TN1219
Technical note

HTS221 digital humidity sensor: reference design implementation

Introduction

The purpose of this technical note is to provide supplementary information regarding product evaluation and the implementation of two reference designs for the HTS221 digital humidity sensor (the STEVAL-MKI141V2 evaluation board and a reference design based on the environmental sensors).

This document does not replace the content of the HTS221 datasheet available on www.st.com.

Contents

1 Product description

The HTS221 is an ultra-compact sensor for relative humidity and temperature. It includes a sensing element and a mixed signal ASIC to provide measurement information through the I^2C or SPI digital serial interface.

Figure 1: HLGA-6L package

The sensing element consists of a polymer dielectric planar capacitor structure capable of detecting relative humidity variations and is manufactured using a dedicated process developed by ST.

The HTS221 is available in a small top-holed cap land grid array (HLGA) package guaranteed to operate over a temperature range from -40 °C to +120 °C.

The package is holed to allow external air to reach the sensing element.

Features:

- 0 to 100% relative humidity range
- Supply voltage: 1.7 to 3.6 V
- Low power consumption: 2 µA @ 1 Hz ODR
- Selectable ODR from 1 Hz to 12.5 Hz
- High rH sensitivity: 0.004% rH/LSB
- Humidity accuracy: ±3.5% rH, 20 to +80% rH
- Temperature accuracy: ±0.5 °C,15 to +40 °C
- Embedded 16-bit ADC
- 16-bit humidity and temperature output data
- SPI and I²C interfaces
- Factory calibrated
- Tiny 2 x 2 x 0.9 mm package
- ECOPACK® compliant

1.1 Package information

Figure 2: HLGA-6L package outline and mechanical data (in mm)

