Data* on page 76. |
|  | *Device -› Log* | Opens the window *Log* (*Advanced Service* only). Refer to the section *Log* on page 95. |
| | *Device -› Runtime adjustments* | Opens the window *Runtime Adjustments* (*Service* and *Advanced Service* only). Please refer to the section *Runtime Adjustments* on page 93. |
| | *Device -› Select Mode* | Opens the window *Select operation mode* in which you can select the operation mode. The following modes are possible: *Manual operation mode*, *Automatic operation mode* or *Switch controls operation mode*. |
| | *Device -› Manual valve adjustment* | Opens the *Manual Valve Adjustment* window. Refer to the section *Manual Valve Adjustment* on page 54. |

| Symbol | Menu | Function |
|---|---|---|
| | *Device -› Manual pump adjustment* | Opens the *Manual Pump Adjustment* window. Refer to the section *Manual Pump Adjustment* on page 54. |
| | *Device -› Pump check* | Starts the initial self test manually. |
| | *Device -› Temperature Extremes* | Opens a window in which the maximum and minimum temperature are displayed. These values are measured throughout the operating time on the board of the emission controller. |
| | *Device -› Error Acknowledge* | All operational errors are acknowledged. |
| | *Device -› Trigger Error* | The process currently being performed by the emission controller is aborted and the emission controller switches into error mode. |
| | *Device -› Access Control* | The setup for the access control to the device is described in a separate section. Please read the section *Access Control for the VariSCR Emission Controller* on page 57. |
| | *Settings -› Language* | Opens the window *Select Language* in which you can change the interface language of the MICT. |
| | *Settings -› Online update settings* | Opens the window *Online Update Settings*. Refer to the section *Online Update Settings* on page 56. |
| | *Settings-› Database settings* | Opens a dialogue window in various databases can be assigned as source for the MICT. |
| | *Settings -› Temperature scale* | Opens the window *Select Temperature Scale*, in which you can change the unit for the temperatures shown in the MICT. |
| | *Settings -› Display by cylinders* | This function is available for certain MOTORTECH ignition controllers and has no effect in conjunction with the VariSCR emission controller. |
| | *Document* | Has no function with the VariSCR emission controller. |
| | *Tools -› Coils* | Opens a database with information on MOTORTECH ignition coils. |
| | *Help -› Help* | Opens the online help function. |
| | *Help -› About MICT* | Opens detailed information on the MICT. |

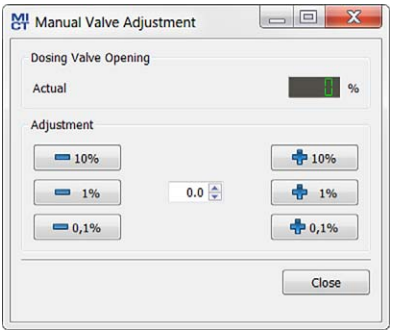
# 8 Settings via the MICT

## 8.6 Manual Valve Adjustment

You can manually adjust the dosing valve for optimization or test purposes. In addition, a manual adjustment of the dosing valve is also required to determine the feed forward control characteristic curve. On this, read the section *Determine Values for Feed Forward Control* on page 98.

You open the window *Manual Valve Adjustment* in manual mode via the following entry in the menu bar:

*Device -› Manual valve adjustment*




You have the following possibilities to adjust the opening of the dosing valve:

– -/+-keys
  Use the keys to adjust the current dosing valve opening by 0.1%, 1% or 10%.

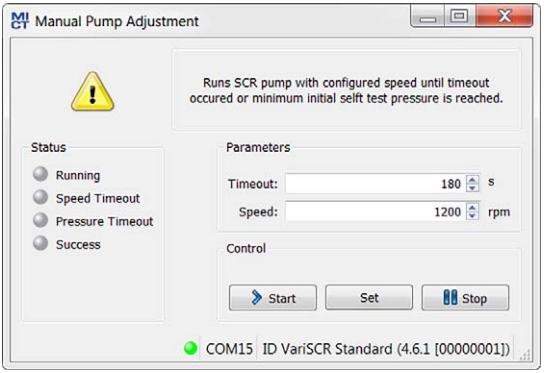
– Entry field
  You can directly enter the desired percentage opening in the field in the middle of the window, or increase or decrease the current value using the side arrows.

For checking purposes, the current percentage opening of the dosing valve is displayed in the field *Actual*.

## 8.7 Manual Pump Adjustment

A manual test can be carried out to vent the pump before operation or to operate it at a constant speed for maintenance purposes. The settings for the test are made in manual mode using the following entry in the menu bar:

*Device -› Manual pump adjustment*




The speed entered in the dialog window is set and held at the start of the test until a timeout occurs or the pressure range configured for the initial pump self test is reached (see *Exhaust Control – SCR – Pump Self Test* on page 67).

You have the following options:

- Parameters
  Enter the speed and timeout for the test. When the dialog window is opened, the values correspond to the settings of the initial pump self test.
- Control
  - Start
    Click the button to start the test.
  - Set
    Click the button to transfer the changed parameters to the emission controller.
  - Stop
    Click the button to stop a running test.

The status displays have the following meaning:

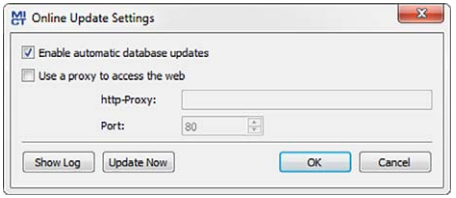
- Running
  The test has been started and is running without errors.
- Speed Timeout
  When the status display lights up, the speed did not match the value specified in the *Speed* field for longer than the time specified in the field *Timeout*.
- Pressure Timeout
  When the status display lights up, the pressure range specified in the initial self test has not been reached within the *Timeout* (see *Exhaust Control – SCR – Pump Self Test* on page 67).
- Success
  The required pump pressure was reached within the time specified under *Timeout*.

# 8 Settings via the MICT

## 8.8 Online Update Settings

The MICT uses data from various databases for the configuration. Such data can be updated with automatic online updates. The settings for the update can be entered with the following entry in the menu bar:

*Settings -› Online update settings*




You have the following options:

- Enable automatic database updates
  Using the check box, you can enable and disable automatic online updates. As the default setting, the online update is activated and is executed daily (if an internet connection is established) at first start-up of the MICT.
- Use a proxy to access the web
  Use the checkbox to activate settings for internet access via a proxy server, which you can then set up by entering *http-Proxy* and *Port*.
- Show Log
  With this button, you can open a window in which the online updates performed are logged.
- Update Now
  With this button, you manually start an online update.

NOTICE

**Online update**

After the online update, the updated data will only be used if these have been downloaded onto the device. However, this requires the relevant authorization.

Whenever the configuration is uploaded from the device, the version of the configuration saved in the device will be compared with the version in the database. If the two versions are not the same, a window with additional instructions will open up.

## 8.9 Access Control for the VariSCR Emission Controller

If the access control to the emission controller is activated, access to the following areas is possible with a PIN only:

- Troubleshooting
- Configuration (Transferring a configuration to the emission controller)

The access control regulates the accesses to the emission controller via the MICT. For explanations concerning access control of the emission controller and the delimitation of the access levels in the MICT, refer to section *Access Control* on page 46.

The access control functions can be accessed in the menu bar via:

*Device -› Access Control*

### 8.9.1 Enable/Disable Access Control


**Enable/Disable access control**

As a default setting, the access control is not activated, and all PINs are set to *oooo*. Once the access control has been activated, and the PINs were changed, these PINs will continue to be used. To activate the access control again, you will need the PIN for level 3 (*Master*). It is therefore recommended to reset all PINs before disabling.

If that was not done, or a system must be unlocked for another reason, a request key can be issued in the MICT. Refer to the section *Reset all PINs* on page 58.

To enable or disable the access control, proceed as follows:

1. Open the input dialog via *Device -› Access Control -› Enable* or *Disable access control*.
2. Enter the PIN for the level *Master (Level 3)*.
3. Confirm the input with OK.

### 8.9.2 Login/Logout

If the access control is activated, you are prompted to log in if you want to execute functions that are allocated to a specific operating level. In addition, you can log in specifically to an operating level via the menu bar.

To log into a specific operating level, proceed as follows:

1. Open the input dialog via *Device-› Access Control -› Login*.
2. First select the level you wish to log on to.
3. Enter the PIN for the desired level.

4. Confirm the input with OK.
   - ▸ You are now logged into the corresponding level and can execute all functions that are allocated to this operating level without having to log in again.

After completing the log-in, you can log out again as follows:

*Device -› Access Control -› Logout*

### 8.9.3 Changing the PIN

To change the PIN for a specific operating level, proceed as follows:

1. Open the input dialog via *Device -› Access Control -› Change PIN*.
2. First select the level for which you wish to change the PIN.
3. Enter the current PIN for the desired level.
4. Enter the new PIN in the two subsequent fields.
5. Confirm the input with OK.
   - ▸ The PIN for this operating level has now been changed.

### 8.9.4 Reset all PINs

To reset all PINs, proceed as follows:

1. Open the input dialog via *Device -› Access Control -› Reset all PINs*.
2. If you are not yet logged into the *Master (level 3)* level, you will be prompted to log in with the relevant PIN.
3. Confirm the input with *OK*.
4. To reset all PINs, you will be prompted again to enter the PIN for the level *Master (Level 3)*.
5. Confirm the input with *OK*.
   - ▸ All PINs are now reset to the value *oooo*.

To reset all PINs, you need the PIN for the level *Master (level 3)*. To be able to unlock a system in case of emergency that was locked in this way, you have the following option:

1. In the menu bar, select the entry *Device -› Access Control -› Get reset all PINs request key* to open a window with the same name.
2. Send the request key with the serial number to your service contact person at MOTORTECH (refer to *Customer Service Information* on page 107). This key is valid only for the respective controller and only for a certain amount of time.
   - ▸ Your information will be verified, and you will receive an authorization key from your contact person.
3. From the menu bar, select the entry *Device -› Access Control -› Set reset all PINs authorization key* to open a window with this name.

4. Enter the authorization key received in the input field.
5. Confirm the input with *OK*.
   - ▸ If the input was correct, all PINs are reset to the default value *oooo*.

## 8.10 Working with Configurations

To ensure that the VariSCR emission controller interprets incoming data correctly and converts them to the desired control signals, it requires information on the device connected and the master control connected. This information is stored in a configuration file on the emission controller

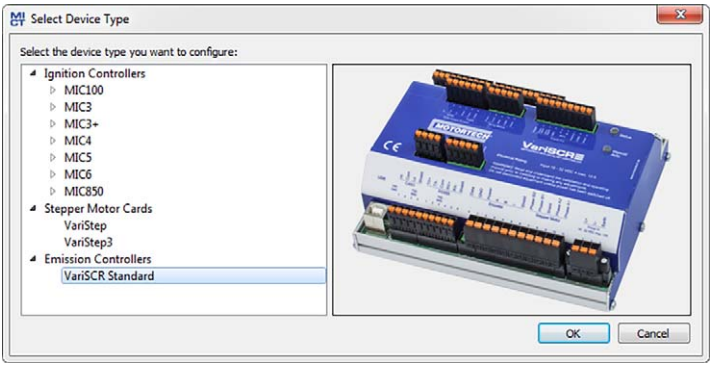
You need the MICT for the following tasks:

- Creating configuration files
- Opening configuration files from a storage device
- Processing configuration files
- Saving configuration files on a storage device
- Download configuration files to the emission controller
- Upload configuration files from the emission controller
- Displaying current and saved runtime data

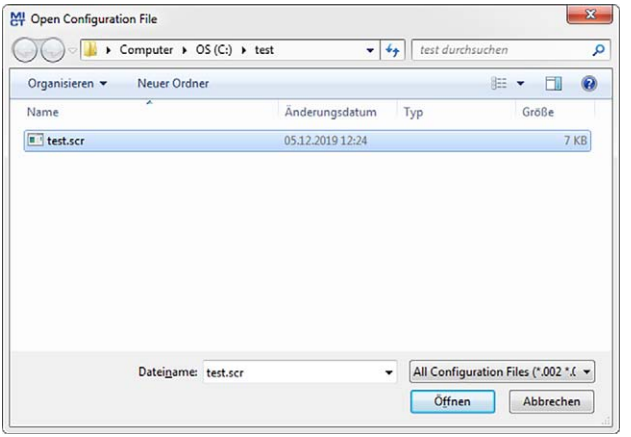
# 8 Settings via the MICT

## 8.10.1 Create, Open, Save

Click on the symbol to create a new configuration and select the entry *Emission Controllers -› VariSCR Standard*.




