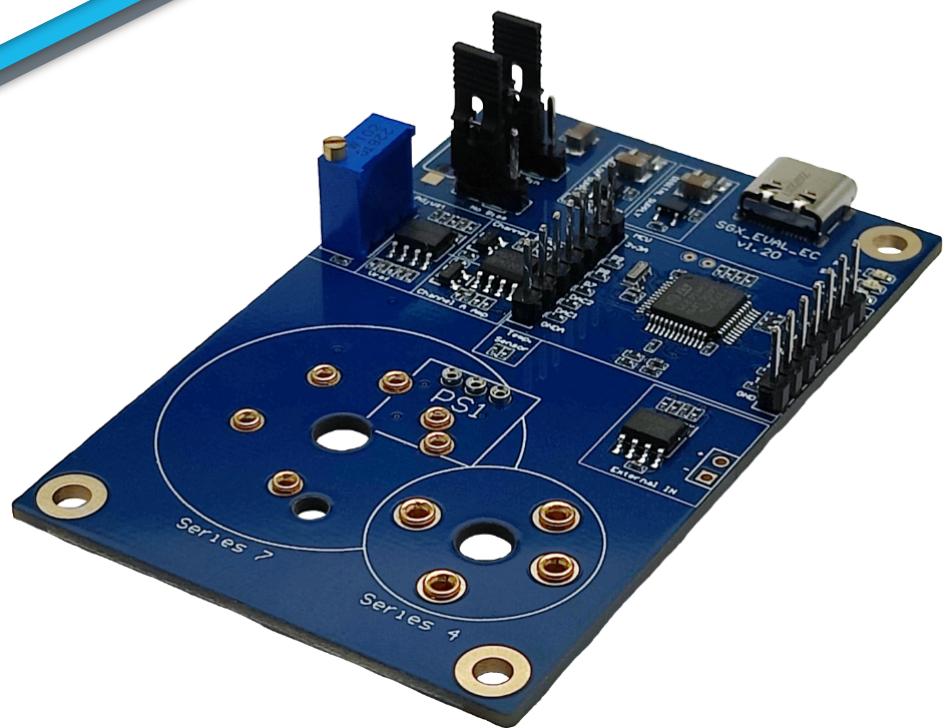




**SENSORTECH**

An Amphenol Company



**SGX\_EVAL\_EC** is  
dedicated to  
our sensor series:

**SGX-4xxx**

**SGX-7xxx**

**PS1 & PS4**

**SGX-AOX/EOX/VOX**

## **SGX\_EVAL\_EC**

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# **Electrochemical Gas Sensor Evaluation Kit**

# User Guide



*Quality, Safety, Responsibility*

# Important Information

Before using this product, please study all the instructions and warnings. SGX Sensortech does not accept responsibility for damage or injury resulting from failure to follow the instructions provided.

## WARNINGS

- The Evaluation Kit is dispatched from SGX Sensortech in a safe condition. Any unauthorized modifications may compromise safety and invalidate the warranty.
- The Evaluation Kit is not certified as intrinsically safe and therefore must not be operated in potentially flammable or explosive atmospheres.
- **Neglecting the above may result in injury or death.**

## CAUTIONS

- The Evaluation Kit is intended for engineering development, demonstration or evaluation purposes only. It is not considered to be suitable for general consumer use and should be handled by people with suitable electronics training.
- The Evaluation Kit contains electrostatic discharge sensitive devices. Always observe handling precautions.
- The Evaluation Kit and Gas Sensor Devices should always be used within their ratings as given in their data sheets.

## COMPLIANCE

- This Evaluation Kit has been tested (but not certified) and deemed to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules and European Union directives on electromagnetic compatibility. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. The user is responsible for providing reasonable protection against interference with other electronic equipment.
- The Evaluation Kit is not intended for automotive use. It does not contain protection devices against vehicle supply transient voltages and must not be used for the control of a vehicle, a vehicular safety system or in a way that may disturb the driver, data bus or statutory devices fitted to a vehicle.

## ENVIRONMENTAL

- SGX Sensortech declares that the Evaluation Kit complies with EC directive 2011/65/UE and 2015/863 (the RoHS Directive) restricting the use of certain hazardous materials in electrical and electronic equipment. See section 14 for China RoHS information.
- The Evaluation Kit is classified as Electronic and Electrical Equipment according to directive 2012/19/EU (the WEEE Directive) and should be segregated from domestic waste for disposal. Contact your SGX Sensortech Ltd for disposal instructions.



