

## Multi-sensor predictive maintenance kit with IO-Link stack v.1.1



### Features

- Kit content:
  - Sensor node (marked STEVAL-IDP005V2; not available for separate sale)
  - Communication adapter board (marked STEVAL-UKI001V2; not available for separate sale)
  - [STLINK-V3MINI](#) programming and debugging interface
  - Cables and connector
- Main supply voltage: 18 - 32 V
- Main components of the sensor node:
  - 32-bit ARM® Cortex®-M4 core for signal processing and analysis ([STM32F469AI](#))
  - Ultra-wide bandwidth 3-axis digital accelerometer ([IIS3DWB](#))
  - Absolute digital pressure sensor ([LPS22HB](#))
  - Relative humidity and temperature sensors ([HTS221](#))
  - Digital microphone sensors ([IMP34DT05](#))
  - IO-Link PHY device ([L6362A](#))
  - EEPROM ([M95M01-DF](#)) for data storage
  - Step-down switching regulator and LDO regulator ([L6984](#) and [LDK220](#))
  - ESD protection ([ESDALC6V1-1U2](#), [SMBJ33CA](#))
- Complete set of firmware demo examples based on 3D accelerometer library with advanced frequency and time domain signal processing for predictive maintenance, including:
  - Programmable FFT size (256, 512, 1024, 2048), overlapping and averaging
  - Programmable windowing (Flat Top, Hanning, Hamming, Rectangular)
  - Speed RMS moving average, acceleration max. peak
  - Programmable threshold for warning and alarm conditions in spectral band
- Microphone algorithms for:
  - PDM to PCM
  - Sound pressure level (SPL)
  - Audio FFT
- IO-Link device stack v1.1 protocol and IO-Link Device Descriptor (IODD) for all measurements included (provided by TEConcept GmbH)
- M12 standard industrial connector
- SWD connector for debugging and programming capability
- Reset button
- Expansion connector with GPIO, ADC, I²C bus, timer
- Designed to meet IEC industrial standard requirements

Product summary	
Multi sensor predictive maintenance kit with embedded IO-Link stack v.1.1	<a href="#">STEVAL-BFA001V2B</a>
High-performance advanced line, ARM Cortex-M4 core with DSP and FPU, 2 Mbytes Flash, 384+4 kB of RAM, DMA controller, up to 17 timers	<a href="#">STM32F469AI</a>
Ultra-wide bandwidth, low-noise 3-axis digital accelerometer for industrial applications	<a href="#">IIS3DWB</a>
IO-Link communication transceiver device	<a href="#">L6362A</a>
Compact in-circuit debugger and programmer for STM32	<a href="#">STLINK-V3MINI</a>
Software package for STEVAL-BFA001V2B evaluation kit	<a href="#">STSW-BFA001V2</a>

### Description

The [STEVAL-BFA001V2B](#) is an industrial reference design kit designed for condition monitoring (CM) and predictive maintenance (PdM).

The layout is designed to meet IEC61000-4-2/4 and EN60947 requirements for industrial applications.

Product summary	
Applications	<a href="#">Condition monitoring and predictive maintenance</a> <a href="#">Smart industry</a>

The hardware development kit consists of an industrial sensor board (STEVAL-IDP005V2; not available for separate sale), specifically designed with dimensions (50mm x 9mm x 9mm) that reflect real industrial applications and needs, an [STLINK-V3MINI](#) programming and debugging tool, an adapter (STEVAL-UKI001V2; not available for separate sale), a 0.050" 10-pin flat cable, a 4-pole cable mount connector plug with male contacts and an M12 female connector with a 2 m cable which is used for power on and connection with a master port. The connection is managed using a standard multipolar cable with one wire used for IO-Link data, one for the L+ line (positive supply voltage pole) and one for the L- line (negative supply voltage pole).

The [STSW-BFA001V2](#) firmware package (freely available on [www.st.com](http://www.st.com)) includes dedicated algorithms for advanced time and frequency domain signal processing and analysis of the high bandwidth 3D digital accelerometer for vibration monitoring. The package includes pressure, relative humidity and temperature sensor monitoring samples as well as audio algorithms for acoustic emission (AE).

The firmware runs on the high performance [STM32F469AI](#), ARM® Cortex®-M4, 32-bit microcontroller. The sensor data analysis results can be displayed on a user PC terminal emulator via wired connectivity (by connecting the STEVAL-IDP005V2 UART to a USB PC port through the STEVAL-UKI001V2 adapter and [STLINK-V3MINI](#) Virtual COM) or the related IO-Link master board interface (connecting the STEVAL-IDP005V2 to an IO-Link master board through the M12 cable).