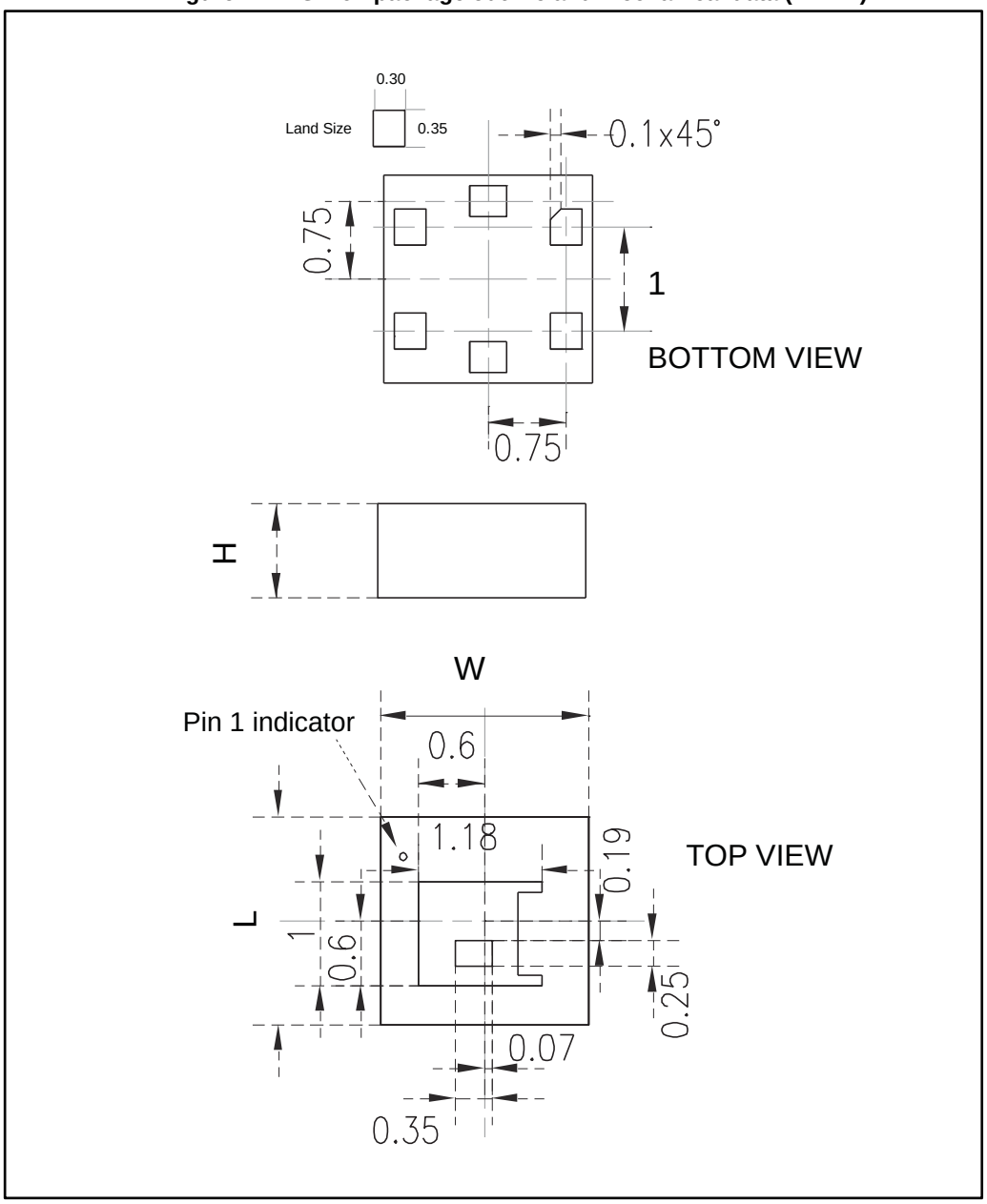


Table 1: HLGA-6L outer dimensions and pad size

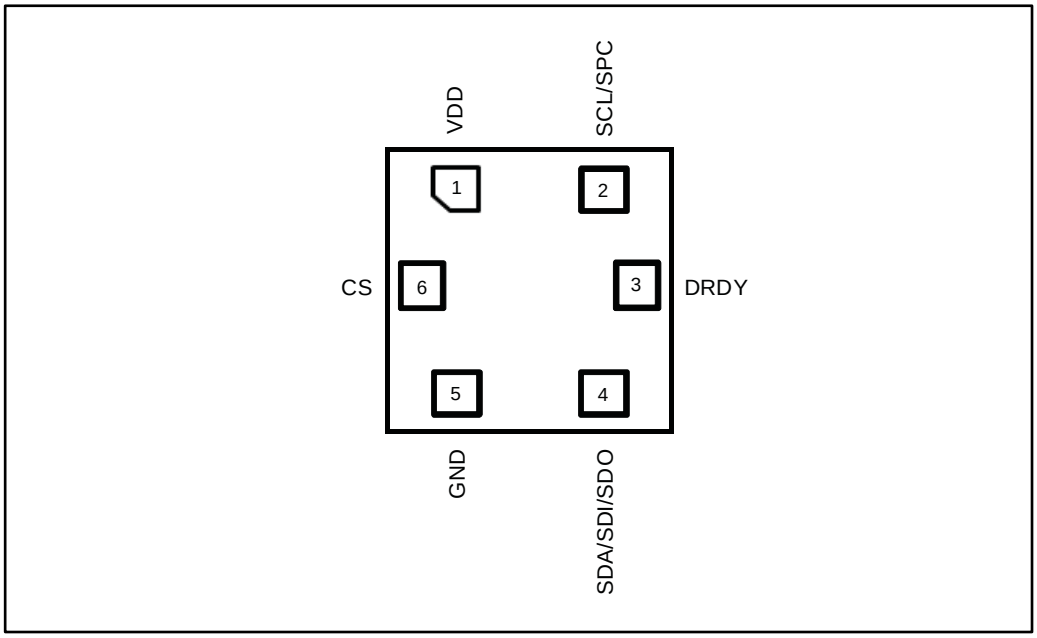
Item	Dimension [mm]	Tolerance [mm]
Length [L]	2.0	±0.1
Width [H]	2.0	±0.1
Height [H]	0.9	±0.1
Pad size	0.30 x 0.35	±0.05

