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JANUARY 1986

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The AUSTRALIAN ELECTRONICS Monthly

excitement electronics

UHF CB beam to build

Build David Tilbrook's

3-WAY BASS REFLEX LOUDSPEAKERS

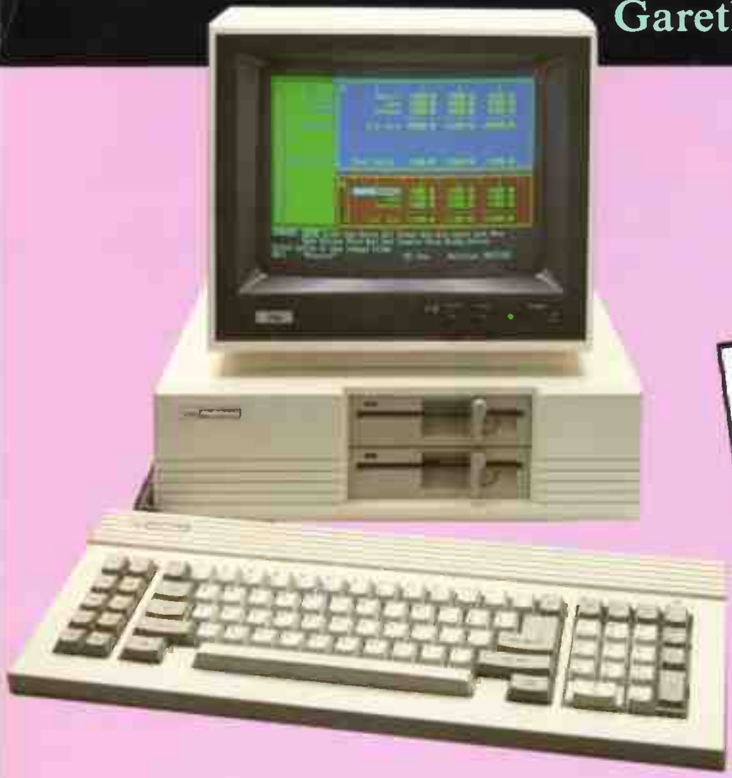
Inside 8mm Video

Listening Post Apple II software

- Troubleshooting car electrics with your multimeter
- Turn your Microbee into a 'Port-A-Bee'
- Australian-built speakers reviewed
- Radio Communicators Guide — variations of the ionosphere

" . . . . full-scale computing power is now well within the reach of the smallest business":

Gareth Powell, Computer Editor, Sydney Morning Herald



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COMPUTERSTOP

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The Australian Electronics Monthly

1985 WAS CERTAINLY AN EVENTFUL YEAR! and I'm not referring just to the launch of Australian Electronics Monthly — a significant event in itself. Some far-reaching changes in both the direction and organisation of the CSIRO last year should reflect favourably within the Australian electronics industry.

The establishment of CSIRO's Office of Space Science and Applicationss (COSSA) promises to do much towards thrusting our industry forward in the global space industry. A shift in the CSIRO's research priorities also promises a much-needed 'shot in the arm' for the local electronics industry. If not the 'prime mover', the the CSIRO should act at least as a catalyst with a concentration on selected microelectronic devices and communication technologies, plus the application of computer technologies and microelectronics to industrial processes.

The launch of two of the three AUSSAT series of communications satellites was undoubtedly a major event with far-reaching consequences, socially and technologically. Arthur C. Clarke's prophetic proposal forty years ago has certainly proved the kernel from which a mighty crop grew!

The entrepreneurial efforts of both small and large local electronics companies last year have made some impact on the world outside our shores, and it's good to see firms like Netmap (ex-RanData),Summit communications, Statronics and our old friend, AWA, numbered among them.

And what of ourselves? Well, we certainly seemed to have stirred things up! For us, personally, it's been a highly eventful and rewarding year (though, perhaps, a little exhausting) and we look forward to 1986 with keen interest and anticipation.

To all our readers, advertisers and adversaries, we wish you all the best for 1986.

Roger

Roger Harrison
Editor

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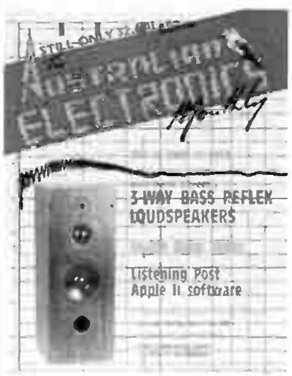

COVER

The superlative bass end performance of David Tilbrook's new three-way loudspeakers is shown by the graph, taken from measurements made on the prototype. (The squiggles are simply the chart recorder's pen responding to the low frequencies.) Speaker photo by Mark Rowland, design by Marni Rapraqer.

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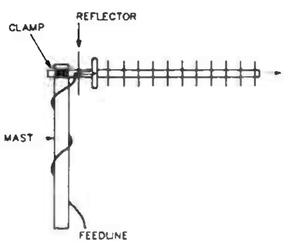

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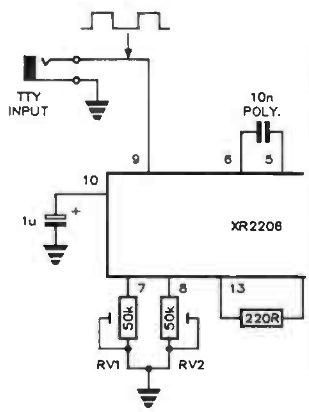

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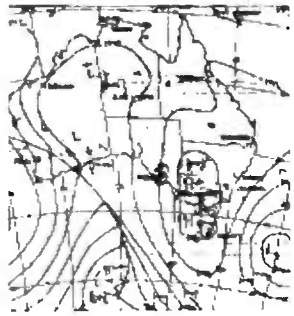

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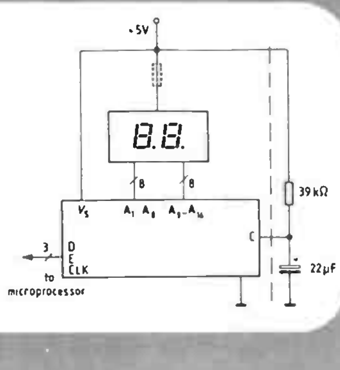

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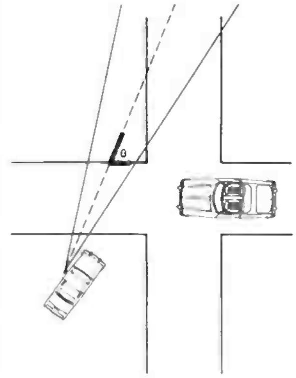
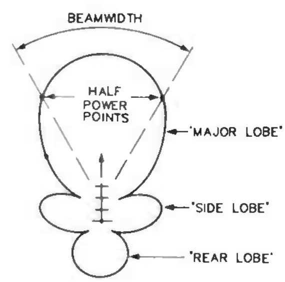


HONESTY, FALLIBILITY AND POLICE RADAR
A technical hitch held up production of this feature, but now it's all systems go. We examine how police radars work, and what they can and can't tell in any given situation. In plain terms we describe how police radars are used and what can go wrong. In addition, we explain what to do if you feel you've been unfairly caught.

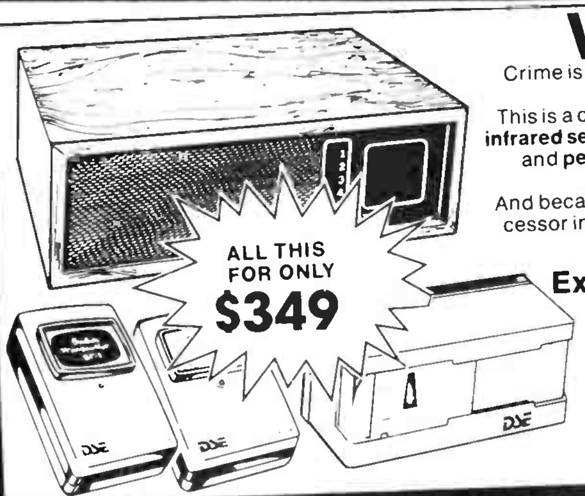


SIMPLE TO BUILD YAGI FOR THE AMATEUR 70 CM BAND
Modern design and analysis techniques have yielded many different approaches to Yagi beam design allowing much simplified mechanical design whilst retaining good RF performance. Here's a good example. This 13 element Yagi yields around 12.5 dB gain, matches 50 ohm cable and requires no tune-up. Cheap, too!

While these articles are currently being prepared for publication, unforseen circumstances may affect the final contents of the issue.

LITTLE DICK'S SUMMER SIZZLERS

WIRELESS BURGLAR ALARM



Crime is on the increase! Your home, unit or office needs 'effective' security. And with DSE's Wireless Alarm System, you'll have total protection and enjoy peace of mind. This is a complete package. Included with the sophisticated Central Processor are a **passive infrared sensor** for whole room monitoring, **remote reed switch** for guarding entry/exit points and **personal remote control**. You can even extend the system by adding on more of these affordable peripherals shown below.

And because it's wireless there are no expensive installation costs. Just plug the Central Processor into the power point, connect the peripherals and set the alarm. As simple as that! It's like having a personal security guard — but without the cost. Cat L-5120

Extend your system by adding 'more' of these. . .

PERSONAL REMOTE CONTROL
Use to remotely turn the alarm on and off. Convient! Cat L-5124
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Monitors whole rooms (covers 64sq.m.). Any movement is instantly transmitted to the CPU. Cat L-5122
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REMOTE REED SWITCH
Guards entry/exits. Any intrusion and the alarm sounds. Cat L-5126
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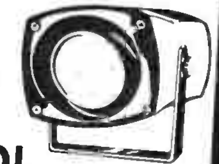
LOCAL AUDIO ALARMS

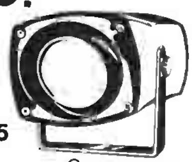
LARGE PIEZO ELECTRONIC



Compact but it delivers an earsplitting sound! Ideal for car, home or van alarms. Operates from 12V DC at 500mA; 110dB output at 1m. Cat L-7030
$24.95

REDUCED!

PIEZO ELECTRONIC ALARM



What a bargain! Amazing output for such a tiny unit! Suits most systems. Working voltage: 7.5-15 (200mA at 12V). Sound ouput: 110dB at 1 m. Frequency: 2800Hz.
~~$14.95~~ NOW $9.95
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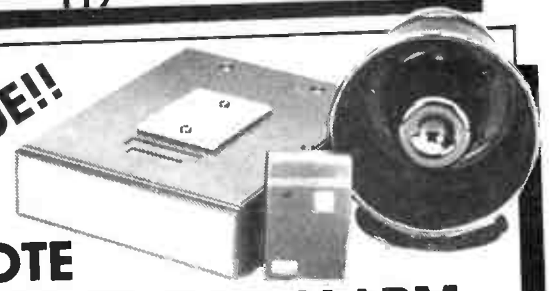
VALUE!!



REMOTE SWITCHED CAR ALARM

Stops thieves 'stealing off' with your valuable car! Hard to imagine that real protection could be so affordable — but DSE covers all the angles. Features boot and bonnet trigger, ignition cut-out, battery backup capability and more. Loud 110dB siren should scare off thieves instantly. Cat L-5096
$159

CAR COMMANDER

Tells you what's happening under the bonnet!

BARGAIN!

Incredible! Every family car can have the monitoring facilities of a Formula One racer with this inexpensive unit. An LCD displays the status of vital functions: oil pressure, RPM, voltage and water temp. Programmable RPM and water temp. alarm warns of impending problems. Built-in stopwatch too! Cat Y-3011
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"Picture phones next," says Arthur C. Clarke

A telephone call via satellite from London to a ship in the South China Sea on 21 October, marked the 40th anniversary of the mooting of communications via space.

It was UK author, scientist and futurist, Arthur C. Clarke, who first explored the possibility of using satellites stationed over certain parts of the earth to provide a new means of world-wide communications. He did so in an article that was published in a magazine then named *Wireless World* in October 1945.

Today, the magazine is known as Electronics and Wireless World and its Editor, Philip Darrington, paid tribute to Mr Clarke's farsightedness by using the very system he advocated to talk to him direct from London to his ship while it was en route from Hong Kong to Colombo.

The call was made from the London headquarters of the International Maritime Organisation (IMO) to the coast Earth station at EIK in Norway from where it was beamed via an Intelsat satellite, stationed above the Indian Ocean, to the SS Universe. The ship received the call on a dish aerial about one metre in diameter. This tiny antenna is specially stabilised so that it is alway pointing at the satellite regardless of the ship's course or movement.

Clarke says he has been surprised at the speed of satellite communication developments. When he first put forward the idea he thought it would materialise nearer the end of this century.

But in the short period since the mid-1960s, hundred of satellites have been launched into the "Clarke" orbit — that is, a geosynchronous orbit where the satellite revolves with the earth to stay at the same place above one of the three major oceans so as to form a chain capable of relaying telephone calls or TV pictures to any part of the world.

Geosynochronous satellites have now become the world's dominant medium for long-distance communications. About two-thirds of the world's overseas communications are carried via satellite and almost 4000 ships, oil rigs and other vessels are now on call to their bases from anywhere in the world via a satellite network operated by the London-based International Maritime Satellite Organisation known as INMARSAT.

Clarke believes there are immense possibilities in space still to be explored. One of the next developments could enable people to see one another when they speak to each other via space, he predicts.

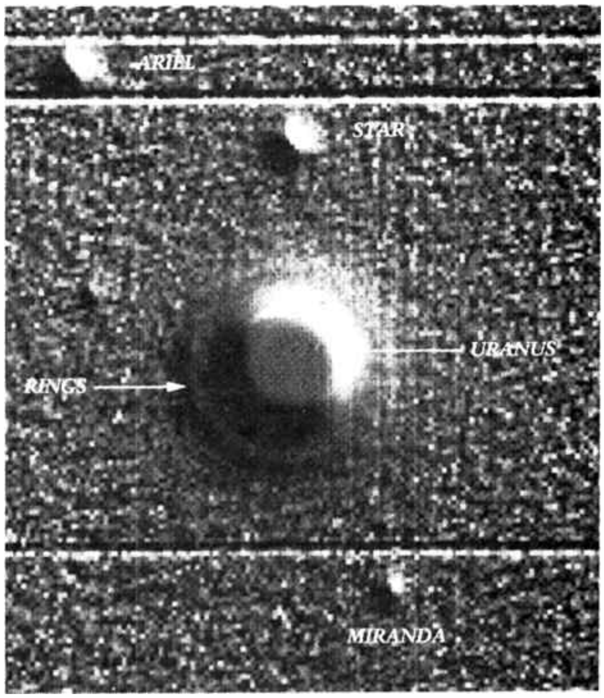
John F. Webb

Get onto Viatel and "reap the benefit"

We hear from Dick Smith Electronics of their new decoder suitable for connection to Telecom Australia's Viatel videotex service.

Apart from the huge array of information available on Viatel, with everything from stock exchange reports to video games, banking transactions can now be carried out (no, dear hackers, you cannot withdraw cash with it).

We're told that DSE staff are gamboling thrillingly in the aisles (the press release said they are "extremely excited") about their decoder and they believe it will considerably lessen the workload of the householder and business user. We can but agree. Ask for catalogue number X-9700 at any Dick Smith Store. The price is $499.



SEE CLOSE-UP IMAGES OF URANUS

As from 7 December, visitors to the CSIRO Visitors Centre at Parkes in NSW have been able to see images of the Planet Uranus being recorded and transmitted back to Earth by NASA's Voyager II spacecraft.

The signals received by the telescope are beamed to the USA for processing and then returned (within minutes) for display to the public at the Visitors Centre. The service will continue into February 1986 and should be available for most days during this period while the telescope is tracking the spacecraft.

Currently the images show Uranus as a white disk with some darkening around the edges and a vague hint of surface features. Some of the planet's moons are also faintly visible.

Nine dark rings were observed to encircle Uranus in 1977, as the planet passed in front of a distant star. The picture here, courtesy of NASA, is the first clear photograph of the rings, from an observatory in Chile, acquired with an electronic camera and computer processed. Some of the moons are shown, too. (Picture by R. J. Terrile and B. A. Smith.)

The Parkes Radiotelescope, linked to NASA's tracking station at Tidbinbilla, is a prime receiving station for the Voyager mission.

Mobile radio solves 'phone shortage in China

Philips' first mobile automatic telephone service (MATS) system is now in service in Beijing, a city of 8 million people covering an area of 1700 square kilometres. The MATS system has been installed for the use of the Beijing Power Supply Bureau.

The present telephone system is very limited in China and mobile maintenance units do not have access to conventional call-box facilities, so it was necessary for the city to provide their own system for Beijing's maintenance and service crews.

The system provides dependable communication between the Beijing Power Supply headquarters and remote sites, and was a co-operative effort of several member companies of the worldwide Philips Group; Philips Hong Kong handled the negotiations, Philips Communication Systems of Australia delivered the mobile telephone equipment, and Te Ka De of West Germany provided the system's infrastructure.

Future MATS systems, scheduled for installation later this year in the Kuizhou and He Nan Provinces, will again provide Philips with the opportunity to work closely on this important development.

Troubleshooting vehicle electrics with your multimeter

Roger Harrison

Here's a guide to locating faults in any vehicle electrical system using a multimeter.

PERHAPS THE MOST IMPORTANT TOOL that can be used in troubleshooting vehicle electrical systems is the multimeter. The basic multimeter measures voltage, current and resistance. More elaborate multimeters might include such measuring functions as frequency and temperature, diode tests and 'beep tone' continuity test.

Automotive multimeters have been around for years. These have had various applications and capabilities and many models available over the years have been ruggedly built to withstand the 'knocks' they'd receive in normal use. However, modern vehicles now contain a great deal of electronic circuitry for which such meters were never designed. Some of the older meters (and some new types, too) employ a 9 V battery to power the resistance function and this can destroy some sensitive electronics in modern vehicles.

Meter considerations

The sort of multimeter commonly seen in the past was the *analogue* type with a meter having a needle moving over a scale to indicate the quantity being measured. In recent years, *digital* readout multimeters have become available. In general, they provide greater accuracy and are less likely to damage sensitive electronics as they employ a lower voltage battery to drive the resistance measurement.

However, where you need to see an increase or a decrease in a reading, digital displays simply show changing numbers that make it hard to tell what's happening. The more sophisticated digital multimeters (DMMs) incorporate an analogue scale in addition to the digital readout, generally in the form of a 'bar' beneath the main display. Some types also incorporate a handy feature called "display hold". This 'freezes' the meter display until you're ready to look at it. Manly also incorporate a 'beeper' on the continuity test function that sounds an audible "beep" when testing for continuity of joints, short circuits, diode tests, etc.

If you are looking to purchase a multimeter, then the best guide is to *buy the most expensive model you feel you can afford that gives you the functions and features you require*. If you're unsure about exactly what you want, buy a lower cost model as a 'trial unit'. Using it will teach you more about what sort of instrument you want.

Think first

When troubleshooting electrical systems, it's important to use a logical process of deductive reasoning to arrive at the source of the trouble. This process is most important since you can't see inside or dismantle the majority of electrical components in a vehicle to tell whether they're functioning, as you can with mechanical devices.

Consider the symptoms first. The real problem may actually exist in one system while the symptoms you're seeing appear in another. Deduce the system affected from the symptoms presented. Jumping to conclusions can be time-wasting and expensive. Using well thought out and organised checks you can usually determine the source of the problem first time. Work backwards, from the symptom to the fault. Remember, the system functioned correctly at one stage — operating in a particular manner — the object is to return the system to that condition.

Types of measurement

When fault-finding in any electrical or electronic system, you measure three fundamental parameters:

voltage,
current, and
resistance.

Probably the easiest measurement to make, and often the most useful, is voltage. You need to answer these questions:

- Is voltage present?
- What is the voltage reading?
- What is the *voltage drop* across a component?

The *presence of voltage* tells you that the wiring and components are delivering electricity supply to the component you're testing.

The *voltage reading* tells you whether the proper voltage is arriving at (or present on) the component.

The *voltage drop* across a component tells you how much of the voltage is either available for the component's operation or how much it is consuming.

For example, a relay has 12.8 volts present on the 'input' side and 9.2 volts present on the 'output' side. The voltage drop (the difference between the input and output side) is 3.6 volts. If it's a 12 volt relay (that is, requires a nominal 12 V across it to operate), then there's a fault. Here, it's clearly on the output side. Remember that wires and connections can also be considered 'components' and may experience voltage drops if faults exist.

Separating the systems

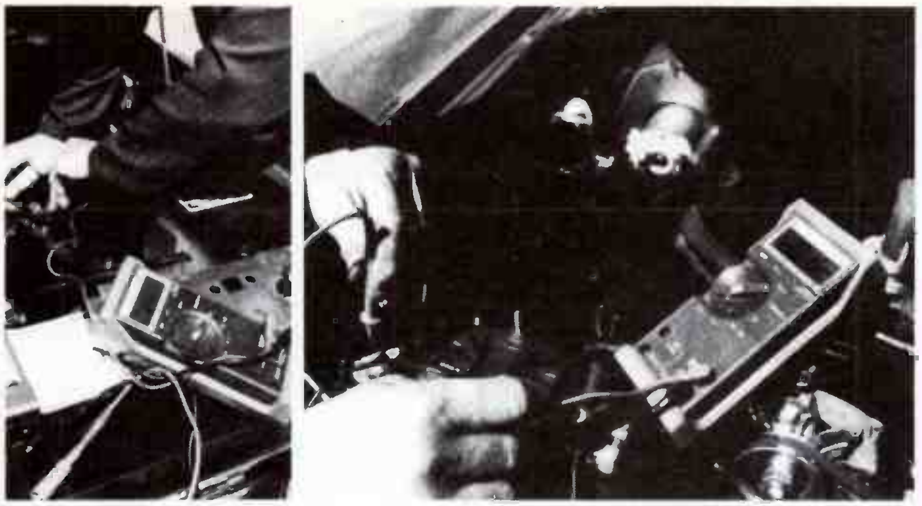
Vehicle electrical problems may be divided into several categories according to the system presenting problems. I'll remind you here that the real problem may exist in one system but symptoms appear in another.

The vehicle electrical system can be broken into five categories:

1) The battery charging system.
2) The starting system.
3) The ignition system.
4) Lighting and accessories.
5) The cooling system.

For a variety of reasons, many vehicle owners wait until one or other of the systems fail totally. As often as not, the vehicle just "won't start". Some failures result in chronic problems of some sort, like a repeatedly discharged battery, hard starting when hot, etc.

Always, the first step is to decide which system is most likely at fault, then proceed with your tests using the multimeter. Table 1 sets out the five systems and the type of measurements you may need to make, in order of importance in the columns from left to right, starting with "voltage presence & level".



System/Component	Measurement Type			
	VOLTAGE PRESENCE & LEVEL	VOLTAGE DROP	CURRENT	RESISTANCE
CHARGING SYSTEM				
Alternators	●		●	
Regulators	●			
Diodes				
Connectors	●	●		●
STARTING SYSTEM				
Batteries	●	●		
Starters		●	●	
Solenoids	●	●		
Connectors		●		●
Interlocks	●			
IGNITION SYSTEM				
Coils	●			●
Connectors	●	●		●
Condensors				●
Contact Set (points)	●			●
Distributor Caps				●
Plug Wires				●
Rotors				●
Magnetic Pick-up	●			●
LIGHTING & ACCESSORIES				
Compressor Clutches	●		●	
Lighting Circuits	●	●	●	●
Relays	●	●		●
COOLING SYSTEM				
Connectors	●	●		●
Fan Motors	●		●	
Relays	●	●		
Temperature Switches	●	●		●
Radiators				

Fluke manufacture a range of DMMs that are ideally suited to vehicle troubleshooting service. Their '20 series' offer fuses on all current inputs and optional high visibility yellow cases. They are ruggedly made, have analogue bargraph displays beneath the LCD readout and the 25 and 27 models have a 'touch-hold' display feature. Elmeasco distribute Fluke instruments in Australia.

Batteries

Charging system faults often present as a "no-start" problem. The battery will have become discharged and the starter won't crank the engine. The first step is to test the battery and charge it if necessary. You can do a hydrometer check too, if it's not a 'maintenance-free' type battery. Because you can't check the electrolyte in a maintenance-free battery with a hydrometer, measuring the open circuit voltage is the simplest way to test the charge.

Using a multimeter to test a conventional battery saves you the time and mess of dipping into the battery acid. A load test should also be performed; it's the only reliable way to test a battery's performance under actual conditions. Turn on the headlights, the battery voltage should drop by less than one volt.

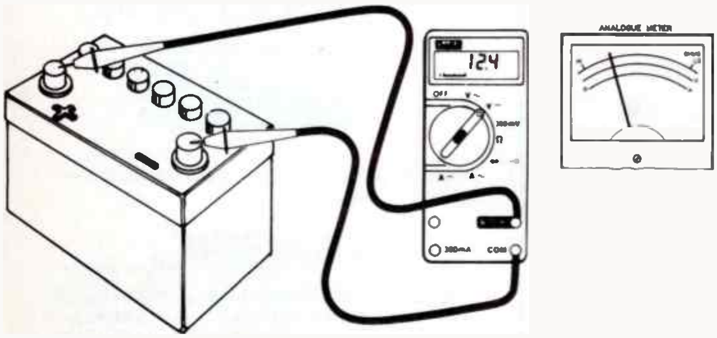


Figure 1. Put the meter probes directly on the battery terminals to measure battery voltage. A fully charged battery should show at least 12.4 volts without a load.

Alternators

Alternators should maintain enough voltage to keep the battery charged even while running at its rated amperage output. Check the alternator output voltage at the battery terminals with the alternator loaded to its rated output. Use a carbon pile (see panel) across the battery to load the alternator.

You can also test the alternator using an inductive current clamp meter accessory. See Figure 2.

Poor performance, particularly when the alternator is heavily loaded, can be caused by worn brushes . The condition of the brushes can be determined by measuring field current (as in Figure 2).

Failing being able to do current checks, proceed to the next step.

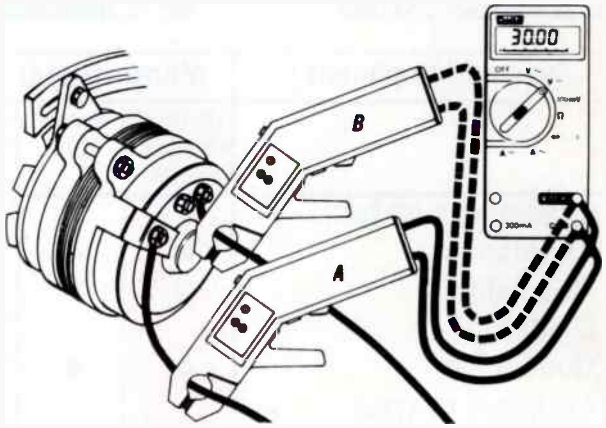
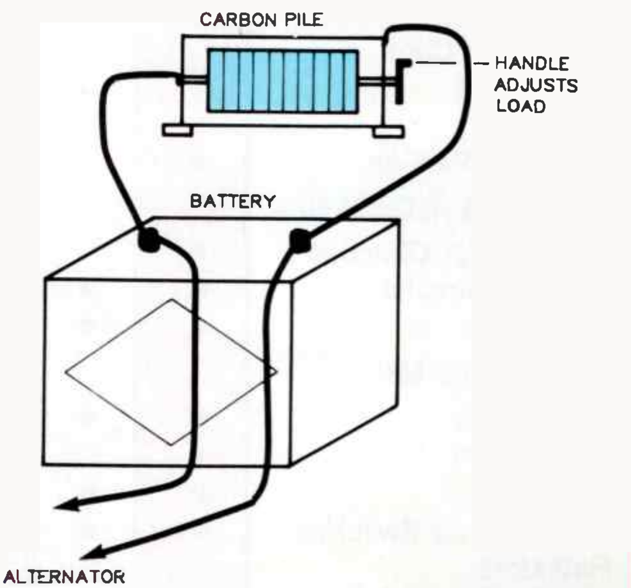


Figure 2. If your meter can use a 'current clamp' accessory (which allows current measurement without having to open a cable), then it's ideal for measuirng alternator output current and field current.

To measure alternator performance, set the engine running at about 2000 rpm and load the battery, using a carbon pile (see panel), to the alternator's rated output. Put the clamp onthe alternator output wire ('A'). If performance is not up to spec, check the alternator.

Field current can be checked in the same manner, only put the clamp on the field wire ('B').

Note that a current clamp is also useful for checking starter current draw.



Shorted diodes run the battery dead overnight, in addition to causing low output current. Shorted diodes can be found using your multimeter's diode test function. Diodes usually short when they fail, but they sometimes go open-circuit. Open diodes can't be detected unless you dismantle the alternator and test each one separately.

Disconnect the battery wire from the alternator's output terminal and perform the test shown in Figure 3.

Regulators

Although most solid-state regulators are not adjustable, many cars are equipped with relay type regulators than can be adjusted when necessary. The digital display of a DMM makes these adjustments much easier.

Low output voltage can be caused by either a faulty regulator or alternator. Determine which is at fault before making any adjustment. Be sure you aren't compensating for a soon-to-fail regulator before you make any adjustments.

Bypass the regulator to check whether the alternator is faulty. CAUTION — Use a rheostat in series with the field connection to control field current instead of shorting the field to the battery.

With the battery fully charged and in good condition, adjust the regulator so that alternator output voltage matches the battery's or manufacturer's specifications.

A voltage drop test is also useful for finding wires between the alternator and regulator that are almost broken, corroded terminals and so forth.

Starter System

Starting system troubles are often confused with charging system problems. Many a dead battery has been replaced when the real cause was a faulty charging system. Be sure that the charging system is functioning properly before you replace the battery. Make sure the battery is charged and passes a load test then look for resistance in the starter circuit if the engine still cranks slowly.

Investigate excessive current draw; check for worn-through insulation; a seized or tight engine, faulty starter, etc. If the starter turns the engine slowly, the current draw is not high and the battery is in good condition, check the resistance in the starter circuit.

Even very slow resistance in the starter circuit will cause the starter to turn slowly. For example: 0.01 ohms resistance

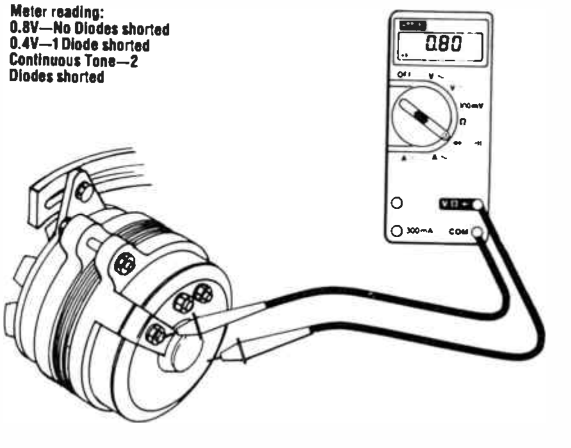


Figure 3. The alternator diode test. Use the multimeter's continuity check/diode test function for this. Touch one meter probe to the output terminal and the other to the alternator housing. Reverse the probes and repeat the test. Check as follows:

Reading — 0.8 V — no diodes shorted
0.4 V — one diode shorted
0.0 V/continuous beep — shorted diodes

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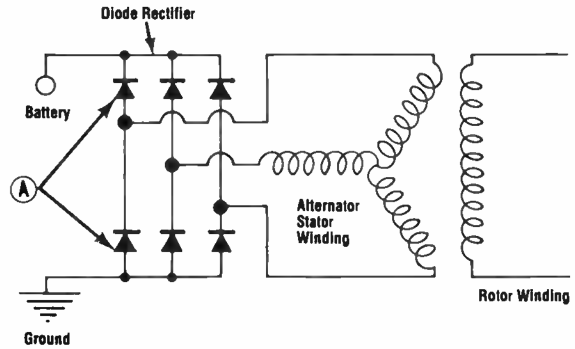


Figure 4. Typical alternator circuit. Note that both diodes in any one of the three circuit 'legs' must be shorted for the DMM to indicate a short. You'll have to dismantle the alternator to find any culprits.

in the starter cable will cause a two volt drop in voltage at the starter. 0.01 ohms is too little for all but the most expensive and sophisticated ohmmeters to measure, but measurements of voltage drop will indicate where there is resistance.

A DMM featuring the 'display hold' function will record the voltage drop for you while you're inside the car turning the key. You can look at the display when you come back to change the test points. Since this function usually ignores zero readings, it will retain the voltage drop on the display after you have stopped cranking the engine.

This procedure is helpful on components and connections except solenoids, which read battery voltage if you measure across them when the engine is not being cranked.

Total voltage drops should not exceed the following:

0.2 V	Wire or cable
0.3 V	switch
0.1 V	ground
0.0 V	connections

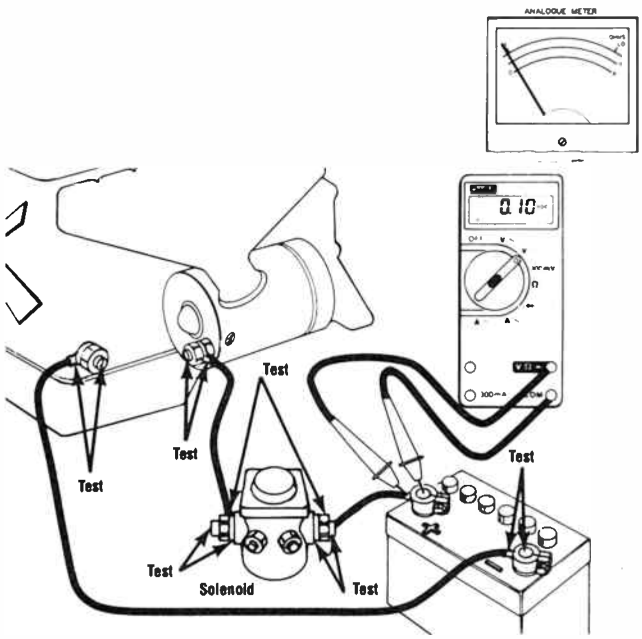


Figure 5. Voltage drop tests. Measuring the voltage drop across terminal assemblies, solenoids, etc shows up starter system faults. Do this while cranking the engine. Measure the drop across the battery post and connecting cable, across the solenoid posts and wires that attach to them, and across the solenoid itself. Also check the connection on the starter and the ground strap connection to the engine block.

Philips Test and Measurement offer three compact DMMs — the '18' series. The PM2618 features an analogue bargraph, frequency counter and logic pulse view display, while the PM2718 has a display hold function. they can be obtained with a 'backlite' feature that lights-up the display automatically in poor light conditions.

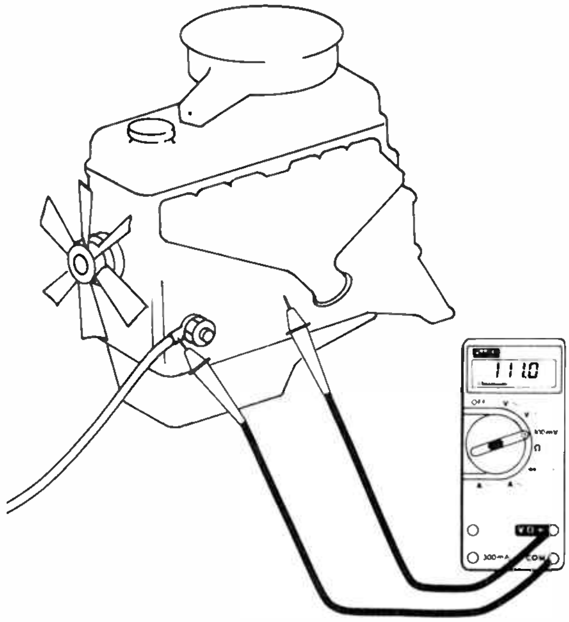


Figure 6. If you have a meter with a 'display hold' facility, voltage drop checks are much simplified. Clip the leads across the connection to be measured, select the function and set the meter to read millivolts (mV). Crank the engine and the meter will 'hold' the reading until you return.

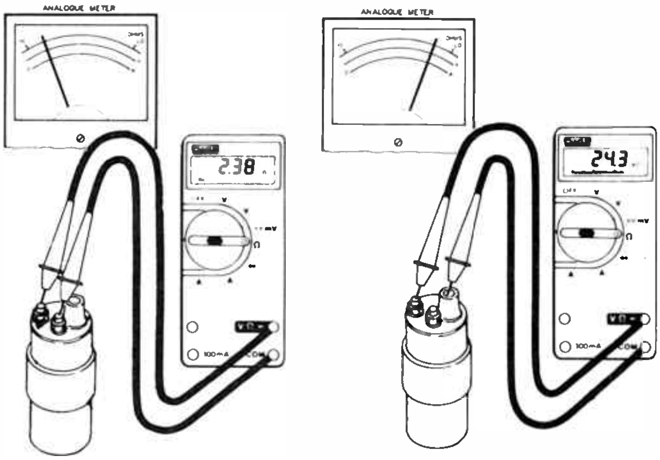


Figure 7. If you suspect the ignition coil, check the resistance of the primary and secondary, both when it's cold and when it's hot. The primary winding should show a low resistance at all times, the secondary a relatively higher resistance. The manufacturer's specs will indicate typical values.

The ignition system

Bad coils can often be found by measuring the initial resistance. The primary should have a very low resistance, and the secondary windings a somewhat higher resistance. To get the actual figures for a specific coil, check the manufacturer's specs. It's often a good idea to check the coil when it's cold as well as when it's hot. Many analogue meters cannot effectively show resistances under 20 ohms, but DMMs come into their own in this area. See Figure 8.

Check for leaking condensers with the ohms function. As the condenser charges up, the resistance should increase to infinity. Any other reading indicates that you should replace the condenser. If the condenser is in place, make sure the points are open. See Figure 9.

Plug wires should be checked if you suspect that there may be a problem or if they're more than a couple of years old. Look for the year and quarter number printed on the wire; however, not all wires are dated. Remember that the wires would have been installed sometime after the date of manufacture.

The resistance of the plug wires depends on length and is generally in the order of 1000 ohms per foot (300 mm) for resistance leads. Wire leads will just be a few ohms.

Check for corrosion or arcing at the rotor tip; they can cause problems. Also check for high resistance between the centre contact and the rotor tip. Remember some foreign rotors have a resistor here or a rev limiter in the rotor. Check your findings against manufacturer's specs.

You have to approach electronic ignition systems differently. Often it's difficult to determine which of the components in an electronic ignition system is at fault. By elimination you can isolate the trouble to either the electronic module or the distributor's inductive pickup.

Check the proper operation of inductive pickup and reluctor wheel by measuring the output pulses. (NOTE — this procedure will not work on Chrysler and other Hall-effect ignitions.) Check for pulses coming from the magnetic pickup as shown in Figure 10.

Current drains, shorts and bad grounds

Current drains, shorts, and bad grounds are the cause of many problems. The cause of the problem often seems to have nothing to do with the symptom. But, using a DMM you can find the cause quickly without using a whole box of fuses.

Current drains that run the battery dead overnight are often referred to as shorts, although they may not actually be short circuits. Shorts that blow fuses can be found using the same trouble-shooting techniques used to find current drains, even though the symptoms are different.

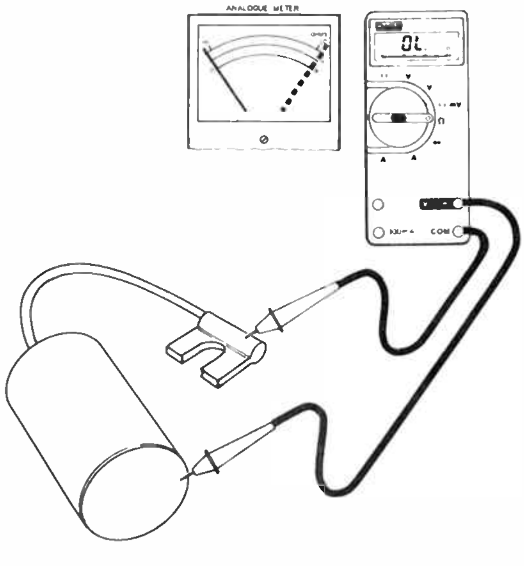


Figure 8. Check condensor leakage with your meter's resistance range. First momentarily short the condensor's two terminals to dissipate any residual charge, then attach the probes. Initially, it will show zero resistance, quickly rising to infinity. Any other indication shows you should replace the condensor.

If you make this measurement with the condensor 'in situ', make sure the points are open.

Parameters' 8005 is a very compact, low-cost handheld DMM that's ideal as a 'starters' digital instrument.

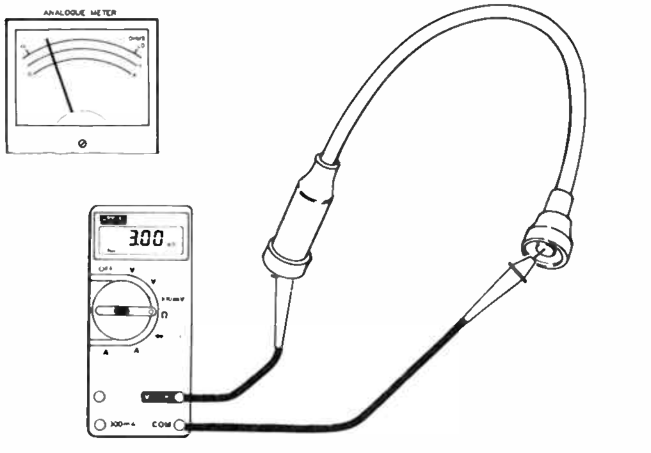
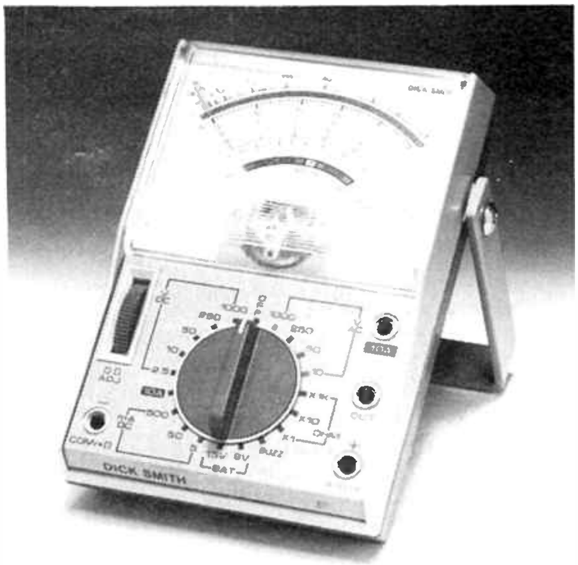


Figure 9. Plug wire resistance should measure around 1000 ohms per foot (300 mm) for resistive-type ignition wire. check manufacturer's specs if you're unsure. Some high energy ignition system cables are good at 30 000 ohms per foot, note.



This low-cost multimeter from Dick Smith Electronics (Q-1022) is typical of many analogue-type multimeters, but features a buzzer for continuity testing.

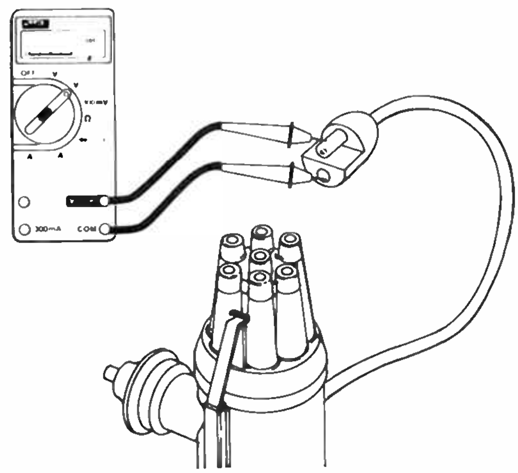


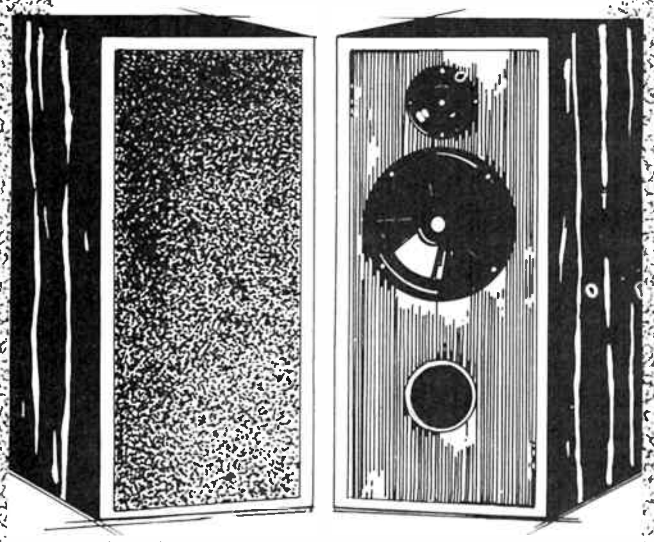
Figure 10. If your car is 'point-less', you can check for pulses coming from the magnetic pickup. To do this, connect the probes across the pickup output connections and set the meter to a low dc voltage range. When the engine is cranked, the readout will pulse (on DMMs with a bargraph). If you can't detect pulses, it's likely the reluctor wheel or inductive pickup assembly is faulty. (This test will not work on Hall-effect ignition systems).