IO-Link device stack v1.1. (for evaluation purposes with some limitations) is included in object library format with IO-Link Device Descriptor (IODD) for all measurements and with dedicated examples to demonstrate device interoperability with any master tool. It supports BLOB transfer for vibration and acoustic FFT data, event generator and parameter configuration.

The package includes also a GUI to demonstrate the IO-Link device features when connected to the [STEVAL-IDP004V2](#) multi-port master evaluation board.

# 1 Solution overview

## 1.1 Block diagram

The **STEVAL-BFA001V2B** kit enables predictive maintenance (early detection of failures on the equipment under monitoring), managing key parameters coming from environmental, vibration and acoustic sensors. It is suitable for monitoring motors, pumps and fans, and can accelerate the development of predictive maintenance solutions and PoCs.

The kit performs advanced time and frequency domain signal processing for vibration analysis, running on embedded high performance MCU with configurable thresholds for alarms and warnings, demonstrating the process at edge level.

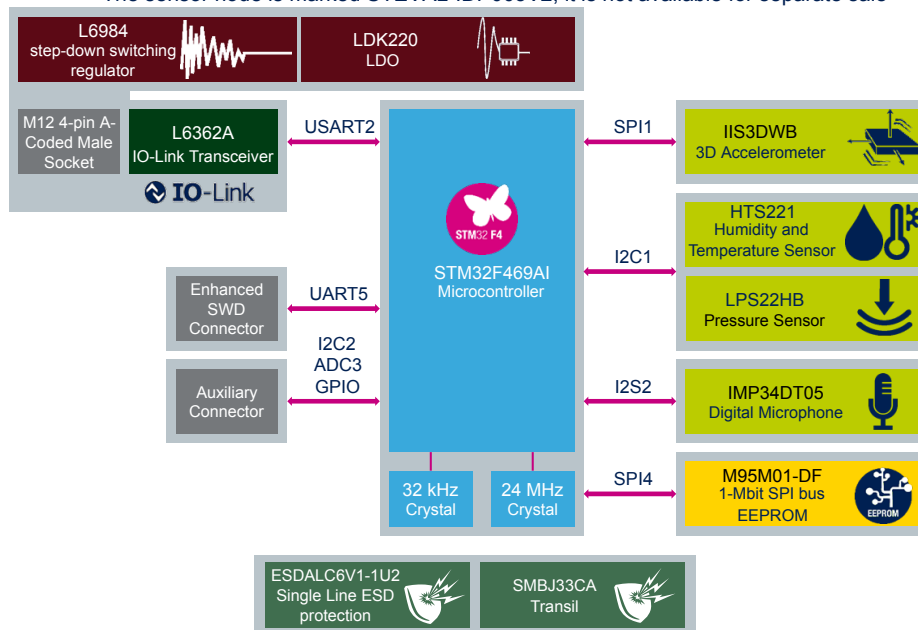
The tiny and compact form factor has been designed to allow placement of the sensor node very close to the equipment to be monitored.

The power management phase generates the low voltage needed for digital sensors and MCU from an industrial 18 to 32 V input voltage range.

The IO-Link device stack protocol is included with the **STSW-BFA001V2** dedicated firmware to demonstrate the IO-Link device features.

