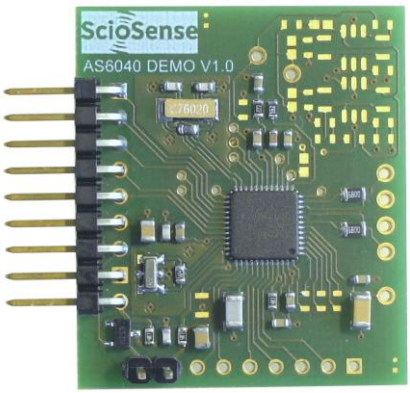

AS6040-QF_DK

Development Kit User Guide

AS6040-QF_DK User Guide

Revision: 5

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Document Status: Production

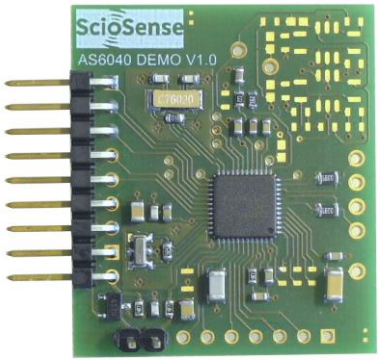
Content Guide

1 Introduction

The AS6040-DK development kit allows customers a quick and intuitive approach to using the AS6040 UFC in ultrasonic flow meter applications.

The kit includes three elements:

AS6040-QF_DK_RB reference board V2.0, based on AS6040-BQFM in QFN48 package



PicoProg Lite with USB-C – USB cable

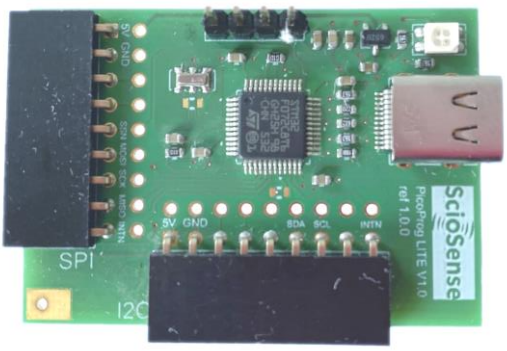


Figure 1: Functional Blocks

Please download the software for the kit from https://downloads.sciosense.com/AS6040 and look for the latest revision of UfcEvaluationSoftware….zip

1.1 Ordering Codes

Table 1: Pin description

Ordering code	Part Number	Description
AS6040-QF_DK V1.0	221010003	AS6040 Demo kit including PICOPROG and cables
AS6040-QF_DK_RB V2.0	221010002	AS6040 reference board

2 Quick Start Guide

This section describes how to quickly set up the AS6040 development kit, to establish basic operation and to make first measurements.

It is crucial to install the software before connecting the evaluation kit to your computer. The software can be downloaded here:

https://downloads.sciosense.com/AS6040

- Unzip the package to the desired directory,
- Connect the PicoProg Lite to the computer and the AS6040 board to the SPI connector on the PicoProg Lite.
- Connect your spool piece to US_UP and US_DOWN. US_UP fires upstream, means versus flow. US_DOWN fires downstream, with the flow.
- Open “UFCEvaluationSoftware.exe”

The following screen will appear:

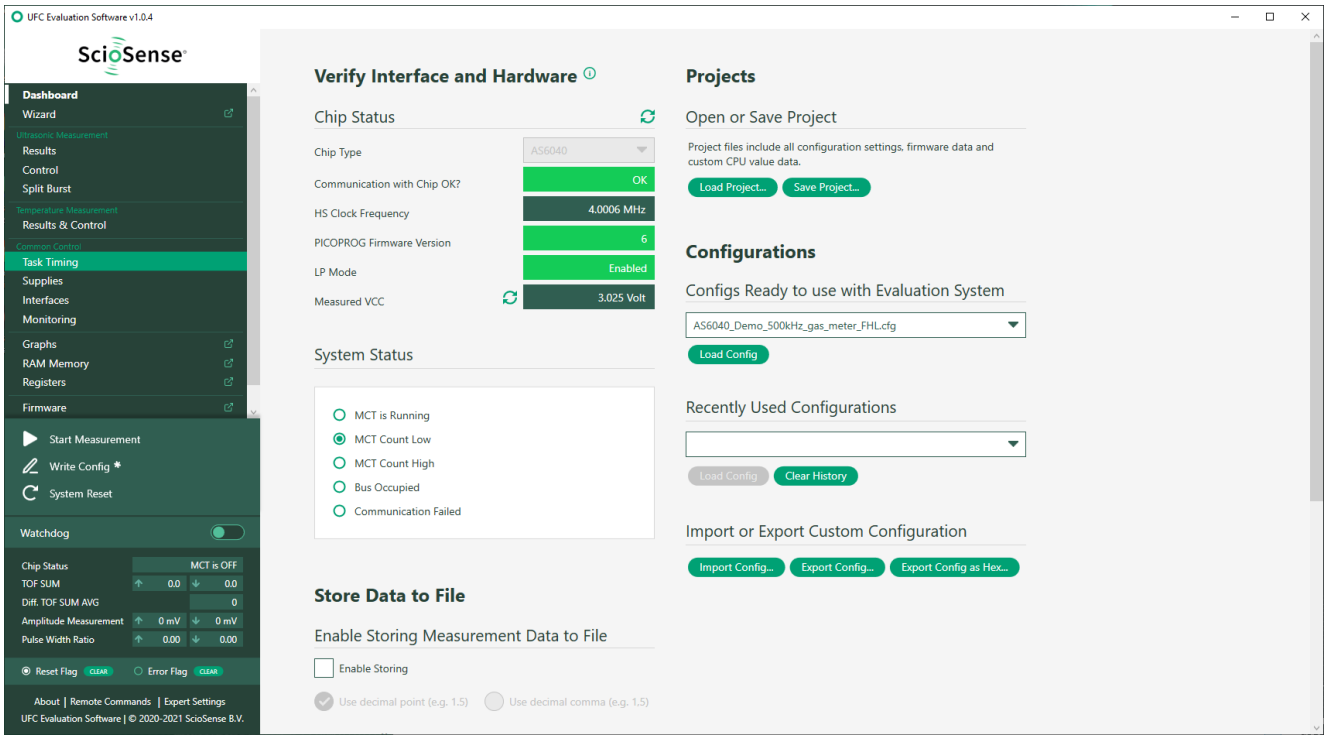


Figure 2: Opening page

- Verify that the right device is selected.
- Select one of the available projects or configuration files, press “Load Project” or “Load Config” and then on the left press “Write Config”.
- Press “Start Measurement” to begin measuring.

3 Hardware Description

3.1 Introduction

The AS6040-QF_DK_RB board, shown in figure 3, is a front-end mainly for gas meters but also water meters. The transducers and temperature sensors are directly connected to this board. It comes with a 32.768 kHz quartz (X2) and a 8 MHz ceramic oscillator (X1).