CAUTION — To avoid blowing the meter's fuse, use the 10 amp input until you are sure that the current draw is less than one amp. Do not crank the engine or operate accessories that draw more than 10 amps. You could damage the meter, possibly beyond repair.

To check the entire system for current drains connect the multimeter in series with the battery. Set the meter to read 10 amps or more. Once you determine the current draw is less than an amp, switch the meter's range switch to a lower range and place the test loads in the meter's low current range and jacks. The meter will then show the total current drain.

to 106.▶

DAVID TILBROOK HAS AROUND $800 TO GIVE YOU, AND A SUPERLATIVE 2-WAY SPEAKER AS WELL!



We're talking about the exciting new David Tilbrook designed speaker kit which uses VIFA's high performance drivers from Denmark. His 2-way, digital-ready 100 Watt capable masterpiece.

The name Tilbrook is synonymous with brilliant design and performance characteristics and this new system keeps the legend alive and well. The magazine 'The Australian Electronics Monthly' – where David is Project Manager – published full details of the design in their August issue. Already there has been considerable interest and many speakers have now been built with superb results.

You'll save around $800 when you hear what you get from this system when compared to something you buy off the shelf with similar characteristics. If you compare its performance to fully imported, high priced, speakers from Mission, Heybrook, Monitor Audio, Bang & Olufsen and many others, you'll see that they too use these VIFA speakers.

This kit of 2-P21WO Polycone Woofers and 2-D25TG-55 Ferrofluid Cooled dome tweeters with Polymer Diaphragms, is available for $350. Cross-overs, cabinets and loudspeaker stands are also available.

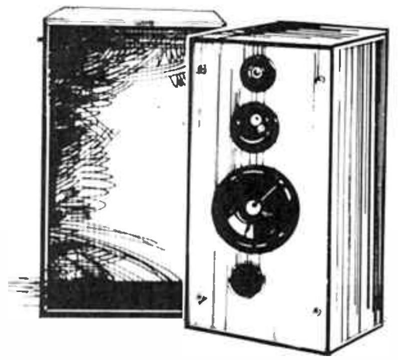
For futher information and a reprint of the full details of the Tilbrook project, please telephone or write to the Sole Australian Distributors, who can also give you the name and address of your nearest stockist.

Stocked by Jaycar Electronics and leading hi-fi and electronic stores.

vifa

Sole Australian Distributor: SCAN AUDIO PTY. LTD., P.O. Box 242, Hawthorn 3122. Telephone (03) 429 2199.
Queensland Distributor: Queensland Stereo Visual Supply. Telephone (07) 265 7945.

A GREAT REFERENCE FOR (AND BY) DAVID TILBROOK



They compete with $2,500 Reference Monitors – but can be built for a third of the price!
We're talking about the VIFA 3-way Reference Monitor designed by David Tilbrook – following the incredible success of David's 2-way AEM-6102 VIFA based design published in August. The 2-way kit has been sold in staggering quantities by hi-fi stores and electronic shops throughout Australia, where they can be heard outperforming 'well known' imported brand names costing two to three times as much!
Now David Tilbrook has done it again, this time with the 3-way VIFA design AEM-6103. Never before has it been possible to get such great value in kit speakers; the reasons being that there is no 25% import duty, no 30-35% freight into Australia, no high freight costs within this country itself, no 30% sales tax and no profit margins added to all these links of the chain which are involved in importing fully assembled speakers.
The 3-way AEM-6103 sounds like two to three times what you'd pay for in a recognised brand name (which may even be using VIFA drivers), and these might well be using inferior cross-overs and cabinets to save cost.

Today. we can offer you the drivers for the 3-way at the following prices:

2 pcs D19DT Tweeters $38.00 each.
2 pcs D75MX Midranges $89.00 each.
2 pcs P25wO Woofers $149.00 each.
2 pcs Factory Built X-overs $119.00 each.

(These introductory prices can only be guaranteed in January.)

Dealers – Sydney: Jaycar Electronics.
Melbourne: Radio Parts.
Brisbane: Queensland Stereo Visual Supply.
Adelaide: International Sound.

For further information, please contact the Sole Australian Distributor:
SCAN AUDIO PTY. LTD.
52 Crown Street, Richmond 3121.
Telephone (03) 429 2199.

Budget cassette deck has host of features

From the Falk Electrosound Group, we have received a lengthy press release on the new NAD6130 cassette deck. Styled in the traditional NAD manner with muted grey tones and the minimum of controls, the NAD6130 should have wide appeal.

This is a 'budget price' cassette deck but claims to be extremely high quality. NAD's philosophy is stated as "reducing external frills to the minimum whilst putting the manufacturing costs into the electronics".

Most of the NAD manufacturing budget is invested inside — on low noise circuitry, a high precision, low flutter tape transport, and a hard permalloy record/play head that produces low distortion recordings over a wide dynamic range. This adds up to a level of performance, in both recording and playback, that normally is found only in more costly tape decks, NAD claims.

The NAD 6130 features include: ● Dolby B and C noise reduction ● increased headroom ● permalloy record/play head for low distortion and high dynamic range ● instant release pause control ● peak reading LED meters.

The price of all this — just $359! Details from **The Falk Electrosound Group, 28 King Street, Rockdale 2216 NSW. (02) 597 1111.**

NAD 20 loudspeakers

The new NAD 20 loudspeaker embodies the same design philosophy that has won worldwide praise for NAD electronic components. The essence of this approach is to concentrate on sonic excellence and real performance, says NAD.

The NAD 20s are designed and manufactured by Braun/ADS in West Germany. ADS woofers are noted for exceptionally quick and articulate transient response while their soft dome tweeters produce crisp, airy, extended, peak free highs, it is claimed.

Special construction techniques are used so that the drivers have an exceptionally small voice coil gap. The cone of the woofer is progressively tapered in thickness which prevents "cone break up" to eliminate coloration. The crossover network is very carefully designed to maximise performance and sonic purity.

The NAD 20 offers extended response, fast, accurate transient tracking, wide dynamic range, precise stereo imaging, a graceful silhouette and all for a modest price. The NAD 20 loudspeaker offers a great choice for the discerning listener who wishes to take maximum advantage of digital recordings, says NAD.

Available from **Falk Electrosound, 28 King St, Rockdale 2216 NSW (02) 597 1111**

One-touch cassette recorder

Sanyo has introduced the M1011, a compact cassette recorder featuring one-touch recording. Particularly suited for outdoor dictation, the unit is designed for one-hand operation, giving users a free hand to carry out other tasks.

Features of the M1011 include pause control for easy editing of tapes, cue and review functions for easy location of recorded selections, and auto stop at the end of the tape in play and record modes to reduce wear on tapes and mechanisms.

Other benefits of the M1011 are the built-in condenser microphone which provides convenient recording in any location, with an automatic level control (ALC) to assure even recording levels.

The M1011 operates on ac (with optional adaptor) or dc power (through external 6 V input jack for four AA batteries).

Available in an attractive black and silver finish, the M1011 is priced to sell for around $59.95. For further information, contact Mr Wally Fabiszewski at **Sanyo, on (02) 439 2411.**

These diamonds are forever?

Following the success of its original high performance "Diamond" speakers, Wharfedale is now introducing a new Mark II version, known in Australia as the "Super Diamond"

Considerable research and development effort was applied in improving the diminutive speaker system, awarded the 1984 Loudspeaker of the year, Category 1, by the Federation of British Audio.

Wharfedale used its laser and computer-assisted design technology to research drive units and crossovers and make three important changes to the original design of the Diamond. These include use of a "build ring" for precision driver assembly, increase of power handling to 100 watts, and a modified crossover.

To defy the normal mathematical relationship between cabinet size, efficiency and bass output, high performance components and materials are used.

The new crossover board uses the original components, but by reducing the number of earth returns within the board, information retrieval has been increased, the makers claim.

The speakers feature the original two-way reflex design, a reflex port firing rearwards instead of the normal forward-facing variety. This design allows the speakers to be mounted on a shelf or stand close to a wall, as opposed to other small speakers which are designed to be positioned well clear of any room boundaries, Wharefedale say.

To improve reproduction of low frequencies, the patented build ring found in the 708 and 508 was incorporated into the 110 mm mineral-filled homopolymer polypropylene bass-mid unit.

A 20 mm high-quality plastic dome tweeter, based on Wharfedale's TSR 102.2 model, is used with a cone made of mineral-filled homopolymer (MFHP), a material pioneered by, and exclusive to, Wharfedale.

The Super Diamond is distributed in Australia by **NZ Marketing Pty Ltd, 553 Pittwater Road, Brookvale 2100,** and you get all this for an astonishing $349 or thereabouts.

The Great business offer from Microbee

THE 128K SMALL BUSINESS COMPUTER

Microbee Small Business Computers are already providing invaluable help to thousands of Businesses around Australia, indeed around the World. It would seem that there are few professions or areas of commercial endeavour that cannot be streamlined or made to be more "accountable" with a Microbee Computer.

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Users range from publishers to pathologists, even car yards are finding the Microbee Small Business System the cost effective technology tool that keeps their records straight, their correspondence in order, and keeps them in touch with the fast moving world of Data Communications and Videotext Services.

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Australian Guaranteed

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The Complete Business Package

The Microbee Small Business System comprises:
Microbee 128K Computer
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Cables and full set of manuals plus

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worth hundreds of dollars including:— WordStar/Mailmerge 3.3, Microsoft Basic, Microsoft Multiplan, MicroWorld Basic, Telcom Communications Package, Full range of support utilities, Comprehensive Training Guides and Tutorials, A complete library of manuals so you can easily and quickly gain the maximum benefit from your system is also included.

The Price

For the complete Small Business System only $2395 including Sales Tax.

As many of the Microbee Systems out there are used extensively for Word Processing with little need for Microsoft Multiplan, the new **'Living Letters Package'** has no Multiplan or Microsoft BASIC. But it does have **The Complete WordStar Package** to bring life to your writing and considerable savings to your pocket.

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As part of Microbee's Product Innovation Program, new releases which will shortly be announced include:

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The MB 7030 High Resolution (0.38 pitch) RGB Colour Monitor.

The MB 3010 Green Screen Monitor.

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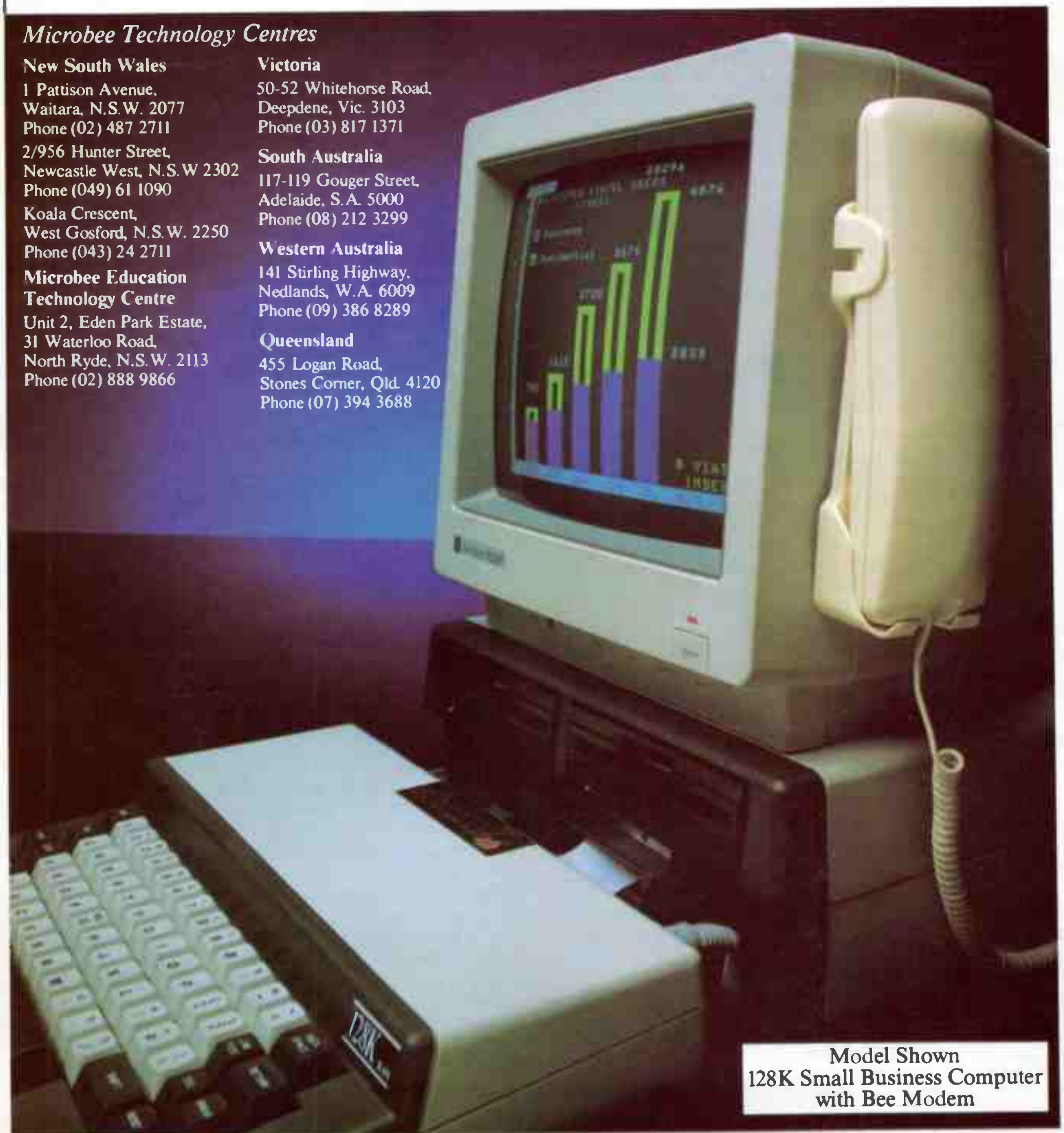

Model Shown
128K Small Business Computer
with Bee Modem

ART PROM 2868

Audiosound Laboratories' 'Motet' 8011A loudspeakers

Robert Fitzell AAAC

Having previously 'scaled the heights' of hi-fi – performance and costwise – this month we look at a pair of 'budget' loudspeakers from a local manufacturer.

IT IS PROBABLY a little unfair to follow our last review, the Nakamichi OMS-7 CD player, and one of the best input ends to the best of systems, with a loudspeaker which probably makes no claims to being a 'top-of-the-tree' output end on even middle of the road systems. However, until we all find that elusive end to the rainbow, once we have all sold our best crockery to fund the OMS-7 and appropriate connectors, we probably also have to look at just the type of loudspeaker the Motel 8011A purports to be for our den, kid's system or party speakers etc., with the few dollars that are left.

The Motet is a low-priced loudspeaker locally manufactured by Audiosound Laboratories at North Curl Curl in Sydney. It is their lowest priced unit. At $295 per pair the units are priced to compete at the low end of the market and the old rule of "you get what you pay for" applies nowhere more so than in the loudspeaker marketplace.

The basics

The Motet 8011A loudspeaker is a two-way loudspeaker using a 150 mm roll-surround bass driver (looking suspiciously like a Magnavox) crossed over to a 60 mm cone tweeter through a filter/equaliser. Apart from promoting it as a "sophisticated 7-element unit", no other details about the crossover are given. The cabinets are manufactured from plastic woodgrain finished particle board with a brown speaker cloth protector. Cable connections are made at recessed spring-loaded clips of adequate size to accommodate quite heavy cables.

The units are small at 370 mm high x 240 mm wide x 290 mm deep and weigh 7 kg each, but are by no means the smallest wide-range bookshelf unit on the market. Overall quality of construction is probably as should be expected from a unit at the low end of the market. My own experience with any items made from plastic veneered particle board is that the material is not likely to take hard wear at all and a bookshelf mounting is where they should stay. The "veneer" will hardly match your rosewood chiffonier or mahogany sideboard, but again it hardly should be expected to.

The use of the paper cone tweeter is a little unusual and Audiosound freely admit that the performance is not up to the 25 mm domes that they use in most of their other systems. The penalties of the dome tweeter are loss of efficiency and higher cost, both of which are likely to make the loudspeakers less attractive to a purchaser looking for a simple system for a low power application. More importantly, I was surprised at the seemingly hasty assembly of the loudspeaker drivers in the cabinet. The drivers are fully sealed with a hard setting sealant, however almost all fixing screws to the drivers, and in fact on the rest of the box itself, were inserted at a variety of angles that suggested rather hasty assembly. The bass driver is slightly recessed so that the plane of the roll-surround is approximately flush with the baffle board, while the tweeter, being a relatively shallow unit is flush-mounted. Fixture of the tweeter is achieved by four astonishingly large protruding screws. The sides of the cabi-

REVIEW ITEM:	Loudspeaker
MANUFACTURER:	Audiosound Laboratories, 148 Pitt Rd, North Curl Curl 2099 NSW. (02) 938 2068
MODEL:	Motet 8011A
FORMAT:	Two-way sealed enclosure
PRICE:	$295 per pair
SUMMARY:	A din for the den

net extend slightly past the baffle board, and this is worsened by the deep frame supporting the speaker grille cloth which extends further still. From a detailed acoustic viewpoint, the junction of the grille cloth frame, the protruding speaker sides and top and the baffle board is both complex and undesirable.

Together with the Motet loudspeakers the purchaser receives a small amount of supporting literature. This is aimed at the non-enthusiast and is quite useful. Audiosound have supplied loudspeakers for some years to the Australian Broadcasting Corporation and from the enclosed literature, the Motet is seen by them as a potential unit for use in schools and other similar applications. Whilst it is not all that clearly stated, the implication from the literature accompanying the lousdspeaker is that Audiosound Laboratories give a transferable five year warranty on the loudspeakers. This is an excellent warranty, particularly for a low-priced unit and would be a great incentive to intending purchasers for schools and similar applications.

As Audiosound rightly claim they have been operating here for 15 years, so have shown the company stability necessary to backup a warranty of this length. As we all know, if a company decides to disappear, it is a little difficult to find someone else interested in meeting the warranty.

The Motet is given the statue of 'Mini Monitor' on the nameplate and in their literature, Audiosound have taken trouble to fire a few volleys over the bows of the "digital sound needs special equipment" brigade. At the end of our review of the Motet I would have to say I feel this status is a little misleading.

The usable (?) frequency response is stated by the manufacturer to be 50 Hz to 20 kHz, with objective performance being stated on the back of the loudspeaker as 60-18 kHz, +/- 6 dB. Recommended amplifier power capacity is from 5 to 50 watts and the sensitivity stated to be 87 dB at 1 watt/1 metre. This gives a theoretical maximum level of 104 dB RMS at 1 metre from the speakers, or an expected level of music in a small room of up to 100 dB(A).

Subjective testing

In listening tests I found the Motet disappointing. However, I found the box relatively free of the immediate colouration of which many similar low-priced units are so guilty, but the overall standard of performance I can only call lifeless. My acoustical analogy when listening to classical music source material is of being in the entry lobby to Sydney Town Hall when the concert has already started — the sound is simply coming from another room. This impression is almost certainly due to a colouration at the bottom end of the loudspeaker performance spectrum and a serious lack of high frequency performance. As I will mention later, the higher frequency deficiencies are so dominant that the colouration simply doesn't stand a subjective chance.

Consequently it is difficult to become involved in the music and for classical music, this is clearly not one to buy. On pop music the performance is considerably better, due primarily to the limited dynamic range, bandwidth and comparative lack of definition of this type of music when compared with orchestral sound. For pop music the speaker can sustain reasonable levels in smaller rooms, but again, is not suited to use in larger rooms where power requirements become high.

Subjectively, the unit seriously lacks treble, an impression which is well supported by the objective test results. Bass response is quite smooth but not as extended as the manufacturers' specifications lead one to expect.

For voice, there is a lack of definition which I suspect may be related to deficiencies at the crossover frequency and above. With the low crossover frequency, most of the voice performance of the Motet is carried by the tweeter. For the market which Audiosound are seeking with the Motet, I feel the basic performance is there to build on but with quite a bit of work. With a superior tweeter, probably crossing over at a higher frequency, since the 150 mm bass driver clearly should have capacity beyond 1 kHz, the presence of the loudspeaker could be greatly enhanced. Bass and alignment of the loudspeaker could also probably be improved with little manufacturing cost increase to clean up the bottom end performance.

Having completed our listening tests which involve CD source, cassette tape and turntable source material we started testing for a little more objective evaluation of the Motet performance. At the end of our subjective performance we had already had the somewhat alarming experience of having one loudspeaker fail on us at quite reasonable listening levels.

For amplification, we were using a 100 watt per side stereo amplifier and so had to be cautious in the use of our output levels. The transient peak power handling capacity of the amplifier is obviously high and for reasonable listening levels through the Motet with wide dynamic range material. I found a real conflict between the power handling capacity of the speakers and the requirements for dynamic range of the source material.

Impedance

Our first test was of the loudspeaker impedance with the results given in Figure 1. It can be seen that the nominal value for the loudspeaker of 8 ohms is really very arbitrary indeed and the impedance at high frequencies drops to as little as

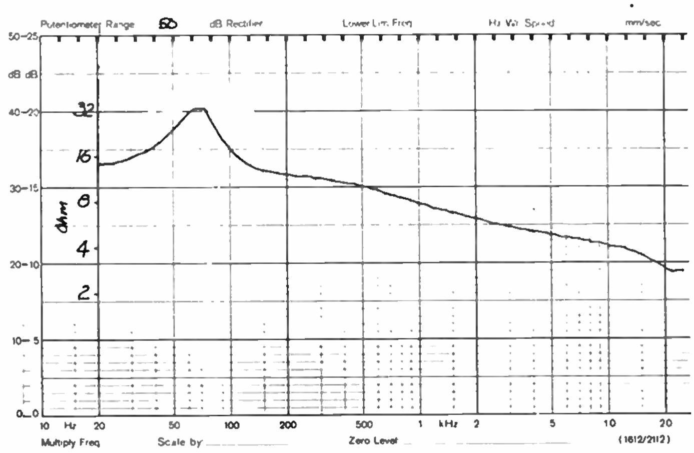

Figure 1. Impedance of the Motet 8011A across the frequency range 20 Hz to 20 kHz.

3 ohm. This rings warning bells for the use of this speaker, particularly with digital sources, since amplifier clipping could well see the end of the tweeters (a little ironic in view of our later experience during testing). The nominal figure of 8 ohms appears only to apply at 1 kHz and the bass driver impedance peak occurs at about 69 Hz. The Motet would certainly not meet the DIN standard of +/- 20% impedance deviation over the working frequency range. On the positive side, the impedance curve is at least relatively smooth, so low impedance apart, the amplifier is probably going to be reasonably happy.

Frequency Response

Frequency response of the Motet shows a number of problems, particularly, despite the claims with the crossover and tweeter unit. Response around the crossover is seriously down and shows that phasing needs some work done to get the best out of the system.

Near-field (50 mm) frequency response sweeps of both drivers (Figure 2) shows that potential response for each driver individually is good, the bass unit particularly so. The tweeter shows an undesirable peak at 12.5 kHz and a very rapid roll-off thereafter, but overall, is also up to the standard of many more expensive units. We still could get nowhere near the 20 kHz upper limit quoted for to the system however.

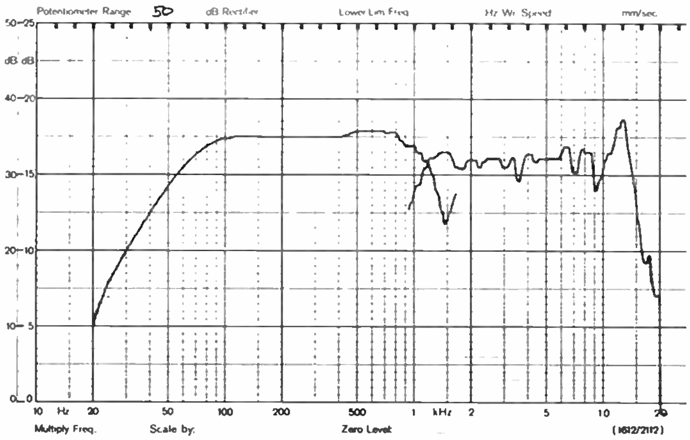

Figure 2. Near-field frequency response of the Motet 8011A.

Put together in the Motet box (Figure 3) the response is far from good. The dip in response at 140 Hz is a ground effect and, being an environmental effect, should be ignored. The dips at 1050 Hz, 2450 Hz and 3150 Hz just cannot be ignored, however. We did not have time to do any investigational work to establish the causes of the two upper dips. However, the box is very simply designed and has many points around each driver, described earlier, from which spurious reflection will occur.

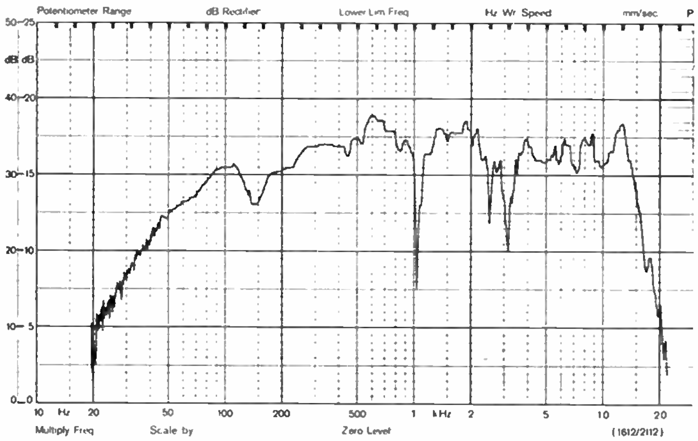

Figure 3. On-axis, free-field frequency response.

This has long been acknowledged as the cause of many performance anomalies at high frequencies, but again to be fair, to eliminate these reflections usually results in higher construction costs and unit prices. Testing of the tweeter alone at two metres on axis (Figure 4) again shows the same anomalies.

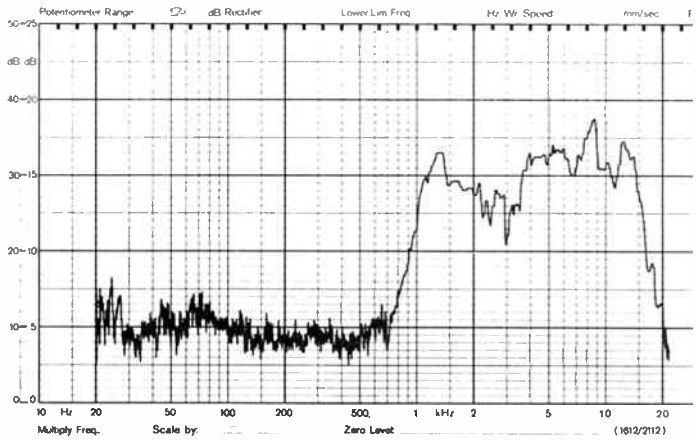

Figure 4. Tweeter response of the Motet, on-axis.

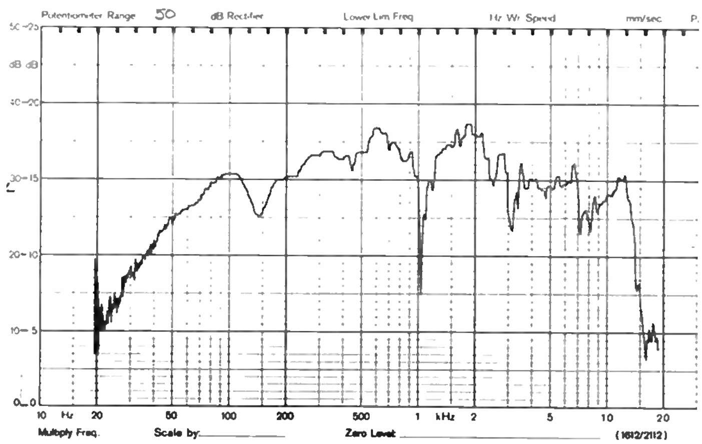

Figure 5. Frequency response of the Motet at 30° off-axis.

The major dip at 1050 Hz shows the claims for high performance of the crossover are not really justified and some more work here might see a much improved loudspeaker.

Our distortion tests were limited to 1 kHz and 10 kHz only. Results are given in Figures 6, 7, 8 and 9 and proved to be reasonably good. Apart from the 1 watt/1 m/1 kHz trace, these tests are of the tweeter alone, and since cone loudspeakers do tend to display relatively low distortion, the results are perhaps not surprising. The distortion products in Figure 6 are mainly those of the tweeter and not the bass driver.

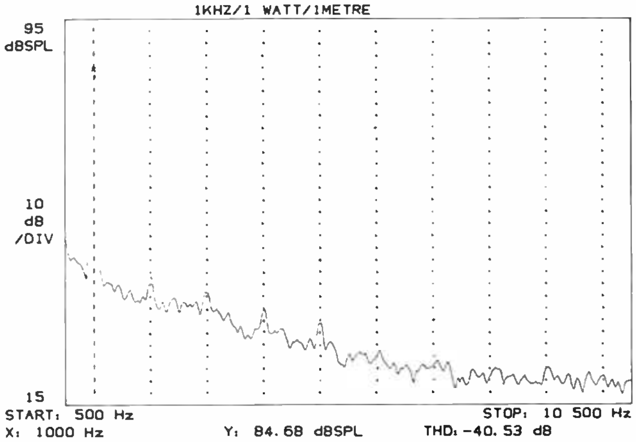

Figure 6. Distortion performance of the Motet 8011A, at one metre with 1 watt drive at 1 kHz.

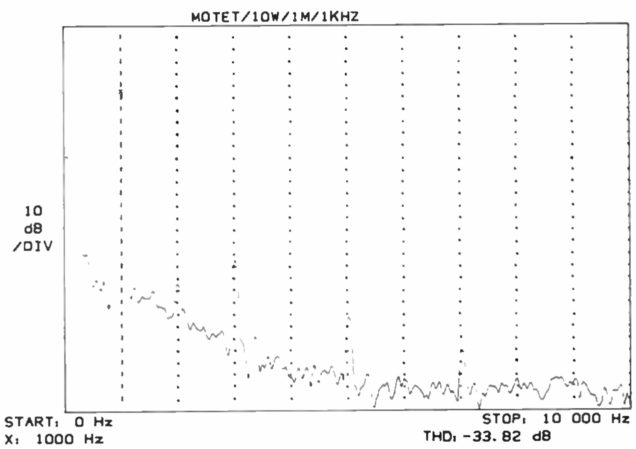

Figure 7. Distortion performance, again at 1 kHz and 1 m, but with 10 watts drive.

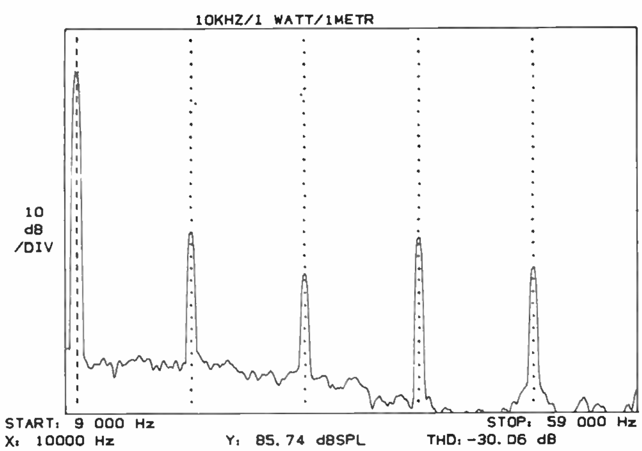

Figure 8. 10 kHz distortion performance, at one metre with 1 W drive.

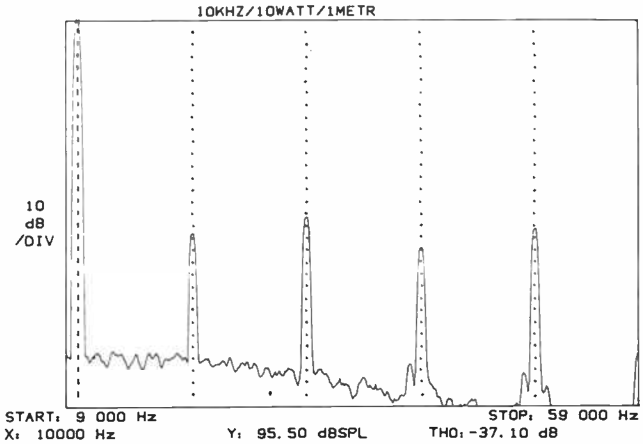

Figure 9. 10 kHz distortion performance at one metre, but with 10 W drive.

Power Handling

We found (the hard way) that the power handling capacity of the Motet is not very forgiving. Power handling capacity of the 8011A is stated to be 50 watts. One of the claims made by many manufactureres over recent years, Audiosound included, is that their equipment is suited to digital sound. (At the same time, other manufacturers are eagerly selling loudspeaker protection circuits.) My own firm opinion is that if you want to run a CD player in your system, and particularly if you want to listen to classical music or live recordings in which the dynamic range is large, then there is no substitute for power, power and more power.

On CD source material, live music recording being replayed at quite comfortable listening levels, we were astonished to see one Motet bass driver loudspeaker fail. On the second Motet, we have no real excuse. We caused the bass driver to fail with a 1 kHz input tone inadvertently set to about 100 watts. We don't really know the power at which the driver failed since it did so as the power was being increased to a final setting of 100 watts. Rated amplifier power was 100 watt and in neither case was amplifier clipping occurring. Whilst the manufacturer does indicate a power limit of 50 watt, the safety margin on the Motet is clearly not great and I would advise caution in its use. In fact, if my earlier guess at the bass driver make is right, I suspect the power handling capacity of the unit may be nearer 30 watts than fifty.

Pulse Tests

The pulse tests given in Figures 10 and 11 highlight a number of anomalies in dynamic performance of the speakers. The most significant of these for the bass unit (Figure 10) are the pronounced bass lag at 80 Hz, a phase-related dip at 320 Hz and the serious dip in performance around 1 kHz. On pulse testing, the deficiency at the crossover can be seen to be quite extreme. Whilst it is not easily seen on the magnitude map display, the anomaly at 320 Hz comprises a very rapid dip in level followed by a crest, or in other words, a 'flutter'. No obvious reason exists for the 80 Hz lag other than probable overdamping of the bass driver due to the sealed enclosure, or perhaps ringing of the box itself. The tests were conducted free-field so there is no contribution from room effects and the lag is clearly a design-related problem. In view of the magnitude of the delay, I am surprised that it was not subjectively more obvious. However, as I have suggested, the deficiences at high frequencies are more serious and therefore tend to dominate subjective performance assessment. ▶

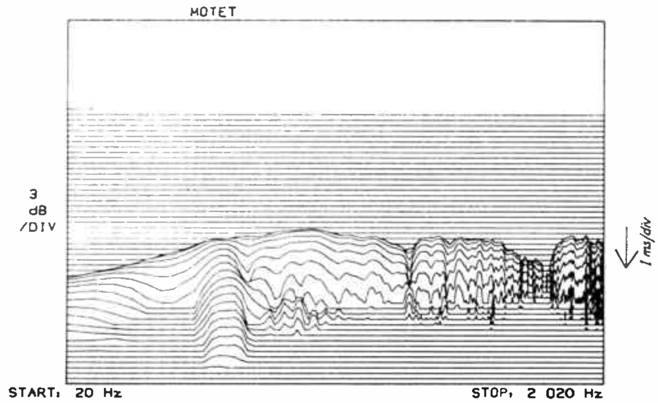

Figure 10. Motet 8011A, impulse source frequency/time response at the bottom end of the frequency range.

The pulse test shown on Figure 10 is for the loudspeaker as a whole, that is, with the tweeter and crossover unit in-circuit, and the roll-off of the bass driver below the crossover frequency can be seen to be quite extreme.

In Figure 11, the tweeter band performance, a similar lag may be seen from the tweeter just above the crossover frequency and this is almost certainly the result of a high Q crossover. Again, something which can be designed out. At 3 kHz the dip apparent in the swept sine wave tests is again seen to be even more significant, as is the poor performance above 7 kHz.

On pulse testing we can see much more clearly how large the 'windows' in performance of the loudspeaker really are. In relation to speech performance, the wideband gaps in information between 1 kHz and 3 kHz will, by all theory, result in clear loss of speech intelligibility. With pop music, the broadband nature of much of the source material will not be so affected by these deficiencies, although this is changing as popular music becomes progressively more complex. The advent of the compact disc will only increase this.

In conclusion

As I have said at the outset, the Motet 8011A is a budget loudspeaker and its performance should be reviewed as such. It is always difficult for an intending purchaser to filter the claims made in supportive literature for all products, since even low budget systems seem to offer performance capacities which differ little from many more expensive alternatives. From a marketing viewpoint, my impression is that the Motet loudspeaker is suggested for a wide variety of users. The nomenclature on the loudspeaker refers to it as a monitor and the very name Motet, evokes a musical expectation. In these repects I feel the loudspeaker would be a disappointment to intending purchasers. However, as we have always recommended in our reviews, listening tests are the only way for you to judge whether the loudspeaker meets your own expectations. The units are low-priced and do seem reasonably well-suited to popular music. For the den, the kids' study or games room the units are well worth comparing with other competitive brands, however, don't expect to use them for long, loud parties in larger rooms.

As I've said, in the loudspeaker industry you do get what you pay for. The loudspeaker is one of the most critical components of any sound system and the use of the Motet in a system using other much more expensive components would simply not be warranted.

SUMMARY OF RESULTS

Frequency Response	
Drivers alone	55 Hz to 9 kHz +/- 3 dB
Loudspeaker	Nominally 100 Hz to 6 kHz +/- 3 dB
Sensitivity	86 dB/W @ 1 metre @ 1 kHz
Impedance	3 to 8 ohm
Power Handling Capacity	?
Crossover frequency	1100 Hz

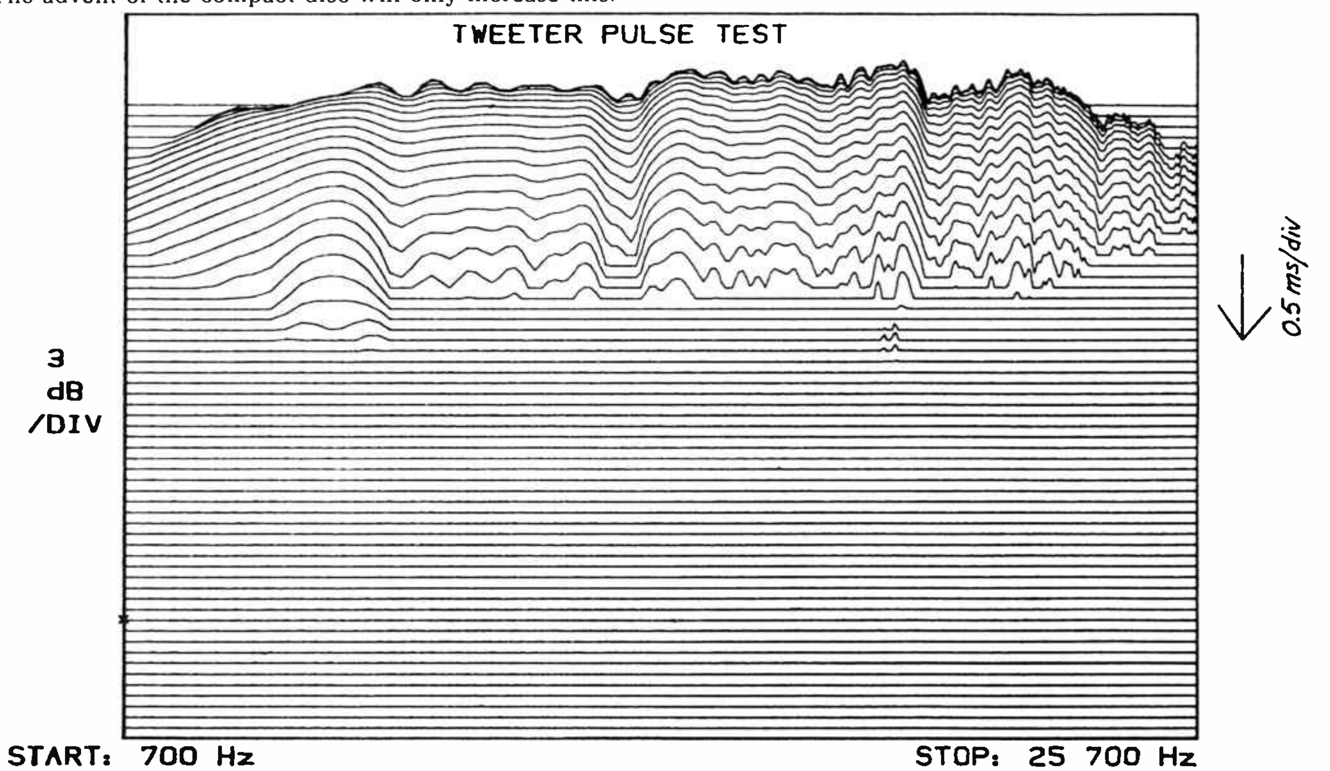

Figure 11. Motet 8011A, top end frequency/time response to an impulse source.

TU-D99X SLDD Digital Synthesizer Tuner
C-2101 Stereo Control Amplifier
B-2101* X-Balanced Power Amplifier

X BALANCED AMP

*RMS power output: 200 watts × 2 (8 ohms), 20Hz – 20kHz, less than 0.003% THD. Dynamic power output: 680 watts×2 (2 ohms).

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LJ 512U05 • Ideal for fine graphics as well as written characters • Effective display area 96mm × 192mm • Number of picture elements 512 × 256 • Outline Dimensions (mm): 148.5(H) × 228.5(W) × 34(D)

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The new 8mm video tape technology

Part 2

Malcolm Goldfinch

The 8mm tape format is the leading edge of a new consumer product group that promises integration of audio, video and 'digital' products for home use.

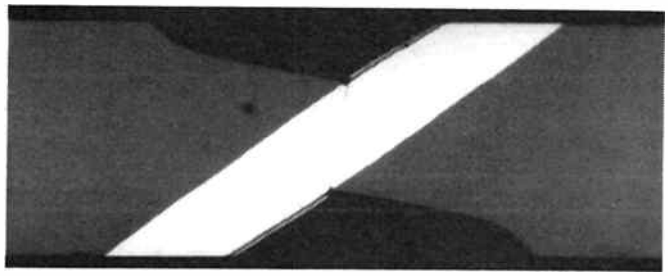


Photo 1. Microphotograph of the SSS head. You might be lucky to discern the gap.

IN PART 1 we established the rules for the new V8 format and got the ball into play by following an image through the lens of a Sony CCD-V8 camcorder, then showing how it is processed by the new CCD imaging system, which includes, auto white balance, timing, synchronising by clock, matrix delay and encoding. The result was an output of four separate sets of signals; two video, one function and one audio. The mini TV with a 1" screen in B&W is the EVF (electronic viewfinder) and is fed a signal which is an image identical with the one to be recorded. (See Figure 6). This EVF also has LED signals activated by the processor to warn the user of what is happening in the camcorder; such as, white balance needed, low light, recording, battery low, etc.

