Table of Contents

1 General of NOx

1.1 General Description

This technical specification describes the smart NOx sensor (SNS) used for catalyst management in vehicles with gasoline or diesel engines. The smart NOx sensor consists of a ceramic sensor element and an electronic control unit.

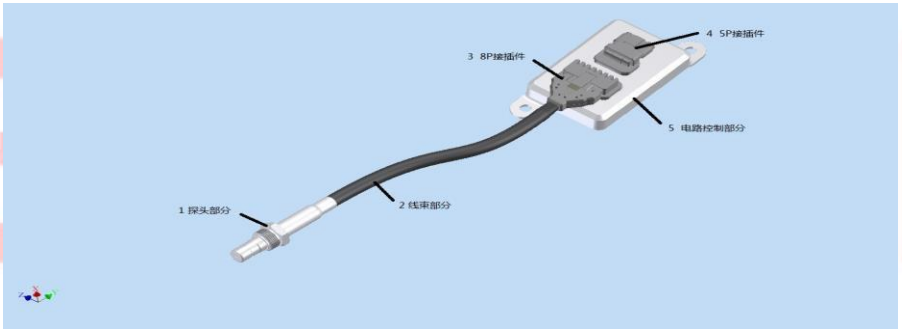
The smart NOx sensor measures the NOx concentration of nitrogen oxides (a mixture of nitrogen oxides such as NO and NO2) and the concentration of oxygen in the exhaust gas

- Lean burn engine (NOx trap)
- Diesel engines (SCR catalysts, NOx trap, closed-loop NOx control)
- On board diagnosis (OBD) (gasoline and diesel engines)

1.2 Function Description

The sensitive element of the NOx sensor is a ceramic sensor made of zirconia electrolyte. The sensor's electronic control unit controls the heating temperature of the sensor probe and measures the current of all pump units. Finally, the NOx concentration and O2 concentration in the pump are determined.

The NOx sensor consists of a sensor probe and an electronic control unit connected by a harness, as shown 1-1。



P 1−1 Assembly system of NOx sensor

2 NOx Sensor Specifications

2.1 Performance review

	Name	Code	Min	Max	Unit	Remarks
1	NO_x concentration	NOx	-1	3063	ppm	NO& NO2
2	O_2 concentration	O2	-12	21	%	
3	Response time NO_x	τ33<-->66% NOx		1300	ms	
4	Response time O_2	τ33<-->66% O2		1000	ms	
5	R-to-L response (T600->300 mV)	TRL		500	ms	
6	L-to-R response (T300->600 mV)	TLR		500	ms	

Allowed gas temperature range for validity of characteristic data: 800℃.

2.1.1 Light-off time

Response Time	Response Time
NOx	< 100 second
O2	< 80 second

Measurement conditions: air

2.1.2 Measurement Accuracy

The flow rate of the gas, the temperature of the electronic sensor control unit, the installation position of the sensor, etc.

The measurement accuracy of the sensor has varying degrees of influence. It is obvious that the measurement accuracy of the O2 concentration also affects the measurement accuracy of the NOx concentration. The measurement accuracy of the experiment under certain conditions is given below for reference only.

Experimental condition:

- Gas flow: 1000mL/min
- Intake pipe diameter: Outer diameter 3mm, the inside diameter 2mm
- Electronic sensor control unit temperature: 60±15℃
- installation angle: 90°
- O2 concentration measurement accuracy: 0.5%FS
- NOx concentration measurement accuracy: 0.5%FS

2.1.3 Heat up strategy

After power-on, the ceramic probe of the sensor is in a power-down state, and the probe is heated or turned off by the CAN bus. The instructions issued are decided.

3 Requirements

3.1 Operating temperature ranges

Range of temperatures:

- Minimum ambient temperature electronics T min = - 40 °C
- Maximum ambient temperature electronics T max = +85 °C
  (Operating temperature 105°C allowed for up to10 min)
- Minimum storage temperature without powering T min = -40°C
- Maximum storage temperature without powering T max = 115°C
  (Maximum storage time in spare part packaging 2 years)
- Maximum exhaust gas temperature T max = 750°C
  (Exhaust gas temperature of 850°C allowed for up to 40h)
- Maximum sensor hexagon screw temperature T max = 500°C
  (Sensor hexagon screw temperature of 630°C allowed for up to 40 h)
- Maximum sensor grommet temperature T max = 200°C
  (Sensor grommet temperature of 230°C allowed for up to 40 h)

Within the operating temperature range, the functionality of the NOx Sensor is guaranteed within the specified tolerances.