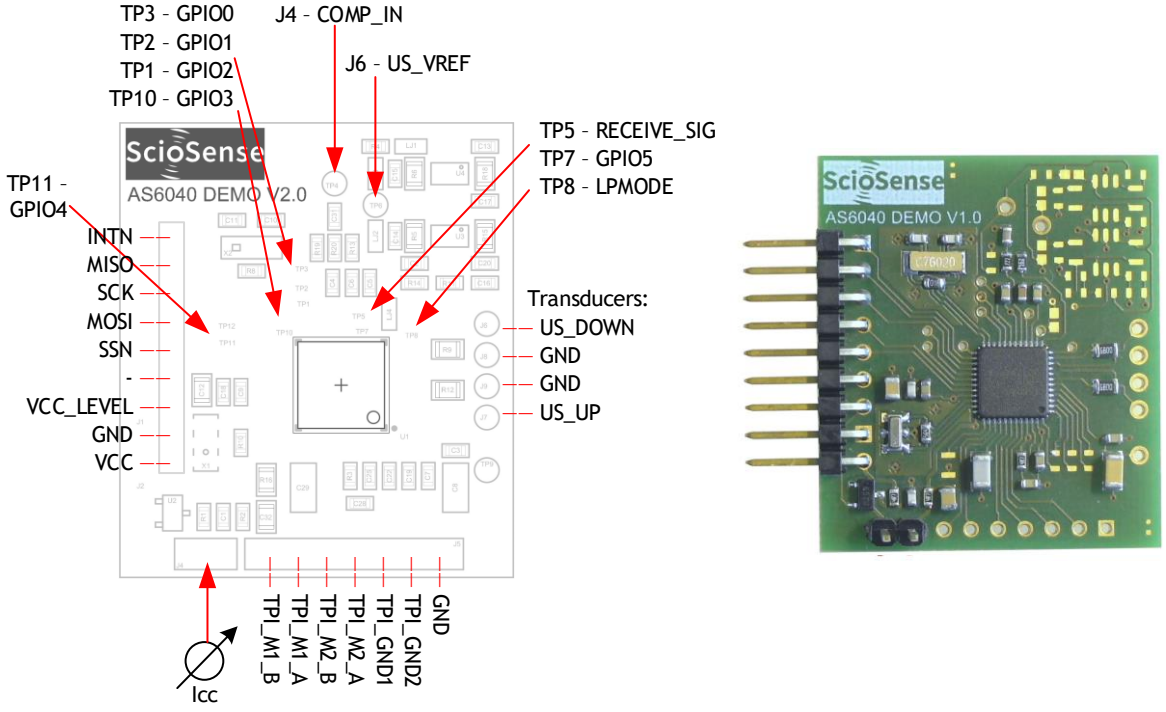


Figure 3: AS6040-QF_DK_RB

3.2 Series Load Resistors

The series load resistors, sometimes also called matching resistors, are assembled by default with 680 Ohm. In case the impedance of the transducers differs a lot those can be replaced.

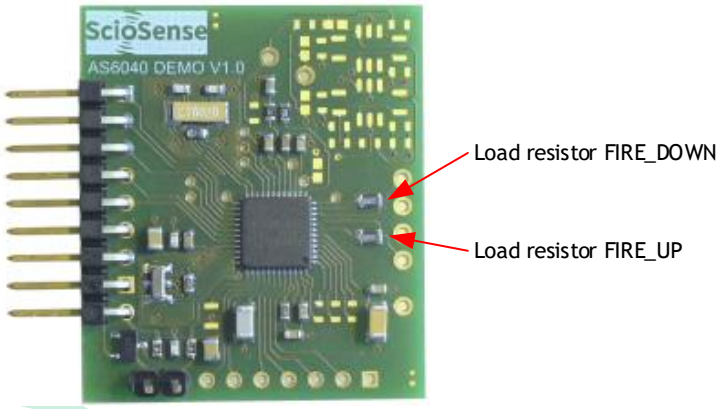


Figure 4: Series load or matching resistors

In application for water with typical frequencies of 1 or 2 MHz the series resistors might better be lower, like 330 Ohm. From experience, the matching does not need to be precise but a rough fit.

3.3 Filter for PGA

In applications with high gain (> 20V/V, like in gas meters) the PGA noise may be reduced by an external filter. The filter is configured by setting TI_PGA_CON_MODE = 2 in the evaluation software. This controls the internal switch to the pad INVERT_IN. The filter has to be connected between the INVERT_IN and COMP_IN pins.

Note: by default, no PGA is assembled on the evaluation board.

The choices for the external resistors and capacitor depend on the fire frequency for the ultrasonic transducer. For gas meters we recommend the following recommended values:

R_i = 5.6 kΩ (R13), C = 10 nF (C31), R_o = 2.2 kΩ (R20)