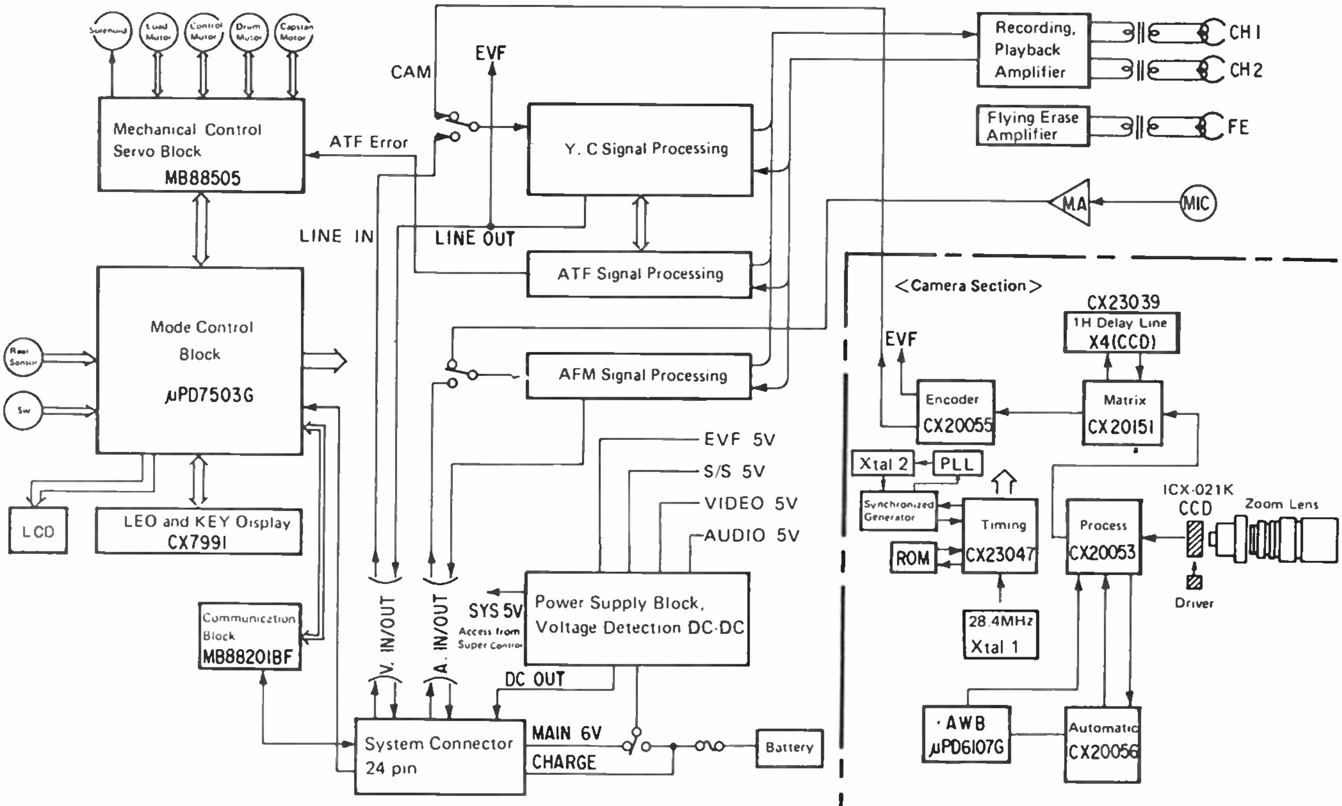
Audio comes from a mic in the camera to the signal processing direct and is processed into a multiplex FM signal and fed to the recording playback amp with two record/replay heads (Ch1, Ch2).

V8 specifications

The V8 specs call for the recording and playback at considerable levels on the 8 mm tape of a band extending some 8 MHz wide. Figure 7 shows the direction, rotation, record/replay track of heads mounted on the V8 format 40 mm rotating drum.

Quantifying the actual head writing speed over the tape is a complex calculation as there is a vector between the heads rotating at 1500 rpm diagonally across the tape and the tape moving in the same direction at 20.0151 mm/sec in Standard Play (normal) and 10.058 mm/sec in Long Play. (Compare this to a cassette with tape speed of 48 mm/sec). The result is a series of diagonal tracks with a pitch of 30.4 μm in standard play, and 17.2 μm in long play. Some manufacturers seem a bit coy about quoting head widths and the actual details of relative speed of the heads over the tape, which is conceded the most critical factor in wideband tape recording.

The formats are rigid and the table here compares the basics of the principal VCR formats; showing the Philips com-



6. Overall block diagram of the Sony CCD-V8 camcorder.

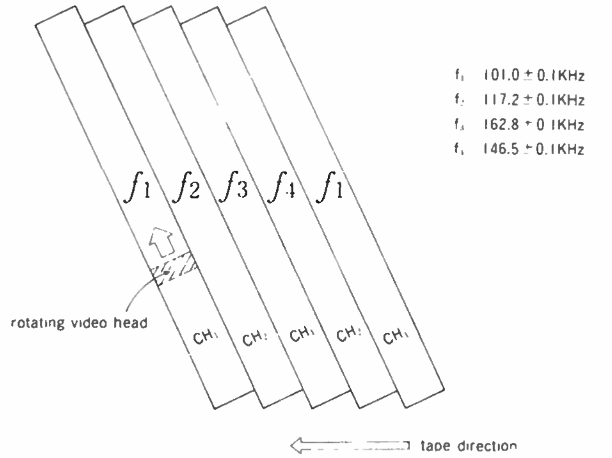


Figure 7. The 8 mm video recording track format. There are two record/replay heads (Ch1 and Ch2) and four pilot tones for tracking (f1 to f4), laid down with the video signal, not along the edge of the tape as with conventional VCRs. This system, proposed by Philips, is called 'ATF' — automatic track finding. The four pilot tones are laid down sequentially — f1 and f3 by the Ch1 head, f2 and f4 by the Ch2 head. (See also Figures 10 and 11).

pact audio compact cassette as a benchmark.

Exhaustive specifications given in the "confidential" Sony V8 Format handbook, specify heads travelling over moving tape at a "head-to-tape speed" of 314 cm/sec in both standard play (SP) and long play (LP). For PAL video, the drum speed must be 25 rps and, multiplied by the circumference of the 40 mm head drum, the scan of the stationary tape is 314.2 cm/sec for a stationary picture.

On standard play (SP), the tape is moving in the direction of the head scan and this speed must be reduced by the vector of the diagonal head scan in relation to the tape speed; 20.05 cm/sec in SP, or LP 10.06 cm/sec. Being such a small portion of the total writing speed it is of little consequence. It is obvious that the writing speed of V8 is very much less than the VHS or Beta formats by 170 cms/sec, or 35% on VHS. More than five years ago, any of these specifications would be a laboratory absurdity, but to-day they are a consumer product for grandmothers to use on their children!

But how does V8, at such a low writing speed and narrow track width, achieve such a high quality video picture and soundtrack from just one head?

Tape coating and head parameters

These are the vital new factors that allow such wideband signals in such a small package. Figure 1 in Part 1 shows tape coating thicknesses for both metal powder and metal evaporated (0.15μ) coatings compared with Beta tape (5μ) as a benchmark. Such fine tape material is useless without an improvement in head technology to match.

The Sony CCD-V8 record/playback heads are a vital part of the products success. In Figures 8 and 9 you see Sony's "Slanted Sendust Sputtered" (SSS) head The gap width is 2μm with an approx. 30 μm depth. The output developed is 150 μVp-p with metal particle tape at a track width of 25 μm. Photo 1 is a microphotograph of the 2 μm-wide head and the faint diagonal line which I call the 'Claytons' head gap . . . when you are apparently not having a gap. The only detail I can get is" . . . a new technique called SSS . . . combines two different types of sendust glass into a head with an extremely precise narrow gap giving a narrow uniform recording field . . . track width 21 μ . . ." The head material is made by sputtering, or electro depositing in a vacuum, two different types of glass, or sendust (sideways?); all the details are very secret, but it works well to achieve extraordinary video quality.

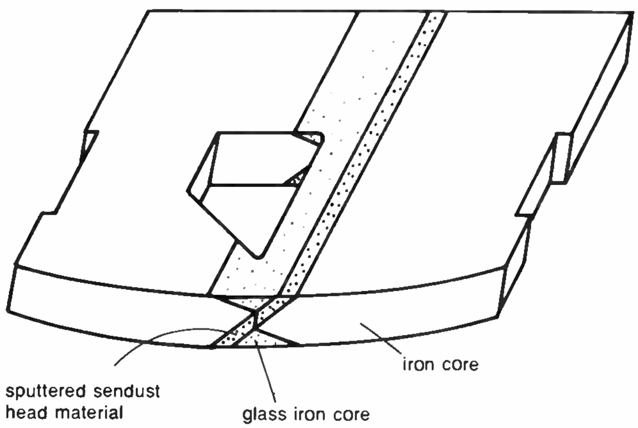


Figure 8. The 'Slanted Sendust Sputtered' recording head.

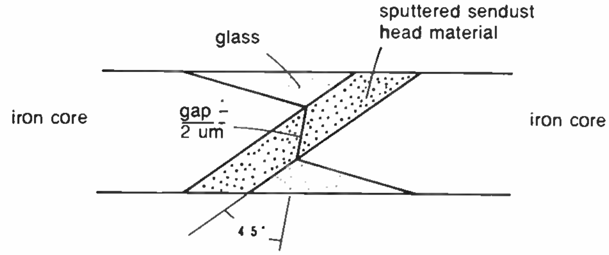


Figure 9. Close-up of the head construction showing how the narrow 2 um gap width is achieved.

TABLE 2 **TAPE, SPEED & SCAN SPEC. BETA, VHS, COMPACT CASSETTE, FORMATS.**

Format	Tape Speed	Head Track Width	Helical Scan Speed	Max. Run Time
BETAMIX	18.7cms/sec	32.8 μm	585.36 cms/sec	3.2 hrs
VHS STANDARD PLAY	23.3cms/sec	49.0 μm	484 cms/sec	4.0 hrs
VHS LONG PLAY	11.7cms/sec	24.5 μm	484 cms/sec	8.0 hrs
V8 STANDARD PLAY	20.05cm/sec	20.0 μm	314.2 cms/sec	1.5 hrs
V8 LONG PLAY	10.06cm/sec	20.0 μm	314.2 cms/sec	3.0 hrs
COMPACT CASSETTE	48.0cms/sec	600.0 μm*	Not Scanned. Single side, one hour	

* The head track width of the compact cassette was laid down some 20 years ago.

Long play squashup

There is a grey area about this SP-LP speed change, which to my eye seems to have little effect on picture quality and none on sound. I buy the explanation that the speed of the heads over the tape is a drum function and the difference in linear speed of the tape is not significant.

In fact, the actual speed at LP should be greater, because the tape moves with the scan and this speed is halved. (See Table 2). But what about the 'squashup'?

The same heads are used for both SP and LP; slow the tape to half speed and you write over half the previous track? The answer I have got, reluctantly, from a number of manufacturers of video hi-fi VCRs is: "Yes, there is some overlap in LP but the 10 degree azimuth, which is plus on one track, and minus on the next, is enough to allow this overlap record/playback, without erase, and without the heads reading too much random noise on the out-of-azimuth overlap. In other words, this is a technical grey area which would seem to have many problems but the suck-it-and-see tests have shown the LP overlap is acceptable; considering it halves tape cost and doubles continuous record playback time.

This theory is borne out by the figures in Sony's V8 manual which says, "video track pitch(μm) 34.4/17.2." Presuming they refer to SP and LP respectively, the head leaves a 21μm track, so in SP there should be a free space of 34.4-21 = 13 μm, being 6.5 μm free on either side of the tracks. In LP, the pitch is 17.2-21 = -3.8, being an overlap of 1.85 μm over adjacent tracks. I cannot get confirmation of this hypothesis but it seems logical from the next V8 feature.

Tracking, heads and azimuth

These inter-related factors make the remarkable performance of the CCD-V8 possible; especially in LP. With a head trackwidth of only 21 μm, the heads must pass along the recorded tracks with extreme accuracy, not only when the unit is new but when there is wear and some loss of mechanical precision.

Since Beta and VHS formats were frozen, technology has moved ahead and Sony CCD-V8 uses a new concept. Previous auto track-finding relied on control signals recorded along the edge of the tape and read at a remote spot from where the action was going on at the head drum. In fact, the V8 auto track-finding (ATF), a system developed by Philips, does away with tracking control signals. It is all accomplished in the flying scan by sampling the adjacent tracks to the one being scanned; a servo centers the head by equalling the sideband signals. It is claimed to eliminate noise bands and rolling.

In Figure 7 is shown the four pilot tracks recorded side by side — f1 and f3 by head 1, f2 and f4 by head 2 — in alternate scans. This allows the heads to sample pilot tones on the adjacent tracks e.g. playing Ch2, frequencies on adjacent channels 1 and 3 are also detected and the servo driven so that tape speed and drum rotation speed are kept close to a constant. Figures 10 and 11 detail the pilot tone frequency releationships and how the head overlap picks up the tracking pilot tones during incorrect and correct tracking.

Azimuth now raises its ugly head, as ever, but the frequencies of the pilot signals are in the 'long wavelength' and suffer little loss with azimuth variation, thus allowing adequate detection from adjacent tracks. To prevent the pilot signals breaking up the picture, they kept 14 dB below the chrominance level. The plusses claimed for the ATF system in the V8 are — nor tracking adjustment, tape variation does not affect tracking, and a simple tape path.

The recording spectrum

This is where V8 takes a leap ahead of other formats.

Figure 12 shows the frequency distribution areas within the rotary scan. The major departure is the inclusion of pilot and audio FM multiplex in the scan spectrum, together with a scanned erase.

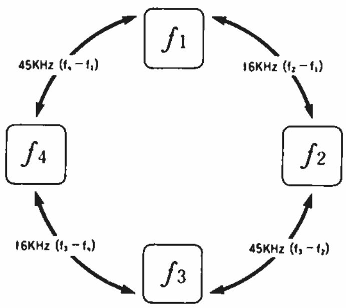


Figure 10. The relationship between the four tracking pilot tones.

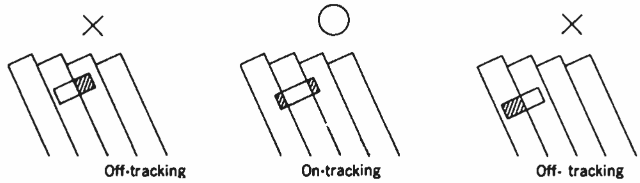


Figure 11. (See also Figure 7). During playback, the rotating video heads detect the pilot signals on the adjacent track(s) and compares their levels. The drum speed and rotation are controlled so that the level difference between the main pilot signal and the adjacent track pilot signals will be equal.

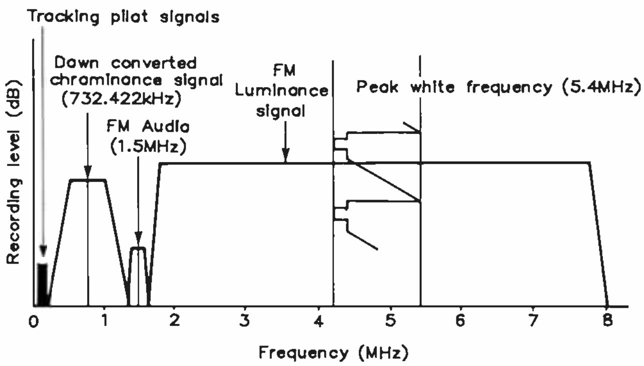


Figure 12. The Video8 recording signal frequency spectrum.

With the record tracks having no spacing and mixing at the joins, one of azimuth's dirty tricks is used to ensure separation; each head is offset from vertical by 10 degrees in opposite directions, thus rejecting the adjacent track's signal except for the low frequency ATF pilot signals. Figure 13 shows the tape format details. In Figure 14, the PCM addition can be seen. Previous formats, including the first 8 mm format, had a 180 degree wrap around the drum. The V8 format has increased this by 41 degrees to 221 degrees. The PCM signals described later are accommodated in the extra wrap.

The flying erase

In video, housekeeping is a vital function and the inclusion of the total recording gamut on the flying heads allows a 'flying erase' to clean up with equal precision. This is a valuable innovation employing an amplifier and head as a separate unit, switched on and off by the signal processor (Figure 6).

It is an integral part of the big leap forward in the CCD-V8. Whereas the VHS/Beta et al, formats used a block erase head for the whole tape width; remote from the scan drum, the flying erase head is on the drum and close to the record head.

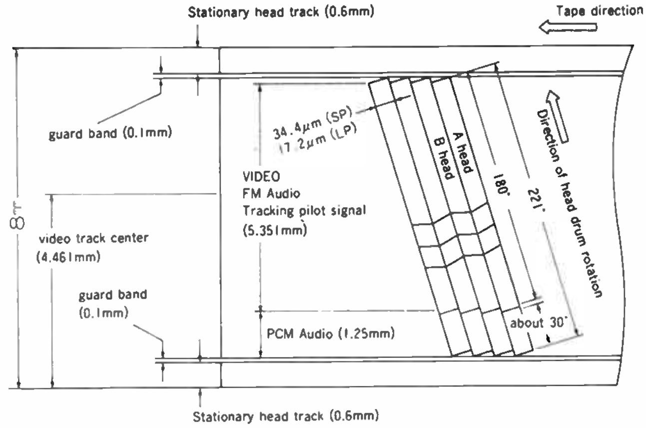


Figure 13. The complete 8 mm video tape format, showing the video. FM multiplex audio and PCM audio track relationships and how they are laid on the tape.

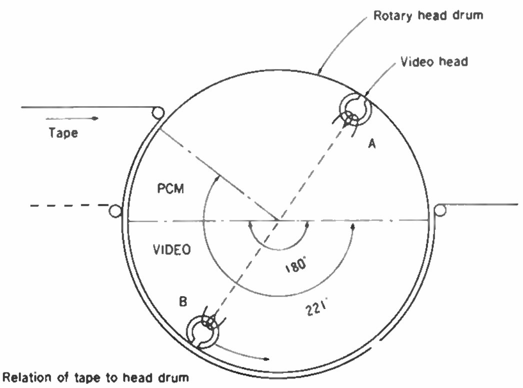


Figure 14. The tape-drum wrap, showing the relationship of the two video heads and the direction of movement of the tape and drum. Note that the tape wraps round the drum for 221 degrees.

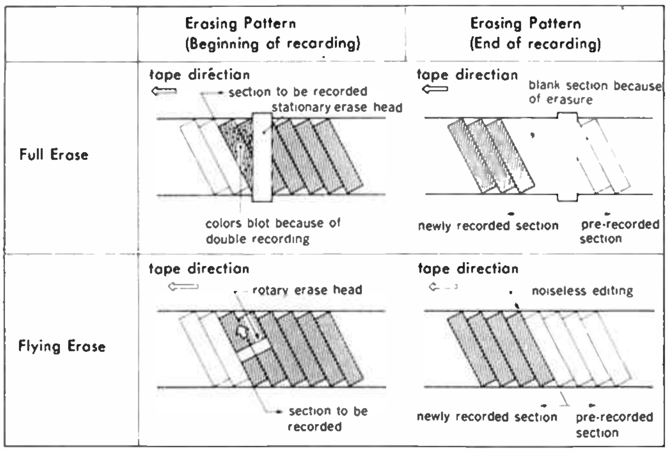


Figure 15. The Video8 employs 'flying erase', as used in professional VCRs, to achieve noiseless editing. Conventional VCRs employ a stationary erase head which leaves a blank at start and finish of the edit, causing colour 'stains'. The flying erase technique employs a rotary erase head to eliminate this problem, but timing is critical. (See Figure 16).

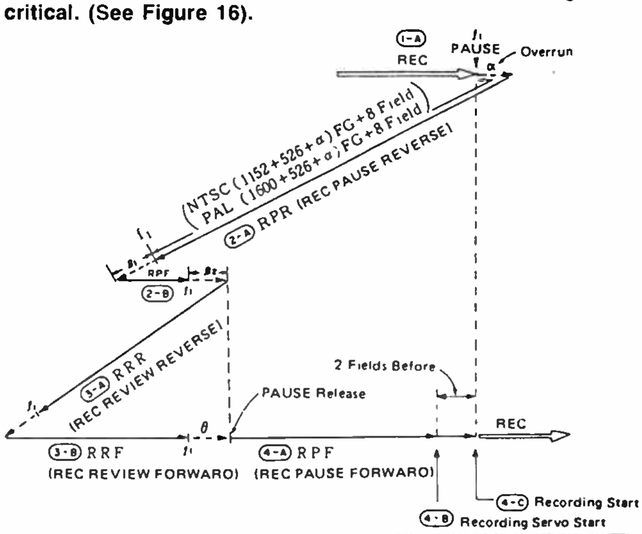


Figure 16. Sequence showing how smooth editing is achieved.

Consider the previous home video edits. Before each new sequence, tape had to be first rewound to a point prior to the block erase, losing up to three seconds, before new video could be laid down. Although it is possible to insert-edit video on a previously recorded tape, it is not 100% being done without proper erase. The sound and control tracks on the edge must be left intact (later audio dub, not lip-sync, is possible) to avoid a period of about seven seconds of glitch lines; an age in video. This occurs whenever a full insert is made in the middle of a recording; the control track is erased.

The most noticeable advance in the V8 flying scan insert-edit is the elimination of all glitches; 'rainbow' effects and 'stains' often seen at the start of a take are eliminated.

Pro quality edits

In the CCD-V8, edit in and out points are held in memory for clean cut insert editing. Only professional VCRs and consoles in the $10 000 range were previously able to give perfect insert edits. The Sony CCD-V8 provides faultless editing at consumer affordable cost. Figures 7 and 10 show the CCD-V8 four-field scan sequences essential for the PAL video standard, and the four pilot signals for auto track-finding: f1 = 101.024, f2 = 117.188, f3 = 162.760, f4 = 146.484 kHz, making a full four-field insert possible.

Three dedicated microprocessors select modes, safely sequence the mechanical section from commands by key, remote control or tuner/timer. Figure 16 shows the intricate timing required to perfectly frame an edit, which is achieved by the chip control of the tape and capstan. Backing up is only 1.2 seconds, and forward is but 0.4 seconds, a nett loss of only 0.8 seconds to get rid of any daggy ends when "pause" is activated.

When "record" is resumed the tape is locked to the correct field sequence and commences at the exact point marked. This also allows a most valuable feature in precise editing; a view on TV of the last three seconds recorded previously without loss of the edit point.

Working in an area of such fine tolerances is desirable, but not mandatory, to use the accessory automatic editing controller, which allows an 8-event memory communicated to the record system of the Sony CCD-V8 via a serial interface.

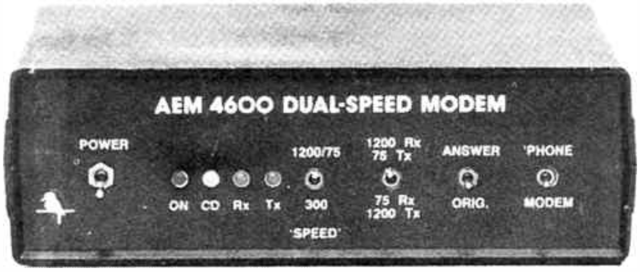
Dynamic track following

Everyone familiar with home video accepts a bar or two of horizontal hash across the screen during search backward or forward, slow motion or still, as the azimuth inclination is not fixed. Some expensive VCRs avoid the problem with double azimuth heads. A method of overcoming the problem in the V8 format was suggested by Philips in conjunction with the ATF described above. Known as the DTF system it makes use of 'bimorphic torque' that bends two ceramic plates when a current is applied. Figure 17 shows how the direction of torque is reversed when the polarity is changed. With polarity and current correctly applied through a processor cou-

to p110. ▶

Attention modem constructors

The AEM4600 dual-speed modem has been a resounding success, with suppliers reporting keen enthusiasts "storming the battlements" for boards, bits and kits. For enthusiasts chasing the odd 'elusive' components, or those looking for kit suppliers, here's a rundown of who's got what.



In last month's Project Buyers Guide on this page, we listed who had indicated 'intentions' of stocking kits — namely, Jaycar, Geoff Wood Electronics and Dick Smith Electronics. Well, both Geoff Wood Electronics and Jaycar indicate they should have complete stocks for kits this month. However, Dick Smith Electronics has since indicated they will not be stocking the AEM4600 modem kit, unfortunately.

If you're assembling the project yourself from parts on hand and buying-in the parts you don't have, then you're most likely after such things as the '7910 modem chip, the 2 uF isolating capacitor, the crystal and pc board.

The distributors of both makes of the '7910 were listed in the data sheet published last month — R&D Electronics for the AM7910, and Promark for the EF7910. If you're looking for retailers of this device — try Geoff Wood Electronics in Sydney, Active Electronics, Magraths and Rod Irving Electronics in Melbourne and Protronics in Adelaide.

The 2 uF/440 V capacitor is distributed by Captron in Melbourne, but try Geoff Wood Electronics in Sydney or Protronics for them in Adelaide. The 2.4576 MHz crystal is a relatively common item. Try Geoff Wood in Sydney, Radio Parts and Rod Irving Electronics in Melbourne.

Printed circuit boards are stocked by ourselves (see the coupon in our advert elsewhere in this issue), Protronics in Adelaide, possibly All Electronic Components in Melbourne, and Geoff Wood Electronics in Sydney.

Dick Smith Electronics maps out new moves

Hardly a week goes by when they aren't doing something new, it seems. The ever-present Dick Smith Electronics has relocated the **Brisbane** city store from Adelaide St to 157 **Elizabeth St,** which explains why you thought it was missing.

For the good citizens of **Underwood QLD,** not to mention all the local electronics enthusiasts, the indefatigable DSE crew has opened a new store in the area. Located on the corner of **Kingston Rd and the Pacific Highway,** you'll find all the familiar stock lines there and an enthusiastic enclave of electronics entrepreneurs eager to 'elp you.

PROJECT BUYERS GUIDE

The AEM6103 'Digital Era' Three-way Loudspeakers are the top of the range in our series of passive speaker projects. This project features performance rivalling the most expensive systems available. The Danish-made Vifa drivers are distributed by Scan Audio, PO Box 242, Hawthorn 3122 Vic. (03) 429 2199. They'll be able to advise your nearest stockist of drivers, crossovers and kits. Jaycar in Sydney has indicated they'll be stocking kits.

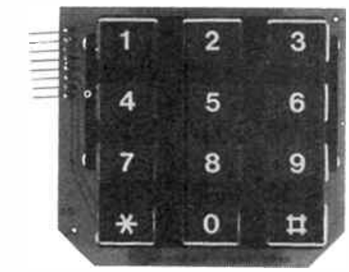
The AEM4503 'Port-A-Bee' is an intriguing and useful project with wide application. The Hitachi LM018L liquid crystal display used in the prototype came from Energy Control, PO Box 6502, Goodna 4300 Qld. (07) 288 2455. Jaycar are agents for the Lascar LCD displays from the UK. The DMX402 is suited to this project, and you might enquire as to its availability from your nearest Jaycar store.

This month's Star Project, a UHF CB 13 element Yagi antenna, is from Dick Smith Electronics who will be stocking complete kits at $39.95. Check your local Dick Smith store.

If at any time you're seeking printed circuit boards for any of our projects, you'll find them (generally) stocked by All Electronic Components in Melbourne, Geoff Wood Electronics in Sydney and Protronics in Adelaide. In the event you can't get the board you want, we keep a limited supply at the magazine. Call us on **(02) 487 2700** for price and availability.

12-key keypads

If you're after a numeric keypad for that special project of yours — like a security system, add-on numeric entry pad for a microcomputer, etc — then check out one of the latest bargains from Altronics.



They have what is described as a 'commercial grade' 12-key keypad with the numerals 0 to 9 plus # and * keys. They are arranged in a 4 x 4 array with connections via an 8-way wiring harness.

These keypads are of quite sturdy construction and, apparently, were supplied as standard on STC-made Telecom 'phones.

Priced at just $3.95 in quantities from one to nine, and significantly discounted in higher quantities, they can be obtained from **Altronics, PO Box 8280, Stirling St, Perth 6000 WA. (008) 99 9007.** Quote cat. no. A 0495 and tel 'em you saw it in AEM!

Fuel flow sensors back in stock

Jaycar advises that they are once again stocking fuel flow sensors for the popular Voyager Car Computer, which has been out of stock for the past year.

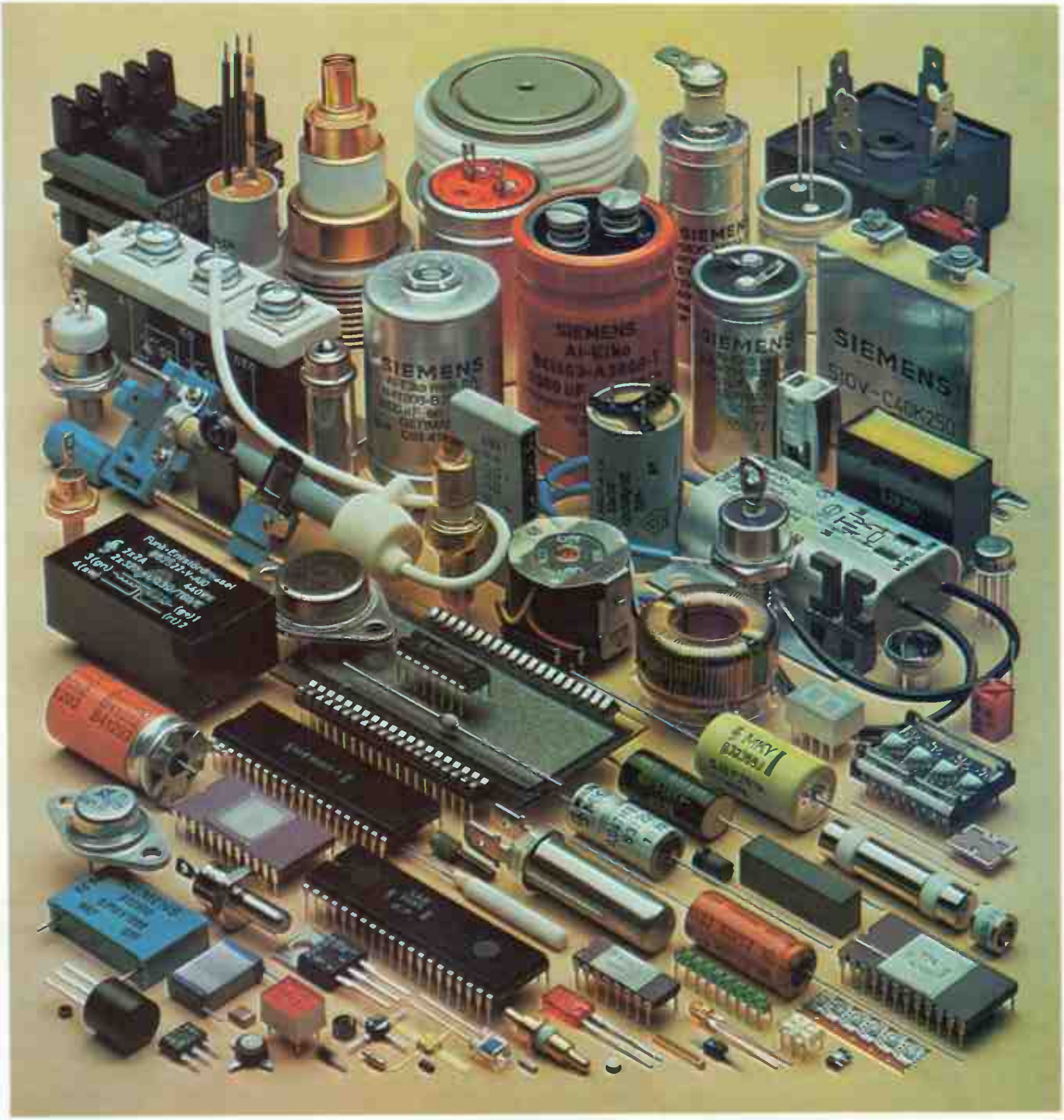
These rugged, reliable sensors have been sought after as being the best of their type on the market. However, Voyager Car Computers are now out of production in the UK and Jaycar advises they do not expect to get any more of these fuel flow sensors.

As you'd expect with a quality item, they're not cheap at $45.00. Quote Jaycar cat. no. XC-2036. Jaycar stores are at four locations in Sydney, plus Buranda in Brisbane. Four stores are open Thursday nights until 8.30 pm — York St, Hurstville and Carlingford in Sydney, and the Brisbane store.

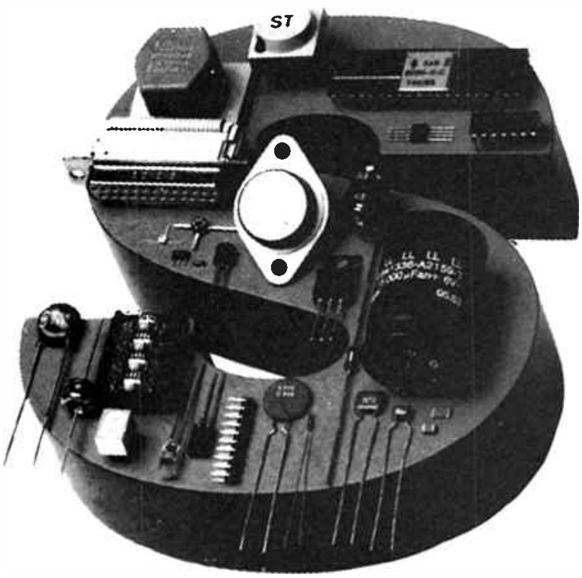
Readers note! — Jaycar has a **new dealer,** servicing the fair citizens of Adelaide and surrounds. You'll find the 'full line' of Jaycar products at **Eagle Electronics, 54 Unley Rd, Unley, S.A., 'phone 271 2855.**

SPECIALISED ICs
APPLICATIONS COOKBOOK

Here's an anthology of useful circuits and interesting applications for a range of specialised ICs available through local dealers and distributors. The device and circuits have been chosen to illustrate practical solutions to circuit requirements in a wide variety of applications ranging across audio, power supplies, radio, displays and lighting control. An index of distributors and dealers stocking the device illustrated in this cookbook is given at the end.



SIEMENS Electronic components range



SMALL SEMIs:

Small-signal semis
- Switching and tuner diodes
- AF, RF, Darlington and Switching Transistors
- Subminiature packages including Surface mounted devices

Microwave components
- RF transistors
- GaAs FETs
- GaAs FET amplifiers
- Schottky and PIN diodes

Displays
- Intelligent Displays™
- Programmable Displays™
- Alphanumeric
- Bar graphs
- Numeric

Optocouplers
- Single and multi-channel
- Fast hi-rel, hi-speed and high voltage
- Low CTR degradation

Visible LEDs
- 3 and 5 mm standard
- Arrays
- Miniature and Subminiature
- Geometric shapes
- Two-colour

Infrared
- Emitters
- Photodiodes
- Phototransistors

Sensors
- Temperature
- Galvanometric
- Pressure

POWER SEMIs

Large power semis
- Thyristors or diode modules
- Flatpack SCRs or rectifiers
- Stud mount SCRs or rectifiers

Small power
- Schottky and fast recovery rectifiers
- TO-220 Triacs/SCRs

Power MOSFETs
- SIPMOS
- SITAC
- SMARTFET

ICs

Microprocessors and Peripherals
- SAB8086 & SAB80286 16-BIT family
- Floppy disk controllers
- SAB8256 MUART

Microcontrollers
- SAB8031/8051 & SAB80515/80535

Memory devices
- 64K dynamic RAM

Integrated circuits
- Telecommunication
- TV and radio
- Analog
- Industrial

ELECTRO-MECHANICAL

Connectors
- 75 ohm coaxial
- DIN 41612

Cable
- 75 ohm Coaxial
- Ribbon

RELAYS

Relays
- Socket-mounted
- PCB-mounted
- Mounting hardware
- Solid state

TUBES & PROTECTION

Tubes
- RF heating
- Travelling wave tubes
- Lasers
- Special purpose tubes

Surge protection
- SVP^{R} gas surge
- Voltage protectors
- Thermistors
- SIOV^{R} varistors

SYSTEMS

Floppy disk drives
- 3½" & 5¼" single & double sided slimline

Printers
- Silent thermal

PASSIVES

Electrolytic capacitors
- Standard axial
- Standard radial
- Low-leakage radial
- High CV radial
- Low ESR
- Extended temperature

Polyester capacitors
- Axial wound
- Radial wound

Stacked film
- Non-encapsulated
- Epoxy-coated
- Box versions

Polypropylene/Polystyrene
- Axial
- Radial
- Encapsulated versions
- Flame-proof

Power capacitors
- Commutation
- Filtering
- Coupling
- Resonant
- Surge discharge

Ceramic capacitors
- E50000 dielectric
- Multilayer-Z5U, X7R
- COG

Filters
- SAW (surface acoustic wave)
- Filters & resonators
- RFI
- Chokes

Ferrites and Accessories
- For S.M. power supplies
- For Inductors
- For Transformers

Touch Dimmer

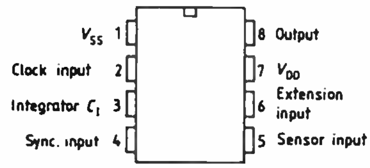
Electronic Dimmer
Electronic Light Switch

S 576 A, B, C
S 576 D

MOS IC

The IC S 576, constructed in PMOS depletion technology, permits the design of a digital electronic dimmer or light switch. Turning on and off as well as the setting of the required brightness are carried out via a single sensor or via an equivalent extension input, respectively.

Pin configuration
top view



Features

- Sensor operation – no mechanically moveable switching elements
- Operation is also possible from several extensions by means of sensors or push-buttons
- Can be interchanged with electromechanic wall switches in conventional light installations
- Easy connection to a wireless remote control
- Brightness control with a physiologically approximated linear characteristic
- Very high interference immunity
- The set brightness value remains stored during short line interruptions of < 1 s
- Low power dissipation
- Very few peripheral components
- Clock input provides for automatic dimming (slumber switch)

Maximum ratings
(without external protective circuitry)

		Lower limit B	Upper limit A	
Supply voltage	V_{DD}	−20	0.3	V
Input voltage	V_I	−20	0.3	V
Ambient temperature during operation	T_{amb}	0	60	°C
Junction temperature	T_j		125	°C
Storage temperature	T_{stg}	−55	125	°C
Thermal resistance (system-air)	$R_{th\,SA}$		135	K/W

Characteristics
$T_{amb} = 25$ °C, all voltage ratings are referred to $V_{SS} = 0$ V

		Test conditions	Lower limit B	typ	Upper limit A	
Supply voltage	V_{DD}		−18	−15	−13	V
Supply current	I_{DD}	$V_{DD} = -15$ V		1.0	1.4	mA
Supply current with missing sync signal	I_{DD}	$V_{DD} = -15$ V			0.85	mA
Input reverse current	I_I	$V_I = V_{SS} - 10$ V		< 0.1	3	µA
Input capacitance	C_I	$V_I = 0$ V, $f = 1$ MHz			5	pF
Sensor input						
H input voltage	V_{IH}	with series resistor 10 MΩ from 220 V line	$V_{SS}-2$			V
L input voltage	V_{IL}				$V_{SS}-8$	V
Input current	I_{IH}				35	µA
HL transition time (trigger transition)	t_{THL}			line sine wave		
LH transition time	t_{TLH}					
Frequency with active signal	f	synchronized with 50/60 Hz clock at sync input		50/60		Hz
Extension input						
H input voltage	V_{IH}		$V_{SS}-2$			V
L input voltage	V_{IL}				$V_{SS}-8$	V
Input current	I_{IH}				35	µA
Sync input (pin 4)						
H input voltage	V_{IH}	with series resistor 1.5 MΩ from 220 V line	1/2 V_{DD}+2			V
L input voltage	V_{IL}				1/2 V_{DD}−2	V
Input current	I_{IH}				240	µA
HL transition time (trigger transition)	t_{THL}			line sine wave		
LH transition time	t_{TLH}					
Frequency	f			50/60		Hz
Clock input (pin 2)						
H input voltage	V_{IH}		$V_{SS}-2$		$V_S+0.3$	V
L input voltage	V_{IL}		V_{DD}		$V_{SS}-8$	V
HL transition (trigger transition)	t_{THL}				100	µs
LH transition	t_{TLH}				100	µs
Clock frequency	f_{CLK}		0		500	Hz
Without clock	V_{IO}		V_{SS}		$V_{SS}+0.3$	V
Integrator (pin 3)						
External components	C_I	compare with fig.1		47		nF
Output						
L output current	I_O	$V_{DD} = -15$ V, $V_{OL} = -3$ V	25			mA
L pulse width	t_{OL}	50 Hz line		40		µs
H output voltage	V_{OH}	compare with text	V_{SS}		$V_{SS}+0.5$	V
HL transition time	t_{HLO}				20	µs
LH transition time	t_{LHO}				20	µs

Operation of the control inputs
Input potential during both half waves of the line phase:

Function	Line half wave	Sensor input	Extension input
operated	positive	L	H
	negative	0	H
not operated	positive	H	L or 0
	negative	0	0 or L

H: V_{IH}
L: V_{IL}
0: any

Control behavior

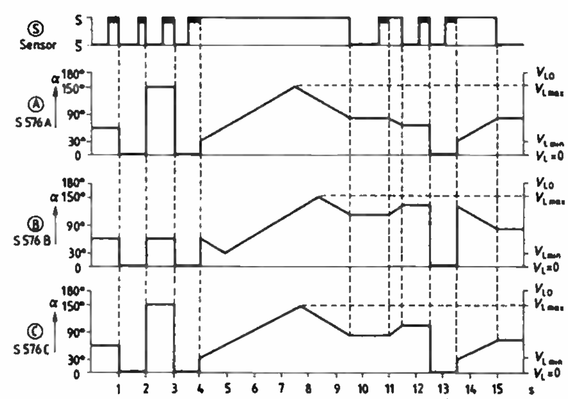
The three versions S 576 A, B, C, differ in their control behavior.

S 576 A With turning on, the maximum brightness is always set; with dimming, control is started from the minimum brightness. With repeated dimming, control is carried out in the same direction (e.g. "brighter").

S 576 B With turning off, the selected brightness is stored and again set when the switch is turned on. Dimming starts at that stored value and the control direction is reversed with repeated dimming.

S 576 C With turning on, the maximum brightness is always set; with dimming, control is started from the minimum brightness. The control direction is reversed with repeated dimming.

Control behavior of the electronic dimmers S 576 A, B, C (schematic)



α Conduction angle V_L Lamp voltage   S Control signal   S Sensor touched (= <0.4s; −>0.4s)   S̄ Sensor not touched   A S576A   B S576B   C S576C

Figure 1

S 576 A, B, C
S 576 D

Light switch S 576 D (see figure 2)

Upon touching the sensor area (> 50 ms) the lamp is turned on or off alternatively with maximum brightness. The switching process is activated at the start of touching.

Dimming or turning off the light via the clock input is also possible, as in the case with the dimmer.

Control behavior of the electronic light switch S 576 D (schematic)

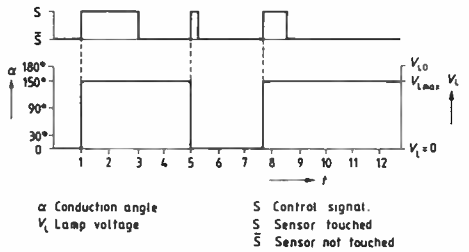


Figure 2

External circuitry (see figure 3)

The suggested circuit design of S 576 performs the following functions:

- current supply for the circuit (R_1, C_2, D1, D2, C_3)
- filtered signal for synchronization of the internal time base (PLL circuit) with line frequency (R_2, C_4)
- protection of the user (R_8, R_9)
- sensitivity setting of the sensor (R_7)
- current limitation in the case of incorrect polarization of the extension (R_5, R_6).
  Both resistors can be omitted if no extension is connected. In this case, pin 6 must be interconnected with V_{DD} (pin 7).
- D3: reduction of positive voltages which may arise during the triggered state at the gate of some triacs, to values below $V_{SS}+0.5$ V (refer to characteristic data). If suitable triacs are used, diode D3 can be omitted. (This feature of the triac depends on the anode current and on the internal resistance between G and A1, and can be measured and specified by the manufacturer).

Extensions

All switching and control functions can also be performed from extensions which are connected to an extension input reserved for this purpose. The central unit and the extensions are equivalent. Electronic sensor switches or mechanical pushbutton switches can be connected to the extensions. During operation, H potential must be applied to the extension input for both line half waves.

An electronic circuit suitable for this purpose, is shown in the application example (figure 4). The circuit operates as return delay and takes over the triggering of the switching transistors during the negative line half wave.

