

PCB 394C06 Handheld Shaker for Testing, and Other Testing Techniques

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Abstract

The PCB model 394C06 handheld shaker is a calibrated tool that is used for rapid calibration and testing at 1g. This application note discusses how to use this tool and a digital multimeter to test the team 4 G-meter with peak/hold on how well it meets the specifications provided by Instrumented Sensor Technology. This application note will also give a brief description of the other testable specifications of the design of the G-meter and how those are tested.

Keywords

Some keywords to keep in mind are PCB model 394C06 handheld shaker (handheld shaker), G-meter with peak/hold (G-meter), 9.8 m/s^2 (g), and digital multimeter (DMM).

Introduction

The PCB model 394C06 handheld shaker is a calibrated tool made by PCB Piezotronics. It will be used to test and calibrate devices that use accelerometers. This will be very helpful in making the team 4 G-meter with peak/hold as reliable and accurate as possible. The Specifications that will be tested with the handheld shaker are below.

- Measurement accuracy: $\pm 3\%$ traceable to national standard or manufacturing certificates
 - Real time, peak/hold, and RMS modes

A digital multimeter is an electronic measuring instrument with several different measurement functions that are selectable by the user. These functions include measuring resistance, Vdc, Vac, Adc, and Aac. For the purposes of this project, team 4 will mainly be utilizing the Adc function to test certain specifications. The specifications that can be tested with the DMM are below.

- Battery Powered operations life: 1+ months on two lithium batteries

The DMM can also be used to test which components of the G-meter are using the most power.

An oscilloscope is an electronic test device that allows for the observation of constantly varying signals. It will be used in the testing of the G-meters bandwidth filter.

Objective

The objective of this application note is to give a detailed description of the handheld shaker, as well as demonstrate how to implement each of these two testing devices on the G-meter. It will also give a brief description of the testing of the G-meter's filter.

About the Handheld Shaker

The handheld shaker produces 1g with a sine wave vibration at a frequency of 159.2 Hz for up to 210 grams of weight. There are also two modes, Peak and RMS, which can be selected by the user via a switch on the side of the device. This is an important feature for the testing of the G-meter, because the G-meter has each of these modes, and they need to be tested. Figure 1 below is an illustration of the G-force delivered by the handheld shaker vs. time. In peak mode the output is 100 mV, while in RMS mode the output is 141 mV. To choose modes, simply turn the switch to point at RMS or Peak. Figure 2 below shows an illustration if the mode selection switches.

