Institute of Acoustics

NEW TECHNIQUES FOR REAL TIME CONTROL

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INTRODUCTION

This paper looks at Sound level controllers, usually called simply Noise limiters from the first crude units to the devices which current technology has made available to us. In 1986 the publication of recommendations for such units have resulted in much effort being expended in trying to make limiters more relevant to the real purpose, which is to protect the customers, neighbours and attendees at disco's from the very high noise levels in such places. Several papers, published over the last few years, detail the problems with the existing units.

HISTORY

As far as is known, the first practical production limiter was designed by the author in 1970/71 although certainly before this there had been "one off" units in Canada, France and the United States. Most of these were designed by electronic engineers with no real knowledge of acoustic problems. The motivation of the original unit was an idea by the Noise Abatement Society to produce such a unit in response to wide publicity against really noisy Disco's. The final result was that the author would design the unit to be featured on television on a science programme.

In the event, this was done and to be newsworthy on television, the name 'Electronic Orange' was thought up for the device. At the time, the film Clockwork Orange was on current release and the name was a great help to the sales people.

By today's standards the device was crude in the extreme. It's sound level meter part was not even a real sound level meter, but simply the circuit board from the cheapest indicator in the range at the time. The trip level circuit was unstable with temperature and the microphone was the cheapest magnetic unit intended for home entertainment applications. The result was that the unit did not meet, nor was it intended to meet, any National or International standard.

For a television show and in concept, it was ideal, but sad to say, for the next 10 years, the company did no serious modification to the circuit to improve it's real performance as despite it's low accuracy, it continued to sell in large numbers to the companies continued profit, which after all is the raison d'etre for a company. As the then chief designer, naturally the author must accept a major part of the blaim, but the rather more important matter of a range of precision meters took all the engineering effort.

It is believed that the same unit may still be in production, 16 years after it's original design with new logo and paint work to achieve significant performance improvements. If so, a remarkable record for a piece of installed electro-acoustic equipment in the first world.

Various versions of the unit were produced, including a unit with multiple display levels, with a similar basic circuit. Between 1971 when the first unit was made, and today, no less than 12 different units have been produced in different countries, all doing essentially the same thing.

What then do they do? In essence, they usually consist of a sound level meter with two electronic triggers fed from the sound level meter's dc output. The first of these usually feeds a device to indicate the pre-set level has been reached. This usually has no other function than as a warning and is usually called the warning level. The second trip is usually at a higher level and has a delay before it actually has any effect. In the original unit, it was arranged that a combination of level and time would set the trip rather than a simple level. This idea, which somewhat pre-dated Leq meters, was an attempt to make the unit respond to noise Dose rather than a simple level. The trip was exactly what it said, in most applications, it simply cut off the power to the amplifiers and thus achieved silence. After a short period, the power would be restored and the dancing could go on. The timings were such that in a normal disco, the actual dancers would not stop, but the DJ or band would be acutely aware that power had gone off.

There were many problems with the system. Firstly, it was difficult to calibrate as the microphone was not a type that would accept a close-coupled calibrator. Thus all calibration had to be done with a sound level meter mounted alongside the microphone or by making an estimate of the difference in levels between the limiters microphone and the sound level meter.

Secondly, the limiter had to have a long lead from the microphone to the controller because of the physical configuration. This often caused pick-up into the input from the ac mains.

Finally, there was often a conflict in the mind of the Environmental Health Officer who wanted to protect the environment and at the same time wanted to use A weigthing to compare results with measurements made with a normal Sound Level Meter.

To protect the environment, the attenuation of the building together with the spectrum of the noise needs to be taken into account. Rock and Pop 'music' has a predominantly low frequency spectrum (ref 1) and A weighting is a poor control for noise escaping via a structure which itself has a poor low frequency attenuation.

The units were also unpopular with groups on the grounds that they "restricted artistic freedom". All manner of ills were laid at their door, including the hoary chestnut that they 'blew up' amplifiers. Despite offers to replace any amplifiers which it could be proved had failed due to the units, no-one ever came foward to claim a new unit. However, despite this, popular myth continues to claim this often happens. It is rather like the elephant and the bubble car. Everyone knows someone who knows someone who actually saw the elephant sit on

the bubble car. Even at professional conventions, consultants claim that this happens, but so far, have only given anecdotal evidence to support the claim. No doubt at some time an amplifier has failed coincedentally with power supply re-connection, it would be a miracle if not.

COMPETATIVE UNITS

During the late 70's several other companies made units which were in essence similar. Even today, there is a large number of units with various performance parameters, all of which function in a manner which either cuts off the power to the amplifiers or puts an attenuator in the loudspeaker line, or elsewhere. Some of these units are made by companies who also make sound level meters and presumably they have an acoustic performance which bears some relationship to a National standard.

Some of the units have clever displays which attempt to improve the visual appearance or to increase the message content. This is usually done by multi-level light displays and in some cases these are very clever indeed.

