SonoQ
Focus on Performance

Evaluation Board
User Manual
for
SQ-Eval-Kit–A1
and
SQ-Eval-Kit–G1

Product Overview

In many applications, the noninvasive control of liquid level in reservoirs like canisters is essential to guarantee proper function and application of systems. An appropriate technology here is the use of ultrasonic waves with their ability to pass layers like vessel walls and nontransparent, conductive and non-conductive materials. The usual method here is the echo sonography, where an ultrasound transducer produces a sonic wave which passes the liquid up to the liquid/air interface on top of the liquid where most of the wave will be reflected back. This wave is again received by the transducer. By estimation of the speed of sound inside the liquid and measuring the travel time of the bouncing ultrasound wave, the liquid level may be calculated.

One of the main advantages of the used ultrasound technology beside the non-contact measurement through the containers wall is the detection of foam/liquid boundaries.

Often the ultrasonic altimeter is - even though best applicable - not used because there is a need of certain knowledge about ultrasound signal processing and ultrasonic transducers.

SonoQ's easy to integrate module offers the possibility to add an ultrasonic level measurement to an existing system or to simplify the design of new products.

There are two different operation modes:

Stand-alone-mode: There is no need to use the existing serial interface. The module may be configured with the Evaluation Board or may be provided with the application specific parameters from SonoQ. The on-board open collector output raises a signal at defined liquid level (with defined hysteresis).

Integrated-mode: If the modules SPI interface is used, all parameter settings and read out of current liquid level are available for customers control unit.

There are three components available:
- SQ-PCB
- Standard or application specific ultrasonic transducers
  - Dry-coupling version for easy container removal
  - Low-cost glue on version with epoxy (e.g. UHU-Endfest – supplied with SQ-Eval-Kit-G1)
  - Customized transducers
- Evaluation Board for quick putting into operation and configuration

Evaluation Board

The Evaluation Board allows a very easy introduction into the ultrasound level metering technology and helps to bring the SQ-PCB into operation. There is no need of additional electronic equipment.

There are different possibilities to work with the board:

- Experimental use

  Evaluation of parameters and transducers by using only the board. All settings may be programmed with the on board buttons and the display. The calculated liquid level and the open collector state are visualized by display and LEDs.

- Parameterization

  All settings may be flashed into the module. After removal it may be used in any OEM application.

- PC-interfacing

  For evaluation of the module it may be of interest to connect the module to a PC. This interface is provided on board with USB-connector. In that case, no additional power is necessary. There is a LabVIEW® VI which helps to make own display software as chart recorders or max-min displays.

Important Notice

The overall quality of the system is depending on the transducer and its adaption to the tank. Depending on fluids density, compressibility and attenuation, only the right choice of working frequency will allow proper measurement. Adequate forming of the sonic beam will give additional help.

There is in principle no general purpose solution for the transducer, especially if a dry-coupling version is used.

Examples for difficult but solvable applications are metal wall tanks. Especially here, the right choice of transducer frequency will help.

For the evaluation kit, best application is the use of standard plastic measuring jugs as used in the kitchen. The transducer should be aligned perpendicular to the reflecting surface.

SonoQ as the manufacturer of the module is well experienced in analyzing the application and manufacturing adequate transducers. Please do not hesitate to discuss this situation with SonoQ.

Board Overview

The Evaluation Board helps to configure and operate this SQ-PCB module for user applications without need of any additional external electric components.
This PCB can work in stand-alone operation or as part of a system.

