

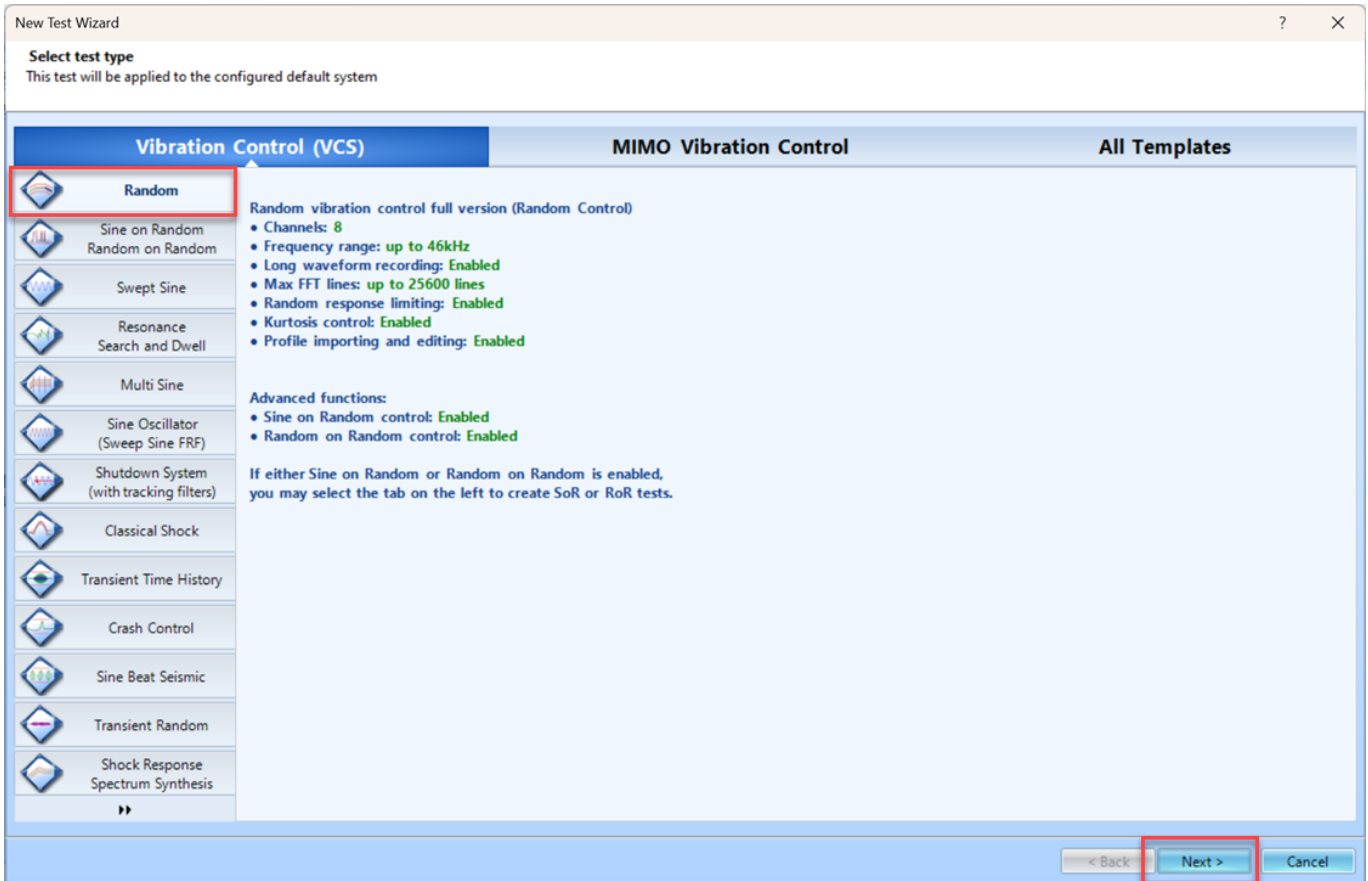
# VCS Random Testing

## Create Test

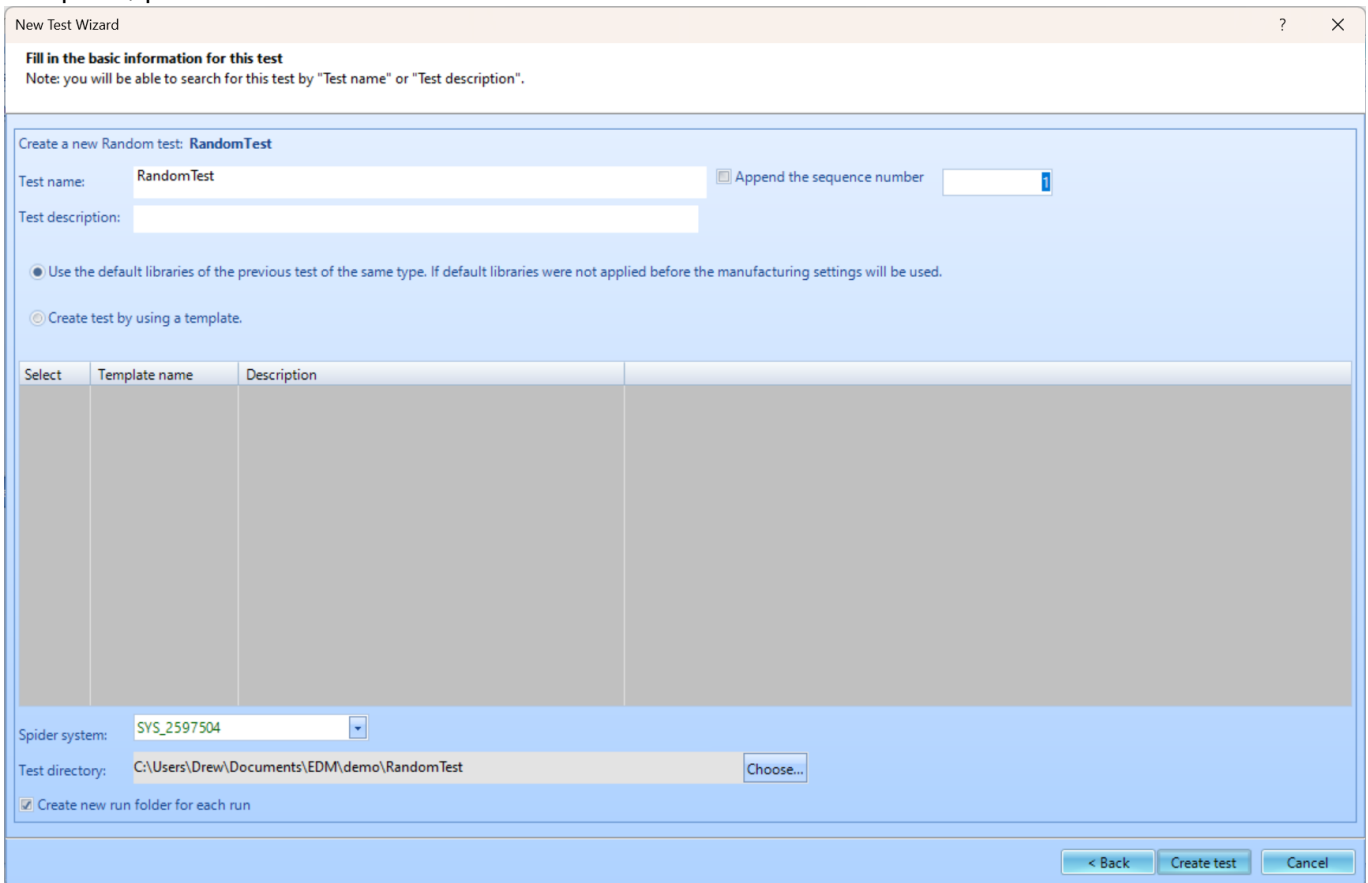
To create a new test, first open up EDM. On the VCS Start Page, select **Random** under the **Create a test** tab.



The **New Test Wizard** will now open up. From here, select **Random** again and then press **Next**.

