Instruction Manual
USB Demo Kit for VZ-87

Version 1.2 12/2014

Please read and understand this instruction manual before handling and operating this demo kit.

THIS DEVICE IS AN INDICATOR; IT IS NOT INTENDED TO BE USED AS A SECURITY DEVICE.
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General information

The USB demo kit for VZ-87 is a device designed to provide easy and fast demonstration of the behaviour of SGX Sensortech indoor air quality monitoring solution.

The kit allows the readout of a VZ-87 module in order to display measurements of the calculated CO2 equivalent and VOC values based on a metal oxide semiconductor gas sensor. Semi-conducting gas sensor exhibits an decrease of resistance value in presence of VOCs.

The device can perform continuous exposure monitoring and data logging of raw sensor signal, CO2 equivalence (measure based on VOC correlated with CO2), VOC, temperature and humidity in environmental conditions for solution developers or people interested in air quality monitoring.

Features include:

- **Environmental monitoring**
  Display gas concentration and a chart of actual measurements
  Display temperature and relative humidity on demand
  I2C communication (status readings, settings)
  Real time clock for stand alone operation
  Data logging
  Store date and time, status, calculated tVOC concentration [ppb], calculated CO2 equivalence concentration [ppm], raw sensor value (resistance value in Ohms), relative humidity [%] and temperature [°C]

- **Programmable sampling rate**
  Stand alone data storage capacity of 1016 data points. Storage intervals programmable for internal and PC data logging.

- **Autonomous**
  Pluggable on 5V AC/DC for stand alone data logging with RTC

- **Compact package**
  Small size: L x W x H: 73.5 x 17.5 x 16 mm (including USB connector)

- **User friendly**
  Easy and speedy setup
  Simple data analysis

- **Applications**
  Evaluation of sensor performance for indoor applications
  Detection of VOCs pollution peaks
  CO2 equivalence monitoring
  Development of solutions for indoor air quality
CO2-VOCs consistency

VZ-87 product has been developed as a demo unit in order to evaluate performances in desk area. Algorithm parameters have been defined to follow CO2 variations in known conditions with a correlation ratio between VOCs and CO2.

As you can see in chart above (VZ-87 monitoring 5-days example), VZ-87 output is slightly different from true CO2 concentration measured with another costly technology (NDIR). This is obviously linked with the fact that MiCS-5524 MOX sensor is not measuring directly the CO2 gas concentration but the VOCs.

These VOCs may come from several sources like:

- Cleaning and maintenance supplies
- Carpets, fabrics, finishes and furniture
- Office equipment (copiers, printers)
- Microbial action
- Renovations
- Pesticides
- Human occupancy (exhalation and perfume)

Only the last one is clearly correlated with CO2 (exhalation of humans). This explains the differences observed between CO2 – ppm monitoring with NDIR detector and IAQ devices.

Spending upwards of 95% of one’s time inside a sealed, high-efficiency building has led to a rise in “sick building syndrome” (SBS) complaints.
According to the American Lung Association, the top five indoor air pollutants include (in alphabetical order):

- Carbon monoxide - seen by VZ-.87 and not by NDIR CO2 module
- Formaldehyde - seen by VZ-.87 and not by NDIR CO2 module
- Microbial contaminants
- Second hand tobacco smoke - partially seen by VZ-.87 and not by NDIR CO2 module
- Volatile organic compounds (VOCs) - seen by VZ-.87 and not by NDIR CO2 module

VOCs detector complements CO2 monitors by providing air quality level correlated with CO2 generated by human presence + VOCs from other sources.
USB-VZ87 Demo Kit specifications

CO2 equ range : 0 to 2000 ppm equ.

tVOC range : 0 to 1000 ppb (isobutylene equ. or other according to VZ-87 firmware version)

Dimensions : 73.5 x 17.5 x 16 mm (including USB connector)

Weight : < 10 gr.

