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REMOTE TUNING DISPLAY

Building your own Robots

Light show controller

How to design audio amplifiers

DIGITAL DIAL

Most transistor radio dials are pretty hopeless these days, so we thought we'd do something about it.

WITH MODERN RADIOS which are designed to be operated anywhere in the world, the local station call signs are no longer marked on the dial. Instead the dial is marked with frequencies making it more universal. Unfortunately the scaling on many receivers leaves a little to be desired, with many car radios lucky to have 3 or 4 markings. The use of pushbutton selection helps but when a cassette is fitted or you are out of your local area there is still the problem of knowing to what station you are tuned.

This project gives a direct readout of the station being received allowing for easy identification and selection. The display is remote from the receiver allowing it to be mounted on the dashboard for easy viewing.

Design Features

While this project has a real use its main purpose is to illustrate how the up/down counter module published in last month's issue can be put to use. We will be publishing a number of projects based around this module over the next few months.

If this module is to be used outdoors i.e. in the car, it is recommended that high brightness displays, such as the Hewlett Packard HDSP 4133, be used. As these have a different pin-out a new display board is presented in this article.

The theory of operation is that we actually measure the frequency of the local oscillator in the radio and subtract the IF frequency. While we could have subtracted this using digital logic we chose to do it by resetting the display not to zero but to 9545 (10 000 - 455).

SPECIFICATION – ETI 550

Frequency range	500-1700 kHz
Accuracy	∓ 5 kHz
Sensor	pickup coil or direct connection
Power supply	7–20 V dc @ 80 mA or 240 V ac
Display	4 digit LED

The first 455 pulses in the timing period are then used getting to zero and in effect, only pulses after this are counted and displayed. This number can be loaded into the counter by selecting the appropriate diodes and using the "load counter" input instead of the reset line. The only difference is that as the data is

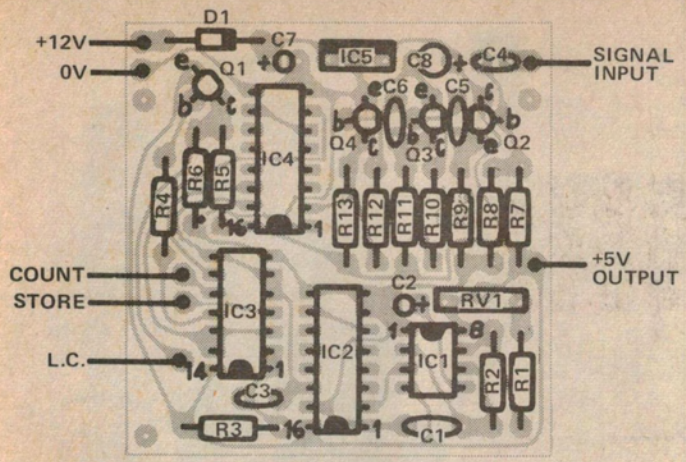


Fig. 1. The component overlay for the control card.

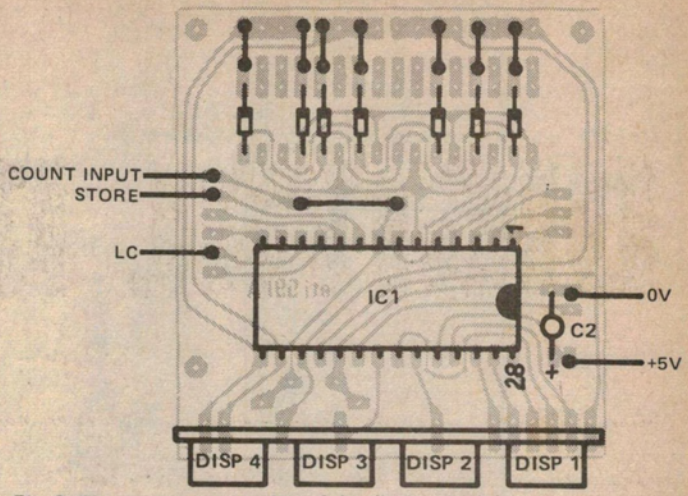


Fig. 2. The component overlay of the display module showing the diodes and links required.