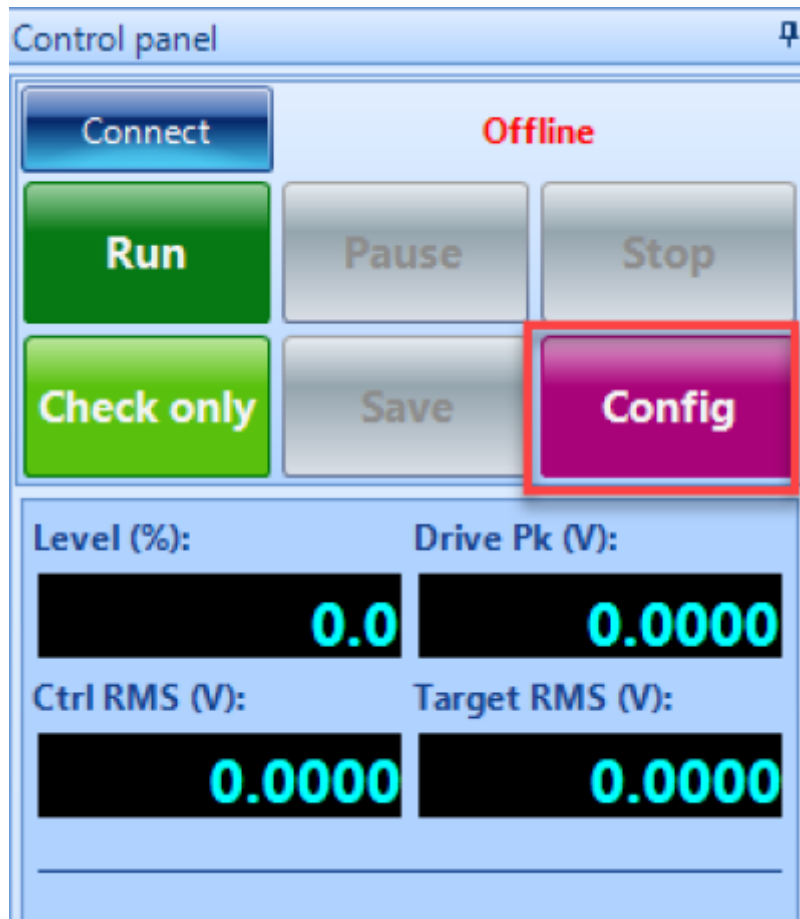


Finally, give the test a name and select the Spider system that will be used to run the test. Once all is complete, press **Create**.



# Test Configuration

The test will now need to be configured to run. This includes inputting information regarding the shaker, creating the schedule for the test to follow, and determining the parameters for the frequency analysis. To access the **Test Configuration** menu, press the **Config** button that can be found on the right side of the screen.



## Shaker Parameters

Click on **Edit Parameters** and enter the information from the shaker specifications. This is important for the safety of the shaker and testing unit.

The screenshot shows a software window titled "Test Configurations for RandomTest [Random]". On the left is a sidebar menu with options: Shaker parameters (selected), Test parameters, Pre-test parameters, Test profile, RMS limits, Run schedule, Limit channels, Event actions, File directory, Save/Recording setup, and Output settings. The main area is titled "Shaker information" and contains several input fields: Manufacturer (Anonymous), Shaker name (Default Shaker), Payload mass (0.22046 lb), and Fixture mass (0 lb). Below this is a section "Actual shaker limits used in this test" with a list of parameters and their values: Force RMS (100.02 LBF), Acceleration RMS (16.667 g), Max. velocity (1.778 m/s), Max. positive displacement (6.35 mm), Max. negative displacement (6.35 mm), Shaker orientation (Vertical), Max. drive voltage peak (10 V), Min. drive frequency (1 Hz), Max. drive frequency (2500 Hz), and Shaker moving mass (0.44092 lb). A note explains that the acceleration limit is adjusted by a factor:  $Actual\ Acc. = \min(Shaker\ param.\ Force / (Armature\ mass + Payload\ mass + other\ mass), Shaker\ param.\ Acc.)$ . It also states that the Max. drive frequency should not be set too high, recommended within 10240 Hz. At the bottom, there is an "Edit parameters" button (highlighted with a red box), and other buttons: "Load from library", "Save to library", "Import manufacturer shaker list", "Export manufacturer shaker list", "Import default library", "Config. library" (dropdown), "OK", and "Cancel".

? X

### Shaker Limits

**Shaker details**

Manufacturer:  Shaker name:

**Force and acceleration**

Random Max. Force RMS (LBF)	<input type="text" value="100.022"/>	Random Max. Acc. RMS (g)	<input type="text" value="16.66667"/>
Sine Max. Force Peak (LBF)	<input type="text" value="2205.866"/>	Sine Max. Acc. Peak (g)	<input type="text" value="75"/>
Shock Max. Force Peak (LBF)	<input type="text" value="100.022"/>	Shock Max. Acc. Peak (g)	<input type="text" value="50"/>

**Displacement**

Max. positive displacement (mm)	<input type="text" value="6.35"/>	Max. negative displacement (mm)	<input type="text" value="6.35"/>
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**General settings**

Max. drive voltage peak (V)	<input type="text" value="10"/>	Max. velocity (m/s)	<input type="text" value="1.778"/>
Min. drive frequency (Hz)	<input type="text" value="1"/>	Max. drive frequency (Hz)	<input type="text" value="2500"/>
Shaker orientation	<input type="text" value="Vertical"/>		