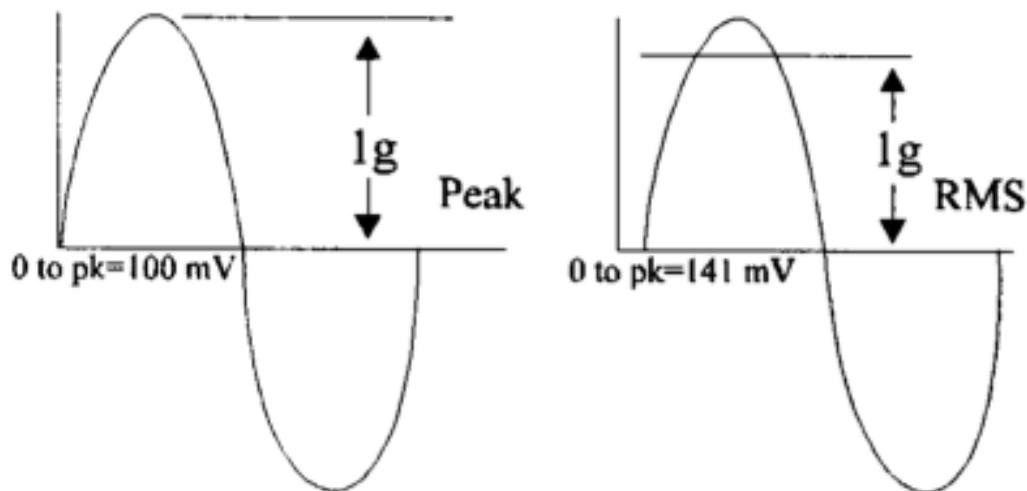


Figure 1: Peak vs. RMS selection

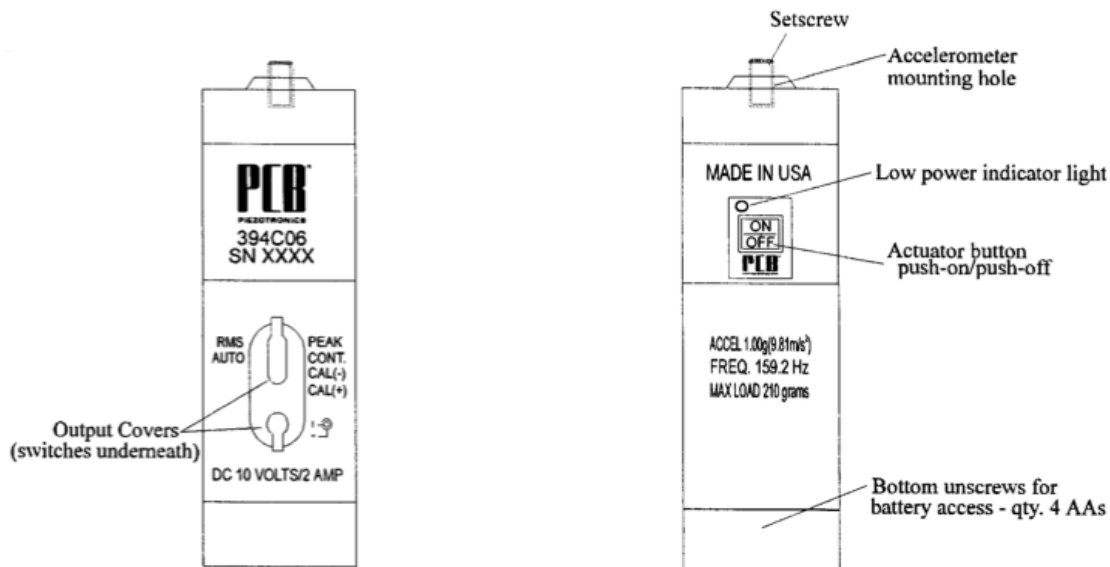
Use of the Handheld Shaker

Using the handheld shaker is very straightforward. The device is attached to the handheld shaker by using the 10-32 BeCu stud. There is also a mounting base supplied for cases when adhesives are used for attachment. To turn the device on, simply press the on/off switch. With the auto selection on, the shaker will automatically shut off after 90 seconds. Turning the auto selection off will allow

the shaker to stay on continuously. Figure 3 below shows the on/off switch and the mounting hole.

The design of the G-meter will have to take into consideration the weight limit of the shaker. If the G-meter weighs more than 210 grams, then we will not be able to reliably use this as a testing instrument. For this reason, the design team has decided to use a plastic enclosure for the G-meter rather than a steel or aluminum enclosure.

When testing and evaluating each variable, it is important to take multiple samples. For the testing of the accuracy specification, at least 20 tests will be taken. After this is done, the results will be compiled and sorted based on percent of error. They will be analyzed using a histogram. A histogram will show where the center of the results is. From this, the design team will be able to see how much to adjust the accelerometer and the results. Adjustments are made by programming them into the microcontroller. This will be repeated for both peak mode and RMS mode.



About the Digital Multimeter

A digital multimeter is an electronic measuring instrument that combines several different measurement functions on one device. For this purposes of measuring the current drain from the battery of the G-meter, any type or brand of DMM will work, as long as it has the ability to measure mA DC. To understand how to use the DMM, read below.

Use of the Digital Multimeter

Using the digital multimeter for testing the power consumption of the G-meter is very straightforward. The G-meter is battery powered, so the only thing that needs to be done to test power consumption is measure current coming from the battery pack. This can be done by selecting the Adc selection on the dial and then connecting the multimeter between the output of the battery pack and the input of the circuit. The batteries that are used for the G-meter have about a 3400 mAh capacity, so the more current being drained by the circuit, the shorter the batteries will last. To make the batteries last 30 days, the circuit can only use 5.55 mA. The equation to determine how long a lithium battery pack will last is shown in equation 1 below. Figure 4 below shows an illustration of how to connect the digital multimeter.

