Brüel & Kjær application notes

Transformer Noise Measurements using Time-Averaging

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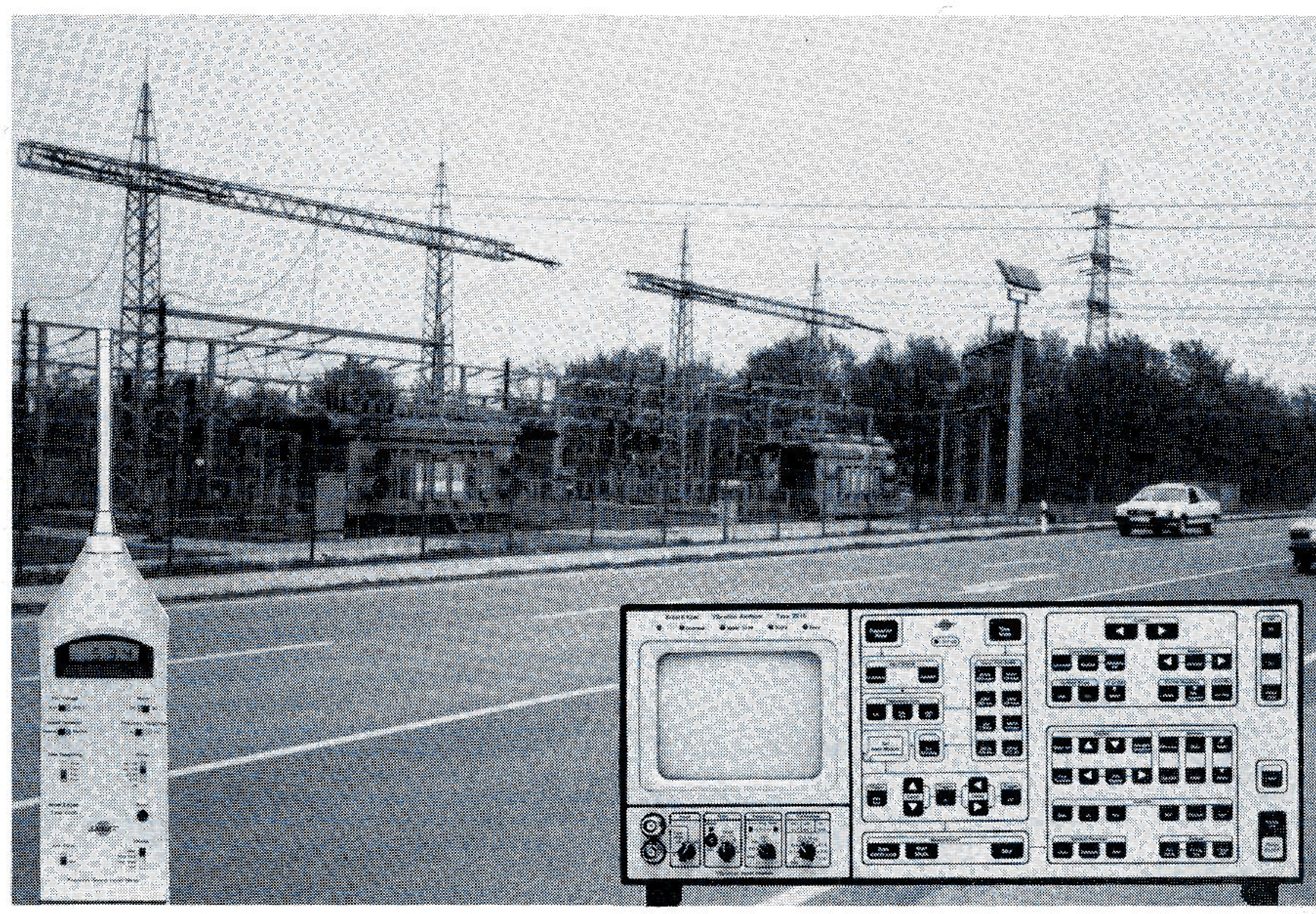
Noise emission from transformers has traditionally been measured using sound level meters fitted with 1/3rd. octave filters. However, interference from background noise can make this measurement troublesome.

This Application Note describes how this problem was overcome when making transformer noise measurements in the West German town of Mettmann near Düsseldorf. By making good use of the *Time Averaging* function of the Type 2515 Vibration Analyzer, the interfering background noise was effectively removed from the measurement. This resulted in accurate, repeatable measurements suffering no interference problems.



