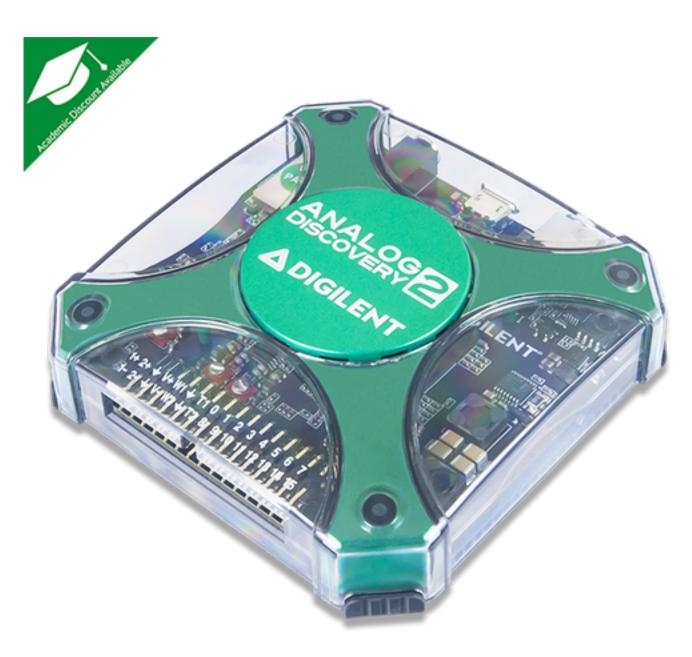
Applied Statistics

Project Preparation — Ball on an incline —

Software installation

- For the project you will be using **Analog Discovery 2** instrument
 - Easily connected to your laptop via standard USB cable (not USB-C)
- Communication between the instrument and your laptop is provided via dedicated **WaveForms** software
 - You need to have it installed in your laptop **BEFORE** the lab starts
 - Available for Windows, Mac OS & Linux (dep, rpm)
 - Download it here : https://reference.digilentinc.com/reference/software/waveforms/waveforms-3/start
 - Easy and straightforward installation (you do not need any special drivers/additional tools)
- Experiment setup of the incline will be prepared for you connected to the instrument
 - No need to worry about this part





Step-by-step preparation

(illustrated on MacOS)



- Launch WaveForms. It should complain that it does not detect any device. Click No
- In the lab, you will plug USB cable first

000		₩ WaveForms (new workspa	
		Welcome 🕂	Help	
Scope	Open Workspace			To create custom application see the <u>SDK</u> . For more information visit <u>www.digilentinc.com/waveforms</u> . Observations are welcome on <u>this forum page</u> or <u>via email</u> .
Wavegen	Recent:			
⊢⊢ Supplies	incline_test /Users/vpaci	k/Desktop/incline_test.	<u>dwf3work</u>	
Logger				
		No device detecte Digilent FTDI Drive		
Patterns		Start driver install	(* ***	lo Yes
StaticlO				
Spectrum				
Network				
Protocol				
{JS} Script	P New 🔚 Save	e 🔏 Save As		DIGILENT °
	Open last workspace	on start		A National Instruments Company
Manual Trigger				Not connected ! Status: NC

Applied Statistics | Project preparation : Ball on an incline

Launch WaveForms





Select Discovery2 DEMO and click Select

		W	WaveForms (new wo	rkspace)		
			😽 Device Manag	ler		-
Scope	Calibrate	🔍 Rename 🛛 🙆 N	Ay device is not listed			ie <u>SDK</u> . <u>lentinc.com/waveforms</u> . <u>orum page</u> or <u>via email</u> .
	Nam	ie	Serial Number		Status	
Wavegen	Discovery2	D	DEMO			
* Supplies	Discovery	C	DEMO			
	EExplorer	C	DEMO			
Voltmeter	DDiscovery	C	DEMO			
	Sound Card					
Logger			•			
	Scope	Wavege		Patterns	Others	
	1 2 x 8 k	4 x 4 k	16 x 4 k	16 x 1 k	DEMO Discov	
StaticIO						
Spectrum						
				Car	ncel Select	
Network				Car	ncel Select	
				Car	ncel Select	
Network				Car	ncel Select	
Network	New In Copen last works		Save As	Car	DIGILEN A National Instruments Comp	

