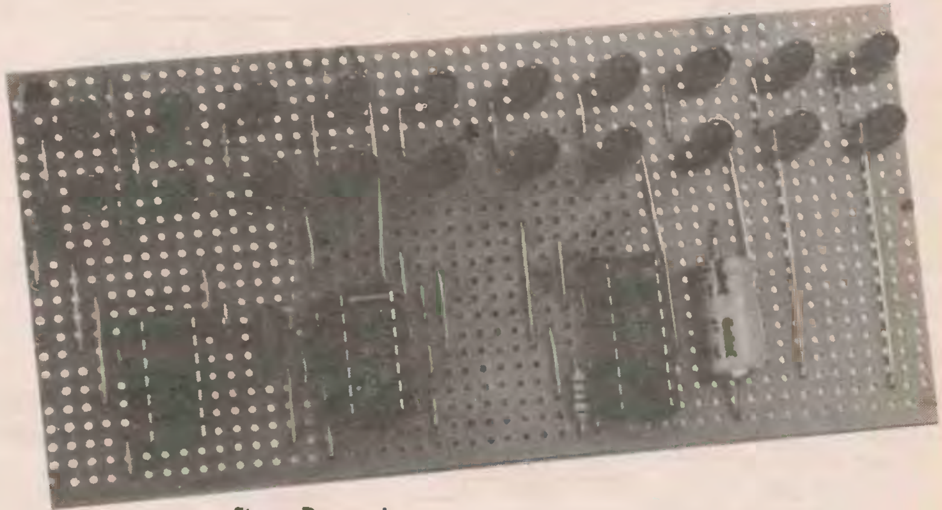
Stereo Bargraph

Ever since they were first introduced, which was several years ago now, the LM3914/5/6 series of bargraph drivers have been popular with project designers. Unfortunately, this popularity has not been reflected in the cost of these devices, which are far from being in the 741 or 555 category in this respect. Where two or more bargraph displays are needed for a project it is possible to make a worthwhile saving in cost by using a single driver plus a system of multiplexing to enable it to drive the displays. This circuit shows how a single LM3914/5/6 device can be used to drive two bargraph displays. The obvious application for the unit is in a stereo Vu meter, using the logarithmically scaled



