



SAWStation SST4

SAW Mixing Development Kit

USER GUIDE

© 2009 Beckman Coulter Biomedical GmbH. All Rights Reserved.

Advalytix SST4 User Guide.

This User Guide as well as the system described in it may be used or copied only in accordance with the terms of copyright. The content of this User Guide is intended for instructional use only and is subject to change without notice.

No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical or otherwise, without the prior written permission of Beckman Coulter Biomedical GmbH. Please remember that existing artwork or images from this guide that you may want to include in your project may be protected under copyright law. The unauthorised incorporation of such material into your new work could be a violation of the rights of the copyright owner. Please be sure to obtain any permission required from the copyright owner. Any references to any company names or peoples names in sample templates and screens are for demonstration purposes only and are not intended to refer to any actual organisation or names of persons.

Germany, Austria, Switzerland and Support contact:

Beckman Coulter Biomedical GmbH
Sauerbruchstraße 50
D-81377 Munich
Phone: +49-(0)89-579589-0
Fax: +49-(0)89-579589-3503
Email: sawmixing@beckman.com

For all other regions go to **www.advalytix.com** for your nearest distributor.

For research use only. Not for use in diagnostic procedures.

Table of Contents

01 Product Information	5
02 Installation	7
03 Extension Module XM-I0	9
04 Stand-alone Operation	11
05 Remote Operation	13
5.1 Overview	14
5.2 Direct Control	14
5.3 Sequence Control	15
06 Externally Triggered Sequences	17
07 Order Information	19



For your notes

User Guide

01 Product Information



- 01 Product Information**
- 02 Installation
- 03 Extension Module XM-10
- 04 Stand-alone Operation
- 05 Remote Operation
 - 5.1 Overview
 - 5.2 Direct Control
 - 5.3 Sequence Control
- 06 Externally Triggered Sequences
- 07 Order Information

01 Product Information



Figure 1: SAWStation SST4

The SAWStation (fig. 1) consists of an RF generator (Generator8) and an extension module containing a chip to generate surface acoustic waves (SAW) used for the micro-agitation of fluids.

The RF generator can be operated by front panel controls in stand-alone mode or programmed by a PC running the control software “G7Control” provided for more advanced operations such as time-dependent RF sequences.

The SAWStation is used to

- mix and homogenise liquids and particles in MTP wells, cuvettes, open droplets, flow chambers
- pump and dose reagents in lab-on-chip systems
- keep beads and cells suspended
- accelerate antigene/antibody reactions
- extract trace minerals in small volume soil samples.

02 Installation



- 01 Product Information
- 02 Installation**
- 03 Extension Module XM-10
- 04 Stand-alone Operation
- 05 Remote Operation
 - 5.1 Overview
 - 5.2 Direct Control
 - 5.3 Sequence Control
- 06 Externally Triggered Sequences
- 07 Order Information

02 Installation

1. Connect the coaxial cable to the XM10 extension module (fig. 2). Press firmly until the plug engages with a "Click".



Figure 2: XM-10 extension module

2. Connect the other end of the coaxial cable to the "RF out" plug of the Generator8 (fig. 3). Press firmly until the plug engages with a "Click".



Figure 3: XM10 connected to Generator8

3. Connect the Generator8 to the mains using the external power supply included (fig. 4).




Figure 4: Generator8 connections

4. Switch on the Generator8 using the power switch on the unit front (fig. 5). The status indicator LED lights up in green.



Figure 5: Generator8 front panel controls

Attention!



Do not use the RF generator with "open" output. Always connect the SAW chip module before switching on the generator.

Note

To disconnect the cable, pull back the housing of the connector as shown in figure 6.

NEVER pull the cable itself, since the connection is locked by a locking mechanism built into the connector. This lock is only released by pulling-back the outer connector housing.