1.2 Pin description

Table 2: HTS221 pin description

Pin number	Name	Function
1	VDD	Power supply
2	SCL/SPC	I²C serial clock (SCL) SPI serial port clock (SPC)
3	DRDY	Data Ready output signal
4	SDA SDI/SDO	I²C serial data (SDA) 3-wire SPI serial data input/output (SDI/SDO)
5	GND	Ground (0 V supply)
6	CS	I²C/SPI mode selection 1: SPI idle mode / I²C communication enabled 0: SPI communication mode / I²C disabled

Figure 3: HTS pinout (bottom view)



2 Application design rules

The main rules for interfacing the HTS221 humidity sensor are summarized as follows:

1. The device power supply must be provided through the VDD line; a power supply decoupling capacitor of 100 nF must be placed as near as possible to the supply pads of the device.
2. CS must be tied high (VDD) in order to select the I²C communication bus.
3. External pull-up resistors have to be added on the SCL and SDA pads, according to the selected I²C bus speed and load. In the case of the reference design system described in the next section, the I^2C lines are powered directly by the microcontroller, whereas in the case of the STEVAL-MKI141V2 evaluation board, the pull-up resistors are external.

Both the reference design system and the adapter board for the HTS221 (STEVAL-MKI141V2) represent examples that are well-suited for controlling the HTS221 humidity sensor in an application.

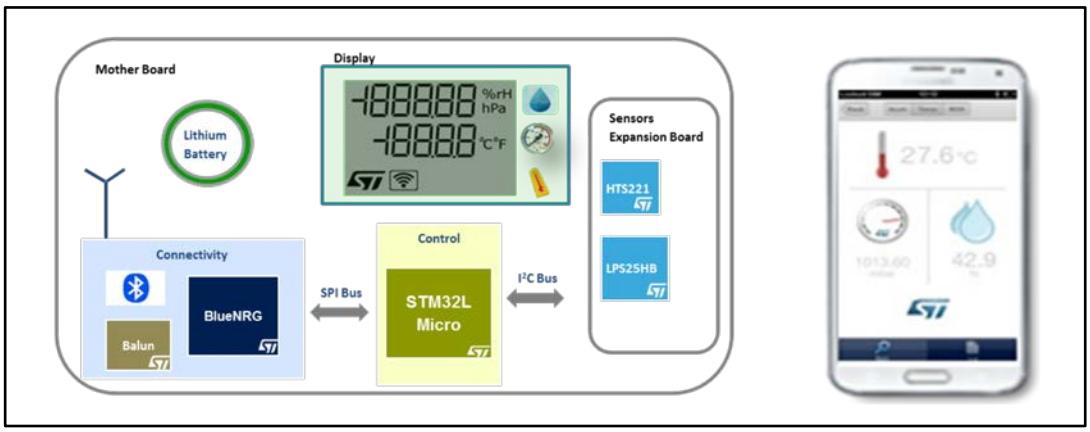
3 Reference design examples

3.1 Reference design system

As a reference design for the HTS221 humidity and temperature sensor, details on a complete system interfacing via Bluetooth Low Energy with a smartphone or tablet are provided in this section. The portable device runs a dedicated application (on OS Android 4.3) to provide the environmental data in real time.

The reference block diagram is depicted in the following figure (together with the software GUI on a personal device) and includes an STM32 microcontroller for the control functions, a BlueNRG device for Bluetooth communication and ST's digital pressure and temperature sensor LPS25HB as well. Humidity, temperature and pressure data are provided in the GUI and on the LCD display mounted on the reference board.

Figure 4: Reference design system block diagram and the related application on a personal device



Devices from ST used in this reference design include the following:

- HTS221: humidity & temperature sensor
- LPS25HB: pressure & temperature sensor
- BLUENRG: Bluetooth Low Energy wireless network processor
- STM32L152: ARM-based 32-bit microcontroller
- BALF-NRG: integrated balun filter
- LD39130S: low quiescent current linear regulator

Expansion boards can be connected to add functionalities. The sensor expansion board in *Figure 4: "Reference design system block diagram and the related application on a personal device"* mounts the LPS25HB pressure sensor and the HTS221 humidity sensor. In order to improve the thermal decoupling of the humidity sensor, it is recommended to implement cuts on the PCB area surrounding the sensor.

