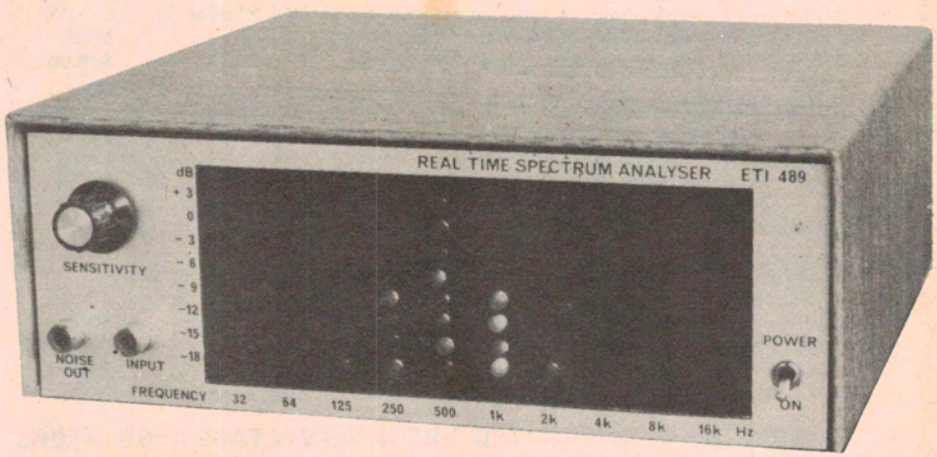
Audio Spectrum Analyser 2

LED display for compact, easy-to-build unit.

OUR PREVIOUS Real Time Audio Analyser design produced beautiful displays on the screen of an oscilloscope but this means, of course, that to use the device one has to have a scope. Not everyone has, and with this in mind, we contemplated the design of a more conventional analyser with LED bar-graph display. Urged on by reader response to our hint that this design was on the cards, we have gone ahead and produced the project in double-quick time.

This version has the great advantage of portability over the previous design, and also looks better than a scope sitting next to your brand new, 21st Century styled hi-fi! It is also easier to set up and trouble-shoot.



Design Features

When we proposed a LED version of the spectrum analyser we initially were going to use the original filter board and design a new logic board which multiplexed the LED display. The only question at that time was whether to multiplex the LEDs as columns or as individual LEDs. The column method is easier on the power supply as the peak current is only 10 times the average current while singly the peak current is 80 times the average. This is not quite accurate because a multiplexed LED requires less average current for the same output than one continuously on. However the column method also requires one extra diode per LED to give the isolation required between columns.

SPECIFICATION – ETI 489

No. of bands	10
Frequencies	31, 63, 125, 250, 500, 1k, 2k, 4k, 8k, 16k
Filter characteristics	–12dB, one octave from nominal centre frequency
Display	LED display 3dB spacing
Input level	50mV – 10V
Input impedance	200k
Pink noise output	200mV

After struggling with the PC board layout which was developing into a double sided board similar the filter board of the previous analyser, we decided there must be an easier way to make a living! The question was then raised of whether it was worthwhile to multiplex the display at all and the answer was the project as it appears here.

The individual board approach not only makes fault finding easier and less likely, it also allows single sided PC boards to be used throughout. The system can also be expanded (or cut down) as desired simply by changing the filter components and the number of display boards. The power supply is capable of supplying up to 20 display boards without increasing the filter capacitors.