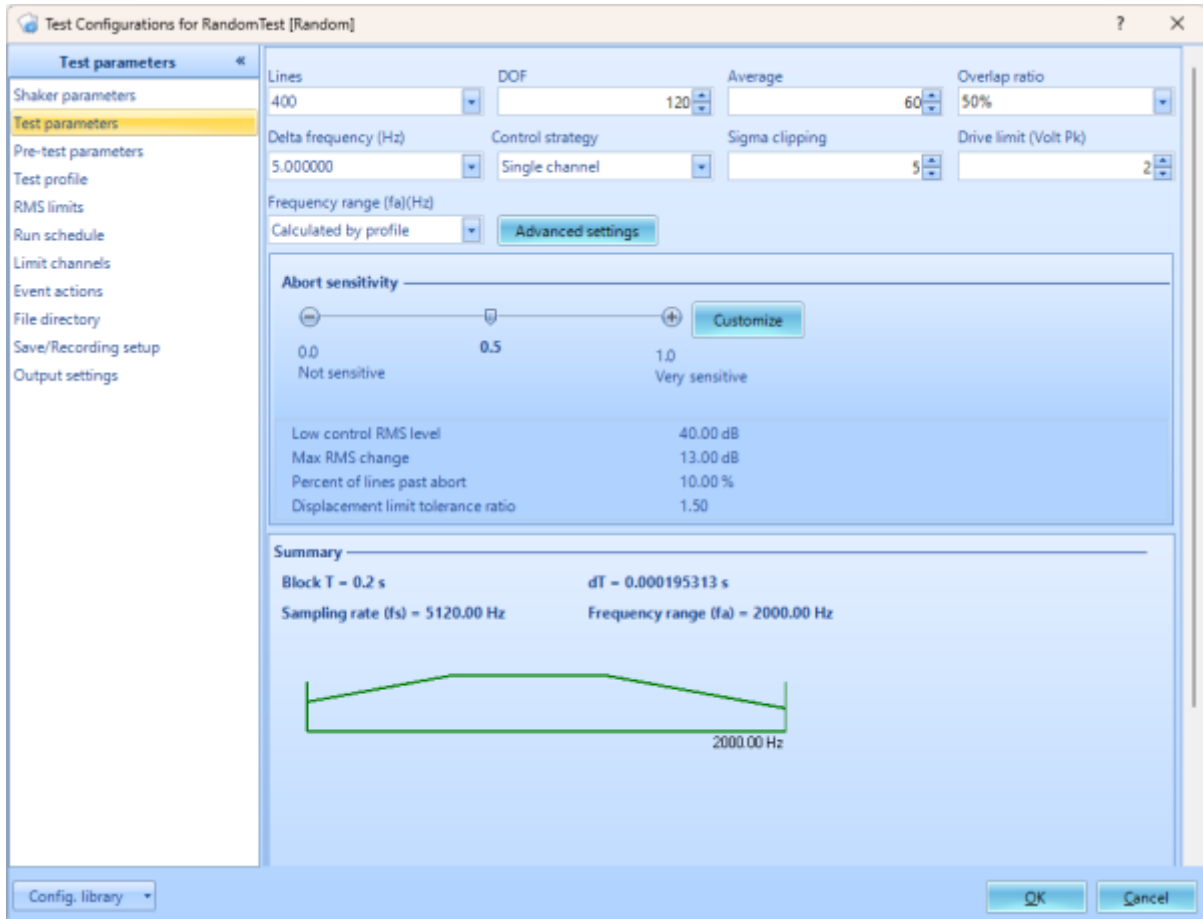
**Shaker moving mass**

Armature mass (lb)	<input type="text" value="0.4409245"/>	Header expander (lb)	<input type="text" value="0"/>
Slip table (lb)	<input type="text" value="0"/>	Drive bar (lb)	<input type="text" value="0"/>