The schematics given in *Figure 5: "STM32L152 - circuit schematic"* through *Figure 7: "BLUENRG - circuit schematic"* provide a reference design which allows further customization according to user requirements.

Figure 5: STM32L152 - circuit schematic

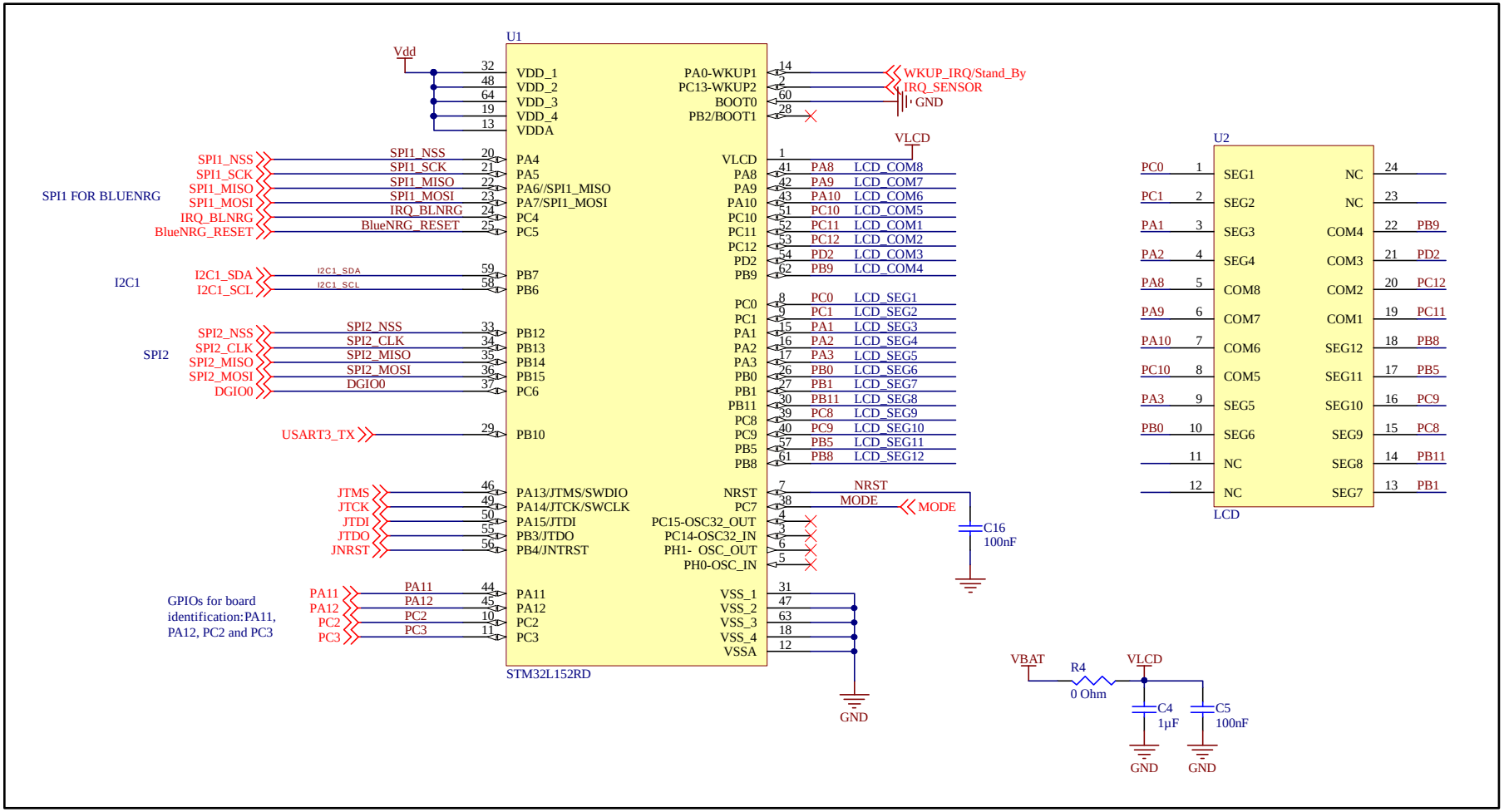