- **Response time approx. 2 ms**
- **Return delay time approx. 30 ms**
- Protection against incorrect polarization (R_1, D1, SI)

Application circuit S 576

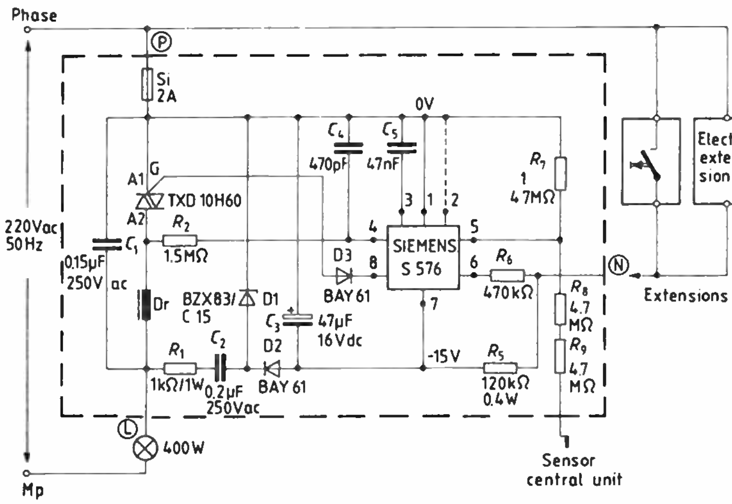


Figure 3

Application circuit: electronic extension

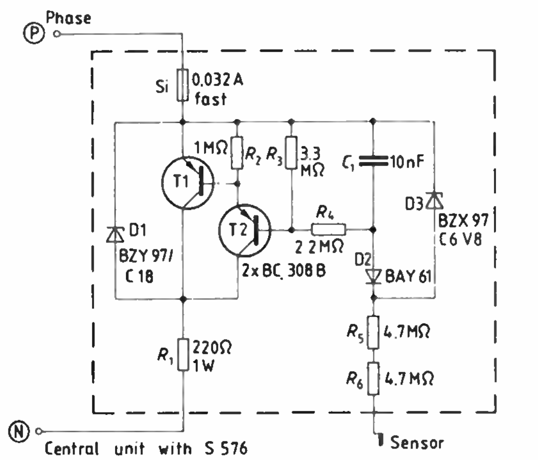


Figure 4

AM/FM Receiver Chips

AM Receiver IC with Demodulator — TDA 4001

Bipolar circuit

The TDA 4001 has been designed to convert, amplify, and demodulate AM signals. In addition, the component provides a search tuning stop pulse.

Features

- Internal demodulation
- Search tuning stop signal
- Low total harmonic distortion
- Minimal IF leakage at the AF output
- 2-stage integrated low pass filter

Maximum ratings

Supply voltage	V_S	15	V
Junction temperature	T_j	150	°C
Storage temperature range	T_{stg}	–40 to 125	°C
Thermal resitance (system-air)	$R_{th\,SA}$	70	K/W

Operating range

Supply voltage range	V_S	7 to 15	V
Ambient temperature range	T_{amb}	–25 to 85	°C

TDA 4001

Characteristics ($V_S = 12$ V; $T_{amb} = 25$ °C; $V_{IRF} = 1$ MV$_{rms}$; $R_g = 50\ \Omega$; $f_{IRF} = 1$ MHz; referred to measurement circuit)

		min	typ	max	
Current consumption	I_S		15		mA
AF output voltage m = 0.8	V_{qAFrms}		800		mV
m = 0.3	V_{qAFrms}		300		mV
$V_{IRFrms} = 15\ \mu$V; m = 0.8	V_{qAFrms}	150		320	mV
20 log (V_{qAFrms}/30 mV : V_{qAFrms}/1 mV)				3	dB
Total harmonic distortion m = 0.8	THD			2	%
m = 0.3	THD			1	%
$V_{IRFrms} = 30$ mV; m = 0.8	THD			5	%
Signal-to-noise ratio (m = 0.3; $V_{IRFrms} = 10\ \mu$V)	$\frac{S+N}{N}$		6		dB
(m = 0.3; $V_{IRFrms} = 1$ mV)	$\frac{S+N}{N}$		46		dB
Reference voltage	V_{stab}		4.8		V
Oscillator voltage	V_{OSCpp}		100		mV
Counter output voltage	V_{qCpp}		100		mV
Input impedance RF input	Z_{IRF}		10/1.5		kΩ/pF
IF amplifier	Z_{IIF}		3.3/1.5		kΩ/pF
AFC offset current without signal	I_{AFC}			±10	µA
AFC offset current in the whole control range	ΔI_{AFC}			±10	µA
AFC output current ($f_{IRF} = 1$ MHz ± 3 kHz)	I_{AFC}		±80		µA
Search tuning stop output current	I_{q13}		2		mA
Search tuning stop output voltage	V_{q13}			0.4	V
Search tuning stop output voltage ($V_{IRF} = 0$ V)	V_{q13}	11			V
($f_{IRF} > 1$ MHz + 3 kHz)	V_{q13}	11			V
($f_{IRF} < 1$ MHz − 3 kHz)	V_{q13}	11			V

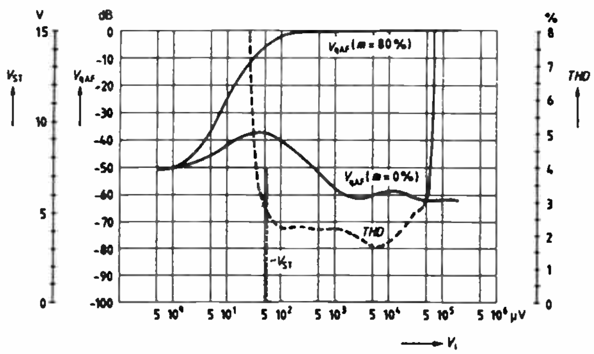
Additional data with respect to application[1])

		min	typ	max	
IF suppression	a_{IF}		40		dB
3 dB limit frequency of the integrated TP	f_G		5		kHz
Conversion gain	G_C		30		dB
AGC IF amplifier	V_{IIFrms}		100		µV
Control range ($\Delta V_{qAF} = 6$ dB)	a		60		dB
Input sensitivity (V_{qAF}/V_{IRFrms} = 1 mV −3 dB)	V_{IRFrms}		30		µV

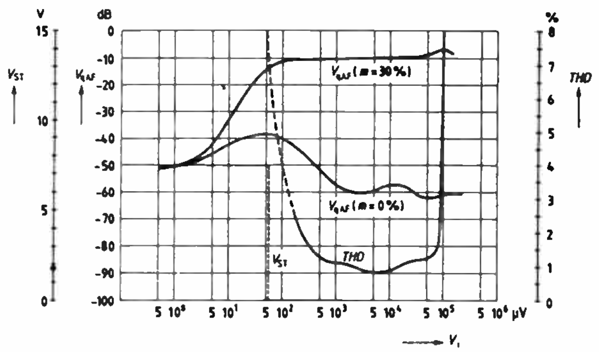
Circuit description

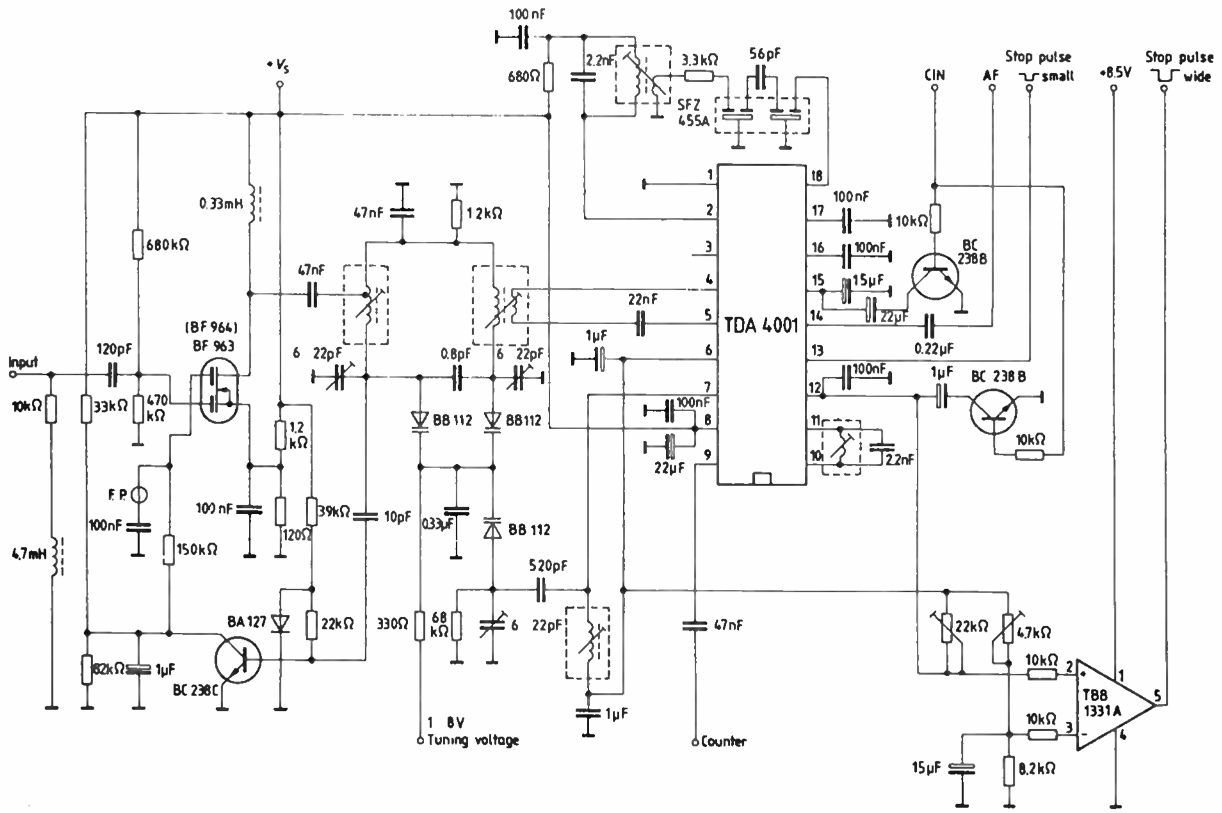
The impedance converter forwards the input signal V_{IRF} to the symmetrical double balanced mixer. Subsequently the signal is converted to IF with the amplitude-controlled oscillator. An external filter forwards the IF signal to the controlled IF amplifier. The amplifier IF signal and the carrier signal will be converted to AF in the subsequent synchmous demodulator (SD). The 2-stage low pass filter forwards the available AF to the AF output. Via an additional limiter amplifier (LA), the AF uses the carrier signal to control the coincidence demodulator (CD). The output signal of the coincidence demodulator provides the stop pulse during exact tuning and sufficient field strength. The stop pulse interrupts the automatic search tuning.

AF output voltage, total harmonic distortion, search tuning stop versus input voltage
$V_S = 15$ V, $f_{mod} = 1$ kHz, $f_i = 1$ MHz
0dB ≙ 775mV (rms)



AF output voltage, total harmonic distortion, search tuning stop versus input voltage
$V_S = 15$ V; $f_{mod} = 1$ kHz, f = 1 MHz
0dB ≙ 775 mV (rms)





FM IF Amplifier with Demodulator for Radio Receivers

TDA 1047

Bipolar circuit

FM-IF amplifier for radio sets with 8-stage amplifier and symmetrical coincidence demodulator. The TDA 1047 additionally offers provisions for feeding an amplitude indicator and either positive or negative mono-stereo voltage as well as an AFT output (push-pull current output) with automatic switch-off. The included squelch can be adjusted within an input signal range of more than 40 dB and depends on detuning.

Features

- Excellent limiting qualities
- Excellent frequency stability of demodulator characteristic
- Large range of operating voltage between 4 and 18 V
- Low current consumption
- Externally adjustable squelch
- Few external components

Maximum ratings

Supply voltage	V_S	18	V
Junction temperature	T_j	150	°C
Storage temperature range	T_{stg}	–40 to 125	°C
Thermal resistance (system-air)	$R_{th\,SA}$	90	K/W

Operating range

Supply voltage range	V_S	4 to 18	V
Frequency range	f	0 to 15	MHz
Ambient temperature range	T_{amb}	–25 to 85	°C

Characteristics ($V_S = 12$ V; $T_{amb} = 25$ °C; $f_i = 10.7$ MHz; $f_{mod} = 1$ kHz; $\Delta f = \pm 75$ kHz; Q_B approx. 20) see test circuit

		min	typ	max	
Current consumption ($I_{14} = 0$)	I_{12}	9	12	15	mA
Voltage for field strength indicator ($R_{14} = 3.3$ kΩ)					
$V_{i\,rms} = 160$ mV	V_{14}	1.6	2		V
$V_{i\,rms} = 16$ µV	V_{14}		10	20	mV
Current	I_{14}			3.6	mA
Voltage for squelch adjustment (approx. log.)					
$V_{i\,rms} = 8$ mV	V_{15}		0		V
$V_{i\,rms} = 16$ µV	V_{15}	2.2	2.5		V
Current	I_{15}			3.6	mA
AF output DC voltage	V_7		2.1		V
AF output voltage ($V_i = 10$ mV; $THD = 0.4\%$)	$V_{7\,rms}$	270	300		mV
Internal DC voltage of output emitter follower	I_7	180	200		µA
Total harmonic distortion ($V_i = 10$ mV)[1]	THD		0.4	0.8	%
Input voltage for limiting[2]	V_i		30	50	µV
Input resistance	R_{i18}	10			kΩ
AF output resistance[3] (emitter follower output)	R_{q7}		0.3	1	kΩ
Threshold of detuning-depending squelch (referred to $f = 10.7$ MHz)	Δf		± 100	± 150	kHz
Switching threshold for AFT OFF	V_2			20	mV
Input resistance	R_{i2}	40	100		kΩ
Voltage for AFT OFF	V_3	0.8			V
Current deviation of the AFT output	ΔI_5		± 150		A
IF output voltage for limiting	$V_{8\text{-}11\,pp}$		500		mV
Input resistance for demodulator circuit	$R_{9\text{-}10}$		5.4		kΩ
Recommended voltage for demodulator circuit[4]	$V_{9\text{-}10\,pp}$		500		mV
Threshold for AF OFF	V_{13}		0.85	0.95	V
AF ON	V_{13}	0.5	0.6		V
Hysteresis for switching threshold	ΔV_{13}		120	200	mV
Internal resistance for AF switch-off time constant	R_{q8}		500		Ω
AM suppression ($V_i = 10$ mV; $m = 30\%$)	a_{AM}	60			dB
Signal-to-noise-ratio ($V_i = 10$ mV)	$a_{S/N}$	70			dB
AF suppression at muting circuit ($V_i = 10$ mV)	a_{AF}		60		dB

[1] In the case of using a band filter: $THD_{max} = 0.3\%$

[2] Limiting application for $V_{AF} = -3$ dB

[3] The output resistance R_{q7} can be reduced by connecting a resistor of at least 2.7 kΩ between pin 7 and ground.

[4] The recommended voltage at the demodulator circuit $V_{9\text{-}10}$ can be adjusted by the capacitors $C_{8\text{-}9}$ and $C_{10\text{-}11}$, which are also influencing the voltage V_{14} and V_{15}.

If the slider of potentiometer P is grounded, the field-strength-dependent squelch is switched off.

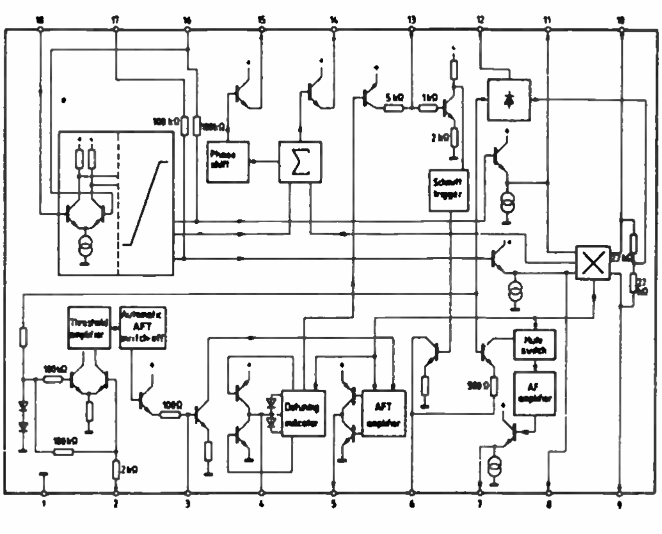
If pin 13 is grounded, both the field-strength- and the detuning-dependent squelch are switched off.

The noise level between the transmitters becomes more or less audible, when pin 6 is loaded with a resistance to +12 V in case of "squelch on". Noise attenuation increases with the size of the resistance ($R \geq 10$ kΩ).

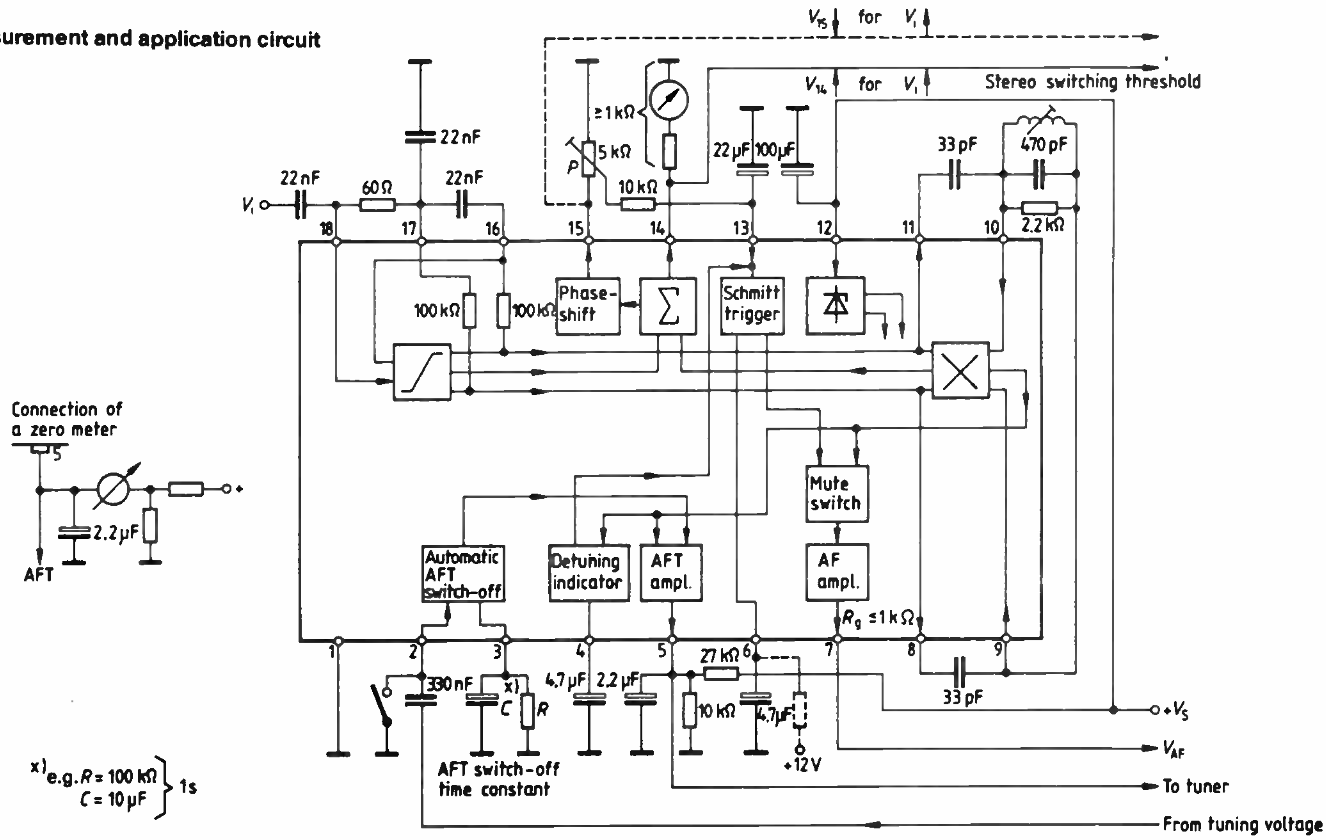
Pin configuration

Pin No.	Function
1	Ground
2	Sensor input for AFT switch off
3	AFT switch-off time constant
4	Low-pass capacitor for detuning-dependent AF switch off
5	AFT output (push-pull output)
6	Low-pass capacitor for suppression of switch off clicks in case of detuning and insufficient field strength
7	AF output (emitter follower with constant-current source)
8	Output of limiter amplifier
9, 10	Phase shifting circuit
11	Output of limiter amplifier
12	Positive operating voltage
13	Input for amplitude-dependent switch off
14	Instrument connection and stereo switching voltage (positive going)
15	Squelch and stereo switching voltage (negative going)
16, 17	Feedbacks for IF amplifier
18	IF input

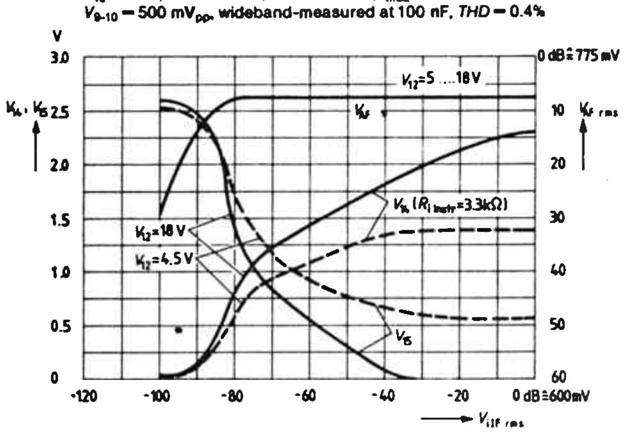
Block diagram



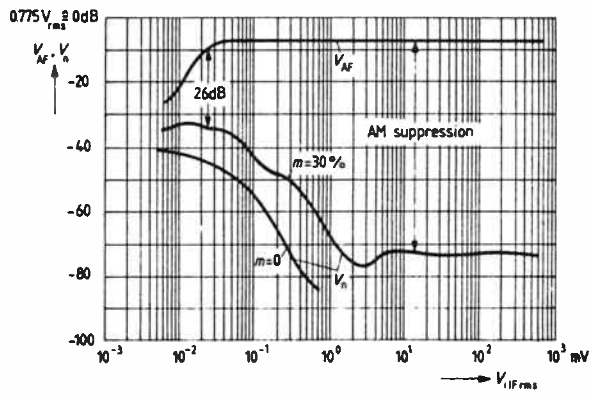
Measurement and application circuit



AF output voltage, indicator voltage, squelch voltage versus input voltage
$V_{12} = 15$ V; $f = 10.7$ MHz, $\Delta f = \pm 75$ kHz, $f_{mod} = 1$ kHz
$V_{9\text{-}10} = 500$ mV$_{pp}$, wideband-measured at 100 nF, $THD = 0.4\%$



AF output voltage, noise voltage versus input voltage
$f = 10.7$ MHz, $\Delta f = \pm 75$ kHz, $V_{12} = 15$ V



LED Array Drivers

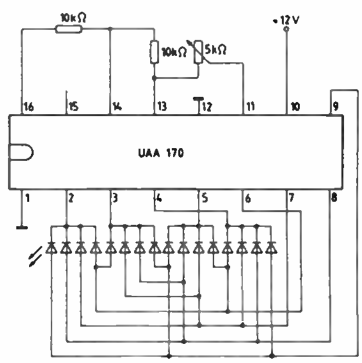
LED Driver for Light Spot Displays — **Bipolar circuit** — **UAA 170**

Maximum ratings

Supply voltage	V_S	18	V
Input voltages	V_{11}, V_{12}, V_{13}	6	V
Load current	I_{14}	5	mA
Junction temperature	T_j	150	°C
Storage temperature range	T_{stg}	–40 to 125	°C
Thermal resistance (system-air)	$R_{th\,SA}$	90	K/W

Operating range

Supply voltage range (LED red)[1]	V_S	11 to 18	V
Ambient temperature range	T_{amb}	–25 to 85	°C



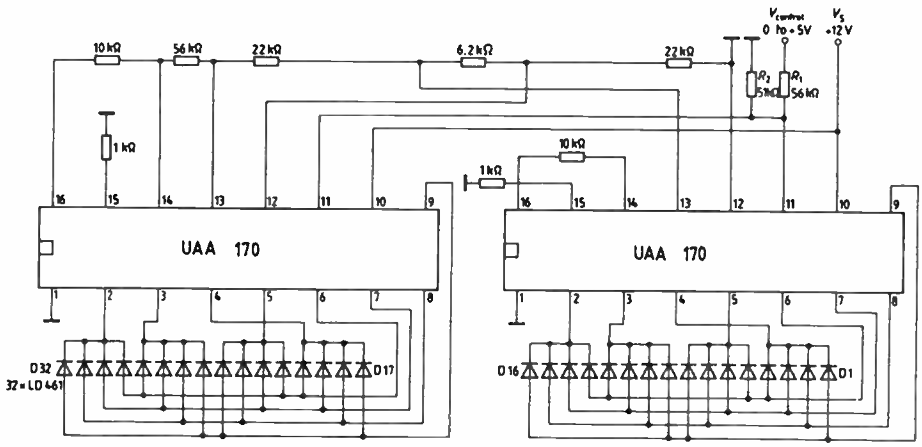
UAA 170

IC for driving 16 light emitting diodes. Depending on the input voltage, the individual LEDs are driven within one row in form of a light spot. The UAA 170 provides a linear relation between control voltage and the driven LED.

By using an appropriate circuitry, the brightness of the LEDs can be varied and the crossing over of the light spot can be set between "smooth" and "abrupt". By connecting two ICs in parallel, up to 30 LEDs can be driven.

Characteristics ($V_S = 12$ V; $T_{amb} = 25$ °C)

		min	typ	max	
Current consumption ($I_{14} = 0$; $I_{16} = 0$)	I_S	2	4	10	mA
Control input current	I_{11}	–2			µA
Reference input current	I_{12}, I_{13}	–2			µA
Voltage difference	$\Delta V_{12/13}$	1.4		6	V
Voltage difference for smooth light transition	$\Delta V_{12/13}$	1.4			V
Voltage difference for abrupt light transition	$\Delta V_{12/13}$	4			V
Voltage difference	$\Delta V_{12/13}$	4			V
Stabilized voltage $I_{14} = 300$ µA	V_{14}		5	6	V
$I_{14} = 5$ mA	V_{14}	4.5			V
Reference input voltage	$V_{ref\,max}$	1.4		6	V
	$V_{ref\,min}$	0		4.6	V
Tolerance of forward voltages of LEDs, mutually	ΔV_D			0.5	V
Output current for LEDs	ΣI_D		25		mA



Application circuit for the control of 30 LEDs with 2 x UAA 170

Range of control voltage $V_{control} = 0$ to 5 V
Voltage difference $V_{12/13} = 2 \times 1.2$ V $= 2.4$ V
Since the diodes D16 or D17 are permanently lit when the maximum or minimum voltages V_{13} or V_{12} adjusted by R_3, R_4, R_5, are exceeded or fall short the diodes should be covered, if necessary.

LED Driver for Light Band Displays

Bipolar circuit **UAA 180**

Integrated circuit for driving 12 light emitting diodes. Corresponding to the input voltage the LEDs forming a light band are controlled similar to a thermometer scale.

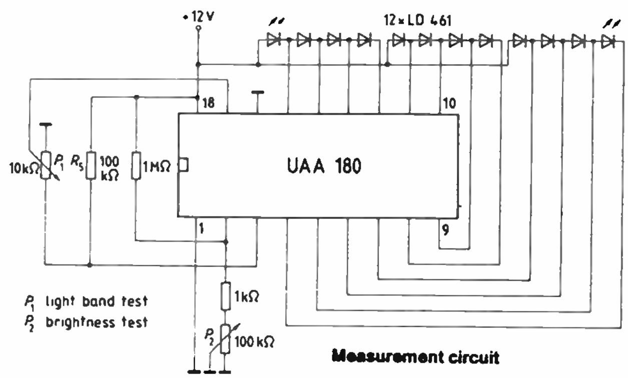
By using an appropriate circuitry the brightness of the LEDs can be varied and the light passage between two adjacent LEDs can be arranged between "smooth" and "abrupt".

Maximum ratings

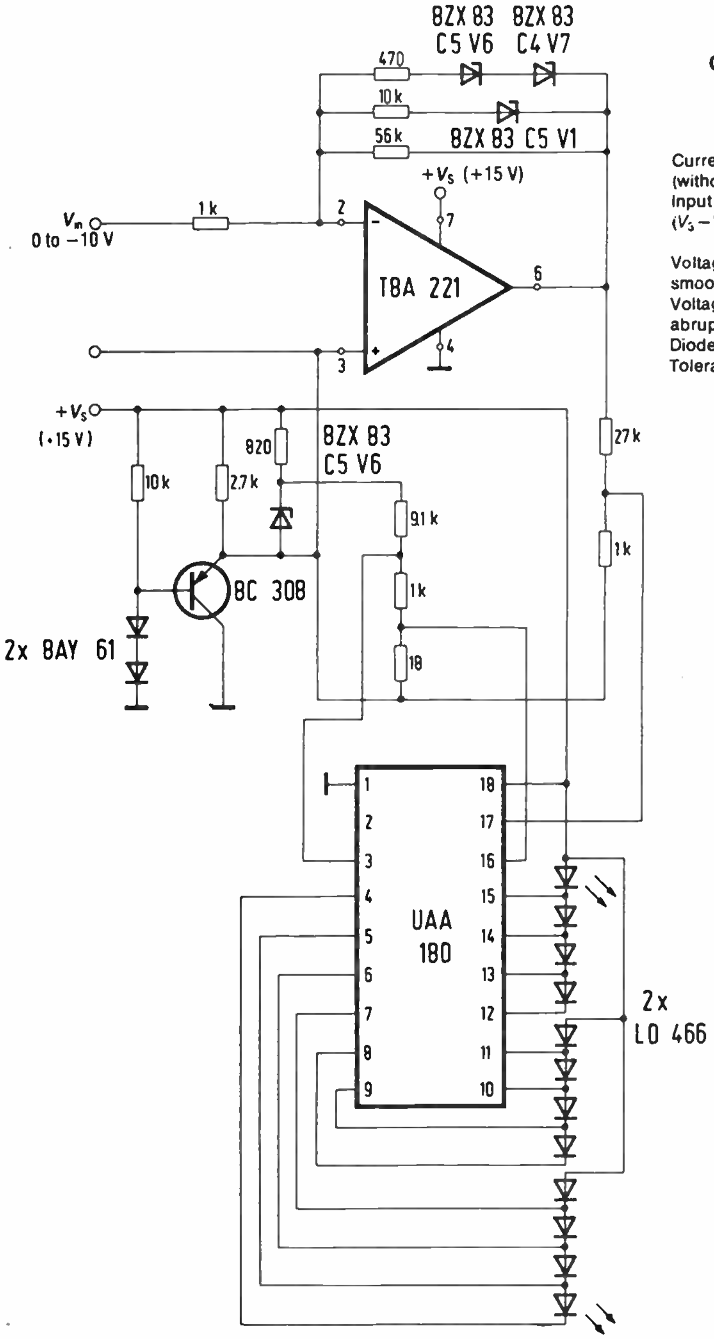
Supply voltage	V_S	18	V
Input voltage	V_3	6	V
	V_{16}	6	V
	V_{17}	6	V
Storage temperature range	T_{stg}	–40 to 125	°C
Junction temperature	T_j	150	°C
Thermal resistance (system-air)	$R_{th\,SA}$	78	K/W

Operating range

Supply voltage range	V_S	10 to 18	V
Ambient temperature range	T_{amb}	–25 to 85	°C



Measurement circuit



UAA 180

Characteristics ($V_S = 12$ V, $T_{amb} = 25$ °C)

		min	typ	max	
Current consumption ($I_2 = 0$) (without LED current)	I_{18}		5.5	8.2	mA
Input currents ($V_3 - V_{16} < 2$ V)	I_3		0.3	1	µA
	I_{16}		0.3	1	µA
	I_{17}		0.3	1	µA
Voltage difference for smooth light transition	$V_{16/3}$	1			V
Voltage difference for abrupt light transition	$V_{16/3}$	4			V
Diode current per diode	I_D		10		mA
Tolerance of LED forward voltages	ΔV_D			1	V

Level Meter with Logarithmic Scale Using UAA 180

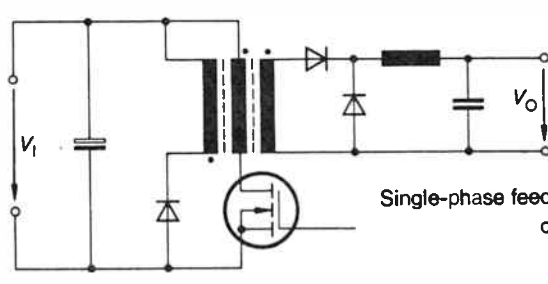
Fig. 4.8 shows a circuit of a level meter with an LED-array for indication. The input signal is applied via a pre-resistor to the operational amplifier TBA 221. The logarithmic characteristic is realized by 3 resistors and 3 z-diodes being part of the reverse feedback circuit. Contrary to the common circuits already described in "Design Examples for Semiconductor Circuits, Edition 76/77, Section 4.10.1" this one operates with only one power supply. A network consisting of the two diodes BAY61 and the transistor BC308 sets a bias of approx. 2 V to the non-inverting input of the operational amplifier. This voltage is also the reference for the UAA 180 and for the 27 k/1 kΩ-divider connected to the output of the operational amplifier. This reference voltage is slightly increased by a 18 Ω-resistor to decrease the threshold for the first light spot. The upper level of the reference voltage is generated by the 9.1 k/1 kΩ-divider and the voltage of 5.6 V being stabilized by the z-diode BZX83C5V6.

With the described circuit a good conformity to a logarithmic characteristic is achieved and the indicated level increases by 5 dB from one light spot to another.

Components for circuit 4.8

1	IC	UAA180
1	Operational amplifier	TBA221
1	Transistor	BC308
2	LED-arrays	LD466
2	Z-diodes	BZX83C5V6
1	Z-diode	BZX83C5V1
1	Z-diode	BZX83C4V7
2	Diodes	BAY61

SWITCHED-MODE POWER SUPPLIES



Single-phase feed-forward converter

Owing to their high efficiency, their low weight and volume Switched-Mode Power Supplies (SMPS) find increasing use in device power supply applications.

This development is aided by new, more efficient active and passive components, such as the SIPMOS transistor and special, highly integrated control and regulating circuits.

This permits a far-reaching standardization of SMPS and a simplification of their circuit technology. The development costs are decreased, so that even small quantities become economically feasible.

The integrated control and regulating devices for SMPS, the TDA 4700, TDA 4718, TDA 4716, and TDA 4714 can be used to implement all common principles of SMPS, such as single-phase converters (flyback, forward, choke converter) and push-pull converters in normal, half-bridge and full-bridge circuits with few external components.

The TDA 4700 IC exhibits the widest range of functions. The other devices are adapted to the different SMPS concepts by omitting various functional parts.

permit the construction of high quality devices with a high degree of operational reliability.

With all the ICs, a facility that is worthy of special mention is that of feed-forward control (50/60 Hz hum suppression) with a separate ramp generator.

Types TDA 4700 and TDA 4718 have a PLL synchronization circuit with a frequency capture range of ± 30 %.

In order to achieve symmetry in push-pull SMPS, the TDA 4700 offers connection capability for an external symmetry correction circuit.

SWITCHED-MODE POWER SUPPLIES

Control IC for Single-Ended and Push-Pull Switched-Mode Power Supplies

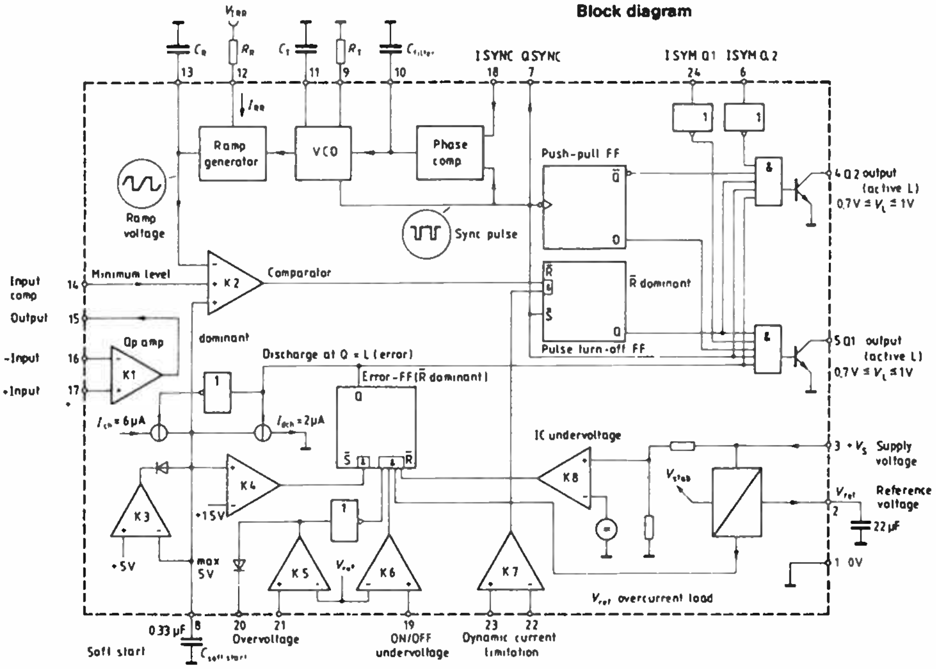
Bipolar IC **TDA 4700 TDA 4700 A**

This versatile SMPS control IC comprises digital and analog functions which are required to design high-quality flyback, single-ended and push-pull converters in normal, half-bridge and full-bridge configurations. The component can also be used in single-ended voltage multipliers and speed-controlled motors. Malfunctions in electrical operation are recognized by the integrated operational amplifiers and activate protective functions.