Operating temperature: 5 to 50°C

Operating relative humidity: 5 to 95% non condensing

Detector: Semi-conducting gas sensor on smart board VZ-87
T&RH sensor on USB-demo kit

Battery: on board battery for RTC 3.0V/48mAh, typ CR1225

Electrical operation: 5V, 100 mA

Visual indicator: 1 status LED on the USB board and 1 status LED on VZ-87

Direct readout: CO2 equ and tVOCs concentrations, chart of last 10 minutes of data logging
On demand: temperature, relative humidity and memory filing level

Data storage capacity: Embedded real time clock and eeprom with 1016 data points with programmable interval 5 sec up to 12 hours for stand alone data logging
**Warranty:**

SGX warrants this product to be free from defects in material and workmanship for a period of 1 year from date of shipment.

This warranty does not apply to defects resulting from product modification or misuse of any product or part. This warranty also does not apply to fuses, software, battery, damage resulting from battery leakage. The warranty is not applicable to problems arising from normal wear and tear or from failure to follow operating instructions.

**Disclaimer:**

This device is for indoor monitoring purposes only. It is intended to provide an indication of the indoor VOCs concentration changes and CO2 equivalence concentration changes. SGX denies any responsibility resulting from the misuse of this product.
Operation of USB-VZ-87 kit

Shipment content
The following items are included with the USB-VZ-87 kit:

- USB-VZ87 board
- VZ-87 IAQ sensor module
- USB 2.0 male/female extension cable 1 meter
- Wall adapter
- Button cell (for clock)
- USB-VZ-87 Instruction Manual (via website)
- “PC Manager” exe-file (via website)

Device handling
Avoid touching the area surrounding the sensor (aluminium cap of sensor present on VZ-87 sensor module) with bare hands. Grease or organic solvents (perfumes) can generate errors. To prevent contamination that could degrade performance, handle the sensor module VZ-87 only by pinching the sides of the board.

Some more caution to take:
- Avoid any use of silicon spray for moulded/injected plastic part used for package as it will poison the sensor over time (silicon spray is used for easy and fast part release in injection moulding process)
- Avoid any variable heat source close to the sensor (voltage regulator, radiator, transformer, ...) as it may affect sensor readings
- Avoid use of rechargeable battery in vicinity of sensor as it may outgas during charging

Storage
Storage temperature should be comprised between -20°C and 50°C and relative humidity between 10 and 80%.

The device should not be stored in silicon contaminated atmosphere (typically HMDS gas). Storage in such conditions may produce sensors sensitivity losses.

Start-up operation
Insert the VZ-87 in the connector of the USB-VZ87 board as shown here below.
**PC interface**
The “PC Manager” application software is an executable file.

Save “PC Manager” exe-file to a specific path and then double click the icon.

After starting the software, it is necessary to detect USB-VZ87. For this, connect the board (with VZ-87 in place) to the PC with USB cable or directly in USB available slot as shown here below:
When USB-VZ87 is plugged, monitoring starts immediately and is displayed in the chart. VZ-87 module LED is blinking during one minute to show that it is in the first minute of operation. VZ-87 CO2 equ output is maintained at 400 ppm during the warm up period of 15 minutes. Refreshing data rate is 1 Hz.

By clicking on RH/T one can see climatic values in another chart.
When clicking on “VZ87 module” one can enter in the VZ87 interface window where it is possible to send and receive I2C data.

Firmware version can be obtained with command (0x0D) as shown here below with the data frame received form VZ-87 device:
Comments:
Other commands will be implemented in next versions of firmware in order to extend the operating mode evaluation (cycled mode, period and duty cycle definition).

USB interface window displays the status of the communication between the components in place.

This window allows check/set internal clock of the device. It is useful to synchronise with a PC when several devices have to be used for a mapping for example. Click the Set date and time from PC button, internal RTC clock is then set to the computer clock.