PARTS LIST – ETI 550

Resistors all ½W, 5%
R1 . . . . . 39k
R2 . . . . . 8k2
R3 . . . . . 1M
R4 . . . . . 10k
R5, 6 . . . . . 1k
R7, 8 . . . . . 47k
R9 . . . . . 1k
R10. . . . . 2M2
R11. . . . . 10k
R12. . . . . 220k
R13. . . . . 1k

Potentiometer
RV1 . . . . . 5k trim

Capacitors
C1. . . . . 47n polystyrene
C2. . . . . 1μ0 tantalum
C3. . . . . 2n2 polyester
* C4. . . . . 10p ceramic
C5, 6 . . . . . 10n polyester
* C7. . . . . 33μ tantalum
C8. . . . . 10μ 25V electro

Semiconductors
IC1 555
IC2 4520
IC3 4001
IC4 4520
IC5 7805

Q1 . . . . . BC558
Q2–Q4. . . . BC548

D1 . . . . . 1N4004

Miscellaneous
PC board ETI 550
Display module ETI 591
* Transformer 240V–12.6V, 150mA

* For 12V operation delete transformer. For 240V version C7 should be 220μ 25V. For use with pickup coil increase C4 to 1n0.

entered into the counter serially the pulse used must be longer than 4 times the internal oscillator period. Also as the LC input is a three state input it cannot be driven by conventional two-state.

We initially tried capacitive coupling onto the tuning capacitor of our portable radio (oscillator section!) but the loading detuned the set too much. We then tried a pickup coil and found enough signal with it in the correct place not to require any electrical connection to the set. With the car radio however the coils are shielded so well that reliable operation was not possible. However it was found that we could tap onto one side of the oscillator coil without affecting the operation.

We use a NE555 as the time base with its output being divided by 128 to improve stability. However if an accuracy of ± 5kHz is to be maintained its frequency has to be better than ¼% and a polystyrene capacitor for C1 and 2% resistors for R1 and R2 are recommended.

Construction

The display board should be built according to the overlay in Fig. 2 which shows which diodes are required. Note that R1,2 and C1 are not used in the display module and a link is used in place of R1.

The control card can now be assembled and wired to the display module. The two boards are mounted one above the other using 9.6 mm spacers. Check that these screws do not touch any tracks and insulate them if too close.

Depending on whether the unit is going to be used with a car radio or portable the values of C4 and C7 will vary. The pickup coil is made by winding about 80 turns of 0.25 mm enamelled wire onto a 25 mm long piece of 10 mm ferrite rod with the end terminated onto a twisted pair of plastic covered wires long enough to go between the radio and the position of the display. Do not use coaxial cable for this as the capacitance is too high.

The case chosen has been left to the individual with our own being from a discarded digital clock. If you use the 240V powered version be careful with the high voltage wiring. For the 12V version the power can come from the radio via a twisted lead (3 wires).

When connecting into a car radio, tune the set to a local station and try the pickup wire on the terminals of the tuning coils in turn until one is found which will give a reading without moving it off station. Permanently connect to this point. With a portable radio try moving the pickup coil around the set, probably in line with the aerial coil, until the best results are obtained.

Calibration

Place the pickup coil in position such that reliable operation is obtained and tune to a know station (preferably near the top end of the dial). Now adjust RV1 until the digital dial agrees with that station. Check then with other stations.

Alternately feed a known signal of between 1 and 2MHz from an oscillator into the input and adjust RV1 until it reads 455 less than that frequency.

Power Supply

The unit can be powered by an ac or dc voltage of between 7 and 20 volts. If an ac voltage is used the capacitor C7 should be increased to 220 μF. A 240V to 12.6V, 150 mA transformer is recommended.