Dimensions: 150x95x20 (l x w x h in mm)
Board supply Voltage: 4.5-5.5VDC (40mA@5VDC)
RoHS status: Compliant
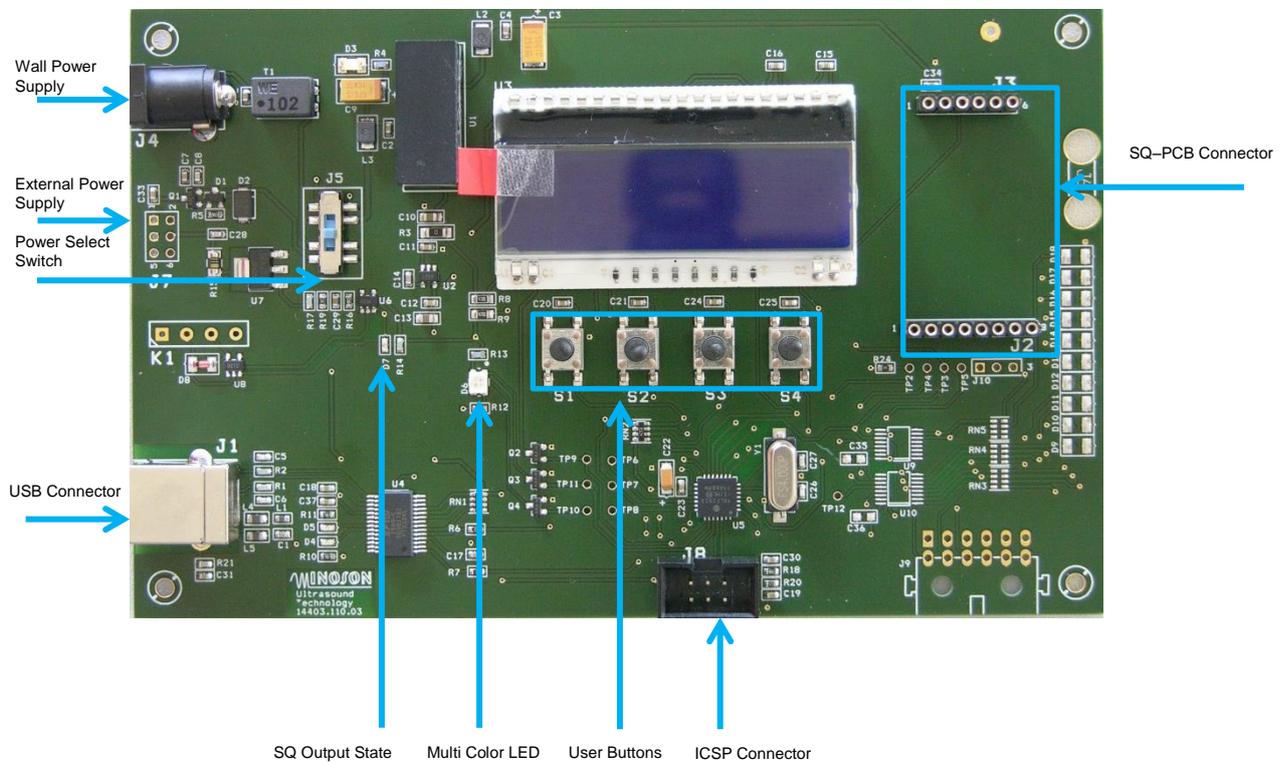
Hardware Description

Power Supplies

The Evaluation Board can be powered from one of three power sources:
- On-board USB connector (J1)
- Enclosed wall power supply (J4)
- External Power supply (J7)

The Power Select Switch (J5) is used to select one of the three power sources (upper pos.: J1, middle pos.: J4, lower pos.: J7). The green power LED indicates proper voltage supply.

The internal 12VDC power supply for the SQ-PCB is provided by an internal DC-DC-converter.

Microcontroller

The Evaluation Board includes a Microchip PIC18LF2523 microcontroller with a quick start application. The SPI interface is connected to the SQ-PCB.

Virtual COM Port

When the USB interface is connected with a PC, the device enumerates a virtual COM port. This function is only available in the USB powered mode.
The LEDs D4 and D5 are indicating the communication between Evaluation Board and PC.

Settings for the COM Port:

Baud rate:	9600Bd
Data:	8Bit Transmission
Start bit:	1bit
Stop bit:	2bits

The commands for reading and writing the registers of the SQ-PCB are the same as the SPI commands.
➔ For further information see *Manual SQ-Level*.

LCD Display

The LCD display shows the measurement results of the SQ-PCB.

LED

There are several LEDs for easy start into operation.
The green power LED D3 indicates the power supply of the board.
The red LED D7 is directly connected to the Open Collector output of the SQ-PCB.