Figure 6: Environmental sensors - circuit schematic

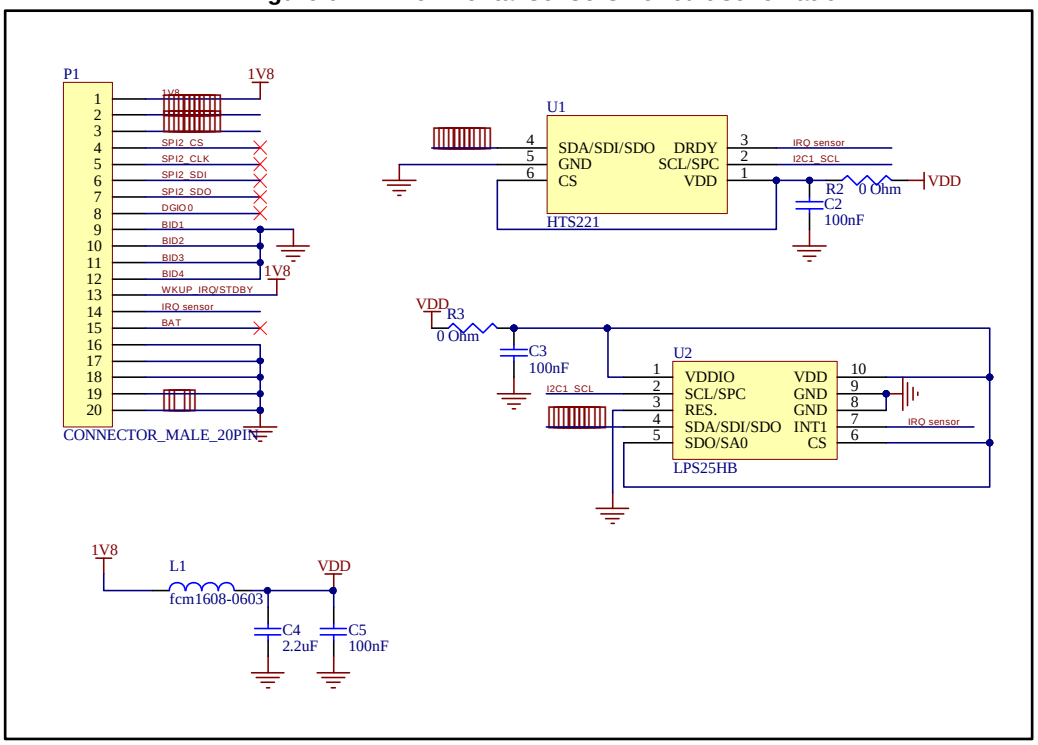
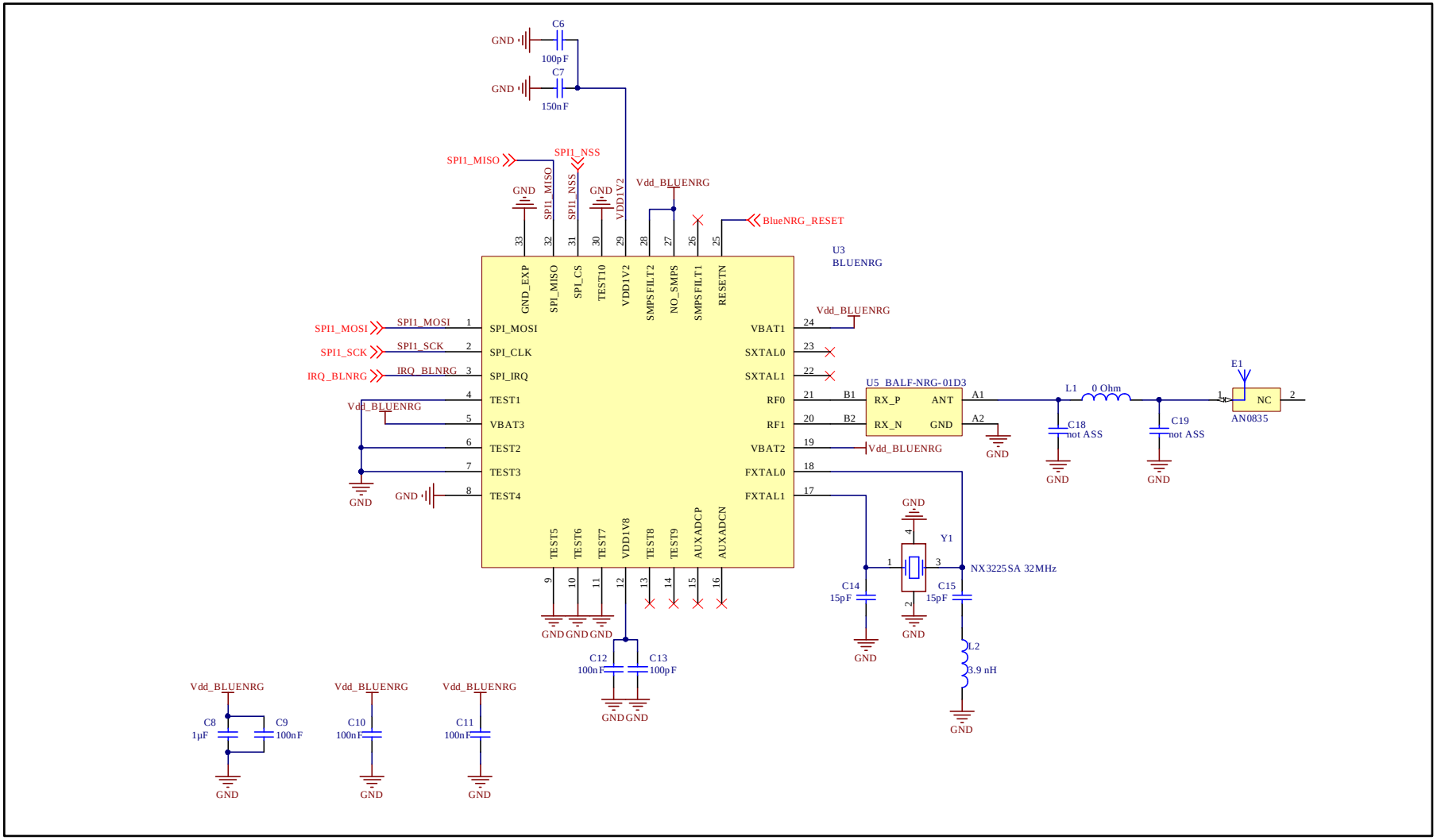


