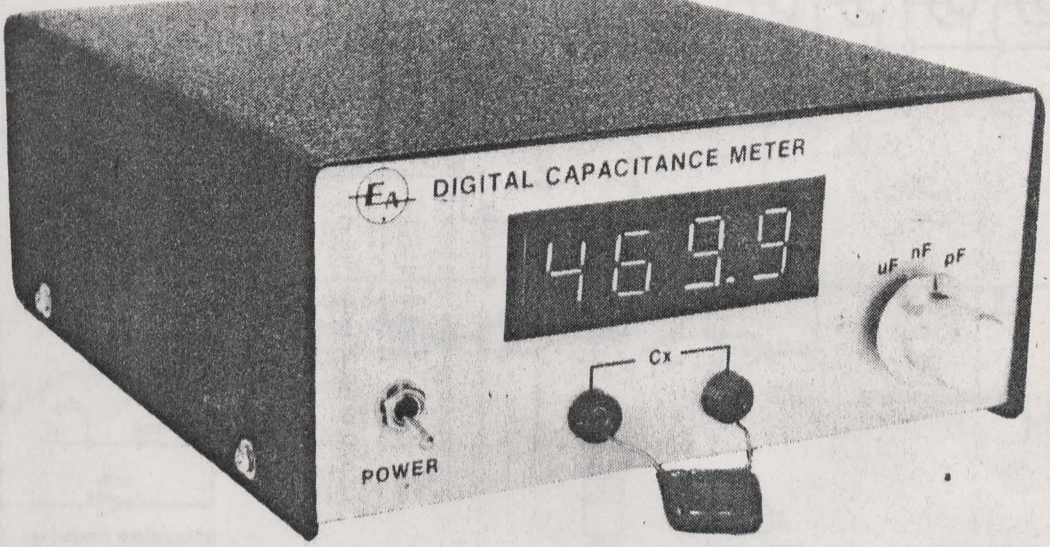
Build this digital capacitance meter



☆ Easy to build

☆ 4 digits

☆ LED display

☆ Measures 1pF-99.99uF

Here is an inexpensive digital capacitance meter which measures from 1pF to 99.99uF in just three ranges. It's simple to use and features a big bright four-digit display with automatic updating and decimal points.

by RON DE JONG

We have described quite a few capacitance meters in the past, the last one published in January 1979 proving to be quite popular. It was a simple analog meter and gave good performance at low cost. Considering the success of that project, we have taken the next "logical" step and developed an up-to-the-minute digital capacitance meter.

Our new capacitance meter uses only five ICs and has a large four-digit LED display. There are three ranges with full scale readings of 9999pF, 999.9nF and 99.99uF with over-range available on each. This means that capacitance measurements can be made over the range from one picofarad to beyond 100 microfarads. No adjustments are necessary to make a reading: just connect the capacitor, select the range and there is the reading — bright and clear.

It is certainly simpler to operate than a conventional impedance bridge but also has the advantage over both bridges and conventional analog meters in that it will accurately measure capacitance down to one picofarad directly. This is possible because of the internal "nulling" circuitry which cancels the effect of any stray capacitance between the test terminals or test leads, so when you measure a 5pF capacitor it will display 5pF! In this respect it also has the advantages of the more complex "probe" type capacitance meters used for in-circuit capacitance measurements.

With features like these our digital capacitance meter should be invaluable to experimenters and even professionals. It is a simple matter to sort capacitors even if they have no markings or the markings are difficult to decipher. This can be the case with capacitors which use colour codes, etc, or tuning and trimmer capacitors which usually have no markings at all.

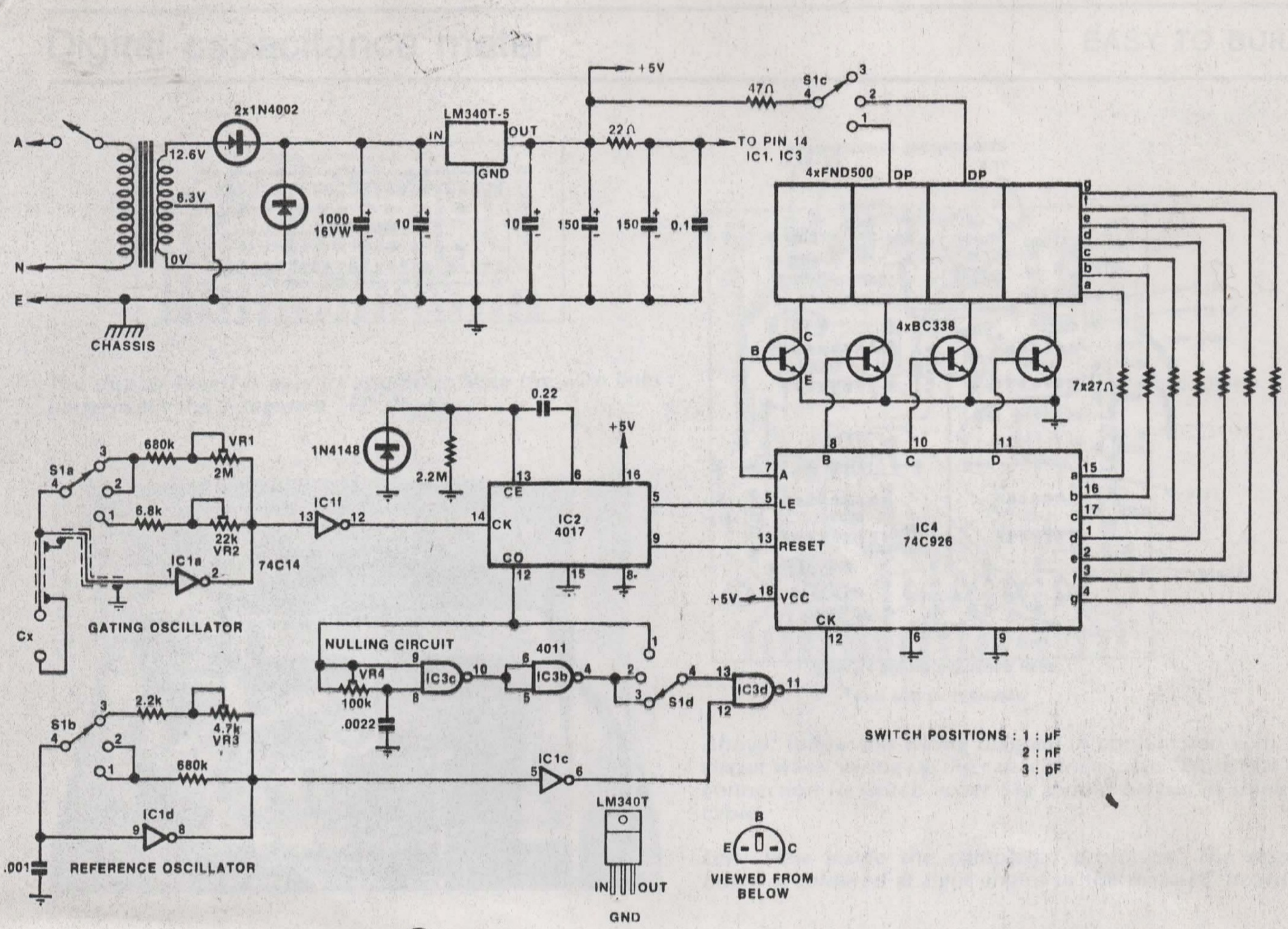
The capacitance of wiring and cables can also be readily measured. For example, it is often desirable to know the capacitance of shielded audio cable when connecting cartridges, since most cartridges usually have an optimum capacitive load.