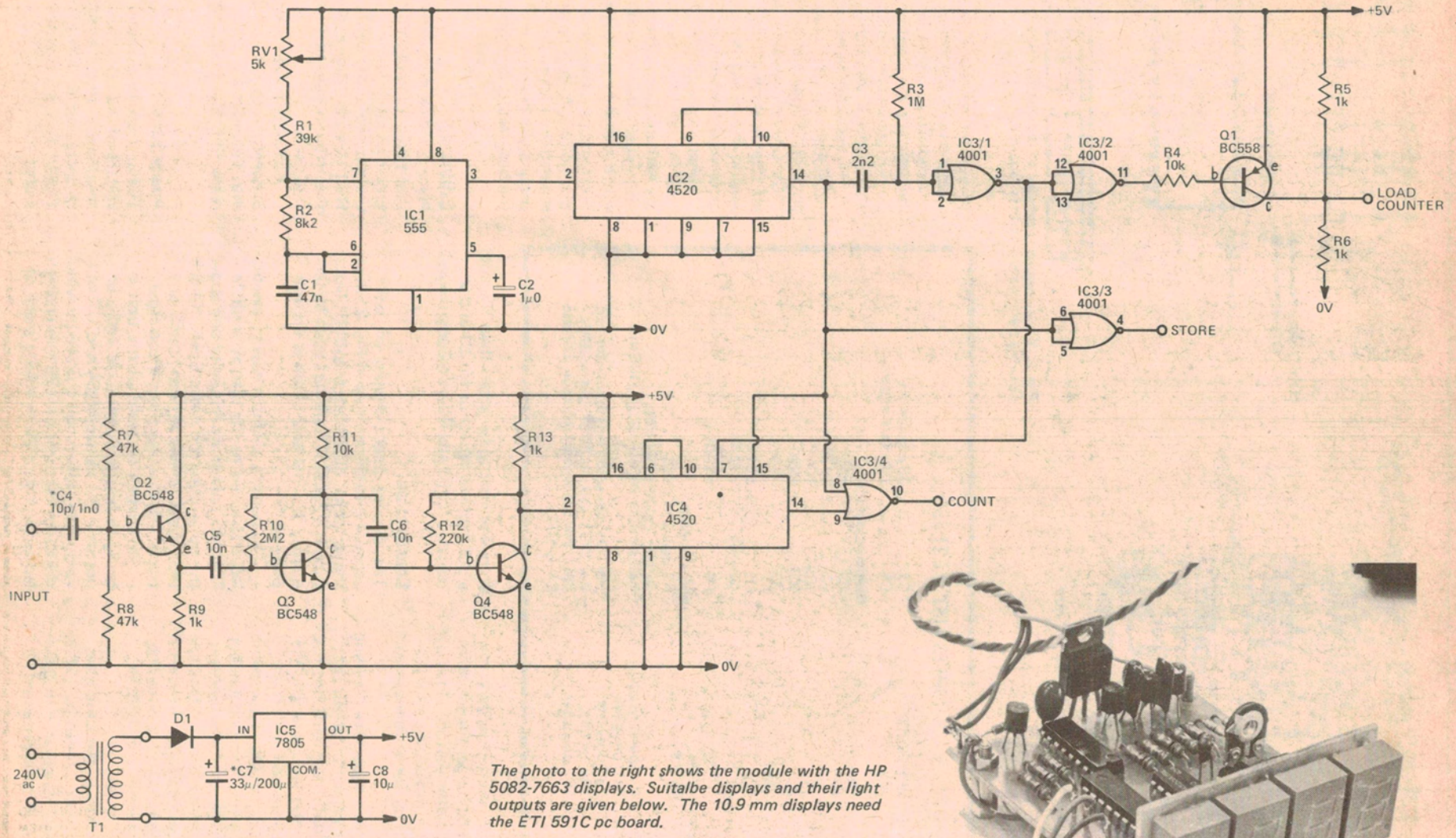


Fig. 3. The circuit diagram of the control logic.