Figure 6: Release of RF connector

03 Extension Module XM10



- 01 Product Information
- 02 Installation
- 03 Extension Module XM-10**
- 04 Stand-alone Operation
- 05 Remote Operation
 - 5.1 Overview
 - 5.2 Direct Control
 - 5.3 Sequence Control
- 06 Externally Triggered Sequences
- 07 Order Information

03 SAW micro-agitation Extension Module XM-10

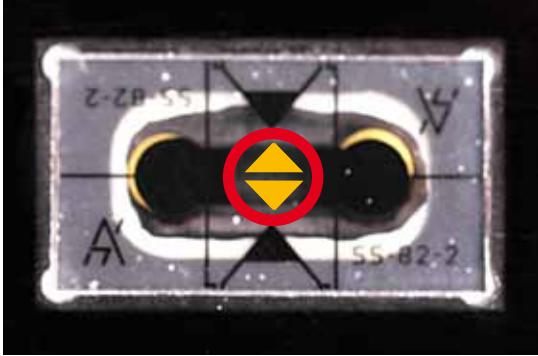


Figure 7: SAW chip (circle mas active area, arrows indicate path of sound)

The Chip module generates surface acoustic waves on the area marked in figure 7 (location of the interdigital transducer, IDT). When conducting your experiments make sure to position your sample over the IDT or in the sound path.

You can either place your sample directly on the chip (fig. 8) or agitate reagents on glass microscope slides or in cuvettes and small vials. In this case a coupling liquid is needed between the SAW-chip and the container/substrate (fig. 9).

Water is a suitable coupling medium, however, for best results we recommend using the AdvaSon coupling liquid provided with the SAWStation. Pipette a droplet of 50 μ L AdvaSon onto the IDT before placing the substrate on the SAW chip. This way a thin liquid film will form conducting the sound wave from the chip into the substrate.



Figure 8: Sample placing directly on the chip

Recommended default settings:

center frequency: 82 MHz

Level: 27 dBm

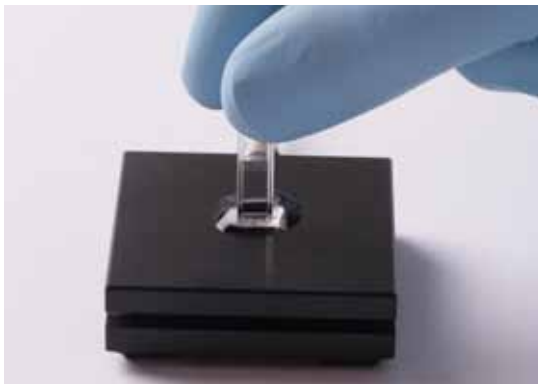


Figure 9: Using a coupling liquid

Attention!



Do not touch the chip when the unit is in operation. High power SAW may cause tissue damage and chip may become hot during extended operation at high power levels.

04 Stand-alone Operation



- 01 Product Information
- 02 Installation
- 03 Extension Module XM-10
- 04 Stand-alone Operation**
- 05 Remote Operation
 - 5.1 Overview
 - 5.2 Direct Control
 - 5.3 Sequence Control
- 06 Externally Triggered Sequences
- 07 Order Information

04 Stand-alone Operation

The basic functions of the SAWStation SST4 can be operated from the front panel (fig. 10):

Frequency

Adjust the frequency at the encoder labelled "Freq. [MHz]" to the operating frequency of your extension module. The operating frequency is noted on the label at the bottom side of the module.

Note that the permitted frequency range of the generator covers 58 MHz to 85 MHz.

Power

Adjust the desired power level at the encoder labelled "Pwr.[dBm]". The available power level range covers 6 dBm to 35 dBm. Increasing the power level by 3 dBm doubles the RF output power of the generator. The maximum level of 35 dBm corresponds to 3.2 Watts output power.

On/Off

The "RF on/off" button is for activating and deactivating the RF output. It is also used to stop the SAWStation if a pulse/pause protocol is running, which has been started by an external trigger signal.

Please note that no front panel controls are active, when the device is under remote control by a PC connected to the USB port.

The meaning of the indicator LEDs are described in tables 1-3.