Unlike conventional meters a digital meter offers high resolution; in this case, four digits. This means it is possible to select close-tolerance capacitors from a batch of low-tolerance units or to match capacitors for use in filters.

Last but not least our "DCM" also measures electrolytic and tantalum capacitors. The test terminals are actually polarised with a potential difference of about 3 volts between them, so electrolytics with voltage ratings of more than 3 volts can be readily measured.

To see how it all works, refer to Fig. 1. The heart of the whole meter is the "gating" oscillator which is actually a simple RC oscillator. The capacitor to be measured forms the "C" part of the oscillator so the period of oscillation will be proportional to the value of the capacitor. For example, a small capacitor will result in a relatively short period of oscillation while a larger capacitor will cause a correspondingly longer period.

The output pulses from the "gating" oscillator gate through a series of pulses from a reference oscillator which operates at a fixed frequency. With this arrangement, the number of pulses gated through to the following counter is proportional to the pulse length of the "gating" oscillator and hence the value of the capacitor being measured.



DIGITAL CAPACITANCE METER 7/CM/-

Just 5 ICs and 4 LED displays make up this accurate digital capacitance meter. Note that, for the sake of clarity, the components associated with S1a and S1b are not shown in the order that they appear on the PCB.

If the reference oscillator is set to an appropriate frequency then, the counter will actually display the capacitance value directly.

There is a little more to it than that, as reference to the circuit diagram will indicate. The two oscillators we've mentioned are IC1a, which is the "gating" oscillator and IC1d, which is the reference oscillator. Both are Schmitt oscillators in which switches S1a and S1b provide for appropriate range selection. The "gate" referred to in Fig. 1 is actually IC3d which is a 4011 NAND gate while the counter is IC4, a 74C926 CMOS IC.

The 74C926 is a four-decade counter which we have used before in other projects such as our digital frequency meter. As well as a four-decade counter, the 74C926 has latches, decoder drivers and internal multiplexing circuitry which drives a four digit LED display directly using four transistors. If conventional ICs were used in place of the 74C926, as many as 12 extra ICs would be required.

To make the 74C926 counter function properly, certain "housekeeping" signals are necessary, namely the "reset" and "latch enable" signals. The contents of the latches are used to drive the display so that the decade counters remain free to count up without affecting the display. When the count has to be displayed the "latch enable" signal goes high, transferring the contents of the counter to the latches. The purpose of the "reset" signal is to clear the counters, so that a new count cycle can begin.

These "housekeeping" signals must be generated in a particular sequence, together with the signal from the "gating" oscillator, IC1a. To do this, we have used a 4017 decade counter IC which has 10 decoded outputs as well as a "carry" output. Only one of the decoded outputs is on (high) at any given time. The "clock" signal for the 4017 is obtained from the "gating" oscillator, IC1a, so that the length of the pulses from each of the 10 decoded outputs is equal to the period of the clock signal.

The sequence of the housekeeping signals is as follows: First the gating signal arrives and the output from the

Fig. 1 (right): how the circuit works. Pulses from the reference oscillator are gated by the gating oscillator and fed to the counter circuit.

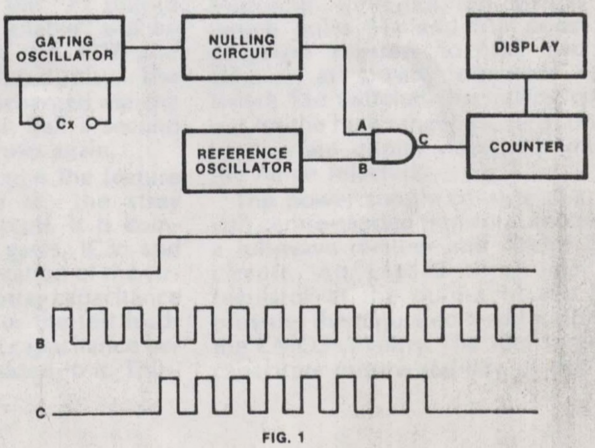
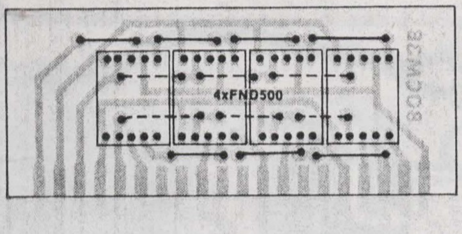
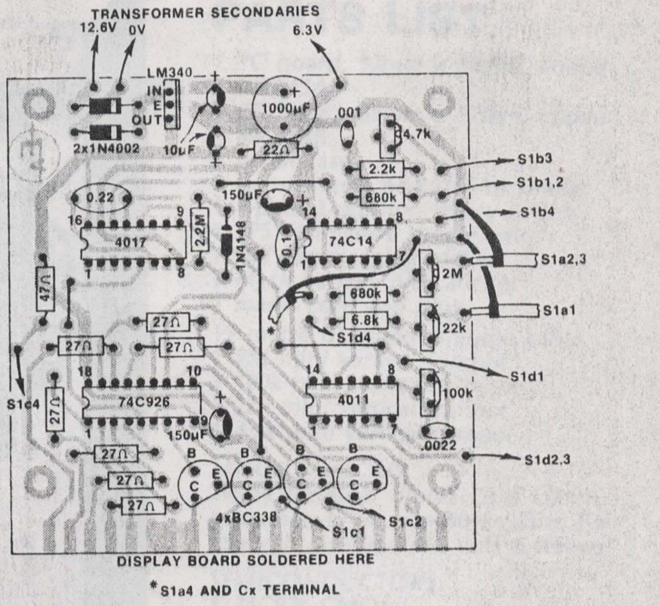


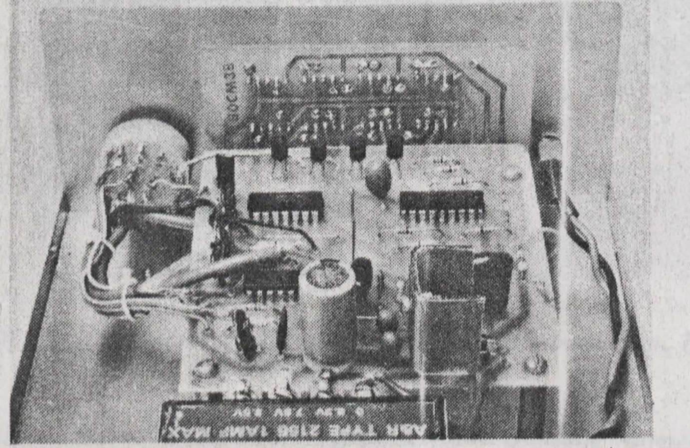
FIG. 1



The display board is easy to assemble. Note the wire links underneath the 7-segment LED displays.



