Testing the J-Board for EMI

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1. INTRODUCTION

The aim of this measurement is to identify the possible source of electromagnetic interference within the J-board. Using a spectrum analyzer, EMI measurements were carried out on the J-Board. The board was tested in three major configurations: open (no shielding), with the Arduino board encased in a metal box, and with the J-Board and Arduino board both housed in a metal box. The Arduino was swapped out for a 9V battery to generate the switching logics, a 10V battery was used to replace the power supply, and RF probes were used to isolate the MEMS switch network.

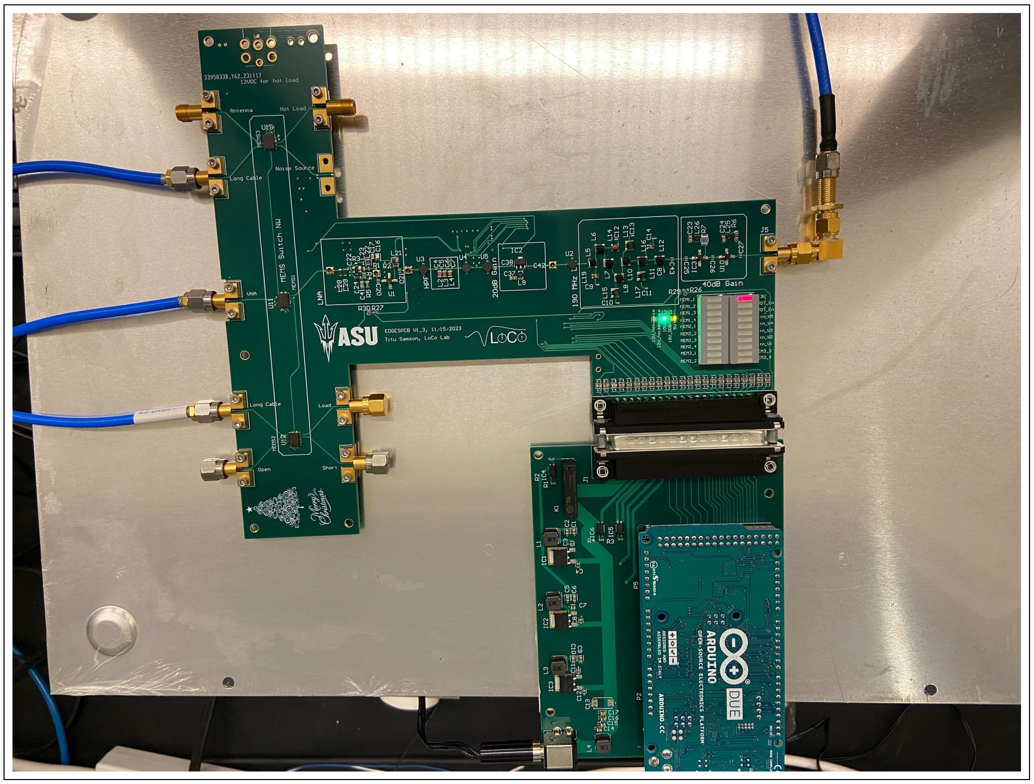

Fig. 1. J-board with Arduino board attached

2. MEASUREMENTS AND ANALYSIS

A. EMI Shielding using metal box

Figure 2 shows the measurement setup and spectrum of the J-board without any metal shielding. The spectrum makes it clear that a lot of EMI is getting into the RF line. The high-gain RF path could pick up this EMI from surrounding or within the J-board. As seen in Figure 3, the Arduino is placed in a metal box to provide shielding, and the spectrum is taken to see any variations in the spectrum when Arduino is shielded versus when it is not. Spectrum in Figure 2 and 3 shows that there isn't any noticeable difference between the Arduino with and without the metal box shield. As seen in Figure 4, the Arduino is placed in a metal box, and the J-board and Arduino are situated inside another metal box. A spectrum is taken to determine how efficiently the J-board is isolated from the ambient radiation that it picks up. The figure 4 spectrum indicates an improvement in the emission pickup from the surroundings.