Applied Statistics | Project preparation : Ball on an incline

Select (DEMO) device



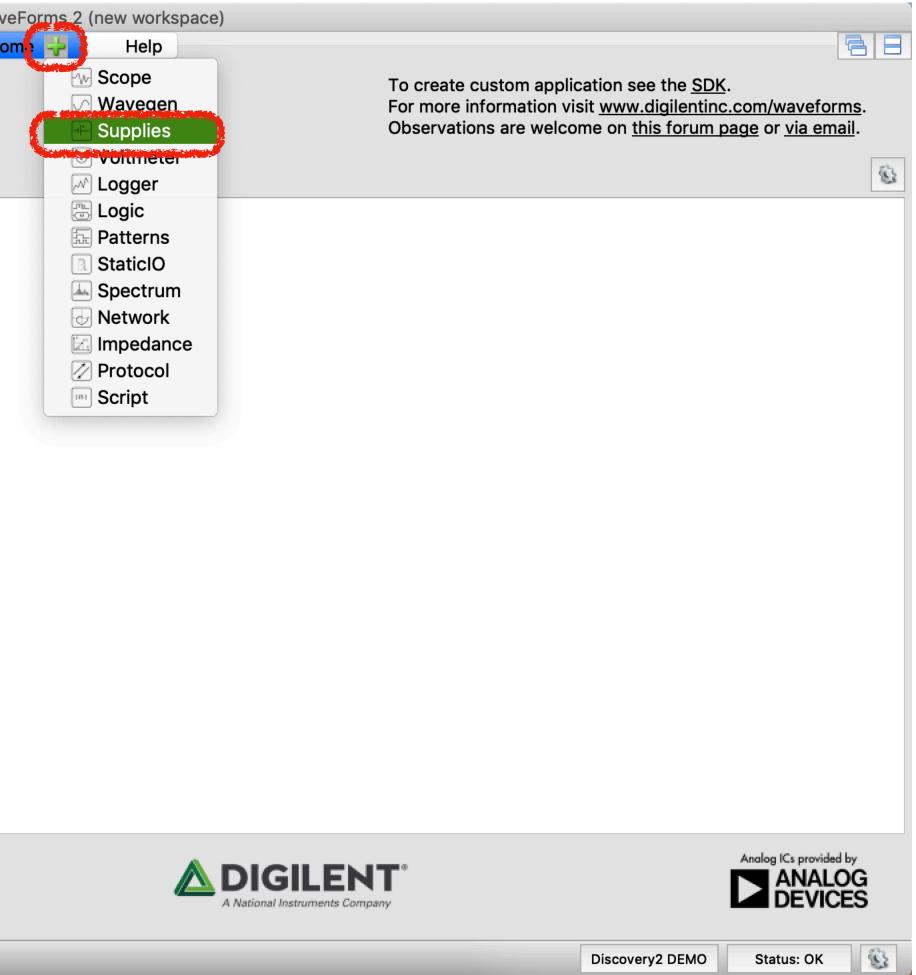


Click green plus and select **Supplies**

	₩ Wa Welc
Scope	Open Workspace
Wavegen	Recent:
⊣ ⁺ Supplies	incline_test /Users/vpacik/Desktop/incline_test.dwf3work
Logger	
Patterns	
StaticIO	
Spectrum	
Network	
Protocol	
{J5} Script	 New Save Save As Open last workspace on start
Manual Trigger	

Applied Statistics | Project preparation : Ball on an incline

Add power supplies





Power supply

- Set Positive Supply (V+) Voltage to 5V
- By clicking on Master Enable is OFF you turn-on power supply for the instrument 0