Above: follow this wiring diagram in conjunction with the circuit when wiring up the capacitance meter. Note that the connection to switch wiper S1a should be run in shielded cable.



Left: view inside the completed prototype. The display board is soldered at right angles to the main PC board.

reference oscillator, IC1d, clocks up the 74C926 counter; as soon as the gating signal is finished the latch enable goes high and the contents of the counter are displayed (ie, the reading is updated); finally, the reset goes high, clearing the counter for the next cycle.

In practice, we have used the "carry" signal from the 4017 as the gating signal instead of using the output of the gating oscillator direct. However, this does not alter the principle of operation. The "carry" signal from the 4017 is high during the time the decoded outputs 0 to 4 are high, so the 74C926 is clocked during this period. The latch enable signal is the decoded "6" output from the 4017 (pin 5) while the reset signal is the decoded "8" output (pin 9).

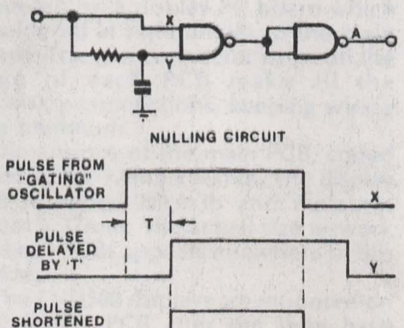


FIG. 2

Note that with this system there is a discrete clock period (ie, period of the gating oscillator IC1a) between each housekeeping signal, so that the circuit operates reliably and without "glitches".

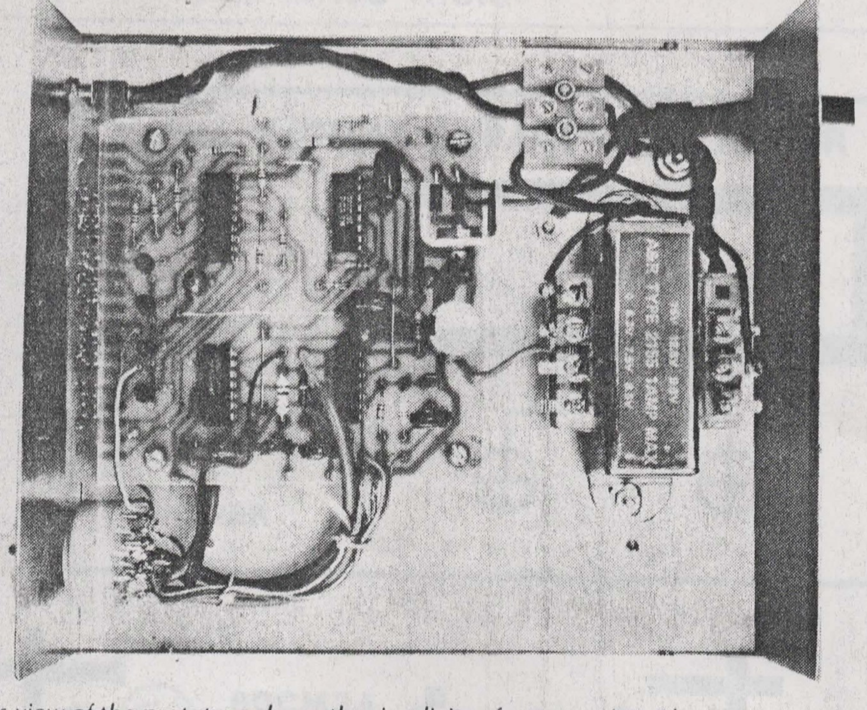
One point that emerges from the foregoing description is that the display will be updated at a rate given by the "gating" oscillator which can be quite rapid when small capacitors are being measured. To prevent the display from flickering as a result of this rapid updating, a half second delay is introduced by connecting the decoded output "7" to the clock enable (pin 13) via a 0.22uF capacitor. When in the normal course of events the "7" output goes high, the "clock enable" will be forced high, disabling the 4017 and effectively freezing the display. The 0.22uF capacitor is discharged via the 2.2M resistor. So about half a second later clocking commences again.

Finally, we can describe the feature we are quite proud of: the stray capacitance nulling circuit. It is comprised of two NAND gates, IC3c and IC3b and the basic operation of the circuit is shown in Fig. 2. Stray capacitance in the internal wiring or the test leads acts in parallel with the capacitance being measured and is added to it. Thus, stray capacitance has the effect of lengthening the pulses from the gating oscillator by a fixed amount.

The function of the nulling circuit is simply to shorten the gating pulses, effectively removing the additional time due to the stray capacitance. Fig. 2 shows the timing diagram of the nulling circuit. The gating pulse is fed to one input of NAND gate IC3c and to the other input via a delay network with time-constant "T", consisting of a variable resistor VR4 and a .0022uF capacitor. When the delayed version of the gating pulse is "ANDed" with the original, the resultant output pulse is shortened by the corresponding amount.

Range selection is provided by a four-pole three-position switch S1: switch poles S1a and S1b select appropriate resistors for the two oscillators as already discussed while switch S1d switches the nulling circuit out for the high range; S1c turns on the appropriate display decimal point for the range selected.

The power supply consists of a 12.6 volt centre-tapped transformer feeding a full-wave rectifier and 1000uF filter circuit. An LM340 three-terminal regulator at the output of the filter provides the regulated 5-volt supply for the CMOS circuitry. The 10uF tantalum capacitors ensure stability of the reg-



This view of the prototype shows the simplicity of construction. The PCB assembly is mounted using 25mm brass spacers.

ulator. An additional 150uF capacitor on the output of the regulator is mounted close to the 74C926 so as to decouple the display multiplex "hash".

The oscillator circuits (IC1) are separately decoupled from the regulator via a 22 ohm resistor and 0.1uF and 150uF capacitors. This is necessary to prevent the oscillators locking onto any "hash" signals superimposed on the supply.

The seven-segment readouts used for the display are Fairchild FND500s which have 15mm high digits and integral red plastic filters, eliminating the need for a separate red filter in front of the display.

Construction of the digital capacitance meter is fairly straightforward. Most of the components are mounted on the main PC board while the seven-segment displays are mounted on a display PC board which is soldered at right angles to the main board. The two connector strips on the edge of each PCB make all the necessary connections, keeping wiring to a minimum.

Dimensions of the main PCB, coded 80cm3a, are 92mm x 89mm. The display PCB is coded 80cm3b and measures 89mm x 37mm. The actual size artwork for both PCBs appears elsewhere in this article.

The FND500 displays are mounted on the display PCB after the links have been installed. Some links pass underneath the displays so care should be taken to ensure the displays are flush and in line with each other. This can be done by soldering only two of each of the display leads, checking alignment and adjusting where necessary and then finally soldering the remaining leads.