Transformer located in a residential district close to a heavily used road. Accurate noise measurements were made at a distance of 250 m by utilising the time averaging function of the Type 2515 Vibration Analyzer

Introduction

In order to overcome the problems of measuring transformer noise in the presence of high background noise, it is usually necessary to make the measurements on a reasonably quiet day. Passing traffic, pedestrians and even bird twitter can effectively ruin any measurements. Having found a quiet period, the transformer noise could then be tape recorded for later analysis in the laboratory. However, for obvious reasons it is usually very difficult to obtain unambiguous and repeatable results using this method.

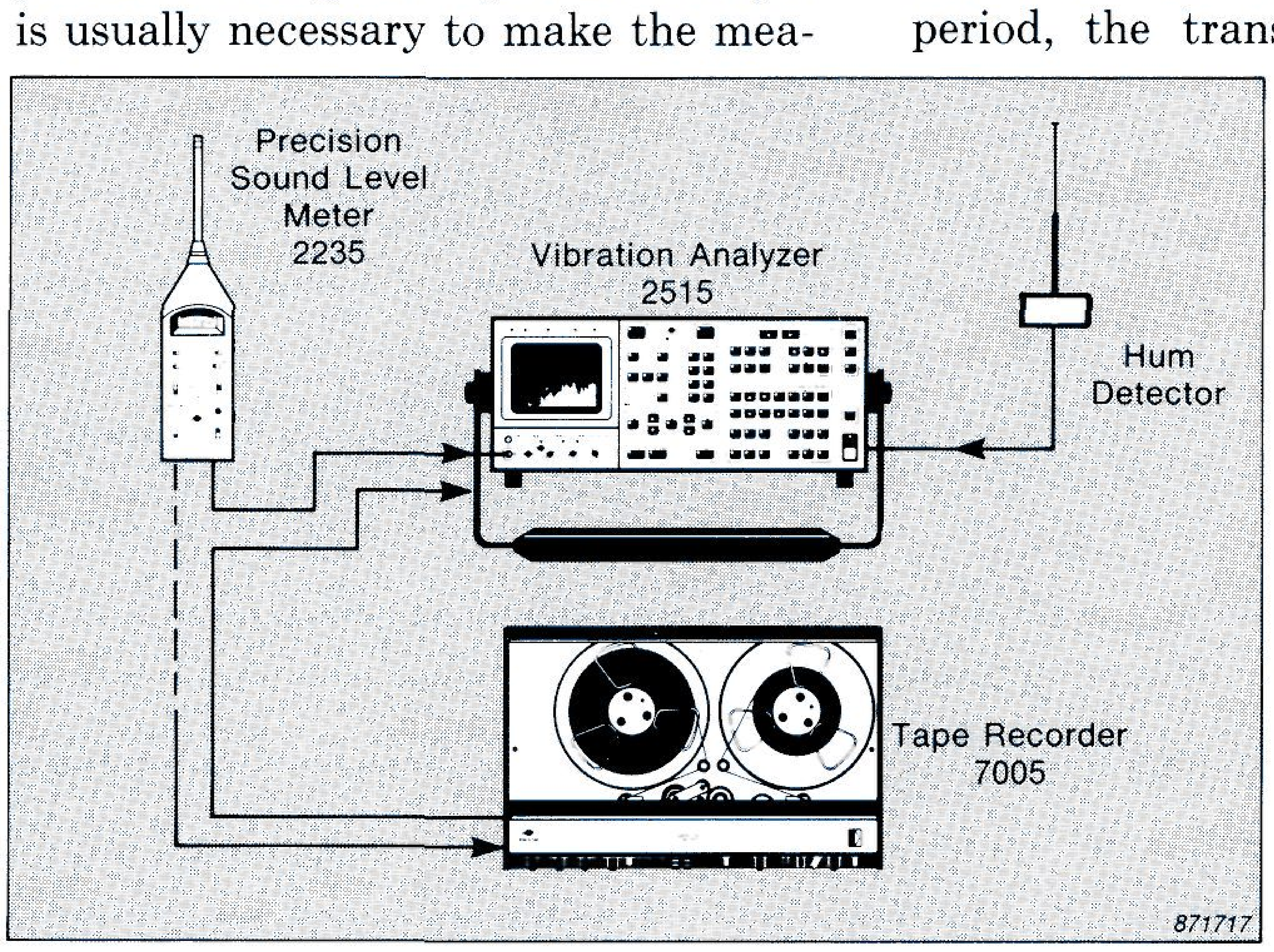