Click on the symbol to open a saved configuration.




Click on the symbol to save the configuration currently displayed in the MICT to a storage device.

### 8.10.2 Upload, Download

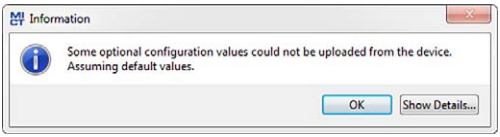
Click the symbol to upload the current configuration from the VariSCR emission controller to the MICT. If applicable, the MICT first establishes a connection to the device connected.

Click the symbol to download the configuration in the MICT to the emission controller. This function can only be executed when the emission controller is in manual mode. This action overwrites the existing configuration on the device. If applicable, the MICT first establishes a connection to the device connected.


**Existing configuration is cleared!**

If you download a configuration to a VariSCR emission controller the previously used configuration is deleted and the new settings are immediately implemented.

### 8.10.3 Compatibility Information




If you upload a configuration from the VariSCR emission controller to the MICT that does not correspond to the status of your MICT, or if you open this type of configuration in the MICT, the following situations may occur:

– No values are present in the configuration for certain MICT functions. The MICT assumes the standard values for these functions.

– The configuration contains function values that are not support by the MICT.

The following situations can occur if you download a configuration from the MICT to a VariSCR emission controller whose firmware does not correspond to the status of your MICT:

– No values are present in the configuration for certain firmware functions. The firmware continues to use the preset values for these functions.

– The configuration contains function values that are not support by the firmware.

If you download a configuration to the emission controller and are notified of functions that are not supported by the MICT, you should check the emission controller settings. Re-upload the configuration from the emission controller to the MICT. You can then see which settings are not transmitted to the MICT.

Perform a firmware update, if necessary, and/or update your MICT so that you can use all the emission controller functions without restriction.

# 8 Settings via the MICT

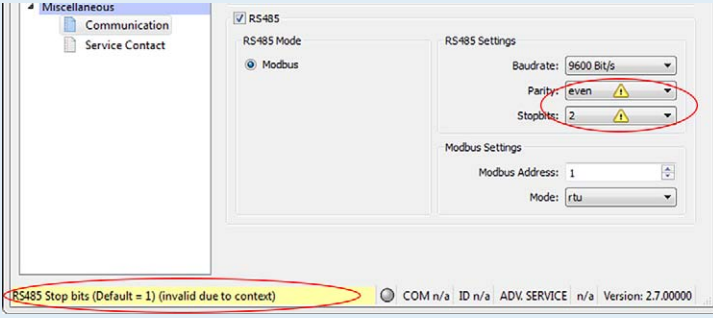
## 8.11 Configuration

The window opens after you select the device type for a new configuration or an existing configuration or have uploaded one from the device. You can make changes to the configuration by selecting an entry from the navigation bar. The corresponding configuration data are then displayed in the configuration section and can be processed. The following sections will describe the settings and adjustments you can implement in the different areas.

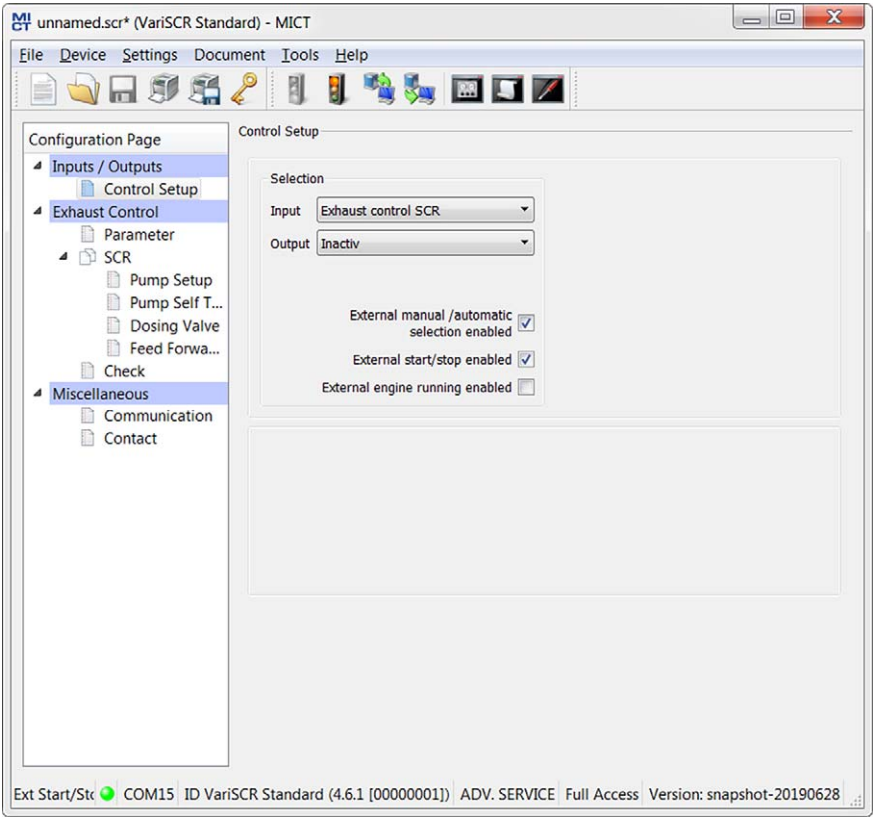

**Indication of invalid entries**

An invalid selection or invalid input values are highlighted by pulsating warning signs on the configuration pages of the MICT. Additional information is provided in the status bar.

Example:



## 8.11.1 Inputs/Outputs – Control Setup




To make changes, approval for the access level *Advanced Service* is required.

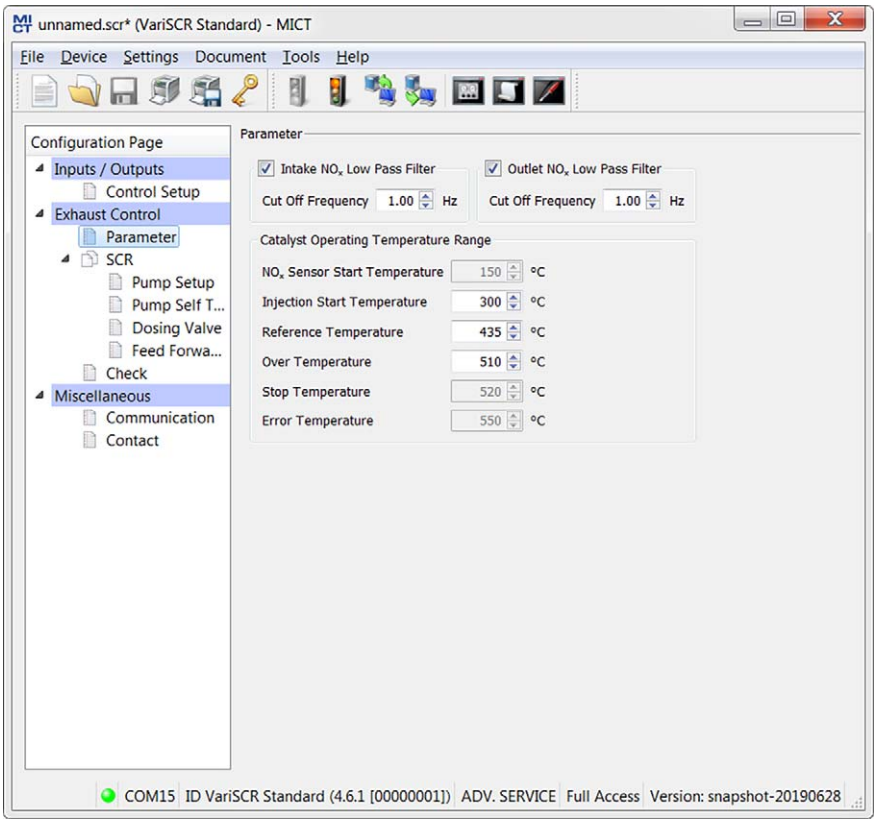
### Selection

- Input
  For the function of the VariSCR emission controller, only the value *Exhaust control SCR* can be set.
- Output
  Currently no output can be selected.
- External manual/automatic selection enabled
  Disable the check box to deactivate the *Manual/Auto* switch on the emission controller. The emission controller may then only be used in manual mode via the MICT with the relevant authorization.

# 8 Settings via the MICT

– Enable start/stop enabled
  Activate the checkbox to enable the binary input *Start/Stop* on the emission controller. This input is used to start the device from the master control.
– External engine running enabled
  Activate the checkbox to enable the binary input *Engine Running* on the emission controller.

## 8.11.2 Exhaust Control – Parameter



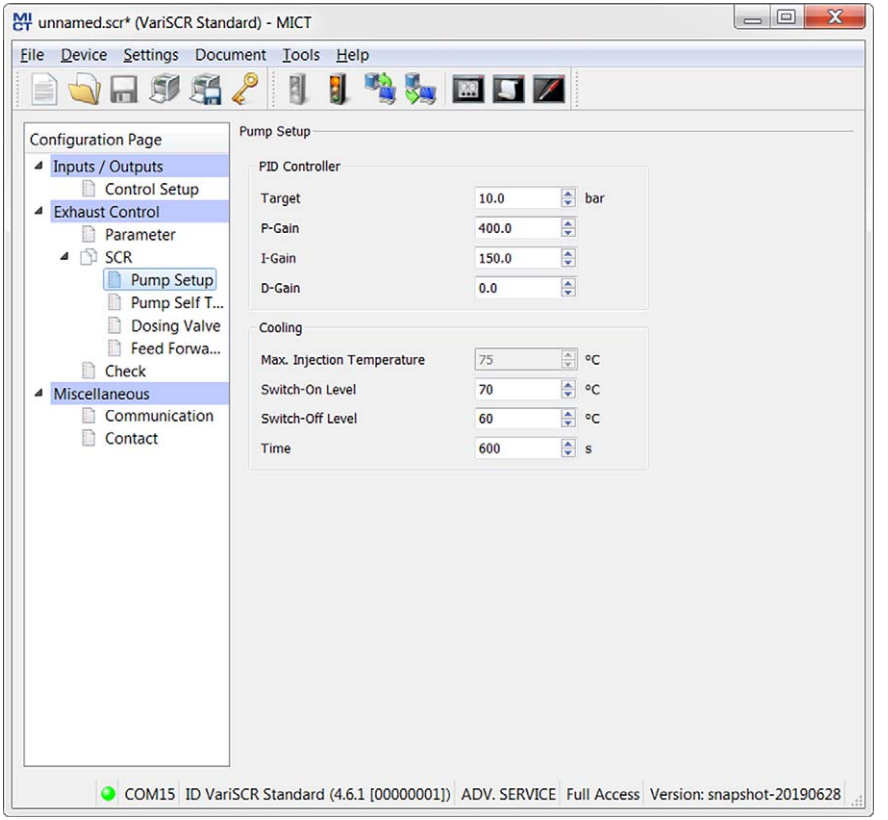

Set the following parameters:

– Intake NOx Low Pass Filter
  Activate this option and change the cut off frequency. A lower cut off frequency causes the NOx sensor to react more slowly.

- Outlet $NO_x$ Low Pass Filter
  Activate this option and enter the cut off frequency. A lower cut off frequency causes the $NO_x$ sensor to react more slowly.
- Catalyst Operating Temperature Range
  Define the temperature range in which the catalytic converter may be operated. Observe the specifications of the catalytic converter manufacturer.
  - $NO_x$ Sensor Start Temperature
    The displayed value depends on the $NO_x$ sensors used and cannot be changed. This value is for information only.
  - Injection Start Temperature
    Lower limit of the operating temperature at which the injection of AdBlue® into the catalytic converter is started.
  - Reference Temperature
    Internal value for the calculation of temperature-dependent corrections of the control system.
  - Overtemperature
    Upper limit of the operating temperature. If the overtemperature is reached, the *Catalyst Overtemperature* output is switched. This output should be used as signaling for the master control.
  - Stop Temperature
    The stop temperature depends on the overtemperature. When the stop temperature is reached, injection is stopped. This value is for information only.
  - Error Temperature
    When the error temperature is reached, the emission controller goes into the error mode. This value is for information only.