Remark:
Before every acquisition period, it is advisable to synchronise the instrument with the PC. It is also useful to erase the instrument memory for availability of the full memory space (click on Clear memory)
Memory capacity is of 1016 data points with recording intervals going from 5 seconds to 12 hours. When this capacity is exceeded, next data will not be stored.

<table>
<thead>
<tr>
<th>Interval</th>
<th>Period covered with 1016 points</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 sec</td>
<td>84 min</td>
</tr>
<tr>
<td>15 sec</td>
<td>4.2 hours</td>
</tr>
<tr>
<td>1 min</td>
<td>16.9 hours</td>
</tr>
<tr>
<td>5 min</td>
<td>3.5 days</td>
</tr>
<tr>
<td>15 min</td>
<td>10.5 days</td>
</tr>
<tr>
<td>1 hour</td>
<td>42 days</td>
</tr>
<tr>
<td>3 hours</td>
<td>127 days</td>
</tr>
<tr>
<td>12 hours</td>
<td>508 days</td>
</tr>
</tbody>
</table>

Internal interval recording period is selected by clicking on desired value.
Once internal acquisition period is over **Log memory is full** will indicate this status by changing colour (orange).

Download of logged data is done by clicking on the button and download data status will appear. The data transfer starts automatically after having defined the destination file and whole memory is read and decompressed in .txt file.
Software setup window allows defining data file format, PC recording file interval and units.

When clicking on **Save live monitoring** a **SAVE DATA TO FILE** browse window is prompted. Simply enter destination file name in a specified path. Once this is done, data will be stored in the file at defined timing interval. To stop click **Stop saving** – this option replaces **Save live monitoring** once this one is selected.
Operation with AC/DC plug

USB-V87 device can be operated in stand alone (no PC connection). The system is powered through the USB connector with 5V DC.

In this configuration, the device will start data logging once operated. The settings (internal recording interval and memory clear) are the ones defined at last operation with “PC Manager” application.

According to operation location, specific AC/DC charger can be ordered (Europe, UK, USA, see spare parts list for details).
Data file

Here below is an example of measurement file with description of each column:

<table>
<thead>
<tr>
<th>Date and Time:</th>
<th>Status</th>
<th>VOC (ppb)</th>
<th>CO2 (ppm)</th>
<th>Ana (mV)</th>
<th>Raw sensor (Ohms)</th>
<th>Device status</th>
<th>PWM frequency (Hz)</th>
<th>PWM value (ppm)</th>
<th>RH (%)</th>
<th>T (°C)</th>
</tr>
</thead>
<tbody>
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<td>1924</td>
<td>2162040</td>
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<td>0.5</td>
<td>1015</td>
<td>34.96</td>
<td>31.42</td>
<td></td>
</tr>
<tr>
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<td>1022</td>
<td>1946</td>
<td>211240</td>
<td>0</td>
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<td>1022</td>
<td>34.48</td>
<td>31.06</td>
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<td></td>
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<td>219500</td>
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<td>31.41</td>
<td></td>
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<td>1946</td>
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</tr>
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<td>223020</td>
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<td></td>
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<td>1923</td>
<td>220000</td>
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<td>31.18</td>
<td></td>
</tr>
<tr>
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<td>1015</td>
<td>1924</td>
<td>223020</td>
<td>0</td>
<td>0.5</td>
<td>1013</td>
<td>35.38</td>
<td>31.19</td>
<td></td>
</tr>
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<td>1924</td>
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<td>1015</td>
<td>35.6</td>
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<td></td>
</tr>
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<td>1008</td>
<td>1900</td>
<td>222010</td>
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<td>0.4</td>
<td>1008</td>
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</tr>
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<td>1001</td>
<td>1879</td>
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<td>1879</td>
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<td>1816</td>
<td>223260</td>
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</tr>
<tr>
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<td>1793</td>
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<td>972</td>
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<td>30.53</td>
<td></td>
</tr>
<tr>
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<td>1745</td>
<td>223460</td>
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<td>0.5</td>
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<td>37.15</td>
<td>29.93</td>
<td></td>
</tr>
<tr>
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<td>1702</td>
<td>230000</td>
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<td>36.9</td>
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<tr>
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<td>37</td>
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</tr>
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<td>237680</td>
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</tr>
<tr>
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<td>975</td>
<td>36.32</td>
<td>28.1</td>
<td></td>
</tr>
</tbody>
</table>