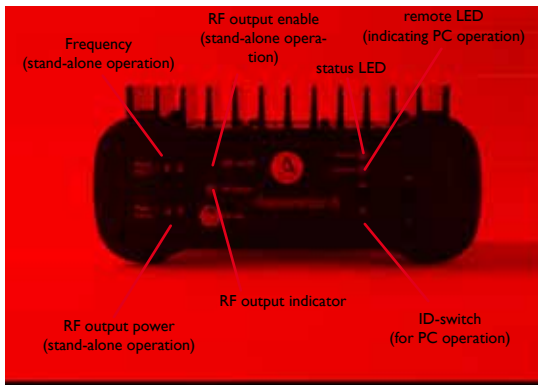


Figure 10: Front panel

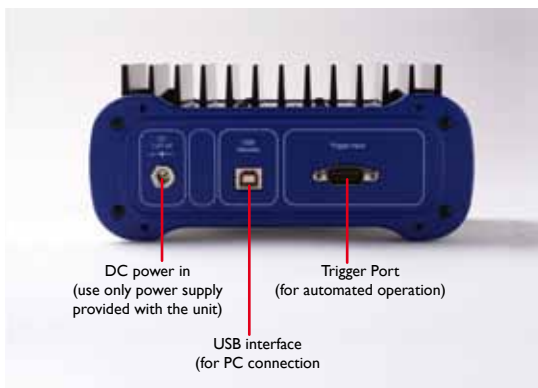


Figure 11: Backpanel

Table 1: Status indicator LED

colour	meaning
red	remote control, front panel inactive
green	idle
yellow	predefined mixing protocol active (triggered by hardware trigger lines)
flashing red	hardware failure (contact Advalytix support)


Table 2: RF active indicator LED

colour	meaning
off	idle
red	RF active
yellow (3 flashes)	front panel encoder values (freq., power) outside the permitted range
flashing red	RF output stage protection circuit triggered

Table 3: Remote indicator LED

colour	meaning
flashing blue	commands received from PC

Attention!



Do not use the RF generator with "open" output. Always connect the SAW chip module before switching on the generator.

05 Remote Operation

- 5.1 Overview
- 5.2 Direct Control
- 5.3 Sequence Control



- 01 Product Information
- 02 Installation
- 03 Extension Module XM-10
- 04 Stand-alone Operation
- 05 Remote Operation**
 - 5.1 Overview**
 - 5.2 Direct Control**
 - 5.3 Sequence Control**
- 06 Externally Triggered Sequences
- 07 Order Information

05 Remote Operation

5.1 Overview

The Generator8 can be operated by a PC running the G7Control software. The PC communicates with the generator via USB (fig. 12). The Generator8 USB interface supports version 1.1 and 2.0. Up to 9 Generator8 units can be controlled simultaneously. Please make sure to assign each Generator8 a unique ID by adjusting the ID-switch accordingly (fig. 10).

G7Control is provided for more advanced operations such as time-dependent RF sequences. Two operating modes are provided. In Direct Control mode, the user sets the operating parameters of the generator such as frequency, power and pulse/pause modulation to optimise the performance of a given experimental setup. In Sequence Control mode, up to eight RF output sequences can be defined in a run. The sequences are stored in the non-volatile memory of the generator unit. This allows to operate the Generator8 in stand-alone mode where a sequence is triggered by logic signals applied to the trigger inputs at the back of the unit.



Figure 12 : USB interface on the rear of the unit

5.2 Direct Control

The most important parameter to set for your SAW system is the center frequency (fig. 13). Make sure the frequency setting matches the resonance frequency of the SAW chip marked on the module connected to the RF generator. Enter the value into the frequency box.

If “fix” is selected in the row of “sweep span”-buttons the RF generator will only operate at the selected center frequency. This is the frequency of most efficient SAW generation, however, the resulting micro-agitation may not be optimal since interference effects may partially cancel out the waves at specific frequencies in a given system.

In general, it is therefore recommended to apply a frequency sweep to cover a wider range of SAW frequencies. A setting of 1 MHz is a good starting point for experiments. The generator will change the frequency in steps of 0.5 MHz every second covering the band of up to +/- 5 MHz around the selected center frequency.

Use the “level” box to set the amplitude of the SAW. The scale is based on the logarithmic dBm unit. Therefore, increasing or decreasing the value by 3 units will double or half the applied SAW power. Possible values are 6 to 35 dBm.