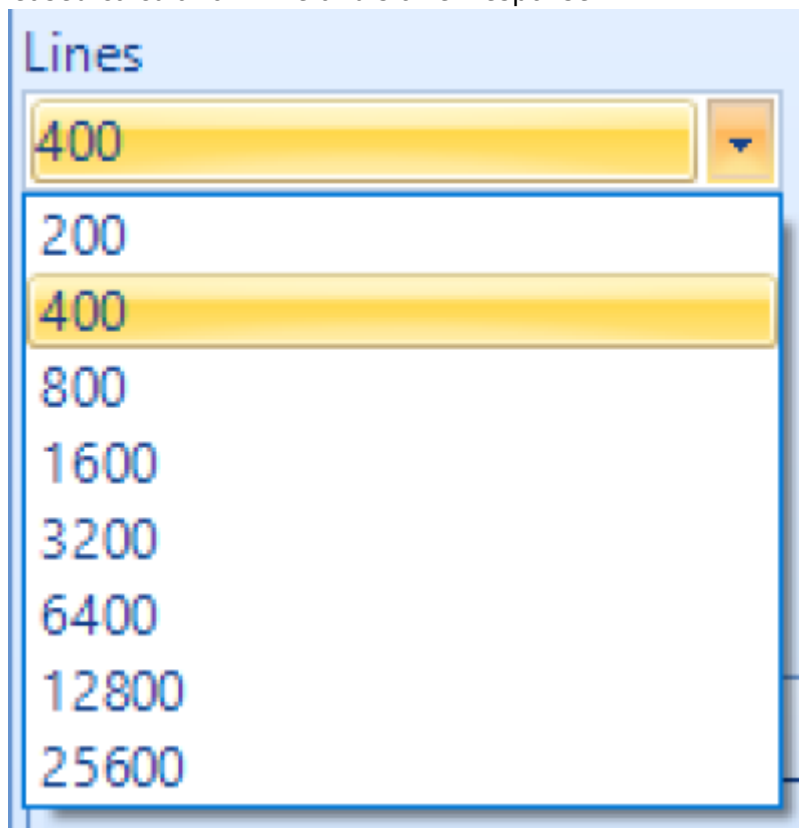
**Note:** the **Payload Mass** can be entered in the shaker parameters page. Actual acceleration limits used in each test will be re-adjusted by following factor:  
**Actual Acc.** = Min(Shaker param. force / (Armature mass + Payload mass + other mass), Shaker param. acc.)  
**Max. drive frequency** should not be set too high, the recommended range within 10240 Hz.

### Test Parameters

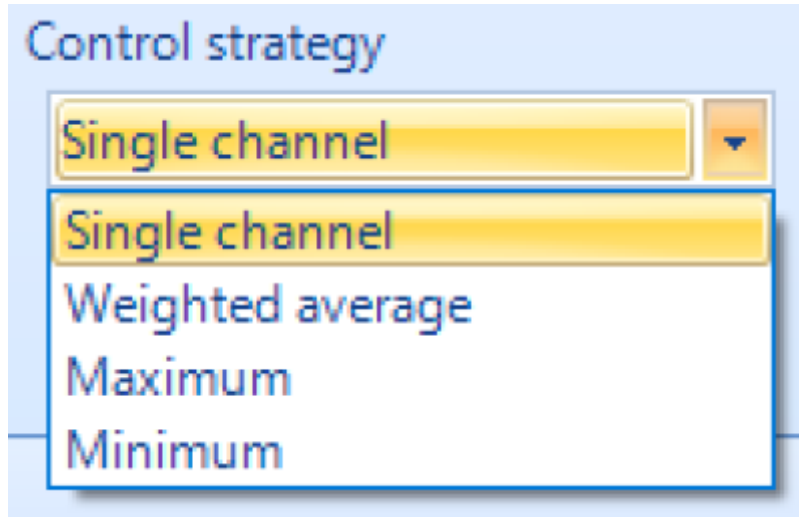
The **Test parameters** section in the **Test Configuration** window has settings for the analysis parameters, abort sensitivities and control strategy.



Lines: The useful number of spectral lines, proportional to block size. Increasing the lines / block size will improve the resolution of the frequency spectrum (allowing better detection of lower frequencies) at the tradeoff of increased calculation time and slower response.



Control Strategy: Determines whether one or multiple control channels are used, and how the composite control signal is generated (if multiple channels are used).



**Test Profile**

The test profile is defined in the Test Profile section of the Test Configuration window. A graphical preview of the profile plot is displayed above, with a breakpoint table below for entering the profile. CSV import / export is also supported as an alternative to profile editing.

	Frequency Hz	Voltage V²/Hz	Slope dB/Oct	High abort dB	High alarm dB	Low alarm dB	Low abort dB
▶ 1	20	0.000273233		6	3	-3	-6
			3				
2	80	0.00108776		6	3	-3	-6
			0				
3	350	0.00108776		6	3	-3	-6
			-3				
4	2000	0.000191497		6	3	-3	-6

Breakpoint Table: Breakpoints can be added via **Insert row**, **Delete row** and **Append row**. Use **Clear table** to clear out all rows except for the first and last row. Breakpoint Calculation: In the profile editor, EDM can calculate the crossover point given a specified slope and point value. If a '?' is entered as a Frequency or Amplitude value, EDM will interpolate that value given the slope before and after that point.

	Frequency Hz	Voltage V <sup>2</sup> /Hz	Slope dB/Oct	High abort dB	High alarm dB	Low alarm dB	Low abort dB
▶ 1	20	0.000273233		6	3	-3	-6
			3				
2	80	0.00108776		6	3	-3	-6
			0				
3	350	0.00108776		6	3	-3	-6
			-3				
4	2000	0.000191497		6	3	-3	-6

### RMS Limits

The overall RMS level of the control channel(s) is monitored with alarm and abort limits. These limits are set under the **RMS Limits** section of the **Test Configuration** window. The table displays the expected RMS and peak values for the configured broadband profile, compared to the shaker limits as a percentage.

