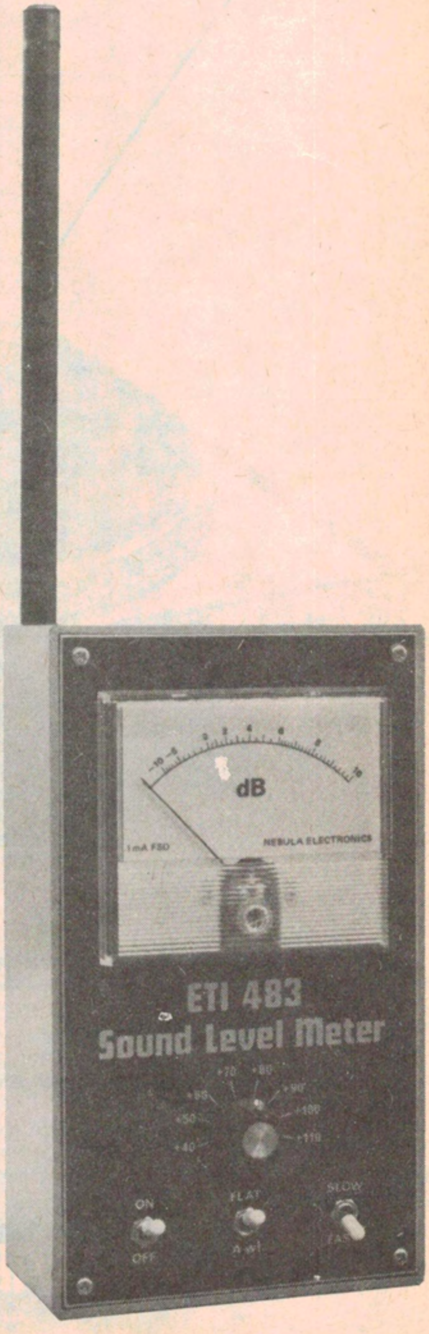
Sound Level Meter

This sound level meter gives accurate results to allow noise levels to be monitored and controlled. An 'A' weight response is provided as well as the 'flat' mode.



THE PUBLIC TODAY is increasingly critical of excessive noise levels. Aircraft like the Concorde, for example, face opposition on grounds of noise levels while jet aircraft of around 1958 were just as noisy but then they were a great advance in science! Public awareness of noise has caused laws to be passed limiting the sound levels which can be produced without prosecution.

However, while it may be good to have a law to say the acoustic output of your party should not exceed 85 dB, how can you tell precisely what the actual level is! If the local constable is called the chances are he will not have a meter and will only be able to give his subjective assessment.

For this reason we have designed this project. It is not a super-duper do-all sound level meter but one which is economical yet gives meaningful results. The microphone used is relatively cheap (about $3.00), but is rugged and has a good frequency response. The microphone used in the B & K sound level meter is delicate and costs a small fortune !

There are many weighting networks used with sound level meters including ones which need a computer to calculate the results. We chose only the two most popular, the "A" weight and flat. The response of the "A" weight filter is given in Fig. 2.

SPECIFICATION – ETI 483

Sound level range	30dB to 120dB
Weighting networks	Flat or 'A' weight
Microphone	Electret
Power supply	9V dc @ 10mA

Calibration

This is a little difficult as a known reference is needed or another sound level meter to match it against. Initially however the "flat" attenuator potentiometer must be adjusted. To do this a 1kHz audio tone or sine wave signal across R1 is needed. Select "A" weight and an appropriate range and note the reading. Switch to "flat" and adjust RV1 to give the same reading.

Calibration is performed by RV2 and is adjusted with a known audio signal. If you cannot calibrate the meter Nebula Electronics Pty Ltd have offered to help. See page 30 for details.

Construction

Assemble the PC board according to the overlay in Fig. 4. The rotary switch can be either of the two popular sizes and can be mounted either with tinned copper wires or by drilling large (3mm) holes in the PC board, through which the leads of the switch can be passed and soldered directly to the tracks. Check when assembling that the wiper contact is in the correct position.

Assemble the front panel and leave the leads to the switches and meter long enough to be able to hinge it forward, as the PC board is mounted in the base of the box. The microphone insert is mounted on the end of a length of aluminium tube well away from the box. This is to help prevent reflections from the box affecting the readings. We attached the microphone using a length of heat shrink tubing over the aluminium tubing.