In-Circuit Debug Interface

The Microchip ICSP (In-Circuit Serial Programming) interface allows the usage of own application software on the PIC18LF2523.

User Switches

There are four user switches (S1, S2, S3 and S4) to navigate in the display menu and to change SQ-PCB parameter.

Display menu and parameter setting

Display menu

The Evaluation Board is connected to the SQ-PCB via the SPI interface. Parameters can be changed with the buttons S1 to S4 and are shown in the LCD display.

S1 and S2 are for navigating in the display menu.

There are four main menus with several submenus.
- Menu 000: **Main Menu**
      Shows the current level in percent.
- Menu 100: **LevelParameter**
      Setting the low and high level of the tank.
- Menu 200: **Threshold**
      Setting the threshold and hysteresis
- Menu 300: **Damping/Response**
      Setting response time and damping of the SQ-PCB.
- Menu 400: **Eval Options**
      Setting options for signal evaluation
- Menu 500: **Transmit Power**
      Setting transmission power and measurement mode
- Menu 600: **Version**
      Shows the firmware version of the SQ-PCB

With S1 the user can navigate through the main menus. By pressing button S2 the user can select the submenus for changing parameters.

Menu 000:
No submenus.
Only current level value is shown.

Menu 100 LevelParameter:
Submenu 110: **Set LowLevel**
      Pressing button S3 or S4 for changing the low level.
      With button S1 the new low level (in percent and the corresponding time) is saved in the SQ-Level. Pressing S2 aborts the operation.
      See application example.
Submenu 120: **Set HighLevel**

Pressing button S3 or S4 for changing the high level.
With button S1 the new high level (in percent and the corresponding time) is saved in the SQ-PCB. Pressing S2 aborts the operation.
See application example.

Menu 200 Threshold:
Submenu 210: **Set Threshold**

Pressing button S3 or S4 for changing the threshold of the switching output.
With button S1 the threshold (in percent) is saved in the SQ-PCB. Pressing S2 aborts the operation.
See application example.

Submenu 220: **Set Hysteresis**

Pressing button S3 or S4 for changing the hysteresis of the switching output.
With button S1 the hysteresis of the threshold (in percent) is saved in the SQ-PCB. Pressing S2 aborts the operation.
See application example.

Menu 300 Damping/Response:
Submenu 310: **Set Damping**

Pressing button S3 or S4 for changing the damping (disable/soft/medium/strong) of the filling level.
With button S1 the damping is saved in the SQ-PCB. Pressing S2 aborts the operation.
For strongly sloshing surfaces a high damping is recommended.
See application example.

Submenu 320: **Set Response Time**

Pressing button S3 or S4 for changing the response time (slow/medium/fast) of the SQ-PCB.
With button S1 the response time is saved in the SQ-PCB. Pressing S2 aborts the operation.
Response time slow: 50s
Response time medium: 5s
Response time high: 0.5s
See application example.

Menu 400 Eval Options: (see SQ-PCB datasheet for details)

Should only be used if the SQ-PCB has problems to detect the correct level.
Submenu 410: **Set Tmin 1Echo**

Pressing button S3 or S4 for changing the time for 1-echo-analysis of the SQ-PCB.
With button S1 the time is saved in the SQ-PCB. Pressing S2 aborts the operation.

Submenu 420: **Set Tmin**

Pressing button S3 or S4 for changing the minimum measured time of the SQ-PCB.
With button S1 the minimum time is saved in the SQ-PCB. Pressing S2 aborts the operation.

Submenu 430: **Set Tmax**
> Pressing button S3 or S4 for changing the maximum measured time of the SQ-PCB.
> With button S1 the maximum time is saved in the SQ-PCB. Pressing S2 aborts the operation.

Submenu 440: **Set Tmax check**
> Pressing button S3 or S4 for changing the time for checking transmission power of the SQ-PCB.
> With button S1 the time is saved in the SQ-PCB. Pressing S2 aborts the operation.

Submenu 450: **Set Xmax check**
> Pressing button S3 or S4 for changing the checked transmission power of the SQ-PCB.
> With button S1 the changing the checked transmission power is saved in the SQ-PCB. Pressing S2 aborts the operation.