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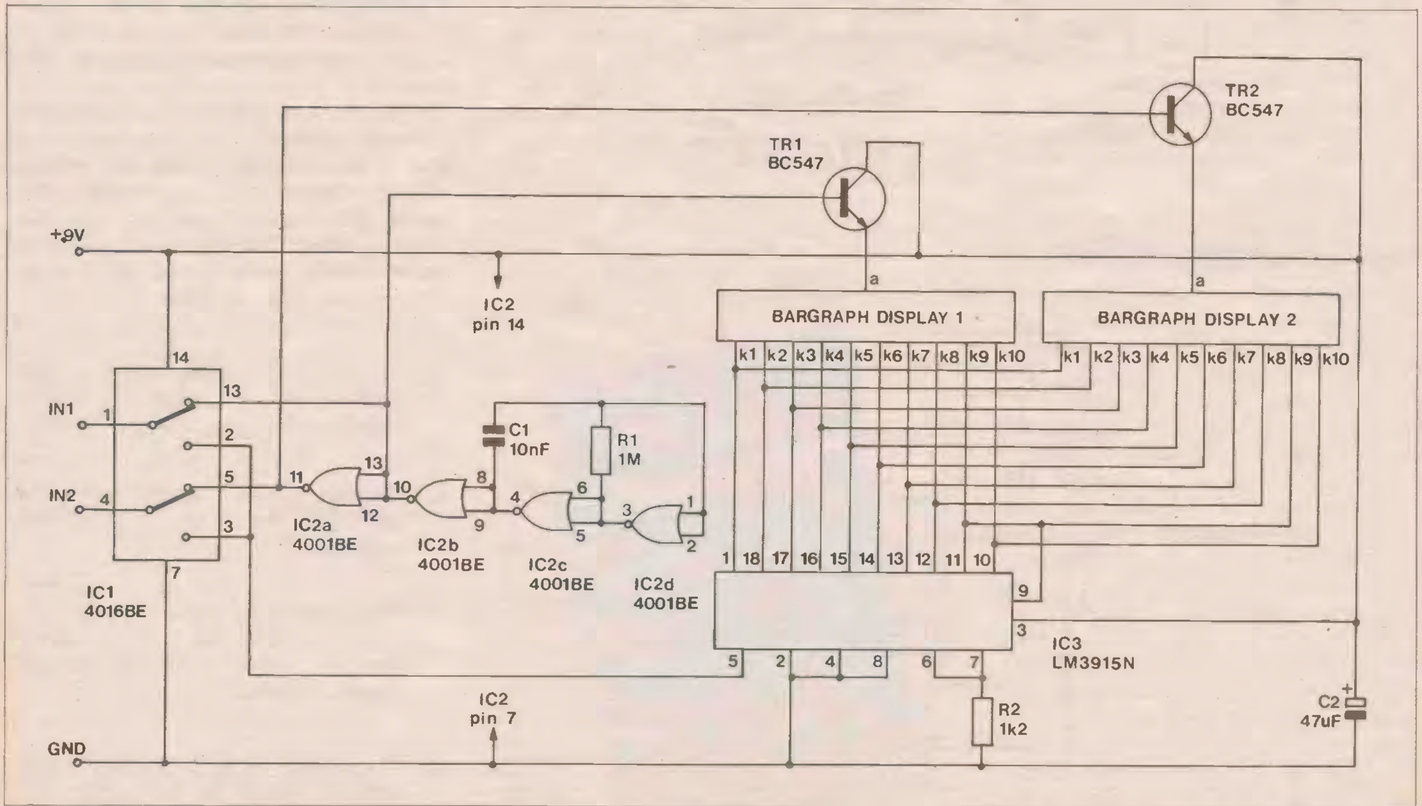


Stereo Bargraph Circuit

LM3915N, but there must be many other applications which require dual bargraph displays, and where this circuit could be used to good effect. Although the unit is based on a single driver chip, it has two separate inputs and can be used exactly as if it had two driver chips.

Multiplexing is very straightforward in principle, and it merely involves repeatedly driving first one display and then the other. The switching frequency must be high enough to avoid display flicker, which means that each display must be pulsed on at least twenty five times per second, and preferably somewhat more frequently than this. With most digital displays there is no difficulty in doing this, but with a bargraph display there is a slight problem in that the input is an analogue signal. The two input signals must be switched in unison with the switching of the displays, but analogue electronic switches are available at low cost, and this does not represent a tremendous technical problem.

In this circuit the analogue switches are two of the SPST types in a CMOS 4016BE quad analogue switch (IC1). The other two switches are not used and are simply ignored. The outputs of the two switches are connected together and coupled through to the input of the bargraph driver chip (IC3). A two phase oscillator is needed in order to drive the control inputs of the switches out-of-phase, and IC2 operates as this oscillator. It is a 4001BE quad 2 input NOR gate, but in this circuit all four gates are wired to act as simple inverters. IC2c and IC2b operate as a standard CMOS astable having an operating frequency of very roughly 100 Hertz. The other two gates act as inverter/buffers which generate the anti-phase output signals.

