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NEW TECHNIQUES FOR DATA TRANSFER

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1 Introduction

Over the past decade we have seen a rapid increase in the number of micro-processor controlled instruments. Gone are the days when the old fashioned analogue meter was the only read-out option. Today digital display and processing are also available to us at a cost often less than the analogue equivalents. This computer revolution has put manufacturers under increasing customer pressure to put more and more features into their instruments to increase the functionality and the sales specification. The logical way of achieving this has been to introduce a microprocessor into the heart of the unit.

This leads to the dangerous situation where the instrument size is falling, the features are increasing and the ability of the user to operate the instrument becomes more and more problematical, the 'video recorder' syndrome. This paper describes how one UK manufacturer has approached the problem by not only transferring the data to a host PC for manipulation, the 'outbox' processing technique but has as well ensured that all computer software is designed at the same time as the instrument allowing the users needs to be kept in mind at all stages of the development.

This ergonomic approach rather than the common 'computer programmer' approach, has led to a rapid acceptance of the micro-processor as an essential element in new designs. In particular, the use of Electrically erasable PROM has allowed units to be built where the memory is truly non-volatile as opposed to battery backed data which is always at the mercy of discharged batteries. The field is still fluid and no doubt in a decade, we will see instruments of a power beyond the imagination of many designers. For these, computer operation will be essential. For less complex designs it will simply be less expensive.

2 The Instrument

The particular instrument we have chosen to illustrate this progress is the Cirrus Research CRL 702 Integrating Sound Level Meter. This unique unit is a two channel instrument with multiple functions. The two channels measure the 'C' Peak value at the same time as the 'A' weighted exponential sound level or Leq. As far as we know it is the first such unit and has features which show the unique advantages of a micro-processor design. For Cirrus, it is a second generation unit, the first generation instruments while very sophisticated were as large as the units they replaced. This new instrument is as small as a simple analogue meter, in fact it shares a case design with such a device, to reduce manufacturing costs.

However, the main features of the instrument are the provision of several features which rely on the use of the microprocessor for their implementation. These are:-

A raw data store
A user programmable key-pad.
An 'Event' store
Housekeeping functions
Remote control via the RS 232 port.

2.1 Raw Data

The technique of outbox processing [1&2] has been well documented and is essentially the storage of large amounts data, usually as short integrals within the instrument. At any time later, this data can be retrieved and transferred to a personal computer to re-process. Figure 1 is a re-constituted data file where 1 second Short Leq was the basic data element. The data was in fact taken on a CRL 702, but could equally have come from the original data storing unit, CRL 236. The form and storage of the data is identical, a vital point for the user. The CRL 702 can store data elements going from 1/16th Sec up to 16 seconds giving almost unlimited operating times. The software to produce this is the suite ACOUSTIC EDITOR and an important point is that the software was commercially available for some time before the instrument, thus compatibility was clearly kept in mind during the design and is thus not a problem.