# 8 Settings via the MICT

## 8.11.3 Exhaust Control – SCR – Pump Setup




Set the following parameters of the pump:

PID Controller

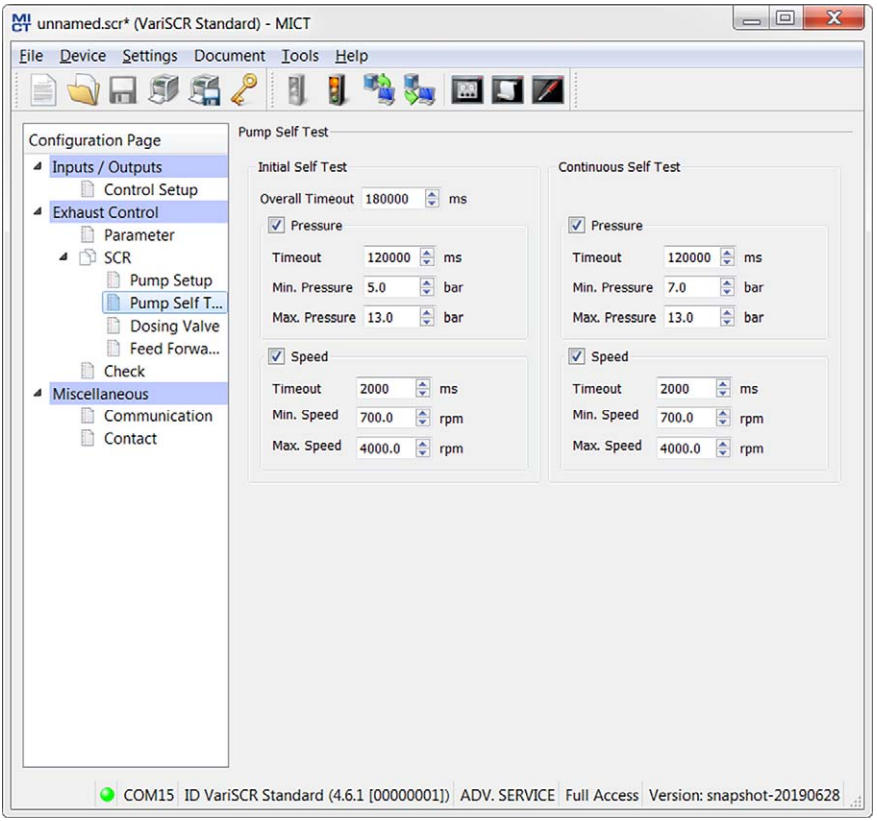
If necessary, change the basic setting for the PID control of the pump. This can be adjusted during operation via the runtime adjustments (see *Runtime Adjustments – Pump* on page 93). When you make the settings, you can be supported by the trend views in the runtime data (see *Runtime Data – Trends* on page 85).

– Target
  Enter the target value for the pump pressure.

### Cooling

You use the switch-on and switch-off level to define the corresponding limit values for cooling of the dosing valve. When the device is switched off, the pump ensures cooling for the time specified in the corresponding field.

## 8.11.4 Exhaust Control – SCR – Pump Self Test




You can activate and adjust two types of pump self-test for pressure and speed monitoring, respectively:

– Initial Self Test
  The initial self test is performed once after starting the emission controller and after each error acknowledgment.

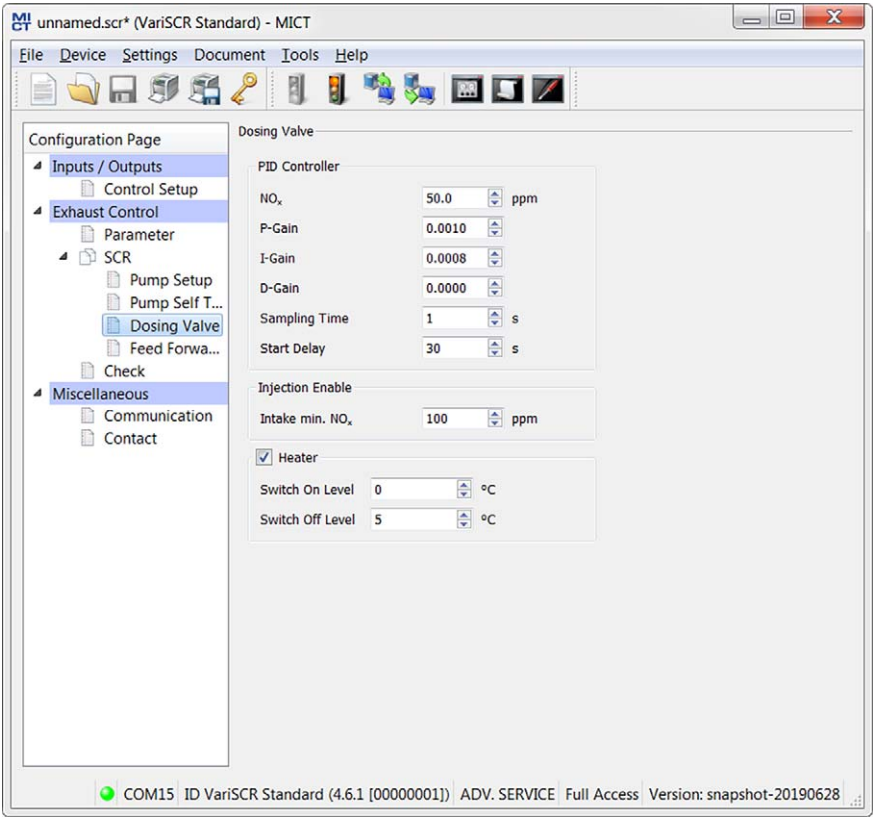
– Continuous Self Test
  The continuous self test is performed permanently during operation of the emission controller.

Refer to the section *Pump Self Test* on page 44.

You have the following options:

– Overall Timeout
  Enter the total time for the initial self-test, after which the pressure and speed tests must be completed successfully at the latest. If the time is not observed, the self-test is aborted and the emission controller goes into the error mode.
– Pressure
  Activate the checkbox to monitor the pump pressure.
  – Timeout
    If the pressure is not within the specified minimum and maximum values within the specified time, the self-test is aborted and the emission controller goes into error mode.
  – Min. Pressure/Max. Pressure
    Enter the limits for the pump pressure.
– Speed
  Activate the checkbox to monitor the pump speed.
  – Timeout
    If the pump speed is not within the specified minimum and maximum values within the specified time, the self-test is aborted and the emission controller goes into error mode.
  – Min. Speed/Max. Speed
    Enter the limits for the pump speed.

## 8.11.5 Exhaust Control – SCR – Dosing Valve




Set the parameters of the dosing valve:

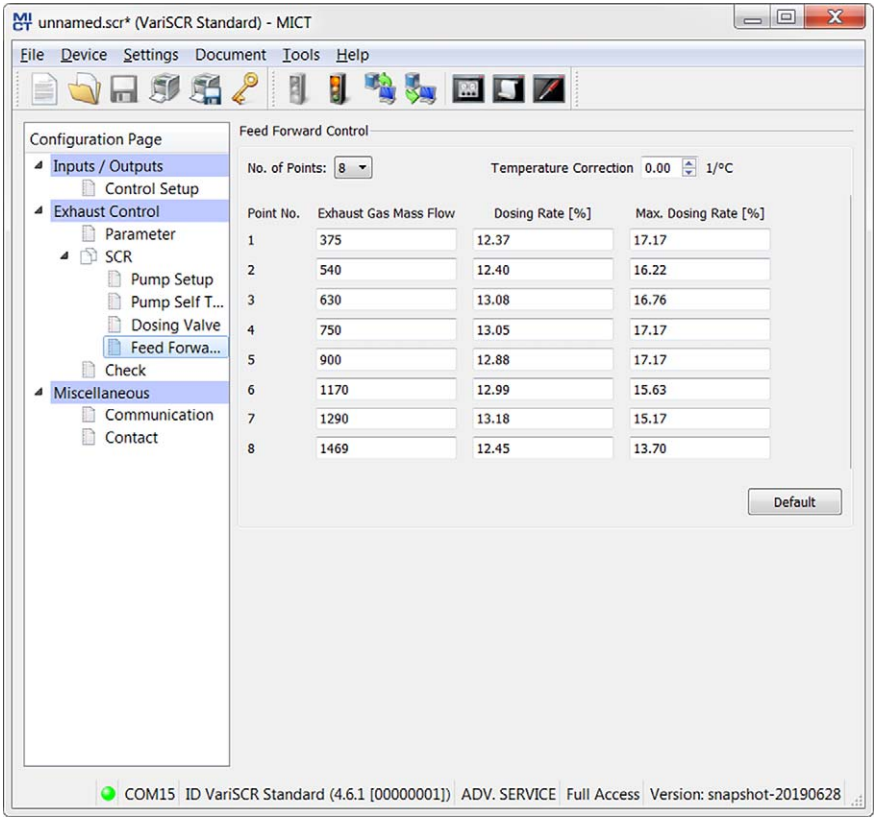
### PID Controller

If necessary, change the basic setting for the PID control of the dosing valve. This can be adjusted during operation via the runtime adjustments (see *Runtime Adjustments – Dosing Valve* on page 94). When you make the settings, you can be supported by the trend views in the runtime data (see *Runtime Data – Trends* on page 85).

- NOx
  Enter the target value for the NOx sensor at the outlet of the catalytic converter.
- Sampling Time
  If required, change the sampling time of the PID control.
- Start Delay
  If necessary, change the start delay of the PID control.

– Injection Enable
  Enter the NOx value at the intake from which the injection is to take place.
– Heater
  Activate the heater via the corresponding checkbox. You define the respective limit values via the *Switch On Level* and *Switch Off Level*.

## 8.11.6 Exhaust Control – SCR – Feed Forward Control

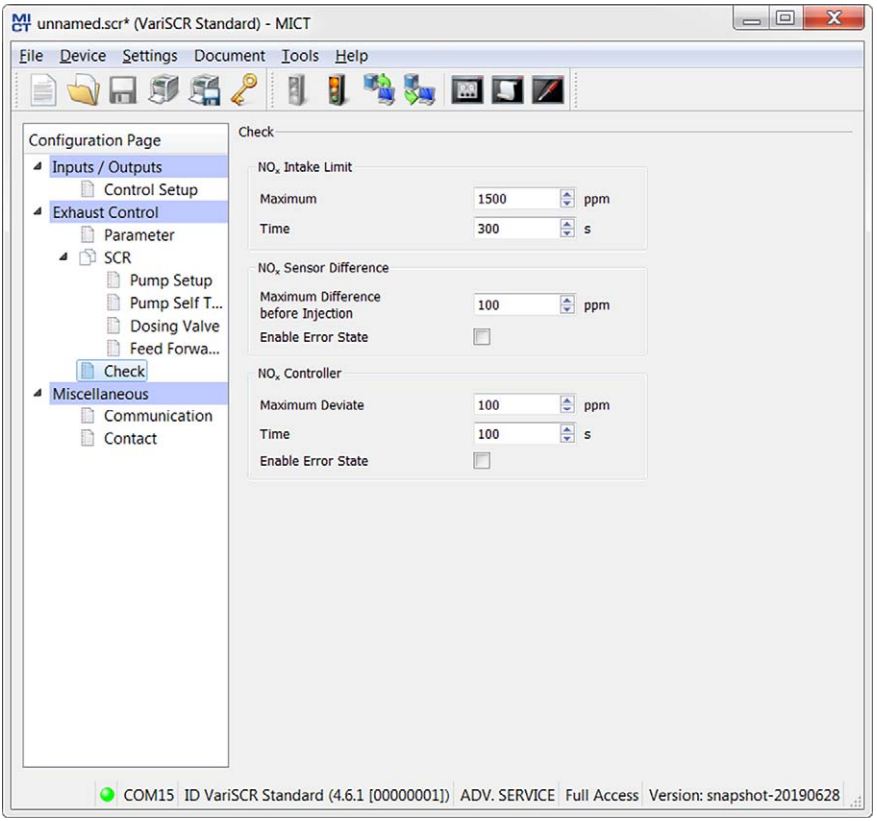


On this configuration page you define a characteristic curve for the feed forward control. A maximum of eight points can be configured for this purpose. Each point consists of the dosing rate in dependence of the exhaust gas mass flow. In addition, the maximum dosing rate can also be set for each point of the characteristic curve. This setting must be determined once for each SCR system. This is supported by an Excel® file that you can find on the storage device included with the controller. For a detailed description of this procedure, see *Determine Values for Feed Forward Control* on page 98.