Figure 7: BLUENRG - circuit schematic



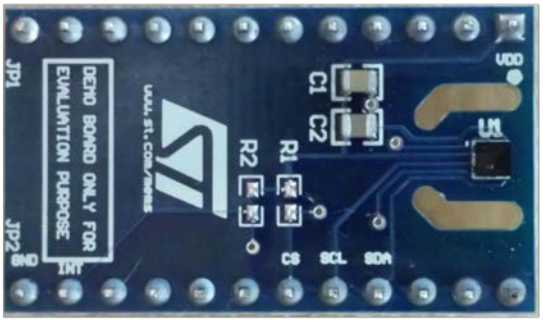
3.2 STEVAL-MKI141V2 evaluation board

The adapter board STEVAL-MKI141V2 is available as an HTS221 evaluation board, providing an effective solution for fast system prototyping and device evaluation directly within the user's own application due to the fact that it can be plugged into a standard DIL24 socket.

The DIL24 board provides easy access to the sensor pads and comes ready-to-use with the recommended decoupling capacitor on the VDD power supply line. No pull-up resistors are provided.

The STEVAL-MKI141V2 schematic can be used as a reference when designing the PCB for new applications concerning the HTS221.

Figure 8: STEVAL-MKI141V2 HTS221 adapter DIL24



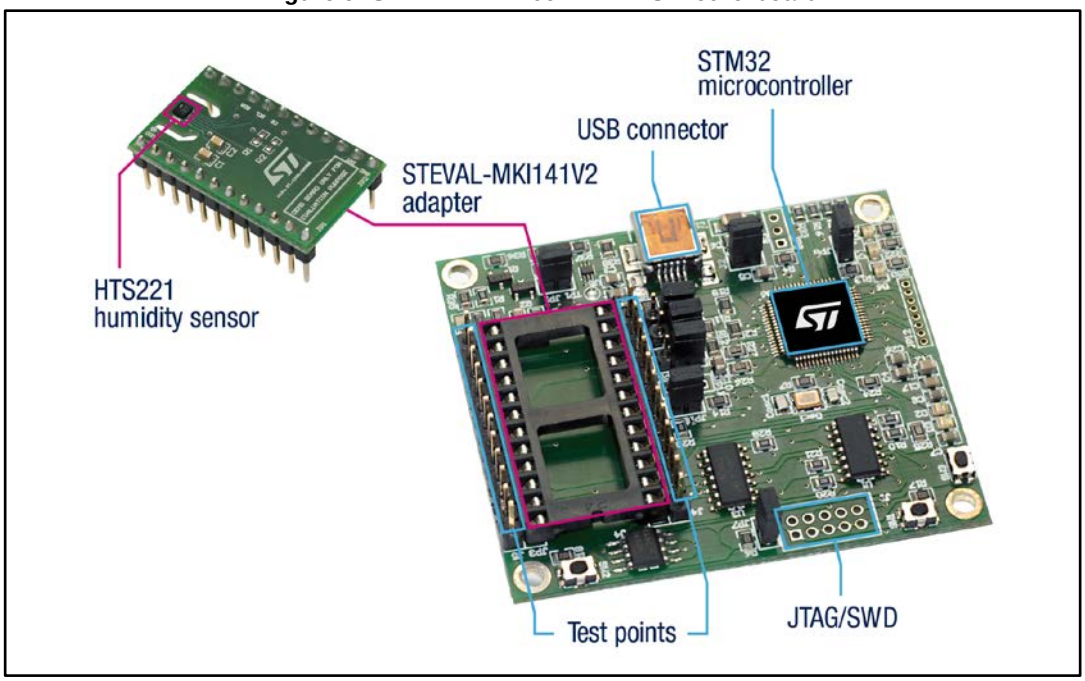
The STEVAL-MKI141V2 can also be used with the eMotion motherboard, STEVAL-MKI109V2, designed to provide users with a complete, ready-to-use HW/SW platform for the demonstration of STMicroelectronics MEMS devices housed in the LGA and HLGA packages. The board features a DIL24 socket to mount all available DIL 24 adapters for ST's MEMS sensors.

The motherboard includes a high-performance 32-bit microcontroller, which functions as a bridge between the sensor and a PC, on which it is possible to use the UNICO SW available on www.st.com that comes with an easy-to-use graphical user interface (GUI) for PC interconnection through the USB.

UNICO may be used as a simple real-time demonstrator or to verify device performance.

It also allows easy monitoring of the status of the registers and allows changes to them based on user requirements.

Figure 9: STEVAL-MKI109V2 MEMS motherboard



It is recommended to connect the DIL24 board to the socket with a flat cable in order to maximize HTS221 performance in the evaluation phase.

The schematics and layout given in *Figure 10: "HTS221 schematic example (DIL24 adapter board)"* and *Figure 11: "HTS221 layout example (DIL24 adapter board)"* are recommended for this reference design which allows further customization according to user requirements.

Figure 10: HTS221 schematic example (DIL24 adapter board)