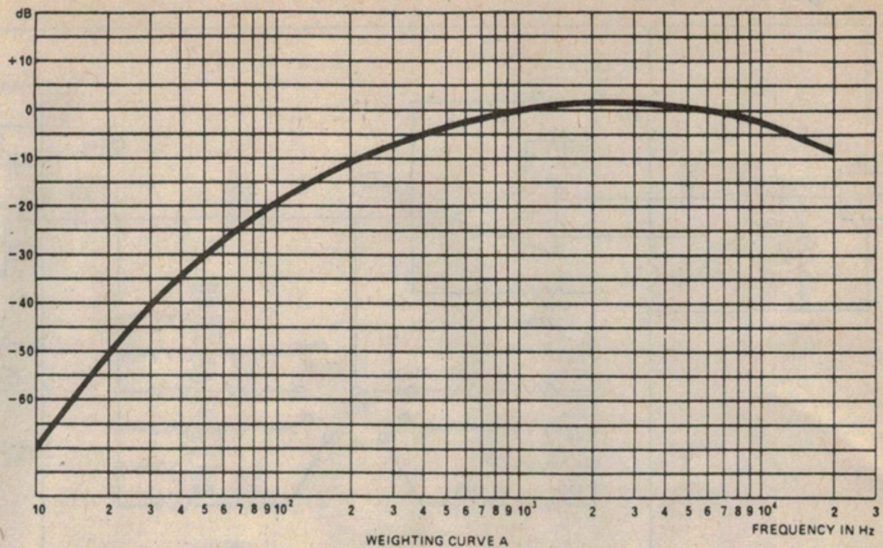


Fig. 2. The response of the 'A' weight filter.

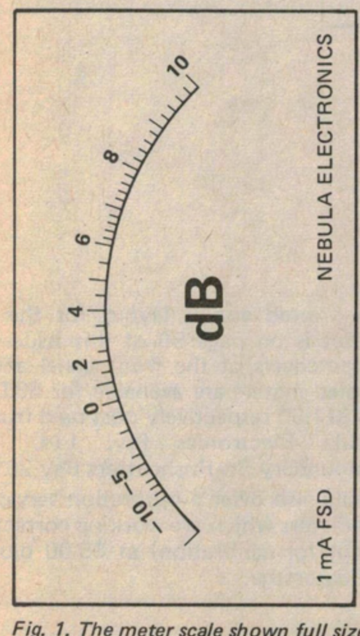
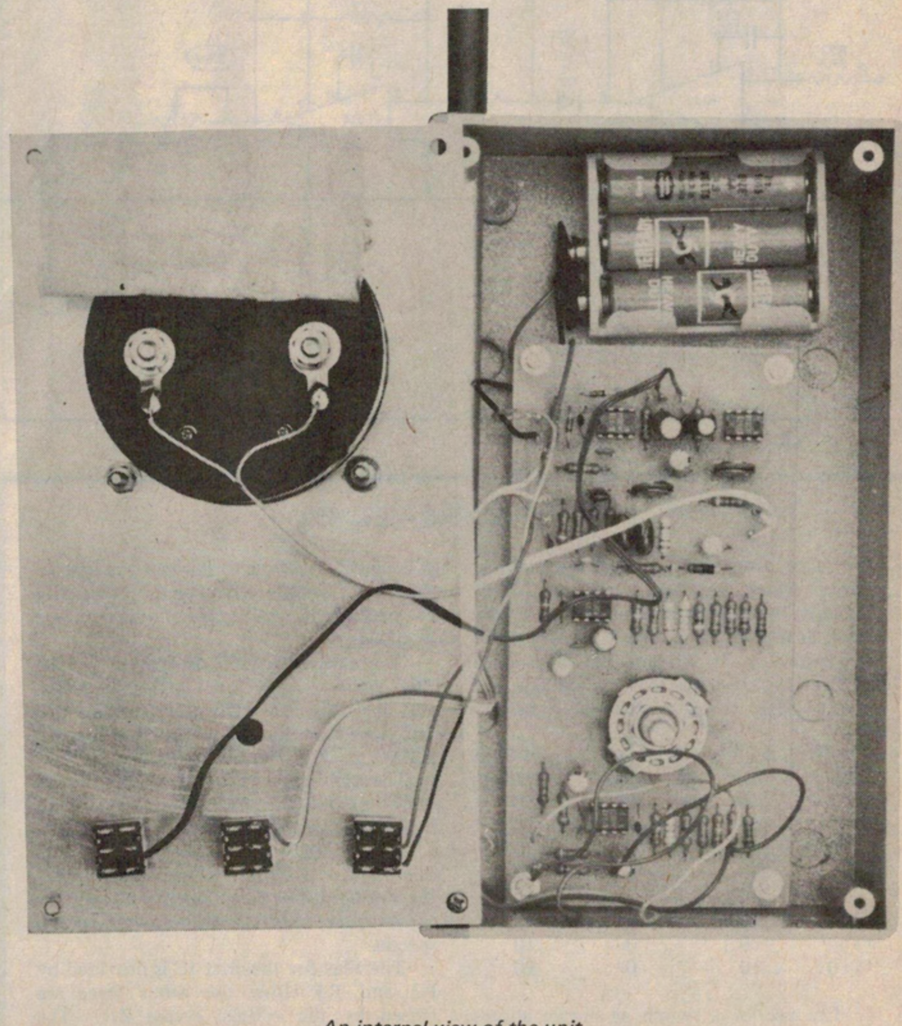