Construction

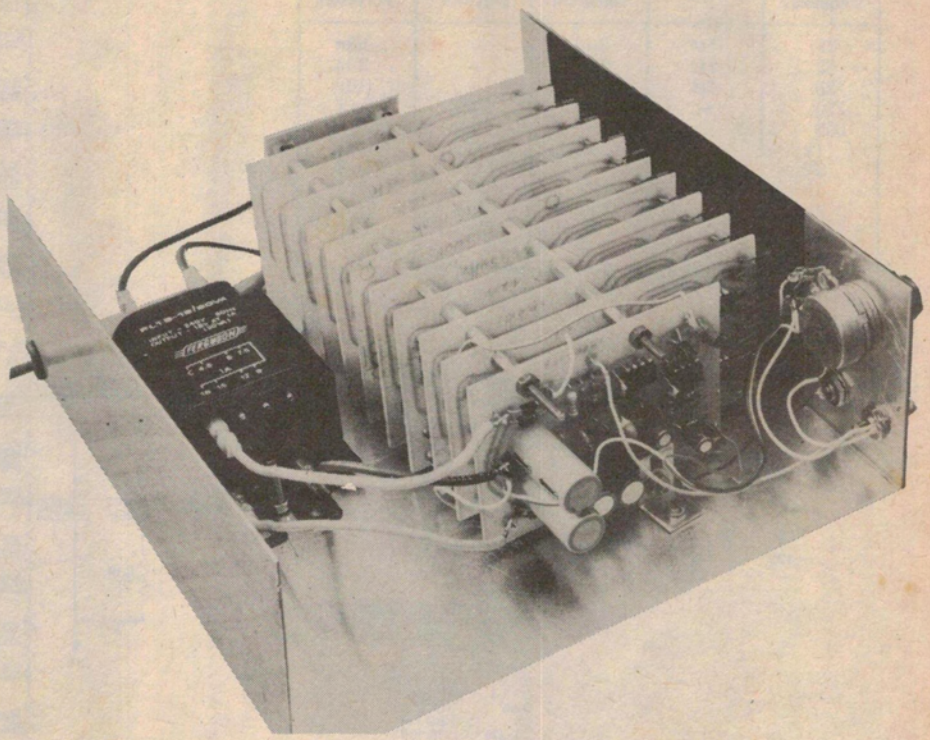
Assemble the power supply board and the ten filter display boards with the aid of the overlays. The filter components can be selected from Table 1 noting that when the tantalum capacitors are used in the three lower octaves a bias resistor R15 is needed. The LEDs should be installed as evenly as possible with the polarity correct.

We assembled the units on 1/8" brooker rod with 12.5mm spacers between the boards. Metal brackets are used at each end to support the assembly. On the filter display boards the power rails and the input are all common and for the power supply we used long lengths of tinned copper wire threaded through the holes. The input lead should be done with separate links to allow the units to be serviced later if needed.

Before assembling the unit however each board should be checked with an oscillator to check it for the correct frequency and to adjust the calibration potentiometer. This is best done by measuring the sensitivity of the 16 kHz board with RV2 set for maximum sensitivity and adjusting all the others till they are the same.

We made a metal box with a piece of red perspex for a window to house the unit. If it is to be used with an equaliser (such as the ETI 484) it could be built into the same box.

It will be found with the economical LED available that there will be a difference in brilliance between them. If desired matched LEDs are available but not for 20 cents each!



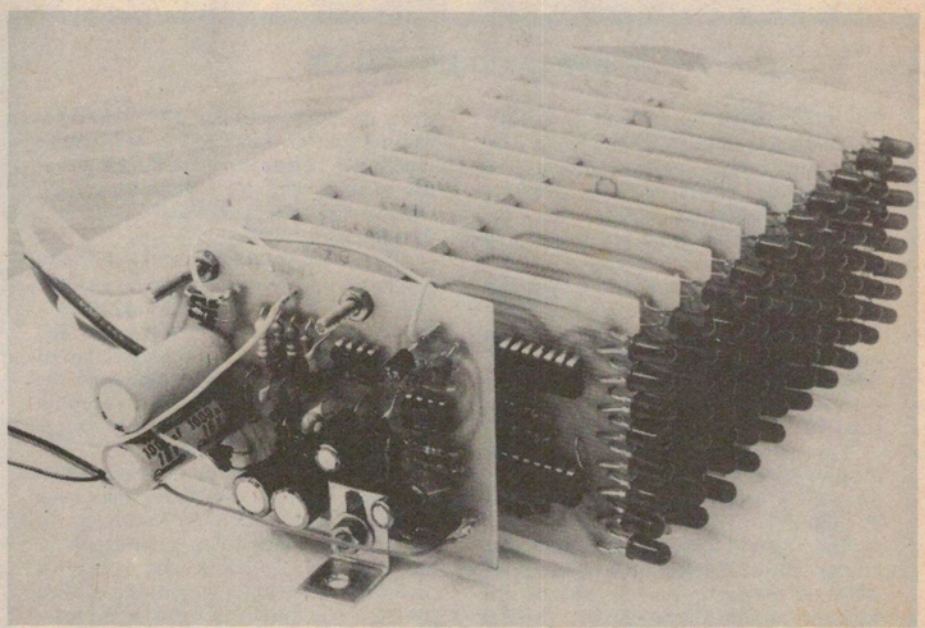


TABLE 1

Centre frequency	R15	C14,C15 tantalum	C16 polyester	C17 polyester
32	1M	3μ3	–	68n
63	1M	1μ5	–	33n
125	1M	1μ0	–	18n
250	–	–	220n	8n2
500	–	–	100n	3n9
1k	–	–	47n	2n2
2k	–	–	27n	1n0
4k	–	–	12n	560p
8k	–	–	6n8	270p
16k	–	–	3n3	150p