Fig. 1. Setup used to measure and record the transformer noise

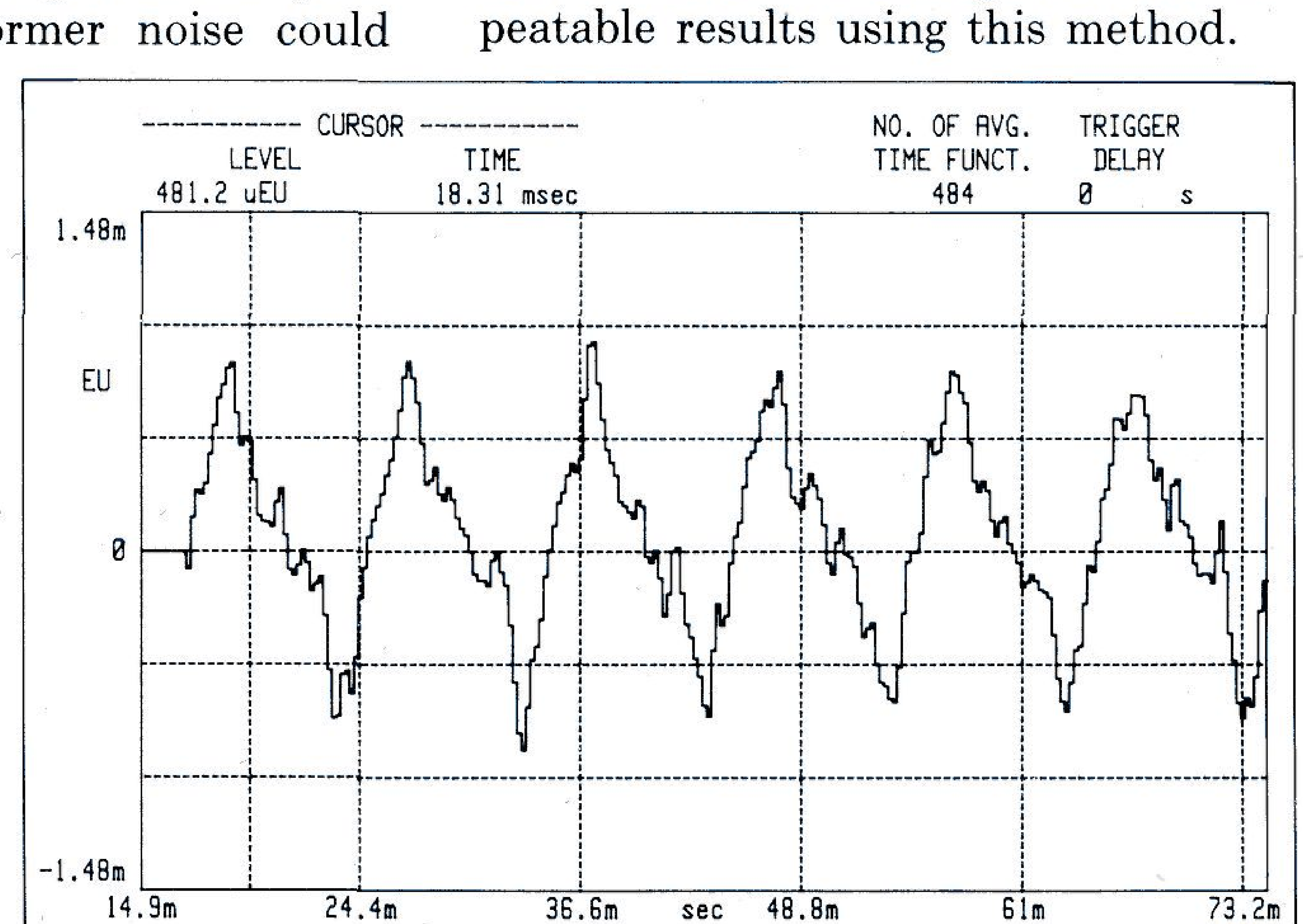


Fig. 2. An example of a time-averaged signal from the transformer. Time averaging has the effect of removing background noise

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Time-domain Averaging

These measurement problems, caused by the presence of the heavy background noise, can be overcome by using the time averaging function of the Vibration Analyzer Type 2515. The Type 2515 is a portable, battery-operated analyzer which, as the name implies, is designed for use in the analysis of vibration. However, by using a sound level meter for input to the analyzer instead of a vibration pickup, and adding an external trigger, it is possible to average the measured sound level in the time domain.