On-off-modulation of the SAW or varying the amplitude are alternative methods to control the mean amount of SAW energy. However, in some setups (e.g., viscous media) agitating at high power in short pulses can be more effective than using a constant SAW-field at low power. Also thermal heating due to sound absorption is different in both modes. Some biochemical systems may also need a “rest time” during the agitation cycle to yield optimum results.

The control software provides a set of radio-buttons to modulate

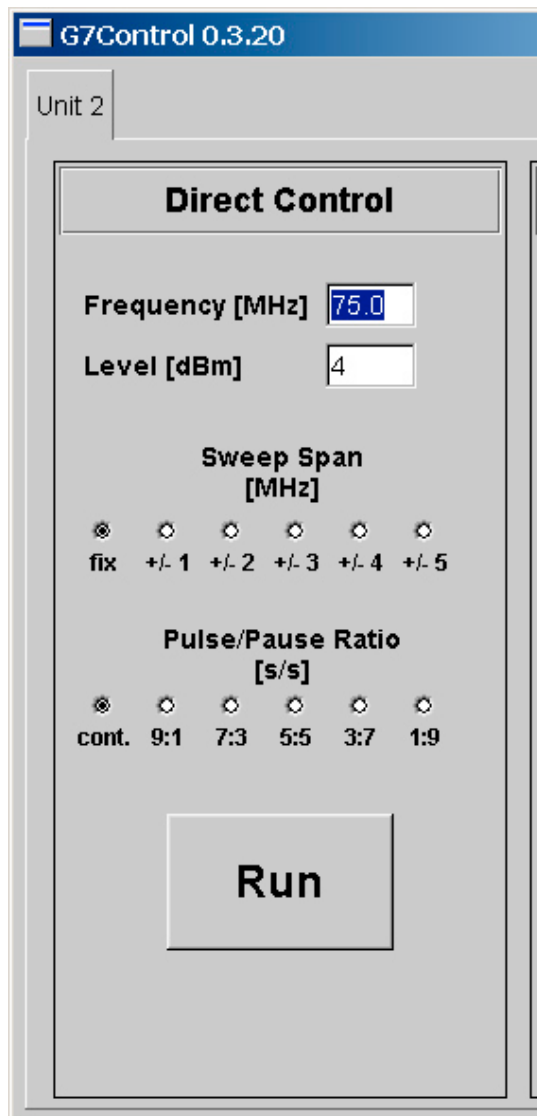


Figure 13: Control software user interface

the RF output. The “cont.” setting applies the RF continuously. The other buttons are labeled according to on- and off-times in seconds, so a setting of 3:7 will apply RF for three seconds followed by a pause of seven seconds.

Note: If frequency sweep is selected the sweep will be suspended during off-time and resumed at the next scheduled frequency when the RF is switched on again.

After selecting the desired parameters use the “run” button to switch the RF output on or off.

5.3 Sequence Control

The Generator8 stores up to 8 user defined RF output sequences. Each sequence consists of up to 10 steps. To define a sequence press the corresponding „Edit“ button in the „Sequence Control“ section of the PC user interface (fig. 14). The sequence editor will be displayed as shown in figure 15.

For each step of your sequence you have to define four parameters:

Frequency [MHz]: This is the start or base frequency. A frequency sweep will use this as the lower frequency limit of the sweep. If set to zero, in this step RF will remain switched off, however, the step will be executed according to the parameters “# Frequencies” and dwell time.

Increment [MHz]: In a frequency sweep definition this parameter defines the frequency increment. If the parameter is set to zero, the generator only outputs the base frequency.

Frequencies: This parameter defines the number of frequencies. In a frequency sweep, the generator starts at “Frequency [MHz]” incrementing by “Increment [MHz]” for “# Frequencies” - 1 times. If “# Frequencies” is set to one, the generator only outputs the base frequency, if set to zero the whole sequence step will be skipped.

Level [dBm]: This parameter defines the RF output power for the particular step of the sequence in question.

Loops: This parameter defines the number of subsequent executions of the complete sequence, i.e. all 10 steps. If it is set to zero, the sequence does not execute at all disregarding the single step settings. The maximum value for “Loops” is 250.