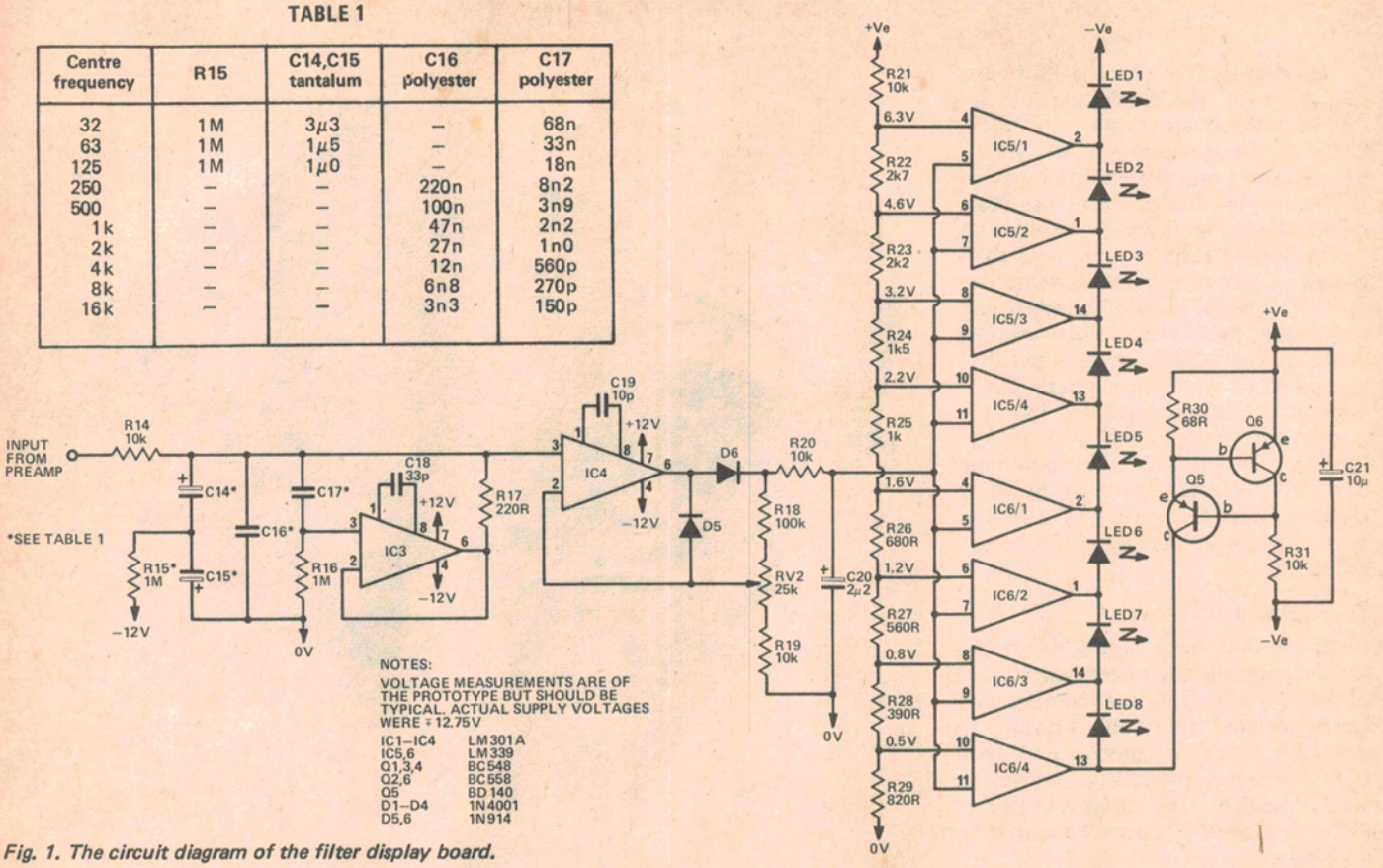


Fig. 1. The circuit diagram of the filter display board.

HOW IT WORKS – ETI 489

The input signal to the unit is initially buffered and amplified by IC1 and is then split into octave bands, rectified and displayed by a "bar" of LEDs. We have used 10 separate boards for the rectifier-display as only the component valves in the filter are different.

The filter is a parallel LC network where the inductive part is a gyrator formed by IC3, CI7, R16 and R17. The valve of such an "inductor" is R16 x R17 x C17 Henrys (C17 in Farads). This, with the parallel capacitor C16 and the series resistor R14, form a band pass filter.

The output of the filter is half wave rectified by IC4 which also provides a gain of about 5 before the signal is smoothed by C20.