**Figure 1. STEVAL-BFA001V2B main board (sensor node) block diagram**

The sensor node is marked STEVAL-IDP005V2; it is not available for separate sale



## 1.2 Schematic diagrams

Figure 2. STEVAL-UKI001V2 (adapter board) circuit schematic

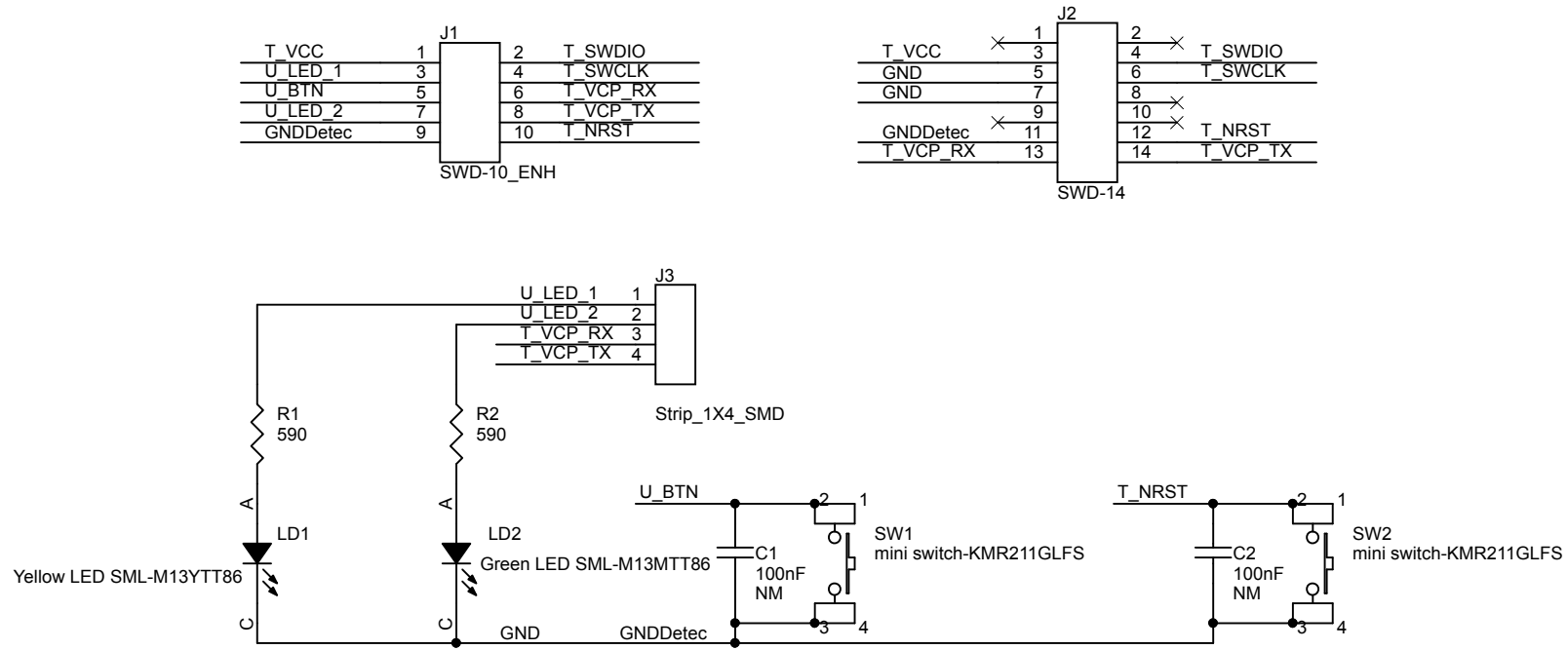


Figure 3. STEVAL-IDP005V2 (main board) circuit schematic

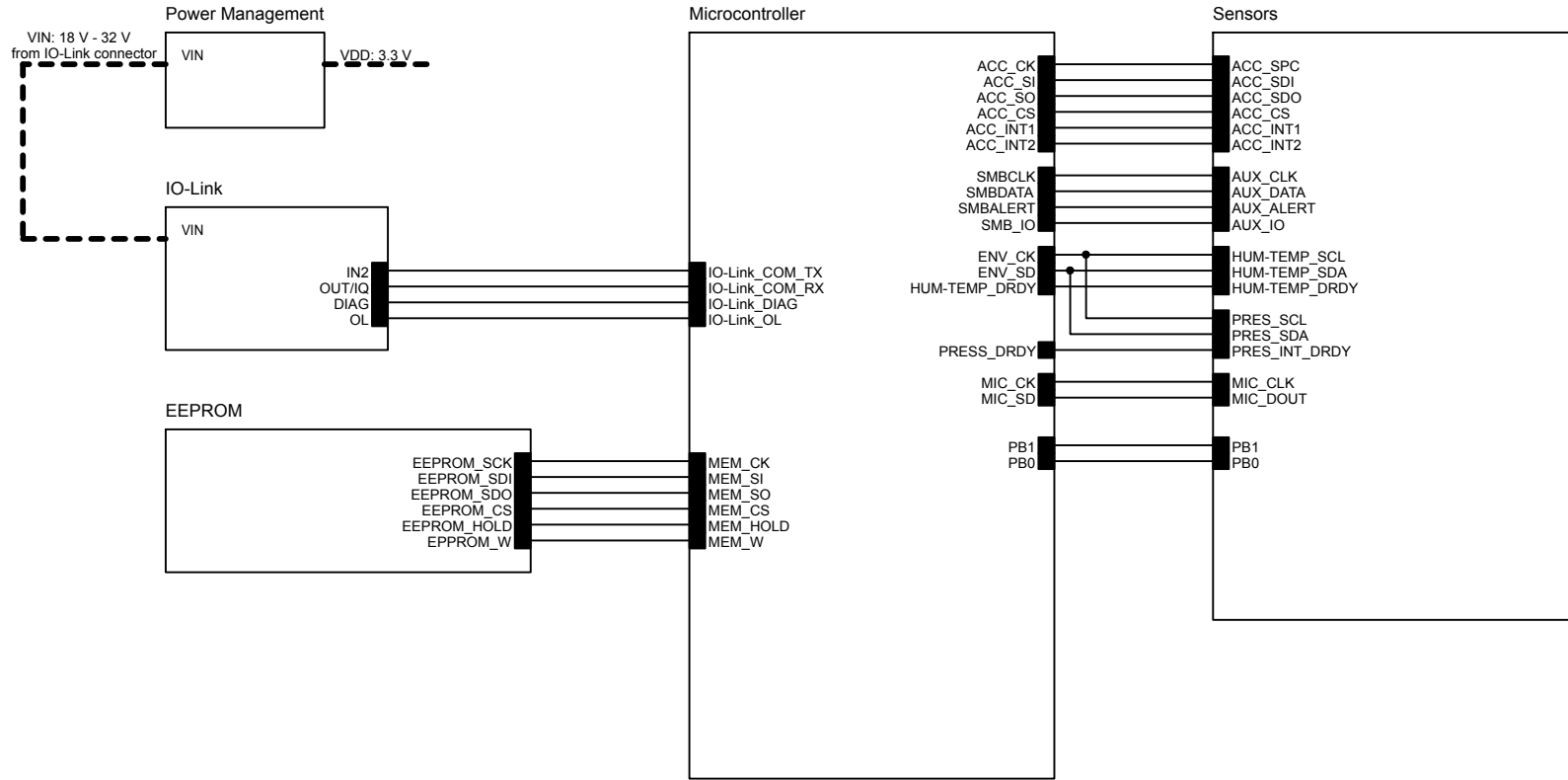