Dwell [s]: The dwell time in units of seconds defines the time, each frequency in every step of the sequence is held. The permitted range for “Dwell [s]” is 0.01 to 2.5.

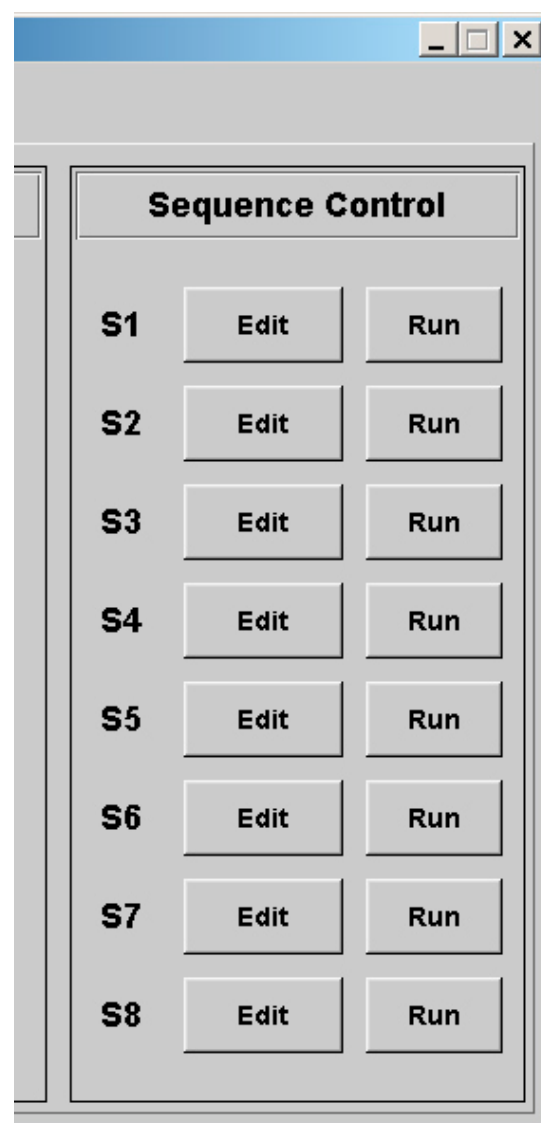


Figure 14: Control software user interface

When you have defined all sequence steps, load the sequence to the non-volatile memory of the Generator8 by pressing the „Program“ button. Stored sequences can be read back by pressing the „Read Out“ button.

In addition, you have the possibility to store a sequence on your PC's hard disk for later use („Save“ and „Load“).

Programming hints:

The generator cannot output frequencies lower than 58 MHz or higher than 85 MHz. Please take care that the final frequency of a sweep does not exceed the upper range limit. For programming pause phases of defined duration just set “Frequency [MHz]” to zero. This will suspend RF output. The duration of this step then can be adjusted by appropriate values for “# Frequencies” and “Dwell [s]”.

Example

The sequence according to figure 15 reads like this:

Sequence of 3 steps, executed 10 times. Dwell time for each frequency 0.01 s. First step running from 65 MHz to 69.9 MHz with 0.1 MHz increment and 1 dBm output level. Duration of the first step is 0.5 s. Second step running from 75 MHz to 79.9 MHz with 0.1 MHz increment and 2 dBm output level. Duration of the second step is 0.5 s. The third step is not permitted, since the end frequency of the sweep will be 89.9 MHz overstepping the upper frequency range limit of the generator. Omitting the third step, the total sequence will run for 10 s. The example does not contain a pulse/pause scheme, but will continuously output RF energy.

Running a sequence

To run a sequence press the corresponding „Run“ button in G7Control (fig. 14). Alternatively, a sequence can also be triggered by an external trigger signal. External triggers are described in detail in section 6.

