FTPMAN 1 KHz Snapshots

Addition to FTPMAN

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For several years, there has been support in FTPMAN for kiloHertz data in continuous mode. The addition described here provides such support in snapshot mode. It was prompted by the need to obtain FFTs for data from an accelerometer used as a vibration sensor. There is already a Vax console client program that uses the FTPMAN snapshot protocol to acquire the data on which it then performs FFT calculations. By providing snapshot support, one can obtain an FFT by using this client program.

The kHz digitizer is part of any IRM system. This Analog/IP (IndustryPack) board supports 64 multiplexed A/D channels. Every millisecond, the digitizer scans through channels 0–63 at 12.5 μs per channel, storing the results into 128 bytes of a 64K-byte circular buffer, thus allowing space for 512 sets, or slots, of data before wrapping. A pointer register holds the last written memory address. After the required 800 μs to digitize and store the 64 channels, an interrupt is delivered that allows the underlying system to time stamp the slot—by reading a 32-bit μs counter on the CPU board. After another 200 μs, the digitizations start again. This sequencing of digitizations is done by the hardware; no software intervention is required, except that a particular piece of data is available in the hardware buffer for only 512 ms, when it is overwritten by another set. Separate from the Analog/IP board, via the clock event decode logic on the Digital/IP board, an interrupt is generated that allows time-stamping each clock event. The first set of time stamps allow knowing the time that each data point was digitized, while the second set allows detection of the arming clock event time. Note that the digitizer does not have to be "reserved" to make a specific snapshot measurement. Its data can be shared for any number of purposes at the same time, just as a clock on a school room wall is shared by all students in the class. Thus, multiple users can be accommodated without interference with each other.

Building on the support already in place in FTPMAN for both Swift and Quick digitizers, additions were made for the kHz case. The characteristics of this support are the following:

- Operates at rates of 1000 Hz, or any submultiple down to 1 Hz.
- Arms on a clock event or when request is issued.
- Delays from 0 to 32 seconds may be specified, with time slot resolution.
- The number of data points are in the range 1–4096.

The logic is written as a state machine, in which the following states apply:

- Wait for event not yet occurred.
- Wait for event occurance.
- Wait for delay time.
- Collect data points at specified rate.
- Done. Data is available.

The logic begins with the present time when the request is received. In order to discover the clock event time, it is necessary to first see a 1000 Hz time slot that is prior to the event to be used. Then we can detect the first slot that occurred after the event and begin waiting out the delay from that time slot. (In the case that no event is specified, the state logic begins at waiting-for-delay. If no delay is desired, merely specify a delay of 0.) The delay logic works in time slot units. After the delay, data points are saved, sampled from time slots with a fixed separation until the specified number of data points have been collected.

While collecting the data, all data points digitized within the past cycle (10–15 Hz) are scanned with the required separation. The separation is 1 slot for a 1000 Hz rate, 2 slots for a

500 Hz rate, 3 slots for a 333 Hz rate, etc. When the last digitized point is reached, one may be only partly through a separation, so that a residuum must be retained for the next cycle's scan. By doing this carefully, one can sample at rates as slow as 1 Hz, even though the circular buffer wraps at about 2 Hz. For each scan, the present time slot is obtained by reading the memory pointer register and taking the upper 9 bits as the slot index. Since the present time slot is active—not all of its digitizations may have been completed—we back up one slot and use it as the last one which can be examined during the current scan. At a cycle rate of 15 Hz, about 66 slots will be scanned each time. During data collection at rates less than 1000 Hz, only slots with the appropriate separation need be scanned.

A simple example is when the digitize rate is the full 1000 Hz. In this case, the separation is, of course, one time slot. The residuum will also be one time slot. The slot number retained from scan to scan is the slot from which the last data point was taken. In another example, with a 500 Hz rate, the separation is 2. The residuum may be 1, or it may be 2. Each cycle, when the scan completes, the slot that is retained is the last one scanned, thus ending at the last data point measured. At a rate of 1000 Hz, this last data point is also the last one accumulated, and the residuum is one. The retained slot, plus the residuum, denotes the slot from which the next data point will be taken, when the time is reached when it has been measured.