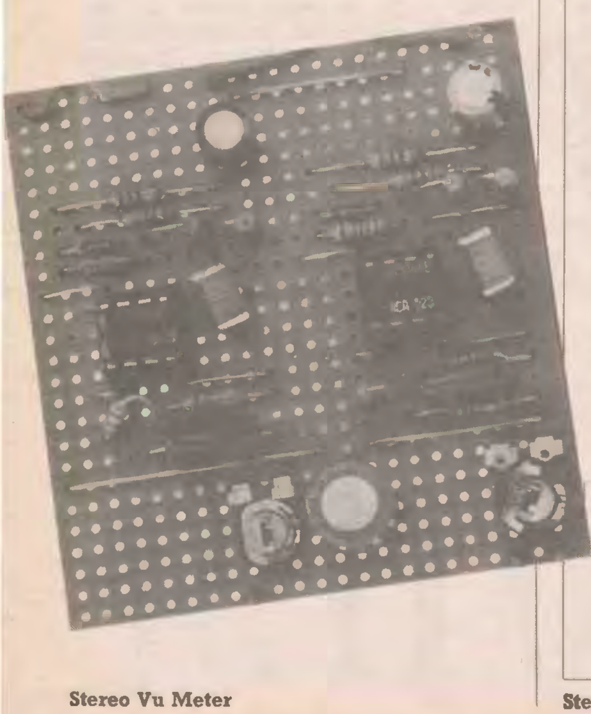
Each output of the bargraph driver drives the corresponding cathode terminal of both displays. The appropriate display for whichever input is currently connected is selected by connecting its common cathode terminal to the positive supply rail. Emitter follower switching transistors TR1 and TR2 provide this switching, and are driven by the two phase output signal of the oscillator. On the prototype the bargraphs are made up from individual 5 millimetre diameter LEDs, but proper bargraph displays can be used if preferred. These mostly have separate cathode and anode terminals for each LED, but components which do not are only suitable if they are of the common anode variety.

IC3 is used in the 'dot' mode in order to keep the current consumption down to an acceptable level. R2 sets the LED current at 10 mA, but as this is split between two displays it only represents about 5 mA per LED. The output current can be boosted somewhat if desired, and changing the value of R2 to 560 Ω will give a nominal LED current of just over 10 mA per LED. The input sensitivity is the standard 1.2 volts for this series of chips, but this can obviously be changed by the addition of an input amplifier or attenuator.

