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LOOPING ANALOG DATA TAKING PROGRAMS

INTRODUCTION

Looping analog data taking programs are assembly language programs, written for the LSI 11 computer, that will sample 4000 data points in a loop until ST2, on the clock, is externally triggered by some event. The programs then sample up to 12,000 more points. The first 4000 points are saved in one area of memory, and the points after the trigger are saved in another area in memory. There are two separate A/D converters; one has DMA hardware. The A/D without DMA has 16 channels, single ended; the A/D with DMA has 32 differential channels, of which we only use 16. The program named DATAKE is used with the A/D without DMA and the program FASTAK is used with the DMA A/D. Both programs trigger the A/D converters at specific intervals. Minimum time is 300 microseconds for this interval. The interval time, number of points, and number of channels are user selectable. These programs were written to replace ASP_1 and $ASP2_2$. Both programs are used for superconducting magnet quench studies, but could be used for other purposes.

GENERAL

In the quench studies, it was found that some prequench data was needed. These programs continually loop through 4000 points until the quench triggers ST2, thus allowing better resolution as to where and how the quench started.

After the selection of interval time, number of channels, and number of reads, the program starts taking data and storing it in memory. After 4000 points have been read, and there was no trigger, the program loops back to the beginning of this data area and starts writing over the data already stored. When Schmitt trigger 2 on the clock receives a trigger, the program jumps to an interrupt routine. This routine then saves the location, in the loop, where the last point, before the trigger, was stored. Also, the number of points to the end of the loop, from that point, is stored. The interrupt routine then sets things up to start storing data in the second data area. When all points selected by the user have been taken and stored in memory, the program then goes to a routine to store this data onto a floppy disk in RT 11 format; each file represents a channel. The data is taken out of memory and stored a channel at a time starting with the next location, in the loop, after the location which was saved by the ST2 interrupt routine. This sequence runs to the end of the loop and then picks up the locations at the beginning of the loop and runs to where the ST2 interrupt came. At this point, the locations are picked up from the second data area, and the routine stores the rest of the data.

This sequence is repeated for each channel read and each file is named CHxx.DAT. xx representing a 2 digit channel number, i.e., ØØ,Ø1 etc. If 16 channels and 16000 points per quench are read, then 3 quenches per side can be stored on a disk. To retrieve data from the disk, any routine which can read RT 11 formatted data can be used. The stored data is a 16 bit word with the lower 12 bits (0-11), a representation in offset binary of the analog voltage. Bits 12-15 are zeros.

If the A/D converter without DMA is used, then the data is taken by sequentially reading each channel selected at the interval rate selected. The data is stored with the channel number in memory. This program is called "DATAKE".

If the A/D converter with DMA is used, then the data is taken in bursts. All channels selected are read at the converters maximum throughput and the interval time between bursts is that selected by the user. The data is stored in memory without the channel number. After all points have been taken, the channel numbers are inserted in the upper four bits of the data word and then transferred to the disk. This program is called "FASTAK".

Both of these programs rely on the RT11 operating system to remain in memory; hence, only 16,000 total number of data points possible. When the program ends, control goes back to the RT11 monitor at which time, the new files can be renamed so they are not overwritten by another run of the program.

PROGRAM PARAMETERS

Query is made at the start of the programs for the user selected parameters, in the following sequence.

Select Interval Time

This is the time interval between readings. With the A/D without DMA, this means time between channels. With the A/D with DMA, this is the time between bursts of reads. Times run from 0.3 millisec to 999 msec. There is a restriction with the DMA A/D. That is, with 1 to 2 channels. 0.3 millisec is allowed. With 3 to 5 channels, 0.4 millisec. With 6 to 10 channels, 0.5 millisec; and with 10-16 channels, 0.6 millisec is allowed. These times are set by A/D throughput and memory refresh times.

Select Total Number of Reads

The "DATAKE" program asks this question and the input by the operator is the total number of reads including reads in loop; i.e., 16,000 = 4000 in loop and 12,000 after ST2 or 10,000 = 4,000 in loop and 6,000 after ST2. Must request at least 4000 reads.

Select Total Number Reads Per Channel (Max 1000 with 16 Channels)

The "FASTAK" program asks this. Input by operator is the total number of reads per channel including reads in loop. This number times number of channels to be read not to exceed 16,000. Must select a number that will give at least 4000 reads total.

Select Channel Numbers (A = ALL)

The "DATAKE" program asks this. Operator input is the channel numbers wanted to be read; i.e., Ø,1,2,3, or 1,5,7,11. If the A is typed, all 16 channels will be read.

Select # of Channels to be Read

The "FASTAK" program asks this. Operator input is the number of channels to be read starting with channel ØØ; i.e., 1Ø would mean channel Ø-9 would be sampled.

Required Hardware

LSI 11	28K Memory
Dual Floppy Disk	
A/D	Either DMA for FASTAK or no DMA for DATAKE.
Clock	KWV 11-A
CRT Terminal	

Comments

These programs have been tested and are free of software and hardware bugs. The minimum interval time is a hardware restriction with LSI 11, due to memory refresh.

References

1. Analog Sampling Program, EP&S Tech. Note 85, V. Kovarik and R. Stoehr 11/20/78.
2. Analog Sampling Program 2, EP&S Tech. Note 86, R. Stoehr and Kovarik, 3/2/79.