Alert Mode of SHT3x- and STS3x-DIS

Humidity and temperature watchdog functionality

SHT3x-DIS and STS3x-DIS feature an Alert Mode, when operated in the periodic data acquisition mode[1]. The Alert Mode allows to monitor the environmental condition (humidity and temperature) relative to programmable limits. When limits are reached the value of a dedicated ALERT pin will change. Additionally, a status register bit indicates the cause of the alert. Using the ALERT pin allows to create a switch with a minimal bill of materials.

For example, only a transistor is needed next to the sensor to switch an LED on or start a climate control.

Alternatively, the ALERT pin may be connected to the interrupt pin of a microcontroller. After an alert from SHT3x/STS3x the microcontroller can wake-up from sleep mode and then perform certain actions.

The ALERT pin is configured push-pull.

1 Activation and Deactivation of the Alert Mode

Whenever the sensor operates in periodic data acquisiton mode the alert mode is active. It is possible to deactivate the limit for temperature and humidity individually, by setting the Minimum set point to values higher than the Maximum set point (LowSet>HighSet for deactivation of the alert mode).

2 Alert Mode Limits

The limits can be controlled by the user through the corresponding commands (see Table 3). SHT3x-DIS allows to set different limits for temperature and humidity as well as for high and low limits. STS3x-DIS only offers setting of temperature limits. Additionally, the activation and the deactivation of the alert can be controlled separately from another, by choosing the set and clear limit appropriately. This allows to remove fast oscillations of the ALERT pin close to set limit values. The different limits are shown in Figure 1.

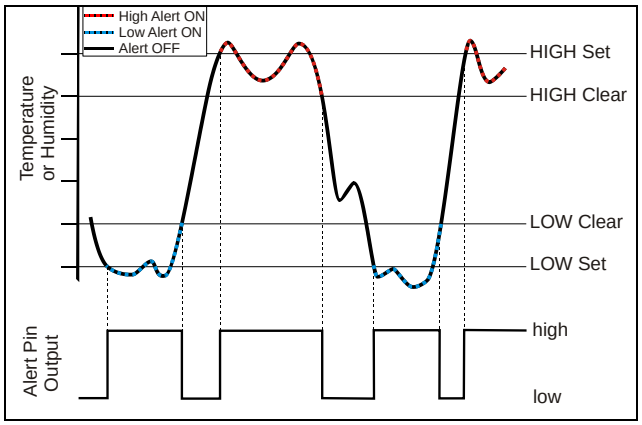

Figure 1 Different limits for the Alert Mode

2.1 Data Format for the Alert Limits

SHT3x-DIS

The sensor stores the limit information in a reduced data format. The standard data format of SHT3x-DIS has a width of 16 bits. For the limits only the most significant bits (MSB) are used to determine whether an alert has been met (7 bits for humidity and 9 bits for temperature), see Figure 2.

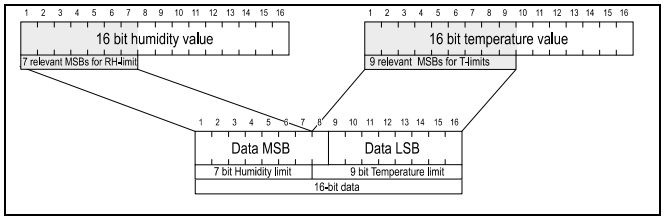

Figure 2 Relevant bits for the SHT3x limits

This allows to transfer temperature and humidity limits with the same command and to process them internally more efficient.

As a consequence the limits have a different resolution than the measurement values. The resolution of the temperature limits are $\Delta T \approx 0.5°C$, whereas the humidity limits can be set with a resolution of $\Delta RH \approx 1\%$. Please note that data is always measured and stored in the full 16 bit format. The reduced data format is only used to judge whether an alert condition is met.

STS3x-DIS

In the case of the STS3x the limits are composed as shown in **Figure 3**.

[1] See Datasheet SHT3x-DIS and STS3x-DIS Section 4 for the distinction between periodic and single shot mode.

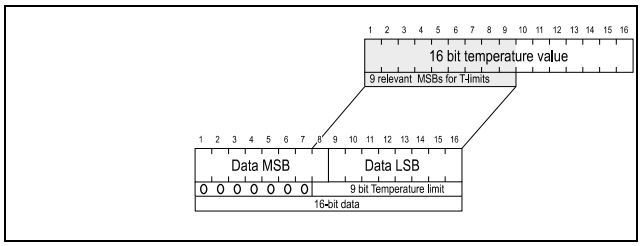

Figure 3 Relevant bits for the STS3x limits. N.B.: The first seven bits are always zero.