3.2 Cable

Min. cable bending radius (each single wire) r = 3.5 mm

3.3 Acceleration

- Maximum acceleration of NOx sensor gs = 490 m/sec²
- Maximum acceleration of electronic interface gs = 3.81 g RMS
  (38 m/sec²) at 10Hz to 1000Hz (random)

3.4 Electrical Characteristics

3.4.1 Supply Voltage	Supply Voltage: 24V Operating voltage range: 16V—36V
3.4.2 Supply current Average	Supply current: 0.6A
3.4.3 Supply power	Maximum supply power: 20W
3.4.4 CAN Lines	Minimum line voltage: -3V Maximum line voltage: 36V

4 CAN Transmit Protocol（according to SAE1939 standard）

Data format:

Transfer rate	250KBaud
Repetition	50ms Data
Format	Intel
Identifier	Extended

4.1 Transmit signals

Transmit address	Wiring	Remarks
18F00F52h	Function line dangling(5.3)	The ECU is downstream
18F00E51h	Function line ground(5.3)	The ECU is upstream

General Overview:

	7	6	5	4	3	2	1	0
0 (L-Byte)	NOx	NOx	NOx	NOx	NOx	NOx	NOx	NOx
1 (H-Byte)	NOx	NOx	NOx	NOx	NOx	NOx	NOx	NOx
2 (L-Byte)	O2	O2	O2	O2	O2	O2	O2	O2
3 (H-Byte)	O2	O2	O2	O2	O2	O2	O2	O2
4	Status Byte	Status Byte	Status Byte	Status Byte	Status Byte	Status Byte	Status Byte	Status Byte
5	not used**	Status Heater Mode	Status Heater Mode	Error* Heater	Error* Heater	Error* Heater	Error* Heater	Error* Heater
6	not used**	not used**	not used**	Error* NOx	Error* NOx	Error* NOx	Error* NOx	Error* NOx
7	not used**	not used**	not used**	Error* O2	Error* O_2	Error* O_2	Error* O_2	Error* O_2

** not used bits = 0

	Range Coding	Definition
NOx	-1 — 3063 [ppm] signal: unsigned integer	Transmitted is the NOx-concentration which is detected by the NOx-Sensor. The transmission is in 0.05 ppm NOx/bit +200 ppm. (f.e.: 2F30 corresponds to 404ppm NOx 0.05×12080-200=404ppm
O_2	-12 — 21 [%] signal: unsigned integer	Signal of the actual oxidation factor (%O_2): The transmission is in 0.000514%/bit +12%. (f.e.:5B32 0.000514×23346-12= 0%

4.2 Receive signals

Receive ID: 18FEDF00h or 18FEDF3Dh
Overview receive signals:

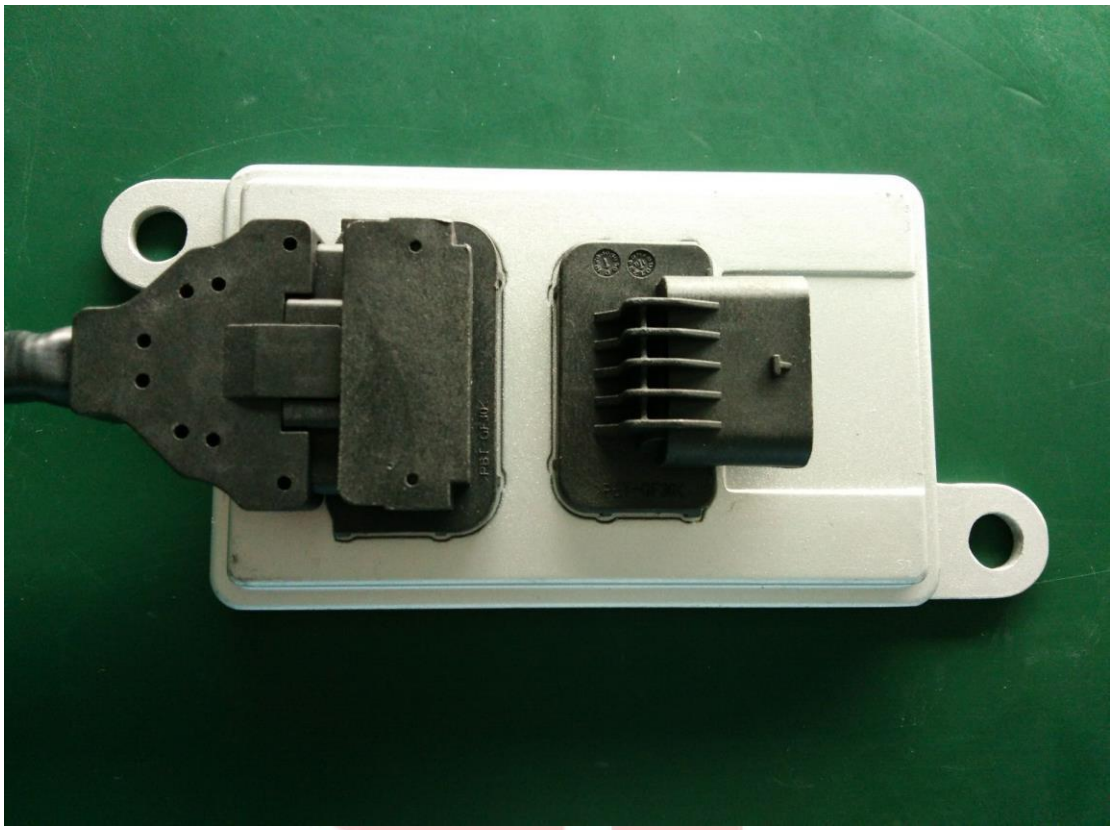
	7	6	5	4	3	2	1	0
0	tbd.	tbd.	tbd.	tbd.	tbd.	tbd.	tbd.	tbd.
1	tbd.	tbd.	tbd.	tbd.	tbd.	tbd.	tbd.	tbd.
2	tbd.	tbd.	tbd.	tbd.	tbd.	tbd.	tbd.	tbd.
3	tbd.	tbd.	tbd.	tbd.	tbd.	tbd.	tbd.	tbd.
4	tbd.	tbd.	tbd.	tbd.	tbd.	tbd.	tbd.	tbd.
5	tbd.	tbd.	tbd.	tbd.	tbd.	tbd.	tbd.	tbd.
6	tbd.	tbd.	tbd.	tbd.	tbd.	tbd.	tbd.	tbd.
7	**Start-Code**	**Start-Code**	**Start-Code**	**Start-Code**	**Start-Code**	**Start-Code**	**Start-Code**	**Start-Code**

