Proceedings of the Institute of Acoustics

A NEW TECHNOLOGY DATA STORING DOSEMETER

Wallis A.D. (1) & Krug R.W. (2)

(1) Cirrus Research Ltd. Acoustic House, Hunmanby, United Kingdom
(2) Cirrus Research Inc. 6818 West State St., Wauwatosa, WI 53212, USA

INTRODUCTION

With the constant increase in speed and power of microprocessors, the performance gap between 'inbox' and 'outbox' processors has been reduced. This has allowed the development of a new generation of Sound Exposure Meters which combine the performance of the older 'Dosemeters' with that of a Sound Level Meter, an Leq meter, a Data Logger and a Statistical Analyser. Originally designed to meet the new IEC standard for Personal Sound Exposure Meters, not yet published (1), the technology now available offers unparalleled accuracy and performance in a unit less than one fifth the volume of current units.

The new unit, the CRL 7.01, while retaining a conventional analogue sound level meter input, incorporates a microcomputer to control its operation and thus all the functions fitted are user programmable, although for normal use this feature is not needed as the unit is supplied set up for the location and function required. However, if the user does wish to reprogram the unit, this can be done by means of an external program and a standard MS-DOS computer.

The unit is essentially three instruments together. The first is a Short Leq Data Logger somewhat similar to instruments previously described, (2). The second is a keyboard operated two channel Sound Level Meter with a statistical analyser added to store a series of Ln values at predetermined intervals, while the third is a Dosemeter.

While the CRL 7.01 is tested to type 1 of IEC 651, in common with other instruments having the Cirrus concept of Grade Convertibility; a standard option allows the use of a microphone to type 2 of this standard, thus making a considerable saving on the initial purchase price for applications where type 1 is not required.

The instrument is designed to meet the new proposals for a class 1 unit (3) which, in the first draft, suggests that the tolerances for electrical performance should be similar to current type 0 standards, thus fully meeting type 1 performance when a microphone is fitted. This implies that even after long use as a type 2 unit, the tolerances should remain well inside the Industrial Grade performance requirements.

A NEW TECHNOLOGY DATA STORING DOSEMETER

TECHNOLOGY

The construction of the unit follows conventional computer practice being totally designed, drawn and produced using CAD techniques. This allows the internal construction to be made entirely in surface mount components, taking very little space and increasing the reliability of the final unit. This is particularly important in a computer based unit, as reliability has been a significant problem with the first generation of computer instruments.

The microprocessor is a new device, intended for use in the electronic control of vehicles and has already been chosen by a major automobile manufacturer for incorporation in their 1991 models. This means that the manufacturer of the computer chip has been able to invest time and effort into increasing the performance of the chip with the knowledge that there will be a mass market. Thus the cost of the chip is much reduced and there is a large body of data including compliers, assemblers etc. available for use. For an instrument manufacturer this means a chip is available with up to the moment technology.

The complete external control of the instrument also allows the user to load in a completely different operating program. Thus, if the 'housekeeping' algorithms are not suitable for a particluar use, or are in any way flawed, a new program can be loaded into the unit from a floppy disk. Thus, the problem of instrument updating is simplified to simply sending the user a new disk which will automatically update the internal firmware. As the history of computers tells us that all programs are 'bugged', this is likely to be a very useful bonus to users.

APPLICATIONS

The CRL 7.01 is designed to be used as a Dosemeter, a Sound Level Meter, an Leq Meter or as a Data Logger. As an 'outbox' processor, it can acquire over 50,000 samples as 'Short Leq' elements or as sound level samples, allowing it to operate for well over 12 hours storing a new Leq or sample every second. The data so acquired can be transferred to an MS-DOS computer for analysis using a standard program such as Acoustic Editor or dBTRAIT. Naturally elemental periods and sample times other than 1 second are available giving longer or shorter operating times with varying time resolutions. In this 'outbox' processing mode, the CRL 7.01 can be used as a 'stand alone' Data Logger, but the main use envisaged for the function is to act as a control to the 'in box' processing functions. There is a user option to change the amount of raw data stored and instead store more processed data. For example, if 5 Ln values were stored, each set of Ln values would equate to 40 samples.

In an 'in box' processing mode, the CRL 7.01 can itself make many of the calculations required and print these out onto a standard printer without the need for a computer. Thus for example, the Leq and up to 8 Ln values can be printed out as often as required. The values are calculated internally and

stored in an area of memory reserved for the 'Print' function. Naturally, the data can also be played back on the instrument's own display so even a printer is not essential for operation in this mode. The limitation of this mode is the same as all 'inbox' processors, in that a decision has to be taken as to what indices are computed. There is an advantage, however, in that the power of the microprocessor used allows many more simultaneous functions than has been previously practicable.