		Welcome
ile Control	window	
		Positive Supp
		Negative Sup
		USB powered, allowir

₩ WaveForms 2 (new workspace) Help ⊗ Supplies			68
Master Enable is Off			
ply (V+) Rdy	Voltage	5 V	
oply (V-) Rdy	Voltage:	-1 V	~
ng up to 500 mW total or 700 mA output per channel.			
	Discovery2 DEMO	Status: OK	6





Now add Scope by clicking on green plus again

Welcom	
	Window
Positive Su	
Negative S	
USB powered, allo	

Add scope

	WaveForms 2 (pow Help X	v workspace) Stipplies				88
ıbt	 Wavegen Supplies Voltmeter Logger Logic Patterns 	s Off		Voltage:	5 V	
up	 StaticlO Spectrum Network 	or 700 mA output por channel		Voltage:	-1 V	~
wir	Impedance Protocol Script	or 700 mA output per channel.				
			Dis	scovery2 DEMO	Status: OK	8



- Oscilloscope display will appear
- Tick-off Channel 2
- Select trigger mode Record

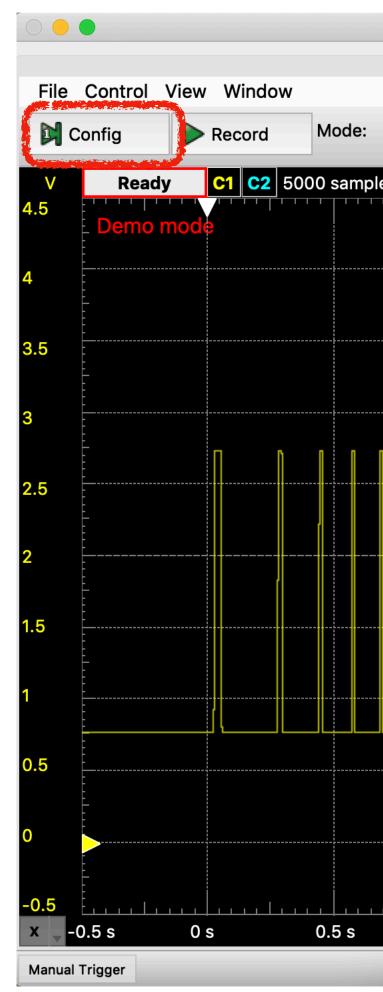


Setup for oscilloscope



Configure your measurement

- Click on Config and set the the values according to picture 0
- Do not forget tick-off Noise and tick-on Draw while recording
- Set Level to 2 V
- Adjust Time and Channel 1



		voEorme 2	(new werkspace	elen and and a second				
Welcome								
	Samples:	25k						
Record 🗘 Aut	Rate:	5 kHz			F Rising	Level: 2	2 V	~
es at 1 kHz 2018-11-02 10:56	Base:	5 s			•	🔺 🗄 🗄 😵 🛛		
	Trigger:	10 %					🗹 Time	
	nigger.	10 /0					Position:	2 s
	Noise						Base:	5 s
		while recor	ding				Average:	None
	Not reco	mmended a	at high sample r	ate.			Overs.:	Off
							Samples:	25k
		Can	cel 🕑 St	art			Rate:	5 kHz
							L.	î
							Ada	d Channel
							Channel	internation and the series
							Offset:	-2 V
							Range:	500 mV/div
							Channel	Z
						<u></u>		
	2 s	2.5	s 3 s	3.5		4.5 s		
1 s 1.5 s	25	2.5	5 35	3.8	5s 4s		coverv2 DEMO	Status: OK





Now you are ready to measure !

