



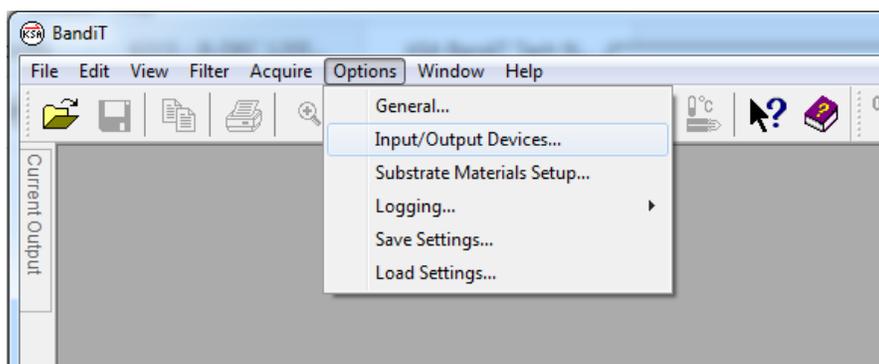
# kSA Tech Note – kSA BandiT Analog Output Configuration



## How to configure kSA BandiT analog outputs

The kSA BandiT system supports various data acquisition boards for real-time analog output. It allows for custom configuration of these boards for a particular process control and/or data logging application, including mapping the output channel(s) to a suitable voltage range. This tech note describes the steps required to configure kSA BandiT for such an application. For more information see the kSA BandiT user manual.

1. From the **Options** menu, select **Input/Output Devices...**





# kSA Tech Note – kSA BandiT Analog Output Mapping

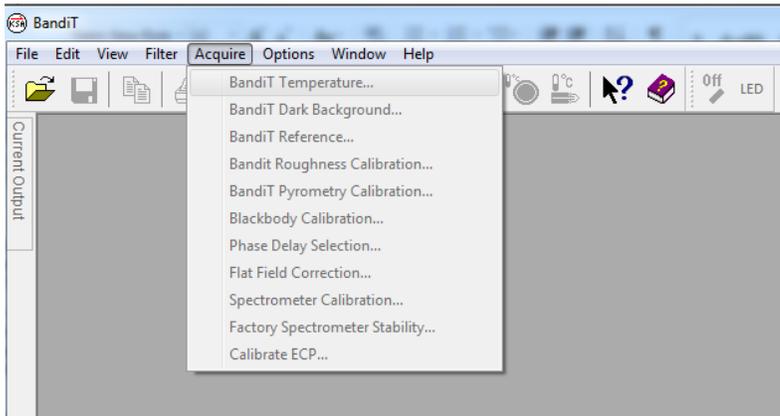
- In the **Input/Output Device Options** dialog, select the **Analog Output Board** tab. From the drop-down menu, select the model of the board present in the system in question. Most systems use the **ACCESS IO USB-AIO12-16E 0-5V** board which is referenced in this example. For each of the desired output channels, verify that the **Voltage range** is set properly (0-5V in this case). Also verify that the proper **Control channel** is selected. Channel 0 is most commonly used, as it is wired to the BNC connector on the back of the kSA BandiT rack.

Board channel	Voltage range	Control channel	Board channel	Voltage range	Control channel
0	0 to +5	Ch. 0	8		Ch. 8
1	0 to +5	Ch. 1	9		Ch. 9
2		Ch. 2	10		Ch. 10
3		Ch. 3	11		Ch. 11
4		Ch. 4	12		Ch. 12
5		Ch. 5	13		Ch. 13
6		Ch. 6	14		Ch. 14
7		Ch. 7	15		Ch. 15