**Warning:** The expected values are estimated. The actual shaker demand values may be significantly higher. Narrowband RMS and Overall RMS includes narrowbands and sine tones that will be turned on in schedule. Does not include all narrowbands and sine tones profiles.

Check AVD against shaker limits

Physical quantity	Profile RMS	Profile expected values	Shaker limits	Expected/Shaker limits
Acceleration (g)	0.102	0.3061 (Peak)	50 (Peak)	0.6%
Velocity (m/s)	0.0008846	0.002654 (Peak)	1.778 (Peak)	0.1%
Displacement (mm)	0.003273	0.01964 (Pk-Pk)	12.7 (Pk-Pk)	0.2%
Force (LBF)	0.06749	0.2025 (Peak)	100 (RMS)	0.1%

Control RMS limits during test

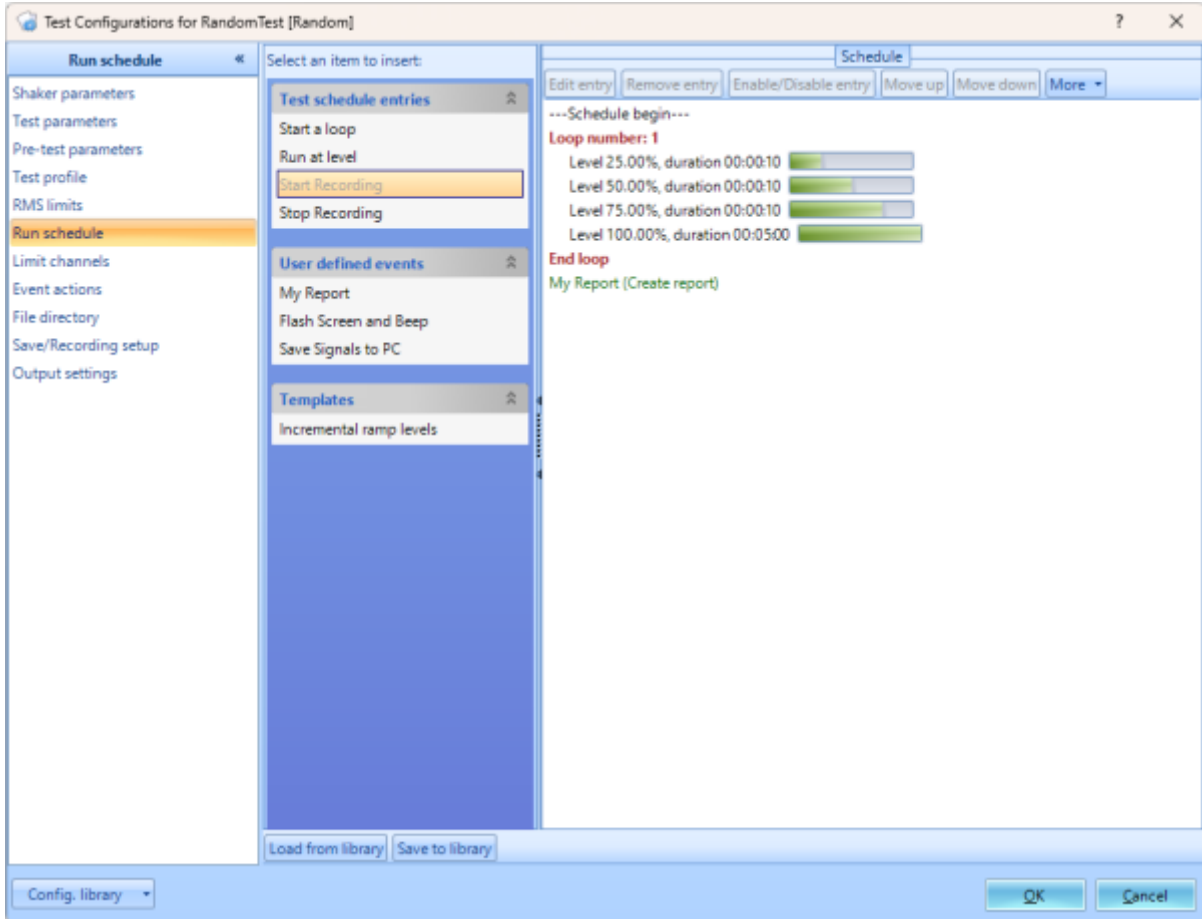
- Calculate based on the table
- Enter manually (g)
- Enter manually (dB)
- Enter manually (%)