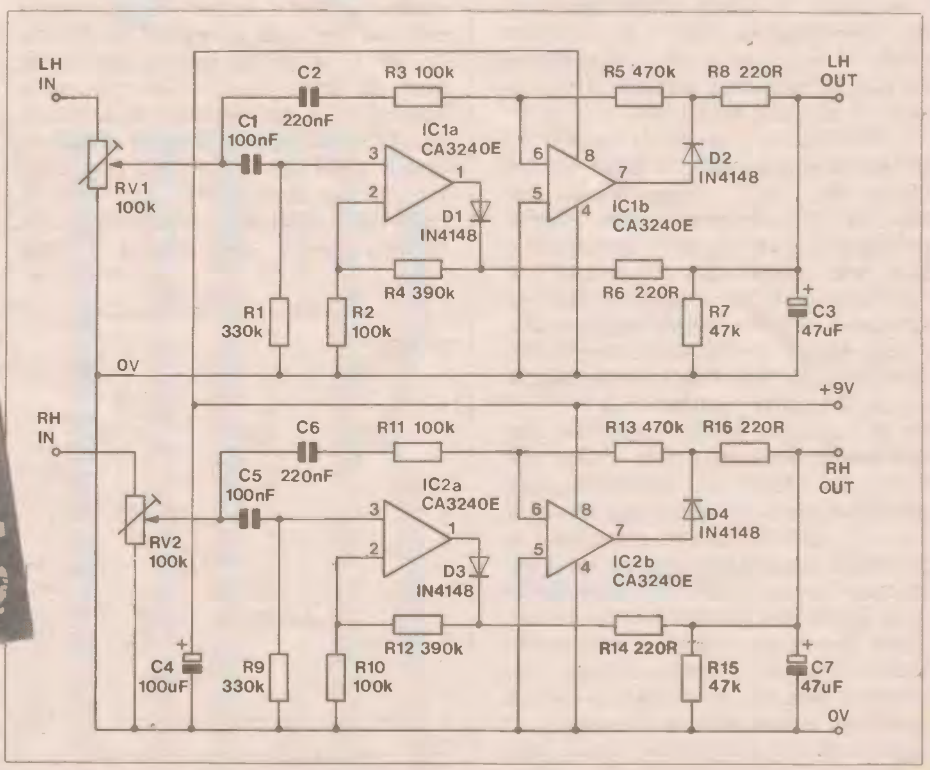
Stereo Vu Meter

This circuit was designed primarily as an add-on to the stereo bargraph unit described elsewhere in this feature. It converts the twin bargraph circuit into a stereo Vu meter of the peak reading variety. Using the LM3915N bargraph driver the unit provides indications at 3dB intervals. Just what level each LED corresponds to obviously depends on how the unit is calibrated, but typically the unit would provide indications from −21dB through to +6dB, or perhaps −24dB to +3dB. At maximum sensitivity the circuit requires only about 200 millivolts rms for full scale indication, and each channel has a separate variable attenuator to permit accurate calibration. The input impedance is in the region of 47k. If a conventional Vu meter is preferred to a LED bargraph type, the bargraph circuit can easily be replaced with two (moving coil) Vu meters.

Many Vu meters are simple average reading types, but these offer what is generally accepted as less than totally reliable results. The problem is simply that meters of this type are calibrated using a sinewave test signal, and this type of waveform has a fairly high average level relative to its peak amplitude. A signal which has a spiky waveform will then produce quite a low average reading even with the peaks of the waveform going well beyond the clipping level. Much more reliable results are obtained using a circuit which has a fast attack time and a very much longer decay time. Typically these times are around 2 milliseconds and 5 seconds respectively. The meter then reads the peak amplitude of the signal, and with the hold-on provided by the very slow decay time, any readings beyond the 0db level should be clearly indicated. In fact with most designs the odd transient exceeding the 0dB level will pass undetected, but in practice signals of this type are few and far between, and would not significantly degrade the audio quality anyway.



Stereo Vu Meter



Stereo Vu Meter Circuit

This circuit is a fairly conventional type, and as the two channels are essentially the same we will only consider the operation of one of them (the left hand channel). The circuit is basically just a precision fullwave rectifier. Semiconductor diodes introduce a forward voltage drop, with a substantial drop of about 0.6 volts being produced in the case of silicon types. With the bargraph circuit having a full scale sensitivity of about 1.2 volts, this would give very poor accuracy. Not all types of diode are as bad in this respect as silicon types, but none provide quite the degree of accuracy required for this application. The diodes are therefore included in the negative feedback networks of operational amplifiers, and the feedback precisely compensates for the forward voltage drops through the diodes. In order to give fullwave rectification, two precision rectifiers connected in parallel are used. One is based on a non-inverting amplifer (IC1a), and this processes the positive half cycles. The other is built around an inverting amplifier (IC1b), and this inverts negative input half cycles to give a positive output. Note that the CA3240E is a type that can operate with a single supply rail, and that most other types (the 1458C for example) will not function properly in this circuit unless a dual supply is used. C3 is the smoothing capacitor, and a fast attack time is obtained due to the low source impedance from which it is driven. Its only significant discharge path is through the much higher resistance of R7, which gives the circuit its long decay time.

Construction of the unit should prove to be quite easy, but remember that the CA3240E is a MOS input type, and the usual anti-static handling precautions should be taken when dealing with IC1 and IC2. If moving coil Vu meters are preferred, two Maplin (RW73Q) Vu meter movements are suitable, and these should be driven from the outputs via 15k series resistors. This gives lower sensitivity and a shorter decay time than using the stereo bargraph circuit, but performance in both respects is still perfectly adequate.

In order to calibrate the unit, a steady signal at the 0dB level is applied to both inputs. RV1 and RV2 are then adjusted for the lowest sensitivities that result in their respective 0dB LEDs lighting. If meters are driven from the outputs, then the presets are adjusted for precisely 0dB indications from both meters.