PIC16C54A EMI Results

INTRODUCTION

This paper discusses the EMI results of the PIC16C54A. These measurements were taken by an independent consulting firm that specializes in electromagnetic testing. These results are for a specific system design, each design will have its own results.

DEVICES USED

These tests were done on a random PIC16C54A device, and should be considered as typical results. Initial testing was done on three boards / devices. The device frequency of the boards were, respectively, 32 KHz, 4 MHz, and 20 MHz. As would be expected there was a substantial difference (decrease) at the low frequency as compared to the higher frequencies. The difference between the 4 MHz operation and the 20 MHz operation was marginal. The final testing of the device was done at 4 MHz, and was according to the FCC measurement procedure MP-4.

SYSTEM USED

The PIC16C54A device was tested in the Microchip OHMMETER board. This board is a three layer board, with a ground plane. Power and ground planes greatly help in the compliance of designs to the FCC part 15 subpart B testing. This board had minimal other external components, so that the electromagnetic measurements could mostly be attributed to the device and design of the system. To reduce the noise that comes from a power supply, a 10 nF bypass capacitor was attached to the power / ground of the input jack.

EMI TESTING

The testing of electromagnetic noise (EM) on a system has two types of commonly used testing environments, an internal and external environment. The internal test is done is a screen room to reduce the amount of stray EMI. The indoor tests is useful in determining the source of EMI radiation. The external test is done outdoors. This places the equipment under test in an environment to measure radiated emissions (EMI). The FCC only requires the outdoor testing of devices. The equipment under test (EUT) was positioned to maximize the emissions.

INTERNAL TESTS

The equipment under test was performed on a wooden test bench, inside a screen room, 0.8m above the earth ground plane (see Figure 1). The EUT was powered through the Line Impedance Stabilization Network (LISN) bonded to the ground plane. The LISN power was filtered and the filter was bonded to the ground plane. The EUT was positioned on the table with the minimum distance from any conductive surface, as specified in MP-4. The excess power cord was wrapped in a figure-8 pattern to form a bundle approximately 8 cm in length. The EUT configuration was set for the highest emission frequency, and data was collected under the program control of the host computer. The spectrum analyzer collected the maximum peak readings over each spectrum. The six highest emission levels and corresponding frequencies were sorted and are listed in Table 1.

TABLE 1: CONDUCTED EMISSIONS RESULTS

Frequency (MHz)	Emission Level dBuV	Emission Level uV	Specification Limit uV
0.5345	33.2	46	250
7.085	33.1	45	250
10.08	33.1	45	250
10.42	33.3	46	250
11.62	33.4	47	250
13.41	33.8	49	250

While in the screen room additional analyses on the device was done. First a local probe was used to test the emission levels around the board and device. There were no measurable emissions at the I/O pins or their corresponding trace lines. Emissions were measured at the jack to the power supply. The power supply and cord were the greatest source of emissions for the EUT. This is due to the power cord being an antenna which emitted the noise from the power supply. Designers should attempt to minimize antennas, which emit EMI. Antennas could be the power supply cord, as well as traces on the system board.

Second the PIC16C54A was monitored for susceptibility, following the IEC 801-3 specification. This test was measured from 27 MHz to 500 MHz in 10 KHz steps. The device did not display any signs of susceptibility (see Table 2).

EXTERNAL TESTS

The open field site used for radiated emission testing was setup according to the FCC bulletin OST 55. Figure 2 shows the layout of the open field test site. The EUT was mounted on a turntable. The position of the turntable is remote controlled to determine the highest emission levels. Initial testing was done with a broad band mounted on the antenna mast distance of 3 meters. Further investigation was done to determine the EUT positions that produced the maximum level of emissions. The receiving antenna was mounted on the antenna mast. The antenna height was varied to find the highest level of radiated emissions at each frequency. The six highest emission levels and corresponding frequencies were sorted and are listed in Table 3. Figures 3 and 4 show the dBuV vs. MHz graphs.