The photo to the right shows the module with the HP 5082-7663 displays. Suitalbe displays and their light outputs are given below. The 10.9 mm displays need the ETI 591C pc board.

Type	Colour	Size	Light output
HDSP 4133	yellow	10.9 mm	2100µCd @ 20mA
HDSP 3733	red	10.9 mm	1800µCd @ 20mA
5082-7663	yellow	10.9 mm	1500µCd @ 20mA
5082 -7653	red	10.9 mm	1720µCd @ 20mA
DL704	red	7.6 mm	320µCd @ 25mA

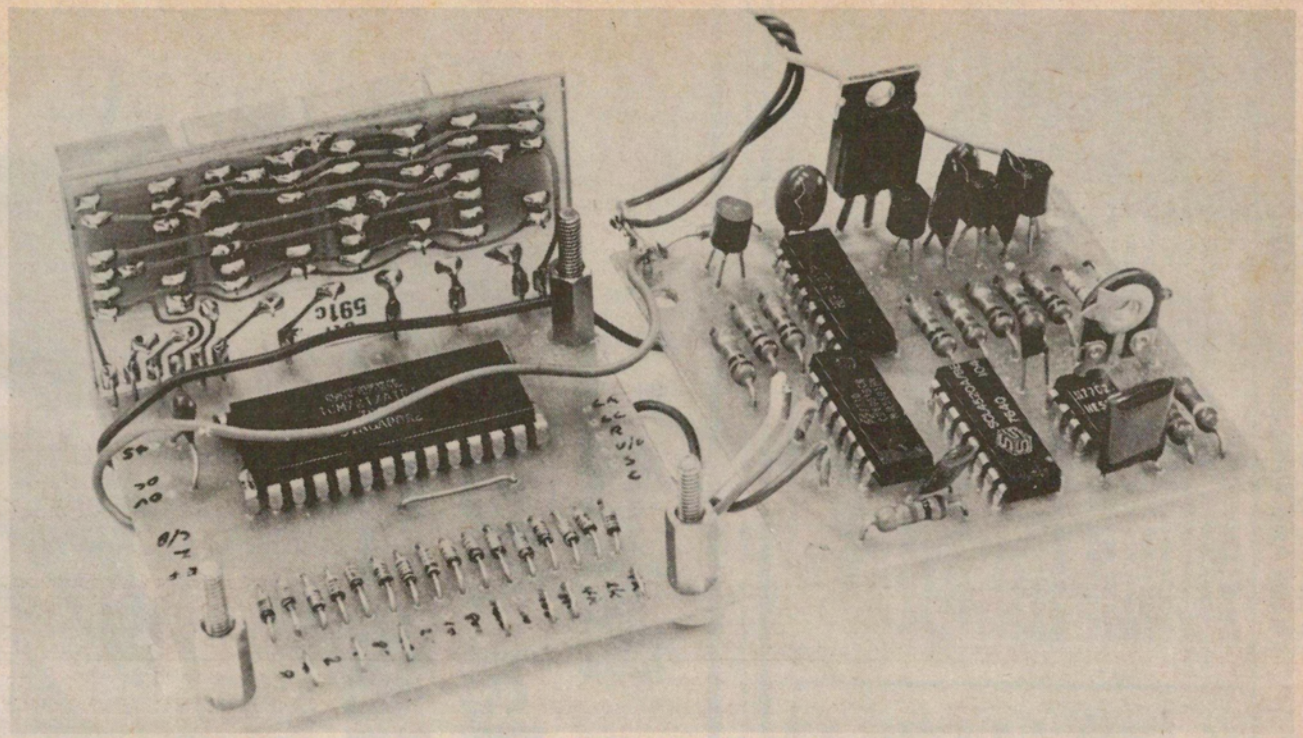
HOW IT WORKS - ETI 550

A signal from the local oscillator in the tuner is picked up either by a pickup coil or by direct connection to the set. It is then amplified by Q2-Q4 to give a square wave on the collector of Q4. The gain of this amplifier is about 250 (48 dB). The frequency of this signal will vary from around 1 MHz to about 2 MHz and this signal is then frequency divided by 256 (2^8) in IC4. This is used to clock the display module.