Figure 4. STEVAL-IDP005V2 (main board) circuit schematic - power management

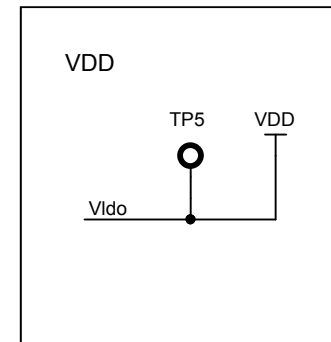
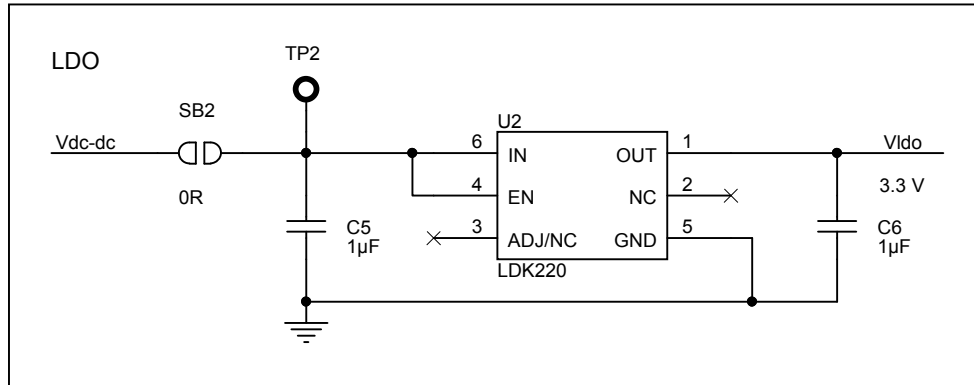
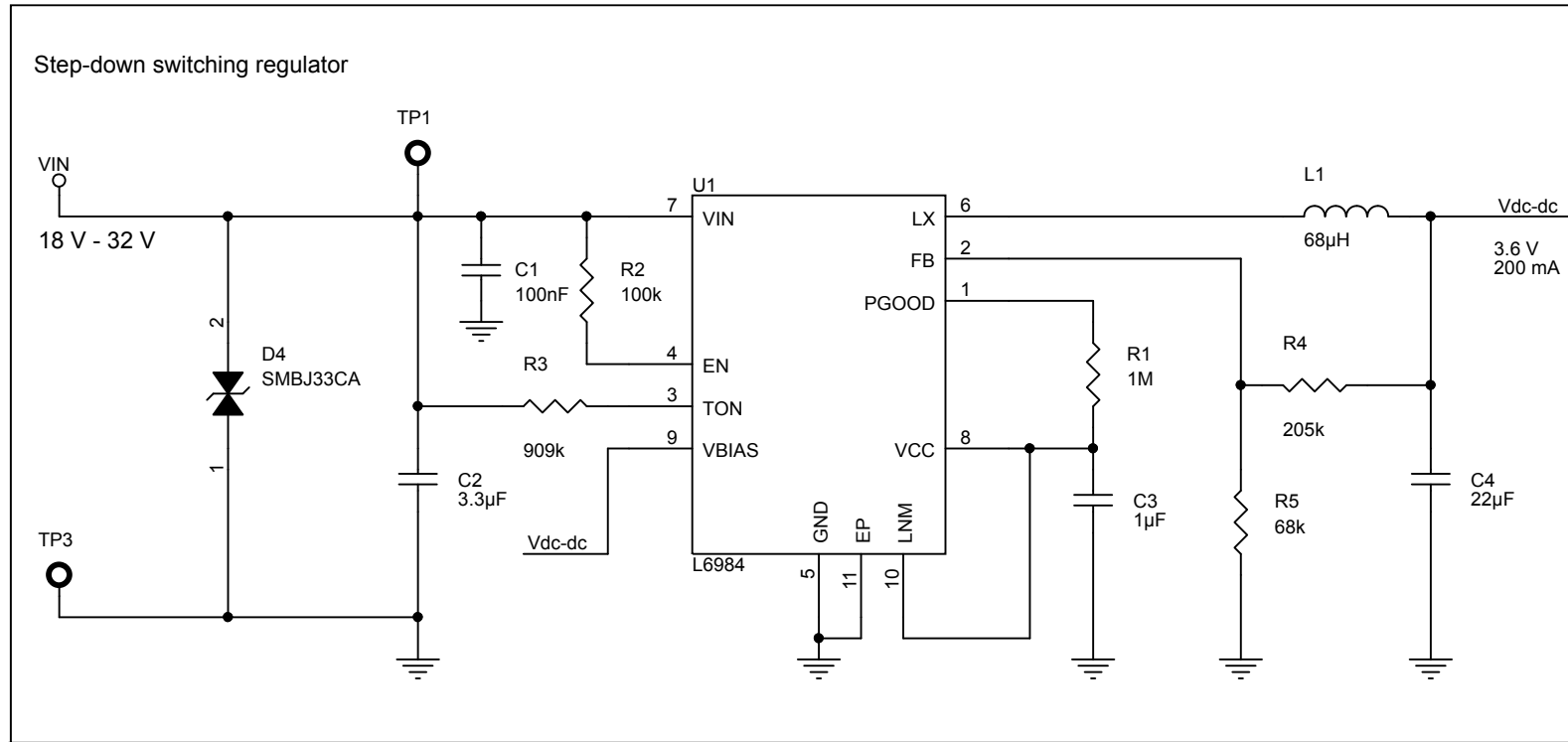