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# INTRODUCTION

Thank you for purchasing the SGX Electrochemical Gas Sensors Evaluation Kit.

SGX Electrochemical Gas Sensors are low power devices capable of detecting a range of toxic gases as well as oxygen. Our device can be used in many different applications and this Evaluation Kit from SGX will allow you to experiment and find the most suitable mode of operation for your particular use.

## This Evaluation Kit allows you to:

- Test an SGX electrochemical toxic/oxygen sensor
- Control the electrochemical sensor bias voltage
- Calibrate sensors based on a linear or non-linear response and then monitor gas concentration levels
- Connect additional circuits to an expansion port
- Log sensor outputs, concentrations and temperature readings using the supplied SGX EC EVAL Software.

## Contents of SGX\_EVAL\_EC Kit

- Evaluation Kit PCB
- USB to USB-C cable
- Paper brochure and manuals

## Accessories Available (separately)

(None are included in the [SGX\\_EVAL\\_EC kit](#))

- **JAS769638AA** – Gas Flow Hood for sensors size Series 4,
- **PS1 Flow Cap** – Gas Flow Hood for sensors size Series PS1.

# QUICK START GUIDE

WARNING: Do not connect or plug in any Gas Sensors until instructed!

1

Download and Install the **SGX EVAL EC** Software Application from  
[https://software.sgxsensor.com/SGX\\_EVAL\\_EC\\_169.zip](https://software.sgxsensor.com/SGX_EVAL_EC_169.zip)

2

Set the jumpers on the **SGX\_EVAL\_EC** PCB according to the specifications of the sensor.

- If the sensor has 2 pins set the jumper on positions 2-3 (Picture 2.).
- If the sensor has 3 pins or more set the jumper on positions 1-2 (Picture 1.).
- For biased set the jumper on positions 1-2 (Picture 3.).
- For unbiased set the jumper on positions 2-3 (Picture 4.).



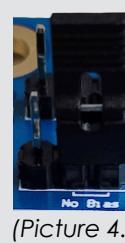
(Picture 1.)



(Picture 2.)



(Picture 3.)



(Picture 4.)

3

- a. Connect the USB cable to the sensor **SGX\_EVAL\_EC** PCB and the PC.
- b. Start up the **SGX EVAL EC** Software Application.

Adjust the bias potentiometer (using a small flathead screwdriver) to value stated in datasheet of sensor. The value of the set bias is displayed in the application in the window →

**Bias**  
-600.0



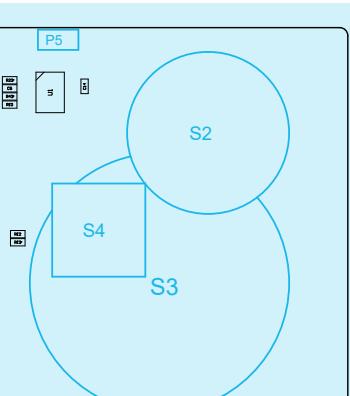
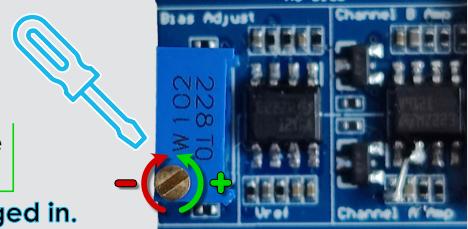
4

## Adjust the bias potentiometer

Turn the potentiometer clockwise to reduce the bias value

Turn the potentiometer counterclockwise to increase the bias value

The bias voltage should be set-up before the sensor is plugged in.  
 Turn the power off when plugging in a sensor.



Structure Diagram of the **SGX\_EVAL\_EC** with marked sensor sockets

5

Place the sensor in the dedicated socket.

|           |                                       |
|-----------|---------------------------------------|
| <b>S2</b> | Socket for SGX series 4 sensors / PS4 |
| <b>S3</b> | Socket for SGX series 7 sensors       |
| <b>S4</b> | Socket for SGX PS1                    |
| <b>P5</b> | Connector for SGX-VOX / AOX / EOX     |

6

Plug the Cap onto the Gas Sensor.