Mount the components on the main PCB next, leaving the CMOS ICs till last. The LM340 regulator requires a heatsink which can be made from a small piece of aluminium bent in a U-shape. Take the usual precautions when soldering the CMOS ICs: avoid handling the pins; use an earthed soldering iron and solder the supply pins first. Make sure the orientation of the electrolytic and tantalum capacitors is correct as well as for the ICs or damage may result.

With the main PCB and display PCB complete, the two can be soldered together. Let the lower edge of the display PCB overlap the lower surface of the main PCB board by about 2mm and make sure the two are exactly at right angles to each other. First, solder "tack" one strip at either end of the boards together and manipulate them until the orientation is correct; then solder the remaining connectors.

The circuitry is housed in a metal case measuring 184mm x 70mm x 160mm (D x H x W). Drill the mounting holes for the transformer, cable clamps and terminating block as shown in the photographs of the internal layout. The mains earth lead should be slightly longer than the other mains leads and should be terminated to a solder lug screwed down to the chassis.

Use the front panel artwork, shown actual size elsewhere in this article, to obtain drill centres for the on/off switch, range selector and banana plug test sockets as well as the dimensions of the cutout for the display. With the cutout complete mount the main board using 25mm washers. Then mount the switches and complete the wiring.

Keep all the leads as short as possible and use shielded cable for all the connections to the gating oscillator. The connection to the input of IC1a continues on from the wiper of S1a and to the test sockets. Make sure the cable is shielded every bit of the way, otherwise multiplex hash may influence readings, causing a slight "sticking" or bouncing of the display.

An attractive finish to the meter can be provided by using a "Scotchcal" photosensitive aluminium front panel. Use the artwork provided to make the

PARTS LIST

1 PC board, 92mm x 89mm, coded 80CM3A
1 PC board, 89mm x 37mm, coded 80CM3B
1 metal case
1 transformer, A&R2155 or similar
1 4-pole 3-position rotary switch
1 SPST miniature toggle switch
1 red banana plug socket
1 black banana plug socket
1 mains cord and plug
½ metre of shielded audio cable
1 2M mini vertical trimpot
1 100k mini vertical trimpot
1 22k mini vertical trimpot
1 4.7k mini vertical trimpot

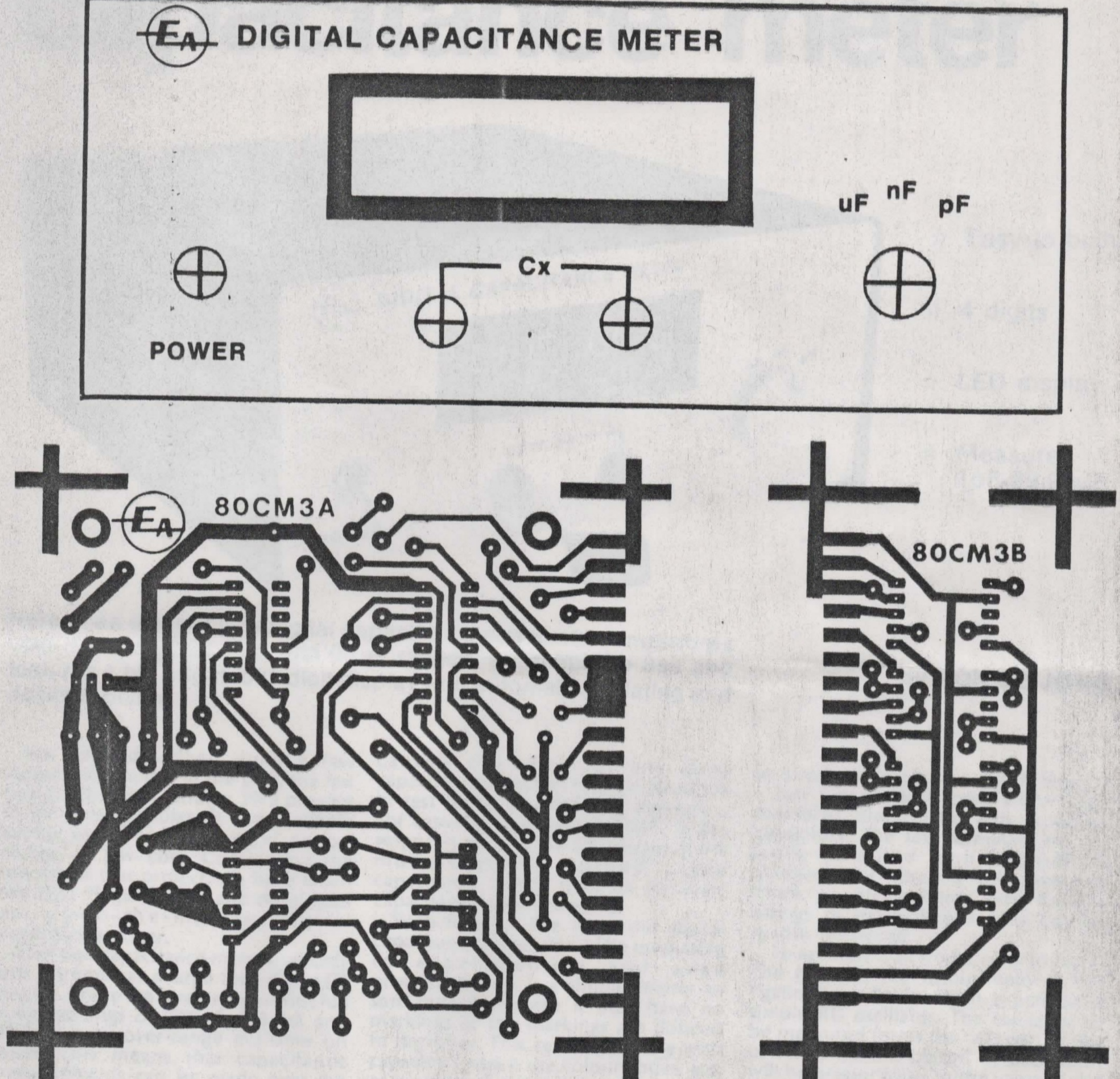
MISCELLANEOUS
3-way terminal block, cord clamp, grommet, knob, rainbow cable, 4 x 25mm brass standoffs, nuts & screws

SEMICONDUCTORS
1 74C926 CMOS IC
1 74C14, CD40106 or MC14584 CMOS IC
1 4017 CMOS IC
1 4011 CMOS IC
4 BC338 transistors
2 1N4002 diodes
1 LM340T-5 regulator
1 1N4148 signal diode
4 FND500 seven-segment LED displays

CAPACITORS:
1 1000uF/16VW PC electrolytic
2 150uF/6.3VW tantalum electrolytic
2 10uF 35VW tantalum electrolytics
1 0.22uF greencap (metallised polyester)
1 0.1uF greencap
1 .0022uF greencap
1 .001uF greencap

RESISTORS: (all ¼ watt 5%)
1 x 2.2M, 2 x 680k, 1 x 6.8k, 1 x 2.2k, 1 x 47 ohm, 7 x 27 ohm, 1 x 22 ohm

NOTE: Ratings are those used on the prototype. Components with higher ratings may generally be used providing they are physically compatible.



