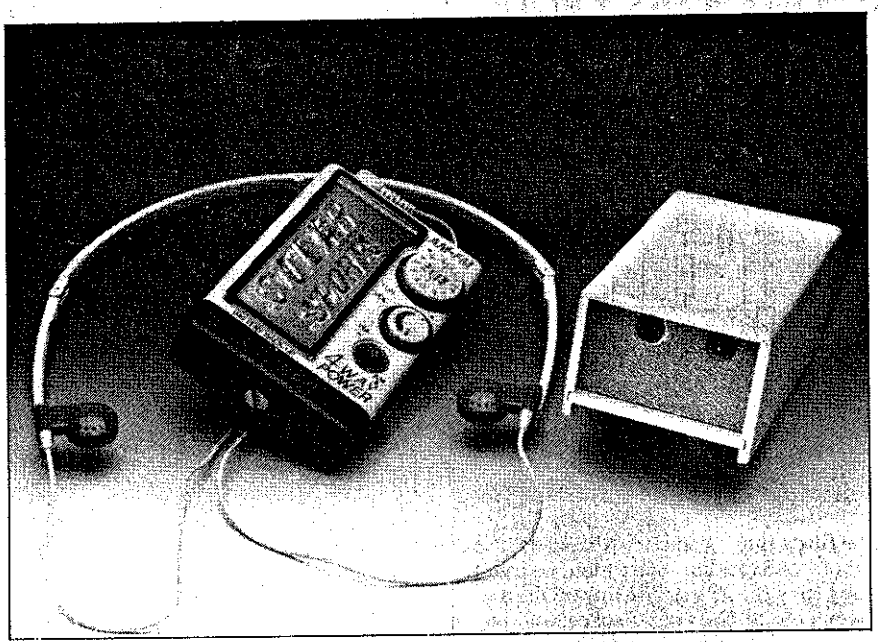
MINI FM TRANSMITTER

J. Bareford

This low-power transmitter for the VHF FM band may be used as a wireless babysitter or a short-range repeater by virtue of its voice operated switch (VOX) and easy connection to a SCART outlet.



The block diagram in Fig 1 shows that the microphone signal is amplified before it is applied to a VOX (voice-operated switch) circuit. The VOX consists of an amplifier, a rectifier, and a comparator with hysteresis. Its function is to switch the transmitter on when a predefined AF signal level is exceeded, and switch it off after a certain period, the length of which is determined by an *R*-*C* network.

The third block is a frequency-modulated (FM) oscillator operating at about 105 MHz.

Circuit description

With reference to the circuit diagram in Fig 2, the electret microphone, M1, receives its bias voltage via resistor R1. The microphone signal is raised in an amplifier based on p-n-p transistor T1. Choke L1 prevents the microphone amplifier being blocked by the RF signal produced by the oscillator. The amplified microphone signal may be taken from terminal '1'. When the transmitter is used for line signals, the microphone preamplifier is not used since these signals are applied to terminals '3' (mono) or '4' and '5' (stereo).

VOX

The voice-operated switch receives the amplified microphone signal at its input, terminal '2'. Preset P1 determines the input level and thus the switch-on threshold of the VOX. The signal at the wiper of P1 is fed to CMOS inverter N1, which functions as an amplifier. The next gate, N2, functions as a limiter. The signal rectifier shown in the block diagram consists of diodes D4-D5, resistor R7 and capacitor C4. The gates that follow the rectifier, N3, N4 and N5, raise the rectified signal to a level suitable for controlling switching transistor T2. The switch-on period of the VOX is determined mainly by the value of C4.

Depending on the signal level that exists at the input of the VOX, transistor T2 is off or on. In that way, it controls the power supply to the RF oscillator, T3. Choke L2 at the collector of T2 prevents the RF signal developed by the oscillator from being short-circuited by the power supply lines.

FM oscillator

LED D3 lights when the VOX powers the RF oscillator based on p-n-p transistor T3. The AF signal received at terminal '3' or terminals '4' and '5' is taken through a pre-emphasis network composed of C5-C6-R11 before it arrives on the modulation level control, preset P2. Frequency modulation of the oscillator is achieved by C7 superimposing the modulation signal on the bias voltage of dual varicap D2, a Type BB204. Transistor T3 oscillates at a frequency determined by tuned circuit L3-C10-D2, with C11 providing positive feedback between the collector and the emitter.

The oscillator frequency can be set between 88 MHz and about 108 MHz by adjusting trimmer C10. Capacitors C8 and C9 decouple the RF and the AF component respectively at the base of T3. The transmitter has no aerial or aerial connection; its RF signal is radiated by L3.