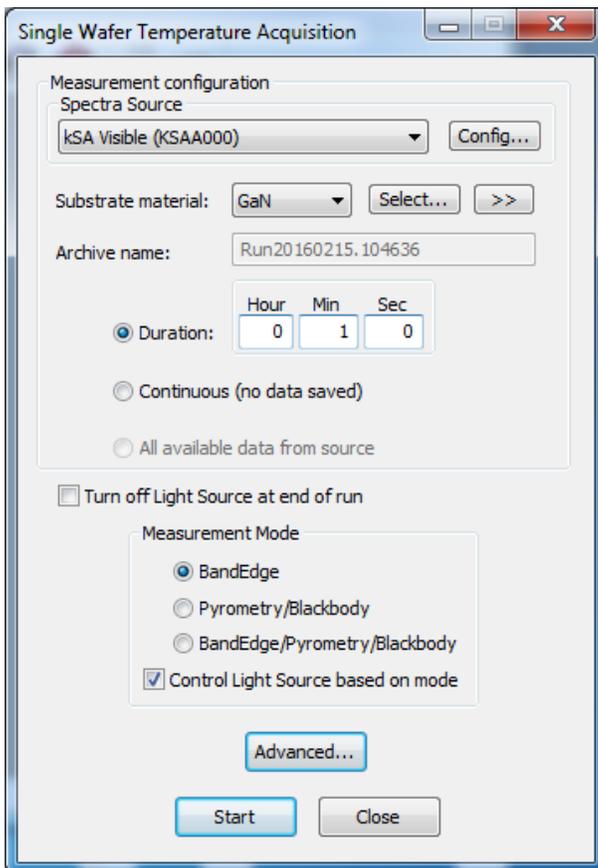


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3. Select **OK** to close this dialog.
4. From the **Acquire** menu, select **BandiT Temperature...**



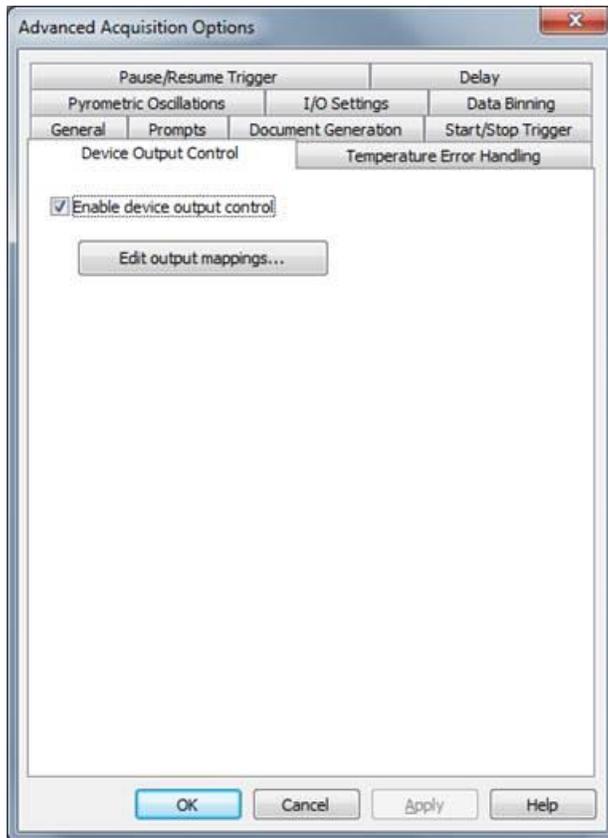
5. In the **BandiT Temperature Acquisition** dialog, select the **Advanced...** button.





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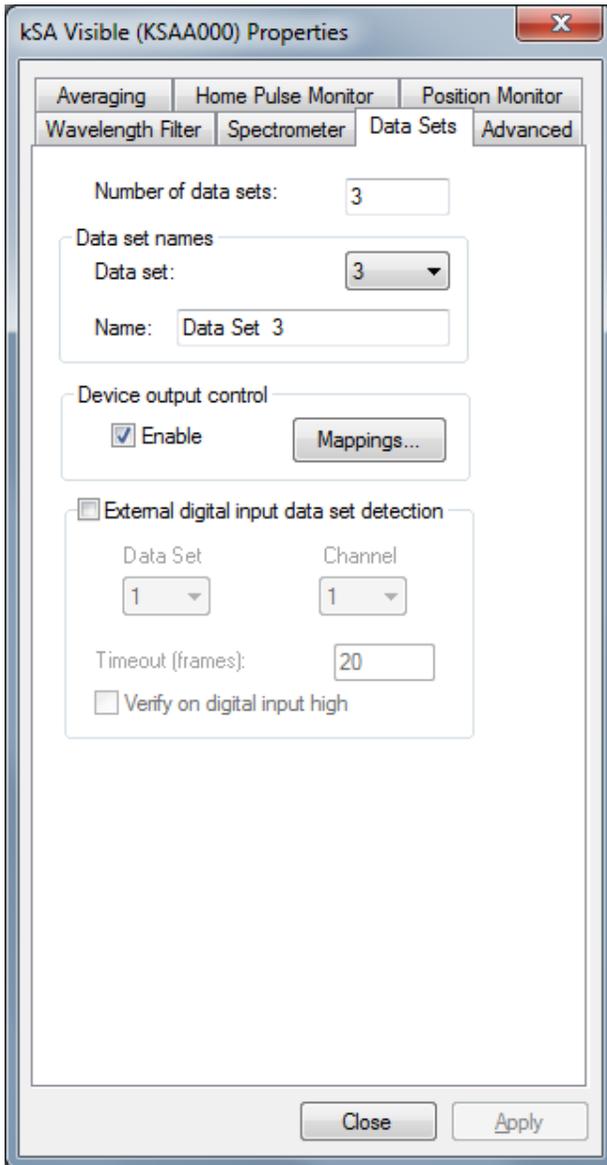
6. In the **Advanced Acquisition Options** dialog, select the **Device Output Control** tab. Select the **Enable device output control** checkbox. Then select the **Edit output mappings...** button.