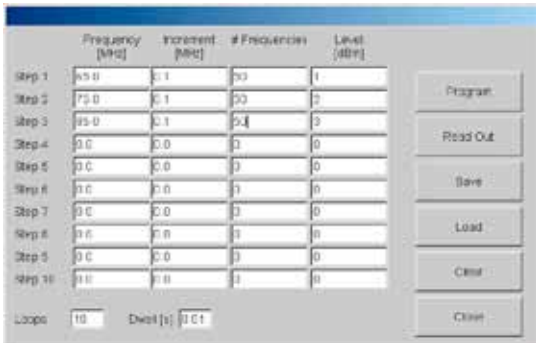


Figure 15: Control software user interface

06 Externally Triggered Sequences



- 01 Product Information
- 02 Installation
- 03 Extension Module XM-10
- 04 Stand-alone Operation
- 05 Remote Operation
 - 5.1 Overview
 - 5.2 Direct Control
 - 5.3 Sequence Control
- 06 Externally Triggered Sequences**
- 07 Order Information

06 Externally Triggered Sequences

The SAWStation can execute up to eight pre-defined output RF output sequences without a PC connected. Editing and loading such sequences is described in section 5.3.

The execution of a stored protocol can be initiated by external trigger signals provided to the SubD9 connector Pins according to table 4.

The trigger lines are at high level (5V) by default. Pulling down a trigger pin to GND (pin 5) starts the associated protocol. A trigger pulse must be longer than 10 ms and must not exceed the length of the triggered protocol. While a trigger line is pulled low, no additional level change on any of the other trigger lines must occur. If two or more trigger lines are pulled low simultaneously, only the associated protocol of lowest order number will be started. Subsequently, the pins must be released also simultaneously. Triggering a protocol while another one is under execution will abort the current execution in favour of the new trigger request. You also can abort a current execution of a protocol manually by pressing the RF on/off button on the front panel for at least one second.

Pin 6 provides a feedback line to the external triggering hardware indicating the current execution of a protocol. While a protocol is running, the line shows low level. When the SAWStation is idle, pin 6 shows high level. This signal may be used as a control signal for automation environments.

Note that the “protocol running indicator” is also active, if a protocol is initiated by a PC connected to USB.

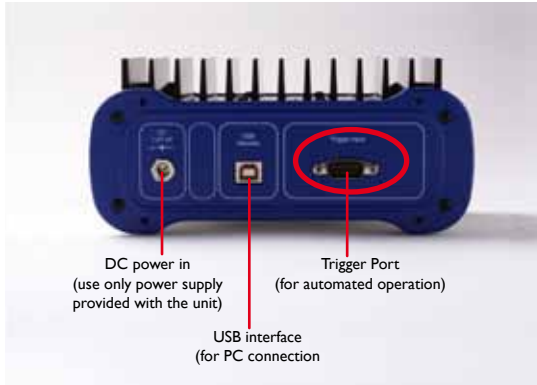


Figure 16: External trigger port

Table 4: Pin description of the trigger port

pin	use
1	trigger protocol 1
2	trigger protocol 7
3	trigger protocol 5
4	trigger protocol 3
5	GND
6	busy indicator (active: low)
7	trigger protocol 6
8	trigger protocol 4
9	trigger protocol 2

07 Order Information



- 01 Product Information
- 02 Installation
- 03 Extension Module XM-10
- 04 Stand-alone Operation
- 05 Remote Operation
 - 5.1 Overview
 - 5.2 Direct Control
 - 5.3 Sequence Control
- 06 Externally Triggered Sequences
- 07 Order Information**

07 Order Information

Table 5: Order Information

Ref.-No	Description
OAX06151	SAWStation SST4 (Generator8 with Extension Module XM10)
OAX06251	Generator8
OAX06252	XM10 Extension Module with 82 MHz BAW-Chip
OAX06253	XM10 Extension Module with 124 MHz BAW-Chip
OAX06254	XM10 Extension Module with 124 MHz SAW-Chip
OAX06301	Power supply for Generator8
OAX06302	RF-cable elongation, 1m, male-male , with RF coupler female-female
OAX05209	AdvaSon AS100: coupling liquid (10mL)

Document History

Version	Date	Remarks
1.0	01.11.2005	Creation of document
2.0	21.11.2006	Modification
3.0	14.03.2007	CI layout Olympus
3.1	31.07.2009	Change of Logo
1.0	11.10.2010	Layout Change Beckman Coulter