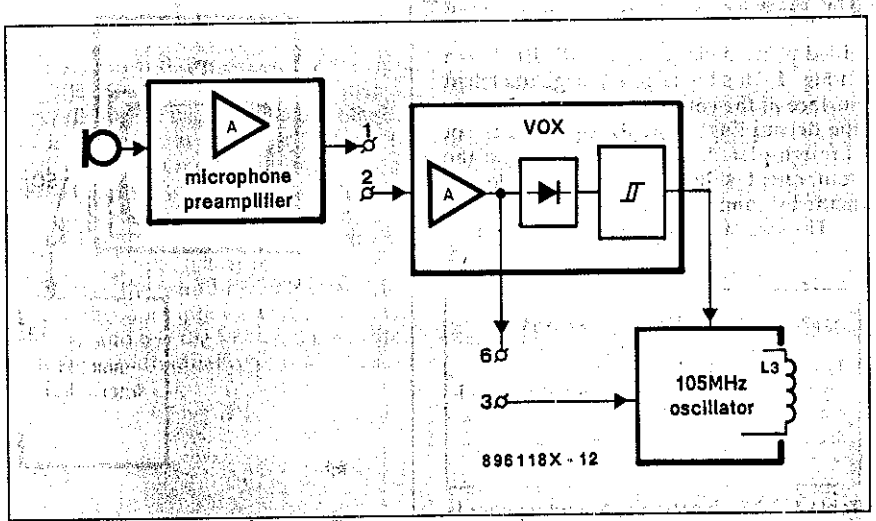


Fig. 1. Block diagram of the FM transmitter. The numbered terminals are interconnected depending on the application of the unit.

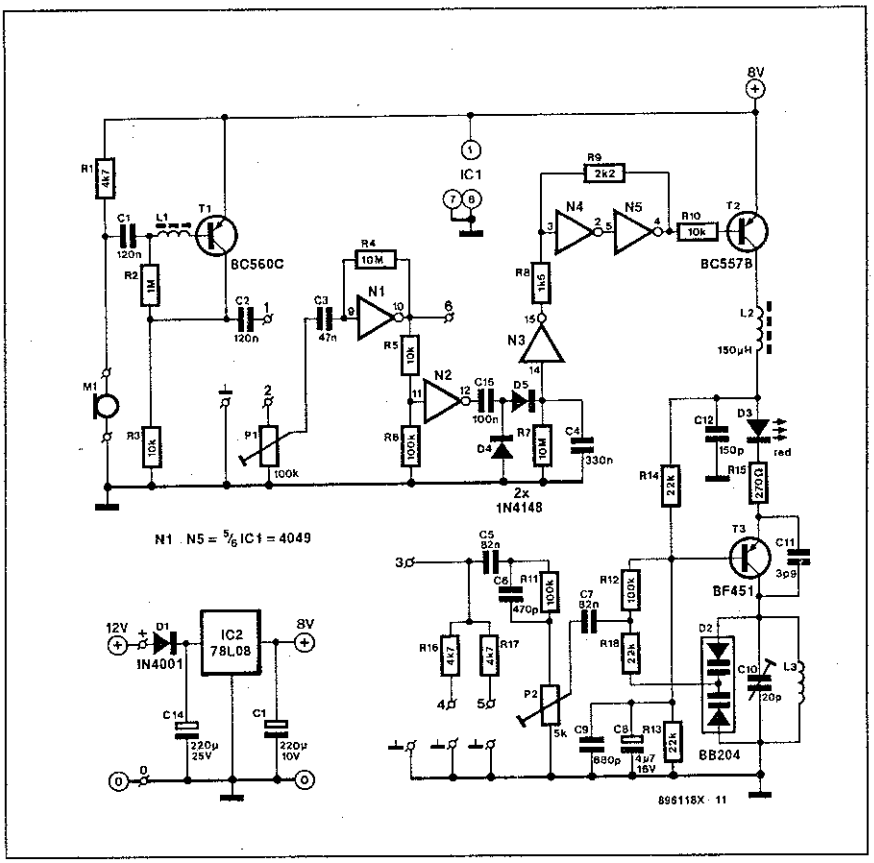


Fig. 2. Circuit diagram of the mini FM transmitter.