Time-domain averaging involves obtaining an average of the measured sound signal in the time- not frequency-domain, by measuring and averaging relative to a fixed point in time. This fixed point in time is obtained from the external trigger, and all sound not related to the trigger (i.e the background noise) is thus averaged out.

The trigger signal used in this case is the electromagnetic hum from the transformer. It is detected by a so-called hum-detector via a telescopic antenna, see Fig. 3. The trigger signal is amplified and transformed into a TTL-signal using a schmitt-trigger. The vibration analyzer provides the necessary power supply for the hum-detector.

Measurements and Results

In the example reported, measurement conditions dictated that the noise from the transformer should be measured at a distance of some 250 m. The measurements were made at 1500 hrs, in the presence of heavy background traffic noise. The measurement setup used is shown in Fig. 1. The A-weighted AC signal from the sound level meter was fed to the analyzer, where it was time-averaged synchronously with the trigger signal from the hum-detector. Using the *Total* function of the analyzer to give the overall level of the analyzer's display, the averaged A-weighted sound level was determined to be 57 dB.

To prove the validity of these measurements (and hence time averaging), tape recorded measurements of both time-averaged and non time-averaged signals were also made for later analysis in the office. Here, frequency spectra obtained from the time-averaged signal were compared with frequency spectra obtained from the frequency-averaged (not time-averaged) signal.