Above are actual size artworks for the front panel and the two PC boards.

panel or you can purchase a finished panel from Radio Despatch Service, 869 George Street, Sydney.

Now you can "fire up" the meter and proceed with the calibration. Ideally a capacitor standard for each range would be desirable. Lacking these or access to an accurate capacitance bridge you can purchase 2% capacitors for the purpose.

Calibrate the "nF" range first using a capacitor of about 0.47uF and adjusting VR1 for the appropriate reading (eg, 470.0nF). Next, switch over to the "pF" range and without any capacitor connected to test terminals or leads, adjust the NULL control VR4 until the display shows "0001" and then just touch it so the display reads "0000". Using, say, a 4700pF capacitor, calibrate the "pF" range using trimpot VR3. Finally, switch over the "uF" scale and calibrate it using trimpot VR2 and an appropriate capacitor.

We estimate that the current cost of parts for this project is approximately

$50.00

This includes sales tax.

to the changing DC output voltage of IC2a and IC2b caused by the biasing currents drawn by the op amps, via the attenuator resistors. Perhaps the 4136 device you are using is marginal in which case you could try replacing it with another 4136 or with the BI-FET equivalent, the Texas Instruments TL075. This has an extremely low input bias current of 7nA hence it should not suffer from this problem.

DELTAHET MARK 2 RECEIVER: In Electronics Australia for February, March, April and May, 1971, you described the Deltahet Mark 2 Communications Receiver. I wish to know if you are going to rejuvenate it, incorporate a printed circuit board and a five digit frequency meter. If so, when? (G. W., East Burwood, Vic).

● We regret to advise you that we have no plans at present to update the Deltahet Mark 2 Receiver.

DIGITAL CAPACITANCE METER: Having constructed your digital capacitance meter (March, 1980) and found it to be a tremendous help to me on the work bench, I was wondering if it would be possible to add inductance ranges to it, as may be done with some analog meters. If this is impractical would it be possible to feature a project on this subject in a forthcoming issue, as I am sure many readers would be very interested in building one using the same digital format. (J. H., Windsor Gardens, SA.)

● Unfortunately the digital capacitance meter could not be adapted to measure inductance but we may consider a combined capacitance/inductance meter as a possible project.

TV ANTENNA: I was wondering if there are any back issues dealing with TV antennas suitable for country areas? As I have an engineering shop, the manufacture of an antenna presents no problem. I merely require a design. (D.A.B., Beverly Hills, NSW.)

● As most enthusiasts prefer not to get involved in complex mechanical construction, it is many years since we published a TV antenna project. However, we published three articles in 1965 which may be of interest to you. They were "Fringe Area TV Reception" (6/ATV/8) in September, 1965, "Log Periodic Dipole Antennas" Pt 1 (6/ATV/9) in December, 1965 and Pt 2 (6/ATV/10) in January, 1966. Whilst the two later articles deal in depth with the design of antennas, the first articles looks at fringe area TV reception and the methods of overcoming the problems involved, and serves as an excellent introduction. We can supply photocopies of each of these articles at our usual price of $3 each (ie $9 the set).

More on the Acoustically Coupled Modem

ACOUSTICALLY-COUPLED MODEM: I have read your magazine over many years and have always found it interesting and stimulating, particularly in this electronic age.

I was very interested in your article in September 1980 on the Acoustically Coupled Modem for joining up terminals or for home computers over telephone lines. However, now that you have whetted our appetites, there is one problem many of us will be faced with. No doubt most of us have had experience with BASIC and understand this part reasonably well.

When it comes to the sort of programming requirements to get these connections to work through the modems, however, many will be as lost as I am. What about a nice helpful article on the requirements for this and perhaps even a few program hints to get things working? (R. G., Glen Iris, Vic).

● We understand your problem although we would assume that most personal computers would have instructions in the manual on how to use the serial ports. If your computer is one that does not have a serial port, such as the Tandy TRS-80 or Dick Smith System-80, you will need a parallel-to-serial adapter or use the serial interface system and program described in our November 1980 issue (File No. 2/CC/56). In general, the PEEK and POKE instructions are used to send and receive data via the serial port and thus via the Modem.

ACOUSTICALLY COUPLED MODEM: Your project in the September issue entitled "An Acoustically Coupled Modem for Computers" appears to be very interesting. Whilst your Acoustic Coupler project is half-duplex in the form in which it was published, it would seem to me to be fairly easy to construct as an answer-only or originate-only device simply by certain substitutions of components on the receive side or transmit side as appropriate.

Such a device would be eminently useful to me and possibly other users. Would you seriously consider publishing the component values required to transmit and receive 980/1180Hz. (G. D., Sydney NSW.)

● To change the transmit and receive frequencies of the Modem from 1650/1850Hz to 980/1180Hz: On the transmitter the .01uF and .0068uF capacitors on IC4 and IC5 are changed to .0168 (.01 in parallel with .0068) and .01 respectively. On the receiver the 1.5kHz high-pass filter will need to be reduced to a 500Hz high-pass filter by using a .016uF capacitor for the .0068uF and .0082uF for the .0047uF capacitor. Also the .033uF on IC7 connecting pin 9 to pin 1 should be changed to .056uF for a centre frequency of 1080Hz.

EPROM PROGRAMMER: Your EPROM Programmer project (EA July 1980) was most timely and I am now procuring the necessary components to have this project built.

My problem is this! I'm currently developing a program that runs in excess of 8K and may possibly exceed 16K. How then can I utilise the EPROM programmer to burn and run programs in excess of 8K?

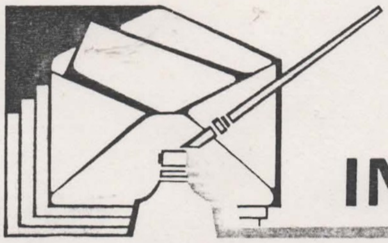
I guess that an EPROM card similar to the S-100 bus 16K EPROM card would be required, but I'm not sure of this.

I would greatly appreciate any assistance that you can provide. Perhaps other EA readers have a similar problem. (R. S., Wagga, NSW).

● The EPROM programmer which we described in July 1980 can only program or read the contents of one ROM at a time. Hence it is possible to burn as many ROMs as you like but not all at once. One other point to be noted is that the programmer is not memory mapped so it cannot run the program in a ROM. This can only be accomplished by plugging the programmed ROMs into ROM sockets provided on the computer or a plug in EPROM board as you have mentioned.

PLAYMASTER 760 ORGAN: I am interested in building the Playmaster 760 Organ as described in March, April, May, June and August, 1976. Would it be possible for me to build such an organ without any previous experience? Unfortunately, I do not have all of the series of articles, so could you send such plans to me if they exist in such a form I could understand? What is a "polyphonic" keyboard? I am also interested in the Auto Rhythm Unit by David Edwards. Could this be incorporated into the organ? Would such an organ be suitable for a rock band? (G. B., Yanco, NSW).