The third mode and the one with particular reference to the new Safety At Work act is the simple 'single number' output of the 8hr LAeq and the unweighted peak value. In this mode, the CRL 7.01 acts just like an old fashioned unit giving a single number at the end of the working shift to comply with the new act. In fact many numbers can be read, including the Leq and the unweighted peak over the same period. In this mode, each key will normally have a single function. However, while in this mode, the unit can still be used as a normal Sound Level Meter without in any way affecting the acquisition of the dose data. A 'cone' is available to fit the end of the unit, to hold the microphone to ensure that when it is used as a type 1 precision Sound Level or Leq Meter, case reflections do not give invalid results. When the cone is fitted, the CRL 7.01 has, therefore, the appearance of a conventional Sound Level Meter.

All these three functions can operate at the same time. Thus, if the CRL 7.01 is being used as a simple 'single number' Dosemeter, there is probably no need to look at the stored data if the final number is less than the local criteria, usually 85 dBA for 8 hours in most responsible industries. However, if the criteria is exceeded, the stored data can be printed out directly onto a printer in the form of say, hourly events, or it can be transferred via the RS232 port to a computer and the exact time history of the noise inspected, on a second by second basis. In this way, the time of each exceedence can be found which allows remedial action to be taken.

READ-OUT FUNCTIONS

The LCD display can show any one of about 60 parameters as the keyboard and display are fully programmable. The internal 'firmware' of the unit is in non volatile yet erasable memory which can be accessed via the RS232 port. Thus, it is a simple matter to reprogram the unit to different functions using a simple external computer. All the acquisition and data calculation parameters can be so modified, although for the normal user, none of this is obvious and the device appears to operate just like a conventional unit with 16 key functions.

To change the parameters, a program is run on the external computer which first shows the current key allocations and the functions being stored. Any or all keys can now be reprogrammed to carry out other functions and to change the whole operating parameters. When this is done, the computer will printout a new keystrip which slips behind the transparent keyboard to show

the current key functions. The same program sets the internal clock if required and adds text into the memory so as to identify the unit on each printout. The probability is that most users will have a series of set measurements to make, in which case the program will never need to be used, except in spring and autumn when most time zones change to or from daylight saving time. In other words, the concept of buying separate modules and faceplates to change the function is replaced by software and a paper label.

OPERATION

The unit is designed to be as foolproof as possible and destructive functions such as 'OFF' cannot easily be found by accident. For example, in one configuration, pushing 'OFF' simply shuts down the current display and stops the current calculations. It does not, however, stop the acquisition of raw Short Leq data into memory, thus a worker cannot override data acquisition.

Also, as each session is put in to memory, that is every time RUN and STOP are pressed, a data header is stored in memory with a summary of the previous session, including the statistical data associated with that session. This allows the user to review the data on the LCD display without the need for a computer or printer, in other words it can mimic the operation of existing units, thus, reducing training periods.

SOFTWARE

For general purpose acoustic measurements, the suite Acoustic Editor is usually used, but special simplified programs are available to present the stored data in forms required by different countries and in many languages. French, German, Spanish and English are standard, but other languages are in development. The different standards of, say, the USA and the UK are also catered for, in particular the 5dB and 3dB doubling rules. However for any function, the CRL 7.01 can behave as a simple terminal and, therefore, any conventional communications program can be used to talk to it, making it available in any language in which communications programs exist. The data format used for storage and the meaning of the commands is included in the operating manual, thus, any special needs or unusual data format can be handled without the need to buy special drivers. In particular, it means that the raw or processed data can be called up by many commercial programs and processed with a standard spreadsheet or wordprocessor.

Naturally, this suggests that the CRL 7.01 can be used with a modem in a remote monitoring role and of course this can readily be done. The RS232 while normally configured for 9600 baud can be slowed down to the standard speed allowed by the telephone company, rather snail like in the United Kingdom. Because the RS232 is configured as a full duplex system, all the functions of keyboard, read-out, calibration and resetting can be performed remotely.

A NEW TECHNOLOGY DATA STORING DOSEMETER

SUMMARY

The use of an embedded microcomputer coupled to a classic analogue design of Sound Level Meter gives a new meaning to the word `flexible'. By the use of software, a simple unit originally intended for use by Industrial Hygienists and Safety Officers, is also able to perform the measurements required by Environmental Health Officers, etc. While limited in total memory storage by its small size, the CRL 7.01 can replace several current units and perform in a similar manner to them all.

It is clear as the power speed curve of embedded microprocessors increases, such devices as the unit described will become more and more powerful, eventually incorporating frequency analysis as well as time and level data.

References:

(1) EC Standard, 'Personal Sound Exposure Meters' voting draft 1989 (unpublished)
(2) Proposed IEC Standard, 'Sound Level Meters' Draft 1 1989
(3) Wallis A.D., 'Short Leq' A New Acoustic Measuring Technique. Acoustics Australia Vol 15 No.3 pp 65-68 Dec 1987