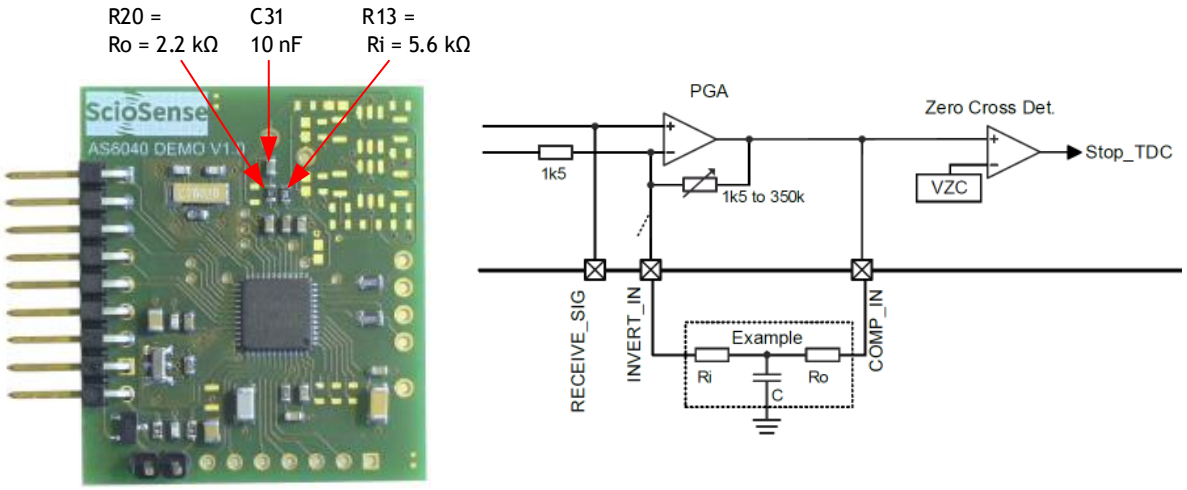


Figure 5: AS6040-QF_DK_RB

The T-filter only becomes effective with high amplification. It then reduces the gain and noise of the PGA at low frequencies. From PGA_TRIM >= 7 on the filter reduces the standard deviation of TOF values. But it also overrides the auto-zero function, and therefore the auto-zero should be disabled when a filter is used, TI_PGA_AZ_DIS = 1.

3.4 Communication Interface

The PICOPROG device is a USB-to-SPI converter box that interfaces all UFC evaluation systems. The PICOPROG is registered by the operating system initially as “PICOPROG v2.0 unprogrammed” (for both PICOPROG V2.0 and V3.0). As soon as the UFC evaluation software starts, a special firmware is written into the PICOPROG to handle the SPI communication with the AS6040-QF_DK_RB board. The PICOPROG is now listed as “UNIPRO” in the device manager.

The flat connector connecting the PICOPROG and the AS6040-QF_DK_RB includes the power lines and the SPI communication lines. VCC_LEVEL is the voltage feedback for the PICOPROG level shifters.

4 Measurements in Practice

We propose to start with one of the example configurations. The most important parameters to review and set are:

- Fire pulse frequency (typically 100kHz, 200kHz or 500kHz)
- Number of fire pulses (20 is a good start)
- Number of TOF hits (10 is a good start)
- Noise mask Window should be =1. Then directly after the fire burst, with about 10µs delay, the chip switches to receive. Typically you see a short oscillation due to the switching between the send and receive transducer.
- Charge pump voltage and PGA gain of receiving amplitude (to get a receive amplitude of 200 to 400mV)

In general, we recommend to have a look at the receive signal by means of an oscilloscope. This clearly helps to find the right settings.

If the signal is measured at the PGA output, at test pin J4 (pin 17, COMP_IN) then there is no influence of the probe to the measured time values. In Figure 3 this point is marked. Another probe should be connected to US_UP for the trigger signal. When looking at minimum noise then this probe of course needs to be removed.