● We would hesitate to encourage you to embark on such an ambitious project without any previous experience. We can supply copies of the original articles for $3 each. A polyphonic keyboard is one where multiple notes may be played at the one time. The Auto Rhythm Unit could conceivably be added to the Playmaster 760 Organ but again we must emphasise that this would require at least some previous experience in the construction of electronics projects. Finally, we doubt that the organ in question would be suitable for rock band work, as it was designed more for use with classical music in mind.



INFORMATION CENTRE

GATE CONTROL: I am regular reader of "Electronics Australia". At our house we have two iron gates which open outwards. Could you suggest a way of motorising these gates, similar to the roller door idea? I am sure other readers are in the same position of opening gates to drive their cars in. (J.K.C., Moana South, SA).

● While we have produced suitable electronics to suit a garage door or gate controller, you will have to solve the mechanical problems yourself. Once you have a suitable mechanism, the job is easy. The two articles we refer you to: "Remote power control receiver", October 1970, 2/MC/6 and "remote power control transmitter", November 1970, 2/MC/7.

CAPACITANCE METER: I have recently built the Digital Capacitance Meter described in the March 1980 issue. I have found it extremely useful, except that it cannot be nulled on the picofarad range. The 22kΩ trimpot was replaced with a 20kΩ and the 150μF tantalum capacitors were replaced with 220μF electrolytics. Could these substitutions have anything to do with the inability to null. (A.M., Arncliffe, NSW).

● The substitutions you have made are quite acceptable. The most probable cause for your meter not being able to be nulled is that the internal wiring capacitance is too high. Note that we have suggested in recent Notes & Errata (November 1980) that only high quality RF cable such as RG58 or colour TV coax be used for the shielded cable.

PLAYMATE AMPLIFIER: I have built and to a degree successfully completed the Playmate as described in the January 1980 issue. Although the unit works well, the voltages measured are nowhere near those stated on the circuit diagram (ie, within ±10%). As a struggling self-taught electronics bug, I would like to know if you can guide me to getting the optimum results for my effort. As well as the "out of spec" voltages, I am also having trouble with the balance control, which is difficult to centre; there is either too much left or right channel. (R. G., East St Kilda, Vic).

● We assume that the power supply is delivering somewhere around 24 volts. If the voltage is considerably lower than this, then look for shorts. A low power supply can affect all voltage readings throughout the circuit. With a correct power supply voltage, the speaker active output should be at a voltage halfway between the supply rails, 12 volts in this case. If not, the resistors biasing Q2 should be checked. The balance control works by increasing the gain of Q2 and decreasing that of Q102 or vice versa. Check that your resistors are correct and that the capacitors in series with the balance control are correctly oriented.

CINEMA SOUND: I am currently considering the use of two of your projects in a cinema Sensuround system. The projects are the Pink and White Noise Generator described in April, 1978 and the Super Bass Filter described in February, 1978. Does the frequency response of the Pink and White Noise Generator extend to or below 10Hz, as the graph in the article only shows response to 20Hz? What sized capacitors would be required in the Super Bass Filter to provide a cut-off frequency as close as possible to but not below 17Hz? Your assistance in answering these queries would be invaluable. (R. K., Singleton, NSW).

● White noise is characterised by equal energy per bandwidth (that is, there is the same amount of energy between five and 15Hz as there is between 20 and 30Hz). Thus in any white noise there is a 10Hz component, although not shown on the graph accompanying our article because it is below the minimum audible frequency.

It should be noted however that the White and Pink Noise Generator based on the MM5837 IC is not a source of truly random noise. The IC generates noise digitally in the form of a long pseudo-random binary sequence, using a 17 stage shift register with feedback. The pseudo-random sequence repeats itself about every 1.31 seconds, and this repetitive pattern is plainly evident if a narrow range of frequencies are

Flash exposure meter drift problems

FLASH EXPOSURE METER: I have just built your Flash Exposure Meter as described in January, 1980 and I find that I am having some problems with it. When zeroed and left switched on for some length of time the needle slowly creeps below the zero mark. The sample and hold function seems a little "leaky". It peaks to say 8 and within 10 to 15 seconds it slowly drifts downwards, making it very difficult to calibrate. Once "calibrated", using the flash set to manual, it behaves inconsistently with the flash on automatic. After further experimentation, I have noted that the flash duration seems to be the critical factor. When the flash is operating so as to produce shorter flashes, the reference meter reads at least one stop lower than the constructed meter. Should not the meter read quantity of light? This one seems to read intensity. When buying the ICs for this project, I noticed that the assistant was not very careful in handling them. When I questioned this procedure, I was told that the relevant ICs were diode protected. Was he right? (C. K., Thornlands, Qld).

● Before answering your questions C. K., we would like to mention that some cases have come to our notice with the complaint that the meter drifted. It turned out that the builders used a corrosive soldering paste in addition to the resin-cored solder. When the boards were thoroughly cleaned of paste, the meters functioned properly, with very little drift. On the prototype, the zero would drift about the thickness of the needle in more than a minute. Similarly, the same amount of drift was observed when a reading was taken. We considered that this was adequate, bearing in mind that we were keeping the design as simple as possible, consistent with satisfactory results. If your unit is substantially worse than this, then there may be a faulty component to blame, such as the 1μF storage capacitor, the hot-carrier diode, or the board may be leaky.

With respect to the use of the meter with the flash set on automatic, there is some doubt as to the validity of the meter's use under these conditions. Normally, only the manual setting would need to be used and the meter reading would be taken under these conditions. The shop assistant was right, in that the op. amp. devices are diode protected. All the same, we like to see them protected by one of the approved packing methods when they are purchased.

over a considerable distance.
(2.) A thyristor-controlled slide projector unit that allows the use of two automatic slide projectors for an audio-visual show. Currently available "fade in-fade out" units appear to be rather highly priced and beyond the means of many small groups such as schools that may already have two automatic slide projectors.

Finally, thank you for the series of articles on infrared remote control and beam relay systems. Most useful. (I. McD., East Malvern, Vic).

● We can satisfy one of your wishes next month, when we publish our Slide Projector Dissolve Unit. In the meantime, we shall keep your other suggestion in mind.

AUSTRALIAN RADIO: Years ago, before tariff reductions killed local manufacture of transistor radios and such, you could buy radios with all the main call signs on the dial. Instead of having to remember the station frequency, you just tuned the pointer in the middle of 2UE or 3LO (or whatever) label and the station was there. No searching back and forth between vague "10" and "12" markings as on today's oriental masterpieces. What about doing a good AM broadcast receiver with a proper dial on it? I am sure it would be a "goer". (L.D., Dee Why).

● Your letter certainly struck a responsive chord amongst some of the older staff at "Electronics Australia". We shall certainly give consideration to this project idea.

Z-80 MICROPROCESSOR: I was wondering whether you could send information and pin connections of the Z-80 microprocessor. I have read many data books but I can't find anything on the Z-80.