### Date and Time:

Recording interval is set in PC Manager, the recorded data is instantaneous value requested by the I2C or measured on VZ-87 board or USB-VZ87 board (Analog out, PWM, RH, T).

### Status

USB-VZ87 board status:
- "board reset" at start
- "vcc overload" if +5V is out of range (module in short circuit or current out of range – protection mode – shortage of 5V)
- "comm error + number :
  - "1" => VZ87
  - "2" => RTC
  - "3" => EEPROM
  - "4" => SHT21
- "ok", everything is OK

### VOC [ppb]

Calculated VOC concentration in ppb based on measurement done by sensor.

### CO2 [ppm]

Calculated CO2 equ. concentration in ppm based on measurement done by sensor.

### Ana [mV]

Analog output value corresponding to the combined output of CO2equ+VOC (see VZ-87 data sheet for details).
**Raw sensor [Ohms]**
Sensor raw resistance value.

**Device Status**
VZ-87 board status byte:

<table>
<thead>
<tr>
<th>Status_bit 4 to 7</th>
<th>Status_bit3</th>
<th>Status_bit2</th>
<th>Status_bit1</th>
<th>Status_bit0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spare</td>
<td>Bit set when VZ-87 is in test-mode</td>
<td>Bit set with sensor sensitive element out of range</td>
<td>Bit set with sensor heating out of range</td>
<td>Bit set with CRC mismatch</td>
</tr>
</tbody>
</table>

**PWM frequency [Hz]**
Pulse width modulation frequency set at 30 Hz in VZ-87. Not changing.

**PWM value [%]**
PWM output value corresponding to the combined output of CO2equ+VOC (see VZ-87 data sheet for details).

**RH [%]**
Relative humidity measurement.

**Temp [°C]**
Temperature measurement. This measurement exhibits temperature offset generated by the selfheating around the sensor area.
Trouble shooting

The most likely problems and causes are listed below.

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Cause</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instrument not detected by USB</td>
<td>Bad USB initialisation.</td>
<td>Disconnect the USB-VZ87 from USB port, close and relaunch PC_Manager, connect the instrument on the USB.</td>
</tr>
<tr>
<td>Download data blocked</td>
<td>USB link lost during data transfer</td>
<td>Close PC_Manager and relaunch the software</td>
</tr>
<tr>
<td>Power will not turn off</td>
<td>ON/OFF button not held long enough</td>
<td>Press button for approx 5 sec. (until instrument turn off)</td>
</tr>
<tr>
<td>Bad RTC reading</td>
<td>On-board battery end of life</td>
<td>Change on-board RTC battery</td>
</tr>
<tr>
<td>Instrument indicates 400 ppm CO2 equ</td>
<td>Warm-up phase of 15 minutes</td>
<td>Wait for 15 minutes after device power up to have warm-up ended.</td>
</tr>
</tbody>
</table>

Spare parts list

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2076A01</td>
<td>USB-VZ87 Demo kit board</td>
</tr>
<tr>
<td>MICS VZ-87</td>
<td>VZ-87 VOC sensor module with CO2 equ algorithm</td>
</tr>
<tr>
<td>2076A02</td>
<td>AC/DC 5V charger EU</td>
</tr>
<tr>
<td>2076A03</td>
<td>AC/DC 5V charger US</td>
</tr>
<tr>
<td>2076A04</td>
<td>AC/DC 5V charger UK</td>
</tr>
<tr>
<td>2076A05</td>
<td>USB cable (1m)</td>
</tr>
</tbody>
</table>