By clicking on Record, you will start measuring (in the lab) which will lasts for 5 seconds (a single run)

	•				14		Forms 2 (new wo					6	
File	Control	View Window			V	/elcome 🕂	Help 🛛 😣 S	cope 1 🕨 📄				Ľ	
	Config	Record		Record	O Auto	Source:	Channel 1	Condition:	F Rising	Cevel: 2 V	~	₽	
V	Ready	C1 C2 5	000 samples at	1 kHz 2018-1	1-02 10:56:34.4	24				2 🛓 🗠 🖉	γ ⇒		
4.5	Demo r	node									🗹 Time		8
4	-										Position:	2 s	
4											Base:	5 s	
3.5	- - -										Average:	None	~
0.0											Overs.:	Off	~
3	- - -										Samples:	5k	
		n 1									Rate:	1 kHz	
2.5						 						î	
											Ade	d Channel	~
2	- - - -					 					🗹 Channe	11	8
										_	Offset:	-2 V	
1.5	- - - -					 !					Range:	500 mV/div	
											Channe	12	8
0.5													
0													
-0.5					<u> </u>	<u> , , , , , , , , , , , , , , , , , , ,</u>				<u> </u>			
	0.5 s	0 s	0.5 s	1 s	1.5 s	2 s	2.5 s	3 s	3.5 s	4 s 4.5		1	
Manua	l Trigger										Discovery2 DEMO	Status: OK	8

Applied Statistics | Project preparation : Ball on an incline

11

Save your workspace !!

Wave	Forms	Workspace	Settings	Window	Help		
	•	🦻 New		1		-	*
		늘 Open	жо			Welco	me 🚽
File	Contro	Save	¥S				
D C	onfig	Save As	<u>ት የ</u> መረጉ	Recor	d 🗘	Auto	🗘 S
V	Sto	p C1 C2	_125000 sa	mples at 25	kHz 2018-11-	10 10:10:15.	458
4.5	Demo	mode		'	I		
	- - -						
4	• • •						
3.5							
	-						
3	 -						
2.5	- - -						
2	- - -						
1.5							
1.0							
1							
0.5	- 						
0							
-0.5			<u> </u>			<u> </u>	
x 🖣 -(0.5 s	0 s	0.5 s	1 s	1.5	ō s	2 s
Manual	Trigger						

Save your settings by clicking on Workspace->Save As so you can open it during lab and start working

	5	👌 医 🔨	* 🔅 ◀	88 % 🗔 🖌 🗚	Sat 10 Nov 10	.10 Q	
🛿 WaveForms (new workspace						
🔶 Help	🛛 😵 Scope 1						68
Source: Ch	annel 1	Condition:	F Rising	Cevel:	2 V		J
			()	<u>⊾ ⊢ ⊨</u> ĝ ₂	Y ⇒		
					✓ Time		8
					Position:	2 s	~
					Base:	5 s	
						None	
					Average:		
					Overs.:	Off	~
					Samples:	125k	~
					Rate:	25 kHz	~
						Î	
					🔶 🕂	d Channel	
					🔽 Channe	el 1	8
					Offset:	-2 V	
					Range:	500 mV/di	iv 🔽
					🗌 Channe	el 2	S
					,		
2.5	is 3s	3.5	s 4:	s 4.5	S		
					Discovery2 DEMO	Status: Ok	



Export your data !!!

After the measurement (in the lab), export your data as CSV file by clicking at File->Export



	ns (new workspaces Supplies	ce) 😣 Scope 1 🕨					
•							
ce:	Channel 1	Condition:	F Rising	ᅌ Level:	2 V		1
			3	<u>k</u> = = Ø	Y ⇒		
' ' '					🗹 Time		8
					Position:	2 s	
					Base:	5 s	
					Average:	None	~
					Overs.:	Off	~
					Samples:	125k	~
					Rate:	25 kHz	~
						î	
					🕂 🕂 Ad	d Channel	
					🔽 Channe	el 1	8
					Offset:	-2 V	
					Range:	500 mV/div	
					Channe	el 2	S
				-			
	2.5 s 3	3 s 3	.5s 4s	4.5	s		
					Discovery2 DEMO	Status: OK	8



Now you are prepared!

Looking forward to seeing you in the lab!