### Default

Use the button to restore the default settings.

## 8.11.7 Exhaust Control – Check



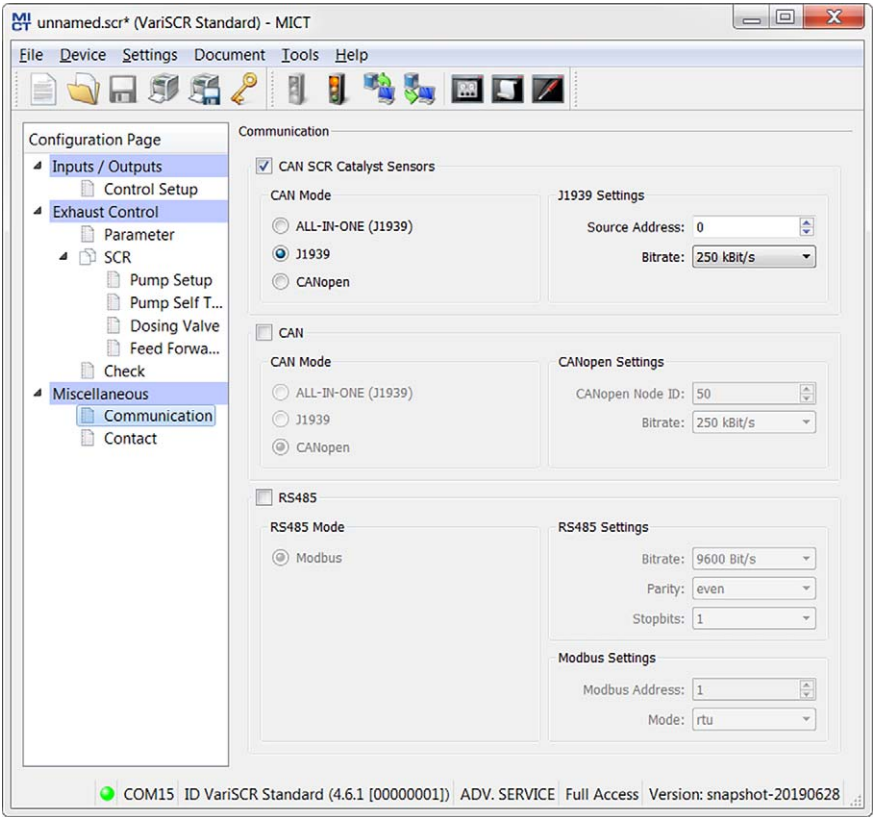

In this view, you make general settings for the verification of the measured $NO_x$ values.

# 8 Settings via the MICT

You have the following options:

- $NO_x$ Intake Limit
  Set the maximum permissible $NO_x$ value at the intake. If this value is measured by the $NO_x$ sensor for longer than the duration specified in the *Time* field, the emission controller enters the error mode.
- $NO_x$ Sensor Difference
  Define the maximum permissible difference between the $NO_x$ values at the intake and outlet before starting injection. If this value is exceeded, the emission controller enters the error mode if the corresponding checkbox has been activated. If the checkbox is not activated, an information is logged in the *Log*.
- $NO_x$ controller
  Define the maximum permissible deviation of the $NO_x$ value from the target value at the outlet. If this value is measured by the $NO_x$ sensor for longer than the duration specified in the *Time* field, the emission controller enters the error mode if the corresponding checkbox has been activated. If the checkbox is not activated, an information is logged in the *Log*.

## 8.11.8 Miscellaneous – Communication




### CAN SCR Catalyst Sensors

To connect the catalytic converter sensors, activate the *CAN SCR Catalyst Sensors* field and select the *J1939*option. Enter 0 for the *Source Address* and select the 250 kbit/s *Bitrate*.

### CAN

Via the field *CAN*, deactivate or activate the CAN interface of the device.

– ALL-IN-ONE (J1939)/ J1939/CANopen
  Select the desired protocol, depending on whether you want to set the communication for the ALL-IN-ONE or for another master control.

- Source Address/CANopen Node ID
  In the protocol *ALL-IN-ONE (J1939)* and *J1939* the source address can be assigned between 0 and 253. In the *CANopen* protocol, a CANopen node ID from 1 to 127 can be assigned. Note that IDs cannot be assigned more than once.
- Bitrate
  Select the desired data transfer rate from the list. In the protocol *ALL-IN-ONE (J1939)* and *J1939*, 250 kbit/s and 500 kbit/s are available for selection. In the *CANopen* protocol, a bit rate from 50 kbit/s to 1 Mbit/s can be set. For both protocols, we suggest the use of a baud rate of 250 kbit/s.

### RS485

Via the field *RS485*, deactivate or activate the RS485 interface of the device.

- RS485 Settings
  - Bitrate
    Select the desired data transfer rate from the list. The Modbus bit rate can be defined between 9,600 bit/s and 115,200 bit/s, the recommended value being 19,200 bit/s.
  - Parity
    Define if a parity bit is used and if the parity is to be even or odd.
  - Stopbits
    Determine if one or two stop bits are to be sent. Two stop bits can only be sent if no parity has been selected.
- Modbus Settings
  - Modbus Address
    The Modbus address can be assigned between 1 and 247. Note that IDs cannot be assigned more than once.
  - Mode
    Define if the data are transferred in the ASCII or RTU mode.


**Setting the transfer rate**

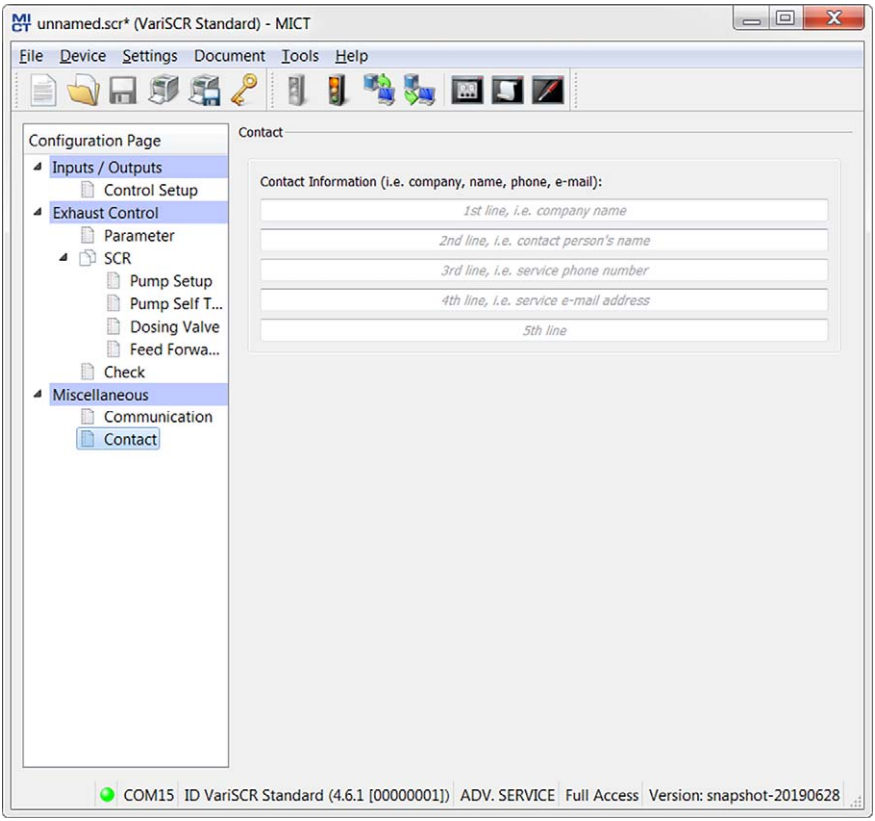
Please note that all devices connected with a bus must be set to the same transfer rate.

**Field bus protocols**

No emission-specific values are currently available in the field bus protocols.

## 8.11.9 Miscellaneous – Service Contact

This configuration page can be viewed by all users, but changes can only be made with authorization for the *Advanced Service* access level.




### Service Contact

In this area, you can store individual contact data.

# 8 Settings via the MICT

## 8.12 Runtime Data

Click on the symbol to open the window *Runtime Data*. The following sections will give you an overview of the data you can view on the individual tabs.

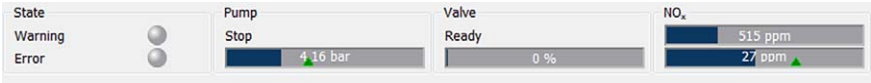
You can print and record the runtime data. For this purpose, the following functions are at your disposal in the toolbar in the window:

| Symbol | Function |
|---|---|
|  | Prints the runtime data. |
|  | Prints the runtime data to a PDF file. |
|  | Opens the print preview. |
|  | Starts the runtime data trace. |
|  | Stops the runtime data trace. |


**Save runtime data locally**

You should always save runtime data on the local computer and not on a network drive or external storage device. Trace files can only be moved freely once the recording is stopped.

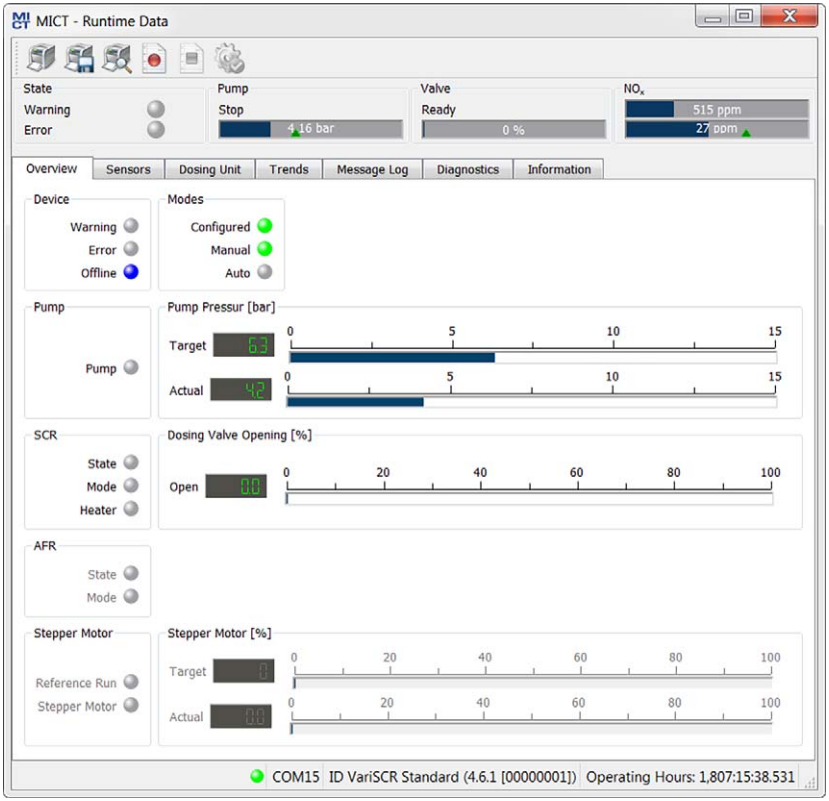
Below the toolbar you will find the most important states and data of your system:




- State
  - Warning
    The yellow status display indicates that a warning is pending. The currently pending warnings are displayed as a tooltip. Refer to the section *Runtime Data – Message Log* on page 87.
  - Error
    The red status display indicates that an error has occurred. The current errors are displayed as a tooltip. Refer to the section *Runtime Data – Message Log* on page 87.
- Pump
  The status of the pump is displayed. Following statuses are possible: Stop, Ready, Operational, Cooling Time, Cooling Off, Cooling On, Error, Self Test, Manual.
  The diagram shows the current pressure as a bar and value. The green triangle indicates the target value. The tooltip displays the target value numerically. A red triangle at the beginning or end indicates that the display range has been exceeded or fallen below.
- Valve
  The status of the dosing valve is displayed. Following statuses are possible: Stop, Ready, Running, Error, Manual.
  The diagram shows the current opening as a bar and value.
- NOx
  For the NOx sensors, the values at the intake (top) and outlet (bottom) are shown in the two diagrams. The diagrams show the current values as bars and values. For the NOx value at the outlet, the target value is also indicated by a green triangle. The tooltip displays the target value numerically. A red triangle at the beginning or end indicates that the display range has been exceeded or fallen below.