TABLE 2: RADIATED SUSCEPTIBILITY

Frequency (MHz)	SPEC V/M	Threshold V/M	Modulation	Comments
27.0 - 500.0 †	3.0	> 3.0	80%	No Susceptibility

† Frequency incremmented in 10 KHz steps

TABLE 3: RADIATED EMISSIONS RESULTS

Frequency	Meter Reading (dBuV)	Antenna Factor dB	Effective Gain dB	Distribution Factor dB	Corr. Rdg dBuV/m	Corr. Rdg. uV/m	Spec Limit uV/m
36.01	53.1	11.8	34.0	0	30.9	35	100
40.04	53.0	11.3	34.2	0	30.1	32	100
44.04	56.1	11.1	34.0	0	33.2	46	100
48.04	55.1	11.0	33.7	0	32.4	42	100
64.05	55.2	9.0	33.9	0	30.3	33	100
112.05	56.0	10.6	33.4	0	33.2	46	150

FIGURE 1

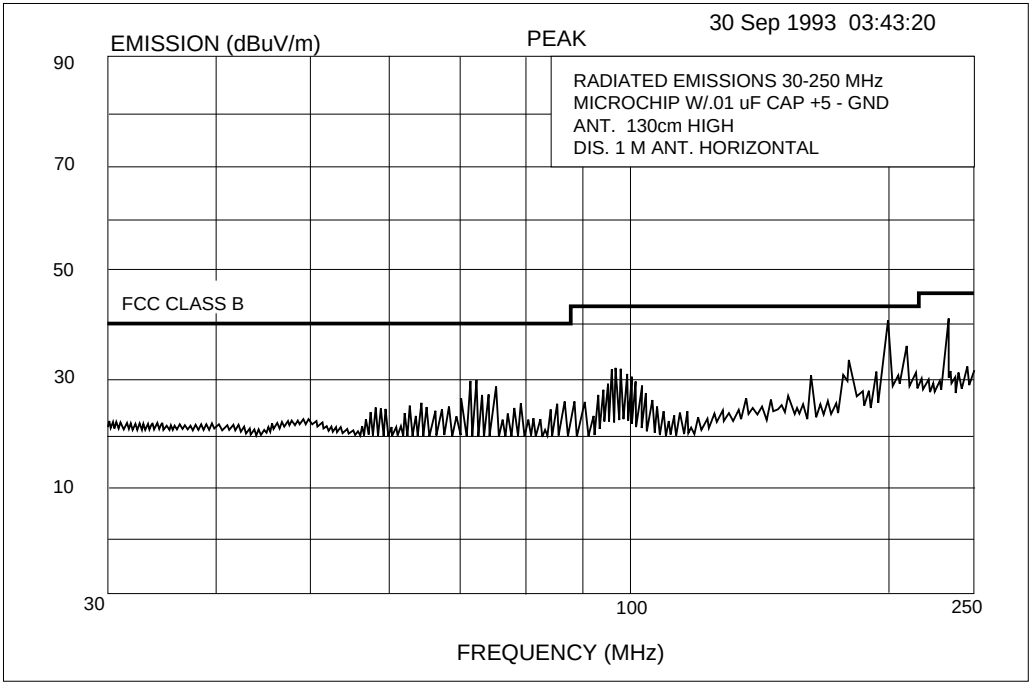
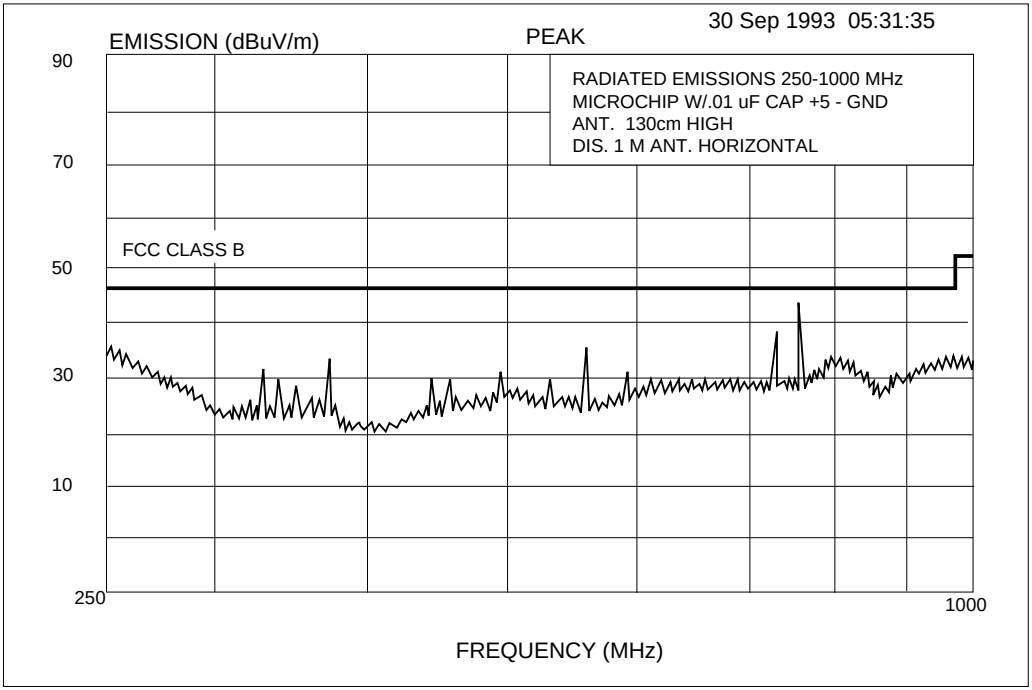