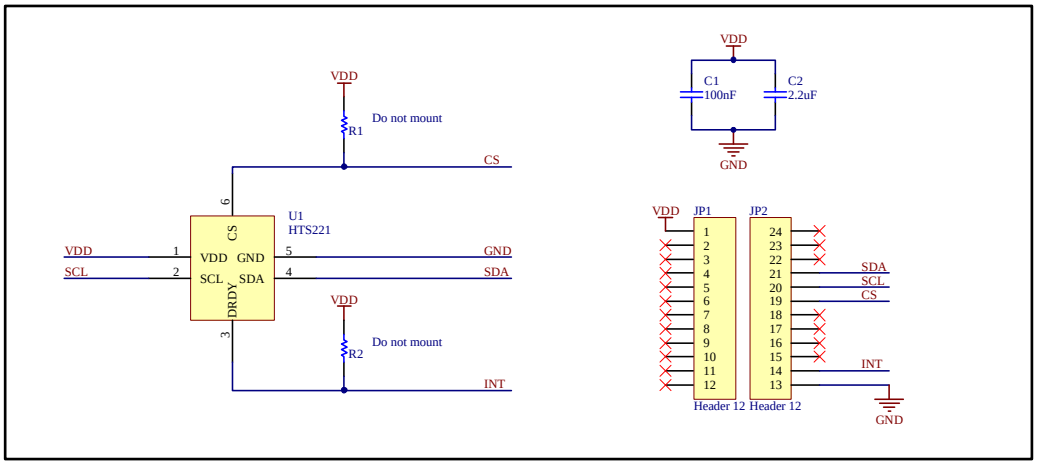
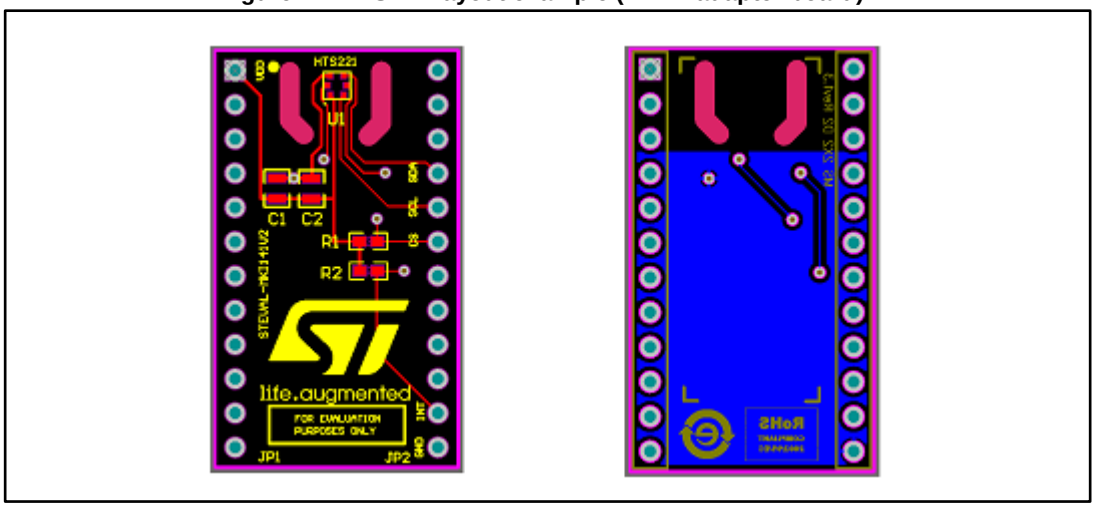


Figure 11: HTS221 layout example (DIL24 adapter board)



4 Revision history

Table 3: Document revision history

Date	Revision	Changes
16-Sep-2015	1	Initial release.
22-Oct-2015	2	Improved humidity accuracy in *Section 1: "Product description"*

IMPORTANT NOTICE – PLEASE READ CAREFULLY

STMicroelectronics NV and its subsidiaries (“ST”) reserve the right to make changes, corrections, enhancements, modifications, and improvements to ST products and/or to this document at any time without notice. Purchasers should obtain the latest relevant information on ST products before placing orders. ST products are sold pursuant to ST’s terms and conditions of sale in place at the time of order acknowledgement.

Purchasers are solely responsible for the choice, selection, and use of ST products and ST assumes no liability for application assistance or the design of Purchasers’ products.

No license, express or implied, to any intellectual property right is granted by ST herein.

Resale of ST products with provisions different from the information set forth herein shall void any warranty granted by ST for such product.

ST and the ST logo are trademarks of ST. All other product or service names are the property of their respective owners.

Information in this document supersedes and replaces information previously supplied in any prior versions of this document.