# 8 Settings via the MICT

## 8.12.1 Runtime Data – Overview




You can find the following information in the window:

### Device

The status displays provide information on the status of the emission controller.

- Warning
  The yellow status display indicates that a warning is pending. Refer to the section *Runtime Data – Message Log* on page 87.
- Error
  The red status display indicates that an error has occurred. Refer to the section *Runtime Data – Message Log* on page 87.
- Offline
  The blue status display indicates that the emission controller is ready for operation, but that the injection conditions have not yet been fulfilled.

### Mode

The status displays provide information about the operating mode of the emission controller.

- Configured
  The following status displays are possible:
  - Green: A valid configuration has been downloaded to the connected emission controller.
  - Red: An error has occurred while downloading the configuration or there is no configuration on the device
- Configured
  The following status displays are possible:
  - Green: The emission controller is in manual mode. Refer to the section *Manual and Automatic Operation* on page 45.
  - Yellow: Manual settings are made (e.g. manual pump adjustment, manual valve adjustment).
  - Red: An error occurred.
- Automatic
  The following status displays are possible:
  - Green: The emission controller is in automatic mode. Refer to the section *Manual and Automatic Operation* on page 45.
  - Red: An error occurred.

### Pump

The following status displays are possible:

- Green: The pump is in operation. This also includes the cooling of the dosing valve.
- Yellow: The pump is adjusted manually or is in self test.
- Red: An error occurred.

### Pump Pressure [bar]

The target value and the actual value of the pressure at the dosing valve are given as values and shown in diagrams.

### SCR

The status displays provide information on the status of the SCR system.

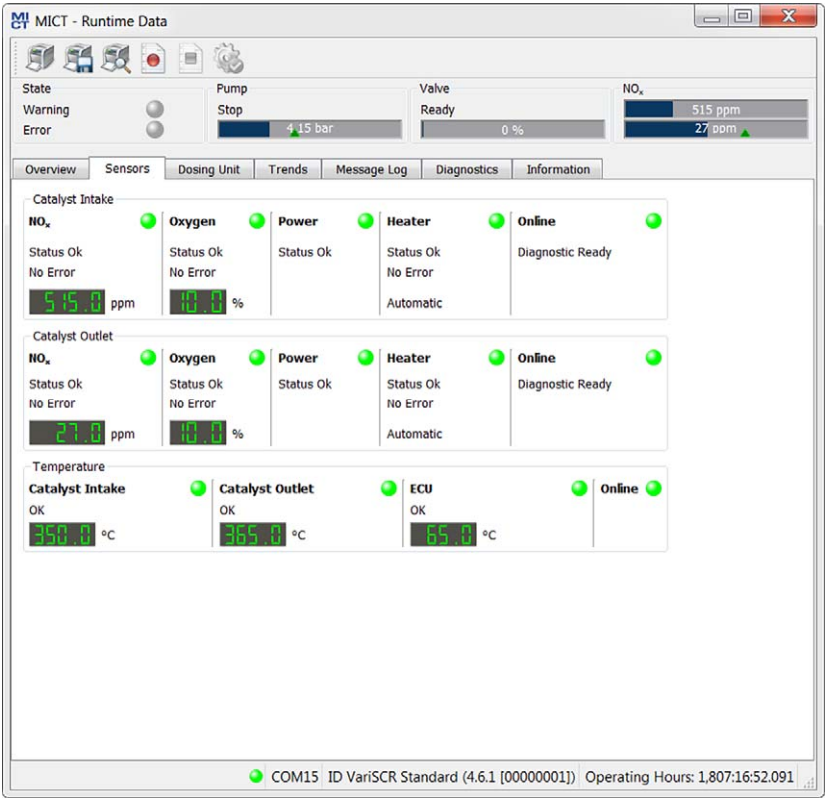
- State
  The following status displays are possible:
  - Green: The SCR system is working correctly.
  - Yellow: The emission controller is in manual mode. Refer to the section *Manual and Automatic Operation* on page 45.
  - Red: An error occurred.

- Mode
  The following status displays are possible:
  - Green: The feed forward control and the PID control are taken into account.
  - Yellow: Only feed forward control is taken into account.
  - Red: An error occurred.
- Heater
  The green status display indicates that the heater of the dosing unit is working.

Dosing Valve Opening [%]
The current percentage opening of the dosing valve is indicated as a value and shown in the diagram.

AFR, Stepper Motor, Stepper Motor [%]
These functions are currently not available.

## 8.12.2 Runtime Data – Sensors




The window displays detailed information about the sensors used in the SCR system. Basically, the colors of the status displays have the following meaning:

- Green: No error
- Yellow: Out of the respective value range
- Red: Errors

# 8 Settings via the MICT

The following information is displayed in the individual areas of the window:

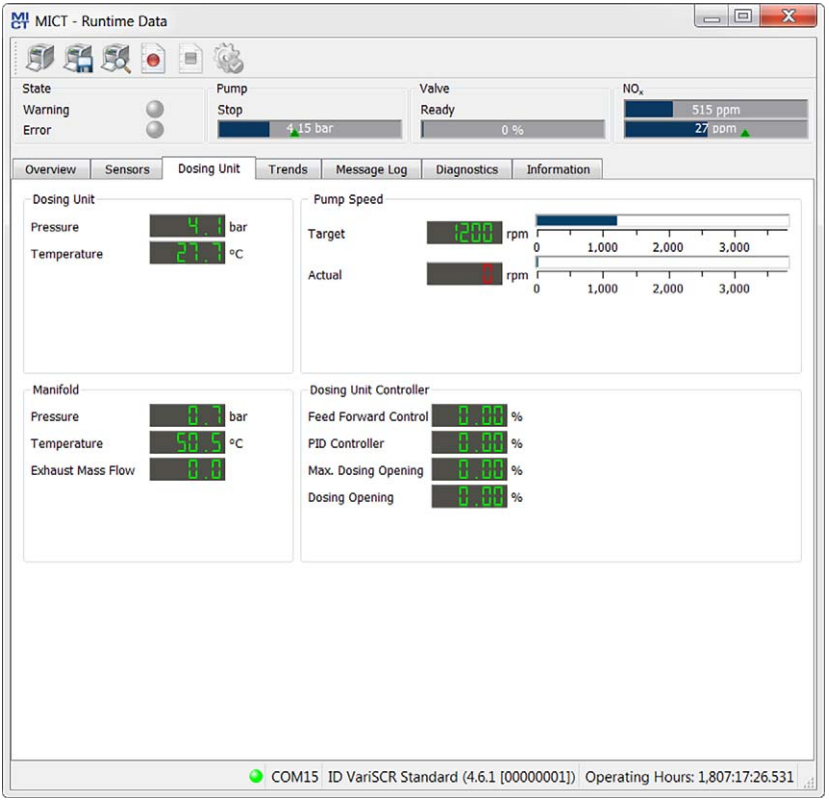
Catalyst Intake / Catalyst Outlet
For the two $NO_x$ sensors at the intake and outlet of the catalytic converter, you will receive the following information:

- $NO_x$
  The green status display indicates that the $NO_x$ measurement of the sensor is working correctly. In addition, the status of the $NO_x$ measurement and the actual measured value are displayed.
- Oxygen
  The oxygen content is also determined by the $NO_x$ sensor. The green status display indicates that the measurement of the oxygen content is working correctly. In addition, the status of the oxygen measurement and the actual measured value are displayed.
- Power
  The green status display indicates that the supply voltage is within the permissible range. In addition, the status of the supply voltage is displayed.
- Heater
  The green status display indicates that the heating of the $NO_x$ sensor is active and is working without errors. In addition, the status and operating mode of the heater are displayed.
- Online
  The green status indicator indicates that the respective $NO_x$ sensor is communicating with the emission controller.

Temperature
The temperature module consists of two temperature sensors for intake and outlet.

- Catalyst Intake / Catalyst Outlet
  The current measured value and the status of the respective sensor are indicated for each of the two temperature sensors.
- ECU
  The temperature of the temperature module and the status of the entire module will be indicated.
- Online
  The green status indicator indicates that the temperature module is communicating with the emission controller.

## 8.12.3 Runtime Data – Dosing Unit




The window displays detailed information on the dosing unit.

### Dosing Unit

- Pressure
  Current AdBlue® pressure at the dosing valve
- Temperature
  Current temperature at the dosing valve

### Pump

- Target
  Target value of the speed of the pump as value and diagram
- Actual
  Actual speed of the pump as value and diagram

# 8 Settings via the MICT

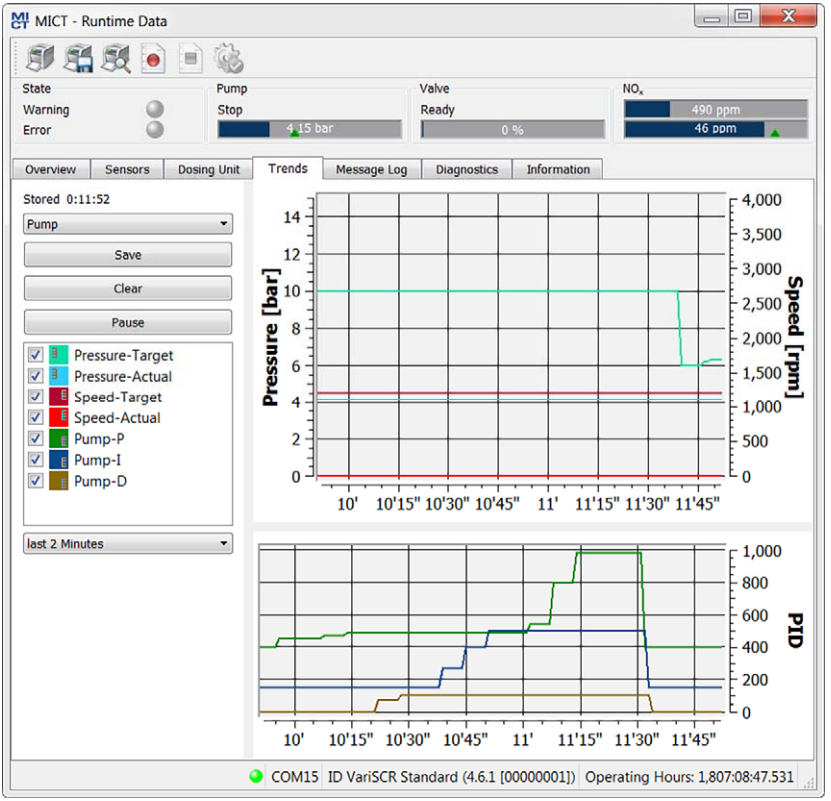
### Manifold

- Pressure
  Pressure measured by the MAP sensor in the manifold
- Temperature
  Temperature measured by the MAT sensor in the manifold
- Exhaust Mass Flow
  Mass flow equivalent calculated from the measured values of the MAP and MAT sensors.

### Dosing Unit Controller

- Feed Forward Control
  Opening angle resulting from the feed forward control.
- PID controller
  Opening angle resulting from PID control.
- Max. Dosing Opening
  Maximum value defined in the feed forward control (see *Exhaust Control – SCR – Feed Forward Control* on page 70).
- Opening
  Actual opening angle of the dosing valve resulting from the feed forward control and the PID control.

## 8.12.4 Runtime Data – Trends




The trend view shows you the chronological history of essential values of your SCR system. The information provided can help you optimize the PID controllers of the pump and dosing valve.