	(g)	(dB)	(%)
High abort	0.2036	(+) 6.00	199.5
High alarm	0.1441	(+) 3.00	141.3
Profile RMS	0.102		
Low alarm	0.07224	(-) -3.00	70.8
Low abort	0.05114	(-) -6.00	50.1

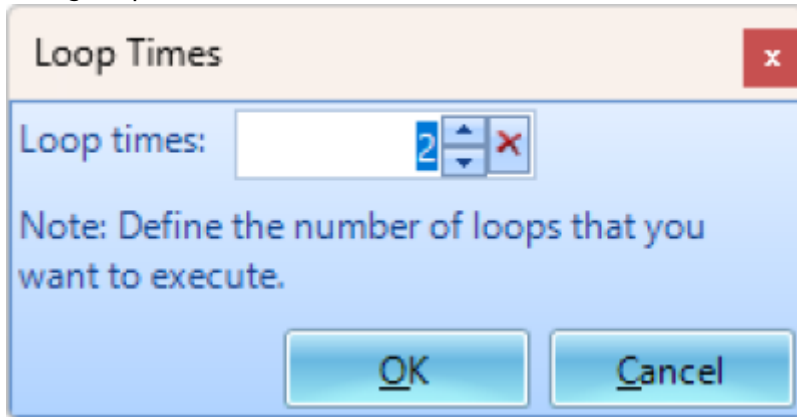
### Run Schedule

The **Run Schedule** defines how the test is run automatically through a preset routine. This schedule can support loops and periods of running at a specified level and duration. The **Run Schedule** can also include user-defined events in **Event Action Rules**.

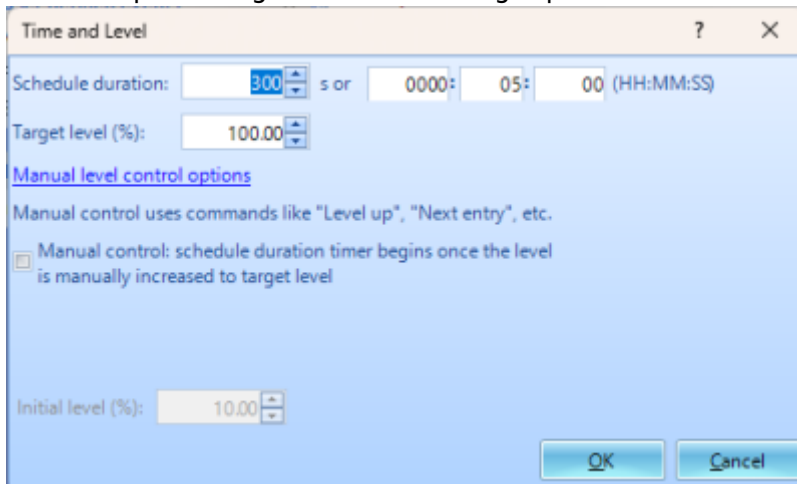




Start a loop: Adds a new loop to the schedule – EDM will open a prompt for how many times to loop. Double-click on an existing loop number to edit the number of times for that entry.

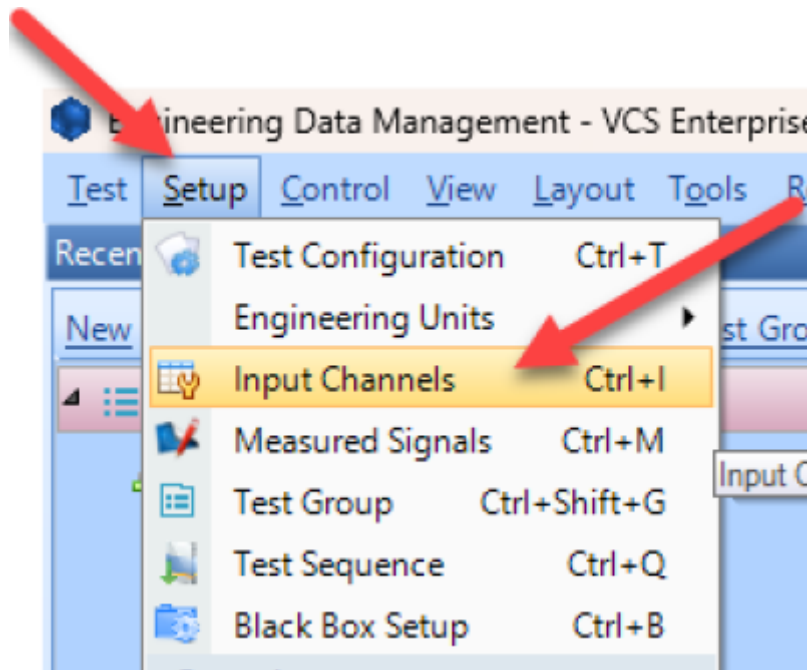


Run at Level: Adds a new entry to run the test profile at a specified level. Schedule duration must be specified, as well as level as a percentage or dB of the target profile.