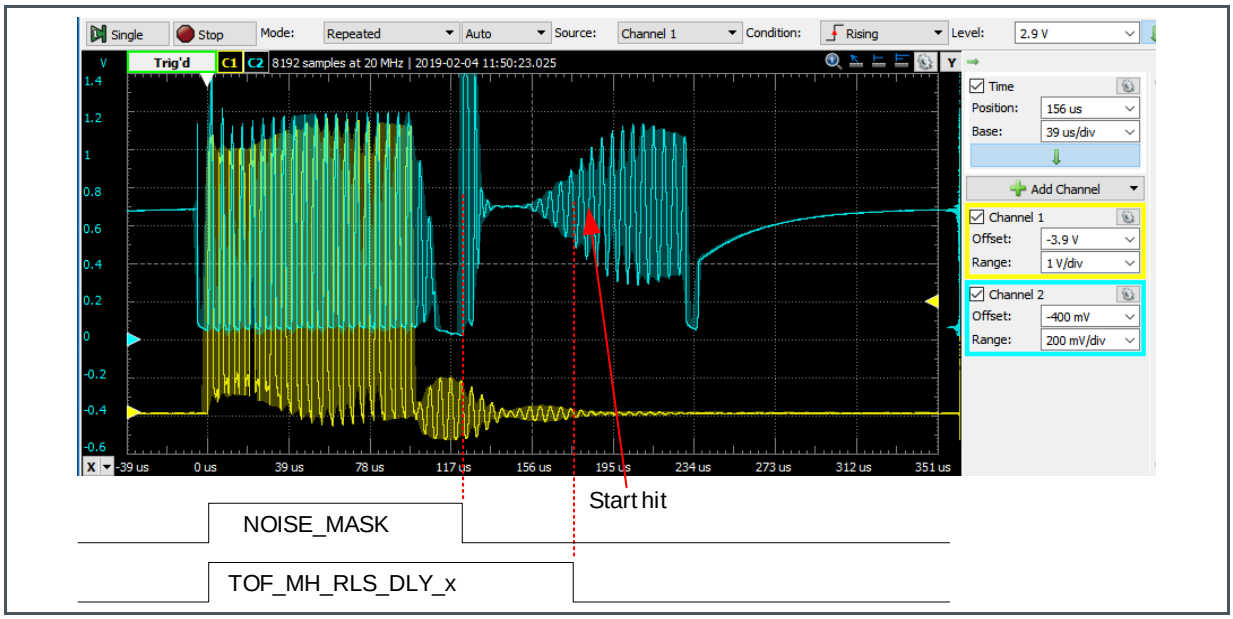


Figure 6: Typical send and receive signals

When working with real gas there might be the need for an external amplification with higher gain than offered by the internal PGA. In this case, please refer to application note SC-000942-AN, “AS6040 with external amplifier” for details.