FIGURE 2



CONCLUSION

The PIC16C54A device can be implemented into system designs that are required to be certified to the FCC Class B specification limits as defined by the FCC Title 47, Part 15 Subpart B and IEC 801-3 susceptibility.

APPENDIX A: TEST SETUPS

FIGURE 3: CONDUCTED EMISSIONS TEST SETUP FOR SITE "A"

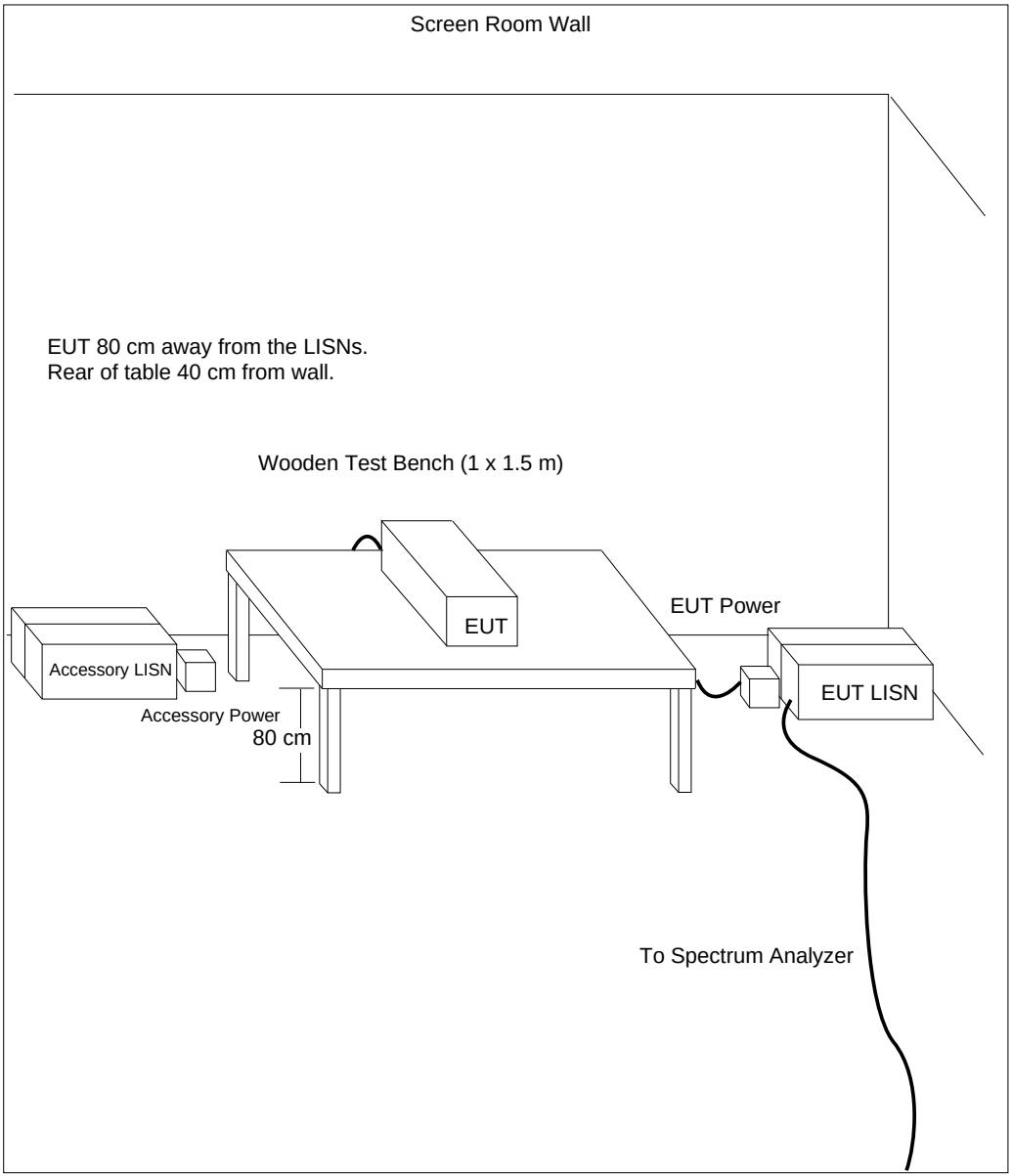
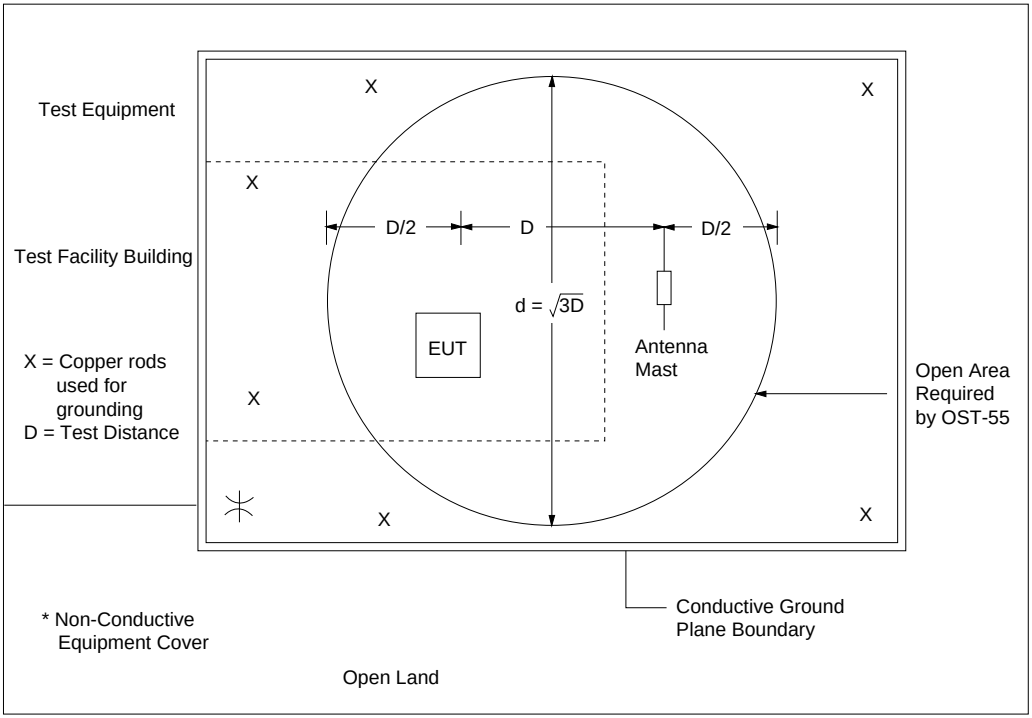


FIGURE 4: RADIATED EMISSIONS TEST SETUP FOR SITE "A"



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