Resistors R16 and R17 sum stereo signals applied to terminals '4' and '5' to create a mono modulation signal

Power supply

This is conventional, taking the form of a low-drop voltage regulator Type 78L08, IC2, with the usual decoupling capacitors, C14 and C13, at the input and output respectively. The input of the regulator is connected to a mains adapter with 12–15 VDC output

Construction

The presence of an RF signal at about 100 MHz governs the use of the double-sided printed-circuit board (PCB) shown in Fig. 4. This board has a large unetched surface at the component side to assist in the decoupling of the RF signal. It is not through-plated: all contacts between the component side and the track side are made by component terminals

The size of the circuit board allows it to be fitted into a compact ABS enclosure of about 8×5.5×3 cm. Start the construction by fitting the single wire link on the board. Next, mount the one IC socket and preset P1. Note that one terminal of P1 is soldered at both sides of the PCB. This is indicated by the absence of a circle on the component overlay and the fact that the copper is not removed around the hole at the component side. Do not fit P2 as yet

Mount the remainder of the components. It will be noted that most of these are fitted vertically. Keep all component

Application	Wire(s)	AF signal to
TV sound	2 – 3	3
stereo sound	2 – 3	4 and 5 (stereo)
babyphone	1 – 2; 3 – 6	use microphone
doorbell extender	1 – 2; 3 – 6	use microphone

Table 1. The function of the transmitter is determined by wire connections as listed here.

COMPONENTS LIST

Resistors:

3	4k7	R1;R16;R17
1	1M0	R2
3	10k	R3;R5;R10
2	10M	R4;R7
3	100k	R6;R11;R12
1	1k5	R8
1	2k2	R9
3	22k	R13;R14;R18
1	270Ω	R15
1	100k preset H	P1
1	5k preset H	P2

Capacitors:

2	120nF	C1;C2
1	47nF	C3
1	330nF	C4
2	82nF	C5;C7
1	470pF	C6
1	4µ7 16V radial	C8
1	680pF	C9
1	20pF foil trimmer	C10
1	3p9	C11
1	150pF	C12
1	220µF 10V radial	C13
1	220µF 25V radial	C14
1	100nF	C15

Semiconductors:

1	1N4001	D1
1	BB204	D2
1	red LED	D3
2	1N4148	D4;D5
1	BC560C	T1
1	BC557B	T2
1	BF451	T3
1	4049	IC1
1	78L08	IC2

Miscellaneous:

1	3-mm long ferrite bead	
1	150µH choke	L2
	0.2-mm dia. enamelled copper wire	
	1-mm dia. silver-plated wire	
1	printed-circuit board	896118

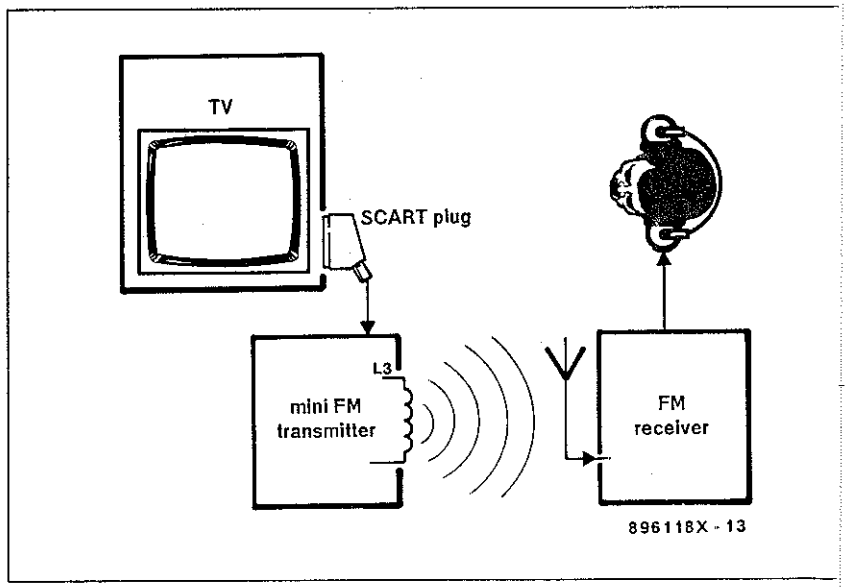


Fig. 3. Suggested application in conjunction with a SCART (Euro-AV) connection on a