(Not included in the **SGX\_EVAL\_EC** kit. You can order Gas sensor cap separately)

# QUICK START GUIDE

WARNING: Do not connect or plug in any Gas Sensors until instructed!

In the application:

1. Calibrate sensor base line
  - a. Connect the Air or Nitrogen, open the Gas Regulator. Use the flow controller to regulate the gas flow ideally around 500ml/min.
  - b. Wait for the Sensor response to stabilize and press „Calibrate Zero” button.
2. Calibrate the Sensor Span
  - a. Disconnect the Gas Cap of the Air or Nitrogen
  - b. Connect the Gas Cap of the Target gas.
  - c. When Signals stabilise, press „Calibrate Span” Button in application\*
  - d. In the application window (1.) select the channel to be calibrated (2.). In most cases this will be channel A only (exceptions are dual-sensors and AOX, EOX, VOX). If you are calibrating a dual-sensor then you should calibrate channel A first and then connect the gas cylinder to calibrate channel B.

\*When calibrating, select the gas concentration in ppm or % (3.).



7

Gas Sensor is now fully calibrated. You can use it for your experiments.

Bias settings table For the most popular Electrochemical Sensor

| Sensor          | Gas               | Bias<br>( $V_{SENSE} - V_{REF}$ ) | LK1<br>setting | Circuit Output<br>Voltage Polarity |
|-----------------|-------------------|-----------------------------------|----------------|------------------------------------|
| <b>SGX-4CO</b>  | Carbon Monoxide   | 0 V                               | 2-1            | Positive                           |
| <b>SGX-4H2S</b> | Hydrogen Sulphide | 0 V                               | 2-1            | Positive                           |
| <b>SGX-4NH3</b> | Ammonia           | 0 V                               | 2-1            | Positive                           |
| <b>SGX-4NO2</b> | Nitrogen Dioxide  | 0 V                               | 2-1            | Negative                           |
| <b>SGX-7NH3</b> | Ammonia           | 0 V                               | 2-1            | Positive                           |
| <b>SGX-7CO</b>  | Carbon Monoxide   | 0 V                               | 2-1            | Positive                           |
| <b>SGX-7H2S</b> | Hydrogen Sulphide | 0 V                               | 2-1            | Positive                           |



If the above table does not contain any information on the sensor you are interested in, check the Datasheet of the respective sensor

# USING SOFTWARE

Follow the instructions in the Quick Start guide to get the software operating.  
The main application screen should look as follows:

## Data logging Page



|     |                            |  |
|-----|----------------------------|--|
| 1.  | Concentration(A)           | Gas concentration (ppm or %) at <b>Channel A</b>   |
| 2.  | Current (A)                | Relative sensor current at <b>Channel A</b> (after Zero Calibration)   |
| 3.  | Current Raw(A)             | Absolllute sensor current at <b>Channel A</b>  |
| 4.  | Concentration(B)           | Gas concentration (ppm or %) at <b>Channel B</b>   |
| 5.  | Current (B)                | Relative sensor current (after Zero Calibration) or voltage(for VOX,AOX,EOX) at <b>Channel B</b>   |
| 6.  | Current Raw(B)             | Absolllute sensor current or voltage(for VOX,AOX,EOX) raw at <b>Channel B</b>  |
| 7.  | Bias                       | Bias voltage value   |
| 8.  | Temperature                | Temperature of PCB   |
| 9.  | Units                      | Units in which the gas concentration is displayed<br>  |
| 10. | Selection table            | To display the graphs for a given parameter (select or deselect)<br>   |
| 11. | ADC Status (For Channel A) | Infirms if sensor readings are not exceeding input range<br>Saturation indication: 0-89% - status: OK      90%+ - status: SATURATED<br>If saturation exceeds „90%“ change the gain value   |
| 12. | ADC Status (For Channel B) |  |
| 13. | Log interval               | Time period between data recordings  |
| 14. | Find me                    | Button causes the yellow LED with the word "Status" to flash rapidly. With this function you can find the Eval kit from this result window (useful function when you have several Eval kits connected at the same time and you want to match Eval kit PCB to software window). |
| 15. | Comms                      | Communication with Eval kit: ERROR or OK. If error look page xx.   |
| 16. | Clear chart                | Button to clear log data and chart area  |
| 17. | Calibrate Zero             | Button to calibrate sensor base line (zero).   |
| 18. | Calibrate Span             | Button to calibrate sensor sensitivity (span).   |
| 19. | Save data                  | Button to save data to a log file.   |
| 20. | Exit                       | Button to exit the application.  |
| 21. | APP Version:               | Aplication Version, Firmware version, Serial number of the EC Eval Board   |
| 22. | Settings                   | Application settings page  |