B. Disconnecting the power supply and Arduino

Two possible sources of internal electromagnetic interference (EMI) are the Arduino and the power supply. To better understand and isolate the source of EMI, the logical signal generated by the Arduino is generated using a 9V battery, while the power supply is replaced with a 10V battery. The measuring setup is shown in Figure 4, and the comparative spectrum with and without an Arduino is shown in Figure 5. Both spectrums have many EMI spikes at various frequencies. Figure 6 illustrates the comparison between with and without Arduino when the 3.3V to MEMS switch is deactivated. A noticeable improvement in the decrease of EMI is evident in the spectrum. This test shows that the MEMS switch is another possible source of EMI. According to the data sheet, every MEMS switch has a 10 MHz ocliator as well as a DC to DC booster that boosts the voltage from 3.3 V to 81 V, which is used to control the switching operation. The harmonics generated by the oscillator are directly leaking into the RF path of the J-board via the MEMS switch. Figure 6 demonstrates the measurement evidence of minimal electromagnetic interference (EMI) in the spectrum when the MEMS switch is deactivated and the arduino replaced with a 9V battery. Figure 6 also shows the coupling of EMI from the Arduino is through the MEMS switch, while figure 7 further confirms this observation. Regardless of whether an Arduino is used or not, if we isolate the MEMS section using an RF probe connected to the input of the LNA, both spectra appear identical. This suggests that EMI from the Arduino is leaking into the RF path through the MEMS switch.

3. SUMMARY

A spectrum analyzer was used to check the J-Board for electromagnetic interference (EMI). Three different configurations of the board were tested: open, with the Arduino board inside a metal box, and with the J-Board and Arduino board inside a metal box. The spectrum analysis reveals that both spectrums had EMI spikes at different frequencies. A 10V battery was used for the power supply, a 9V battery was used to generate the switching logics, and RF probes were utilized to isolate the MEMS switch network. When the MEMS switch was turned off and a 9V battery was used in place of the Arduino, the results revealed very little EMI in the spectrum. It was also noted that EMI from the Arduino was coupled through the MEMS switch. When an RF probe was connected to the LNA's input, the spectra with and without Arduino shows no difference, suggesting that EMI from the Arduino is also being leaked into the RF path through MEMS switch.