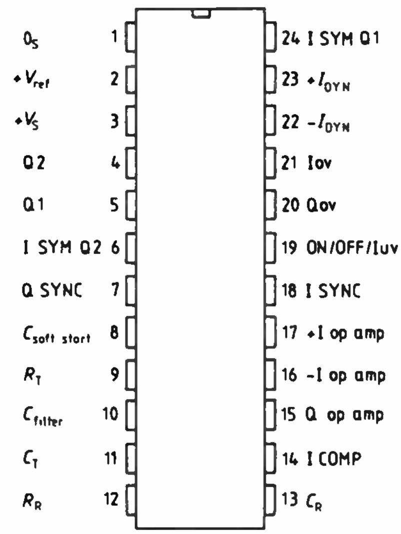
In addition to the noticeable reduction in components, our SMPS ICs offer a number of advantages:

- Feed-forward control (line hum suppression)
- Symmetry inputs for push-pull converter
- Dynamic output current limitation
- Overvoltage protection
- Undervoltage protection
- Soft start
- Double pulse suppression

Block diagram



Pin configuration, top view



Pin designation

Pin No.	Function
1	Q_S
2	Reference voltage V_{ref}
3	Supply voltage V_S
4	Output Q 2
5	Output Q 1
6	Symmetry Q 2
7	Sync. output
8	Soft start $C_{soft\ start}$
9	VCO R_T
10	Capacitance C_{filter}
11	VCO C_T
12	Ramp generator R_R
13	Ramp generator C_R
14	Comparator input
15	Operational amplifier output
16	Operational amplifier input (–)
17	Operational amplifier input (+)
18	Sync. input
19	ON/OFF, undervoltage
20	Overvoltage output
21	Overvoltage input
22	Dynamic current limitation (–)
23	Dynamic current limitation (+)
24	Symmetry Q 1

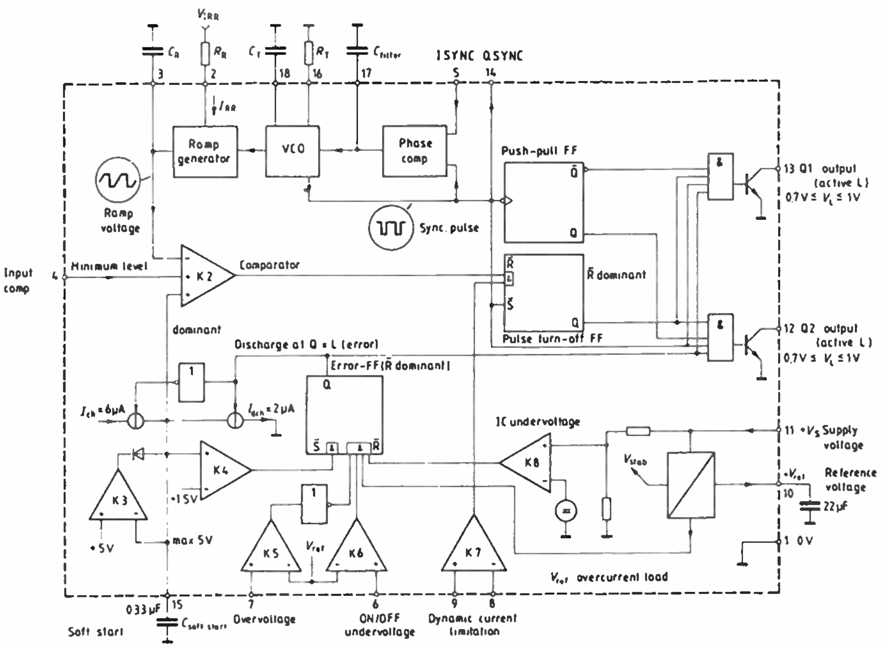
Maximum ratings		Notes	Lower limit B	Upper limit A	
Supply voltage	V_S		–0.3	33	V
Voltage at Q1, Q2	V_Q	Q1, Q2 high	–0.3	33	V
Current at Q1, Q2	I_Q	Q1, Q2 low		70	mA
Symmetry 1, 2	V_{SYM}		–0.3	33	V
Sync output	$V_{SYNC\,O}$	SYNC Q high	–0.3	7	V
	$I_{SYNC\,O}$	SYNC Q low	0	10	mA
Sync input	$V_{SYNC\,I}$		–0.3	33	V
Input C_{filter}	$V_{I\,Cf}$		–0.3	7	V
Input R_T	$V_{I\,RT}$		–0.3	7	V
Input C_T	$V_{I\,CT}$		–0.3	7	V
Input R_R	$V_{I\,RR}$		–0.3	7	V
Input C_R	$I_{I\,CR}$		–10	10	mA
Input comparator K 2, K 5, K 6, K 7	V_{IK}		–0.3	33	V
Output K 5	$V_{O\,K5}$		–0,3	33	V
Input op amp	$V_{I\,op\,amp}$		–0.3	33	V
Output op amp	$V_{O\,op\,amp}$		–0.3	V_S–1 max. 7	V V
Reference voltage	V_{ref}		–0.3	V_{ref}	V
Input $C_{soft\ start}$	$V_{I\,soft\ start}$		–0.3	7	V
Operating range					
Supply voltage	V_S		10.5	30	V
Ambient temperature TDA 4700	T_{amb}		–25	85	°C
TDA 4700 A	T_{amb}		0	70	°C
VCO frequency	f		40	250 000	Hz
Ramp generator frequency	f_{RG}		40	250 000	Hz

Control IC for Single-Ended and Push-Pull Switched-Mode Power Supplies

Bipolar IC **TDA 4718 / TDA 4718 A**

This 18-pin SMPS control IC comprises digital and analog functions which are required to design high-quality flyback, single-ended, and push-pull converters in normal and half-bridge configurations. In addition to the control functions, the circuit contains operational amplifiers which detect malfunctions during electrical operation and suitable protective measures. A PLL circuit for synchronization is one of the special advantages offered by this IC in addition to the following features:

- Feed-forward control (line hum suppression)
- Push-pull outputs
- Dynamic current limitation
- Overvoltage protection
- Undervoltage protection
- Soft start
- Double pulse suppression



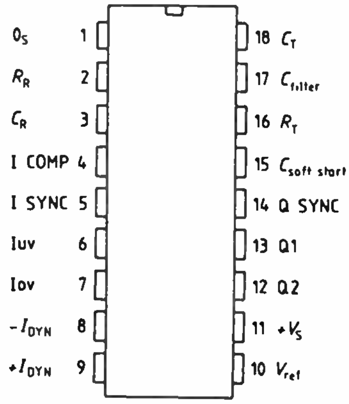
Maximum ratings

		Notes	Lower limit B	Upper limit A	
Supply voltage	V_S		−0.3	33	V
Voltage at Q1, Q2	V_Q	Q1, Q2 high	−0.3	33	V
Current at Q1, Q2	I_Q	Q1, Q2 low		70	mA
Sync output	$V_{SYNC\,Q}$	SYNC Q high	−0.3	7	V
	$I_{SYNC\,Q}$	SYNC Q low	0	10	mA
Sync input	$V_{SYNC\,I}$		−0.3	33	V
Input C_{filter}	$V_{I\,Cf}$		−0.3	7	V
Input R_T	$V_{I\,RT}$		−0.3	7	V
Input C_T	$V_{I\,CT}$		−0.3	7	V
Input R_R	$V_{I\,RR}$		−0.3	7	V
Input C_R	$I_{I\,CR}$		−10	10	mA
Input comparator K2, K5, K6, K7	$V_{I\,K}$		−0.3	33	V
Output K5	$V_{Q\,K5}$		−0.3	33	V
Reference voltage	V_{ref}		−0.3	V_{ref}	V
Input $C_{soft\,start}$	$V_{I\,soft\,start}$		−0.3	7	V

Operating range

Supply voltage	V_S		10.5	30	V
Ambient temperature TDA 4718	T_{amb}		−25	85	°C
TDA 4718 A	T_{amb}		0	70	°C
Max. VCO frequency	f		40	250 000	Hz
Ramp generator frequency	f_{RG}		40	250 000	Hz

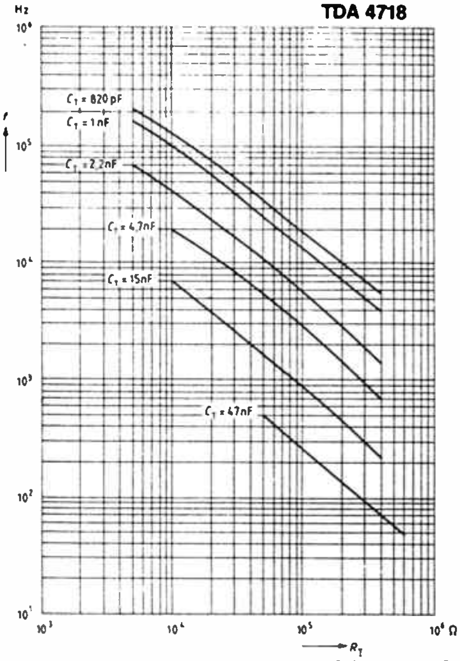
Pin configuration
top view



Pin designation

Pin No.	Function
1	0_S
2	Ramp generator R_R
3	Ramp generator C_R
4	+ input comparator K 2
5	Sync input
6	Input undervoltage, ON/OFF
7	Input overvoltage
8	Input dynamic current limitation (−)
9	Input dynamic current limitation (+)
10	Reference voltage V_{ref}
11	Supply voltage V_S
12	Output Q 2
13	Output Q 1
14	Sync output
15	Soft start
16	VCO R_T
17	Capacitance C_{filter}
18	VCO C_T

VCO frequency versus R_T and C_T **TDA 4700 TDA 4718**



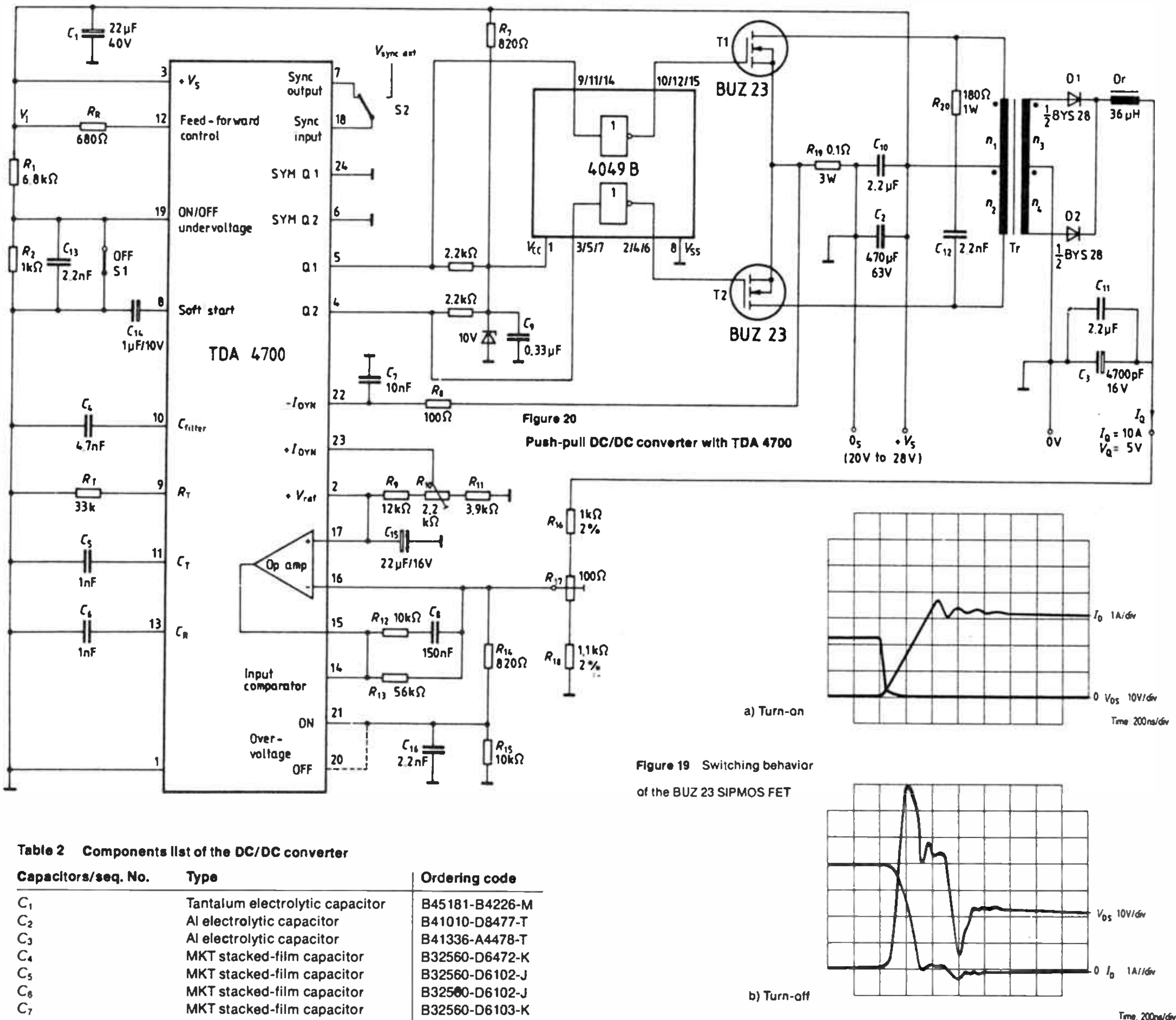


Figure 20
Push-pull DC/DC converter with TDA 4700

a) Turn-on

b) Turn-off

Figure 19 Switching behavior of the BUZ 23 SIPMOS FET

Table 2 Components list of the DC/DC converter

Capacitors/seq. No.	Type	Ordering code
C_1	Tantalum electrolytic capacitor	B45181-B4226-M
C_2	Al electrolytic capacitor	B41010-D8477-T
C_3	Al electrolytic capacitor	B41336-A4478-T
C_4	MKT stacked-film capacitor	B32560-D6472-K
C_5	MKT stacked-film capacitor	B32560-D6102-J
C_6	MKT stacked-film capacitor	B32560-D6102-J
C_7	MKT stacked-film capacitor	B32560-D6103-K
C_8	MKT stacked-film capacitor	B32560-D1154-J
C_9	MKT stacked-film capacitor	B32560-D1334-K
C_{10}	MKT stacked-film capacitor	B32563-D3225-K
C_{11}	MKT stacked-film capacitor	B32563-D3225-K
C_{12}	MKT stacked-film capacitor	B32560-D6222-K
$C_{13} = C_{16}$	MKT stacked-film capacitor	B32560-D6222-K
C_{14}	Tantalum electrolytic capacitor	B45181-C4105-M
C_{15}	Tantalum electrolytic capacitor	B45181-B2226-M
Transformer Tr		
Core: EC 41 ferrite N 27, ungapped		B66339-G-X127
Coil former:		B66274-A1001-T1
Mounting assembly:		B66274-B2001-X
Winding: prim: $n_1 = n_2 = 14$ turns		
sec: $n_3 = n_4 = 5$ turns		
n_1/n_2 and n_2/n_3		
parallel-wound with litz wire 120 × 0.1 CuLs		
Choke Dr		
Core: RM 12 ferrite N 41 $A_L = 160$		B65815-J160-A41
Coil former:		B65816-A1002-D1
Clamps: 2 are required		B65816-A2001-X
Winding: 15 turns		
2 × litz wire 100 × 0.1 CuLs		
Inductance: 36 µH		
Heat sinks		
BUZ 23: 10 K/W		
BYS 15: 2.3 K/W (mounted together)		

Table 1 Technical data		min	typ.	max	Units
Input voltage	V_I	20	24	28	V
Current consumption	I_I				
$V_I = 24$ V, $I_Q = 0$			42		mA
$I_Q = 10$ A			2.7		A
Primary current	I_{prim}		4		A
$V_I = 24$ V, $I_Q = 10$ A					
Output current	I_Q	0		10	A
Duty cycle			0.4		
$V_I = 24$ V, $I_Q = 10$ A					
Output voltage	V_Q		5	5.75	V
Stationary behavior:					
Load regulation $\left(\frac{\Delta V_Q}{\Delta I_Q} \cdot \frac{10\text{ A}}{5\text{ V}}\right)$			0.2		%
$I_Q > 10$ mA					
Output voltage regulation $\left(\frac{\Delta V_Q}{\Delta V_I} \cdot \frac{24\text{ V}}{5\text{ V}}\right)$			2.4		%
Dynamic behavior:					
Overshoot if $I_Q = 10\text{ A} \rightarrow I_Q = 1\text{ A}$			0.2		V
if $I_Q = 10\text{ A} \rightarrow I_Q = 3\text{ A}$			0.15		V
Output ripple 40 kHz (peak-to-peak)				50	mV
Efficiency	η			81	%
Power dissipation at the SIPMOS FET	P_V		1.4		W

DC/DC converter
24 V – 5 V/10 A
f_{osc} = 40 kHz using TDA 4700 and SIPMOS transistors

The circuit in **figure 20** is a finished example for a push-pull SMPS with common ground according to **figure 14**.

The SIPMOS types BUZ 23, driven by the CMOS standard IC 4049 B (hex inverter) are used as switching transistors. Three inverters are connected in parallel, to be able to supply a sufficiently high current for rapid recharging of SIPMOS gate capacitance. In the stationary condition, the SIPMOS transistors consume practically no control power. The SIPMOS FET can be switched at a high speed when driven in this fashion. **Figure 19** shows the switching behavior (turn-on and turn-off) of the SIPMOS transistor BUZ 23 at a drain current of 4 A. The rise or fall times respectively, as well as the turn-on or turn-off delays respectively, are in the range of ≦ 100 ns.

IC external circuitry

The short switching times keep the transistor losses low and guarantee a short reaction time of the dynamic current limiting circuit, which therefore works precisely and with a high degree of switching accuracy. For this purpose, the voltage drop of the current detection resistor R_i is led to the current limiting comparator K7 via a low pass filter to suppress the interference. The operating point of the current limiting circuit can be set with trimmer R_{10} to between 5.4 A and 8.4 A (drain current). On the secondary side, this results in output short-circuit currents of approximately 12 A to 20 A. The converter is permanently short-circuit proof at I_{Omax} < 15 A.

The SMPS can be switched over with switch S_2 from free-running operation to synchronization using an external signal $V_{SYNC\,ext}$.

In order to prevent overdischarge of the battery, in the case of the converter e.g. operating on a 24 V battery, the undervoltage shutdown is adjusted to 19.5 V by the dividing ratio R_1/R_2.

Switch S_1 is used to turn the converter ON/OFF. A transistor can also be used for remote control.

The input voltage V_I is applied to the input of the feed-forward control via R_R.

An input ripple of approximately 4 V_{pp} is recorded each time together with the output voltage. Without feed-forward control, the 100 Hz ripple of V_O is approximately 24 mV, with feed-forward control on the other hand, only approximately 4 mV. This improvement by a factor of 6 is achieved without additional components.

V_O is led to the inverting input of the regulating amplifier via the voltage divider $R_{16}/R_{17}/R_{18}$ for the regulation of the output voltage and for the output overvoltage turn-off. Trimmer R_{17} serves to adjust the output voltage by approx. ± 5 % for the compensation of the tolerance of V_{ref}, which is applied to the non-inverting regulating amplifier input. The combination R_{12}, R_{13} and C_8 form the feedback path of the regulating amplifier, which causes a good stability behavior with low stationary regulating deviations.

The voltage divider R_{14}, R_{15} is dimensioned in such a way that the integrated overvoltage protection switches at approximately 15 % overvoltage and disables both switching transistors. By the connection of pin 20 and 21 (dashed), the switching transistors will continuously remain disabled after the overvoltage has occurred. The converter will only continue after it has been turned off and turned on again (S_1), provided that the error has been eliminated by that time.

Due to the fact that SIPMOS transistors display no storage time, the dissymmetries that occur in this circuit with bifilary wound power transformer Tr are so small that a separate symmetry correction circuit is not required.

Single-phase feed-forward converter using the TDA 4718; 220 V ac – 5 V/10 A (20 A)

Figure 23 shows the circuit arrangement of a single-phase feed-forward converter with 220 V ac input voltage and 5 V/10 A at the output. The control unit is equipped with the TDA 4718 IC, which operates at an oscillator frequency of 100 kHz. Only one output is used, which drives a SIPMOS FET via a CMOS driver 4049 B at 50 kHz. This causes the driver circuit duty cycle to be automatically limited to < 50 %. **Figure 22** shows the wiring of the individual inverters of the driver device.

The control and driver ICs are powered by the 220 V ac line almost without losses, via a capacitive series resistance consisting of the two 1 µF capacitors. The Z diode limits the supply voltage to 12 V.

The transformer, type AZV 2125 with the ferrite core ER 42, is available fully assembled. It is rated for an output current of up to 20 A. The windings of the transformer consist of the primary winding n_2, the demagnetization windings n_1 and n_3, the shield wrap n_4 and the secondary winding n_5.

For current monitoring, the voltage drop at the current sensing resistor R_i caused by the source current arrives at the inverting input of the dynamic current limiting circuit, the switching threshold of which is adjustable.

The dc input voltage V_i is monitored for overvoltage and undervoltage and is fed to the ramp generator via R_R for 50/60 Hz hum suppression (feed-forward control). The SMPS can be switched on and off at the input for undervoltage.

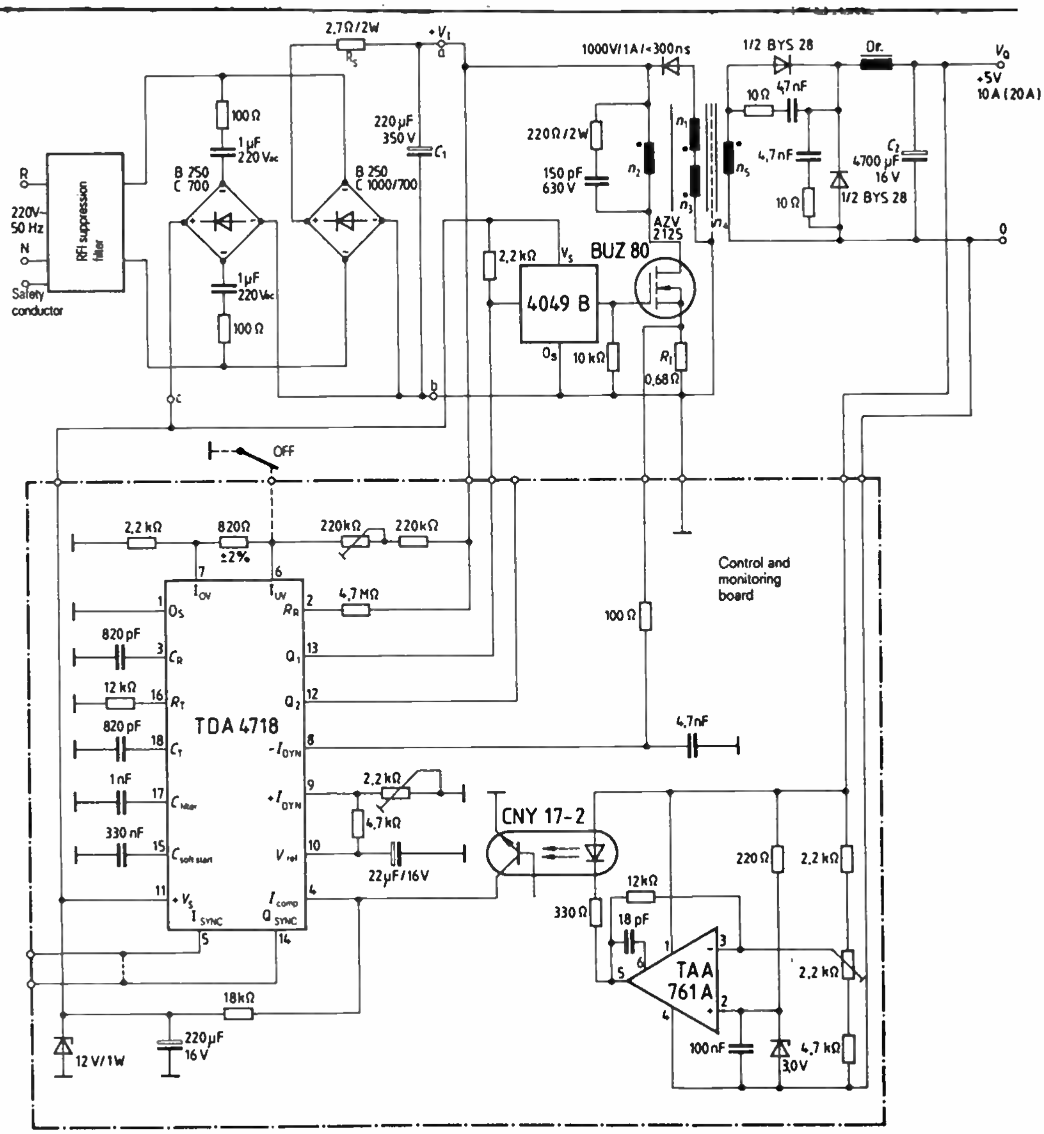


Figure 23 Single-phase SMPS 220 V ac – 5 V/10 A/50 kHz

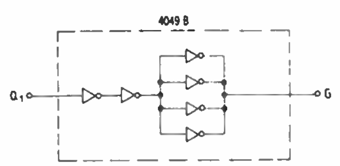


Figure 22 Wiring of driver device 4049 B in **figure 23**

A wire jumper is provided to select between external synchronization and free-running operation.

Regulation of the output voltage is obtained with potential isolation via a separate operational amplifier and an optocoupler. The slight long-term deviation and TC of the optocoupler are compensated for by the closed control loop.

Technical data of the single-phase feed-forward converter

Table 3

AC input voltage (rms value)	V_{iac}	$220^{+10\,\%}_{-15\,\%}$	V
Current consumption (rms value) (at V_{iac} = 220 V and I_O = 10 A)	I_i	0.28	A
Output voltage	V_O	5	V
50 kHz ripple (peak-to-peak value)		40	mV
Load regulation (ΔI_O = 1 A → 10 A)	$\left(\frac{\Delta V_O}{\Delta I_O}\cdot\frac{10\,A}{5\,V}\right)$	0.4	%
Line regulation (ΔV_i = 190 V_{ac} → 240 V_{ac})	$\left(\frac{\Delta V_O}{\Delta V_{iac}}\cdot\frac{220\,V_{ac}}{5\,V}\right)$	0.1	%
Dynamit overshoot during			
load change 10 A → 1 A	ΔV_O	+150	mV
load change 1 A → 10 A	ΔV_O	−150	mV
Regulating time	$t_{10\,\%}$	0.35	ms
Output current	I_O	0 . . . 10	A
Output short-circuit current	I_{Os}	14	A
Efficiency (I_O = 10 A)	η	80	%
Oscillator frequency	f	50	kHz

Table 4

Components list

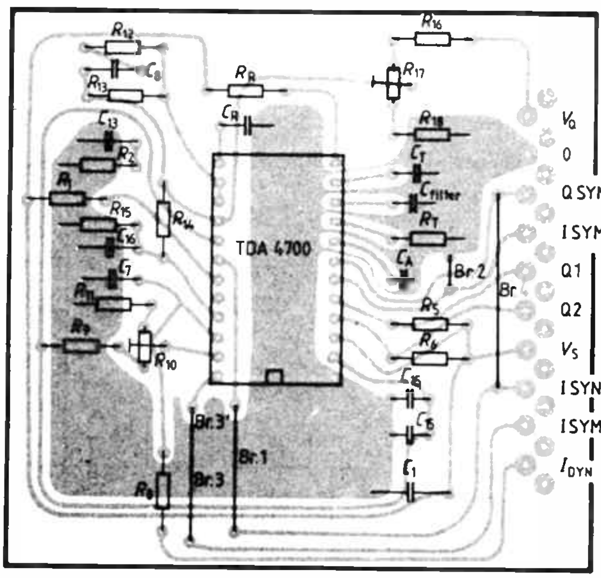
Quantity	Component		Ordering code
1	SMPS IC	TDA 4718 A	Q67000-Y639
1	CMOS HEX inverter	4049 B	–
1	Operational amplifier	TAA 761 A	Q67000-A522
1	SIPMOS transistor	BUZ 80	C67078-A1309-A2
1	Optocoupler	CNY 17-2	Q62703-N1-S2
1	Bridge rectifier	B 250 C 700	Q67067-A1712-A6
1	Bridge rectifier	B 250 C 1000/700	C66067-A1706-A4
1	Schottky dual diode	BYS 28	C67047-Z1341-A1
1	High-speed diode	BY 289/1000	C66047-A1028-A13
1	Z diode	12 V/1 W	–
1	Z diode	3.0 V	–
1	Polypropylene capacitor	150 pF/630 V dc	B33063-B6151-H
2	STYROFLEX capacitors	820 pF/63 V dc	B31310-A5821-H
1	Ceramic capacitor	18 pF/100 V dc	B37979-J1180-J
1	MKT stacked-film capacitor	1 nF/400 V dc	B32560-D6102-J
1	MKT stacked-film capacitor	4.7 nF/400 V dc	B32560-D6472-J
1	MKT stacked-film capacitor	100 nF/100 V dc	B32560-D1104-J
1	MKT stacked-film capacitor	330 nF/100 V dc	B32560-D1334-J
2	X capacitors	1 µF/250 V ac	B81121-C-B60
1	Al electrolytic capacitor	4700 µF/16 V dc	B41336-A4478-T
1	Al electrolytic capacitor	220 µF/350 V dc	B43306-C4227-T
1	Al electrolytic capacitor	220 µF/16 V dc	B41326-A4227-V
1	Tantalum electrolytic capacitor	22 µF/16 V dc	B45181-B2226-M
1	Transformer ER 42	AZV 2125	–
	Choke:		
1	Pot core	RM 10, N 41	B65813-J250-A41
1	Coil former		B65814-A1012-D1
2	Clamps		B65814-A2001-X
	Winding: 10 turns litz wire 4 × 30 × 0.1 mm CuL		
1	Heat sink for BUZ 80	R_{thH} ≦ 10 K/W	
1	Heat sink for BYS 28	R_{thH} ≦ 6 K/W	
1	RFI suppression filter		B84110-A-A5

220 V ac – 5 V/20 A

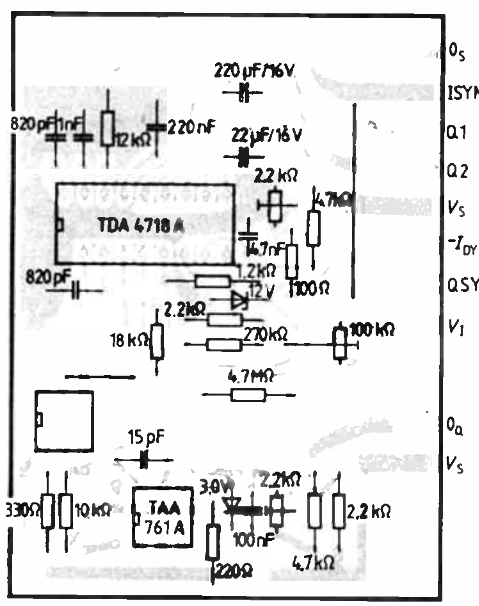
The following components must be used, in order to obtain an output current of 20 A with this SMPS:

1	AC line rectifier	B 250 C 3000/1800	C67067-A1787-A3
1	Series resistor R_s	1.5 Ω/2 W	
1	Filter capacitor C_1	470 µF/350 V dc	B43306-A4477-T
2	Output capacitors C_2	4700 µF/16 V dc	B41336-A4476-T
1	Current measuring resistor R_i	0.33/0.3 W	
	Choke L **= 21.6 µH:**		
1	Cup core		B66443-A4000-X27
1	Cap		B66443-J-X27
1	Coil former		B66443-B1001-T9
	Winding: Litz wire 12 turns 3 × 120 × 0.1 mm CuL		
1	Heat sink for BUZ 80	R_{thH} ≦ 6 K/W	
1	Heat sink for BYS 28	R_{thH} ≦ 3 K/W	
1	RFI suppression filter		B84110-A-A10

SMPS control board with TDA 4700 – component layout



SMPS control board with TDA 4718 – component layout



Warbler

Audible Signal Device **SAE 0700** **Bipolar IC** **Preliminary data**

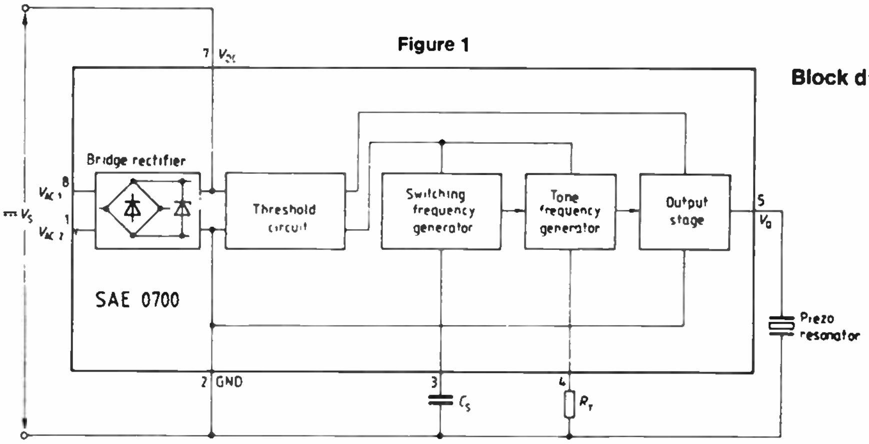


Figure 1

Block diagram (with external components for dc supply)

Pin configuration

Pin No.	Symbol	Function
1	V_{AC2}	AC-voltage input
2	GND	Ground
3	C_S	Connection for capacitor C_S
4	R_T	Connection for resistor R_T
5	Q	Output
6	N.C.	Not connected
7	V_{DC}	DC-voltage input
8	V_{AC1}	AC-voltage input

The audible signal device SAE 0700 generates two tone frequencies in a ratio of approx. 1.4 : 1 that follow one another in a periodic sequence. The tone frequency can be varied throughout a range between 100 Hz and 15 kHz by an external resistor. The switching frequency of 0.5 to 50 Hz is set by an external capacitor. The SAE 0700 can be used to drive either a loudspeaker or a piezo-ceramic transducer. The SAE 0700 can be supplied with voltage in two ways:

1. rms ac voltage from 10 V
2. dc voltage from 9 to 25 V

The SAE 0700 issues the tone sequence for as long as the supply voltage is applied. After application of the supply voltage, the tone sequence commences with the higher of the two tones.

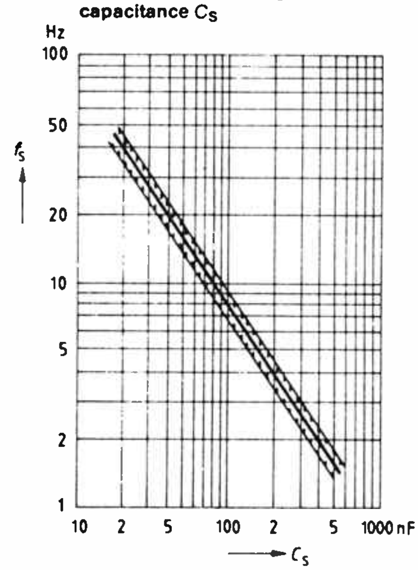
Features

- Direct ac-voltage feeding possible through integrated bridge rectifier
- Integrated overvoltage protection through Z diode, approx. 28 V
- Bridge rectifier provides for protection against incorrect polarity in dc operation
- Few external components (one resistor and one capacitor minimum)

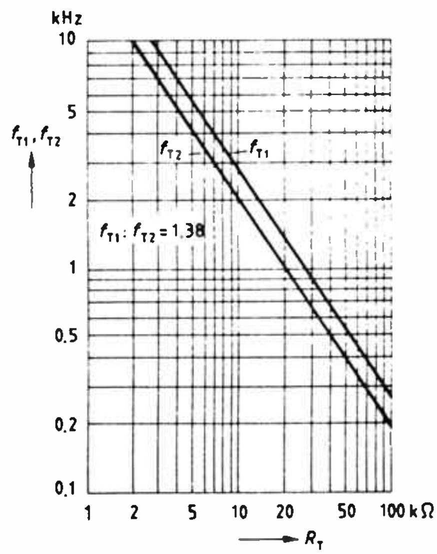
Maximum ratings		Lower limit	Upper limit	
Voltage at pin 7	V_{DC}	−0.5	26	V
Voltage at pin 3	V_{32}	−0.5	5.5	V
Voltage at pin 4	V_{42}	−0.5	7	V
Output voltage at pin 5	V_O	−0.5	V_{DC}+0.5	V
AC voltage at pin 8 and 1 (peak value)	V_{AC}		28	V
Input current of bridge	I_{81}	−50	50	mA
AC input current of bridge	$I_{81\,rms}$		25	mA
Operating range				
Supply voltage	V_{DC}	9	25	V
Tone frequency	f_{T1}	0.1	15	kHz
Ambient temperature	T_{amb}	−25	85	°C

Characteristics T_{amb} = −25 °C to 85 °C		Test conditions	Lower limit B	typ	Upper limit A	
Current consumption	I_{DC}	V_{DC} = 9 V to 25 V, w/o load		1.5	1.8	mA
Switching threshold	$V_{DC\,ON/OFF}$		8	8.6	9	V
Initial resistance	R_{INI}	see characteristic, figure 3	3.5	4.7	6	kΩ
Output-voltage swing	V_O	I_O = ± 10 mA	V_{DC}−3.7	V_{DC}−3		V
Tone frequency	f_{T1}	V_{DC} = 15 V, V_{32} = 0 V, R_T = 16 kΩ	1.275	1.700	2.125	kHz
Switching frequency	f_S	V_{DC} = 15 V, C_S = 100 nF	5.6	7.5	9.4	Hz
Tone frequency ratio	f_{T1}/f_{T2}		1.31	1.38	1.45	
Temperature coefficient of tone frequencies	TC_f			8×10^{-4}		K^{-1}

Switching frequency f_S versus capacitance C_S



Tone frequencies f_{T1} and f_{T2} versus resistance R_T



SAE 0700

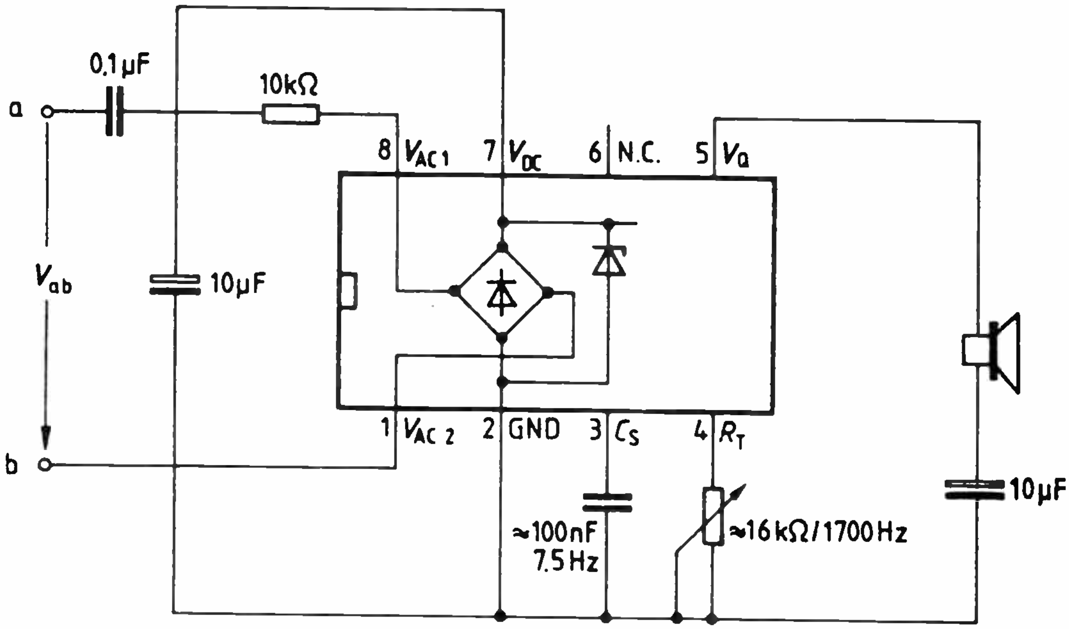


Figure 2

Functional description

The audible signal device SAE 0700 (see blcok diagram, **fig.** 1) includes the following functional blocks:

- bridge (for voltege supply) and overvoltage protection
- threshold circuit
- switching-frequency generator
- tone-frequency generator
- output stage

Bridge rectifier: The bridge rectifier enables direct feeding with ac voltage or dc voltage (independent of polarity). DC-voltage supply without integrated bridge is also possible via pins V_{DC} and GND.

If the voltage is supplied via the bridge, the input voltage V_{B1} should be dimensioned such that at least 9 V appear at the pin V_{DC} (also with output loading). It should also be noted that in the case of voltage supply via the bridge, the maximum output current has to be limited to 50 mA.

Response of the SAE 0700 as a result of spikes on the AC line is prevented by a built-in initial resistance R_{INI}. In a voltageless condition R_{INI} provides for discharging the storage capacitor of V_{DC} to ground.

The Z diode following the bridge serves as overvoltage protection. The bridge circuitry shown in **figure** 2 efficiently protects the SAE 0700 against damage es a result of the following voltage values:

- overvoltages in acc. with VDE 0433 (2 kV – 10/700 µs)
- ac voltages up to 220 V/50 Hz for a duration of 30 s

Threshold circuit: With a threshold voltage of typically 8.6 V this ensures thet the SAE 0700 is not activated by noise pulses.

Switching-frequency generator: This switches periodically between the two frequencies produced by the tone-frequency generator. Wiring with e capacitor C_S produces a switching frequency f_S according to the following formula:

$$f_S\,[\mathrm{Hz}] = \frac{750}{C\,[\mathrm{nF}]} \pm 25\% \quad \text{(valid from 0.5 to 50 Hz)}$$

Tone-frequency generator: This generates a squarewave voltage with the two tone frequencies f_{T1} and f_{T2}. The basic frequency f_{T1} and the second tone frequency f_{T2} are calculated according to the following formulae:

$$f_{T1}\,[\mathrm{Hz}] = \frac{2.72 \times 10^4}{R\,[\mathrm{k\Omega}]} \pm 25\% \quad \text{(valid from 0.1 to 15 kHz)}$$

$$f_{T2}\,[\mathrm{Hz}] = f_{T1} \times (0.725 \pm 5\%)$$

The tone-frequency generator is temperature-compensated for better stability.

Output stage: This boosts the generated tone voltage for direct driving of a piezo-ceramic transducer or a loudspeaker, possibly across a dropping resistor.

aem project 6103

A 'digital era' three-way, passive bass-reflex loudspeaker

David Tilbrook

Here's the second in our range of 'digital era' loudspeaker designs. Like the earlier two-way system, this design employs high-performance Vifa drivers with a bass-reflex port to extend the bottom end frequency range.

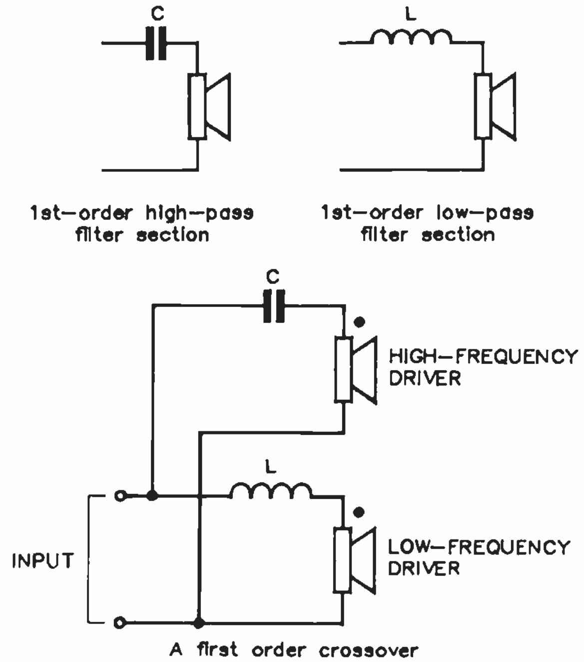


Figure 1.

THE AEM6103 IS THE TOP OF THE RANGE of passive loudspeakers that we will be presenting in the 6100 series. It was originally intended that we might design a two-way, a three-way-loudspeaker. It became quickly obvious, however, that the superb quality of the Vifa drivers we had chosen to use would facilitate the design of a three-way loudspeaker with the performance characteristics that we had laid down for the four-way system! Furthermore, the three-way system offers certain advantages over the more complicated and expensive four-way system. To understand these advantages it is worthwhile looking at the function of the crossover in greater depth.

Crossover considerations

The audio frequency spectrum extends from below 20 Hertz (Hertz = cycles per second) to beyond 20 kHz i.e. around 10 octaves. The reproduction of such a large bandwidth by electromechanical means is an extremely difficult task. At the low frequency end of the audio spectrum, wavelengths are metres long and drivers designed for this region must have large diameter cones which must be capable of very long excursions. At the high frequency end of the audio spectrum however, the wavelengths are around 15 mm and drivers designed for optimum performance at these frequencies have small, very light cones or domes so that they are capable of the extremely high accelerations and cone velocities required.

There are very few drivers with a frequency response which extends over the complete audio spectrum and the few that do achieve this do so by combining various acoustic phenomena in such a way that invariably leads to colouration of the sound and distortion. The only really viable solution is to combine several drivers, each designed for a specific region of the audio spectrum. A minimum multi-way system is the two-way, combining two drivers and an electrical circuit called the *crossover* to divide the audio spectrum into the two frequency regions. Similarly, a three-way system employs three drivers and a more complex crossover.

The perfect crossover would divide the audio spectrum into the relevant frequency bands by providing no impedance to signals with a frequency inside the passband and infinite impedance to all signals whose frequency lies outside the passband. This theoretically ideal crossover is, of course, never realised and the practicalities of crossover design pose considerable difficulties.

The simplest form of crossover consists of just a single capacitor or inductor placed in series with the driver, as shown in Figure 1. This is called a *first-order* filter and gives a frequency response that decreases the amplitude of the input signal at a fairly slow rate outside of the passband (ultimate slope is 6 dB/octave). A crossover using first-order filters has the advantage that, at least theoretically, the outputs of the two filter sections will add together to give the original input signal.

The main disadvantage with first-order filters however, arises due to their relatively slow roll-off. In order to ensure that the outputs of the filter sections sum correctly it is necessary for the drivers to have a linear frequency response well beyond the proposed crossover point. If this is not the case, then the rolll-off generated by the crossover and that due to the driver superimpose to produce a roll-off that is greater than the correct rate and this will not sum correctly with the output from the other filter section. The result is a frequency response characteristic with a dip around the crossover point.

Most drivers do not have a sufficiently extended frequency response for use with first-order crossovers. In order to achieve a faster rate of attenuation outside the passband another element is added to each of the filter sections. This produces a filter with an ultimate roll-off of 12 dB/octave and this is the most commonly used of all crossover designs.

Figure 2 shows the circuit diagrams for the second-order crossover. Note that, unlike the first-order crossover, the phase of the high-frequency driver in the second-order crossover is reversed with respect to that of the low-frequency

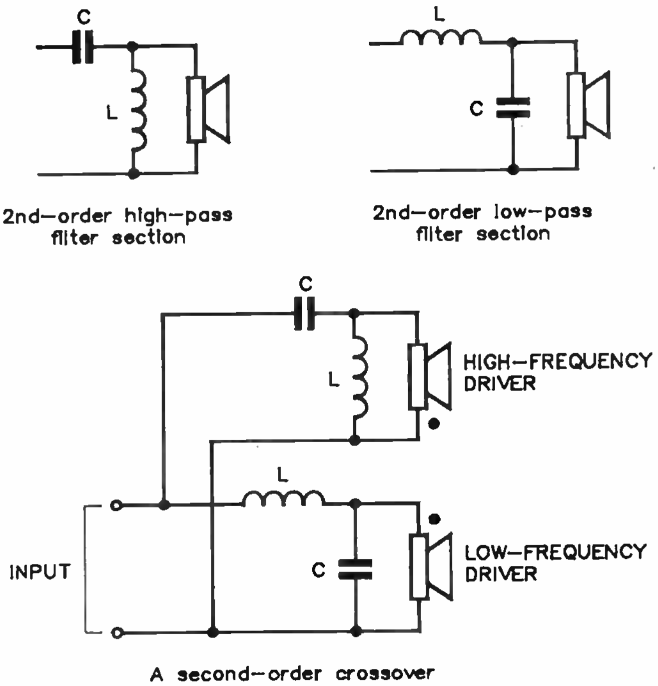


Figure 2.

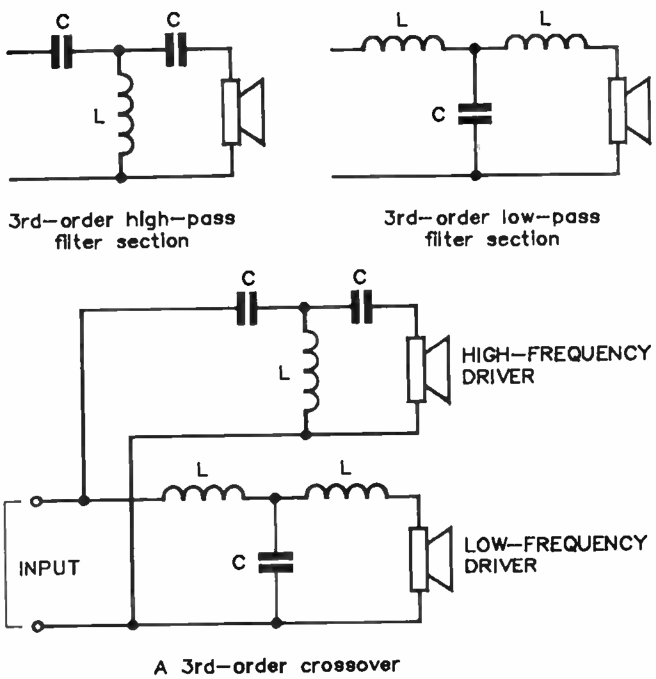


Figure 3.

The prototypes were constructed of an attractive wood-veneered particle board. The protective grille cloth is simply stretched over a particle board frame fitted with plastic pins that clip into corresponding sockets recessed into the front baffle. Note that the grille covers the port too, but the frame should not obstruct the port.

driver. This is necessary since each of the second-order filter sections generates a phase characteristic which leads to an infinitely deep hole in the frequency response at the crossover point.