## Settings Page



Field can be modified by user

|     |  |     |
|-----|--|-----|
| 1.  | In the factory settings this channel is always switched to "Current". If you are connecting VOX/AOX/EOX set it to "OFF"                                    | yes |
| 2.  | Gain/range of sensor current measurement - to get a more precise result from the sensor, increase this value. Exceeding the gain will result in saturation | yes |
| 3.  | Gas Type (data saved in the MICROPROCESSOR and then exportable to a .CSV file) (name up to 12 characters)  | yes |
| 4.  | Span gas value   | yes |
| 5.  | Depending on the sensor type, set to Linear or $s=K \log$ - in accordance with the TECHNICAL SPECIFICATIONS of the respective sensor                       | yes |
| 6.  | Calibration data (read-only) - base line value   | no  |
| 7.  | Calibration data (read-only) - sensitivity value   | no  |
| 8.  | Calibration data (read-only) - temperature reading during most recent calibration  | no  |
| 9.  | In the factory settings this channel is always switched to "OFF". You can choose „Current“ for dual-gas sensors or „Voltage“ for sensors AOX / EOX / VOX   | yes |
| 10. | Sensor name (name up to 12 characters)   | yes |
| 11. | Result averaging time.   | yes |
| 12. | Serial port baud rate  | yes |
| 13. | Serial number of the sensor (number up to 8 characters)  | yes |
| 14. | Load parameters from the board   | no  |
| 15. | Saving the parameters entered in this window on the board  | no  |
| 16. | Updating the firmware  | no  |

# USER INTERFACES, CONTROLS AND INDICATORS

## USB Interface (J1)

J1 is a type USB-C connector for communicating with a PC.

## Electrochemical Sensor Connector (S2, S3 or S4)

Electrochemical sensors should be plugged into S2, S3 and S4. Before plugging the sensor in the socket, ensure that the correct bias voltage has already been set up and that the SGX\_EVAL\_EC power has been switched off.

### User Adjustments (VR, P2, P4)

**VR1:** Electrochemical bias voltage adjust potentiometer (-700 mV to +350 mV range)

**P2:** Jumpers to select 2 or 3-pin sensors:

- If the sensor has 2 pins set the jumper on positions 2-3 (Picture 2.).
- If the sensor has 3 pins or more set the jumper on positions 1-2 (Picture 1.).

**P4:** Electrochemical bias:

- For biased set the jumper on positions 1-2 (Picture 3.).
- For unbiased set the jumper on positions 2-3 (Picture 4.)



## LEDS (D1, D2, D3)



**D1** – LED indicating that the unit is powered.  
(It should always be lit when connected to a computer)

**D2** – LED indicating that the device is measuring  
(Always blinking when taking a measurement)

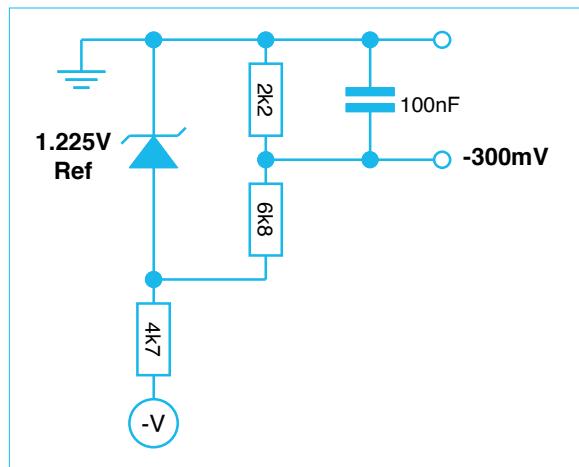
**D3** – LED indicating error occurrence  
(It should never be lit)