To measure the frequency we have to count the number of these pulses for 256/1000 seconds (256 because we divided the input by 256 and 1000 as we want a 1 kHz resolution). We used a 555 oscillator for the time base and its output is also divided by 256 (by IC2). This improves the stability of the time base by averaging out any short term variations in the 555 frequency.

The output of IC2 is a symmetrical square wave and when the output goes low a 1.5 ms wide pulse is generated by R3, C3 and IC3/1. This is then inverted by IC3/2 which turns Q1 on for the 1.5 ms period. Two resistors are used to bias the output of Q1 to 2.5V to ensure that the three level input will work.

This pulse "loads" 9545 into the counters (in the display module). Counting now starts from this number and after 455 pulses it is passing through zero. 256 ms after the load pulse ended the output of IC2 goes high. This resets IC4 back to zero, inhibits any further clocking via IC3/4 and opens the latches via the strobe line allowing the total in the counter to be displayed. 257.5 ms later when the output of IC2 goes low again, the store is closed, the counter is once again preset to 9545 with the process starting again.



The two boards which make up the complete dial. Note the links on the display board. The diodes where the links are not used may be deleted.

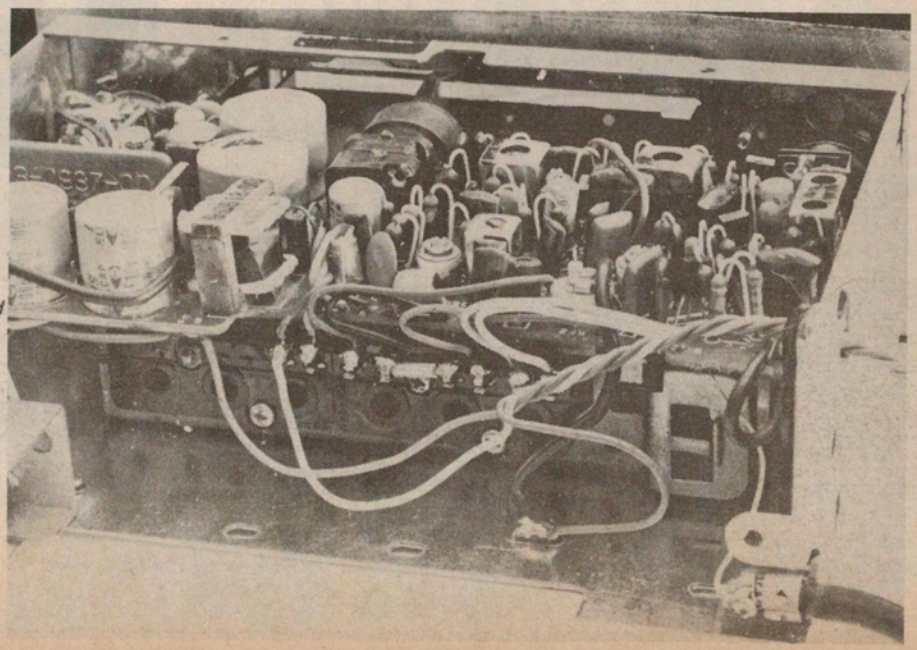


Photo showing where we tapped into the car radio.

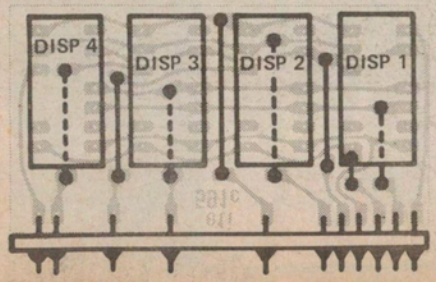


Fig. 4. The component overlay of the display when using the HP display.