By inverting the wiring sense of one of the drivers the outputs of the two sections can be made to reinforce each other rather than cancelling. Unfortunately, this leads to a frequency response with a slight 'lump' of around 2 dB at the crossover point. For the vast majority of loudspeaker designs, however, this is not a real problem since the frequency responses of the drivers used exhibit amplitude nonlinearities significantly greater than 2 dB.

In some designs where the frequency response nonlinearity generated by the second-order filter is regarded as unsatisfactory, or the drivers are being used close to one or both of their useful ranges, the *third*-order filter is used. The design of these filters involves the addition of another set of elements and results in a frequency response characteristic with an ultimate roll-off of 18 dB/octave.

The third-order crossover is shown in Figure 3 and it is this type of crossover that is used for the AEM6103s. Notice that the two drivers are wired in phase this time. The third-order crossover yields a flat frequency response although it generates somewhat more phase error than does the second-order crossover.

All of these crossover schemes make the same implicit assumption that the outputs of the various drivers making up the loudspeaker will add to form a recombined signal that is as close as the crossover will allow to the original input signal.

Unfortunately, this is not the case since the various drivers must be mounted at different locations on the loudspeaker baffle. As the listening point differs in relation to the position of the drivers, the relative distance to the drivers also differs. If the distance of the listening position from each of the drivers is the same, then the outputs will add as required. If the listening position is changed, however, so that one of the drivers is closer than the others, then a frequency will exist for which the difference in distance will be one-half of a wavelength. At this frequency the outputs from the two drivers will interfere destructively, one cancelling the other, and a null appears in the frequency response (see Figure 4).

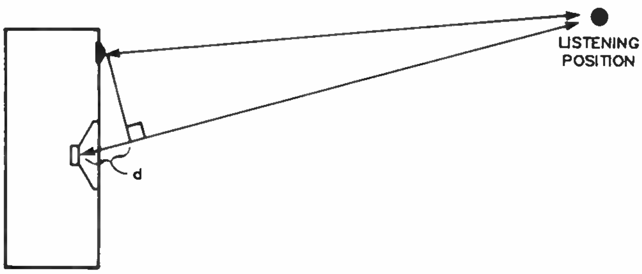


Figure 4. Difference in the distances of the drivers to the listening position will result in a dip in the frequency response at d = ½ wavelength.

The problem of destructive interference around the crossover points and crossover-generated phase errors will occur at every crossover point employed in the design. Unfortunately, this is simply one of the intrinsic disadvantages of multiway passive loudspeakers and there are no easy solutions. One way to decrease the audible effects of these errors is to simply reduce the number of crossover points. This is one advantage of a three-way system over a four-way system. Provided that an equally good frequency response is achievable with a three-way system as with the four-way, then the three-way system with fewer crossover points will exhibit fewer phase related problems.

Driver considerations

The basis of any three-way loudspeaker is the proposed mid-range driver. A good mid-range driver is one with an extended frequency response, covering the range from below 500 Hz to beyond 3 kHz. At the top end of this frequency range cone-type drivers tend to suffer somewhat from a restricted spatial distribution of the high frequency sound waves. This problem of "beaming" at high frequencies is best overcome by the use of dome-type mid-range rather than a more conventional cone-type. Other attributes that are essential for a good quality mid-range are good transient performance, power handling ability and low distortion.

Finding a mid-range driver with all these attributes is not easy but, fortunately, Vifa manufacture just such a device. The D75MX is a 75 mm diameter dome mid-range with a frequency response that extends from below 400 Hz to beyond 4 kHz with a power handling of 80 W (DIN 45573). The transient performance is *exceptional* and one of the first things I noticed when the driver was auditioned.

In the AEM6103s I have combined this driver with a third-order crossover points at 500 Hz and 4.3 kHz. The resulting mid-range frequency response is shown in Figure 5.

This mid-range requires the use of a small separate enclosure of around 1.5 litres capacity. In this design, a small enclosure is fabricated from chip-board and mounted from the front baffle immediately behind the dome mid-range and tweeter.

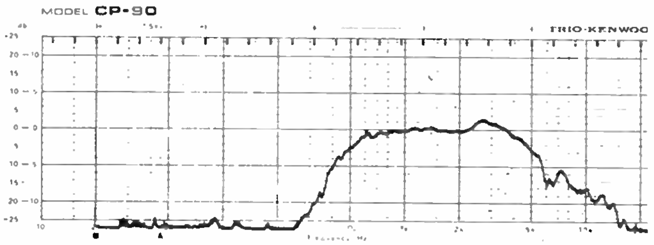


Figure 5. Frequency response of the mid-range driver and mid-range crossover section.

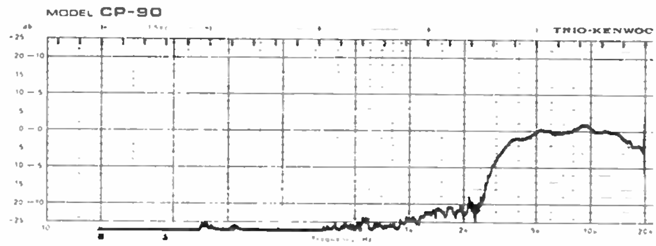


Figure 6. Frequency response of the high frequency driver and high frequency crossover section.

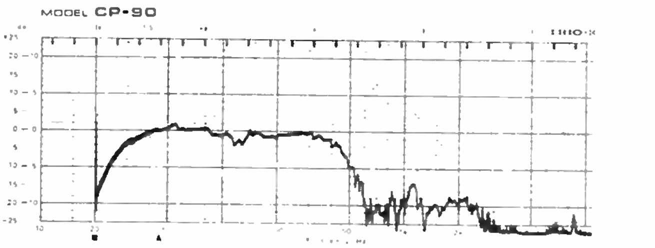


Figure 7. Frequency response of the bass driver and low frequency crossover section.

The high-frequency driver chosen was the D19TD-05 which is a 19 mm dome tweeter with magnetic fluid cooling. The device is capable of remarkable power handling (around 80W, DIN 45573) when used with the third-order crossover specified here.

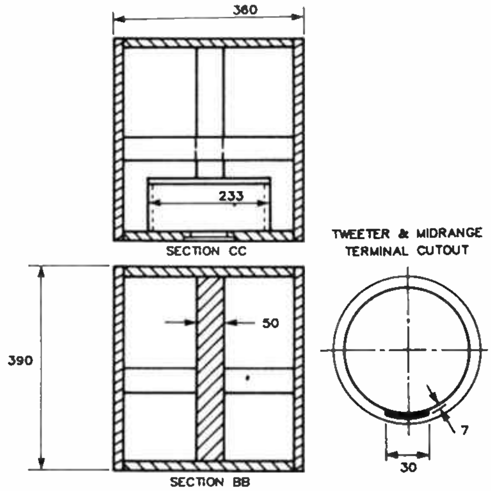
The choice of bass driver and cabinet design was done after carrying out fairly extensive computer modelling to enable the best possible matching of driver, cabinet size and port dimensions. The final choice was to use the P25WO bass driver in a bass-reflex cabinet with an internal volume of 100 litres. This was found to be the optimum box volume for this bass driver. A smaller box would severely restrict the bass end performance while a larger box would impair the frequency response linearity of the design at low frequencies.

The result is a bass end performance that I believe will rival the best loudspeakers, irrespective of price. As shown in Figure 7, the frequency response is only 3 dB down at 30 Hz and the loudspeaker provides useful output well below this

CARE OF THE DRIVERS

The drivers used in this project are expensive and delicate. Take great care when handling them. When soldering to the terminals be careful not to overheat the terminal strip unnecessarily. Do not apply pressure to the terminal strips or these can be displaced from their mounting positions and snap the fine wires connecting these to the voice coils.

The domes of the tweeter and mid-range units are particularly delicate. Be careful not to allow these to be pushed in or damage to the drivers could be irrepairable.



NOTES

ALL DIMENSIONS IN MILLIMETRES

MATERIAL BOX–18mm VENEERED CHIPBOARD,OUTSIDE DIMENSIONS 920x360x390
FRONT BAFFLE DIMENSIONS 884x324x18
BRACES–25x50mm CHIPBOARD,3 PIECES 2x324,1x354
MIDRANGE ENCLOSURE–10mm CHIPBOARD,OUTSIDE DIMENSIONS 233x184x67

CONSTRUCTION
ALL JOINTS ARE GLUED AND SCREWED
SPEAKER CUTOUTS HAVE A 5mm DEEP ROUTING FOR FLUSH MOUNTING OF THE SPEAKERS
TWEETER AND MIDRANGE CUTOUTS HAVE AN EXTRA SLOT FOR THE TERMINALS
–SEE SEPARATE DETAILS
THE APPROXIMATE POSITIONS OF THE CROSSOVER AND OUTPUT TERMINALS ARE SHOWN.
ACTUAL POSITIONS DEPEND ON THE TYPE OF EACH USED

CUTOUTS SP3 TWEETER ID=70 OD=96
SP2 MIDRANGE ID=118 OD=154
SP1 WOOFER ID=233 OD=263
PORT=90 DIA
(ID=INSIDE DIAMETER,OD=OUTSIDE DIAMETER)

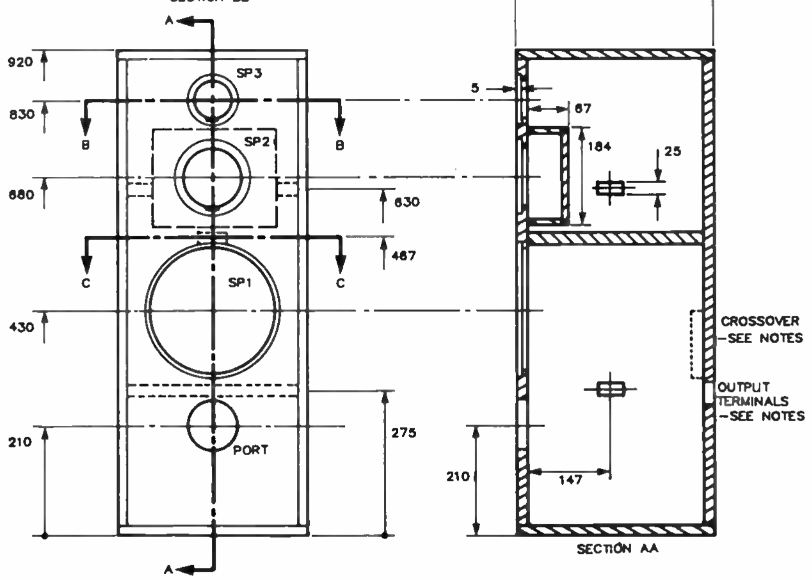


figure. The transient performance of the bass end is also excellent and it was this aspect of the overall performance of the loudspeaker which drew most of the comment during the subjective testing phase of the development.

Data sheets for the three Vifa drivers are included elsewhere in this issue.

Construction

The prototype loudspeaker enclosure was constructed using 19 mm veneered particle board to which additional bracing was fitted to minimise the effects of vibration which is likely at higher output powers. The internal bracing was accomplished using pieces of particle board glued from side to side, and from front to back as shown in the construction drawings accompanying this article. All of the drivers are externally mounted so the box need not have a removable back or front.

The bass reflex port is a length of PVC irrigation pipe which is glued into position on the front baffle. The length of this port is critical and should be cut as accurately as possible (within +/- 1 mm).

If you are constructing the boxes yourself, it is very important to ensure that *all* of the joints are sealed well. The pressure inside even a ported enclosure is substantial and leaks generally give rise to whistles or hissing sounds that will impair the performance of the loudspeaker at high volumes. The best solution is to line all of the joints on the inside of the box with a silicone sealant, available from most hardware stores (e.g: Selley's 'Silastic').

The mid-range enclosure should be built before mounting the front baffle in place and installed within the cabinet. It can then be sealed to the front baffle once this is mounted in place. The speaker input terminals mount on the rear baffle, low down. They should be of a type designed to maintain a good seal.

The entire mid-range enclosure should be filled with medium density mattress overlay foam (I obtained some from a Clark Rubber store). I found it easier to work with the 25 mm thick material for the mid-range enclosure and the 50 mm material for the lining of the main bass chamber.

Before lining the enclosures, however, it is necessary to construct the crossover and solder the wires to it that will lead to the drivers. The crossover for this project is being manufactured by Nelson Components, (66 Blackbutt Ave, Lugarno (02) 53 9684) and will be available in full assembled form through a variety of retail outlets. to p. 100 ▶

LEVEL

We expect that hobbyists who are

BEGINNERS

in electronics construction should be able to successfully complete this project.

Circuit-Board-Design Without the Tedium

smARTWORK™ lets the design engineer create and revise printed-circuit-board artwork on the IBM Personal Computer.

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- ☐ Multicolor or black-and-white display
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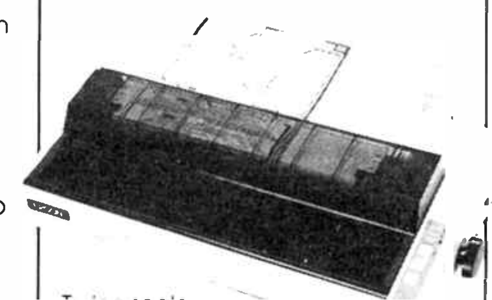
- ☐ Can use optional Micro-soft Mouse as pointing device.



Twice scale hardcopy of your artwork is produced using the Epson dot-matrix printers or the Houston instrument DMP-42 pen-and-ink plotter. Quick 1X check plot is also available from Epson printers.

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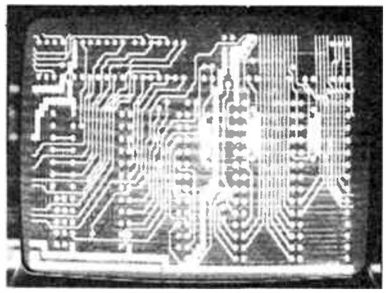

Dual-layer color display of a 2" by 4" section of a 10" by 16" circuit board

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System Requirements

- ☐ IBM PC, XT or close compatible with 192K RAM, 2 disk drives and DOS Version 2.0 or later.
- ☐ IBM Color/Graphics Adaptor with RGB color or B&W monitor.
- ☐ Epson MX80/MX100 or FX80/FX100 dot matrix printer or compatible with Graftrax.
- ☐ Houston Instrument DMP-42 pen-and-ink plotter (preferred). Small Houstons and HP7475A also supported.
- ☐ Microsoft Mouse (Optional).

microtrix

Australian Distributors: **Microtrix Pty. Ltd. 24 Bridge Street, Eltham. Victoria. (03) 439 5155**

Commodore's Amiga to appear March-April

Commodore's Amiga, much-heralded in the overseas press, will make its appearance in the stores here around March-April. Commodore says it's delaying the release until sufficient programs are available for it.

The Amiga combines the text & numeric-oriented approach of the 'IBM-line' PCs with the graphics & sound approach of the 'Macintosh-line' PCs.

Commodore claim that, before the Amiga, users were stuck with one approach or the other in making a choice on which hardware to buy. Now they can happily combine both in the one machine to produce "... more powerful, imaginative, colourful and multi-dimensional work."

The Amiga features a Motorola 68000 processor running at just over 7 MHz, 256K dynamic RAM (user-expandable to half a meg) and 192K of ROM containing multitasking, graphics, sound and animation support routines.

Five graphics modes are provided: two 32-colour modes of 320 x 200 and 320 x 400 pixels, two 16-colour modes of 640 x 200 and 640 x 400, plus a sample-and-hold mode. You get independent horizontal and vertical scrolling of dual 'playfields', eight hardware sprites and a palette of 4096 colours. Apparently, the sound capabilities have to be heard to be believed, Commodore describing them as "compact disc-like".

As you'd expect, it comes with a two-button mouse. Optional peripherals include a 3½ inch 880K-byte disc drive, RGB analogue colour monitor, 256K-byte memory expansion module, 300/1200-bps modem, a MIDI interface and a video frame grabber.

As a multi-tasking system, the Amiga is capable of working on several chores simultaneously. It can display multiple windows, each with its own task, as well as simultaneously displaying multiple screens with different graphics resolution modes. And moving from one screen to another can be achieved at the touch of a single button.

Another new feature is the system's bundled text-to-speech capability with an unlimited vocabulary using plain English typed in to the machine. You can call on a range of pitches for both male and female voices, and even place expression on selected words.

Integration of video images with computer sound and graphics is another feature that makes Commodore's Amiga the most advanced personal computer available for applications at both professional and consumer levels, says Commodore.

It is expected to find a big demand in architecture, movies and television production, computer-aided design and construction, type-setting, technical documentation and video animation.

NEW PROGRAMMERS CLUB IN MELBOURNE

We have been asked by the Personal Programmers of Melbourne (PPM Club) to advertise their existence in our "excellent publication" (flattery will get you everywhere).

Although PPM is a new club, many of the members come from a previous club devoted to Hewlett Packard handheld calculators.

The new club has broadened its range to include all handheld computers or calculators. They meet on the third Tuesday of every month at 8pm on the 9th floor of the Menzies Building, Monash University. The club also sends out a monthly newsletter of interesting and helpful news, which includes a summary of the talk given by the guest speaker at the previous meeting.

Details from **Paul Cooper, Subscription Manager, 40 Karen Street, Box Hill North, 3129 Vic. (03) 898 7672.**

Better backups

When we first received Daneva's information about flexible streaming backup, we thought that the cure for the common cold had been found at last. However, Wangtek (which Daneva represents) claim to have solved the driver interchangeability problem which has plagued the cartridge backup system for years.

By using a combination of precision drive mechanism and burst track on the tape, the Wangtek drive will position its head relative to this "home track", thus allowing tape cartridges to be read in any other Wangtek drive.

PC-DOS 2.0, 2.10, and 3.0 will support the drive controller which plugs into the PC or PC/XT expansion slot. Designated model PC-36, the package comes complete with cables, menu-driven disk-based software, and drive unit.

Now there is no excuse for not performing regular backups. Information is available from **Daneva Australia Pty Ltd in Victoria on (03) 598 5622**, or the newly-opened Sydney office **at 47 Falcon Street, Crows Nest 2065 (02) 957 2464.**

Philips PC Displays Videotex Graphics

Philips Communications Systems are including Videotex software at no extra charge with every Philips P3100 personal computer it sells.

To access Telecom's Viatel videotex service, a Philips personal computer user will only need to register as a Viatel user and buy a suitable modem to connect the P3100 to the telephone system.

The P3100 is compatible with the industry standard for personal computers but has significant enhancements over competing models, Philips claim, with built-in graphics capability whereas with other personal computers this is an optional extra.

Significantly, this means that the P3100 can display both text and graphics videotex data on its standard monochrome screen, *without* the addition of a graphics board.

Philips' videotex software package also works with the P3100's optional colour monitor and a colour graphics board.

For users of other industry-standard personal computers, Philips are selling the videotex software for $175.

Using the Listening Post with your Apple

Neil Duncan VK3AVK

Now it works on the Apple 11, too! Snoop through the airwaves with the multimode, all bells and whistles Listening Post with yet another computer.

THIS VERSION of the Listening Post Software has some rather 'different' design parameters — ones I suspect will meet the needs of others who, like myself, wish to try computerised radio without much cost. The features aimed for at the design stage were:-

- A printer should not be essential
- The Apple 'games port' is used (no expensive card needed)
- FAX pictures to be built on-screen before your very eyes!
- Inversion of FAX pictures available
- Inversion of RTTY code possible
- CW and RTTY 'tuner-upper' mode built in
- Main programming in machine code
- Supervision of code from BASIC

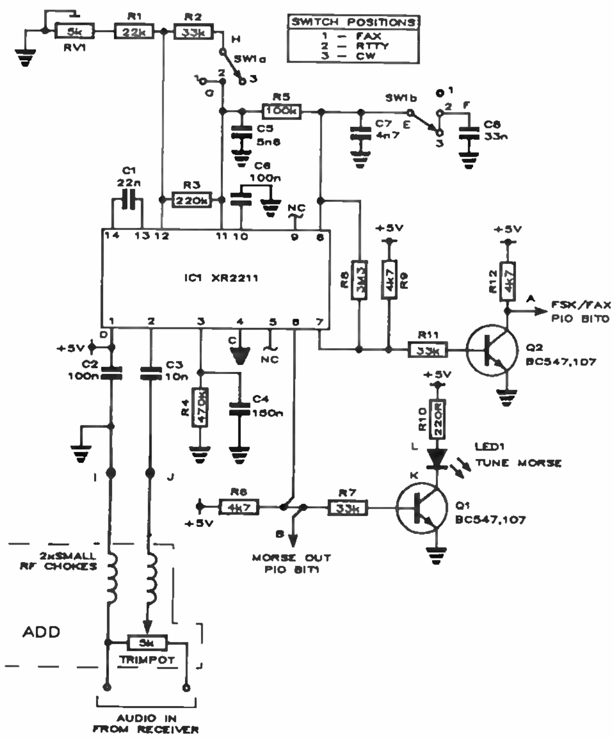
Hardware Requirements

Here is the shopping list. First, one 'Listening Post' kit of parts. I purchased a kit. If you are intending to buy parts separately, you could achieve a significant improvement by buying a die-cast (i.e: metal) box for the thing. It should reduce RFI (RF inteference generated by the computer getting into the radio by a worthwhile amount compared with the plastic box otherwise suplied).

Next, you need one metre of three (or more) core cable. It *must* be shielded, for RFI reasons, again. I found some five-core stuff with a very solid outer layer of metal which does the trick. Cable with separate shielding would be fine, but be prepared for some pretty tricky soldering at one stage if you choose to use it. You need one 16-pin 'DIP header' — you know, a plug looking like an IC with no brain and that you can solder onto. These plugs come in various grades. Go for the best one you can find. Note that if your shielded cable is as solid as mine, you will probably be unable to use the little hat supplied with some styles of plugs.

You'll need two RF chokes. I found a significant RFI reduction was achieved by putting them in series with the audio lines into the project. As a measure of economy (perhaps your computer is well and truly removed form the radio set) you may wish to start off without these and see how things go.

Also,add one 5k trimpot. The level coming from my receiver was too high and this helped considerably in beating the problem of noise-spiked triggering of the program. The input circuit now looks like this —



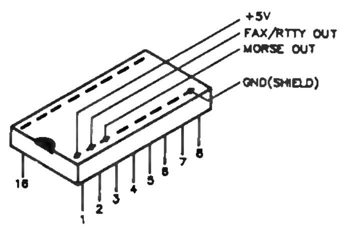
Modified input circuit for the Listening Post. The RF chokes may be any value less than 1 mH. The trimpot allows input level adjustment.

Finally, you will need one length of cable for connecting the Listening Post to the receiver, terminated in suitable connectors. Shielded, of course.

Constructing the decoder

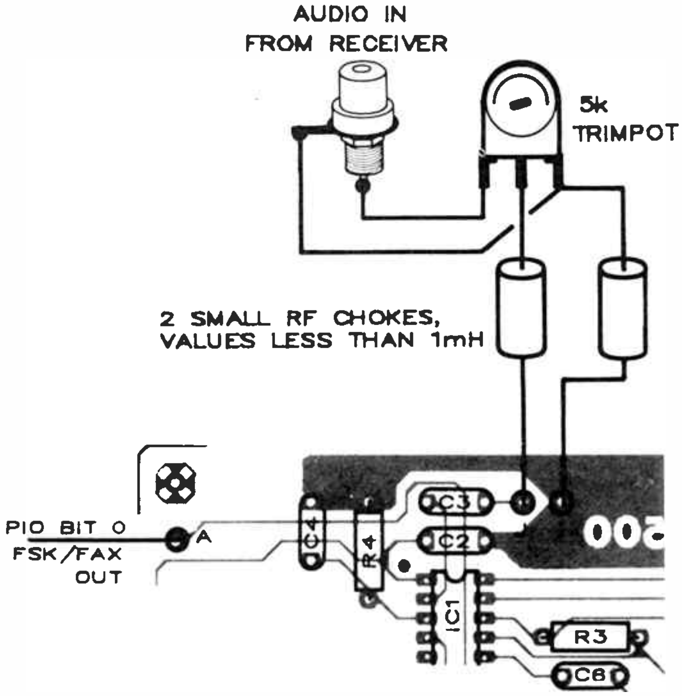
Carefully sort out the connections from the Apple to the decoder, particularly the +5 volt line. Take care with the LED polarity and the wiring of the audio input plug. That aside, it would spoil your whole day to have baked Apple rather than weather pictures — the connecting-up stage is quite critical.

Once the project is finished, connect it to the 16-pin plug according to this diagram:-



16 PIN DIP HEADER WIRING

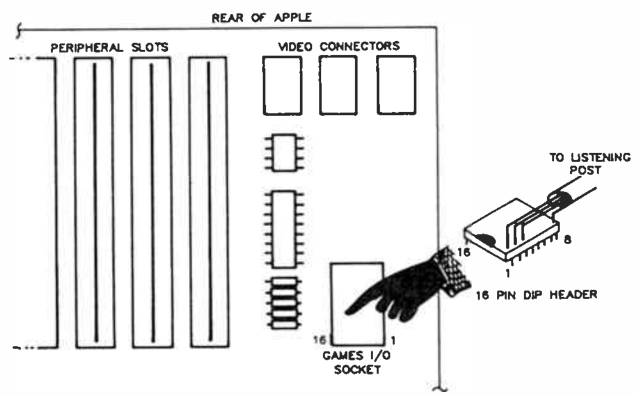
Here's how you wire-up the 16-pin DIP header for connecting the Listening Post to the Apple //.



Here's how you connect up the extra components to the Listening Post's input.

Another possibility — it is becoming popular to include a word-processor modification to Apple computers called the 'keyboard strap'. This takes some thinking about if you are to have it at the same time as the 'Listening Post' plug. It *can* be done without much fuss (I use it). A similar crisis will arise if you have a joystick connected to the input. That is more difficult and may require a change in lifestyle. Playing games via the games port? Tsk,tsk.

It is most important to observe how the new plug is orientated with respect to the Apple board:-



Here's where you plug the Listening Post into the Apple //.

The first item on that list caused the largest number of headaches. To me, anyway, the compulsory need for a printer seemed the greatest drawback to the Moffat design (gedday Tom!) for the Microbee. There are lots of computer owners who do not have a dot matrix printer. I guess they would see the need for one if the package uses it as the central concept. Not here folks! The Apple graphics scheme allows easy point-by-point plotting and that is how the picture is constructed with this software.

From the outset, the decision to draw the FAX picture on-screen dictated the overall shape of the project. If the picture is built in memory and then dumped to a printer then so much memory is used that many of the other features mentioned above would not have been as easily accommodated.

In addition, it is really interesting to to sit back and watch a weather map being built up on the screen. I must say that I haven't found a use for an on-the-spot weather map yet, but that is all part of the charm of it all. None of my neighbours have freshly squeezed weather maps first thing in the morning! I must mention though, that printing out the map (perhaps you do have a printer, eh?) is a very simple option if you want it. Screen dumps are particularly straightforward. Just look up the particular command sequence from BASIC to dump hi-res page 1 and put it into the program. The package here has a typical command built-in already.

That completes the good news. Now for some bad. Having committed hours to the wretched FAX program, and having delighted in the beautiful on-screen goodies that are produced, the matter of picture resolution became a rather depressing feature. The ideal thing would have been to have a computer screen with 400 or so dots across and similar numbers down. Such is not the case with the Apple screen (and not, for that matter, many other computers).

We have a screen 280 dots wide and 192 down and I have used just about all of the dots for the picture. That is the limiting factor of the whole thing. The problem, is when they send writing in their pictures. It just is too smudgy to read. Ah well, a small price to pay when a no-mystery, real-time display is available. It really beats waiting nine minutes or so (with a blank screen) before for the printer does its thing. The pikkie builds up in front of your eyes. Lots of little pixels marching into a pattern.

If, however, there is a veritable surge of people gnashing teeth and shaking fists over this little matter, then perhaps a second on-screen, printer based version could be arranged. It is pretty difficult to have both, by the way. On-screen build-up and very hi-res printer pictures; you can't get the memory, you know.

The other little negative feature is within the CW (Morse) section. I found a very tempting corner to cut at one stage. The 6502 only has 8-bit registers and as a consequence, counters can only count as far as 255. With quite a bit more work, I could have programmed the automatic speed tracking feature to cope with all speeds. What I did, however, was to split the speed range in two. From 4-25 words per minute (wpm) and 25-100 wpm. You must select one of those speed ranges otherwise the dots and dashes cause the computer to throw up a bit. Personally, I don't find this two-range requirement a problem — I hope you don't! Blame those 8-bit counters (and the fact that I can't resist life's little temptations!) if you do.

The way in which I wired the two new RF chokes and the trimpot to the audio input plug does not warrant a special diagram here. Suffice to say that the pristine neatness of the kit degenerates at this stage.

Software: where do you get it?

There are two main ways of approaching the acquisition of the software for this project. You may purchase a copy (obviously the least difficult method). You won't even need a bank loan. You also won't really need to read the next few paragraphs unless, of course, you want to modify the program at some stage. For the genuine hacker/home brewer, here are the series of steps you will need to go through in order to get the system up and running.

Stage 1.

Load DOS into the computer from a standard disk (i.e: switch on and put a disk in). When things settle down a bit, put a blank (or spare) disk in and enter the following code:-

Type NEW then

```
10  REM  BOOT PROGRAM
30  PRINT  CHR$ (13); CHR$ (4);"BLOAD MORFART"
40  PRINT  CHR$ (13); CHR$ (4);"RUN MAINLINE"
```

Now type INIT HELLO. This will become the 'boot program'. ▶

Stage 2.

Type NEW and then the following little program. Watch the usual traps of O's and zeros and of I's and ones. Tell yourself it will all be worth it in the end!.

```
10  TEXT : HOME : VTAB (23): PRINT "FAX/RTTY/CW DECODER BY NEIL DUNCAN":
20  VTAB (10): HTAB (15): PRINT "PRESS ANY KEY": GOSUB 9000
30  FOR I = 1 TO 11: READ N,D: POKE LNGTH%,1: POKE FRQ%,N: POKE
    TIME%,D: CALL PLAY%: NEXT I
50  RESTORE : FOR I = 1 TO 100: IF  PEEK ( - 16384) > 127 THEN I = 1000
55  NEXT I: IF I < 1000 THEN 10
60  POKE  - 16368,0: HOME : HTAB (15): INVERSE : PRINT "MAIN MENU": NORMAL
70  VTAB (8): HTAB (10): INVERSE : PRINT "1";: NORMAL : PRINT " FAX"
80  VTAB (10): HTAB (10): INVERSE : PRINT "2";: NORMAL : PRINT " RTTY"
90  VTAB (12): HTAB (10): INVERSE : PRINT "3";: NORMAL : PRINT " CW"
100  VTAB (14): HTAB (10): INVERSE : PRINT "4";: NORMAL : PRINT " END"
110  VTAB (19): HTAB (20): PRINT "SELECT";: GET A$: IF A$ < "1" OR A$ >
     "4" THEN  PRINT "control-G": GOTO 60
120  IF A$ <  > "4" THEN 180
130  HOME : VTAB (10): PRINT "TO END, PRESS E OTHERWISE PRESS ANY KEY"
140  PRINT  TAB( 15);"-"
150  VTAB (19): HTAB (20): PRINT "SELECT";: GET A$: IF A$ <  > "E" THEN 10
160  A$ = "4"
180  ON  VAL (A$) GOSUB 1000,2000,3000,20000
190  GOTO 60

1000  REM  FAX RTN
1005  GOTO 1045
1010  HOME
1020  HCOLOR= 0: POKE 230,32: HPLOT 0,0: CALL 62454
1030  TEXT : HOME : VTAB (10): HTAB (10): PRINT "TO START, PRESS A KEY";:
      GET A$
1040  POKE 49239,0: POKE 49236,0: POKE 49232,0: POKE 49234,0: CALL FAX
1045  TEXT : HOME : PRINT "NOW SELECT.."
1050  VTAB (8): HTAB (10): INVERSE : PRINT "1";: NORMAL : PRINT
      " RECEIVE PICTURE"
1060  VTAB (10): HTAB (10): INVERSE : PRINT "2";: NORMAL : PRINT
      " VIEW PICTURE AGAIN"
1070  VTAB (12): HTAB (10): INVERSE : PRINT "3";: NORMAL : PRINT
      " INVERT PICTURE"
1080  VTAB (14): HTAB (10): INVERSE : PRINT "4";: NORMAL : PRINT
      " PRINT PICTURE"
1085  VTAB (16): HTAB (10): INVERSE : PRINT "5";: NORMAL : PRINT
      " MAIN MENU"
1090  VTAB (19): HTAB (20): PRINT "SELECT";: GET A$: IF A$ < "1"
      OR A$ > "5" THEN  PRINT "control-G": GOTO 1045
1100  ON  VAL (A$) GOTO 1010,1300,1400,1200,1999
1200  REM PRINTER COMMANDS
1210  PR# 1

1220  PRINT  CHR$ (145)

1230  PR# 0
1280  REM   PRINTER COMMANDS
1290  GOTO 1045
1300  REM  VIEW SCREEN
1310  POKE 49239,0: POKE 49236,0: POKE 49232,0: POKE 49234,0: GET A$
1320  GOTO 1045
1400  REM  INVERT
1410  CALL NGTIVE
1420  GOTO 1300
1999  RETURN

2000  REM  RTTY
2010  TEXT : HOME : PRINT "NOW SELECT.."
2020  VTAB (8): HTAB (10): INVERSE : PRINT "1";: NORMAL : PRINT
      " RECEIVE RTTY"
2030  VTAB (10): HTAB (10): INVERSE : PRINT "2";: NORMAL : PRINT
      " TUNE UP"
2040  VTAB (12): HTAB (10): INVERSE : PRINT "3";: NORMAL : PRINT
      " INVERT"
2050  VTAB (14): HTAB (10): INVERSE : PRINT "4";: NORMAL : PRINT
      " CARRIER/NON CARRIER"
2060  VTAB (16): HTAB (10): INVERSE : PRINT "5";: NORMAL : PRINT
      " MAIN MENU"
2070  VTAB (19): HTAB (20): PRINT "SELECT";: GET A$: IF A$ < "1"
      OR A$ > "5" THEN  PRINT "control-G": GOTO 2000
2080  ON  VAL (A$) GOTO 2100,2200,2300,2400,2900
2100  HOME : VTAB (23): HTAB (5): PRINT
      "ESC 123456789 B OR A OR L OR F": POKE 35,22: VTAB (1): HTAB (1)
2110  CALL RTTY
2120  POKE 35,22: GOTO 2000
2200  CALL RYTUNE
2210  GOTO 2000
2300  REM  INVERT
2310  HOME :X =  PEEK (17345):A = 0: IF X = 0 THEN A = 1
2320  POKE 17345,A:A$ = "NORMAL": IF A = 1 THEN A$ = "INVERTED"
2330  VTAB (15): HTAB (10): PRINT "SENSE NOW ";A$: VTAB (21): PRINT
      "PRESS ANY KEY";: GET A$: GOTO 2000
2400  REM  CARRIER REQUIRED?
2410  HOME :X =  PEEK (17082):A = 234:B = 234:C = 234: IF X = 234 THEN
      A = 76:B = 78:C = 66
2420  POKE 17082,A: POKE 17083,B: POKE 17084,C:A$ = "REQUIRED":
      IF A = 234 THEN A$ = "NOT REQUIRED"
2430  VTAB (15): HTAB (10): PRINT "CARRIER NOW ";A$: VTAB (21):
      PRINT "PRESS ANY KEY";: GET A$: GOTO 2000
2490  GOTO 2000
2900  RETURN

3000  REM  CW DECODE
3005  POKE 35,24
3010  TEXT : HOME : PRINT "CW ROUTINE. TO EXIT AT ANY ": PRINT
      : PRINT "STAGE, PRESS ANY KEY."
3020  VTAB (10): HTAB (10): INVERSE : PRINT "(1)";: NORMAL : PRINT
      " TUNE UP"
3030  VTAB (12): HTAB (10): INVERSE : PRINT "(2)";: NORMAL : PRINT
      " RUN DECODER"
3040  VTAB (14): HTAB (10): INVERSE : PRINT "(3)";: NORMAL : PRINT
      " SPEED"
3050  VTAB (16): HTAB (10): INVERSE : PRINT "(4)";: NORMAL : PRINT
      " MAIN MENU"
3055  VTAB (20): HTAB (18): PRINT "SELECT";: GET A$
3060  IF A$ < "1" OR A$ > "4" THEN  PRINT "control-G": GOTO 3000
3070  IF A$ = "4" THEN  RETURN
3080  IF A$ = "1" THEN  CALL TUNE: GOSUB 3200: GOTO 3000
3090  IF A$ = "2" THEN  GOSUB 3200: CALL CW: GOTO 3000
3100  HOME :X =  PEEK (17683):A = 5: IF X = 5 THEN A = 37
3110  POKE 17683,A:A$ = "HIGH": IF A = 37 THEN A$ = "LOW"
3120  VTAB (15): HTAB (10): PRINT "SPEED NOW ";A$: VTAB (21): PRINT
      "PRESS ANY KEY";: GET A$: GOTO 3000
3200  HOME : VTAB (24): HTAB (10): PRINT "TO EXIT. PRESS ANY KEY"
     : VTAB (1): HTAB (1): POKE 35,22: RETURN

9000  REM  DATA SETUP
9010  FAX = 16768:RTTY = 16954:CW = 17347:NGTIVE = 16790:TUNE = 16825
     :RYTUNE = 16861
9020  LNGTH% = 16950:FRQ% = 16947:TIME% = 16948:PLAY% = 16897
9100  DATA   100,40,0,2 ,93,40,0,2,81,40,0,1,74,66 ,0,60,100,40,
      0,10,74,254
9110  RETURN

20000  REM  THATS IT!
20010  RESTORE
20020  FOR I = 1 TO 11: READ N,D: POKE LNGTH%,1: POKE FRQ%,N:
       POKE TIME%,D: CALL PLAY%: NEXT I
20030  HOME : END
```

Then type SAVE MAINLINE. This is the program which supervises tthe rest of the suite.

Stage 3.

Type NEW and enter the following program.

```
10  HGR :BASE = 16384
20  HCOLOR= 3
30  FOR Y = 0 TO 191
40  HPLOT 0,Y
50  A% =  PEEK (38):B% =  PEEK (39): POKE 16384 + 2 * Y,A%:
    POKE BASE + 2 * Y + 1,B%
60  NEXT Y
70  REM  DATA AT $4000-$417F
```

You do not save this program. Rather, run it and ignore the special effects. Press CONTROL-RESET and go to Stage 4. The program has generated a table of values which is needed by the machine code.

Stage 4

Enter the machine code monitor by typing CALL — 151. You should see the '*' prompt appear. Now type this lot:-

```
4190- FF FF FF FF FF FF 48 08
4198- A9 20 85 30 A0 00 84 2F
41A0- B1 2F 49 FF 91 2F C8 C0
41A8- 00 D0 F5 A6 30 E8 86 30
41B0- E0 40 30 EC 28 68 60 FF
41B8- FF 08 48 AD 00 C0 30 03
41C0- 4C CB 41 A9 00 8D 10 C0
41C8- 68 28 60 AD 62 C0 10 EB
41D0- A2 FF 8D 30 C0 CA E0 00
41D8- 30 FB 4C BB 41 08 48 AD
41E0- 00 C0 30 03 4C EF 41 A9
41E8- 00 8D 10 C0 68 28 60 AD
41F0- 61 C0 10 EB A2 FF 8D 30
41F8- C0 CA E0 00 30 FB 4C DF
4200- 41 08 48 AC 34 42 A9 90
4208- 8D 35 42 AE 33 42 E0 00
4210- F0 03 AD 30 C0 CE 35 42
4218- D0 13 A9 90 8D 35 42 88
4220- D0 0B AC 34 42 CE 36 42
4228- D0 03 68 28 60 CA D0 E5
4230- 4C 0B 42 4A FE 31 01 01
4238- FF FF 48 08 A9 00 8D BC
4240- 43 AD B3 43 A9 0E 8D C0
4248- 43 A9 10 8D BF 43 AD 00
4250- C0 10 62 F0 60 A0 00 8C
4258- 10 C0 C9 C6 D0 08 A9 01
4260- 8D BC 43 4C 4E 42 C9 CC
4268- D0 08 A9 00 8D BC 43 4C
4270- 4E 42 C9 C2 D0 08 A9 10
4278- 8D BF 43 4C 4E 42 C9 C1
4280- D0 08 A9 80 8D BF 43 4C
4288- 4E 42 C9 9B F0 24 C9 D3
4290- D0 08 AD C1 43 49 01 4C
4298- 4E 42 C9 B0 90 B0 C9 BA
42A0- B0 AC 38 E9 B1 8D C0 43
42A8- A8 B9 B3 43 8D C0 43 4C
42B0- 4E 42 28 68 60 AD 62 C0
42B8- 30 03 4C 4E 42 20 67 43
42C0- 90 8C AD BF 43 C9 80 D0
42C8- 0F AD C0 43 C9 0E F0 08
42D0- A9 80 8D BE 43 4C DD 42
42D8- A9 20 8D BE 43 AD BF 43
42E0- 8D BD 43 20 58 43 20 55
42E8- 43 20 67 43 AD BD 43 6A
42F0- 8D BD 43 90 F1 20 55 43
42F8- AD BD 43 49 FF 8D BD 43
4300- AD BF 43 2A 90 0A AD BD
4308- 43 18 6D BE 43 4C 43 43
4310- AD BD 43 18 6A 18 6A 18
4318- 6A 8D BD 43 C9 1B D0 08
4320- A0 01 8C BC 43 4C 4E 42
4328- C9 1F D0 08 A0 00 8C BC
4330- 43 4C 4E 42 AD BD 43 18
4338- 0A 6D BC 43 A8 B9 73 43
4340- 18 69 80 20 49 43 4C 4E
4348- 42 C9 A0 90 07 C9 DB B0
4350- 03 20 ED FD 60 20 58 43
4358- AE C0 43 A0 60 88 98 C9
4360- 00 D0 FA CA D0 F5 60 AD
4368- 61 C0 0A A9 00 2A 4D C1
4370- 43 6A 60 05 05 45 33 0A
4378- 0A 41 2D 20 20 53 27 49
4380- 38 55 37 0D 0D 44 00 52
4388- 34 4A 87 4E 2C 46 25 43
4390- 3A 4B 28 54 35 5A 22 4C
4398- 29 57 32 48 00 59 36 50
43A0- 30 51 31 4F 39 42 3F 47
43A8- 24 04 04 4D 2E 58 2F 56
43B0- 3D 0B 0B 0E 0C 0B 08 06
43B8- 05 04 02 01 01 14 20 10
43C0- 0E 00 42 48 08 A9 FE 8D
43C8- 60 45 AD 00 C0 10 0A F0
43D0- 08 A9 00 8D 10 C0 28 68
43D8- 60 20 E8 44 30 03 4C CA
43E0- 43 A0 00 8C 62 45 AC 62
43E8- 45 C8 D0 02 A0 FF 8C 62
43F0- 45 20 0D 45 20 E8 44 30
43F8- ED AD 62 45 C9 05 90 D9
4400- AD 60 45 C9 00 F0 17 10
4408- 15 AD 64 45 0A CD 62 45
4410- 90 04 18 4C 17 44 38 AD
4418- 60 45 2A 8D 60 45 AD 5E
```

```
4420- 45 8D 5D 45 AD 64 45 8D
4428- 63 45 AC 62 45 8C 5C 45
4430- 20 BC 44 AD 5D 45 8D 5E
4438- 45 AD 63 45 8D 64 45 AD
4440- 66 45 0A B0 0B CD 64 45
4448- B0 06 AD 64 45 8D 66 45
4450- A0 00 8C 65 45 EE 65 45
4458- AC 65 45 F0 2C 20 0D 45
4460- 20 E8 44 F0 F0 10 EE AD
4468- 66 45 0A B0 27 CD 65 45
4470- B0 22 0A B0 0B 18 6D 66
4478- 45 B0 05 CD 65 45 90 09
4480- 20 9A 44 20 EC 44 4C C5
4488- 43 20 EC 44 A9 A0 20 ED
4490- FD 4C C5 43 20 9A 44 4C
4498- CA 43 AC 65 45 8C 5C 45
44A0- AD 66 45 8D 63 45 AD 5F
44A8- 45 8D 5D 45 20 BC 44 AD
44B0- 5D 45 8D 5F 45 AD 63 45
44B8- 8D 66 45 60 AD 5C 45 0A
44C0- B0 0E CD 5D 45 B0 09 AD
44C8- 5C 45 8D 63 45 4C E1 44
44D0- AD 5D 45 0A B0 0B CD 5C
44D8- 45 B0 06 AD 5D 45 8D 63
44E0- 45 AD 5C 45 8D 5D 45 60
44E8- AD 62 C0 60 A0 00 AD 60
44F0- 45 D9 28 45 F0 0A C8 C0
44F8- 34 D0 F3 A9 DF 4C 09 45
4500- 8C 61 45 AD 61 45 18 69
4508- A7 20 ED FD 60 8C 61 45
4510- A0 06 A2 20 CA E0 00 F0
4518- 03 4C 14 45 88 C0 00 F0
4520- 03 4C 12 45 AC 61 45 60
4528- 9E D6 AD CA C8 B3 A1 95
4530- D2 DF CF C7 C3 C1 C0 D0
4538- D8 DC DE B8 AA 00 D1 7F
4540- 8C 85 F9 E8 EA F4 FC E2
4548- F6 E0 F8 E7 F5 E4 FB FA
4550- F7 E6 ED F2 F0 FD F1 E1
4558- F3 E9 EB EC 00 00 00 00
4560- 00 00 00 00 00 00 00 FF
4568- 48 08 A9 00 8D 62 46 8D
4570- 63 46 85 2F 8D 10 C0 A9
4578- 40 85 30 A9 40 8D 65 46
4580- A0 30 20 32 46 C9 00 30
4588- F9 88 C0 00 10 F4 20 32
4590- 46 C9 00 10 F9 F0 F7 AD
4598- 00 C0 30 0D A5 30 C9 40
45A0- F0 0F AD 62 46 C9 3F 30
45A8- 08 A9 00 8D 10 C0 28 68
45B0- 60 A9 05 8D 64 46 AE 64
45B8- 46 CA 8E 64 46 AD 62 46
45C0- 18 2A A8 B1 2F 85 26 C8
45C8- B1 2F 85 27 AD 65 46 18
45D0- 2A 8D 65 46 C9 80 D0 1B
45D8- A9 01 8D 65 46 AC 63 46
45E0- C8 8C 63 46 C0 28 D0 0B
45E8- 20 43 46 A2 00 8E 63 46
45F0- 4C 12 46 20 32 46 30 0D
45F8- AC 63 46 AD 65 46 11 26
4600- B1 26 4C BD 45 AC 63 46
4608- AD 65 46 11 26 91 26 4C
4610- BD 45 AE 64 46 E0 00 10
4618- 9D F0 9B AE 62 46 E8 8E
4620- 62 46 E0 80 30 39 A2 00
4628- 8E 62 46 A2 41 86 30 4C
4630- 97 45 A2 31 CA 48 68 08
4638- 28 E0 00 D0 F7 AD 61 C0
4640- 49 FF 60 A2 BE 8C 66 46
4648- CA A0 93 88 C0 00 D0 FB
4650- E0 00 D0 F4 A0 7D 88 C0
4658- 00 D0 FB AC 66 46 60 4C
4660- 97 45 00 00 00 00 00 D0
4668- FB AC 75 46 60 4C 97 45
4670- 32 28 FE 01 7F 28 FF FF
```

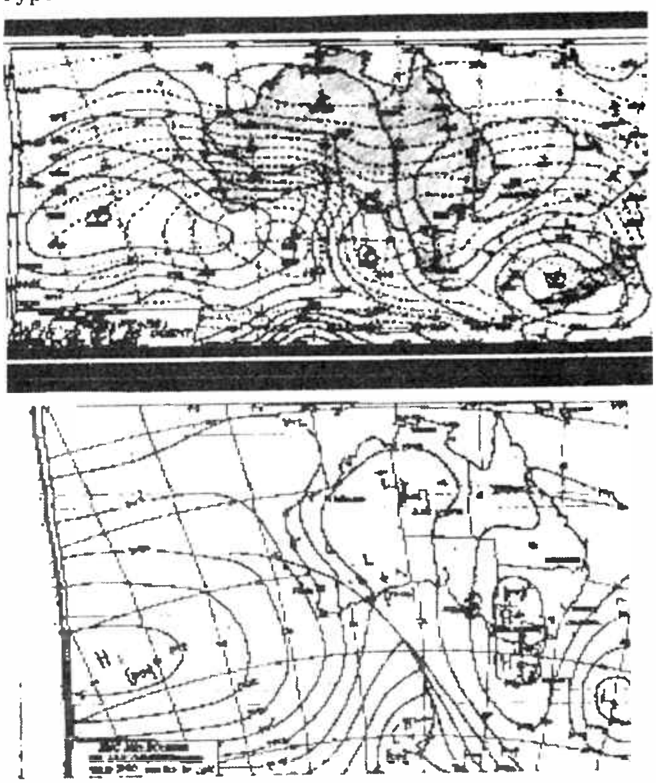
Note that this code fits in memory just after the tables generated by the previous stage. The entire code is now save to disk:

BSAVE MORFART, A$4000,L$700

(Short for MORse, Fax and Radio Teletype — not a pun on a surname)

Stage 5.