# Input Channels

The input channels will now need to be set up. All sensors will be properly configured before testing. The **Input Channels** menu can be found through **Setup → Input Channels**.



## Channel Type

**Control vs. Monitor.** When running a test, there will need to be at least one control sensor. The control sensor is used to monitor the actual vibration levels that the shaker is producing. It then sends this data to the controller so that it maintains the targeted profile. This sensor should be mounted somewhere on the shaker/slip table itself, not the Device Under Test (DUT). Monitor sensors will show the levels that the DUT itself is experiencing.

On/Off	Channel type	Location ID
<input checked="" type="checkbox"/> On	Control	Ch1
<input checked="" type="checkbox"/> On	Monitor	Ch2
<input type="checkbox"/> Off	Monitor	Ch3
<input type="checkbox"/> Off	Monitor	Ch4
<input type="checkbox"/> Off	Monitor	Ch5
<input type="checkbox"/> Off	Monitor	Ch6
<input type="checkbox"/> Off	Monitor	Ch7
<input type="checkbox"/> Off	Monitor	Ch8

## Measurement Quantity

Defines the physical unit that will be measured by the sensor connected to the channel.

## Sensitivity

Sets the proportionality factor for the measurement (millivolts per engineering unit) given as a parameter of the sensor.

## Input Mode

There are five modes in which the inputs can operate:

*DC-Differential-* In the DC-Differential mode, neither of the input connections is referenced to the local ground. The input is taken as the potential difference between the two input terminals, and any potential in common with both terminals is canceled out. The Common Mode Voltage (CMV) will be rejected as long as the overall input voltage level does not saturate the input gain stage. Beware that very high CMV will cause clipping and may damage the input circuitry. Signals with a nonzero mean (DC component) can be measured in this mode.

*DC-Single End-* In single-ended mode, one of the input terminals is grounded and the input is taken as the potential difference of the center terminal with respect to this ground. Use this mode when the input needs to be grounded to reduce EMI noise or static buildup. Do not use this mode when the signal source is ground referenced or ground loop interference may result. This mode also allows signals with a non-zero mean to be measured.

*AC-Differential-* AC-Differential is a differential input mode that applies a low-frequency high-pass (DC-blocking) analog filter to the input. It rejects common mode signals and DC components in the input signal. Use this when DC and low-frequency AC voltage measurements are not required or when a DC bias voltage is present. The analog high-pass filter has a cutoff frequency of -3dB at 0.3 Hz, and -0.1dB at 0.7 Hz for the IEPE input mode.

*AC-Single End-* AC-Single End grounds one of the input terminals and enables the DC-blocking analog filter. Use this mode for non-ground referenced sources where measuring the DC or low-frequency components are not required. It shares the same high-pass filter as that of AC-Differential.

*IEPE (ICP)-* All Crystal Instruments products support IEPE (Integral Electronic PiezoElectric) constant current output type input channels. IEPE refers to a class of transducers that are packaged with built-in voltage amplifiers powered by a constant current. These circuits are powered by a 4 mA constant current source at roughly 21 Volts.

*Charge-* Some sensors provide a high-impedance charge output. Usually, these are high-sensitivity piezoelectric units that lack a built-in voltage mode amplifier (i.e. IEPE), allowing them to be used in high-temperature environments. The Spider-81 front-end module has a built-in charge amplifier that allows the system to read the output of these sensors

Sensitivity	Input mode
100 (mV/g)	IEPE
100 (mV/g)	IEPE
100 (mV/g)	IEPE
100 (mV/g)	AC-Single End
100 (mV/g)	DC-Single End
100 (mV/g)	AC-Differential
100 (mV/g)	DC-Differential
100 (mV/g)	In-Line Charge Convert
100 (mV/g)	External Charge Amplifi
100 (mV/g)	External Charge Amplifi
100 (mV/g)	AC-Single End

## Running the Test

Now that all of the parameters for the test have been setup, the test is ready to run. Here are the final steps to start the test.

1. Press the **Connect** button to connect to the controller.
2. Press the **Run** button.
3. The **Spider Check List** will now appear. Here you can check the settings of the test and verify that all is set up properly. Press **Start** once this has been verified.
4. The Pre-Test will now begin. This will verify that the control loop is properly established and provide data that the control loop needs.
5. The test is now running

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