5 Schematics, Layers & BOM

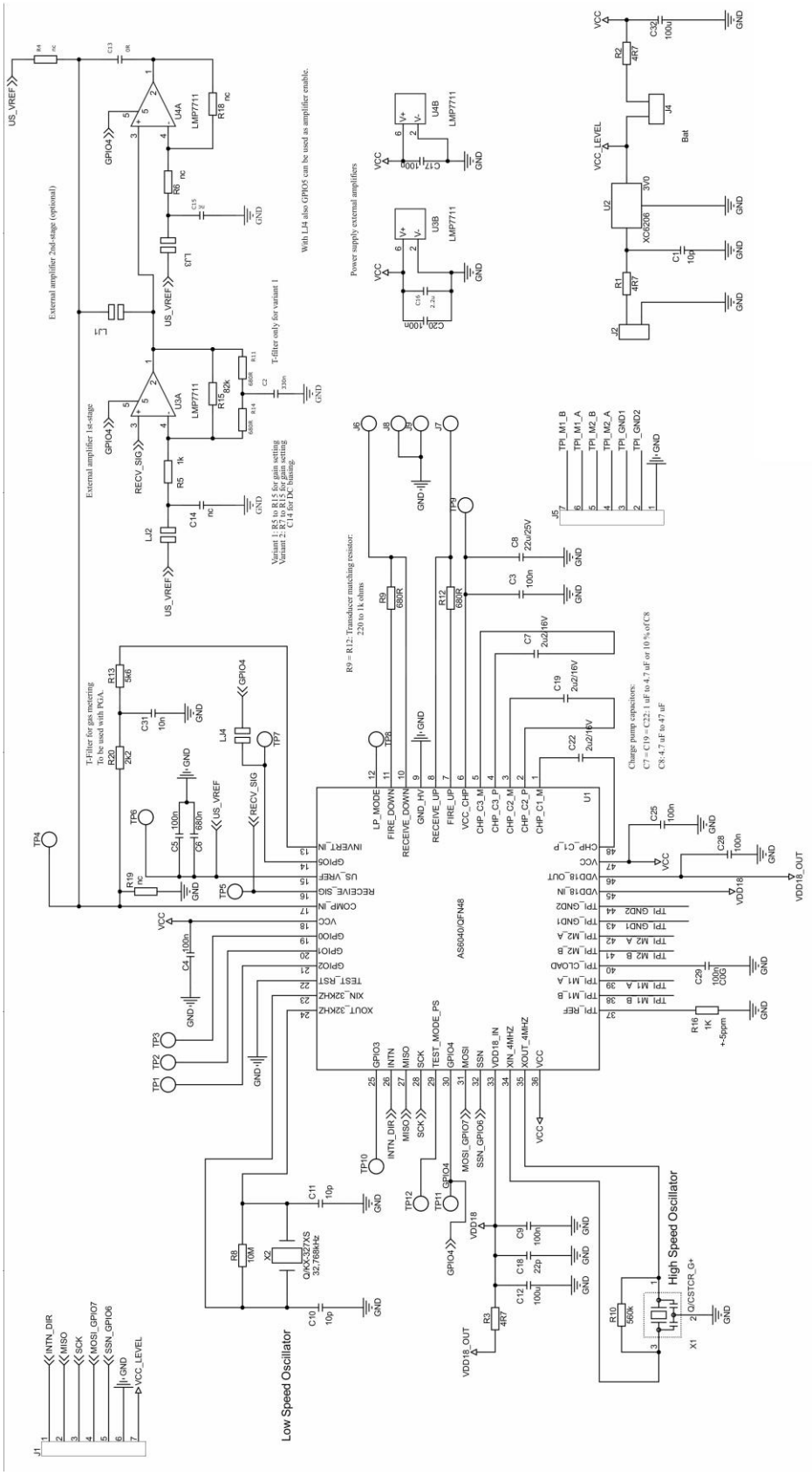


Figure 7: AS6040-QF_DK_RB schematics

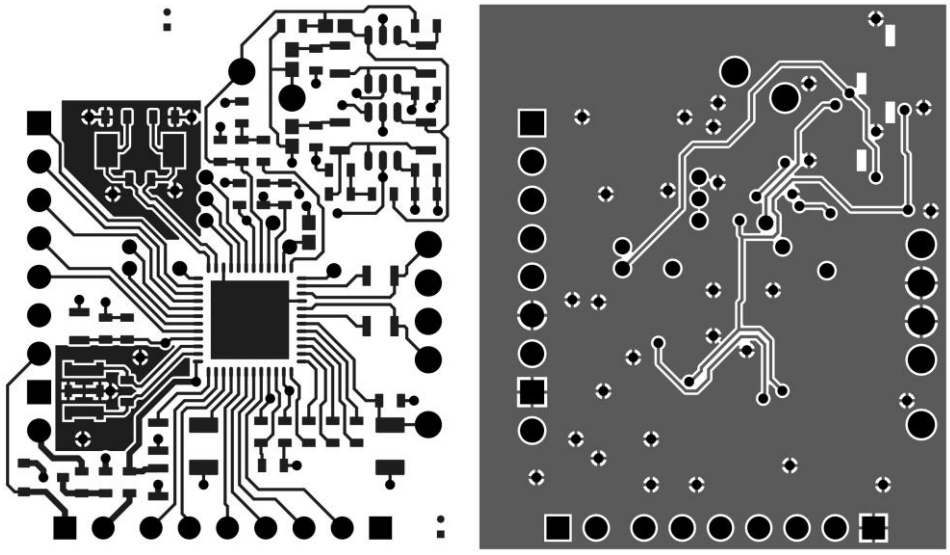


Figure 8: AS6040-QF_DK_RB layout 2:1t

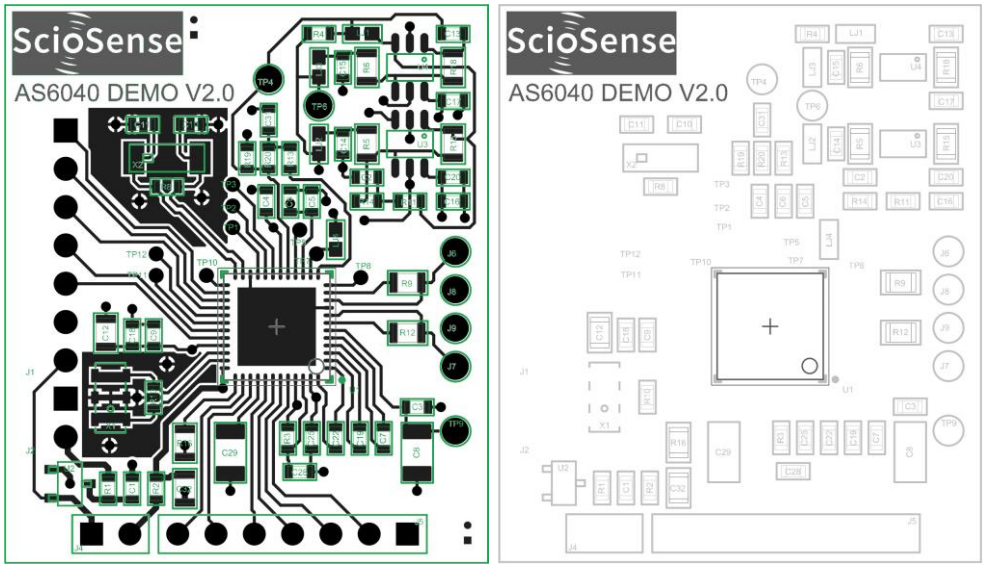


Figure 9: AS6040-QF_DK_RB assembly 2:1

Table 2: Bill of materials for AS6040-QF_DK_RB V2.0

Quantity	Designator	Value	Comment	Footprint
3	C1, C10, C11	10p	CHIP-CAPACITOR 0603	0603
1	C18	22p	CHIP-CAPACITOR 0603	0603
1	C31	10n	CHIP-CAPACITOR 0603	0603
5	C4, C5, C9, C25, C28	100n	CHIP-CAPACITOR 0603	0603

1	C6	680n	CHIP-CAPACITOR 0603	0603
1	C3	100n/25V	CHIP-CAPACITOR 0603	0603
2	C12, C32	100u/6V3	CHIP-CAPACITOR 0805	0603
1	C29	100n C0G	CHIP-CAPACITOR GRM31C5C1E104JA01L	1206
3	C7, C19, C22	2u2/16V	CHIP-CAPACITOR 603	0603
1	C8	22u/20V	Tantal BF. B TAJB226K020RNJ AVX	
7	C2, C13, C14, C15, C16, C17, C20		CHIP-CAPACITOR 0603	0603
3	R1, R2, R3	4R7	CHIP-RESISTOR 0603	0603
1	R20	2k2	CHIP-RESISTOR 0603	0603
1	R13	5k6	CHIP-RESISTOR 0603	0603
1	R10	560k	CHIP-RESISTOR 0603	0603
1	R8	10M	CHIP-RESISTOR 0603	0603
2	R9, R12	680R	CHIP-RESISTOR 0805	0805
1	R16	1K	CHIP-RESISTOR 0805 RN73C2A1K0B	