If you can't send the information could you tell me where I could get the information. (B.R., Campbelltown, NSW).

● Have a look at the circuit and accompanying description of the Super-80 in this month's issue. That should fill you in on the Z80.

RLC BRIDGE: I have just recently completed building an RLC Bridge which was a project listed in one of your editions of Electronics Australia. I have thoroughly gone over the circuit and wiring of the bridge and all seems to be in order, but the accuracy of the instrument is somewhat limited due to the fact that I only obtain a 40% meter movement even with the gain at maximum.

There were no details given as to what meter deflection one could expect and I'm wondering if the 40% meter deflection I am getting, even with the gain at maximum, is correct or perhaps I have a fault. The meter I am using is 400μA FSD. (G.M. Wonga Park, Vic.)

● The RLC Bridge was described in the March, 1978, issue. The fact that you only can obtain a 40% full scale reading on the meter suggests that the gain of amplifier is on the low side. This could be caused by faulty transistors or incorrect resistor values, particularly in the feedback circuit.

Perhaps you should check the 10kΩ gain potentiometer to ensure that it is the correct value and also that its resistance reduces to zero at the maximum gain setting. If everything seems in order then the 470Ω resistor in the emitter of the BC549 can be reduced to increase the gain of the circuit.

DIGITAL CAPACITANCE METER: I recently completed the Digital Capacitance Meter. After redoing all the shielded cable with good quality coax, the scales work reasonably well up to about .047, .47, .0047, but if testing .068, etc, the readout tends to hunt around and not remain steady. I used low tolerance capacitors to line up the meter OK. On the μF range the right hand display shows 1 or 0 but all other ranges are zeros. Could you suggest any likely area to check? Also how can you check electrolytic capacitors if they are over 100μF.

I built your SCR-PUT tester and have used it OK to detect faulty components but how can you check Triacs? Could you use the Anode lead to the A2 terminal, gate to gate and cathode lead to A1 and push KG button – appears OK that way? Keep up the good projects in the magazine as it is still the best around. (B.H., Clermont, Q.)

● Since the display of your capacitance meter tends to hunt only at the higher end of each scale, ie, where the frequency of the capacitance oscillator is quite low, we would guess that there may be some hum injection into the circuit. Note that in Notes & Errata for April, 1980, we mentioned that the circuit board should be earthed to the case to prevent interference from hum fields. It is also possible that the multiplexed outputs of the 74C926 could be causing interference – for this reason we suggest that you route your wiring away from the display and possibly use a shield around the input terminals.

Regarding the SCR&PUT Tester (September, 1979, File 7 VT/16), you could connect up a Triac just as you have described but you would have to increase the gate trigger current to at least 50mA (typical for most Triacs at 25°C). This can be readily accomplished by reducing the 39Ω resistor connected to the emitter of the BC559 transistor to 10Ω. The Triac should also latch on when the KG trigger button is released. Unfortunately the minimum latching current is typically around 100mA so will also have to include an 82Ω resistor in parallel with the 390Ω resistor and LED.

Due to the increased current drain when testing Triacs we would suggest that you use a larger 9V battery or 9V regulated supply capable of delivering at least 150mA.

SOUND LEVEL METER: I wish to clarify two points with regard to the Sound Level Meter project as described in the May issue of "Electronics Australia". I purchased a kit from Dick Smith which was most satisfactory and readily assembled. I have access to a B and K type 2203 Precision Sound Level Meter which I used to calibrate the completed project and there the problems began.

In the Fast Mode, the meter would not go above 0dB. This I traced to the diodes connected to the input of IC5 going into conduction when the meter reading was just less than 0dB. Disconnection of these diodes overcame this.

In the Slow Response mode, the meter would not read greater than −7dB, irrespective of the attenuator setting or sound level. Voltage checks showed 2.3

lights are not desirable at today's dances. (P.M., Mount Chalmers, Qld.)

● Many readers suggested that the Musicolour and Chaser should be combined so this is what we did in the Musicolour IV which is considerably cheaper than two separate units with four channels each. We agree that a failure of equipment at a dance could be a disappointment.

One way to avoid these problems is to give your equipment a long "heat soak" before a scheduled dance. Let the gear run for say 24 hours with music signals driving it. That should sort out any doubtful components before the event.

We do not insist that readers use high power although the facility is there if you want it. In fact, we do not recommend the use of individual lamps of higher than 100W rating because of the risk of a lamp blowing the associated Triac. We should add that we have not had complaints about continual blowing of Triacs in the past so we wonder if your local mains supply does not have excessive surges on the line.

Perhaps the easiest way of adding the indicator lamps is to use neon bezels, with integral limiting resistors, wired across the output sockets for each channel.

DIGITAL CAPACITANCE METER: I have recently built the EA designed Digital Capacitance Meter (EA March, 1980) and have run into difficulties. All of the LEDS light up and the LED on the right flickers. When a test capacitor is applied, the right hand LED remains steady but resumes its flickering when the capacitor is removed, all of the other LEDs segments are lit up no matter what adjustments or tests are carried out. I have changed all of the ICs but with no avail. I would be interested to hear of your opinion on the above defect. (R.R.E., Pannawonica, WA.)

● From your description of the fault we assume that the display actually reads 0000 with the right hand digit flickering between 0 and 1. If this is the case then the most probable fault is that the reference oscillator is not working. Check the PC board in this area for solder bridges or hairline cracks in the pattern and check the wiring to switch S1b.

STEREO INFRARED REMOTE CONTROLLER: I have completed the Stereo Infrared Remote Controller (October 1979) and now find that after considerable testing I cannot get the receiver to work as described in the article.

All that appears to happen when power is applied is:

(a) No. 1 LED is illuminated;

(b) 12 & 5V supplies appear to be OK;

(c) Operation of transmitter has no receiver response.

Could you please advise if there have been any subsequent alterations to circuit and/or components, if not, any helpful hints on how to get it working would be appreciated. (R.C.G., Greenwood, WA.)

● There have been no alterations to the circuit or to component values. The only trouble shooting procedure we can advise is that you carefully check the orientation of the ICs, diodes and electrolytics and also look for any solder bridges between tracks or pads on the PC board.

PLAYMASTER MOSFET STEREO AMPLIFIER: I refer to the publication of your Playmaster Mosfet Stereo Amplifier project design.

I firstly wish to compliment you on the very fine job you have done in detailing both the circuit operating philosophy and construction details of the amplifier.

Your closing comments on page 51 of the January '81 edition are, however, a little mystifying, ie construction details of the 14 microhenry chokes.

You have suggested the use of a "special grade of ferrite rod", and that "ordinary ferrite rod used for AM radio antennas is not suitable".

I would appreciate you advice regarding the most suitable grade of ferrite and the name(s) of any possible suppliers.

Thank you once again for a most interesting project. (T.J.D., Lilli Pilli, NSW).

● Most grades of ferrite are not suitable for use at audio frequencies. It is necessary to use a grade which will have reasonable permeability and Q-factor at frequencies down to at least 20kHz. However, we have hesitated to specify a particular type because this can cause supply problems. Instead, we have left it to kitset suppliers to either arrange for the supply of wound chokes or a suitable ferrite. Either way, that solves the problem for the kit-builder.