Figure 5. STEVAL-IDP005V2 (main board) circuit schematic - IO-Link

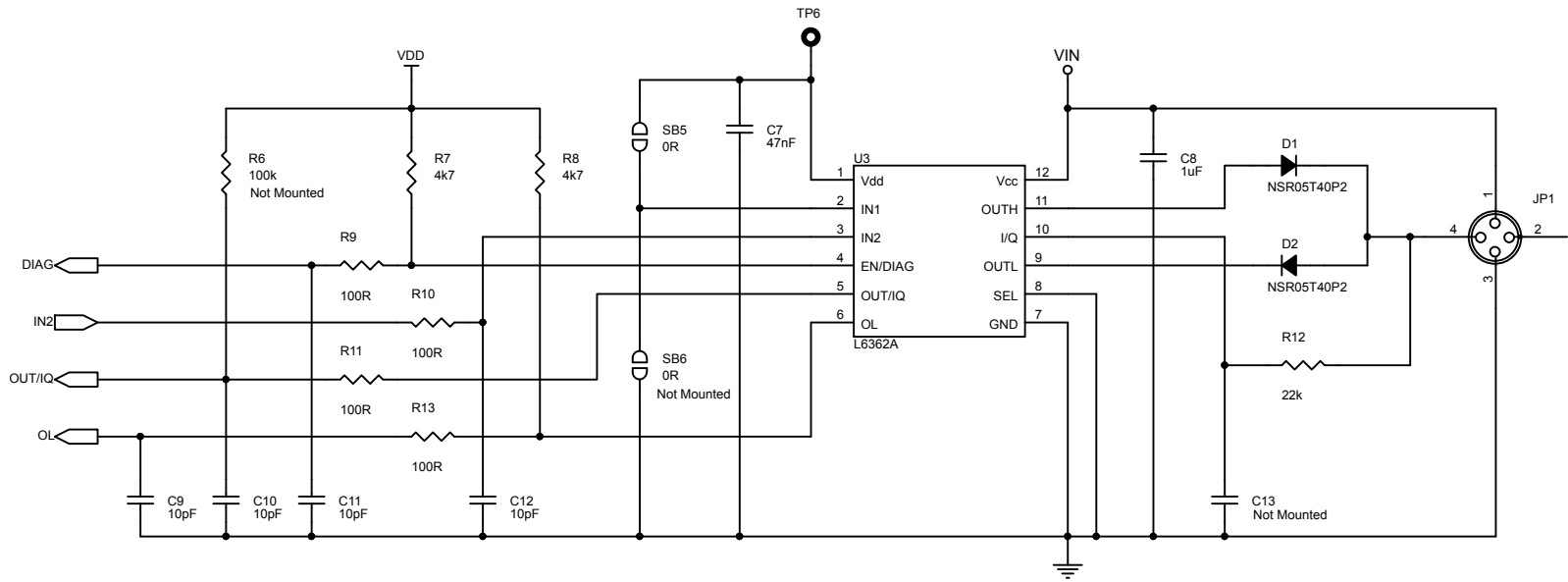


Figure 6. STEVAL-IDP005V2 (main board) circuit schematic - sensors

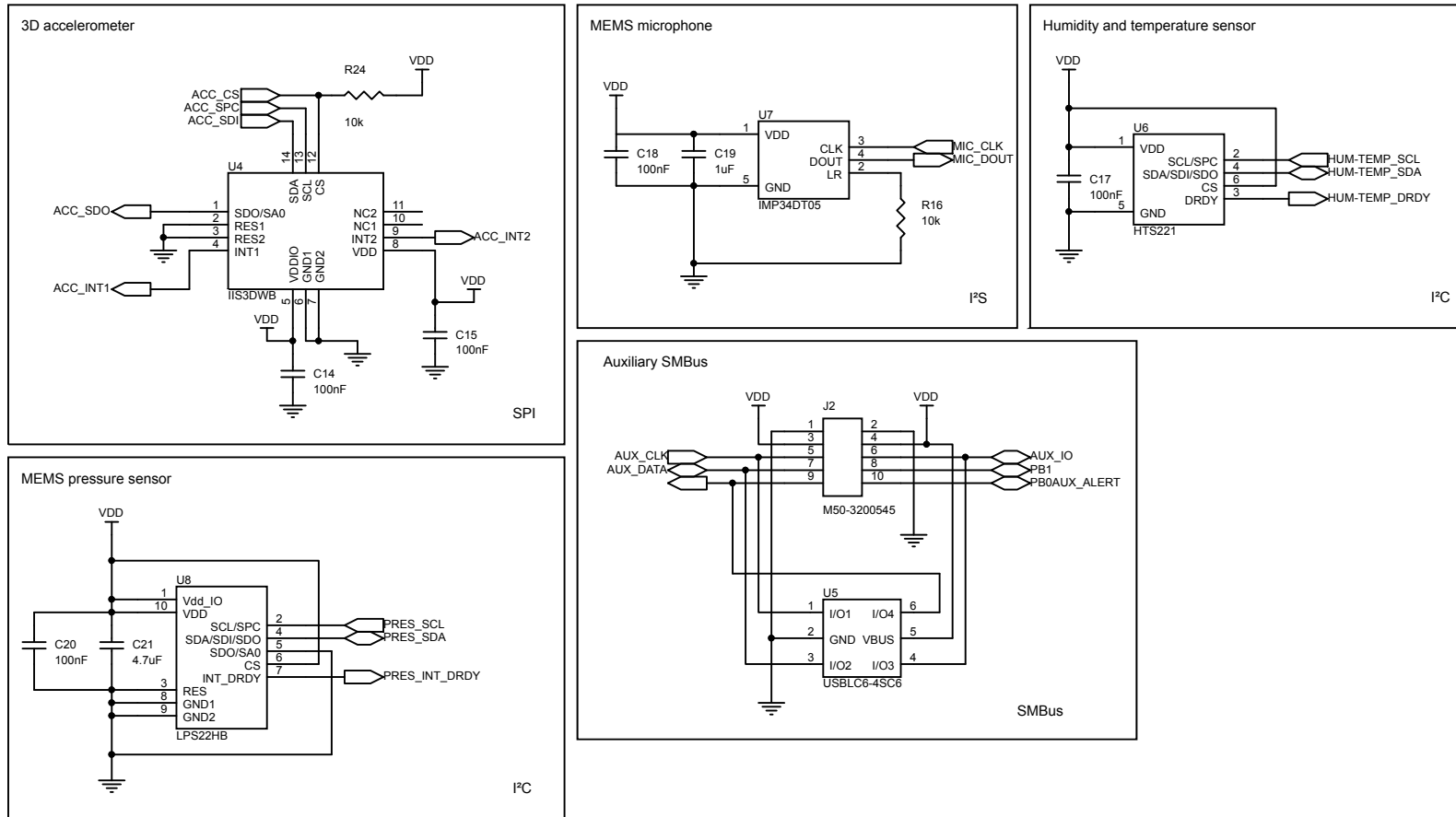




Figure 7. STEVAL-IDP005V2 (main board) circuit schematic - microcontroller (1 of 2)