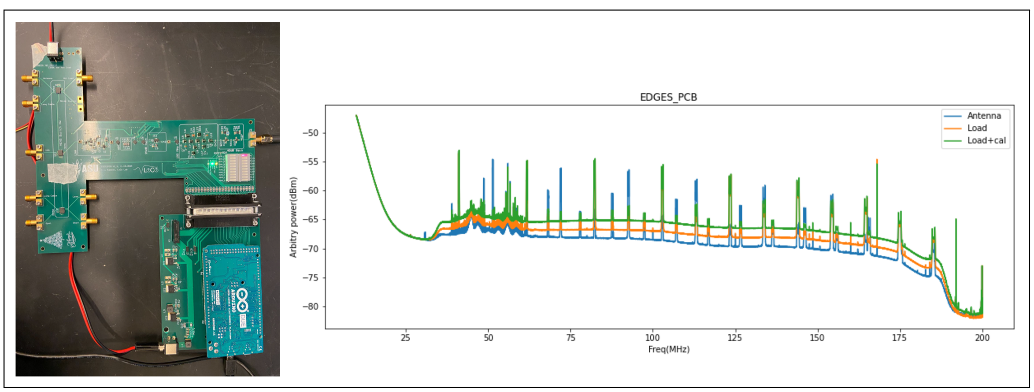

Fig. 2. Spectrum without any shielding

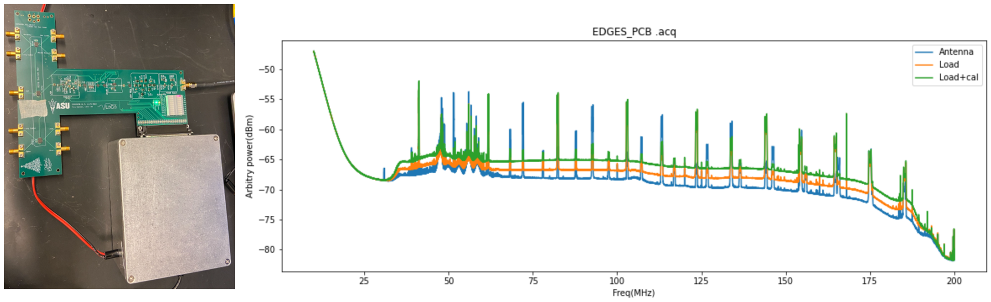

Fig. 3. Spectrum with Metal-box shielding for Arduino board

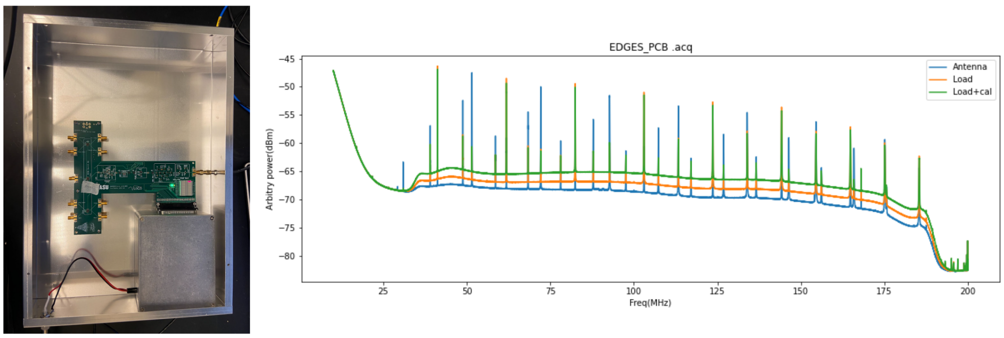

Fig. 4. Spectrum with Metal-box shielding for Arduino board and J-board put inside another metal box.