Type PR#6 and see if it all works!



Here's a couple of FAX samples, from station AXM on 5100 kHz.

Memory allocation

It may be useful to have the memory allocation of the machine code segments listed here, although they are available from the assembly listings. If you find a bug in a particular routine, then you can more easily locate your typing error by narrowing down the search!

Code	Start address
SCREEN ADDRESSES	$4000
BLANK	$4182
SCREEN INVERT	$4196
MORSE MONITOR	$41B9
RTTY MONITOR	$41DD
TONE GENERATOR	$4201
RTTY CODE	$423A
CW CODE	$43C3
FAX CODE	$4568
END	$4666

Operating the programs

Since the supervising program is written in BASIC, there was no problem putting in some 'user friendliness'. Thus, there is a main menu and, for each, a sub menu. The main menu looks like this:-

1 FAX
2 RTTY
3 CW
4 END
SELECT;

FAX (main menu choice 1).
Assuming you have the decoder box switched to FAX and that the radio is choofing along on a suitable station, the FAX menu choice 1 (and a keypress prompt) will start you running a picture. Tune the radio so that lots of action takes place on the screen.

If the transmitted picture is already partially sent at this stage, the picture you see will have a great stripe down its innards somewhere. This is because the program doesn't know where the border is. You see, the trick is to wait 'till the picture is *about to start*. That is announced by a lengthy period of regular 'pip-pip' tones. The keypress offered you is designed for that stage. Hit any key during those 'pips' and the picture will synchronise nicely.

If the picture seems predominantly white, then you are on the wrong sideband. Either switch over next time or receive it now and invert the picture when it is finished (you lose resolution that way). At any stage during the display of a picture, you may exit to the main program by pressing any key, by the way.

The printer option built in will work straight off with an 'Epson' card. Look at the BASIC code at line 1220 if it doesn't. Modify it to suit 'how to dump HI-RES page 1' according to your printer manual. The printer picture (as with all Apple picture dumps) is squashed vertically by a factor of 0.8. There is a way to get around this. You increase the vertical length of the picture on the screen by that factor. Trouble is though, you lose the last 10% of the picture. Can you imagine the fun I had at that stage when I remembered that?

If the picture slopes badly left or right, try trimming the speed. Lower numbers make the thing slope more right. The coarse adjustment is at location $4644 and the fine at $4655. There is also an adjustment for the width of the picture. I have left it a maximum. As noted in the Moffat article, some experimenting is required. The Apple timing varies from machine to machine, but not a great deal. It will not affect CW or RTTY. ▶

Try station on AXM 5100 kHz or AXI on 10 555 kHz and use USB. You get good FAX pictures and RTTY at 50 baud. It is also a good one for telling the difference 'twixt RTTY and FAX.

RTTY (main menu option 2)

This mode is the most complex to operate and gave the most headaches in the development stage. The main problem I had was getting test signals. Anyway, you have a tune-up mode which should allow you to simulate the sound of RTTY from the receiver.

The 'invert' option should only be used when the radio set can't be switched from upper to lower sideband. (That effectively inverts the code). Listening to lots of RTTY teaches you the requisite operating skills. The RTTY tones should be such that most of the sound is low pitched. When data is firing along, the tone should jump high for lots of little instants.

If the printer races along with lots of repeated letters (in strings of the same letter) then select a lower speed. You simply press 1-9 from within the executing machine code for that. A '1' gives the lowest speed. In the unlikely case that ASCII is being sent, try pressing A. If there appears to be lots of numbers, press 'L' to force it back to letters. ('F' forces it to figures). You can return to the BASIC menu by pressing 'ESC'.

I wrote the audio invert option as part of the BASIC code and made 'it hard to get at', since the option should not be needed. I also gave a carrier/no carrier option. That allows the program to be used on signals of different quality. Again, not too useful.

The default conditions (if you don't do any choosing) are —

Speed	1 (45.5 Baud)
Mode	Baudot
Sense	Mark = high tone
Case	Expects letters
Carrier	Expects a carrier

CW (Main menu choice 3)

The operation of this section of code is pretty straightforward. Tune in a CW signal using the LED indicator on the decoder as a guide. Selecting the 'tune-up' mode from the inner menu will allow you to listen to the computer reproducing the code. The reason that I included such a routine was to convince you that the received signal must be relatively clean and spike free to be really successful. The decoder is a little too simple for CW. What is needed is a sharp audio filter in front of it . . .

If the morse printout is full of Es and Ts then you must select the high speed option. If it is full of spaces, select the low speed option. Allow a few seconds for the speed to stabilize though. If the stuff just won't decode, try monitoring the code and see if it is clean. Perhaps the sending is just too gunky for the computer to understand. Those nasty noise spikes really throw the speed routine. I have included a certain amount of 'de-glitching' in the machine code but the software can only do so much if you hit it with noisy input.

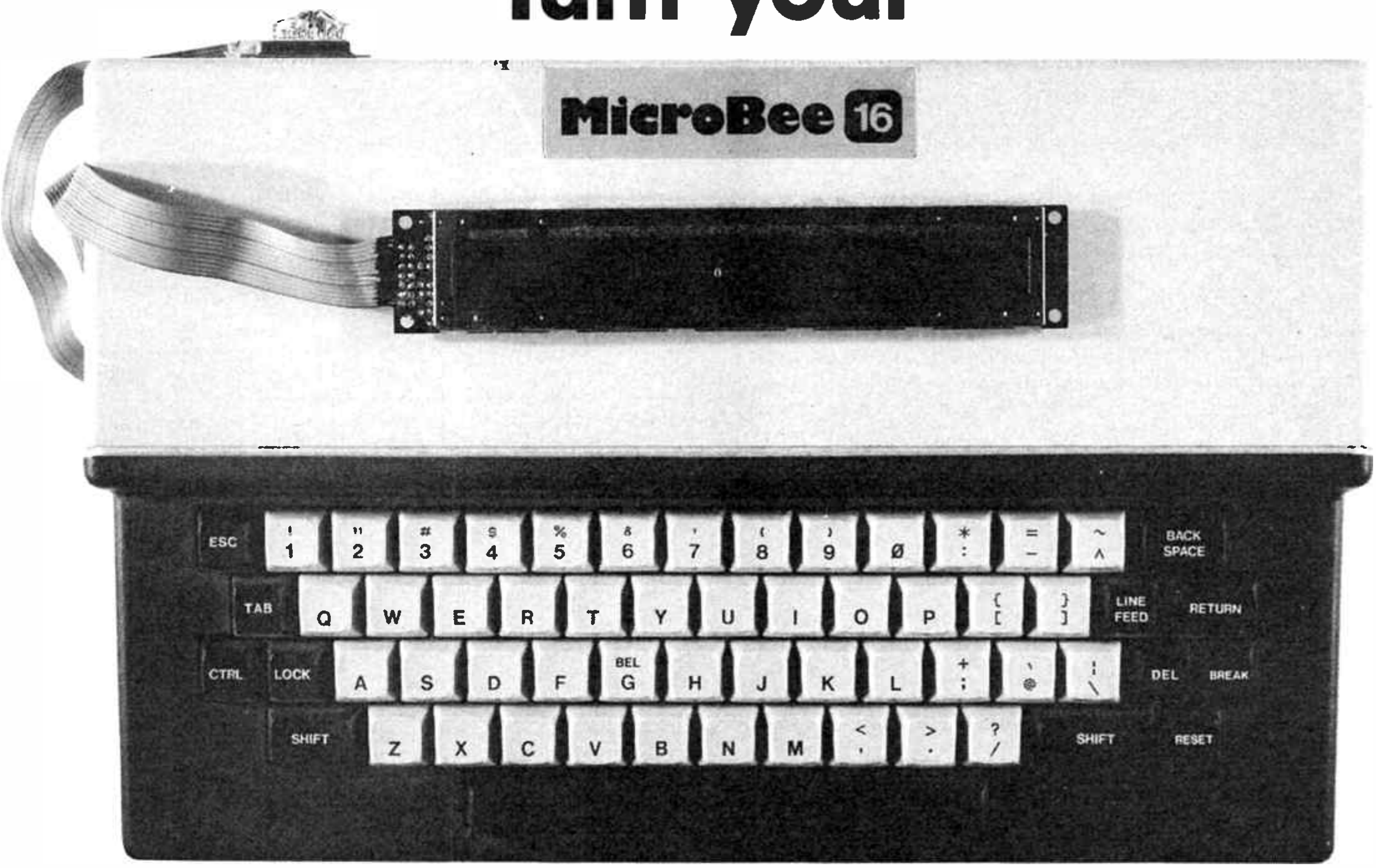
Try adjusting the audio level trimpot if you have included it. That can often lead to improved signal-to-noise ratio.

I hope you enjoy using the Apple package as much as I do. Good decoding!

Commented, disassembled listings of the C64 and Apple II Listening Post programs were too large (8-10 pages!) to reproduce, but photostats can be obtained from the magazine for $2.50 post paid. Please mark your request "C64 Commented Listing," or "Apple II Commented Listing," as required.

NOTE: The July '85 issue (No. 1!) contained the original Listening Post article. If you want a back copy, or a photostat of the article, either costs just $3.60, post paid anywhere in Australia, or A$4.60 to NZ or PNG.

Turn your



into a 'Port-A-Bee'

Paul Leonardi

If you've ever needed a 'portable' Microbee – this project's for you! Just attach a readily available liquid crystal display and run a little software – bingo, the 'Port-A-Bee'!

THIS PROJECT SHOWS HOW to attach a two-line by 40 character liquid crystal display (LCD) to your ROM-based Microbee to enable you to do limited operations *without* the video monitor. It was initiated by my need for a high quality daisy wheel printer. How, I can hear you asking, does that lead to a project for an LCD for the Microbee? Well, the story goes like this . . .

I already have a good quality printer (a HP Thinkjet) but wanted letter quality print sometimes. To my wife, I couldn't justify the second printer (it was hard enough with the first one) and knowing of a very nice printer at work, I thought I would use that. Doing that involved getting up a little earlier to put the Microbee and monitor in the car, unloading it at the other end, finding power and cables then printing out the Wordbee file on the daisywheel. Then, of course, came the repacking and subsequent unpacking again back at home.

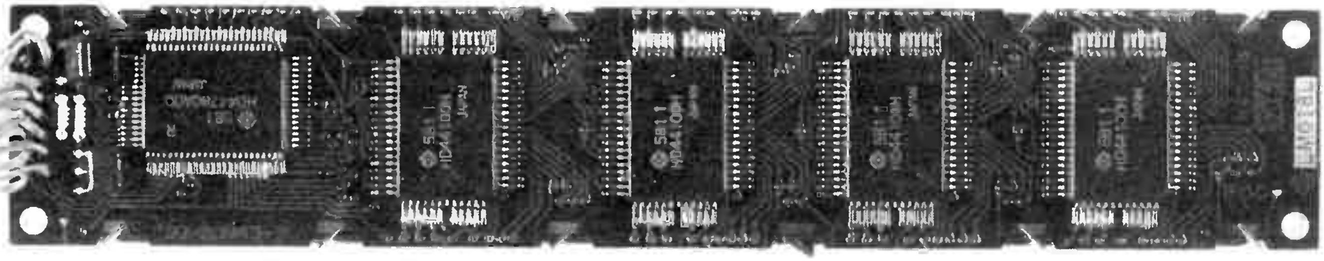
As you can see, this was all quite laborious and time consuming, so I decided that maybe it would be easier if I just took the 'Bee itself and a 12 V battery, then it would all fit in my case, thus saving time and energy.

The ROM-based 'Bee (I have a 32K IC series) has the advantage of battery backup so that the file can be loaded in the night before. But once you connect the printer-'Bee-battery you're missing the very important user interface (something to see what the 'Bee is doing). That doesn't matter. You power up the 'Bee in BASIC (it beeps, remember), type (very carefully) the incantation EDASM (to go to WORDBEE) then, presuming we're looking at a file, hit the linefeed key to go to command level Wordbee; then hit the P key followed by the return key. If all goes well the printer starts up. If not, you try the incantation a couple of times more and either it works or give up in disgust.

I swore that, if ever there was a cheap LCD that would connect to the 'Bee so that I could see what was happening, I'd get one.

After a little research, I discovered a range of displays from Hitachi. They range from 1-line by 8-characters to 2-lines by 40-characters, with a 200-by-640 graphics one available also.

To suit my purpose, the 2 × 40 display, known as the LM018L, seemed to suffice. Although this project is written around this display it is left sufficiently open so that similar ▶



Rear view of the LCD. Thank goodness you don't have to build it!

Energy Control, PO Box 6502, Goodna Qld 4300. (07) 288 2455. They cost around $70. Other types may be used, of course, but this Hitachi display was the best value.

This project describes how to connect the unit to the port, (notice there is no external hardware except for the 15-pin D-type plug) and the routines have needed to drive the LCD. I have provided some applications, such as LISTING and printing to the display from BASIC, and a small game incorporating the PCG abilities of the display. Note that it can be attached to both ROM-based and disk-based Microbees.

The LM018L display (and similar)

The LM018L liquid crystal display is a unit incorporating all the circuitry needed to accept ASCII information from the real world, convert it to dot representations of the alphabetic characters, then convert them to voltage signals to pulse the correct dots on the LCD, thus displaying the information to us. It runs from a single 5 V supply (± 2 V) at an incredible 0.5 mA typical. Thus can be supplied from port A. It has 14 lines for connection to the real world. Three are used for the power circuit, eight for the data bus, and three control lines. In fact, it can be reduced to four lines of data bus (as is the case here), reducing the lines to the real world to 10.

Figure 1 shows a block diagram of the LM018L. It ties together one LCD, four 60-pin flat pack ICs (HD44100H) and one 80-pin flat pack IC (HD44780A00). Each 44100H has the guts to drive 20 characters of 8-by-5 dot matrix display. With the 44780 doing all the heavy work of I/O buffering, instruction decoding, character generation (in ROM) and user characters (in RAM), timing generation, parallel-to-serial conversion, cursor control, display data RAM, common and segment signal drivers and a 40-bit shift register. The 44780 is so full of features it would take too long to describe it here, so I will be describing only the parts necessary to understand the operation for this project.

Operation

The unit can be operated in two modes using the 4-bit data bus or the 8-bit data bus. As we have only active lines on port A and the LCD requires three control lines, in addition to the bus, we have to run it in the 4-bit data bus mode.

Figure 2 shows the timing diagram necessary to operate the LCD.

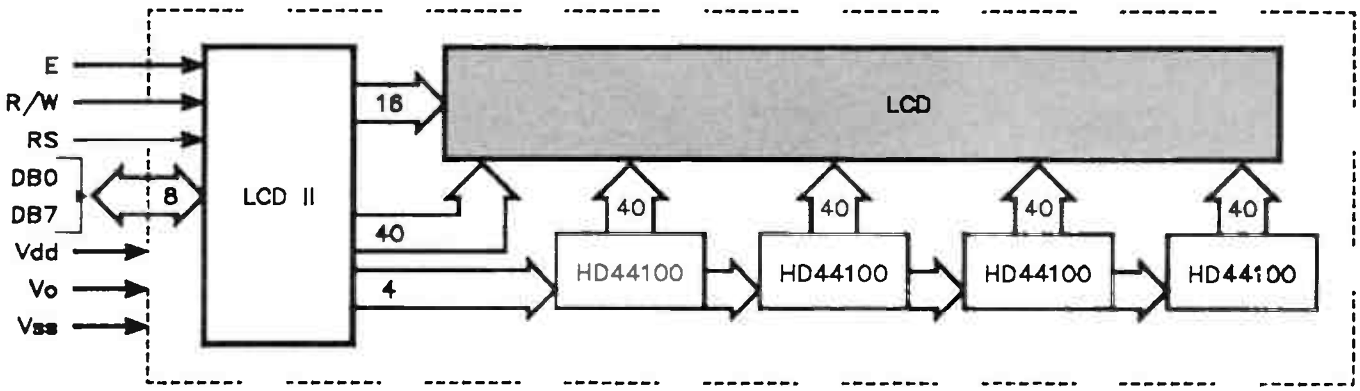
TIMING CHARACTERISTICS

ITEM	Symbol	MIN	MAX	UNITS
Enable cycle time	Tcyc	1.0	–	us
Enable pulse width	Pweh	450	–	ns
Enable rise/fall time	Ter, Tef		25	ns
RS, R/W setup time	Tas	140		ns
Data delay time	Tddr		320	ns
Data setup time	Tdsw	225		ns
Hold time	Th	10		ns

The lines we have to connect from port A to the LCD are set up this way:

D15 plug		LM018L
D0 — pin 13 on the D15 plug	<—>	DB4 — pin 11 on the LCD
D1 — pin 5 "	<—>	DB5 — pin 12 on the LCD
D2 — pin 12 "	<—>	DB6 — pin 13 "
D3 — pin 4 "	<—>	DB7 — pin 14 "
D4 — pin 11 "	<—>	RS — pin 4 "
D5 — pin 3 "	<—>	R/W — pin 5 "
D6 — pin 10 "	<—>	E — pin 6 "
5 V — pin 1 "	<—>	Vdd — pin 2 "
0 V — pin 8 "	<—>	Vss — pin 1 "
0 V — pin 8 "	<—>	Vo — pin 3 "

Where: **DB4-DB7** is the 4-bit data bus, **RS** is the 'register select' bit selecting between data register/instruction register; **R/W** is the read/write bit selecting the direction of data transfer along the 4-bit data bus (read from LCD or write to LCD); **E** is the enable bit and the clock bit for data transfer (see timing diagrams). Figure 3 shows the pin numbers and their functions on the LM018L and the 15-pin D-type plug for the Microbee port A.



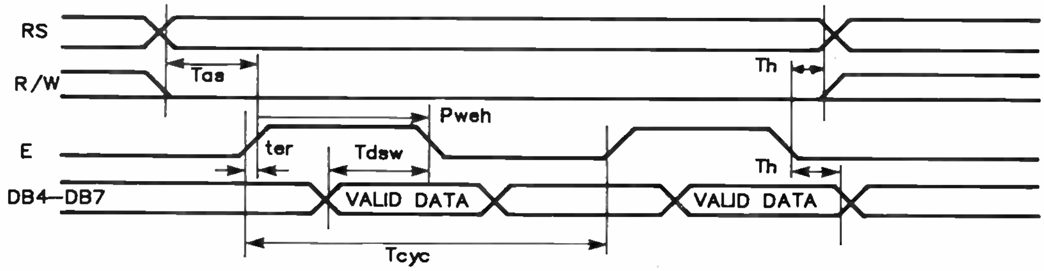


Figure 2.1

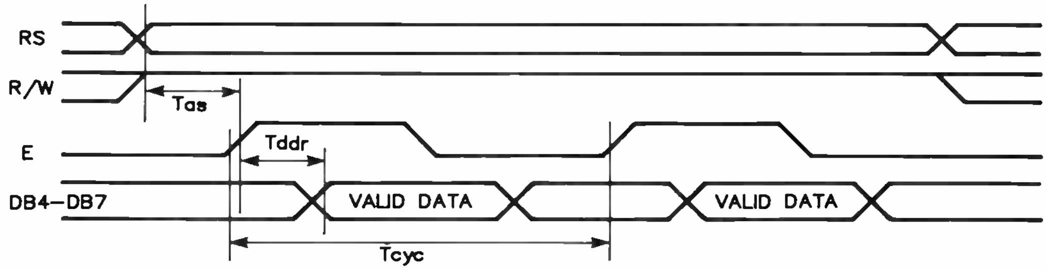
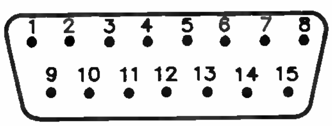
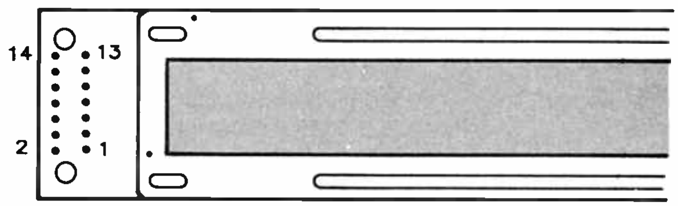


Figure 2.2.

DISPLAY TIMING DIAGRAMS



15 PIN D TYPE CONNECTOR (FRONT VIEW) MICROBEE PORT A



LIQUID CRYSTAL DISPLAY LM018L (HITACHI)

PIN	CONNECTION
1	+5 volt
2	A7
3	A5
4	A3
5	A1
6	—
7	—
8	GND
9	—
10	A6
11	A4
12	A2
13	A0
14	—
15	—

PIN	SYMBOL	FUNCTION
1	Vss	0 volt
2	Vdd	+5 Volt
3	Vo	0 volt
4	RS	Register select
5	'R/W	Read/Write
6	E	Enable
7	DB0	Data bus lines
8	DB1	
9	DB2	
10	DB3	
11	DB4	
12	DB5	
13	DB6	
14	DB7	

Figure 3. Port A and LM018L pinouts.

The driver routines.

As you can well imagine there is more to it than just connecting the wires between the LCD and port A. That's just the electrical and mechanical interface. Next is the functional interface, the procedures needed, for example, to initialize the LCD and the procedure to take the contents of the A register in the Z80 and make it appear on the LCD. This involves putting the top nibble of register A at positions D0-D3 on the PIO (port A driver), setting the R/W and RS bits, pulsing the enable line, setting the lower nibble of register A on the D0-D3 lines of the PIO, pulsing the enable line again and then release the control lines.

INIT is the first routine to be called as this sets up the LCD to respond to the 4-bit data bus, 2-lines by 40-characters and make a 5-by-7 character font. It only needs to be called after power-up.

The output routines have been called OUTR1, OUTR1C, OUTR0 and OUTR0C, and mean OUT to register 1, and OUT to register 0 respectively. This means when the routines are called the contents of the A register is passed to the respective register in the LCD. Where the label is followed by C, such as in OUTR1C, it means the contents of the C register is output instead of the A register. This is especially useful for BASIC USR calls as the C register can be passed in these.

These are the most fundamental routines needed to communicate with the LCD.

TABLE 1.

INSTRUCTION	RS	R/W	DATA (HEX)	DATA (DEC)	DESCRIPTION
CLEAR	0	0	01H	1	CLEARS THE LCD AND HOMES CURS.
HOME	0	0	02H	2	RETURN THE CURSOR TO HOME POSN.
ENTRY MODE	0	0	04H	4	CURSOR MOVES TO LEFT AFTER INPUT
	0	0	05H	5	DISPLAY SHIFTS LEFT AFTER INPUT
	0	0	06H	6	CURSOR MOVES RIGHT AFTER INPUT
	0	0	07H	7	DISPLAY SHIFTS RIGHT AFTER INPUT
DISPLAY	0	0	08H	8	DISPLAY OFF
	0	0	09H	9	CURSOR CHARACTER BLINKS.
	0	0	0AH	10	CURSOR ON ONLY.
	0	0	0BH	11	CURSOR ON AND CHARACTER BLINKS
	0	0	0CH	12	DISPLAY ON
	0	0	0DH	13	DISPLAY ON,CURSOR & BLINK OFF
	0	0	0EH	14	DISPLAY & CUURSOR ON, BLINK OFF
	0	0	0FH	15	DISPLAY, CURSOR AND BLINK ON.
CURSOR SHIFT	0	0	10H	16	MOVE CURSOR LEFT ONE POSITION.
	0	0	14H	20	MOVE CURSOR RIGHT ON POSN.
	0	0	18H	24	SHIFT DISPLAY LEFT ONCE.
	0	0	1CH	28	SHIFT DISPLAY RIGHT ONCE.
FUNCTION SET	0	0	20H	32	DATA 4 BITS,1 LINE 5*7 FONT.
	0	0	24H	36	DATA 4 BITS,1 LINE 5*10 FONT.
	0	0	28H	40	DATA 4 BITS,2 LINES 5*7 FONT.
	0	0	2CH	44	DATA 4 BITS,2 LINES 5*7 FONT.
	0	0	30H	48	DATA 8 BITS,1 LINE 5*7 FONT.
	0	0	34H	52	DATA 8 BITS,1 LINE 5*10 FONT.
	0	0	38H	56	DATA 8 BITS,2 LINES 5*7 FONT.
	0	0	3CH	60	DATA 8 BITS,2 LINES 5*7 FONT.
SET CG RAM	0	0	40H	64	SETS CG RAM TO ADDRESS 0H
	0	0	XXH	XX	SETS CG RAM TO XXH-40H
	0	0	7FH	127	SETS CG RAM TO ADDRESS 3FH
SET DD RAM	0	0	80H	128	SETS DD RAM TO ADDRESS 0H
	0	0	XXH	XXX	SETS DD RAM TO XXH-80H
	0	0	FFH	255	SETS DD RAM TO ADDRESS 7FH
WRITE DATA	1	0	XXH	XXX	WRITES ASCII XXH TO CURRENT POSN EITHER CG RAM OR DD RAM.

READING DATA FROM THE LCD.
READING REGISTER 0 GIVES THE STATUS OF THE LCD WITH BIT 7 INDICATING THE BUSY FLAG. AND BITS 6-0 GIVING THE ADDESS OF THE ADDRESS COUNTER. (ie WHAT POSITION IS THE CURSOR AT)

READING REGISTER 1 READS THE CHARACTER FROM THE DD RAM (DISPLAY DATA RAM) OR THE CG RAM (CHARACTER GENERATOR RAM) DEPENDING WHICH WAS LAST SET.

Table 1 lists the instructions the LCD has available. These functions are available for your use, simply by loading the A register (in the Z80) with the data specified and calling OUT0 or OUTR1 (depending whether you want to display some data, or setup the LCD unit).

The panel here shows a list of functions available and the data needed to effect these functions. (i.e: to clear the LCD and move the cursor to the home position you would need to put the data 01H into the LCD instruction register 0, or using the software provided here, load the A register of the Z80 and call OUTR0).

```
                00100 ;**********************************
                00110 ; LCD DRIVER ROUTINES FOR THE BEE
                00120 ; BY PAUL LEONARDI 15-OCT-1985 VER 1.4
                00130 ; CALL INIT FIRST TIME TO SETUP THE LCD
                00140 ; CALL OUTRO TO WRITE  LETTER TO THE DISPLAY
                00150 ;**********************************
                00160
0028            00170 FUNCT   EQU     028H     ; SETS DATA 4. LINES 2,
                                                 FONT 5*7
000E            00180 DON     EQU     00EH     ; DISPLAY ON, CURSOR ON
0008            00190 DOFF    EQU     008H     ; DISPLAY OFF
0001            00200 CLR     EQU     001H     ; CLEAR THE DISPLAY
0002            00210 HOME    EQU     002H     ; HOME CURSOR
0006            00220 EMODE   EQU     006H     ; ENTRY MODE SET
0010            00230 BREGS   EQU     010H     ; REGISTER SELECT BIT
0020            00240 BRW     EQU     020H     ; READ WRITE BIT
0040            00250 BENAB   EQU     040H     ; ENABLE BIT
                00260
3000            00270         ORG     3000H
                00275 ;#############################################
3000 CD1130     00280 INIT    CALL    SETUP    ; SET UP BITS AND PORTS
3003 CD5C30     00290         CALL    RESET    ; INITIALIZE LCD
                                                 BY INSTRUCTION
3006 C9         00300         RET
                00305 ;#############################################
                00310
3007 79         00320 OUTR1C  LD      A,C      ; BASIC PASSES VARIABLES
                                                 IN BC PAIR'
3008 CD3830     00330 OUTR1   CALL    WRITE1   ; OUTPUT REGISTER A
                                                 CONTENTS TO LCD
300B C9         00340         RET
                00345 ;#############################################
                00360
300C 79         00370 OUTROC  LD      A,C      ; BASIC PASSES VARIABLES
                                                 IN BC PAIR
300D CD1E30     00380 OUTRO   CALL    WRITEO   ; OUTPUT Z80 A TO
                                                 REGISTER O LCD
3010 C9         00390         RET
                00395 ;#############################################
                00400
                00410         ;SETUP PIO
3011 3EFF       00420 SETUP   LD      A,OFFH   ; IO INSTRUCTION TO PIO
3013 D301       00430         OUT     (1),A    ; CONTROL REGISTER OF PIO
3015 3E00       00440         LD      A,O      ; 8 LINES OF OUTPUT
3017 D301       00450         OUT     (1),A    ; SELECT AS OUTPUT
3019 3E20       00460         LD      A,BRW    ; READ WRITE BIT
301B D300       00470         OUT     (O),A    ; SET R/W BIT HIOH
301D C9         00480         RET
                00490
301E 47         00500 WRITEO  LD      B,A      ;SAVE A REGISTER
301F CB3F       00510         SRL     A        ; SHIFT RIGHT ONE
3021 CB3F       00520         SRL     A        ; SHIFT RIGHT ONE
3023 CB3F       00530         SRL     A        ; SHIFT RIGHT ONE
3025 CB3F       00540         SRL     A        ; MOVE TOP  OF A TO
                                                 BOTTOM NIBBLE
3027 D300       00550         OUT     (O),A    ; OUTPUT DATA ON BUS
3029 CD5330     00560         CALL    PULSEE   ; PULSE THE ENABLE BIT
302C 78         00570         LD      A,B      ; GET A AGAIN
302D E60F       00580 WR05    AND     OFH      ; SAVE BOTTOM NIBBLE
302F D300       00590         OUT     (O),A    ; OUTPUT THE LOWER NIBBLE
3031 CD5330     00600         CALL    PULSEE   ; PULSE ENABLE AGAIN
3034 CD9330     00605         CALL    DELAY
3037 C9         00610         RET
                00620
3038 47         00630 WRITE1  LD      B,A      ; SAME AS WRITEO
3039 CB3F       00640         SRL     A
303B CB3F       00650         SRL     A
303D CB3F       00660         SRL     A
303F CB3F       00670         SRL     A
3041 C610       00680         ADD     A,BREGS  ; SELECT REGISTER 1
3043 D300       00690         OUT     (O),A
3045 CD5330     00700         CALL    PULSEE
3048 78         00710         LD      A,B
3049 E60F       00720         AND     OFH
04B C610       00730         ADD     A,BREGS
304D D300       00740         OUT     (O),A
304F CD5330     00750         CALL    PULSEE
3052 C9         00760         RET
                00770
3053 CBF7       00780 PULSEE  SET     6,A      ; SET THE ENABLE LINE HIOH
3055 D300       00790         OUT     (O),A    ; OUTPUT IT
3057 CBB7       00800         RES     6,A      ; SET THE ENABLE LINE LOW
3059 D300       00810         OUT     (O),A    ; OUTPUT IT
305B C9         00820         RET
                00830
                00840 ; THE ROUTINE NEEDED TO INITIALIZE THE LCD
                        BY INSTRUCTION
                00850
305C 3E03       00860 RESET   LD      A,03H    ; FUNCTION SET
305E CD2D30     00870         CALL    WR05     ; WRITE THE LOW NIBBLE ONLY
3061 CD9330     00880         CALL    DELAY    ; WAIT > 4.1mS
                                                 AS PER INSTRUCTION
3064 3E03       00890         LD      A,03H    ; AGAIN
3066 CD2D30     00900         CALL    WR05
3069 CD9330     00910         CALL    DELAY
306C 3E03       00920         LD      A,03H    ; AND AGAIN
306E CD2D30     00930         CALL    WR05
3071 3E02       00940         LD      A,02H    ; FUNCTION SET TO 4 BIT
                                                 DATA BUS
3073 CD2D30     00950         CALL    WR05
3076 3E28       00960         LD      A,FUNCT  ; FUNCTION
3078 CD1E30     00970         CALL    WRITEO   ; WRITE A TO THE
                                                 INSTRUCTION REG
307B 3E08       00980         LD      A,DOFF   ; DISPLAY OFF
307D CD1E30     00990         CALL    WRITEO
3080 3E01       01000         LD      A,CLR    ; CLEAR
3082 CD1E30     01010         CALL    WRITEO
3085 CD9330     01020         CALL    DELAY    ;CLEAR REQUIRES 1.6mS
3088 3E06       01030         LD      A,EMODE  ; SET UP ENTRY MODE
308A CD1E30     01040         CALL    WRITEO
308D 3E0E       01050         LD      A,DON    ;DISPLAY ON
308F CD1E30     01060         CALL    WRITEO
3092 C9         01070         RET              ;READY TO WRITE TO.
                01080
                01090
3093 0EFF       01100 DELAY   LD      C,OFFH   ; A TIME DELAY
3095 3E00       01110 LOOP    LD      A,O
3097 E5         01112         PUSH    HL
3098 E1         01113         POP     HL
3099 10FA       01120         DJNZ    LOOP     ; DELAY FOR FUNCTIONS
309B C9         01130         RET
                01140
0000            01150         END
00000 Total errors
```

Some applications.

Having the data, correct connections and the right driving routines we can now do some programming to use the LCD.

1) As a list device for BASIC.

Firstly, the LCD must be initialized by calling the routine at 3000H. From BASIC, this is as simple as USR(12288). Or, if you require, the initialization could be carried out automatically upon power-up by setting the warm-start vector at 00A2H to point to the BASIC program which calls the INIT routine with a USR(12288) call.

Next, to provide a pointer to the OUTR1 routine we could set up one of the output device vectors. If we decided to use vector 1, for example, we need to enter 11H & 30H into B4H & B5H respectively. Thus, a simple OUT #1 from BASIC would allow all listings to show up on the LCD. Program 1A is a machine code programme which sets up these pointers and initializes the LCD on power-up so that what you type into the Microbee is echoed on the LCD. You simply run this program once and reboot the system to start LCD listing. Thus, subsequenct power-ups would allow communications to the LCD. The disk-based Microbee would have to setup an autostart .COM file as it isn't battery-backed.

Programme 1B is the all-BASIC version of this.

PROGRAM 1a

```
                00100 ;*****************************************
                00110 ; PROGRAM 1a - AFTER CALLING THIS PROGRAM
                00120 ; THE FIRST TIME, OUTPUT FROM BASIC WILL BE
                00130 ; ON THE LCD AS WELL AS THE MONITOR.
                00140 ; THE DRIVER ROUTINES ARE ASSUMED TO BE ORGED
                00150 ;  AT 3000H.
                00160 ; by P.LEONARDI 14-10-85 VER 1.0
                00170 ;*********************************************
                00180
3000            00190 INIT     EQU     3000H
3007            00200 OUTR1C   EQU     3007H
3008            00210 OUTR1    EQU     3008H
300C            00220 OUTR0C   EQU     300CH
300D            00230 OUTR0    EQU     300DH
                00240
3100            00250          ORG     3100H
3100 CD0030     00260 START    CALL    INIT          ; INITIALIZE THE LCD
3103 210031     00270          LD      HL,START      ; ADDRESS OF
                                                      WARM START VECTOR
3106 22A200     00280          LD      (00A2H),HL    ; NEXT WARM START
3109 210830     00290          LD      HL,OUTR1      ; ADDRESS OF
                                                      OUTPUT ROUTINE
310C 22B400     00300          LD      (00B4H),HL    ; OUT#1 AT ADDRESS
310F 3E03       00310          LD      A,03H         ; OUT#0 & OUT#1
3111 32E200     00320          LD      (00E2H),A     ; OUTPUT DEVICE BYTE
3114 C31A85     00330          JP      0851AH        ; BASIC WARM START
0000            00340          END
00000 Total errors
```

PROGRAM 1b - BASIC VERSION

```
0010 REM PROGRAM 1b - THE BASIC VERSION OF 1a
00020 REM IF YOU RUN THIS PROGRAM IT WILL SET UP THE POINTER
00030 REM AND LINKS TO ALLOW LISTINGS ON THE LCD AS WELL AS THE
00040 REM SCREEN. by P.Leonardi 14-10-85 VER 1.0
00050 REM IT WILL ALSO INITIALIZE THE DISPLAY UPON POWERUP
00060 REM
00100 FOR A=12288 TO 12443
00110 READ B:POKE A,B
00120 NEXT A
00130 U=USR(12288):REM INITIALIZE THE LCD
00140 POKE 162,30:POKE163,123:REM WARM START START, THIS PROG
00150 POKE 180,8:POKE181,48:REM OUT#1 VECTOR POINTS TO LCD R1
00160 POKE 226,3:REM OUTPUT DEVICE =OUT#1 AND OUT#0
00170 STOP
10000 REM data for poking from  16000 to  16155 dec
10010 DATA 205, 17, 48, 205, 92, 48, 201, 121, 205, 56
10020 DATA 48, 201, 121, 205, 30, 48, 201, 62, 255, 211
10030 DATA 1, 62, 0, 211, 1, 62, 32, 211, 0, 201
10040 DATA 71, 203, 63, 203, 63, 203, 63, 203, 63, 211
10050 DATA 0, 205, 83, 48, 120, 230, 15, 211, 0, 205
10060 DATA 83, 48, 205, 147, 48, 201, 71, 203, 63, 203
10070 DATA 63, 203, 63, 203, 63, 198, 16, 211, 0, 205
10080 DATA 83, 48, 120, 230, 15, 198, 16, 211, 0, 205
10090 DATA 83, 48, 201, 203, 247, 211, 0, 203, 183, 211
10100 DATA 0, 201, 62, 3, 205, 45, 48, 205, 147, 48
10110 DATA 62, 3, 205, 45, 48, 205, 147, 48, 62, 3
10120 DATA 205, 45, 48, 62, 2, 205, 45, 48, 62, 40
10130 DATA 205, 30, 48, 62, 8, 205, 30, 48, 62, 1
10140 DATA 205, 30, 48, 205, 147, 48, 62, 6, 205, 30
0150 DATA 48, 62, 14, 205, 30, 48, 201, 14, 255, 62
10160 DATA 0, 229, 225, 16, 250, 201
```

2) To use the display from BASIC as an OUTPUT medium.