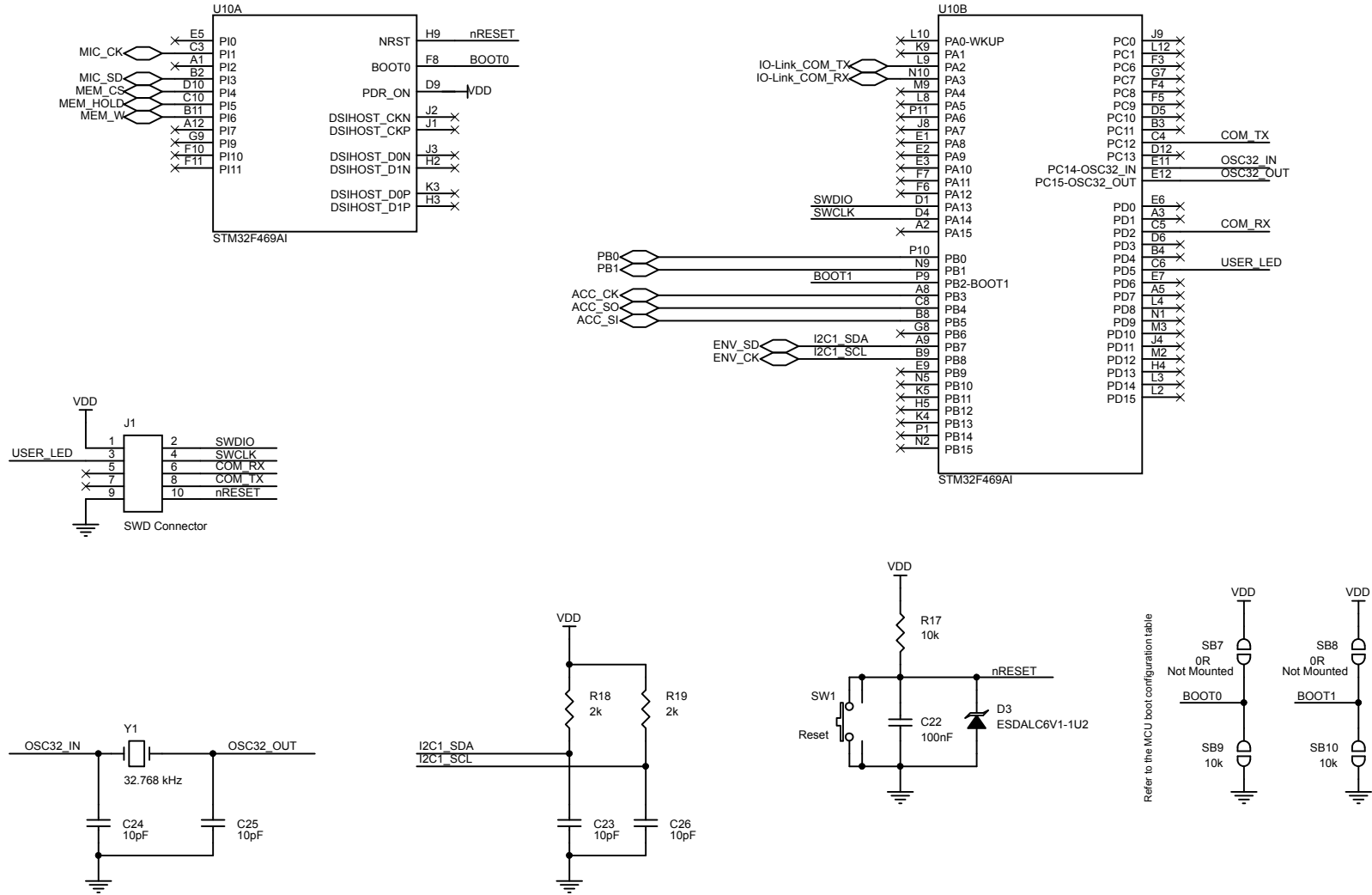
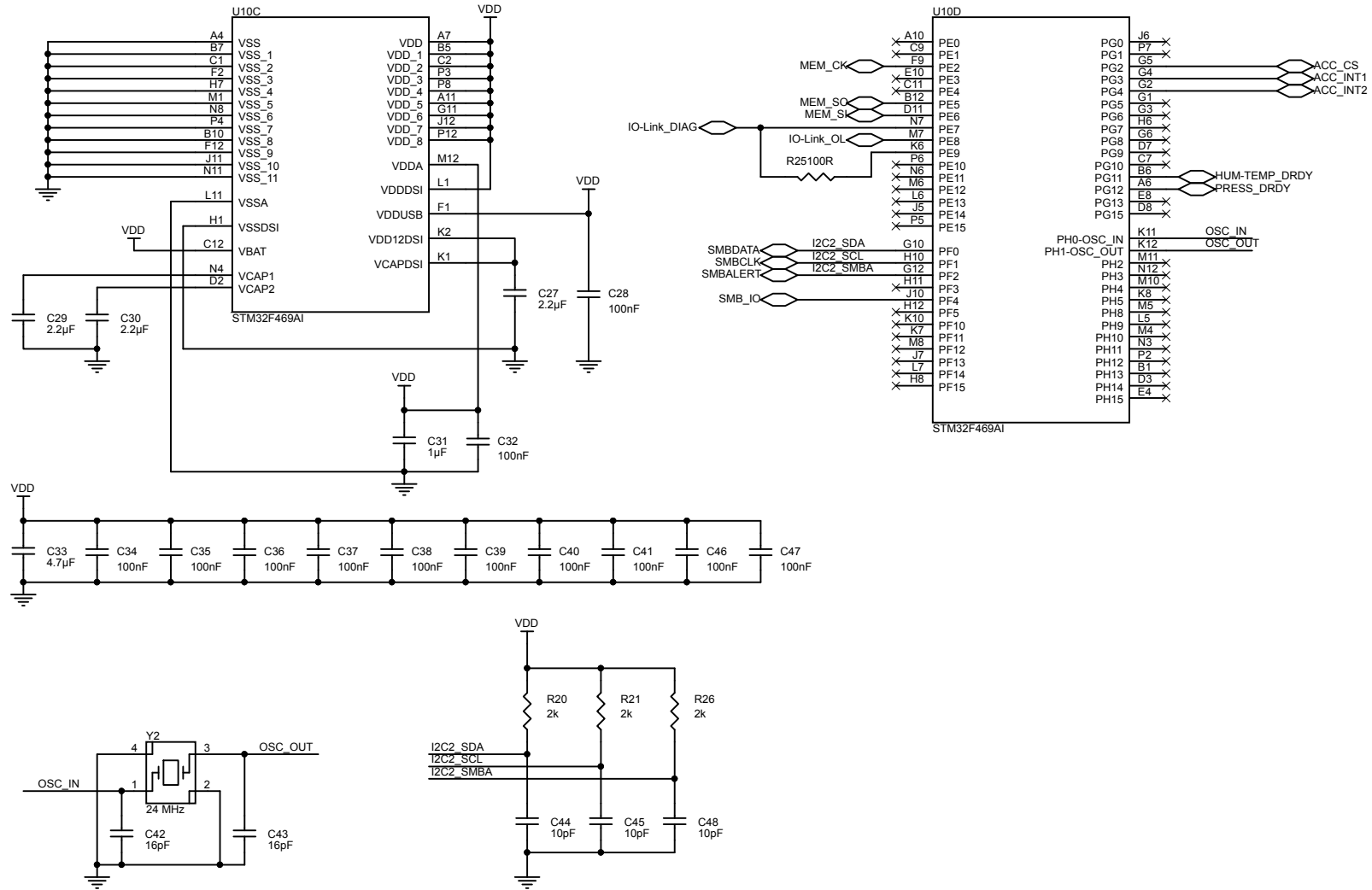


Figure 8. STEVAL-IDP005V2 (main board) circuit schematic - microcontroller (2 of 2)



## Revision history

**Table 1. Document revision history**

Date	Version	Changes
20-Nov-2019	1	Initial release.

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