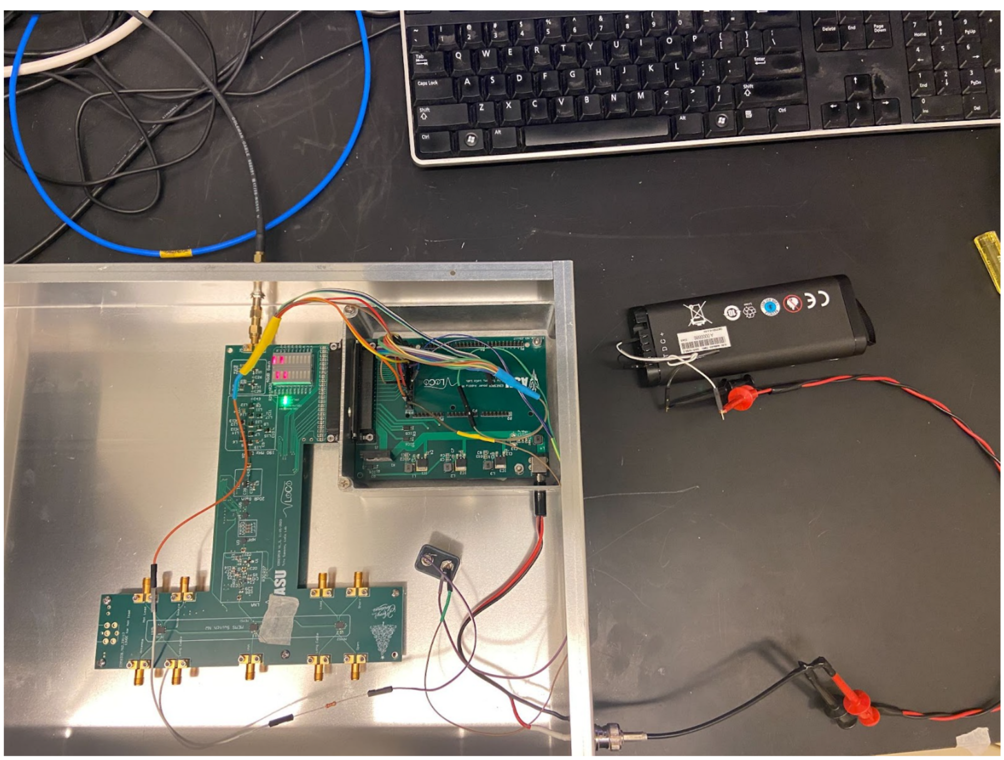

Fig. 5. The Arduino was replaced with a 9V battery and power supply replaced with 10V battery.

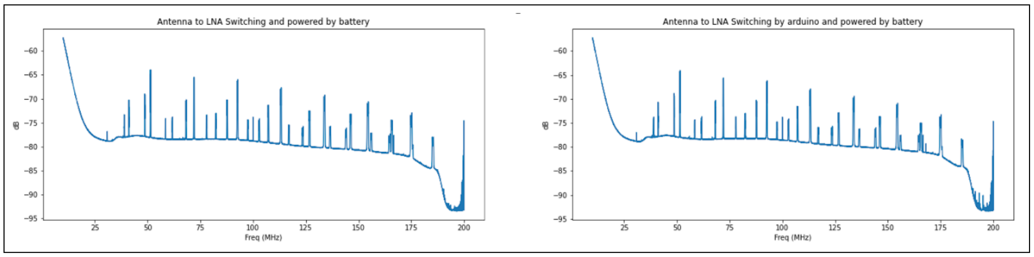

Fig. 6. Powered by battery, switching controlled with and without Arduino

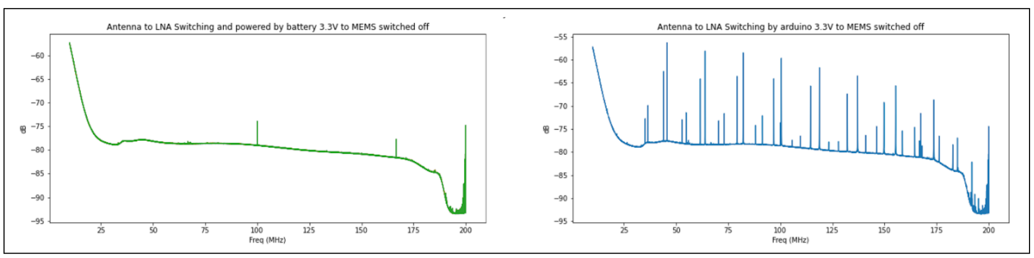

Fig. 7. Powered by battery, switching controlled with and without Arduino along with 3.3VDC to MEMS switched off

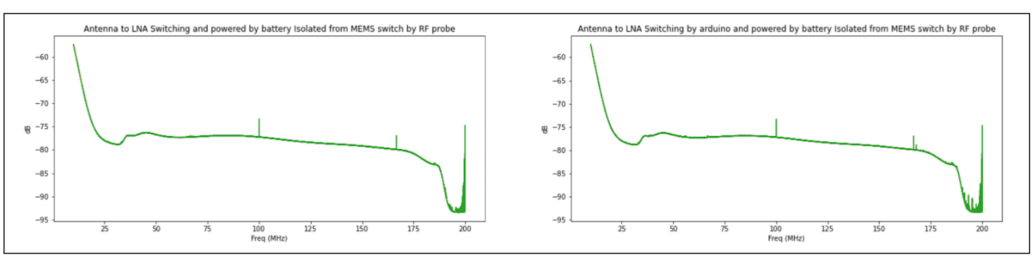

Fig. 8. Powered by battery, switching controlled with and without Arduino isolated from MEMS switch RF probe at the input of LNA