If you wish to wind your own you should contact the distributors of Neosid products, Watkins Wynne Pty Ltd, 32 Falcon Street, Crows Nest, regarding the type and availability of a suitable ferrite. In the meantime, we understand that most kit suppliers do have the chokes in stock.

Electronics Australia Reader Service

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PROJECT QUERIES: Members of our technical staff are not normally available to discuss individual projects, either in person at our office, or by telephone.

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COMPONENTS: We do not sell electronic components. Prices and specifications should be sought from advertisers or agents.

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REMITTANCES: Must be negotiable in Australia and made payable to "Electronics Australia". Where the exact charge may be in doubt, we recommend submitting an open cheque endorsed with a suitable limitation.

ADDRESS: All requests to the Assistant Editor, "Electronics Australia", Box 163, Chippendale, 2008.

Notes & Errata

ON SCREEN GRAPHIC ANALYSER (March 1981, File No. 1/SC/11): Due to the propagation delay of IC5b a glitch may be generated in the horizontal sync pulse. This occurs just after the colour burst and may result in loss of colour on the TV display. The solution is to connect a .001uF capacitor between pin 6 and pin 7 of IC1b to delay the signal from IC6f.

EXPOSURE METER FOR ELECTRONIC FLASH (January 1980, File No. 3/EF/16): connections to the solar cell are shown reversed on the component overlay diagram. The circuit diagram is correct.

SUPER-80 COMPUTER (August, September, October 81, File No. 2/CC/62,63,65); Dick Smith Electronics has advised that a small number of these computers have exhibited a fault in the display whereby a column of "@" characters appears. Readers experiencing this fault are advised to contact the Dick Smith Electronics Computer Hotline on (02) 888 2002.

CYLON VOICE (January 1981, File No. 1/MS/22); The 4.7uF capacitor connected to pin 3 of the 741 op-amp is shown reversed on the overlay diagram. The circuit diagram is correct.

INFORMATION CENTRE

DIGITAL CAPACITANCE METER: I am experiencing considerable difficulties in constructing the March 1980 Digital Capacitance Meter, published in your magazine. The problem is this; The . . . thing won't calibrate!!

All other functions seem to work correctly. (Range selection etc). On "switch on" the displays are usually zeroed. If a capacitor (or even a finger) is applied to the input terminals, the display changes to some erratic value, which cannot be altered by adjustment of any of the trimpots.

On removal of this capacitor, the display continues to show the same value, although if the terminals are prodded it does change to some other value (not zero).

I have performed all subsequent errata published, without success. The project is not in kit form and the only components not used which were specified in the parts list were the two 150µF/6.3VW tantalum capacitors.

These were replaced by ordinary 150µF electrolytics, since those specified were just not available anywhere in Perth. (V. C., Midland, WA).

● From your description it would appear that there is a malfunction in the reset circuit for the 74C926. This means that the circuit involved with IC1 or IC2 is faulty. If you connect a 10µF capacitor to the instrument, you should be able to check that the gating oscillator is running and that the housekeeping signals are present on pins 5 and 13 of the 74C926. You can do this by switching your multimeter to the 10V DC range and watching the fluctuations of the meter pointer.

SLIDE CROSS FADER: How do I achieve "Titleing" on the Slide Cross Fader-Auto Advance Unit as per the November issue of EA? Could you please give me a diagramatic sketch and details of the additional parts I would need?

"Titleing" is holding one projector on whilst slides are displayed with the other projector. This would necessitate holding both projector bulbs on, one projector still, whilst the other projector slide advance was in operation. I doubt whether any bulk fade would be necessary with this because normally the slide advance would be operated at maximum speed, thus maintaining a title effect. (R. B., Pialba, Q.)

● If both projector bulbs are required to be on, this can be achieved by connecting the non-inverting inputs (pins 6 and 14) of IC5b and 5b to the +10V rail. In addition, you would need to be able to disable the slide advance circuitry to one projector by interrupting the base drive to one of the BC557s. This could all be achieved by substituting a 4-pole 4-position switch for S2. Two poles would be used to switch the non-inverting inputs of IC5b and 5d, as at present, while the other two poles could be used to interrupt the base drive to one or other BC557.

SLIDE CROSS-FADER: Having had some correspondence with you regarding the possibility of the above project, I was pleased when you announced its forthcoming publication, and awaited its release with interest.

Having now seen the article, I must express my disappointment. No doubt the unit will perform as intended, however, as a fader to be used by practical audio-visual workers (particularly those involved in competition work) it leaves much to be desired. If these seem like hard words, let me detail the main requirements of a suitable fader.

1. The fade rate should be completely variable by means of a hand control, with microswitches at each end to operate the off projector. It should be possible to halt the fade at any point or reverse it. (eg to superimpose titles.)

2. The fade rate should be visually linear.

3. Snap fades (cuts) from projector A to projector B are often required.

4. The hand control should have a flash or "twinkle" button to allow rapid alternation between projectors.

5. The signal when recorded onto tape and replayed, should exactly reproduce the original effect.

6. Adjustments should be provided for the projector lamps so that the off lamp filament just glows. This minimises lamp inertia and prolongs lamp life.

7. Some type of anti-snatch delay should be provided to inhibit a fade rate

Parts for the Mosfet Amplifier

PLAYMASTER MOSFET STEREO AMPLIFIER: Having decided to build the Playmaster Mosfet Stereo Amplifier as described in issues December 1980 to February 1981 inclusive, I set about the task in the manner to which I was accustomed before one store in Adelaide issued complete kits, ie, use whatever parts I had on hand and purchase the rest from the parts suppliers. So far the only parts I cannot purchase are the volume control that the article specified (dual 50k log with 40% loudness tap); 2 x 47µF 50V non-polarised electrolytic capacitors to suit the PC board layout; the front panel; the 0.56Ω 5W resistors (the only store in Adelaide which appears to stock these resistors, is, at the time of writing, presently out of stock); and the 4-pole, 4-position rotary switch.

My reason for writing is to ask, "Why should an article be published in your magazine if some of the parts cannot be obtained?" Shouldn't a check be made that the parts are available in all states before the project is published, or does it mean that in future, all projects in yours and the opposition's magazine be available only in kit form? (K. T., O'Sullivans Beach, SA).

● Each month we advise some 35 electronic parts retailers throughout Australia of projects to be published in coming issues of EA. Each of these retailers is supplied with parts lists for these projects and many take action to stock complete kits. However, if we were to wait until we were sure that there were dealers in every state who would sell separate parts for our projects and not just complete kits, we could not publish any constructional articles at all. As it is, most readers seem to want kits complete down to the last screw and nut, so most suppliers are meeting this demand.

Be that as it may, we understand that Electronic Agencies, of 115-117 Parramatta Road, (PO Box 185), Concord, NSW 2137, have all parts for the Playmaster Mosfet Stereo Amplifier available separately.