However whatever the limiter display, at the end of the day, either the power must be cut off, or the signal level must be reduced. The reduction can be a step function or it can be a progressive level reduction. The former is usually to be preferred as this tends to lead to a better sound signal. Many companies use limiting amplifiers, as the method of progressive reduction, while others use simple clipping either hard or soft depending on their point of view. However, if the amplifier has nonlinearity, by definition it distorts.

THE FUTURE

It is often said that the last thing a manufacturer should do, is to make predictions on the future form of a particular unit. If they are correct, or even believable, all this does is to give notice to their competitors of the form of a new device. However, in the present situation, there is really no choice, as only the publication of proposals will bring out comment and ideas from the acoustic community. Certainly, the proposals of 1986 (ref2) can be implimented without technical difficulty. The question must be posed as to wether this is a sensible use of resourses.

What can we do today? To answer this question, we need to look at current sound level meter technology just as the first devices did. The next question is of course, What do we want to do today? This is the question this paper addresses.

Firstly, we can automaticlly assume that a computer will be involved in the data acquisition and collation. This then gives us the possibility of making real time calculations and storing either the raw data or the results of these calculations.

Secondly, as electronic circuits are now so small, the problems of having to have all the circuitry behind the stage has gone. We can now build all the circuitry in the display unit mounted in the most convenient point.

The circuitry, the memory, the 'decision' blocks are all in the ceiling mounted unit. The connection between the unit and the actual cut-off relay is now a standard electricians task and does not require any specialist 'installation' knowledge.

Thirdly, we can decide what the method and time interval of data collection shall be. By this I mean that the user can decide after the unit has been delivered. The programme in the unit could allow the user to change many of the acquisition parameters. The changes are then put into the 'start-up' RAM memory, which is battery backed and will remain there until changed. This means there are no controls for the Disc Jockey or band to 'adjust'. this removes one of the problems with the original unit.

Next, we can automatically calibrate the system. This can be done by a variety of means, but all involve sending a signal from the computer and measuring this signal. The form of the signal can be insert calibration or any other method the manufacturer can invent, including true acoustic calibration. Certainly, this will be an area of competative endeavour. This calibration also automatically checks for the presence of the microphone. It has not been unknown for bands to place all manner of substances in the microphone to stop it functioning. Some of these have been biological in origin.

DATA COLLECTION

One of the things the computer does really well, is store data. This suggests that the data can be routinely downloaded to a host computer for checking. For example: The license conditions for a club may contain a clause that the level in perhaps the form of a 5 minute Leq must not be above XdB more than once a week. The computer based controller can record either the time history of any 5 minute period, or simply any period that exceeds the criterion or any combination of the two. The method of collection can be by telephone, by visiting the club and downloading the data, or by removing some storage device during a visit. I have used 5 minutes as an example, the computer could not care less if it was 7,32 minutes.

Not only are all these things readily available with the use of a computer based system, but other advantages accrue as well. The computer can display any parameter the local EHO requires. For example, it has been proposed that a digital display should be fitted to show the Leq to the patrons. While wondering about the wisdom of such a move, if it is required, the computer can do it. The manufacturer can programme the unit to read out any parameter that is acquired. The time period of the Leq, that is how often a new acquisition is started, is simply a number to the computer. Assuming that the device acquires it's data by the method of short Leq, the only restriction on the time is the elemental period, which has traditionally been 125 Milliseconds. It is not felt likely that this will be too long an elemental period. With an ac mains operated unit, there is no maximum time. The limitation on hand-held units being the battery life.

Should a trip and warning be required, the internal firmware, that is the programme inside the unit, can be changed to show whatever combination of level, time, number of exceedences etc is desired. With the older technology

units, this was a major task. When a computer is invoved, all this is done by software and can be changed at will BY THE USER. He simply connects up a desktop computer and the very simple multiple choice programme asks for all the parameters required. This should end the misery and financial loss of many visits to a site to set and reset the trip and warning levels.

These then are some of the things available to us now that computer chips are inside the units. What all manufacturers need is a clear guidance from the marketplace as to the real requiremlents of the EHO and the actual purchasers, IE. the clubs and resurants. We at Cirrus Research as one of the leaders in the 'chips with everything' approach are only one of the organisations who want this information. Certainly, no manufacturer will be in a position to go foward to production with a unit until feedback from the industry is available.

Perhaps the idea of computers will frighten off the potential customer and therefore the fact that it is computer based should be played down. Again, the possibility of an almost limitless choice of parameters, could be too much for non computer literate people. The next year will probably see a revolution in these devices and no doubt some will be over-ambitious, some will be downright bad and others will fit into the exact market parameters. Only you the users can influence us the manufacturers in the correct direction.

CONCLUSION

Current technology will allow manufacturers to provide a new generation of Real time, installed Disco controllers which can remove the limitations imposed by the technology of the early 1970's. However, to make use of this technology, the users must give the potential manufacturers a clear lead in writing a performance specification. If we wait until we have a British Standard, it is probable that this second generation technology will itself be out of date by the time of publication. If we are to be taken seriously as an industry by the public at large, it is the use of current technology to meet scientifically defendable units, which will provide credibility, not the continued installation of devices which appear to generate as many problems as they solve.

References:-

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