The recording is started as soon as the runtime data window is opened and deleted as soon as the window is closed again. The trend view is not available in the runtime data trace.

You can choose between two views:

– Pump
  Trend of the pump pressure and the pump speed (target and actual values) as well as the PID parameters of the pump

– Exhaust
  Trend of the NOx values at the intake and outlet, as well as the PID parameters and the percentage opening of the dosing valve. In addition, the lower diagram shows an area with a red background where the value of the dosing valve opening may be located. The upper limit is the maximum permissible dosing valve opening.

# 8 Settings via the MICT

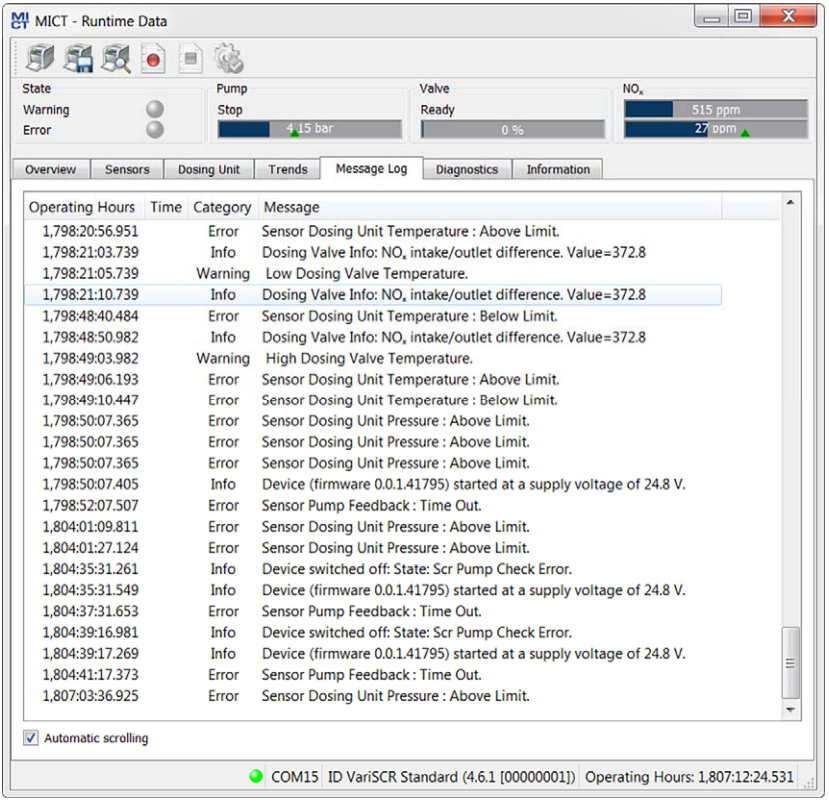
You have the following options:

- Save
  The recorded values are saved on the connected computer as a CSV file. You can open and process these in other programs such as Microsoft Excel®.
- Clear
  Deletes previously recorded data and starts a new recording.
- Pause
  The displaying of the values is paused. However, the recording of the values continues in the background.
- Show/Hide values
  Use the checkboxes in front of the values to specify which values are displayed in the diagrams.
  The color of the fields behind the checkbox corresponds to the color of the respective curve in the diagrams. The small symbol within the color fields indicates in which diagram the corresponding value is displayed and to which scale the value refers. The label on the scale does not always reflect all the values displayed.
  Examples:

   Pressure-Actual – The actual value of the pump pressure is shown as a blue curve in the upper diagram and the values are read off the left-hand scale.

   Pump-P – The P parameter of the PID control of the pump is shown as a green curve in the lower diagram and the values are read on the right scale.
- Change displayed time period
  Using the drop-down menu, you can select the time period that is displayed in the diagrams.

## 8.12.5 Runtime Data – Message Log




In the view *Message Log*, information, warnings and errors are listed.

The following information is provided:

- Operating Hours
  Operating hours counter reading at the time of message
- Time
  Time and date cannot be shown for VariSCR emission controllers.
- Category
  Message type (information, warning, error)
- Message
  Message text; you can find more information on the message text in the following sections.

# 8 Settings via the MICT

You have the following options:

– Automatic scrolling
  If this box is checked, the system automatically displays the last list entry until a new event occurs.

### 8.12.5.1 Information

| Information |
|---|
| Configuration changed. |
| Device (firmware *version*) started at a supply voltage of *value*. |
| Device switched off. |
| Message log cleared. |
| NVRAM formatted. |
| One or more messages are lost due to exhausted memory pool or message queue overrun. |
| Shutdown timestamps cleared. |
| Dosing valve info. |
| Output catalyst overtemperature is set. |

For each information, the status of the emission controller at the time the information occurred is provided. Additional parameters are provided if necessary.

### 8.12.5.2 Warnings

| Warning |
|---|
| Cpu usage. |
| General warning. |
| Reset life time. |
| Use backup life time. |
| SCR pump: Low pressure |
| SCR pump: High pressure |
| SCR pump: Low feedback |
| SCR pump: High feedback |
| Low catalyst outlet temperature |
| High catalyst outlet temperature |

| Warning |
| --- |
| High dosing valve temperature |
| Low dosing valve temperature |

For each warning, the status of the VariSCR emission controller at the time the warning occurred is provided. Additional parameters are provided if necessary.

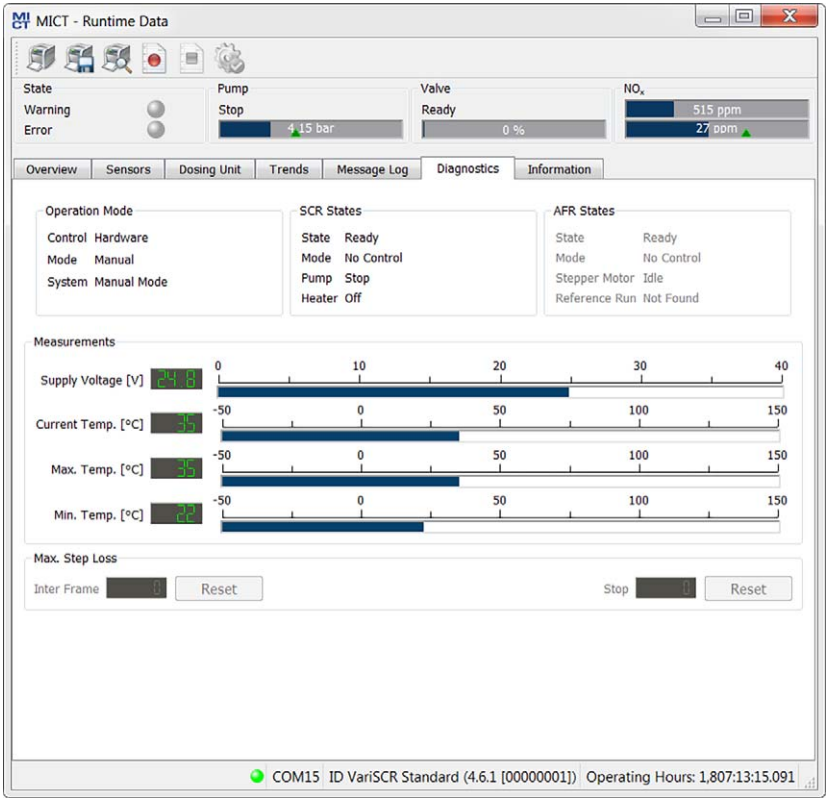
### 8.12.5.3 Errors

| Errors |
| --- |
| CAN handler message queue full. |
| Error triggered by command. |
| Coprocessor handler message queue full. |
| General error. |
| Input handler message queue full. |
| Low Power |
| Output handler message queue full. |
| Over current. |
| Over temperature. |
| Power failure. |
| Timeout. |
| Background task message queue full. |
| Control handler message queue full. |
| SCR pump selftest failure in *state*. |
| SCR dosing valve failure. |
| Sensor |
| Bus |

For each error, the status of the VariSCR emission controller at the time the error occurred is provided. Additional parameters are provided if necessary.

# 8 Settings via the MICT

## 8.12.6 Runtime Data – Diagnostics




In this screen, you can find the following information:

### Operation Mode

The operation mode section shows which operation mode (*Manual* or *Automatic*) is currently active and how the operation mode was adjusted. Here, there are the following two options:

- Control
  Displays whether the operation mode was adjusted using the MICT or the switch *Manual/Auto* on the device (*Hardware*).
- Mode
  The set operating mode is displayed.
- System
  At present, only the system status *Operation SCR* is possible.

### SCR

In this area the current states of the emission controller, the pump and the heating are displayed. These serve as an overview of the overall system.

### AFR

This function is currently not available.

### Measurements

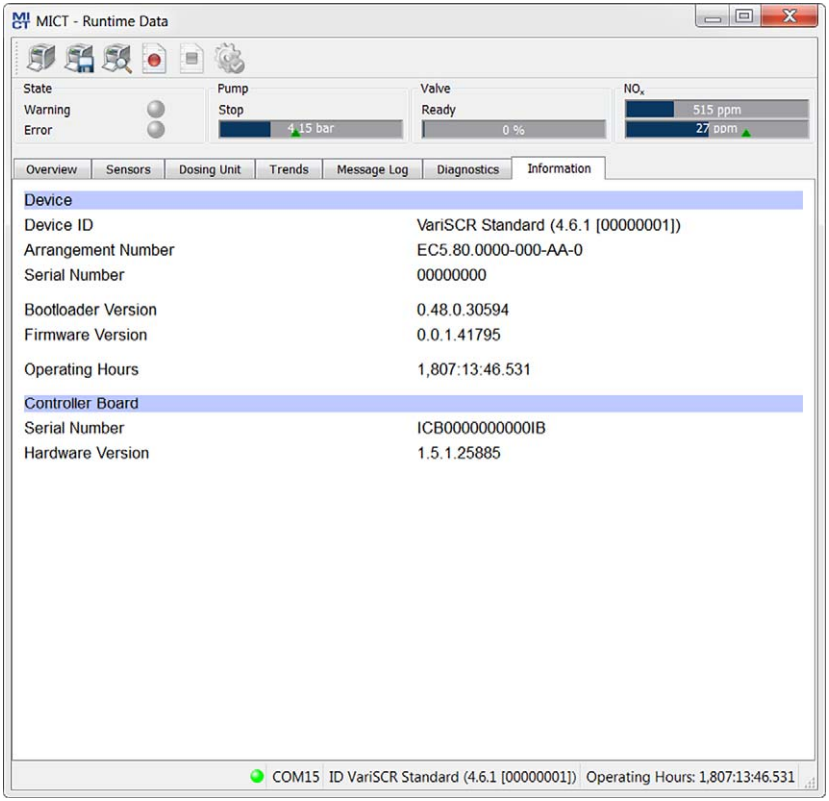
- Supply voltage
  Current supply voltage of the emission controller
- Current Temp.
  Current temperature of the board
- Max. Temp.
  Maximum board temperature reached since the last time the emission controller was switched on
- Min. Temp.
  Minimum board temperature reached since the last time the emission controller was switched on

### Max. Step Loss

This function is currently not available.

# 8 Settings via the MICT

## 8.12.7 Runtime Data – Information




In this view, you can find an overview of the device and version data. You can also print the current runtime data or, in case of problems, send them to the MOTORTECH Service Department via fax or as a PDF file via e-mail. For fast support, we will then immediately have all required information.

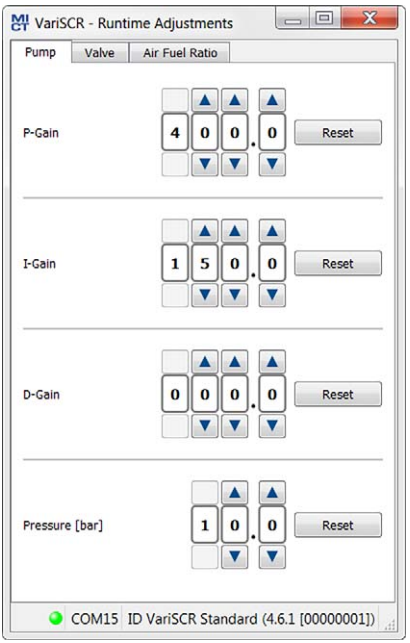
## 8.13 Runtime Adjustments

Click on the symbol to open the window *Runtime Adjustments*. This window is only available to users with authorizations starting with access level *Service*.