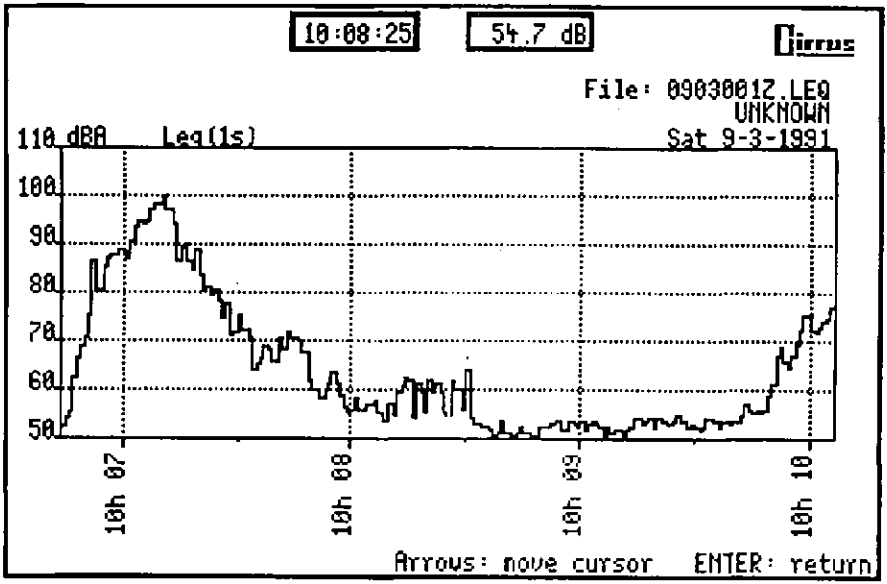

Figure 1 Plot of Short Leq data

2.2 A user programmable key-pad

This is another unique feature available only by the power of the micro-computer. The instrument has in its internal program over 100 different key functions. The front of the instrument has only 16 keys and therefore the problem of accessing the 'lost' 85 has to be addressed. One way is to have a new front panel for every module or version, but this is expensive, complex and rather old fashioned. Instead, the keyboard is made semi-transparent and the key functions are printed on a piece of paper introduced behind the front of the key-pad. A small piece of paper being rather less expensive than a new front plate for every different configuration.

The paper slip is generated by an program on the external computer as part of the selection process for the keys. Figure 2 shows the screen display for this program, which shows the current key allocation. To change this, the computer offers a full list of all the possibilities and they are selected with the cursor. The limits of paper size do not allow the full list to be shown.

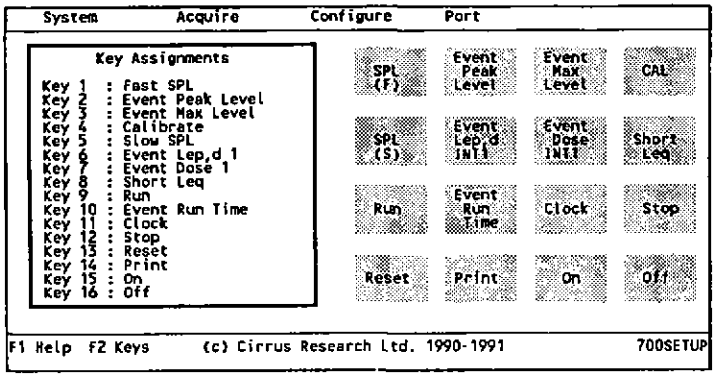

Figure 2 Keypad Configuration

Naturally, many users will not wish to change their key functions and therefore simpler software is provided with the unit to allow simple housekeeping functions, described below.

2.3 An 'Event' store

This function is another which could not really be incorporated without a microprocessor. An 'event' in this connotation is simply a set of measurements taken over a defined period. For example, the following set of measurements could be used to describe an 'event'.

L1, L10, L50, L90, L99, Leq, Start time, Duration, Max level

An event could equally be 10 other acoustic parameters including the peak value in the period for example. The event itself can start at pre-set periods, on demand, or any combination of times required, all programmed into the memory of the instrument, using the EEPROM. Some of the uses of this technique in the recording of noise data have been reported elsewhere. [3]

2.4 Housekeeping functions

These are more and more coming into prominence as vital tasks for the micro-processor. Such matters as the internal real time clock, time slicing the operation, remembering the key strokes and functions and a host of other things, which were once done by slide switches and hard wiring, are now part of the task of the

computer. In addition new tasks have been invented. For example, there can be a 'watchdog' which checks for correct operation and resets the system if problems occur and routines to check the calibration to allow data correction to be carried out post acquisition. Other critical functions include such things as locking the keyboard to prevent tampering

2.5 Remote control via the RS 232 port.

Naturally, most of the features described above would not be possible without a method of talking to the outside world, usually a host computer. However, an RS232 allows direct 'talking' to a printer and so the housekeeping function allows data to be sent out to a printer in formatted ASCII. Figure 3 shows the results of such a printer 'dump'. The RS232 is bi-lateral, that is to say data can be sent to the instrument to re-program the keys, operate it remotely or the instrument can be connected to a MODEM and remotely controlled via a telephone line or hard wired link.