Submenu 460: **Set Xmin lowcomp**
> Pressing button S3 or S4 for changing the transmission power for using the low comparator level of the SQ-PCB.
> With button S1 the transmission power is saved in the SQ-PCB. Pressing S2 aborts the operation.
> The value ranges from 0 to 31, and also this option can be disabled.

Menu 500 Transmit Power: (see SQ-PCB datasheet for details)
Submenu 510: **Set Measure Mode**
> Pressing button S3 or S4 for changing the measurement mode of the SQ-PCB.
> With button S1 the measurement mode is saved in the SQ-PCB. Pressing S2 aborts the operation.
> The options are time measurement with static or automatic transmission power and the measurement of the ringing (with static transmission power).
> Ringing measurement with automatic transmission power is undefined and not selectable, but will be displayed (if it was previously set in the SQ-PCB).

Submenu 520: **Set Puls Length**
> Pressing button S3 or S4 for changing the transmission power of the SQ-PCB.
> With button S1 the transmission power is saved in the SQ-PCB. Pressing S2 aborts the operation.
> Will only be used if static transmission power is set.

Submenu 530: **Set Comp Level**
> Pressing button S3 or S4 for changing the comparator level of the SQ-PCB.
> With button S1 the comparator level is saved in the SQ-PCB. Pressing S2 aborts the operation.
> It is high and mid/low (depending on menu 460) selectable.
> Will only be used if static transmission power is set.

Example

1. Setting the low level:
   Fill the tank to the low level. **Be sure having a quiet level (no sloshing, no flow). A minimum level is necessary; a calibration with a completely empty tank is not possible.**
   Step to menu 110 *SetLowLevel* and set your low level (for example 15.0%).
2. Setting the high level:
   Fill the tank to the high level. **Be sure having a quiet level (no sloshing, no flow).**
   Step to menu 120 *SetHighLevel* and set your high level (for example 85.0%).
3. Setting the threshold:
   Step to menu 210 *SetThreshold* and set your threshold (for example 20.0%).
   Filling the tank to this level is not necessary.
4. Setting the hysteresis:
   Step to menu 220 *SetHysteresis* and set your hysteresis (for example 1.0%).
   Filling the tank to this level is not necessary.
5. Setting the damping:
   Step to menu 310 *SetDamping* and change to your damping the filling level.
6. Setting the Response Time:
   Step to menu 310 *SetResponseTime* and change to your response time of the SQ-PCB.

Ordering Information

Part Number	Description
SQ-Eval-Kit-A1	Evaluation Board with transducer in dry-coupling version
SQ-Eval-Kit-G1	Evaluation Board with transducer in glue-on version (UHU Endfest)
SQ-Eval-Kit-xxx	Evaluation Board with transducer in customized version

Revision History

Version	Date	Changes
1.0	13.06.2014	Initial release
1.1	19.01.2015	Description in Display Menu Ordering information
1.2	20.08.2015	Schematic revision, board layout revison
1.3	24.03.2016	Title
1.4	17.07.2017	Small changes
1.5	16.04.2018	PEWATRON-Logo added and IS-LINE Logo removed
1.6	18.04.2018	circuit diagram changed
1.7	17.07.2018	glue
1.8	13.08.2018	New firmware version of evaluation board