**Runtime adjustments are implemented directly**

All runtime adjustments are implemented directly without requiring the input to be confirmed and are retained even in the case of a VariSCR emission controller restart.
Changes that have been saved in the device configuration are only displayed after re-uploading the device configuration in the MICT's main window.

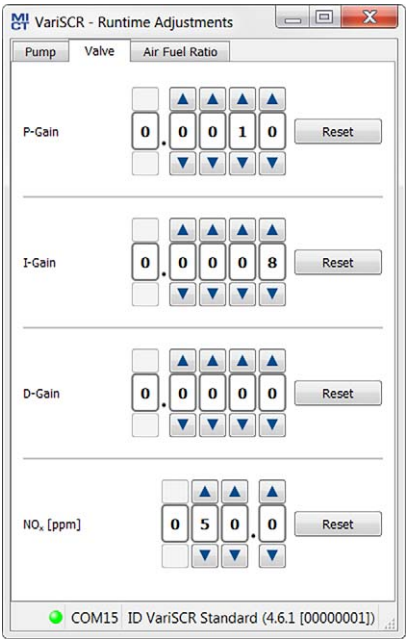
### 8.13.1 Runtime Adjustments – Pump




The PID control of the pump can be corrected during operation of the device. Use the arrow keys above and below the decimal digit you want to increase or decrease. Alternatively you can place the mouse pointer over the respective digit and then change the displayed value with the scroll wheel of the mouse.

The correction of the control is immediately implemented and also remains in place if the device is restarted. The configuration defined in the device is changed directly.

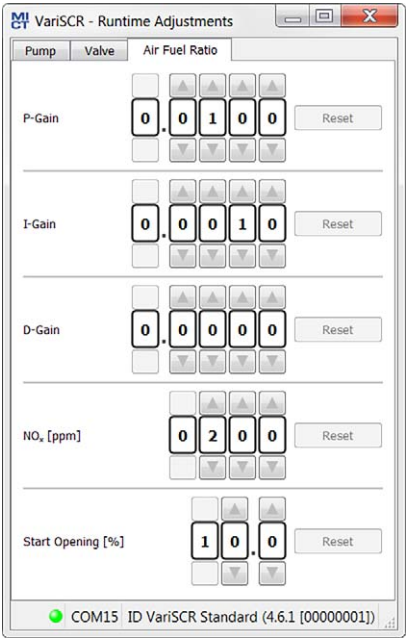
## 8.13.2 Runtime Adjustments – Dosing Valve




The PID control of the dosing valve can be corrected during operation of the device. Use the arrow keys above and below the decimal digit you want to increase or decrease. Alternatively you can place the mouse pointer over the respective digit and then change the displayed value with the scroll wheel of the mouse.

The correction of the control is immediately implemented and also remains in place if the device is restarted. The configuration defined in the device is changed directly.

### 8.13.3 Runtime Adjustments – Gas Mixer

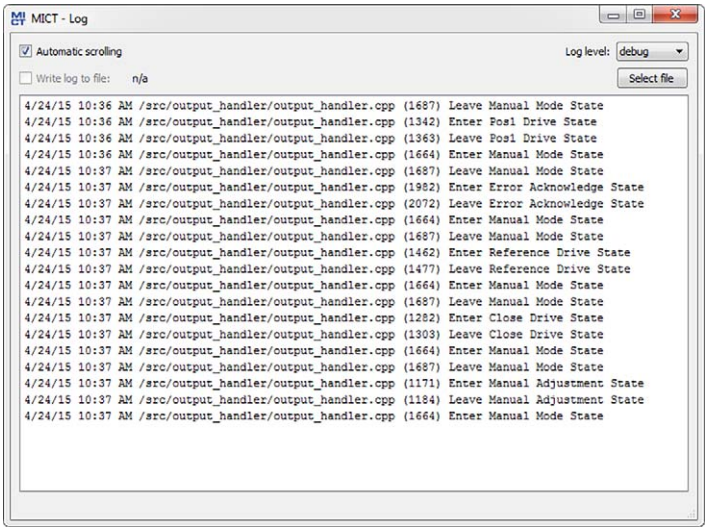



This function is currently not available.

## 8.14 Log

Click on the symbol to open the window *Log*. This window is only available to users with authorizations starting at the access level *Advanced Service*.

# 8 Settings via the MICT




The window *Log* serves to support error diagnostics by MOTORTECH.

– Automatic scrolling
  If the function is active, the view panel focuses on the latest message.
– Log level
  The selection of the log level is specified by MOTORTECH if needed.
– Write log to file
  This checkbox activates or deactivates, respectively, the saving of the logged data in a selected file. If the function is disabled, the logged data are merely shown on the display.
– Select file
  With this button, you can select a file to which you want to save the logged data.

If you are prompted to create a log file in the case of a service request, proceed as follows:

1. Open the window *Log* via the toolbar or the menu bar.
2. Select a path with the *Select file* button and enter the file name for the log file.
   ▸ If the file does not yet exist, it is automatically created with the extension *.log*.
3. Activate the checkbox *Write log to file*.
4. Select the level specified by MOTORTECH from the list *Log level*.
5. Leave the window open.
   ▸ The log messages are logged both in the window and in the selected file.

# 9 Operation

## 9.1 Start-up

To start up the SCR system safely, proceed as follows:

1. Install the SCR system.
2. Set up the AdBlue® circuit so that the dosing unit does not overheat.
3. Adjust the configuration of the VariSCR emission controller, but first for the feed forward control (configuration page: *Exhaust Control –SCR – Feed Forward Control*) use the preset values.
4. Start the engine.
5. Adjust the mixture control so that the $NO_x$ sensor before the catalytic converter measures a $NO_x$ value that corresponds to the engine manufacturer's specifications.
6. Using of a supplied Excel® file, the optimized values for the feed forward control must now be determined and entered into the configuration in MICT. On this, read the section *Determine Values for Feed Forward Control* on page 98.
7. Download the modified configuration to the emission controller.
   - ▸ The start-up is finished.

# 9 Operation

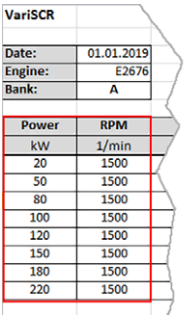
## 9.1.1 Determine Values for Feed Forward Control

The values for the feed forward control must be recalculated once for each SCR system. The determination should also be carried out separately for two identical cylinder banks for a V-engine.

The Excel® file, which is located on the storage device enclosed with the emission controller, supports you in calculating the required values. The determined values are entered in the MICT in the configuration page *Exhaust Control – SCR – Feed Forward Control*.

Proceed as follows:

1. Start the MICT on your computer and connect to the VariSCR emission controller.
2. Open the supplied Excel® file (menue item: *Documentation -› VariSCR*) on your computer.
3. Define eight load points in the Excel® file and enter the power and speed in the columns *Power* and *RPM* .
   Note:
   The load points should cover the range between low load (no idling) and full load.
   Example:



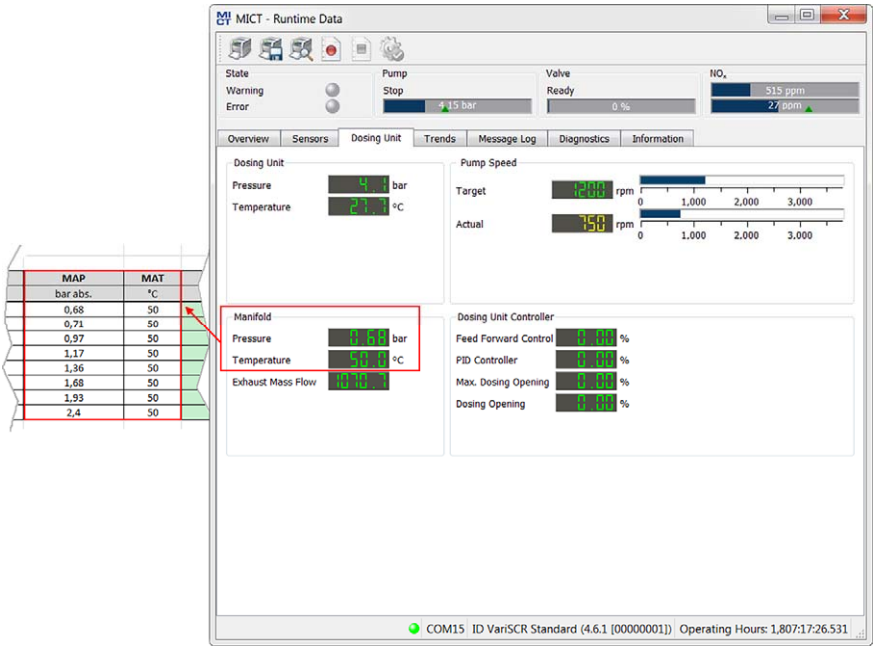
VariSCR

| Date: | 01.01.2019 |
|---|---|
| Engine: | E2676 |
| Bank: | A |

| Power | RPM |
|---|---|
| kW | 1/min |
| 20 | 1500 |
| 50 | 1500 |
| 80 | 1500 |
| 100 | 1500 |
| 120 | 1500 |
| 150 | 1500 |
| 180 | 1500 |
| 220 | 1500 |

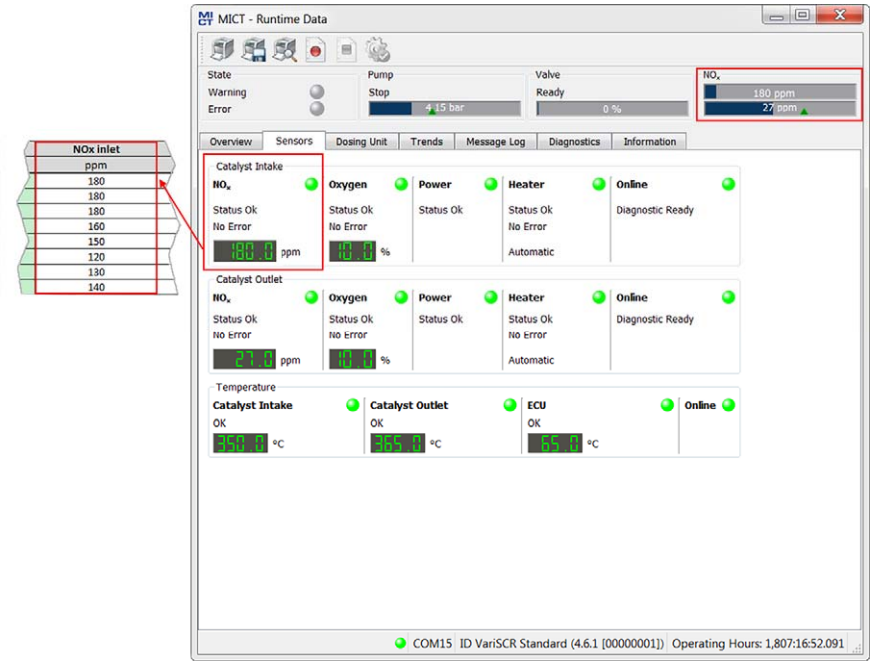
4. Run the engine into the first load point.

5. Read off the pressure and temperature in the manifold in the window *Runtime Data – Dosing Unit* and enter the pressure value in the column *MAP* and the temperature value in the column *MAT* in the Excel® file.
   Example:



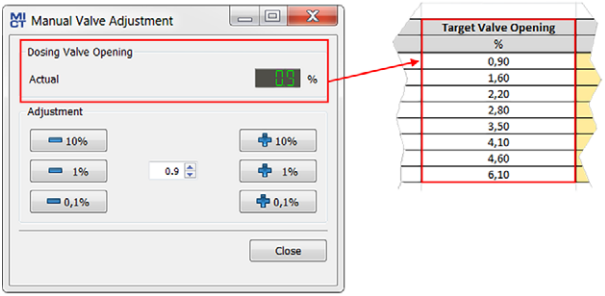

6. In the *Runtime Data – Sensors* window, check the $NO_x$ value before the catalytic converter. It should correspond to the value set via the mixture control and be almost constant during the measurement.
   Tip:
   Alternatively, the $NO_x$ values at the intake and outlet can also be read in the overview below the toolbar.