The eight LEDs in each individual display are connected in a series chain which is supplied with 10 mA by the constant current source Q5, Q6. Control of how many LEDs will be on is done by IC5 and IC6. These are quad voltage comparators which have as the output stage an open collector NPN transistor with its emitter connected to the negative supply rail. These compare the output of the rectifier with the voltage set on the resistive divider R21-R29 and "short" out the unwanted LEDs.

The power supply is a simple fullwave rectified with a centre tap giving∓12V dc. Due to the load (about 150 mA) there is about one volt ripple on the supply rail but this does not affect the operation of the unit. As the current drawn by the filter display boards does not change with the number of LEDs on the supply voltage remains reasonably constant.

The 100 Hz ripple does however affect the noise generator and this has been changed from the 487 analyser to accommodate this. The noise generator consists of Q3 which is used as a zener diode where the noise current is amplified by Q4. The output of Q4 is white noise and to give pink noise a 3 dB/octave filter is needed. IC2 and the associated capacitors and resistors provide this filter.

PARTS LIST – ETI 489A

Filter–Display boards 10 required

Resistors all ½W 5%
R14. . . . . 10k
R15. . . . . see table 1
R16. . . . . 1M
R17. . . . . 220R
R18. . . . . 100k
R19–R21 . . 10k
R22. . . . . 2k7
R23. . . . . 2k2
R24. . . . . 1k5
R25. . . . . 1k
R26. . . . . 680R
R27. . . . . 560R
R28. . . . . 390R
R29. . . . . 820R
R30. . . . . 68R
R31. . . . . 10k

Potentiometers
RV2 . . . . . 25k trim

Capacitors
C14–C17 . . see table 1
C18. . . . . 33p ceramic
C19. . . . . 10p ceramic
C20. . . . . 2μ2 25V electro*
C21. . . . . 10μ 25V electro*

Semiconductors
IC3,4 . . . . . LM301A
IC5,6 . . . . . LM339
Q5 . . . . . BD140
Q6 . . . . . BC558
D5,6 . . . . . 1N914
LED1–LED8

Miscellaneous
PC board ETI 489A

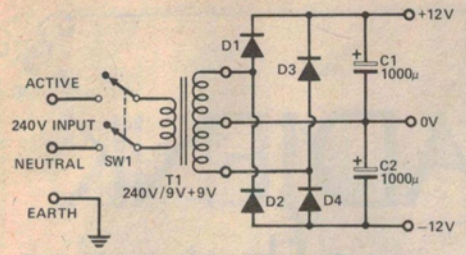


Fig. 2. The power supply circuit.

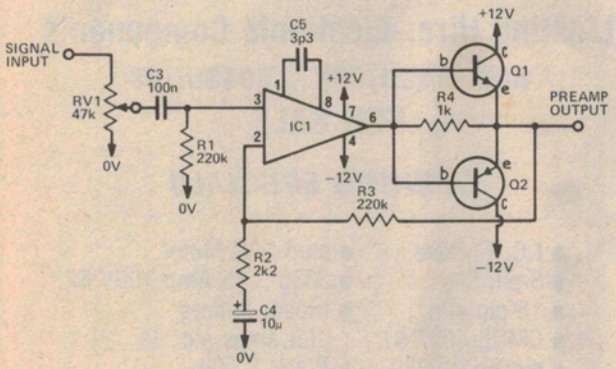


Fig. 3. The circuit of the preamplifier–buffer.

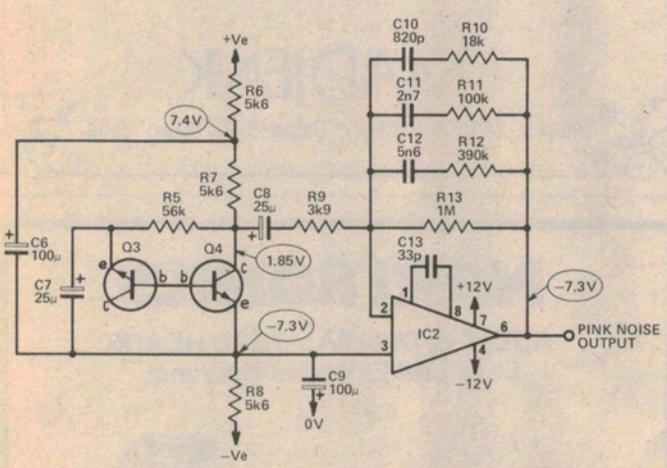


Fig. 4. The circuit diagram of the pink noise generator.