Fig. 1. The meter scale shown full size.



An internal view of the unit.

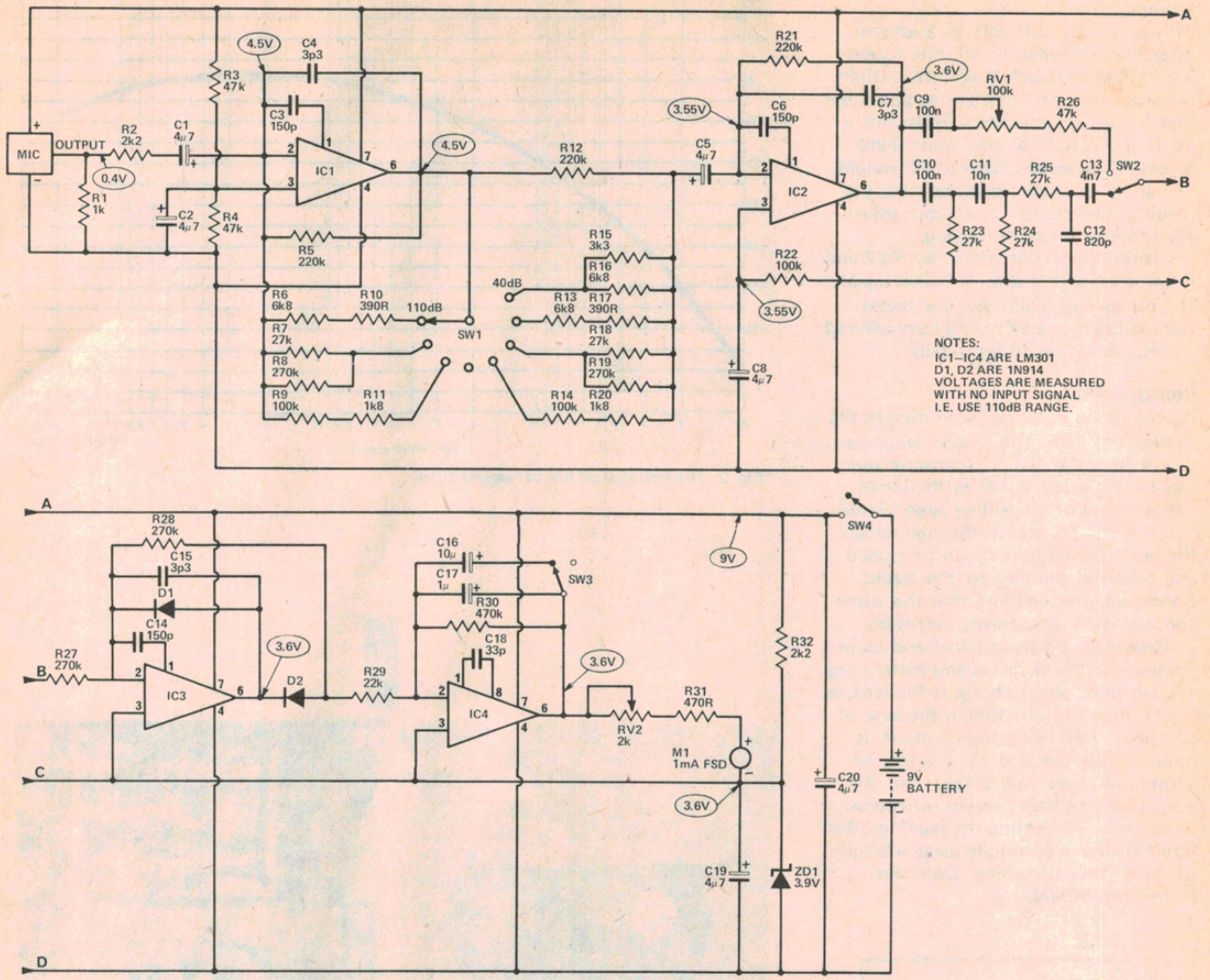


Fig. 3. The circuit diagram of the unit.