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CRL 702

Baud            9600          Calibration Due  01/11/92
Range           60.0-132.3    Weighting  A
Time Constant   Fast          Ln         Fast
Reset Time 13:13:22  5/11/91  Battery    Ok
Time Integrator      .12 sec   # Events   2

             Run       Stop   120.0 Thresh.  Overload
Time         02:27     01:02      00:00      00:00 hr:min:sec

          Peak    Max    Min   Cal 1  Offset 1 Cal 2
Level    114.8   87.4   61.7     0 +     .0       0     dB
Time     13:15   13:15  13:15   00:00                00:00 hr:min

Total  Start  Run Time   Leq  LEPd  L 10  L 90  Peak   Min   Max
       13:13    02:27  68.9  46.1  71.2  62.2 114.8  61.7  87.4


Event  Start  Run Time   Leq  LEPd  L 10  L 90  Peak   Min   Max
 1     13:13    01:06  70.6  44.4  73.9  62.6 101.2  62.0  84.0


 2     13:15    01:20  66.7  41.2  66.3  62.1 114.8  61.7  87.4
```

Figure 3 Dump to printer showing two events

When connected to an external computer, either directly or via a modem, all the 100 or so functions of the instrument can be used, the 16 key limit not being relevant. In fact the only function not really sensible for remote operation is the automatic calibration feature, which requires someone to physically place a sound source over

the microphone. Even the OFF key can be operated remotely, but if this is used the unit cannot be turned ON again.

3 Software

Because the instrument requires an external computer to operate at anything like full performance, it is our contention that the basic software must be provided at no charge as part of the unit. There seems no logical difference between asking the customer to pay extra for the design and asking him to pay for software which is vital to the operation. Other people defend their high software charges on the grounds that it has to be written and the user must pay. The same argument applies to the design. It has to be designed, but that is part of the price. Thus, the minimum software required is shown in Figure 4 and as can be seen allows the vital functions of clock setting, keyboard locking and ASCII data transfer to be done on any MS-DOS computer.

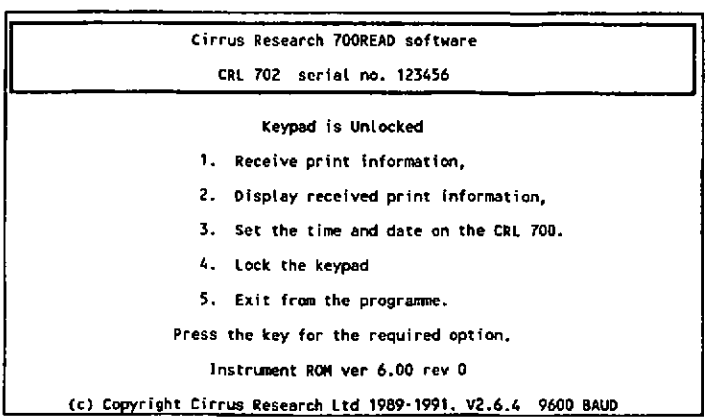

Figure 4

Additional software to carry out higher tasks not needed by every user, are reasonably at extra cost, but again we believe that the costs should not be such as to allow huge profits, but should be part of the service to the user. For instance, the program 700SETUP which allows key function re-allocation, is about 350 kilobytes of executable file, more than many programs with far less functionality which sell for thousands of dollars, or crowns. On the basis that software cost should reflect the

features and commercial appeal, the software cost could be many times that of the unit, an un-acceptable situation in our view.

4 Summary

With recent advances in technology, instruments become more powerful and, of course, more complicated to use. The task of the external computer and software is to attempt to take the strain out of extracting large amount of information from the micro-based instrument and at the same time increasing the processing power. It is essential that the software is designed to make these processes as efficient and straight forward as possible.

The benefits of such a strategy are fairly obvious. With a well designed system, the configuration, measurement, acquisition, transfer to computer, processing and correlation of large amounts of data can be carried out efficiently and with greatly reduced manpower requirements - all the processing and report production is assisted by the computer. Efficiency is considered very important in the current economic climate. The dangers are that a badly designed system could become cumbersome and difficult to use.

5 References

[1] Wallis A.D. & Holding J.M. "A method of generating Short Leq"
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[2] Wallis A.D & Luquet P.J "Computer Acquisition of large data sets"
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[3] Wallis A.D & Hill R.C "A new technique for long term noise surveys"
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