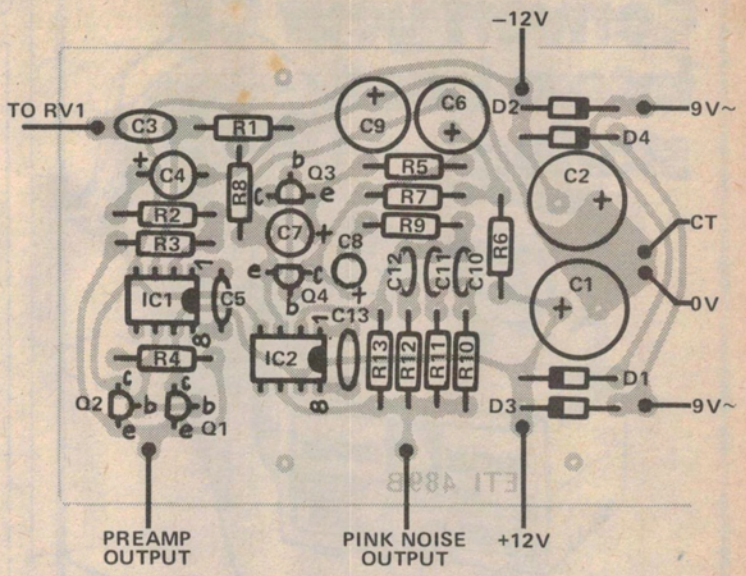
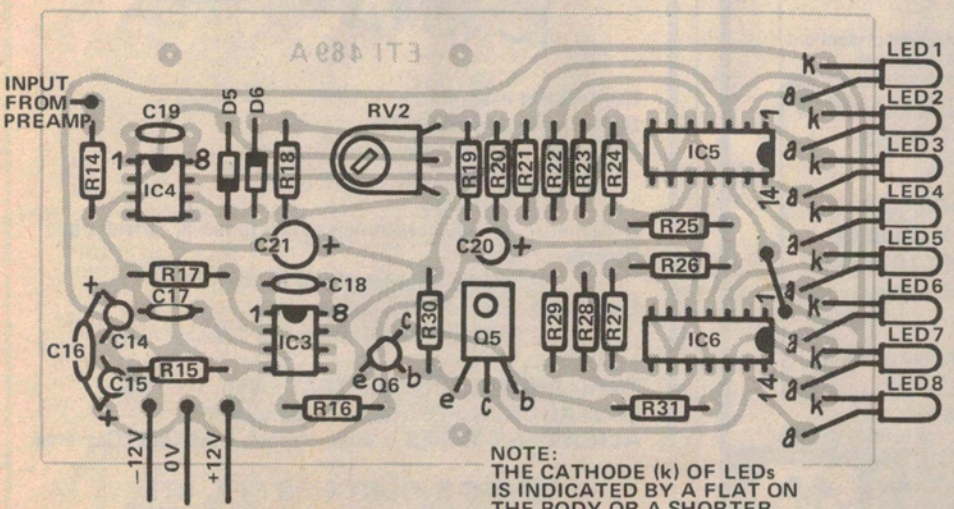


Fig. 5. The component overlay of board B.



NOTE:
THE CATHODE (k) OF LEDs IS INDICATED BY A FLAT ON THE BODY OR A SHORTER LEAD.

Fig. 6. The component overlay of board A.

PARTS LIST – ETI 489B

Power Supply board

Resistors all ½W 5%
- R1 . . . . . 220k
- R2 . . . . . 2k2
- R3 . . . . . 220k
- R4 . . . . . 1k
- R5 . . . . . 56k
- R6–R8. . . . 5k6
- R9 . . . . . 3k9
- R10. . . . . 18k
- R11. . . . . 100k
- R12. . . . . 390k
- R13. . . . . 1M

Potentiometers
- RV1 . . . . . 47k log rotary

Capacitors
- C1,2 . . . . . 1000µ 16V electro*
- C3. . . . . 100n polyester
- C4. . . . . 10µ 25V electro*
- C5. . . . . 3p3 ceramic
- C6. . . . . 100µ 25V electro*
- C7,8 . . . . . 25µ 25V electro*
- C9. . . . . 100µ 25V electro*
- C10 . . . . . 820p ceramic
- C11 . . . . . 2n7 polyester
- C12 . . . . . 5n6 polyester
- C13 . . . . . 33p ceramic

Semiconductors
- IC1,2 . . . . . LM301A
- Q1 . . . . . BC548
- Q2 . . . . . BC558
- Q3,4 . . . . . BC548
- D1–D4. . . . 1N4001

Miscellaneous
- PC board ETI 489B
- Transformer 240V/9V+9V PL18/20VA
- SW1 DPDT 240V toggle switch
- Case to suit

*all electrolytic capacitors PC board or single ended type.