HRM Data Access

Problem analysis

Mon, Dec 16, 2002

After developing the software support for waveform access using listype 82, we have observed anomalous data points within the plots produced on the Macintosh Parameter Page "Fast Time Plot" display. This note describes the analysis of the symptom observed.

The "glitches" consist of mostly single data points that occur at the rate of replies to the request. Normally, the request is made for 15 Hz replies, which at 10KHz implies that 700 data points are delivered every cycle. If the request is made for 7.5 Hz replies, the glitches seem to occur at 7.5 Hz. Although a glitch does not occur for every reply message, glitches are observed to occur with separations that are multiples of 15 Hz cycles.

Along the way, we wondered whether an external noise source was causing some problem at 15 Hz, possibly caused by high power equipment in the hallway outside the lab test area, although this equipment does not fire every 15 Hz cycle. In case some noise interference was reaching the Hotlink communications between the remote and local parts of the HRM, we improved the cable connection that is used to carry the 320MHz Hotlink communications. Unfortunately, there seemed not to be any improvement using the new cable.

Late in the day, with more than one request active plotting this data, we saw that the glitches became worse. They still had a 15 Hz character to them, but there were more glitches when two requests were active rather than only a single request! This was a big surprise, since the system software treats all data requests independently.

This piece of evidence suggests that the glitches may be caused by the software accessing the circular buffer memory to fulfill the data request. Suppose there is an arbitration problem, such that when the CPU accesses a word of data at the same time that a (likely) different word is being stored into memory as a result of interpreting the latest arriving Hotlink frame, the CPU access is successful, but the fresh new data word is not actually stored. The glitch can be caused by the data word that was there 1.6 seconds earlier. (The period of wrapping the circular buffer is 1.6384 seconds. We earlier determined that the glitches do match the expected data that was in the signal 1.6 seconds earlier.) So the 15 Hz characteristic of the glitches is simply caused by the fact that the copying of the data occurs at 15 Hz intervals. During the copying of the data, it can easily be the case that one or more data words arrive to be stored nearly coincidentally with the data accesses. And with more than one request active, there are more chances for such arbitration-influenced glitches to occur, since the circular buffer memory is accessed twice as many times.