HOW IT WORKS – ETI 483

We have used an electret microphone insert which has the necessary FET preamp inside. As its output is a low level, especially in ambients around 40dB it is amplified by IC1 and IC2. The range switch SW1 is used to vary the gain of both ICs as shown below:

Range (dB)	Gain IC1 (dB)	Gain IC2 (dB)	Total Gain (dB)
+40	40	40	80
+50	40	30	70
+60	40	20	60
+70	40	10	50
+80	40	0	40
+90	30	0	30
+100	20	0	20
+110	10	0	10

The use of a switch as shown allows a single pole switch to control the gain of the two ICs while reducing the possibility of instability where gains of 80dB are involved.

The output of IC2 is filtered by the "A" weight network C10-C13, R23-R25 and R27. Switch SW2 selects either this "A" weighted output or the "flat" output via RV1, R25. The potentiometer RV1 is necessary to compensate for the loss of the filter network. Both networks should have the same loss at 1kHz.

IC3 is used to halfwave rectify the signal and IC4 integrates the signal to give the average level. Two values of integration capacitor are used to give the two response speeds.

The bias for the first IC is provided by R3 and R4 while the other three are biased by the voltage across ZD1. The meter is also biased to the zener voltage.

The printed circuit layout for this project is on page 90 of this issue.

Scotchcals of the front panel and rescaled meters are available for $3.00 and $11.50 respectively post paid from Nebula Electronics Pty. Ltd. 15 Boundary St. Rushcutters Bay 2011. Nebula also offer a calibration service (for meters which are working correctly except for calibration) at $5.00 plus $1.00 postage.