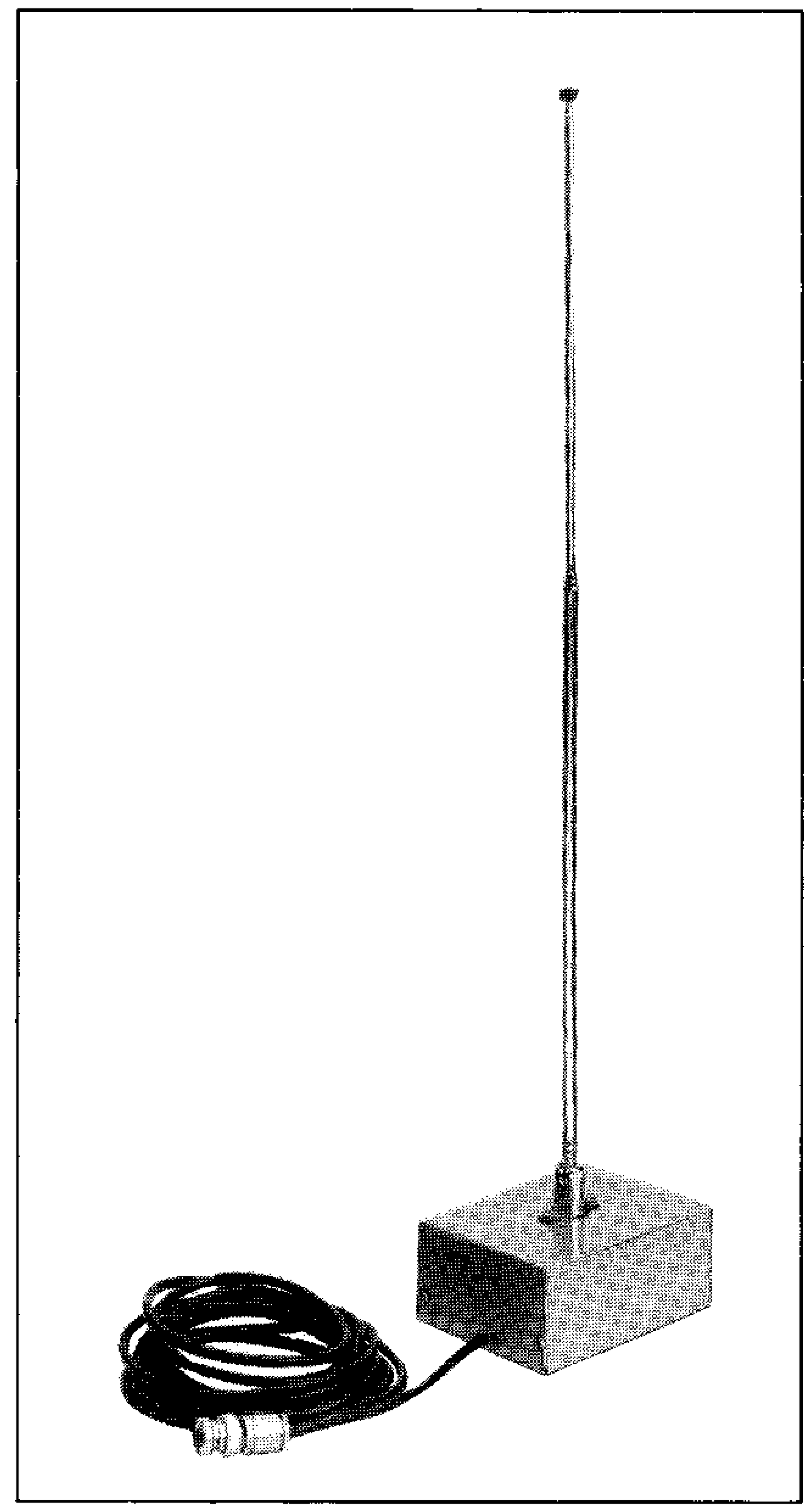

Fig. 3. The hum-detector used to provide the trigger for time averaging

The two spectra in Fig. 4 clearly show the advantages of time averaging. The spectrum shown to the left was made by frequency analysing the time-averaged sound signal, and clearly shows the characteristic frequencies from the transformer. The spectrum shown to the right was made by frequency analysing the directly recorded (i.e. not time-averaged) signal. It can be seen that this contains an average of all the background noise, which tends to obscure the relevant frequency components in the spectrum.

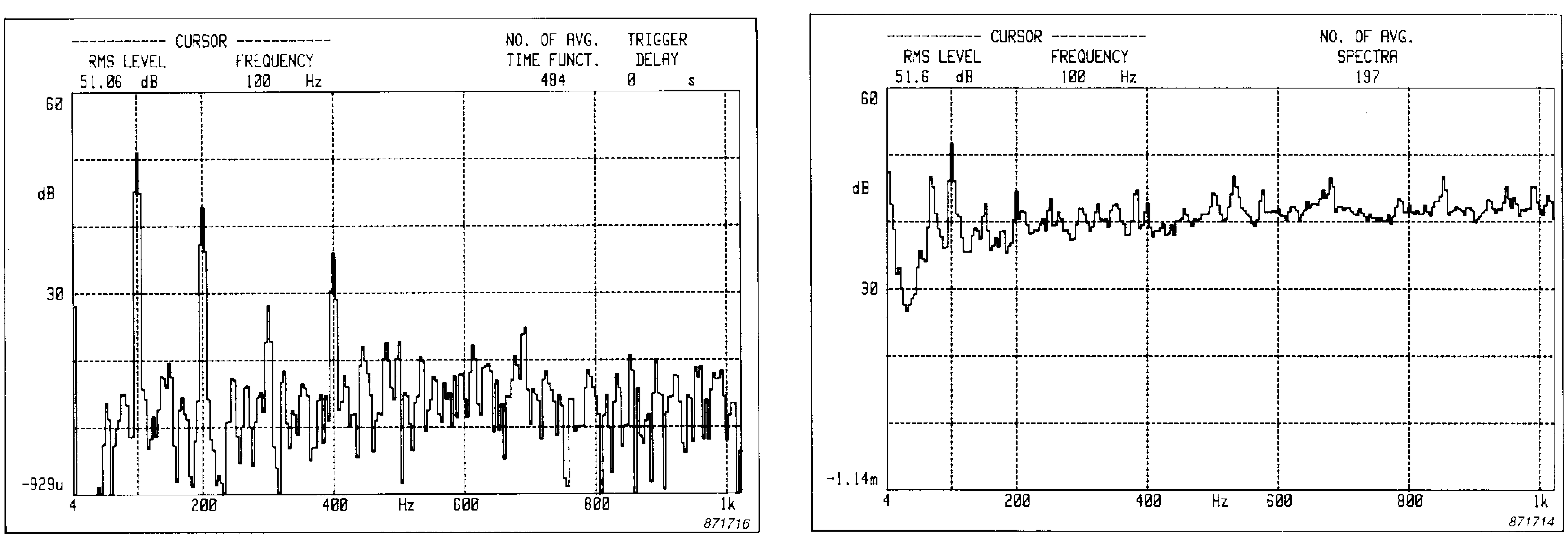

Fig. 4. The spectrum to the left was averaged in the time domain, whilst the spectrum to the right was averaged in the frequency domain

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