7. Enter the value in the column *NOx inlet* of the Excel® file.
   Example:




8. Open the dosing valve manually via the menu item *Device -› Manual Valve Adjustment* until the NOx value at the catalytic converter outlet corresponds to the desired final value (e.g. 30 ppm) in the window *Runtime Data – Sensors*. Refer to the section *Manual Valve Adjustment* on page 54.

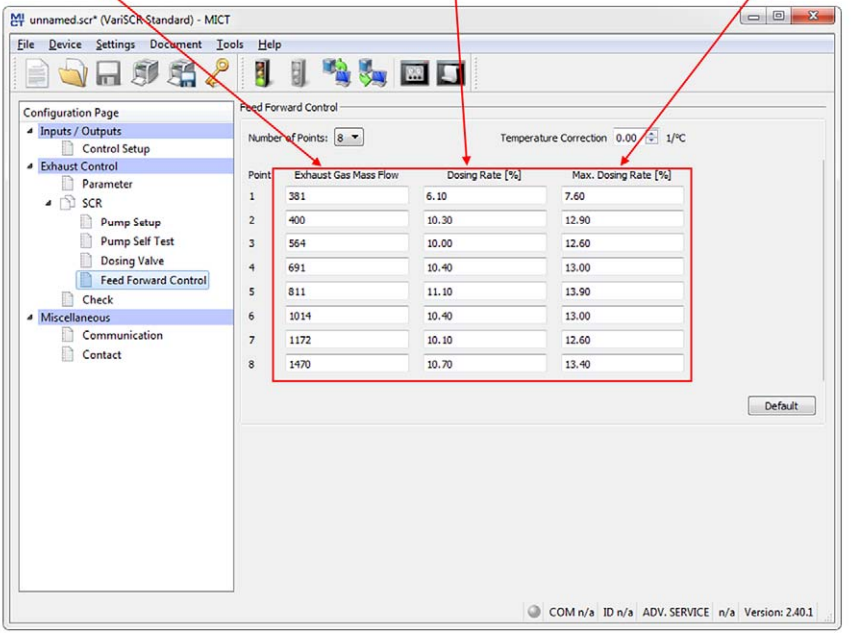
9. Enter the value for the percentage opening in the column *Target Valve Opening*.
   Example:



10. Repeat points 4. to 9. for the remaining seven load points.
    - The colored (green, yellow, red) columns in the Excel® file now contain the optimized values for the feed forward control.

11. Enter the values of the colored columns into the configuration page *Exhaust Control – SCR – Feed Forward Control* in the MICT.
    Example:

| Mass Flow | NOx inlet | Target Valve Opening | Dosing Rate | max. Valve Opening | max. Dosing Rate |
|---|---|---|---|---|---|
| | ppm | % | | % | |
| 381 | 180 | 0,90 | 6,1 | 1,13 | 7,6 |
| 400 | 180 | 1,60 | 10,3 | 2,00 | 12,9 |
| 564 | 180 | 2,20 | 10,0 | 2,75 | 12,6 |
| 691 | 180 | 2,80 | 10,4 | 3,50 | 13,0 |
| 811 | 180 | 3,50 | 11,1 | 4,38 | 13,9 |
| 1014 | 180 | 4,10 | 10,4 | 5,13 | 13,0 |
| 1172 | 180 | 4,60 | 10,1 | 5,75 | 12,6 |
| 1470 | 180 | 6,10 | 10,7 | 7,63 | 13,4 |




12. Download the changed configuration to the emission controller.
    - The start-up of the emission controller is completed and the control is set according to the entered parameters.

# 9 Operation


**Save configuration to file**

If you save the configuration as a file after start-up, you can download it to the new device when replacing the emission controller. A new calibration is then not necessary.

## 9.2 Firmware Update

Using the MOTORTECH Flash Tool, you can update the firmware of your VariSCR emissions controller. The program is provided on the storage device (USB flash drive or CD-ROM supplied).

### Install MOTORTECH Flash Tool

Install the MOTORTECH Flash Tool as follows:

1. Start the installation:
   - Via the menu:
     Start the file *Start.exe* on the storage device. Start the installation routine for the MOTORTECH Flash Tool via *Software -› MOTORTECH Flash Tool -› Install MOTORTECH Flash Tool*.
   - Directly from the storage device:
     Start the installation routine of the MOTORTECH Flash Tool directly. It is on the storage device in the subdirectory *Installation* and for example named as follows: *MOTORTECH-Flash-Tool-0.9.00003-setup.exe*.
2. Install the program.
   Follow the instructions of the installation routine. Note that the license agreement terms must be accepted before using the MOTORTECH Flash Tool.
3. If the USB driver is not yet installed, also install it via the menu or directly from the storage device.
   - Via the menu:
     *Software -› USB Drivers -› Install USB Drivers*
   - Directly from the storage device:
     Start the exe file in subdirectory *Drivers*
     (e.g. *CDM v2.10.00 WHQL Certified.exe*).
   - ▸ The MOTORTECH Flash Tool is set up. You can now connect your computer to the emission controller via the USB interface.

## Menu Bar and Toolbar

After launching the MOTORTECH Flash Tool, the following functions are available to you via the icons on the toolbar and the entries in the menu bar:

| Symbol | Menu | Function |
|---|---|---|
|  | *File -> Open* | Opens a firmware file. |
| | *File -> Quit* | Exits the program. |
| | *View -> Extended file information view* | Fades in / out additional information of the firmware file. |
| | *View -> Extended connection settings* | Fades in / out additional information and settings of the connection to the device. |
|  | *View -> Reload file* | Reloads the file information of the selected firmware file. |
|  | *Device -> Search devices* | Restarts the search for connected devices. |
|  | *Device -> Flash device* | Starts the update process or downgrade process. |
| | *Settings -> Language* | Opens the window *Select Language* in which you can change the interface language of the program. |
| | *Help -> Help* | Opens the online help function. |
| | *Help -> About MOTORTECH Flash Tool* | Opens detailed information on the program. |

## Start Firmware Update


**Access control for firmware update**

If you have activated the access control for the ignition controller, you need the PIN for the level *Master* for the firmware update. For more information read the section *Access Control for the VariSCR Emission Controller* on page 57.

# 9 Operation


**Backup the existing configuration**

Your device's configuration may be lost if the firmware update is not performed properly. Always backup the existing configuration via the MICT prior to performing an update. For more information read the section *Working with Configurations* on page 59.

To start a firmware update, proceed as follows:

1. If an MICT is connected with the emission controller, disconnect this connection.
2. Start the MOTORTECH Flash Tool via *Start -› Programs -› MOTORTECH -› MOTORTECH Flash Tool -› x.x.x (e.g. 0.9.00003) -› MOTORTECH Flash Tool*.
   - The MOTORTECH Flash Tool will now start.
   - The software automatically checks all ports for connected devices.
3. In the *Status* section under *Device*, check if your device has been recognized properly.
   - If the MOTORTECH Flash Tool does not recognize a device that is connected to your computer via the USB interface, you can usually still carry out a firmware update. To do so, observe the instructions in the information windows of the MOTORTECH Flash Tool for the following steps.
4. Select in area *File* using the *Select* button the desired update file.
5. By reading the displayed file information, ensure that the update file is correct for your device.
6. Start the update process using the *Flash* button or using the menu or toolbar.
   - The emission controller will be restarted automatically.
   - Now, a window opens informing you about the firmware version currently used on your emission controller and also about the relevant update version.
7. Confirm with *Yes* to proceed with the update process.
   - Now the update will start.
   - If the firmware update was successful, you will see a relevant message.
8. After a successful firmware update, check all configuration data.


**Downgrade process**

The process for a downgrade is largely the same as the update process. You will only be informed that a new firmware has been installed on the device.


**Help with connection problems**

If a correctly connected device is not found during the automatic search, this can, for example, be because too many communication interfaces are assigned and must be checked. In this case, an interface from the drop-down list *Port* in the area *Connection* can be selected and thus specified.

If the desired port is not yet displayed in the list or if the problem should continue, an adjustment of the time-outs for the connection helps. The time-out settings are displayed in the main view by the following entry in the menu bar: *View -› Extended connection settings*

Enter the following settings:

– Update Request Timeout
  Adjustment range: 1,000 ms to 10,000 ms, standard value: 3,000 ms. An extension of the time-out can be an advantage, especially with connection problems that occur because the computer has many assigned ports.

– Start Timeout
  Adjustment range: 1,000 ms to 10,000 ms, standard value: 3,000 ms. A time-out change can be an advantage, especially with connection problems that occur because the communication between the computer and the device has been interrupted.

# 10 Errors

## 10.1 Troubleshooting

If the VariSCR emission controller detects any error, the LED *status* starts blinking in red. You can find details about status signaling in the following information box. In automatic mode, the binary output *Error* is also activated in the event of a fault and the corresponding LED lights up. Using the MICT you can see the type of error occurred. Refer to the section *Runtime Data – Message Log* on page 87.


**Status signaling**

The status of the VariSCR emission controller is signaled via the LED *Status*.

- Flashing **green**: Error-free operation
- Flashing **orange**: Warning
  Warnings can be acknowledged by simultaneous pressing of buttons *Open* and *Close* (in manual mode) or by the external reset signal. Warnings can for example be caused by:
  - Overload of the device
  - Overtemperature or over current error confirmed by MICT.
- Flashing **red**: Error
  Errors can be acknowledged by simultaneous pressing of buttons *Open* and *Close* or by the external reset signal. Errors can for example be caused by:
  - Overtemperature
  - Low voltage
  - Over current
- Alternate flashing of **red** and **green**:
  The supply voltage for the device was too low during start up.

## 10.2 Possible Faults

**Low Power**

Supply voltage has dropped below 11 V.

Potential causes:

- The power supply is dimensioned too small.
- The battery is worn out.
- The wiring for the power supply is defective.
- The wiring for the power supply is routed incorrectly.

**Overtemperature**
The temperature of the board of the VariSCR emission controller has been exceeded.

Potential causes:

– The ambient temperature is too high.
– Air circulation around the device is insufficient.

## 10.3 Acknowledging Faults

In manual mode, you have the following options for acknowledging operational errors:

– Via *Error acknowledge* in the MICT
– By pressing the *Open* and *Close* button simultaneously

In automatic mode, you have the following options for acknowledging operational errors:

– The master control sends a signal to the binary reset input
– By pressing the *Open* and *Close* button simultaneously
– Via *Error acknowledge* in the MICT

Critical errors can only be acknowledged by switching the device off and on.


**Error confirmation in automatic operation**

If the VariSCR emission controller is in automatic mode and an error immediately reoccurs after the acknowledgment of this error via the MICT, switch over into the manual mode before re-acknowledging the error again. After you have acknowledged the error, you can correct a defective configuration and transfer it to the device via download.

## 10.4 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

# 10 Errors

## 10.5 Returning Equipment for Repair/Inspection

To return the device for repair and inspection, obtain a return form and return number from MOTORTECH.

Fill out the return form completely. The completely filled out return form guarantees fast, uncomplicated processing of your repair order.

Send the device and the 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

## 10.6 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.

# 11 Maintenance

## 11.1 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*.

# 12 Index

**MOTORTECH GmbH**
Hogrevestr. 21–23
29223 Celle
Germany

Phone: +49 (5141) 93 99 0
Fax: +49 (5141) 93 99 99
E-Mail: sales@motortech.de
Web: www.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
E-Mail: info@motortechamericas.com
Web: www.motortechamericas.com

**MOTORTECH Shanghai Co. Ltd.**
Room 1018 Enterprise Square,
No. 228 Meiyuan Road,
Jing'An District, 200070 Shanghai
China

Phone: +86 (21) 6380 7338
E-Mail: info@motortechshanghai.com
Web: www.motortechshanghai.com

## GAS ENGINE TECHNOLOGY

- Ignition Systems
- Spark Plugs & Accessories
- Gas Engine Control Systems
- Sensor Systems
- Air/Fuel Ration Control Systems
- Exhaust Gas Aftertreatment
- Gas Engine Accessories