# ELECTROCHEMICAL SENSORS

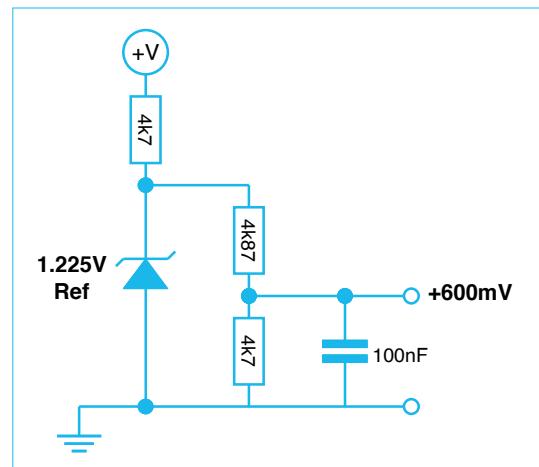
The user is advised to study the Electrochemical Sensor Application Notes at SGX website for information on principles of operation of electrochemical sensors.

## Biasing

Electrochemical sensors are normally operated in a 'potentiostat' circuit which is designed to maintain a constant bias between the sensing electrode (sometimes called the "working electrode") and the reference electrode. The bias voltage is given in device datasheets as the 'applied potential' and is also summarised in the quick start guide (page 4.).



Example Bias Circuit for -300mV



Example Bias Circuit for +600mV

## Output Amplifiers

The output of an electrochemical sensor is a current proportional to gas concentration. The range of this current can be calculated from the sensitivity values given in individual device data sheets.

SGX\_EVAL\_EC is configured as a current to voltage converter with a gain set by  $R48 + R49 = 3.051k$ . Therefore the output signal of IC7B (EC\_hi\_range\_out) has the following voltage:

- $EC\_hi\_range\_out = 3051 \text{ V/A} = 3.051 \mu\text{V/nA}$

The ADC converter (IC12) is a 16-bit device (65536 steps) using a 5 V reference. Therefore each ADC step corresponds to  $76.29 \mu\text{V}$ . In terms of sensor output current this is as follows:

- $EC\_hi\_range\_out = 0.00007629/3051 = 25 \text{ nA per ADC step}$

This is the basic resolution of the Evaluation Kit when using the high range. This range is primarily intended for operating oxygen sensors which have a very high output. For most other sensors, IC8A provides a gain of 5 so that its output has the following voltage:

- $EC\_lo\_range\_out = 15255 \text{ V/A} = 15.255 \mu\text{V/nA}$

This can be expressed in terms of ADC steps as follows:

- $EC\_lo\_range\_out = 0.00007629/15255 = 5 \text{ nA per ADC step}$

Using the PC software, the Evaluation Kit can be set to either of the two ranges, or to automatically switch between them according to the signal level.

Note that the output current is described as positive for most gases (electrons flowing out of the sensing electrode, although conventional current is actually negative). However for gases which undergo a reduction in the cell (ClO<sub>2</sub>, Cl<sub>2</sub>, NO<sub>2</sub>, O<sub>2</sub>) the output current is described as negative (electrons flowing into the sensing electrode, positive conventional current).

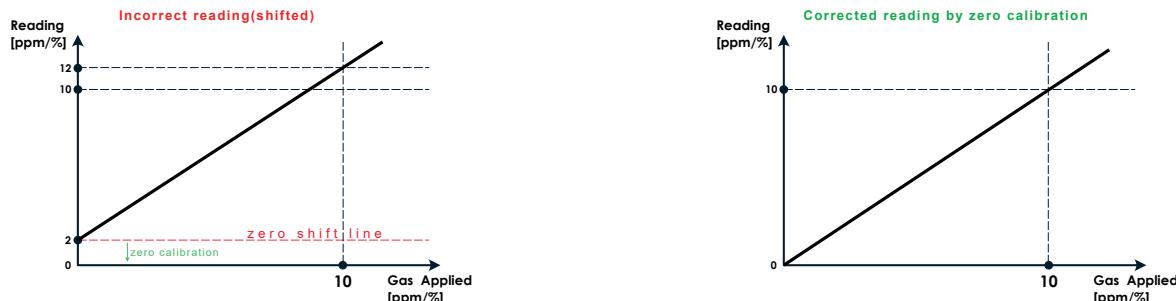
**This will affect the direction of output voltage swing when gas is applied.**

## Setting Zero

To remove any zero offsets, apply clean air to the sensor and press 'Calibrate Zero'. If a supply of nitrogen is available, this can be used to set an accurate zero.