	Range Coding	Definition
Start-Code	0000 DD00 (04h) Rear sensor	DD=00: Dewpoint not reached DD=01: Dewpoint reached, sensor heating up started DD=11: not valid DD=10: not valid
Start-Code	0000 DD00 (01h) Front sensor	DD=00: Dewpoint not reached DD=01: Dewpoint reached, sensor heating up started DD=11: not valid DD=10: not valid

The dew point byte (start code) must only be sent, if the exhaust gas contains no liquid water or other fluids.

Recommended repetition rate is >100m

4.3 Electronic control unit protection

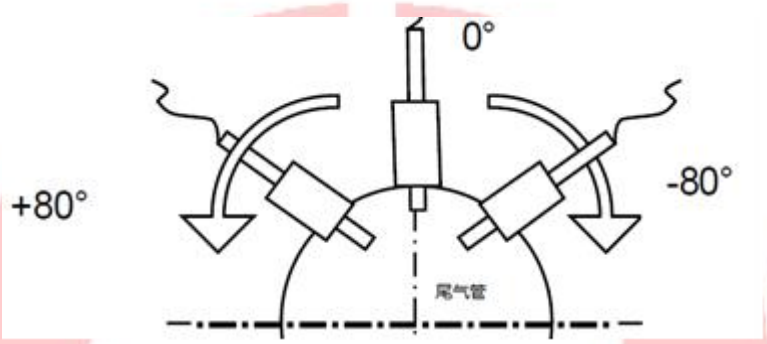


P 4-1 NOx Sensor Electronic Control Unit

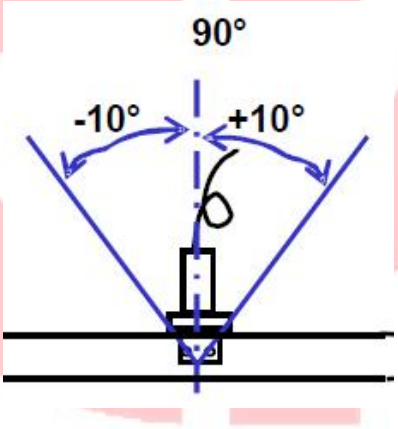
The nitrox sensor electronic control unit is packaged in a box as shown in Figure 4-1. When the electronic control unit and the ceramic sensor are not connected, that is, when the electronic control unit is powered separately without load, the circuit provides protection against burnout of the board.

5 Comments for installation

5.1 Installation



P 5-1 Installation Angle



P 5-2 Tilt angle in gas flow direction

Mounting thread priority recommended specifications：M20×1.5，If the user has special installation specifications, it can be specially treated. The thread surface should be coated with anti-seize agent (above 1000 °C, the material can not contain Si element).

Mounting the sensor probe head should meet two requirements

1. As P 5-1, the installation angle should ensure that the top of the probe is substantially downward to prevent condensate from permanently damaging the sensitive components inside the probe.
2. As P5-2, the recommended tilt angle is 90°±10°. Other angles are possible (as long as other specifications are fulfilled but may be linked with:

- a decrease in response time.
- a need of delayed dew point sending due to an increased amount of condensed humidity and less heating up of the sensor assembly by the exhaust gas in sloped bosses.
- a different gas sensitivity due to the changing gas concentration profiles versus the exhaust pipe diameter.

The thread mounting torque of the product is 50±10Nm. And the thread strength must be appropriate.

5.2 Connector

The electronic control unit of the NOx sensor and its ceramic sensor are connected by a mounting base and 8 wires. Wires are high temperature resistant wire (temperature range: -40°— 200℃), their colors are including white, black, orange, blue, yellow, grey, red, green.

5.3 Power supply and communication connector

P 5-2 connector

As p5-2 shows:

Amount of pins: 5

Connector assignment:

Pin1: +24V
Pin2: GND
Pin3: CAN lines (Low)
Pin4: CAN lines (High)
Pin5: function line