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Note that in kSA BandiT Multi-Wafer, this is located in the **Data Sets** tab found in the spectrometer settings dialog, which is accessed by right-clicking on the live spectrometer window and selecting **Properties...**





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7. In the **Device Output Control Mappings** dialog, enter the following settings for each of the desired output channels:

Output Device	Control channel	Parameter	Rect / line #	Parameter range		Voltage output		Boxcar smooth	Set to Min at End
				Low	High	Low	High		
Analog Output Cont	Ch. 0	Band Edge Temperature	0	500	1000	0	5	1	<input checked="" type="checkbox"/>
[None]		[None]	0	0	0	0	0	1	<input type="checkbox"/>
[None]		[None]	0	0	0	0	0	1	<input type="checkbox"/>
[None]		[None]	0	0	0	0	0	1	<input type="checkbox"/>
[None]		[None]	0	0	0	0	0	1	<input type="checkbox"/>
[None]		[None]	0	0	0	0	0	1	<input type="checkbox"/>
[None]		[None]	0	0	0	0	0	1	<input type="checkbox"/>
[None]		[None]	0	0	0	0	0	1	<input type="checkbox"/>

- Select the desired output **Parameter** from the drop-down menu. Note that one can select from a variety of different parameters.
- Enter the desired **Parameter range** and **Voltage output** range.
- The **Boxcar smooth** dropdown box allows for smoothing of the output using a moving average, a.k.a. boxcar. A setting of  $N$  results in each data point being averaged with the  $(N-1)/2$  neighboring data points on either side. Note that  $N$  must be odd. The default value is 1, i.e. no smoothing.
- The **Set to Min at End** checkbox will force the output to go to the minimum value (0V in this example) at the end of the acquisition.
- Note that the data set selection applies only to kSA BandiT Multi-Wafer, in which each marker is assigned a separate data set. In that case, only information corresponding to the specified marker(s) is output. For more information see the kSA BandiT user manual.

8. Select **OK** to close this and the **Advanced Acquisition Options** dialog.

9. Note that there may be times when it is advantageous to adjust the output mapping to achieve greater resolution.



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- For example, consider the case in which the kSA BandiT output (typically 0-5V w/16 bits) is connected to a typical 12 bit ADC with a fixed 0-10V input range. In this case, the smallest voltage step that could be resolved by the ADC is  $10\text{V}/4096 = 2.44 \text{ mV}$ . If one were to simply map a temperature in the 0-1000°C range to kSA BandiT's 0-5V output, the scaling factor would be  $5 \text{ mV}/^\circ\text{C}$ . Given the ADC's resolution of  $2.44\text{mV}$ , the smallest temperature step that could be resolved is  $2.44\text{mV} / (5\text{mV}/^\circ\text{C}) = 0.49^\circ\text{C}$ .
- If instead, one were to adjust the mapping such that 500-1000°C corresponds to the 0-5V output, the scaling factor would now be  $10 \text{ mV}/^\circ\text{C}$ , and the smallest temperature step that could be resolved would be  $2.44\text{mV} / (10\text{mV}/^\circ\text{C}) = 0.24^\circ\text{C}$ . Thus a greater resolution could be achieved in exchange for a reduced range. This is often a good trade-off, as most users are only concerned about a relatively small range around the process temperature.
- Note that one should always verify that the ADC to which kSA BandiT is connected is set for the correct voltage to temperature mapping. In the example above, the 0-10V ADC input would correspond to 500-1500°C. Of course, the BandiT output would never go above 5V with the board used in this example.
- Also note that if a higher maximum temperature is desired, one could simply shift the mapping, say to 750-1250°C, for example.

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kSA BandiT Analog Output Mapping Tech Note 1/20/2016

## About k-Space Associates, Inc.

k-Space Associates, Inc., is a leading metrology supplier to the semiconductor, surface science, and thin-film technology industries. Since 1992, we've delivered the most advanced thin-film characterization tools and software, thanks to close collaboration with our worldwide customer base. We realize the best products are developed with our customers' input, so we're good listeners. For your real-time surface analysis, curvature/stress, temperature, deposition rate, or custom project, we look forward to helping you with your thin-film characterization needs.