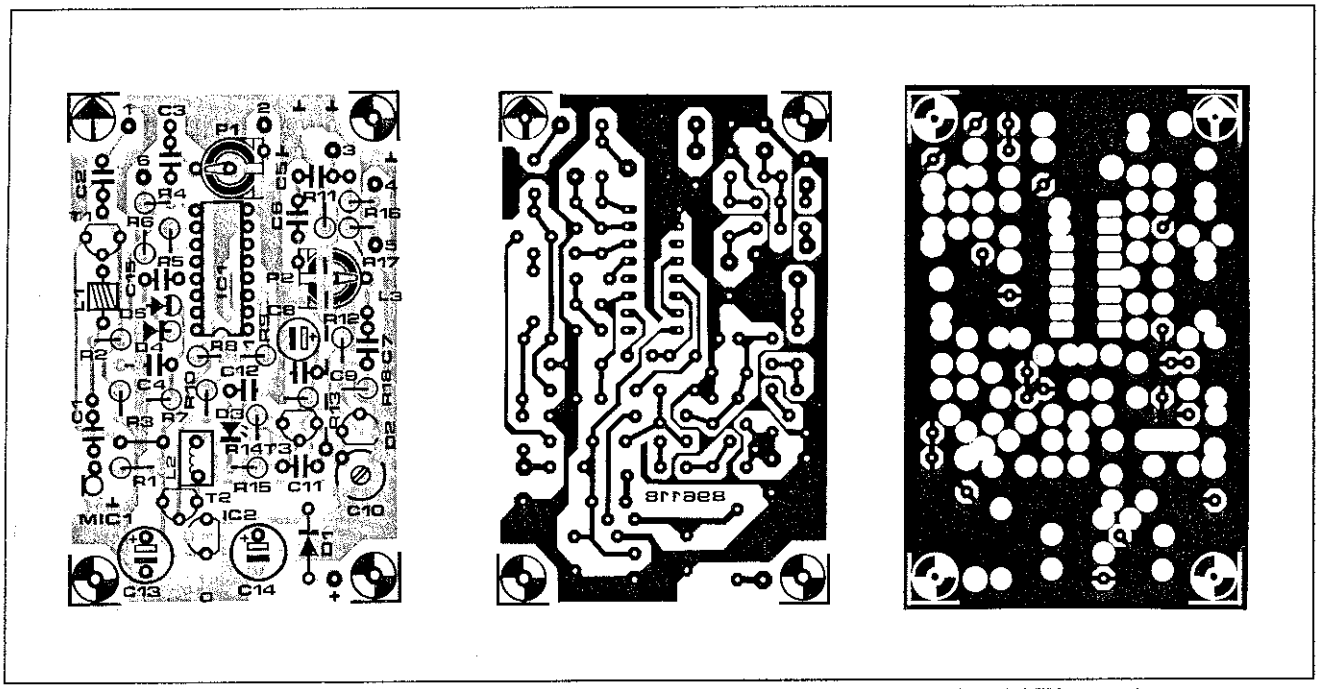


Fig 4. Track layouts and component mounting plan of the double-sided printed-circuit board for the mini FM transmitter.

leads as short as possible. The two ground terminals of trimmer C10 must be soldered rapidly at both sides of the PCB to prevent the rotor package and the internal foil being damaged or deformed by overheating.

Home-made inductors

Choke L1 consists of 5 turns of 0.2 mm dia. (SWG36) enamelled copper wire through a 3-mm long ferrite bead. Carefully remove the enamel at the wire ends of this inductor by heating it with the solder iron while applying a little solder.

Inductor L3 appears on the component overlay (Fig. 3) as a dashed line between positions C11 and P2 to indicate that it is fitted at the track side of the PCB. The inductor consists of 4 turns of 1-mm dia. (SWG20) silver-plated wire drawn out to a length of about 3 cm. The 'cold' end of L3 is soldered to ground at both sides of the PCB. Preset P2 may then be fitted, followed by the wire links (consult Table 1).

The LED and the electret microphone are fitted on the front panel of the enclosure, and the adaptor socket at the rear panel.

SCART connection

The FM transmitter may be used for 'wireless' listening to TV sound as illustrated in Fig. 3. Thanks to its small size, the unit may be fitted permanently near the TV set, connected to it via the SCART socket. The SCART connection is made via pin 3 (mono signal output) and pin 4 (audio ground).

Setting up

Set P2 to the centre of its travel and apply an audio signal to terminal '3' of the transmitter. Tune an FM receiver to a clear frequency near the upper end of the band, e.g., 105 MHz. Switch the transmitter on. Carefully adjust trimmer C10 until the signal is received. If necessary retune the receiver for minimum distortion. Next, increase the distance between the transmitter and the receiver. Adjust P2 until the optimum volume setting is obtained without running into distortion.

Change the wire link configuration to enable the microphone to be used (see Table 1), and test the VOX. Set the switch-on level to individual requirement by adjusting P1. ■