### 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...** 





2. 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.

Inp	out/Output E	Device Options				×					
	Environ	mental Alarm	Chamber	Control	Detector M	otion Hardware					
	Temperature	Control Hardware	Rotation Monito	r Reflectivi	ity Light Control Boa	ard MultiAxis Stage					
	Spectrometer	s Analog Input Bo	ard Analog Out	put Board	Digital Input Board	Digital Output Board					
	Board settings Model: ACCESS IO USB-AIO 12-16E 0-5V										
		(1 ·									
	Base add	ress (decimal):	0								
	Board nur	mber:	0 Calibrate								
	Channel mappings										
	Board channel	Voltage range	Control channel	Board channel	Voltage range	Control channel					
	0	0 to +5 🔹	Ch. 0 🔻	8 [	T	Ch. 8 👻					
	1	0 to +5 🔹	Ch. 1 🔻	9 [	Ŧ	Ch. 9 👻					
	2	-	Ch. 2 👻	] 10 [	-	Ch. 10 👻					
	3	<b></b>	Ch. 3 🔹	] 11 [	-	Ch. 11 👻					
	4	-	Ch. 4 🔻	] 12 [	-	Ch. 12 👻					
	5		Ch. 5 👻	] 13 [	Ŧ	Ch. 13 🔻					
	6		Ch. 6 🔻	] 14 [	Ŧ	Ch. 14 🔻					
	7	-	Ch. 7 👻	] 15 [	-	Ch. 15 👻					
OK Cancel Apply Help											



- 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.

Single Wafer Temperature Acquisition							
Measurement configuration Spectra Source							
kSA Visible (KSAA000)   Config							
Substrate material: GaN    Select >>							
Archive name: Run20160215.104636							
Duration:     Hour Min Sec     1     0							
Continuous (no data saved)							
All available data from source							
Turn off Light Source at end of run							
Measurement Mode							
BandEdge							
Pyrometry/Blackbody							
BandEdge/Pyrometry/Blackbody							
Control Light Source based on mode							
Advanced							
Start Close							



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.

	ause/Resume T		Delay				
Pyromet	ric Oscillations		I/O Settings	Data Binning			
General	Prompts	Docun	nent Generation	Start/Stop Trigge			
Device	Output Contro	4	Temperat.	re Error Handling			
Enable (	device output c	ontrol					
E	dit output map;	oings					



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...** 

kSA Visible (KSAA000) Properties
Averaging Home Pulse Monitor Position Monitor
Wavelength Filter Spectrometer Data Sets Advanced
Number of data sets: 3
Data set names
Data set: 3
Name: Data Set 3
Device output control
Enable     Mappings
External digital input data set detection
Data Set Channel
Timeout (frames): 20
Verify on digital input high
Close Apply



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

vice Output Control Mappings										
Show mappings for data	how mappings for data Data Set 1									
Output Device	Control channel	Parameter		Rect / line #	Parameter range Low High		Voltage output Low High		Boxcar smooth	Set to Min at End
Analog Output Cont 💌	Ch. 0 🔻	Band Edge Temperature	•	0	500	1000	0	5	1 -	
[None]	-	[None]	-	0	0	0	0	0	1 -	
[None]	-	[None]	-	0	0	0	0	0	1 -	
[None]	-	[None]	-	0	0	0	0	0	1 -	
[None]	-	[None]	-	0	0	0	0	0	1 -	
[None]	-	[None]	-	0	0	0	0	0	1 -	
[None]	-	[None]	-	0	0	0	0	0	1 -	
[None]	-	[None]	-	0	0	0	0	0	1 -	
								0		Cancel

- 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 (OV 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.



- 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 10V/4096 = 2.44 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 mV/°C. Given the ADC's resolution of 2.44mV, the smallest temperature step that could be resolved is 2.44mV / (5mV/°C) = 0.49°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 mV/°C, and the smallest temperature step that could be resolved would be 2.44mV / (10mV/°C) = 0.24°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.

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

#### About k-Space Associates, Inc.

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