DATA ACQUISITION WITH MASSCOMP

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Applications and products for data acquisition and control are abundant. Systems and boards for Apple or IBM products collect, store, and manipulate data up to rates in the 10’s of thousands. These systems may suit your application; if so, it would be good for you to obtain one of these systems. However, if you need speed in the hundreds of thousands of samples per second and you want to store, process, and display data in real time, data acquisition becomes much more complex. Operating system code has to be sufficient to handle the load. A company known as Massachusetts Computer Corporation has modified UNIX operating system code to allow "real time" data acquisition and control. They call this operating system Real Time Unix, or RTU. They have built a family of computer systems around this operating system with specialized hardware to handle multiple processes and quick communications, which a "real time" operating system needs to function. This paper covers the basics of an application using a Masscomp 5520 computer. The application is for the KYLE Project Cold Tests in SRL. KYLE is a classified weapons program. The data flow from source to Masscomp, the generic features of Masscomp systems, and the specifics of the Masscomp computer related to this application will be presented.

Temperature and pressure data are generated during a KYLE test in the form of millivolt outputs. Temperatures during testing range from ambient to 1500°C. Type K thermocouples are being used. Pressures range from 0 to 30,000 psi. The pressure transducers being used are Sensotec models, which receive 10V excitation from the signal conditioners. The signal conditioners are Ectron model 687’s. They were chosen for their good performance characteristics: 0.5uV/C zero stability, 0.3uV peak noise, 0.01% linearity, 0.005%/C gain stability, and differential inputs. A set of options for the 687’s used for pressure included a Reference to Output (RTO) zero and an isolated excitation supply. The set of options for the thermocouple conditioners included an RTO zero, a coarse and fine Reference to Input (RTI) zero, and an ambient temperature compensator card on the circuit board. The signal conditioners also operate as amplifiers. During calibration, gain is set to adjust the desired range of operation. Output from the conditioners ranges from 0 to 10V DC. These outputs are fed into the Masscomp computer as differential inputs to the data acquisition module, using twinax cable. The output range corresponds to a calibrated temperature and pressure range. The layout is shown in Figure 1.
As the host processor, memory, and data acquisition system, the Masscomp 5520 computer has the following features:

- MC68010 (12.5 MHz) or MC68020 (16.7 MHz) CPU options
- Board level floating point processors and array processors
- Can utilize up to 2 CPU’s
- SCSI tape drive; 142 Mb hard disk drive
- Modular front end system (9 slots available)
- RTU - enhanced UNIX with System V and Berkley "universes"
- Language compilers - C, FORTRAN, Pascal (additional compilers from third party vendors)

An additional software feature available from Massachusetts Computer Corporation for their Masscomp computer products is a menu-driven program called Laboratory Workbench (LWB). Figure 2 shows a screen display of LWB after setup; it took about three minutes to set up this display the first time. The user builds the data flow diagram with a mouse while the program takes care of accessing the various modules selected. Actual data can be a test signal or an actual signal fed through available modules such as an averager, oscilloscope display, filter, or storage device. Data is displayed and stored in real time. For the KYLE project LWB was used for calibrations.

Front end modules available are clocks, signal conditioners, filters, sample and hold modules, multiplexers, digital-to-analog converters (D/A), analog-to-digital converters (A/D), serial and parallel digital I/O, a GPIB interface, and an IEEE 488 bus. Figure 3 shows these modules in a general arrangement.

The KYLE application contains the following modules:

- Two A/D Converters
- One Parallel, Digital I/O
- One D/A Converter
- Clock Module
The A/D converters are used to input differential field signals. Use of the Parallel Output was attempted in order to generate the initiating pulses for the KYLE tests, but the D/A converter produced better results - a clean, repeatable pulse with accuracy better than 0.01 millisecond. The clock module produces the pulses which trigger the A/D and D/A devices. A program in the C language creates the user interface and calls functions provided by Masscomp to control the modules.

The data parameters of the KYLE application include sample rate, storage and display, averaging, and accuracy. The data for this project is being sampled at 1000 frames per second, 16 channels per frame; that is 16,000 samples per second. We chose a system capable of higher sample rates to allow us to do more averaging. Sample rates on the order of 160,000 samples per second will be used in the future. While sampling, the data is stored and averaged by the C language program. The system resolution is 16 bit. The system accuracy is approximately 14 bit. The acquisition contributes a factor of ten less than the error of the transducers and thermocouples; therefore, the accuracy of the data is limited only by the transducers and thermocouples.

This data acquisition system is a high speed, accurate system of hardware and software presently in use at Savannah River. There are at least four other systems being used in a similar fashion at SRP. As technical assistance needs have arisen with these systems, Masscomp manufacturers have responded quickly and precisely. Masscomp computer systems are certainly contenders for future high speed acquisition applications at SRP.

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KYLE - Data Acquisition Layout

Electron Signal Conditioners

KYLE

ΔT

ΔP

1–8

9–16

MASSCOMP
FIGURE 3

GENERAL DATA ACQUISITION SYSTEM

FRONT-END MODULES

SIGNAL CONDITIONER
SC-16F
TC-16F

(FILTER)
(FL-16F)
FL-16F

S/H
MUX
SH-16FA
MX-48
MX-48F
MX-256

A/D CONVERTER
DA-08F
DA-04H
AD-12
AD-12FA
AD-16FA

SERIAL
DIGITAL
SL-02

PARALLEL
DIGITAL
PI-16
PI-16F

GPIB INTERFACE

IEEE 488 BUS