4	R4, R11, R14, R19		CHIP-RESISTOR 0603	0603
3	R5, R6, R15, R18		CHIP-RESISTOR 0805	0805
1	U1		AS6040-BQF	QFN48
2	U3, U4		LMP7711	
1	U2	3,0V	XC6206P302MR-G Torex	
1	X1	8Mhz	CERAMIC RESONATOR CSTNE8M00G550000R0	
1	X2	32,768kHz	Quartz Crystal KX-327XS	
1	J1		Male Connector 7x1x180° 2,54	
1	J2		Male Connector 2x1x180° 2,54	
1	J4		Male Connector 2x1x90° 2,54	

6 RoHS Compliance & ScioSense Green Statement

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8 Revision information

Table 3: Revision history

Revision	Date	Comment	Page
1.0	2019	Initial version, preliminary	All
2.0	2020 Jun 06	Release	All
3.0	2021 Apr 20	Part description corrected, reference to new UfcEvaluation Software	All
4.0	2021 Oct 22	Reference to update schematics and layout of reference board. PICOPROG picture. Transfer into new ScioSense layout	All
5.0	2023 Mar 01	PICOPROG V3.0 replaced by PICOPROG Lite	3

Note(s) and/or Footnote(s):

1. Page and figure numbers for the previous version may differ from page and figure numbers in the current revision.
2. Correction of typographical errors is not explicitly mentioned.