For any technical question please contact:
SonoQ GmbH

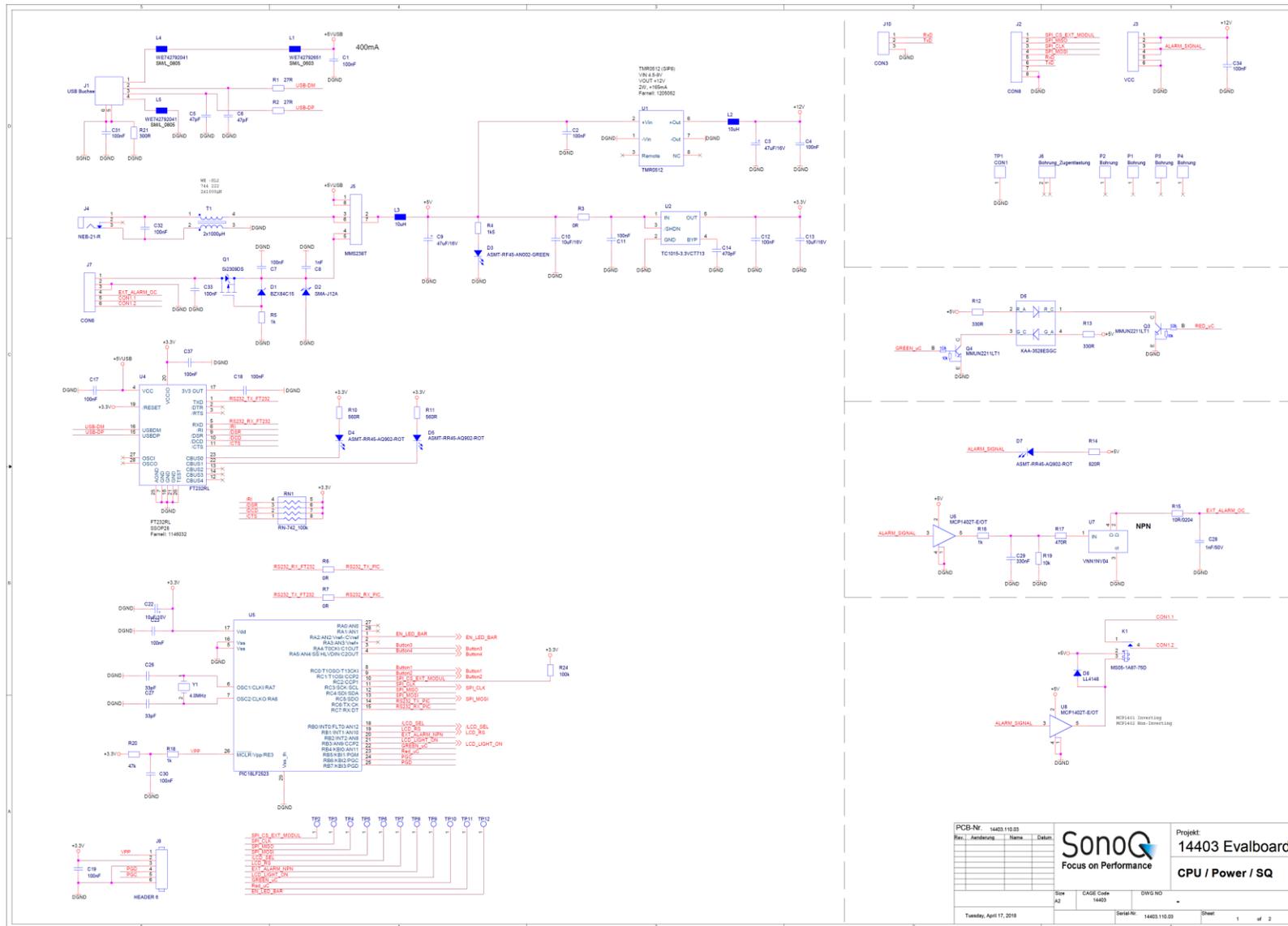Sophie-Krämer-Strasse 8, 66386 St. Ingbert/Germany
info@SonoQ.de, www.SonoQ.de,

For any commercial question please contact:
Pewatron Deutschland GmbH

Edisonstrasse 16, 85716 Unterschleissheim/Germany
info@pewatron.com, www.pewatron.com, +(49) 89 374 288 87-0

Appendix: circuit diagram

The information contained in this document is subject to changes without notice   Rev 1.8

SonoQ
Focus on Performance

PCB-Nr.	14403.110.03			Projekt:
Rev.	Aenderung	Name	Datum	**14403 Evalboard**

SonoQ
Focus on Performance

CPU / Power / SQ

Size	CAGE Code	DWG NO	
A2	14403	-	
Tuesday, April 17, 2018		Serial-Nr.	14403.110.03	Sheet 1 of 2