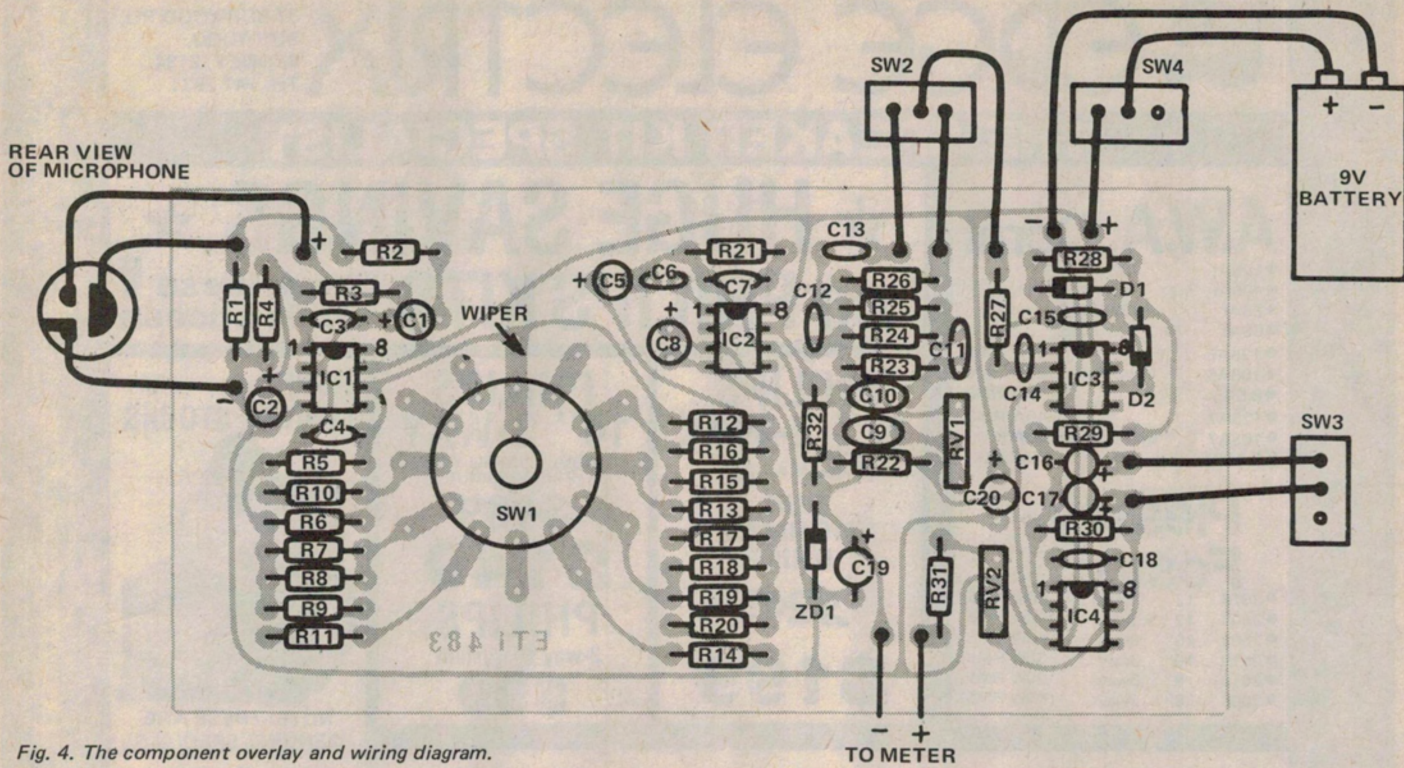


Fig. 4. The component overlay and wiring diagram.

PARTS LIST – ETI 483

Resistors all ½W 5%

R1	1k
R2	2k2
R3,4	47k
R5	220k
R6	6k8
R7	27k
R8	270k
R9	100k
R10	390R
R11	1k8
R12	220k
R13	6k8
R14	100k
R15	3k3
R16	6k8
R17	390R
R18	27k
R19	270k
R20	1k8
R21	220k
R22	100k
R23–R25	27k
R26	47k
R27,28	270k
R29	22k
R30	470k
R31	470R
R32	2k2

Potentiometers

RV1	100k trim
RV2	2k "

Capacitors

C1,2	4µ7 16V electro
C3	150p ceramic
C4	3p3 "
C5	4µ7 16V electro
C6	150p ceramic
C7	3p3 "
C8	4µ7 16V electro
C9,10	100n polyester
C11	10n "
C12	820p ceramic
C13	4n7 polyester
C14	150p ceramic
C15	3p3 "
C16	10µ 16V electro
C17	1µ0 16V "
C18	33p ceramic
C19,20	4µ7 16V electro

Semiconductors

IC1–IC4	LM301A
D1,2	1N914
ZD1	3.9V 300mW

Miscellaneous

PC board ETI 483
Microphone insert for RAPAR ECM1001
SW1 single pole 11 position rotary
SW2–SW4 SPDT toggles
1mA meter
Plastic case
6xAA size battery holder

The Decibel (db)

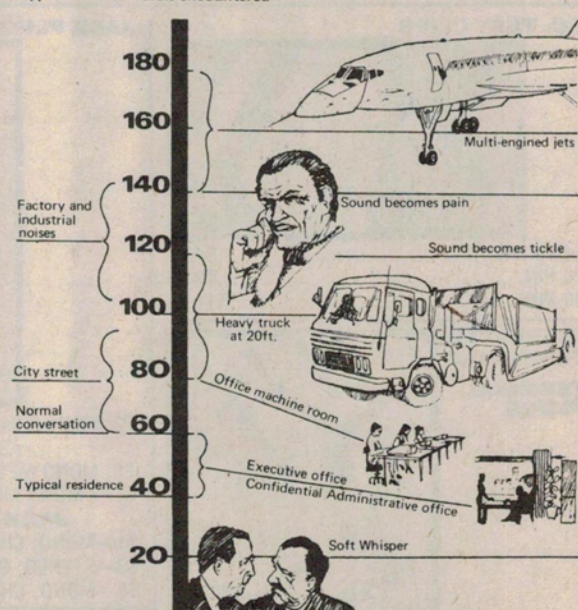
The ear can hear a sound power as low as 10^{-13} watt – this is a pressure of .0002 dynes per cm^2. The ear drum moves an amount approx. equal to the diameter of a molecule of nitrogen. When sound is uncomfortably loud, the hearer "feels" a tickle, then pain in the ear; a power level of 1 watt. approx.

Engineers take the logarithm of the power ratio and call it the DECIBEL (db).

The db level is given by – $db = 10 \log 10 \frac{Watts}{10^{-13}}$

The sound pressure level is = $20 \log 10 \frac{P(dynes)}{.0002}$

Typical Decibel levels encountered



- *For a sound to be perceptibly louder or softer, it must be changed by 3 decibels.*
- *A noise twice as loud or ½ as loud is a change of 10 decibels.*
- *A reduction in noise of a few decibels in the low noise region (administrative office) is not significant. The same change at high sound levels (office machine room)* **is** *significant.*