Equation 1: $\text{Battery length (hrs)} = 3400 \text{ mAh} / \text{mA}$

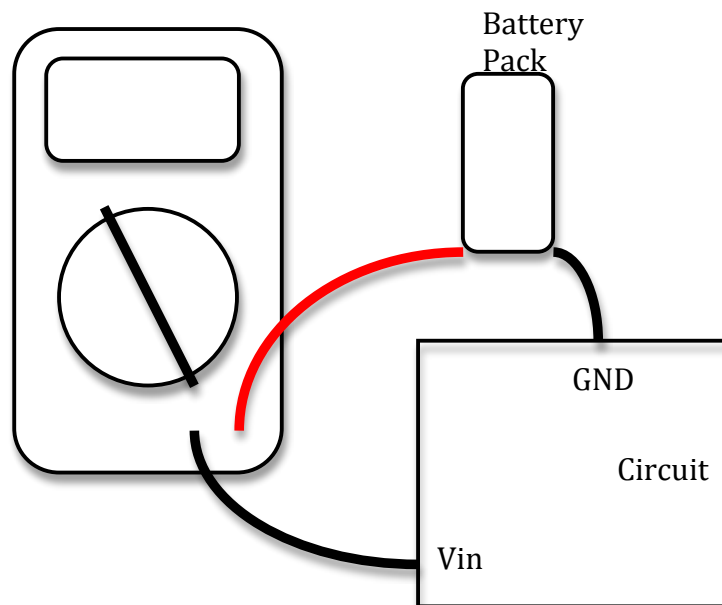


Figure 4: Current testing

Other Specifications and Testing

- Bandwidths: DC to 15 Hz, 30 Hz, 50 Hz, 100 Hz, 200 Hz, 500 Hz
 - This will be tested with an oscilloscope. Each of the filters will be tested separately. The output of the filters will be connected to the oscilloscope. As the frequency is turned up, the voltage will be recorded. When 3db attenuation is reached, that will be the exact cut off frequency for that filter. After one is determined, the next filter will be tested by turning on its switch on the DIP switch. Figure 5 below shows the schematic of the filter.

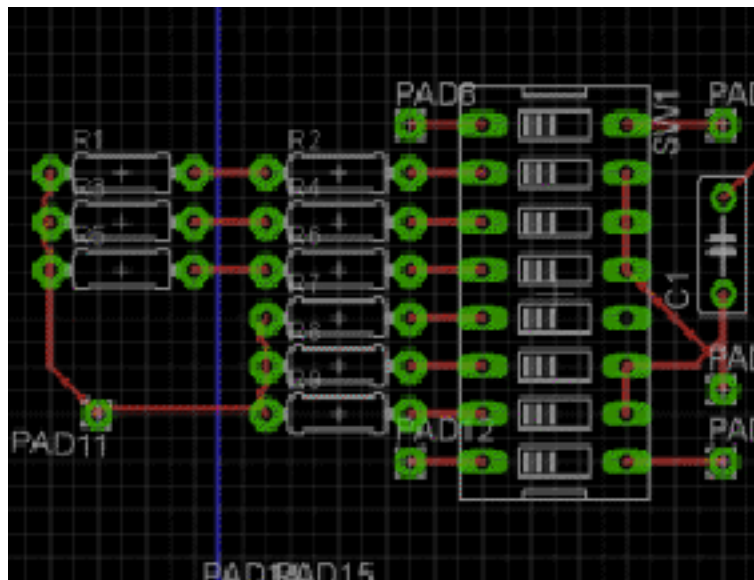


Figure 5: Filter design

References

Operating Manual for Handheld Shaker:

"Model 394C06 Handheld shaker, 1g at 159.2 Hz (for up to 210 grams total weight of Installation and Operating Manual." Business Website. PCB Piezotronics, n.d. Web. 28 Mar. 2013.
<http://www.pcb.com/contentstore/docs/PCB_Corporate/Vibration/Products/Manuals/394C06.pdf>.

Handheld Shaker Product Specifications:

"Product Specifications." PCB Piezotronics, n.d. Web. 28 Mar. 2013.
<<http://www.pcb.com/Products.aspx?m=394C06#.UVtl8qWRL18>>.