2.2 Standard values for the Alert Limits

During power-up or after resets pre-defined limits are loaded into the register, see **Table 1**. The standard limits are "guarding" the grey area depicted in **Figure 4**.

Alert Limit		Initial Value	
		Physical Value (RH/T)	Hex Value
high alert limit	set limit	80% / 60°C	0x CD 33
	clear limit	79% / 58°C	0x C9 2D
Low alert limit	Clear limit	22% / -9°C	0x 38 69
	set limit	20% / -10°C	0x 34 66

Table 1 Initial values for the alert limits. For STS3x, only the temperature limits are set. The limits can be changed with the command shown in **Table 2.**

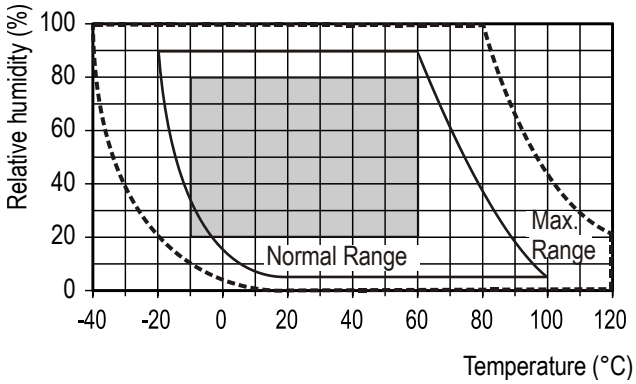

Figure 4 The alert is active in the areas outside the shaded area for SHT3x. For STS3x, the alert is active from -10°C … 60°C.

2.3 Setting different limits

All limits can be read-out and written through the commands shown in Table 3. The detailed I2C communication for read-out of the currently set limits is shown in **Table 3**. Setting of limits is detailed in **Table 4**.

Command			Hex Code	
			Command MSB	Command LSB
READ	High alert limit	set	0xE1	1F
		clear		14
	Low alert limit	clear		09
		set		02
WRITE	High alert limit	set	0x61	1D
		clear		16
	Low alert limit	clear		0B
		set		00

Table 2 Commands to read and write all eight alert limits.

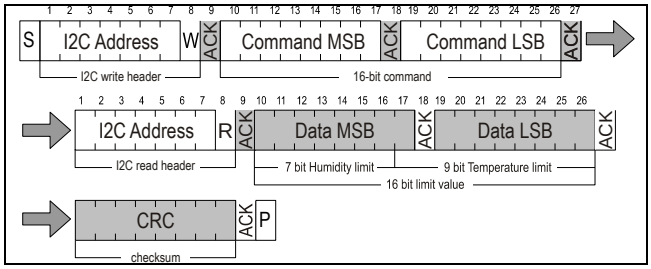

Table 3 Alert limit commands for reading the alert limits. For STS3x, the 7bit MSB are to be neglected.

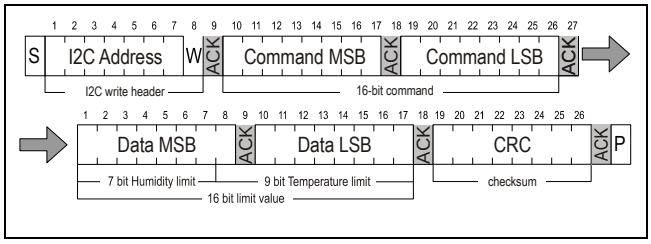

Table 4 Alert limit commands for writing the alert limits. For STS3x, the 16 bit limit value is composed as shown in **Figure 3**.

2.4 Typical procedure to calculate the limits

The reduced data format is shown in Figure 2.

1. Choose the limits for RH and T (e.g. MaxSet limit, RH_{MaxSet}=80% & T_{MaxSet}=60°C)
2. Convert the RH_{MaxSet} and the T_{MaxSet} limits to their respective 16 bit binary value
    a. RH_{MaxSet}= ***1100'1100***'1100'1101
    b. T_{MaxSet}= **1001'1001'1**001'1010
3. Remove the 9 LSBs of the RH_{MaxSet} limits
    a. RH_{MaxSet}=***1100'1100***~~'1100'1101~~
4. Remove the 7 LSBs of the T_{MaxSet} limits
    a. T_{MaxSet}=**1001'1001'1**~~001'1010~~
5. Combine the reduced values (step 3 and 4) according to **Figure 2**
    a. RH,T_{MaxSet}=***1100'1101***'**0011'0011**=0x E699

6. Calculate the 8 bit CRC from the 16 bit limit value

An excel sheet is supplied as well that can be used to calculate the Alert limits.