The sensor output current (nA) is now being correctly displayed with the zero offset removed.

The raw current field will show the absolute value for the reference. This value is not used in the calculation.



## Setting Span/Sensitivity

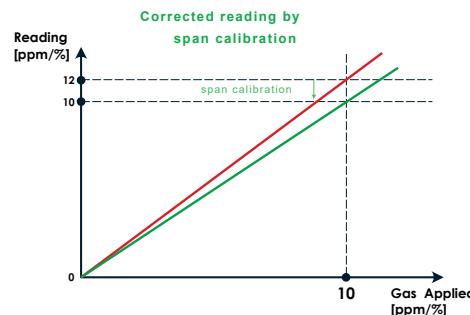
Calibrating zero alone may not provide correct concentration readings. In most cases span calibration is necessary. The Evaluation Kit allows a simple calibration to be performed based on a linear response to the gas.

When the calibration gas has been applied press "Calibrate Span" button in application

- In the application window select the channel to be calibrated in most cases this will be channel A only (exceptions are dual-sensors such as AOX, EOX, VOX). If you are calibrating a dual-sensor then you should calibrate channel A first and then connect the gas cylinder to calibrate channel B.

When calibrating, enter the gas concentration in ppm or %.

In the 'Data' menu the concentration units can be changed between %Volume and ppm.



## Minimising Noise on the Electrochemical Sensor Output

Electrochemical cells have very low output signal levels and can be susceptible to noise pickup. The SGX\_EVAL\_EC has very short track lengths for the sensitive signal to minimise this effect, but the user can take further steps to improve the output.

- Use averaging of the output. The PC software will default to a 10 second rolling average. This can be increased or reduced as required.
- Do not operate RF transmitters (e.g. mobile phones) close to the SGX\_EVAL\_EC. Bursts of RF energy may cause disturbance of the signal. This effect can also be minimised by operating the SGX\_EVAL\_EC in a screened enclosure.

## Temperature Measurement

The temperature sensor has been mounted close to the sensor socket. The ambient temperature is displayed by the computer software. It can be used for differential temperature compensation.

# CHINA RoHS DECLARATION



|  |  | 有毒有害物质或元素<br>(Hazardous Substances or Elements) |                      |                      |  |   |  |
|--|--|---|----------------------|----------------------|--|---|--|
| 零件项目(名称)<br>(Component Name)<br>SGX_EVAL_EC Evaluation Kit |  | 铅<br>Lead<br>(Pb)                               | 汞<br>Mercury<br>(Hg) | 镉<br>Cadmium<br>(Cd) | 六价铬<br>Chromium VI<br>Compounds<br>(Cr <sup>6+</sup> ) | 多溴联苯<br>Poly-<br>brominated<br>Biphenyls<br>(PBB) | 多溴二苯醚<br>Poly-<br>brominated<br>Diphenyl<br>Ethers<br>(PBDE) |
| 1  | 印制电路配件<br>(Printed Circuit Assemblies)<br>DAS768583AA Evaluation Kit PCB | ○   | ○                    | ○                    | ○  | ○   | ○  |
| 2  | 外接电(线)缆<br>(External Cables)<br>E100918 USB Lead                         | ○   | ○                    | ○                    | ○  | ○   | ○  |
| 3  | 文件说明书<br>(Paper Manuals)<br>DF769485A Quick Start Guide                  | ○   | ○                    | ○                    | ○  | ○   | ○  |
|  |  |   |                      |                      |  |   |  |

○: 表示该有毒有害物质在该部件所有均质材料中的含量均在 SJ/T 11363-2006 标准规定的限量要求以下。  
 ○: Indicates that this toxic or hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement in SJ/T11363-2006.

X: 表示该有毒有害物质至少在该部件的某一均质材料中的含量超出 SJ/T 11363-2006 标准规定的限量要求。  
 X: Indicates that this toxic or hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement in SJ/T11363-2006