MINIMAL HARMONICS

A final characteristic of the MC1496 modulation circuit that must be carefully controlled is the existence of harmonics in the spectrum of the output. These harmonics – portions of the signal which appear at multiples of the carrier frequency – do not actually harm the part of the spectrum necessary to recover the modulating signal. However, in the future of the project, we plan to add the output from multiple sensors to a single signal by modulating the outputs to different frequencies and then summing them. Harmonics in the output of the modulation would muddle the spectrum of the summed signal and make recovery of the original signals impossible. The mode of operation of the top-level transistors control the harmonic output of the modulator. If the transistors are run in saturation (with a carrier signal input of greater than about 15 mV) gain is increased but harmonics are outputted. A small carrier signal causes the transistors to run in linear mode, resulting in a much smaller gain but a cleaner signal.

RESULTS

In order to test all of these design choices together, a simulation was performed with a 3.2V source and configured for carrier suppression and minimal harmonics. The results are as follows:

FIGURE 7: Modulator output when the carrier-input transistors are run in saturation.

FIGURE 8: Modulator output when the carrier-input transistors are run linearly.

FIGURE 9: The frequency domain of the initial output. Note the carrier injection and harmonics.

FIGURE 10: The time domain of the initial output. Note the distortion on pin 2.