2.5 Typical procedure to change the alert condition

1. Calculate the limits as explained in section 2.4 (the predefined values are the normal range and shown in Table 1)
2. Set the periodic frequency to the desired value through issuing of the appropriate command

The alert mode is now active.

3 Further condition that can raise an alert

The ALERT pin will also become active (high) after power-up and after resets, regardless whether the later was triggered by a brown-out, by a user command (general call) or via the nRESET pin.

Description of the Content of the status register

Bit	Field description	Default value
15	Alert pending status '0': no pending alerts '1': at least one pending alert	'1'
14	Reserved	'0'
13	Heater status '0' : Heater OFF '1' : Heater ON	'0'
12	Reserved	'0'
11	RH tracking alert '0' : no alert '1' . alert	'0
10	T tracking alert '0' : no alert '1' . alert	'0'
9:5	Reserved	'00000'
4	System reset detected '0': no reset detected since last 'clear status register' command '1': reset detected (hard reset,general call reset or supply fail)	'1'
3:2	Reserved	'00'
1	Command status '0': last command executed successfully '1': last command not processed. It was either invalid, failed the integrated command checksum	'0'
0	Write data checksum status '0': checksum of last write transfer was correct '1': checksum of last write transfer failed	'0'

Table 5 Status register of SHT3x

3.1 Readout the status register

Command	Hex Code
Read Status register	0x F3 2D

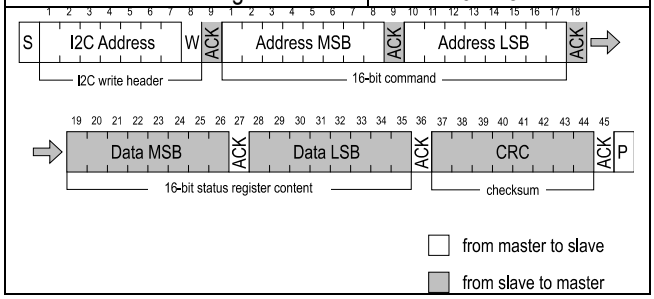

Table 6 Read out status register. The content of the user register is described below (Clear blocks are controlled by the microcontroller, grey blocks by the sensor.)

3.2 Clear Status register

All flags (Bit 15, 11, 10, 4) in the status register (Table 5) can be cleared (set to zero) by sending the command shown in Table 7.

Command	Hex Code
Clear Status Register	0x 30 41

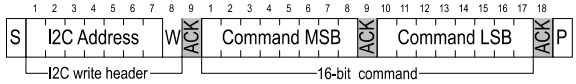

Table 7 Command to clear all status register flags (Clear blocks are controlled by the microcontroller, grey blocks by the sensor.)

3.3 Behaviour in the case of brown-out or power-up

If a brown-out or power-up occurs, the sensor will restart automatically. This sets all values to the default values (Table 1). Therefore, all customer defined limits are lost. As explained above an Alert is issued in this case.

Revision History

Date	Version	Page(s)	Changes
May 2015	1	all	Release of Version 1
September 2019	2	All	Including STS3x
October 2021	3		Included push-pull configuration of Alert pin
November 2023	3.1	3	Corrected when a system reset is detected in **Table 5**.

Important Notices

Warning, Personal Injury

Do not use this product as safety or emergency stop devices or in any other application where failure of the product could result in personal injury. Do not use this product for applications other than its intended and authorized use. Before installing, handling, using or servicing this product, please consult the data sheet and application notes. Failure to comply with these instructions could result in death or serious injury.

If the Buyer shall purchase or use SENSIRION products for any unintended or unauthorized application, Buyer shall defend, indemnify and hold harmless SENSIRION and its officers, employees, subsidiaries, affiliates and distributors against all claims, costs, damages and expenses, and reasonable attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended or unauthorized use, even if SENSIRION shall be allegedly negligent with respect to the design or the manufacture of the product.

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The inherent design of this component causes it to be sensitive to electrostatic discharge (ESD). To prevent ESD-induced damage and/or degradation, take customary and statutory ESD precautions when handling this product.
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