Programme 2 is a little self-contained program which will do nothing more than print some information on the LCD, show how to shift the display (by using the USR BASIC statement), etc.

```
00100 REM PROGRAMME 2 - A BASIC PROGRAMME TO RUN THE LCD FROM
00110 REM BASIC USING USR STATEMENTS AND WRITING CODES INTO
00120 REM THE REGISTERS OF THE LCD.
00130 REM  by P.Leonardi 16-10-85 VER 1.0
00140 REM
00150 REM USR(12288)    : INITIALIZES THE LCD
00160 REM USR(12295,X) : PUTS THE VALUE X INTO LCD REG 1
00170 REM USR(12300,X) : PUTS THE VALUE X INTO LCD REG 0
00180 REM ##############################################
00190 CLS
00200 GOSUB 320:REM CALL THIS TO LOAD THE DRIVERS
00210 U=USR(12288):REM INITIALIZE THE LCD
00220 I=USR(12300,1) : REM CLEAR LCD
00230 PRINT "HIT SOME KEYS TO TRANSFER THEM TO THE LCD, FOLLOWED BY <RET>"
00240 A1$=KEY:IFA1$=""THENGOTO240
00250 I=USR(12295,ASC(A1$)) : REM PUTS A CHAR ON THE LCD
00260 IF A1$<>CHR(13) THEN GOTO 240
00270 PRINT "SHIFT THE DISPLAY RIGHT TEN TIMES, HIT <RET "
00280 A1$=KEY:IFA1$=""THEN GOTO280
00285 FOR A=1 TO 10
00290 I=USR(12300,28) : REM SHIFTS DISPLAY RIGHT
00300 NEXT A
00305 PRINT "TO CLEAR LCD AND GO AGAIN, HIT THE <RET "
00306 A1$=KEY:IFA1$=""THEN GOTO 306
00310 GOTO 220
00320 FOR A=12288 TO 12443
00330 READ B:POKE A,B
00340 NEXT A
00350 RETURN
00360 REM data for poking from  16000 to  16155 dec
00370 DATA 205, 17, 48, 205, 92, 48, 201, 121, 205, 56
00380 DATA 48, 201, 121, 205, 30, 48, 201, 62, 255, 211
00390 DATA 1, 62, 0, 211, 1, 62, 32, 211, 0, 201
00400 DATA 71, 203, 63, 203, 63, 203, 63, 203, 63, 211
00410 DATA 0, 205, 83, 48, 120, 230, 15, 211, 0, 205
00420 DATA 83, 48, 205, 147, 48, 201, 71, 203, 63, 203
00430 DATA 63, 203, 63, 203, 63, 198, 16, 211, 0, 205
00440 DATA 83, 48, 120, 230, 15, 198, 16, 211, 0, 205
00450 DATA 83, 48, 201, 203, 247, 211, 0, 203, 183, 211
00460 DATA 0, 201, 62, 3, 205, 45, 48, 205, 147, 48
00470 DATA 62, 3, 205, 45, 48, 205, 147, 48, 62, 3
00480 DATA 205, 45, 48, 62, 2, 205, 45, 48, 62, 40
00490 DATA 205, 30, 48, 62, 8, 205, 30, 45, 62, 1
00500 DATA 205, 30, 48, 205, 147, 48, 62, 6, 205, 30
00510 DATA 48, 62, 14, 205, 30, 48, 201, 14, 255, 62
00520 DATA 0, 229, 225, 16, 250, 201
```

3) To show some of the features of the LCD and its graphics ability.

Program 3 is a little game, a take-off from Cannibals & Missionaries, called 'Feminists and Chauvinists', as the 7 × 5 font for PCG characters would not allow enough distinction betwen Cannibals and Missionaries. (The feminists play the same roll as the Cannibals!!).

It's written in BASIC (rather inefficiently, I'm sorry), and is quite long. So, if you don't want to type it in you may just like to view it as an example, or you can get a disk or tape of all the programs in this project by writing to the magazine (see accompanying advertisement).

```
00100 REM PROGRAMME 3 - A BASIC LCD GAME USING
00110 REM LCD GRAPHICS AND TEXT.
00120 REM *** FEMINISTS AND CHAUVINISTS ****
00130 REM  by P.Leonardi 20-10-85 VER 1.0
00140 REM
00150 M=1:W=0
00160C=3:F=3:D=0:G=0
00170 N=0:P=1
00180 REM USR(12288)    : INITIALIZES THE LCD
00190 REM USR(12295,X) : PUTS THE VALUE X INTO LCD REG 1
00200 REM USR(12300,X) : PUTS THE VALUE X INTO LCD REG 0
00210 REM ##############################################
00220 CLS
00230 GOSUB 840:REM CALL THIS TO LOAD THE DRIVERS
00240 U=USR(12288):REM INITIALIZE THE LCD
00250 U=USR(12300,64):REM NOW WE TALK TO CHARACTER GEN RAM
00260 GOSUB 1450:REM CG RAM SETUP
00270 CLS
00280 GOSUB 1200:REM ASK PLAYER
00290 IF X>F OR Y>C:B1$=" NOT ENOUGH PEOLE THERE     ":GOSUB1300:GOSUB1390:GOTO2
80
00300 F=F-X:C=C-Y:D=D+Y:G=G+X
00310 GOSUB 1250
00320 GOSUB 890
00330 GOSUB 460
00340 GOSUB 1030
00350 GOSUB 1410
00360 IF G=3:IF D=3:B1$= "  YOU HAVE SAVED THE DAY     ":GOSUB1300:STOP
00370 GOSUB 1180
00380 IF X>G OR Y>D:B1$="NOT ENOUGH PEOPLE THERE":GOSUB1300:GOSUB1390:GOTO370
00390 GOSUB 1250
00400 G=G-X:D=D-Y:C=C+Y:F=F+X
00410 GOSUB 1030
00420 GOSUB 640
00430 GOSUB 890
00440 GOSUB 1410
00450 GOTO 270
00460 REM **** take boat right ****
00470 FOR A=202 TO 219
00480 I=USR(12300,A-1)
00490 I=USR(12295,32)
00500 I=USR(12295,5)
00510 I=USR(12295,6)
00520 I=USR(12295,6)
00530 I=USR(12295,7)
00540 I=USR(12300,A-64)
00550 I=USR(12295,32)
00560 I=USR(12295,N)
00570 I=USR(12295,P)
00580 REM PLAY 20,1
00590 NEXT A
00600 I=USR(12300,A-63)
00610 I=USR(12295,32)
00620 I=USR(12295,32)
00630 RETURN
00640 REM *** take boat & cont left ****
00650 FOR A=219 TO 201 STEP -1
00660 I=USR(12300,A)
00670 I=USR(12295,5)
00680 I=USR(12295,6)
00690 I=USR(12295,6)
00700 I=USR(12295,7)
00710 I=USR(12295,32)
00720 I=USR(12300,A-64)
00730 I=USR(12295,N)
00740 I=USR(12295,P)
00750 I=USR(12295,32)
00760 REM PLAY 10,1
00770 NEXT A
00780 I=USR(12300,A-64)
00790 I=USR(12295,32)
00800 I=USR(12295,32)
00810 RETURN
00820 STOP
00830 REM **** MACHINE CODE ROUTINE
00840 FOR A=12288 TO 12443
00850 READ B:POKE A,B
00860 NEXT A
00870 RETURN
00880 REM ** display people left ***
00890 U=USR(12300,128):REM NOW WE TALK TO DISPLAY RAM
00900 IF C=0:GOTO0940
00910 FOR A=1 TO C
00920 U=USR(12295,M)
00930 NEXT A
00940 IF F=0:GOTO0980
00950 FOR A=1TOF
00960U=USR(12295,W)
00970NEXTA
00980 IF C+F>=5:GOTO1020
00990 FOR A=0 TO 5-C-F
01000 U=USR(12295,32)
01010 NEXT A
01020 RETURN
01030 REM ** DISPLAY THE PEOPLE RIGHT ****
01040 U=USR(12300,161)
01050 IF D=0:GOTO 1090
01060 FOR A=1 TO D
01070 U=USR(12295,M)
01080 NEXT A
01090 IF G=0:GOTO 1140
01100 FOR A=1TOG
01110U=USR(12295,W)
01120 NEXT A
01130 IF D+G>=5:GOTO 1170
01140 FOR A=0 TO 6-D-G
01150 U=USR(12295,32)
01160 NEXT A
01170 RETURN
01180 CLS
01190 REM **** ASK HOW MANY? ON LCD***
01200 B1$="  HOW MANY FEMINISTS?  ":GOSUB1300:INPUT X:IFX=2:Y=0:GOTO1240
01210 B1$=" HOW MANY CHAUVINISTS? ":GOSUB 1300:INPUT Y
01220 IF X+Y<1:B1$="NEED AT LEAST 1 PERSON":GOSUB1300:GOSUB1390:GOTO1200
```

```
01230 IF X+Y>2:B1$="TOO MANY PEOPLE IN BOAT":GOSUB1300:GOSUB1390:GOTO1200
01240 RETURN
01250 IF Y=2:P=M:N=M
01260 IF X=1:N=W
01270 IF Y=1:P=M
01280 IF X=2:P=W:N=W
01290 RETURN
01300 REM * SCREEN PRINT LCD ROUTINE
01310 REM CENTRE AT 148
01320 A=148-(LEN(B1$)/2)
01330 I=USR(12300,A)
01340 FOR A=1 TO LEN(B1$)
01350 I=USR(12295,ASC(B1$(;A,A)))
01360 NEXT A
01370 RETURN
01380 REM TIME WAIT
01390 FOR A=1 TO 1000:NEXTA:RETURN:REM TIME DELAY
01400 REM *** BLEW IT ROUTINE
01410 B1$=" BLEW IT. THE FEMS GOT YOU"
01420 IF C<>0:IF F>C:GOSUB1300:STOP
01430 IF D<>0:IF G>D:GOSUB1300:STOP
01440 RETURN
01450 REM *** SET UP CG RAM ****
01460 FOR A=1 TO 64
01470 READB
01480 U=USR(12295,B)
01490 NEXT A
01500 GOSUB 880
01510 I=USR(12300,168)
01520 FOR A=1 TO 7
01530 I=USR(12295,2)
01540 NEXT A
01550 I=USR(12295,2)
01560 I=USR(12295,3)
01570 I=USR(12295,32)
01580 I=USR(12295,5)
01590 I=USR(12295,6)
01600 I=USR(12295,6)
01610 I=USR(12295,7)
01620 I=USR(12300,224)
01630 I=USR(12295,4)
01640 FOR A=1 TO 7
01650 I=USR(12295,2)
01660 NEXT A
01670 RETURN
01680 DATA 205, 17, 48, 205, 92, 48, 201, 121, 205, 56
01690 DATA 48, 201, 121, 205, 30, 48, 201, 62, 255, 211
01700 DATA 1, 62, 0, 211, 1, 62, 32, 211, 0, 201
01710 DATA 71, 203, 63, 203, 63, 203, 63, 203, 63, 211
01720 DATA 0, 205, 83, 48, 120, 230, 15, 211, 0, 205
01730 DATA 83, 48, 205, 147, 48, 201, 71, 203, 63, 203
01740 DATA 63, 203, 63, 203, 63, 198, 16, 211, 0, 205
01750 DATA 83, 48, 120, 230, 15, 198, 16, 211, 0, 205
01760 DATA 83, 48, 201, 203, 247, 211, 0, 203, 183, 211
01770 DATA 0, 201, 62, 3, 205, 45, 48, 205, 147, 48
01780 DATA 62, 3, 205, 45, 48, 205, 147, 48, 62, 3
01790 DATA 205, 45, 48, 62, 2, 205, 45, 48, 62, 40
01800 DATA 205, 30, 48, 62, 8, 205, 30, 48, 62, 1
01810 DATA 205, 30, 48, 205, 147, 48, 62, 6, 205, 30
01820 DATA 48, 62, 14, 205, 30, 48, 201, 14, 255, 62
01830 DATA 0, 229, 225, 16, 250, 201
01840 DATA 14,14,4,31,4,14,31,10,14,14,4,31,4,14,10,10
01850 DATA 31,31,31,31,31,31,31,31,16,24,28,30,30,31,31,31
01860 DATA 1,3,7,15,15,31,31,31,0,0,0,0,31,15,7,3
01870 DATA 0,0,0,0,31,31,31,31,0,0,0,0,31,30,28,24
01880 NEXT A
01890 END
```

Finally

Now that you have the physical and electrical connection specified, as well as some driver routines and examples, it should be quite simple to discover some uses for the LCD for your own benefit. As a final thought, the LCD could be connected internally to the Z80 bus, but there are a few restrictions. The Z80 has separate read and write signals, and the enable clock is too fast for the LCD as it is. So in the interest of keeping the Microbee in original condition, I have described this as a port A device.

Note that all programs in this text have been tranferred from their appropriate environment, EDASM or BASIC. They haven't been typed in by copying a listing, and each has been verified prior to the transfer.

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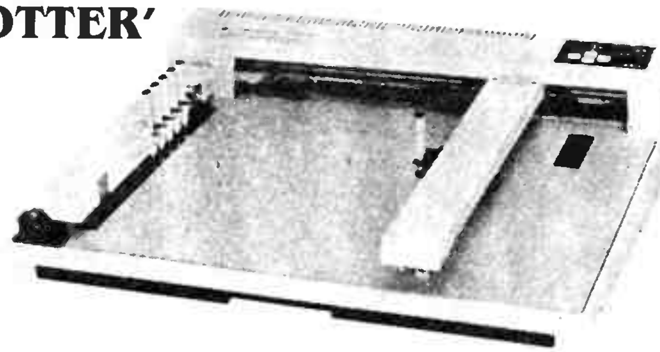

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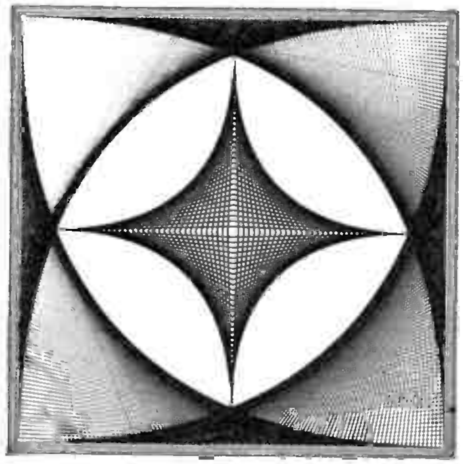

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Some New Year speculation

SEEING AS it's the New year, I thought I'd indulge in a little speculation. Remember though, that this is just speculation on my part — Microbee Systems might do something else entirely.

What's might the Microbee of the future look like internally? Perhaps I have already seen it. I hope so.

The Japanese have come up with a new microprocessor chip called the HD64180. It's mostly the good old Z80, the chip used in all current Microbees. But this new one has a few enhancements. The package size has grown from 40 pins to 64, so there's space for, among other things, some more address lines. So, the HD64180 becomes a Z80 that can directly address 512K of memory instead of the 64K the Z80 is limited to.

The chip is based on CMOS technology, meaning its power consumption is very low. It runs the full Z80 set of machine code instructions, as well as a few extras. The most significant of these is the ability to multiply two numbers in hardware (within the chip). The Z80 can only add and subtract and do logical bit shifts, so for it to multiply and divide it has to combine adds and shifts into a software routine.

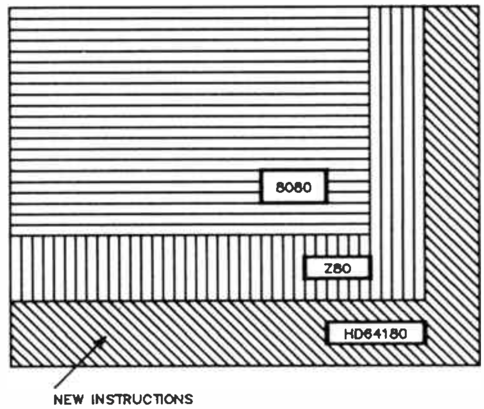
The Microbee has got along fairly well with the Z80. It's ideal for the 32K ROM-based machines, such as the current PC-85 and the disk-based 64K Computer-In-A-Book. But extending beyond 64K of memory is a bit messy, since the Z80 can only address 64K. The 128K Small Business Computer gets around this by switching back and forth between banks of memory, all with the same physical addresses. Like I said, it's messy, but it seems to work. And all of the current Microbees have somewhat limited memory devoted to the screen display. But even with only 3K of screen to play around with, they turn out some quite remarkable graphics by sneaky software manipulation of the 3K.

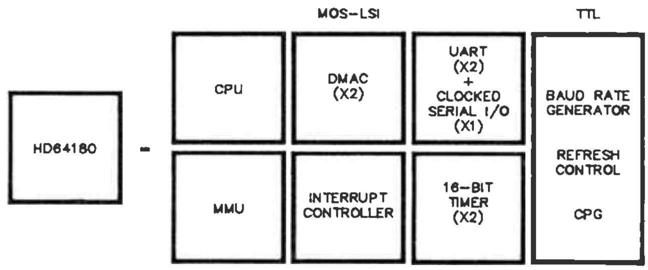
A recent issue of *Byte* magazine (Sept. '85) featured a kit computer based on the HD64180, and the basic design had Microbee written all over it (not as a kit mind you; been there, done that). This little beauty has 256K of user RAM, as well as 32K of ROM for the boot routines and machine code monitor. There are not one, but two, serial ports and I'd use one for my modem and the other for my printer. There's also a parallel port into which you could plug your Listening Post or whatever.

This little computer has a disk controller which can supervise up to four disk drives in any combination of 3½", 5¼" or 8" formats. The whole computer runs on one single 5 volt power supply, except for a little bit of + 12 that's needed for the serial ports. this could make the power supply design super-easy.

As to the operating system, it's good old CP/M, sort of. There's an enhanced version of CP/M used on many Microbees called ZCPR. Well, this new computer runs ZCPR-3, an enhancement of the enhancement of the enhancement! The operating system is written entirely in Z80 code, not 8080 as is the "pure" CP/M, so it takes full advantage of the processor's abilities.

A new Microbee could be designed much along these lines. You could keep the present PCG method of generating graphics, so all current software would still run on the new machine. But there should be another graphics mode available, using some of that as yet empty address space: full dot-addressable graphics, the whole screen, the full load! Imagine the applications of that . . . on-screen weather maps and satellite pictures. Digitized photographs. Slow-scan television. Oooh! I want one!





The Hitachi HD64180 is sure to revitalise 8-bit microcomputing with all the features it offers on-board.

Just for the record, the Australian representative for Hitachi semiconductors is Ellistronics,797 Springvale Road, Mulgrave, Vic. 3170.

The too-hard file

For some weeks I have been sharing an office with a new you-beauty Brand-X 16-bit computer with hard disk, heaps of memory, red and white tail fins and benzine supercharger. This device is supposed to be the wave of the future for the electronic office and it would retail for around $8000. The only trouble is, we're still trying to get it to work.

This machine was bought without a monitor, since we have about half a dozen of them already. Trouble is, the You-Beauty has nowhere to plug one in. There is a nine-pin socket on the video board, and we soon discovered by poking around with an oscilloscope that it has three separate lines carrying horizontal syncs, vertical syncs and video. We soon built a little external circuit to combine these signals into normal "composite video" for our existing monitors. This worked nicely except for one problem. The left hand edge of the picture (about 10 typed characters per line) was missing. Reason: the You-Beauty uses a funny line scanning rate, so it will only work with its own monitor. Result: new monitor. But what's a few hundred dollars between friends?

The You-Beauty arrived with lots of nice software on its hard disk. This we discovered by snooping around with commands like "DIR", even though the first 10 columns on screen or so were missing. Even tried to run the Flight Simulator program on the floppy disk. (It wouldn't go.) Let the machine ▶

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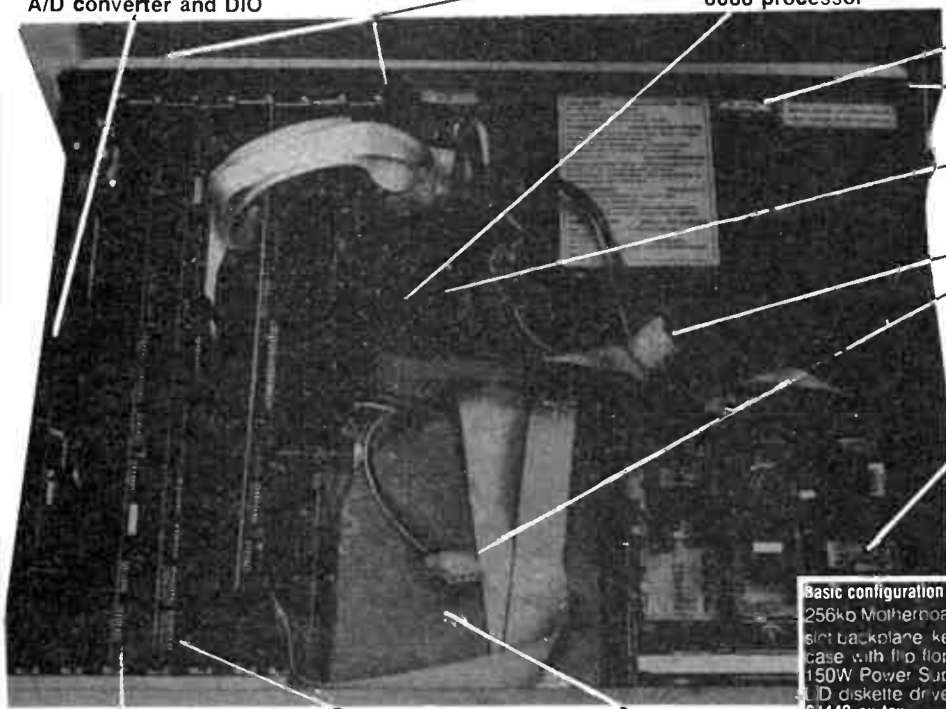

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rest over the weekend. Came back Monday to find it no longer realised it has a hard disk, and claimed drive "C" was illegal.

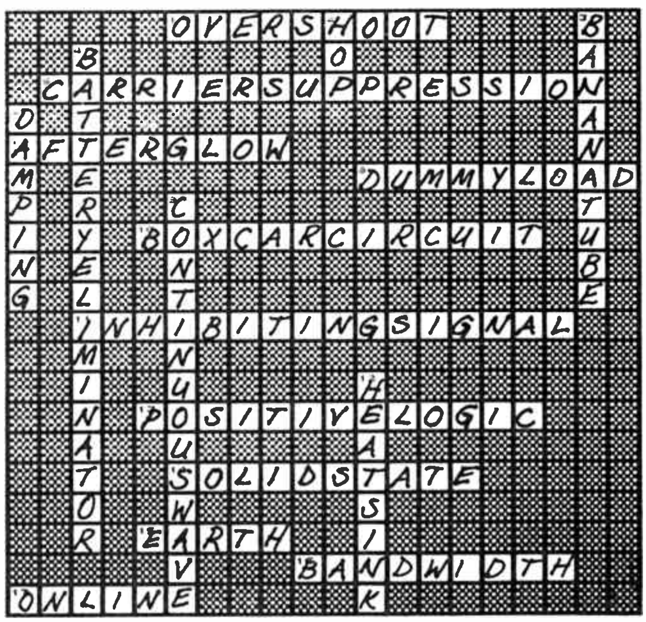
The current theory is that some disk we had in the floppy drive managed to overwrite the operating system on the hard disk, and the only way to fix it is to re-format the hard disk. Goodbye software. I realize that a lot of this is "cockpit trouble" but I don't think our good old Microbee 128K machine would be capable of such devastation, no matter how stupid the operator. So, if Microbee systems are thinking of producing a version of the trendy You-Beauty, I hope they think twice about it. Has anyone really figured out a good use for 16-bit hardware yet?

I would like to welcome my old mate Neil Duncan's new column in this magazine. He's the guy who writes about those other computers, Crapple and Vomitore. Lets see if we can think up some insults to hurl at the users of those machines. I'm sure they can do the same for us.

Seriously, though, I recently spent a week as the Duncan family's house guest during the IREE convention in Melbourne. Even though they are Victorians they do speak reasonable English. Neil seems to know which button to push to make his Apple's screen light up, and he finally has a ham radio rig that works. This is interesting, considering the number of hours I've spent trying to communicate with a collection of snorts, shrieks, and whistles that came from his home-brew rigs. The store-bought one actually produces sounds you can understand.

Plug time: If you know anybody who needs educational software for the Apple, they should contact Neil. He turns out that clever sort of stuff we see from Goodison for the Microbee.

The answers to last month's Weller Crossword



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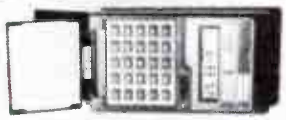

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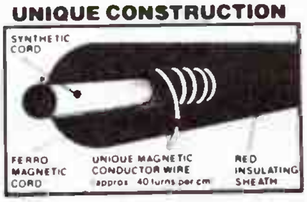

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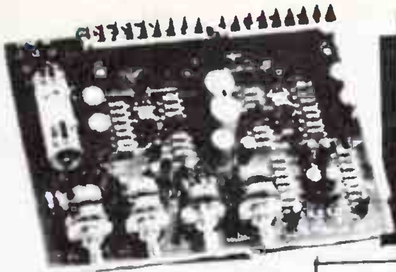

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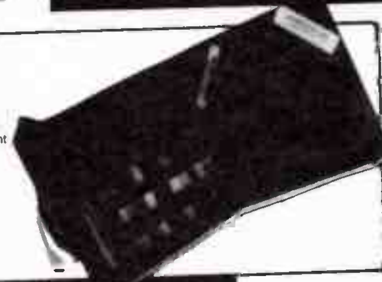

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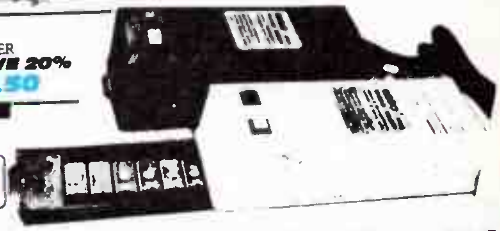

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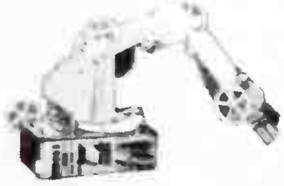

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AWA switches to 'local' mobile radio production

Don Jamison of AWA (left) and Brian Chapman of AGL with the first NZ-made RT-85 mobile.

In a bid to win additional government contracts, AWA has transferred the manufacturing of its RT-85 mobile radio from Japan to its New Zealand based company, AWA New Zealand Limited.

Under the recent "Australia/New Zealand Closer Economic Relations Trade Agreement", which allows for reciprocal manufacturing advantages, New Zealand manufactured communications equipment is considered "locally" made by Commonwealth and State Government departments.

Mr Greg Hughes, General Manager of AWA's Ashfield Division, said, "Local manufacture of the RT-85 Carphone will position AWA to effect increased penetration into these government departments, as we are now able to satisfy their long-standing preference for locally made and serviced products.

"This AWA microprocessor controlled VHF/UHF FM two-way land and mobile radio undergoes the same stringent quality control procedures in New Zealand as it did in Japan."

The 64 channel capacity VHF/UHF mobile radio comprises a simple push button digital display control unit with attached lightweight microphone, a sealed, rugged diecast transmitter/receiver and a tailored speech frequency response high efficiency loudspeaker.

Designed specifically to overcome the space and mounting limitations of modern vehicles, the RT-85's control head mounts conveniently near the driver while the transmitter/receiver mounts in a sturdy cradle under the dashboard or in the boot.

AWA's RT-85 Carphone also has a wide range of options that expand the capabilities of the system, allowing for future operational requirements such as automatic number identification, selective calling and status.

"Sophisticated options such as these are essential to services such as public utilities, metropolitan and bush fire brigades, police and police rescue squads and ambulance services," said Mr Hughes.

AWA has been consistently involved in the mobile radio communications field since 1922 and supplied the radio communications needs of many large and small organisations throughout Australia and overseas.

As an example, the company has recently been awarded a contract to supply the Australian Gas Light Company with 260 RT-85 Carphones for their customer service fleet and for their emergency gas maintenance services.

RTTY/CW computer interface

A computer interface designed to connect to a radio transceiver or receiver and allow computerised RTTY/ASCII/AMTOR/ARQ/FEC/CW operation is available from GFS Electronic Imports.

Known as the Model MFJ-1224, and manufactured in the USA by MFJ Enterprises of Mississippi, it offers a number of unique features, claim GFS. For example, it may be used on most of the common computers about today due to its versatile I/O circuitry. Such machines include the VIC-20, C-64, Apple and TRS-80C. Included in the unit's price is a CW/RTTY software cassette to suit the VIC-20/C-64 computers.

The MFJ-1224's design makes use of a sharp 8-pole active filter when in the 170 Hz shift or CW modes. GFS claim that this, coupled with its XR2211 PLL detector, provides good copy from almost unreadable signals. It is capable of operating on 850 Hz and 425 Hz as well as the 170 Hz shifts.

Operation on AMTOR, ARQ and FEC are accommodated provided the host computer has the appropriate software. A single dc power source of 12 to 15 volts is all that is required for operation.

Price of the MFJ-1224 is $345 plus $14 P&P. For further information contact **GFS Electronic Imports, 17 McKeon Road, Mitcham 3132 Vic. (03) 873 3777.**

GFS/AEM 'WIN A SCANNER' CONTEST RESULTS

This contest, which ran over the July to September 1985 issues, proved quite popular. It was verydifficult judging the winner, but

John Bailey of Surrey Hills, Vic.

pulled it off. Congratulations, John. Thanks to all those who entered. Answers and more details next month.

UHF CBers — boost your signal with this beam antenna

Garry Crapp
Technical Products Department
Dick Smith Electronics

This simple to construct beam antenna comes as a kit and will boost your signal by a factor of around 18 times. Make your four watt signal sound like 70 watts!

THE RANGE you can reliably achieve on the 477 MHz UHF Citizens Band is entirely determined by what is called 'station system performance'. A station system comprises:

1) the antenna
2) the feedline
3) the receiver, and
4) the transmitter

The height of the antenna above the 'average terrain' also matters. This means that, either you live on top of the biggest hill around, or you put up a big tower to get the same advantage! The transceiver you buy or own will have a given level of performance, so that's more or less fixed. However, the antenna and feedline parts of the station system provide a wide latitude for obtaining improved station system performance.

Omnidirectional antennas (that transmit and receive equally in all directions of the compass) are widely used on the UHF CB band. Such types range from the humble groundplane to 'high gain' collinears. An omnidirectional antenna which exhibits some gain will give better range and improved signal strengths compared to a groundplane type.

A beam antenna will also give improved range and signal strengths in its favoured direction, and at the same time reduce the possibilities of interference from (or to) directions it does not favour, which an omnidirectional antenna will not.

However, a beam antenna needs to be 'aimed' in the desired direction. For this purpose, a wide range of antenna rotators are available, either designed for aiming TV antennas or for radio amateur use.

Design details

The antenna described here is a Yagi type, named after one of its co-inventors, Hidetsu Yagi. The Yagi antenna is a popular type because it gives the most gain for the least amount of materials used in construction. Or, as the Americans put it, ". . . best bang for the buck."

A Yagi comprises a dipole *driven element*, a *reflector* behind it, and one or more *directors* in front of it, as shown in Figure 1. It receives and transmits best as shown by the direction of the arrow in front. In actual fact, it will work, to some extent, in all directions, but best over a range of directions in front of the antenna, as illustrated in Figure 2.

The close-spaced lines show the area over which it gathers more energy on reception or where it sends more energy when transmitting. Note that, to the side of the antenna, the lines are widely spaced and to the rear they are a little more closely spaced. This shows that very much less energy is received or transmitted off the sides of the antenna and little is received or transmitted to the rear, but nowhere near as much as to the front. Figure 2 looks "down" on the antenna. If you looked from the side, the diagram would be similar.

If you draw a diagram of *signal strength* from all directions around the antenna looking, say, top down, you get something like Figure 3. In front of the antenna is the *main lobe*. Where the signal strength falls to 'half power' either side of the forward direction determines the antenna's *beamwidth*. For a Yagi it will be different when looking 'top down' to looking 'side on', so two beamwidths are generally quoted in such antenna specifications. Figure 4 illustrates the side-on view.

The ratio of the signal strength in the forward direction to the signal strength in the rearward direction is called the *front-to-back ratio*. The ratio is conveniently expressed in decibels (dB).

The advantage a beam antenna gives you is called its *gain*. The gain is always expressed as a ratio compared to either a theoretical antenna (i.e: convenient, but impossible to make!) called an *isotropic antenna*, or a dipole (which is a practical antenna), and expressed in decibels (dB). An isotropic antenna radiates or receives equally well in *all* directions. Gain quoted with respect to such an antenna is written "dBi", while gain with respect to a dipole is written "dBd". If the reference antenna is not quoted — don't believe the gain figure! Incidentally, a dipole has gain compared to an isotropic antenna. Hence dBi gain figures are always higher than dBd figures.

In a Yagi antenna, the reflector is a few per cent longer than the driven element, while the directors are a few per cent shorter than the driven element. The driven element is a half wavelength dipole. The directors may be of varying lengths or all the same length. Also, the director spacings may vary, or may be constant, the first director being a different distance from the driven element.

The first major requirement of this design was simplicity of construction. To this end, a simple spacing scheme was settled on and the antenna designed around that criterion. A manageable beam size of about one and a half metres was decided on and this resulted in a beam with a total of 13 elements, allowing some 245 mm of boom behind the reflector for mounting. The reflector to driven element spacing and driven element to first director spacing is the same, being 125 mm. The spacing between directors is constant, being 100 mm centre-to-centre. All the directors are the same length — 258 mm. Figure 5 gives all the mechanical details.

All elements, except the dipole driven element, are cut from commonly available aluminium strip 10 mm wide by 3 mm

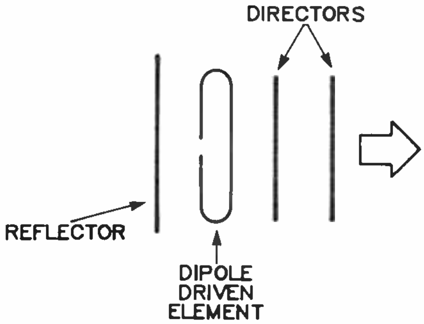


Figure 1. The general form of a Yagi antenna. The driven element is a dipole a half wavelength long at the design frequency. The reflector is a few per cent longer than the driven element, while the directors are shorter. The reflector is spaced about one-fifth to one-quarter of a wavelength behind the driven element. The directors are spaced between about one-tenth and one-fifth of a wavelength apart and the first director may be quite close to the driven element. It transmits and receives best in the direction of the arrow.

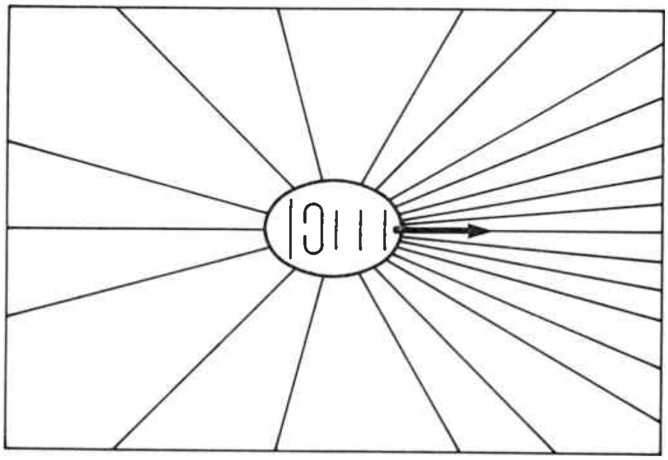


Figure 2. The antenna will receive (and transmit) signals in all directions, but better in some directions than others. The close-spaced lines show where more energy is gathered when receiving or more energy is concentrated when transmitting.

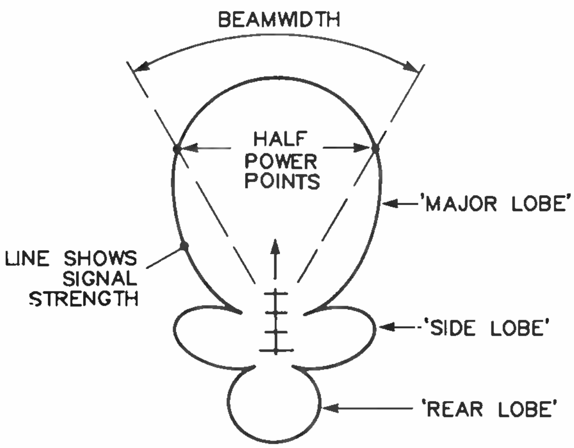


Figure 3. This shows the typical 'radiation pattern' of a beam. The distance from the antenna to the line is a measure of signal strength (radiated or received). This is a top-down view of the antenna. Note the various 'lobes' and how very little is received or radiated from the sides of the antenna. This view of a yagi is generally known as the electric plane, or 'E-plane', view.

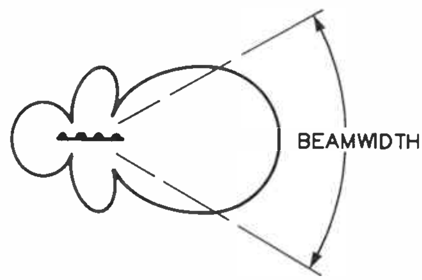
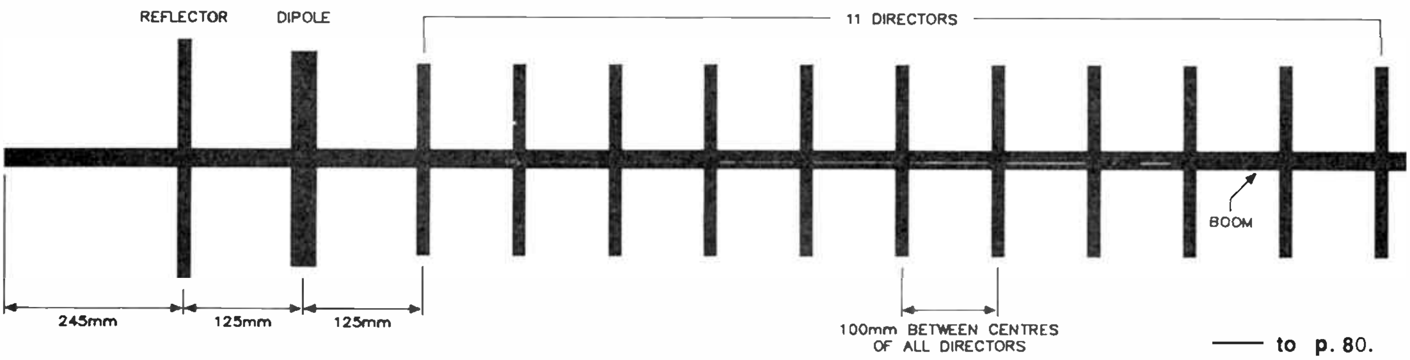


Figure 4. This shows the typical 'side-on' radiation pattern of a beam. Note the similarities to Figure 3. This view of a Yagi is generally known as the magnetic plane, or 'H-plane', view.



— to p. 80.

NOTE: DIPOLE,PC BOARD DSE ZA1698
REFLECTOR–10x3x310mm ALUMINIUM STRIP–1 OFF
DIRECTORS–10x3x258mm ALUMINIUM STRIPS–11 OFF
BOOM–19x19x1500mm SQUARE SECTION ALUMINIUM

Figure 5. Overall assembly details and general dimensions of the project.

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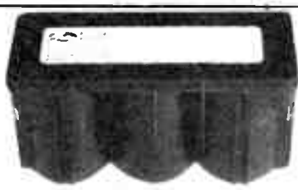

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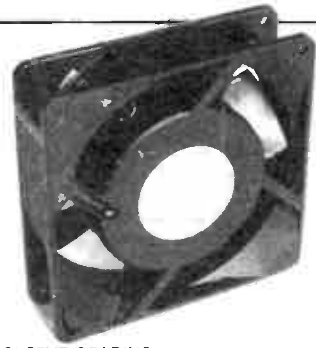

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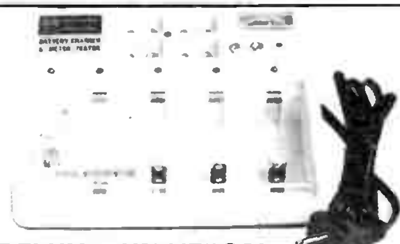

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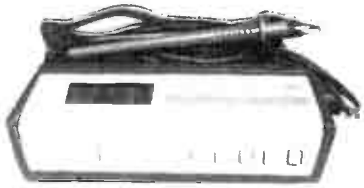

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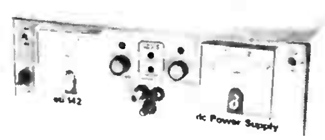

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thick. The boom is a length of 19 x 19 mm square-section aluminium tubing. The elements, except the dipole, are all secured to the boom with PK screws. The kit comes with all the elements and the boom pre-drilled.

The driven element is quite cunning in its design. To 'match' 50 ohm cable to the dipole, we have employed a "gamma match". Its form is shown in Figure 6. This form of matching is quite commonly used on lower frequency antennas. The impedance at the centre of a dipole driven element in a Yagi is quite low. The 'gamma arm' is 'tapped' out along one side of the dipole to a point that gives a match the 50 ohms of the coaxial cable feedline. However, this 'arm' adds a little inductance in series, so a small capacitor is used to 'tune out' this inductance.

The problem is, at UHF, the addition of the matching paraphernalia unbalances the dipole driven element and the beam does not perform properly. The solution is to *shorten* that arm of the dipole to which the gamma match is attached.

The dipole driven element here is constructed from double-sided, fibreglass substrate printed circuit board. A disc at the end of the gamma match arm forms the required capacitance with a disc on the opposite side of the pc board and the inner conductor of the coax feedline connects to this. Figure 7 illustrates.

This month's ★ Star Project ★ is from Dick Smith Electronics who will be marketing kits through their stores and dealers; cat. no. K6304, $39.95. Mail order enquiries to PO Box 321, North Ryde 2113 NSW. (92) 888 3200.

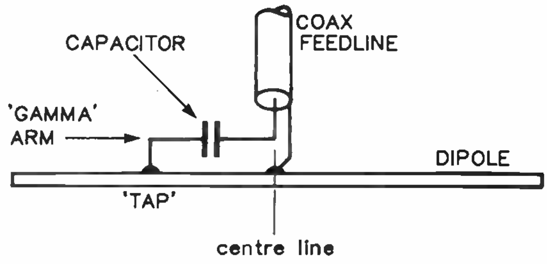

Figure 6. A 'gamma match'. The tap provides an impedance match to the coaxial cable, but the gamma arm introduces a small inductance. This is tuned-out by the capacitor.

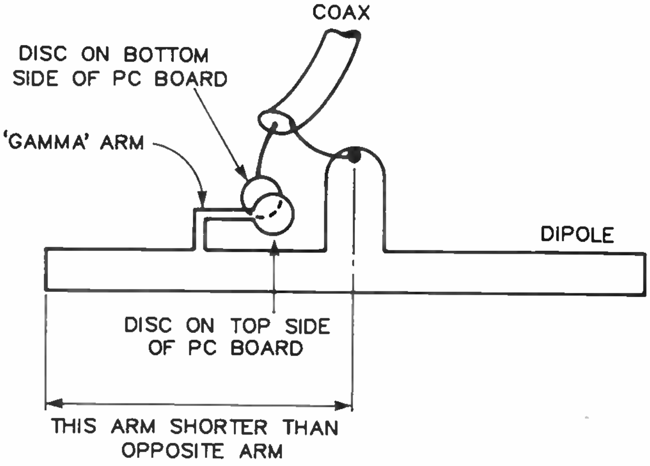

Figure 7. General view of the driven element. The effect of the gamma match on the operation of the dipole is compensated for by shortening that side of the dipole.

Assembling the beam

Assembly of the beam is quite straightforward as the elements and boom come pre-drilled. No measuring, cutting or drilling is required! First, identify all the directors and the reflector. The reflector will be the longest 10 x 3 mm aluminium strip. The 11 directors are all the same length. Determine which end of the boom is which. The reflector is mounted about 245 mm from one end, the leading director is right at one end. Screw the reflector and all the directors to the boom using PK screws.

To assemble the dipole driven element, a short length of 6.5 mm diameter coax needs to be attached. This should be a high quality, relatively low loss type, such as RG223/U. You'll need only 200-300 mm. The other end should be terminated in a suitable connector, such as a BNC type. Figure 8 shows how it's done. To prepare the cable, expose about 12-15 mm of the inner conductor and insulation. Undo the braid, twist it around and lay it to one side. Don't leave any stray braid wires hanging around loose. The centre conductor passes through the hole adjacent to the pad at the end of the gamma arm and is soldered to the lone pad on the underside of the board.

The driven element assembles to the boom as shown (Figure 8), with the driven element track on the pc board uppermost. Secure the cable with the cable clamp beneath the rearward bolt, and solder the braid to the solder lug right up close to the cable. This is achieved more easily if you 'tin' both the braid and the solder lug with solder first. Use a hot iron with a medium diameter tip and work quickly. Try and avoid melting the coax's insulation. After you've completed this, seal the coax and the joints against the ravages of the weather by coating them liberally with a silicone sealant, such as Selley's 'Silastic'. The copper track dipole can be protected by spraying with clear lacquer.

The short length of coax passes over the reflector and should be secured to the boom with either insulation tape or a plastic 'zip-up' cable clamp. Your feedline to the rig should be terminated in a suitable connector and plugged into the coax from the dipole via a suitable coupling joint.

Mounting

As vertical polarisation is predominantly used on the UHF CB band, the beam should be mounted with the elements vertical. So as to avoid a metal mounting mast (which is, naturally, vertical) interfering with the operation of the beam, a length of boom has been left behind the reflector. Thus, the beam can be 'cantilevered' from the mast, as shown here in Figure 9. It is quite light enough and short enough so as not to 'droop' noticeably.

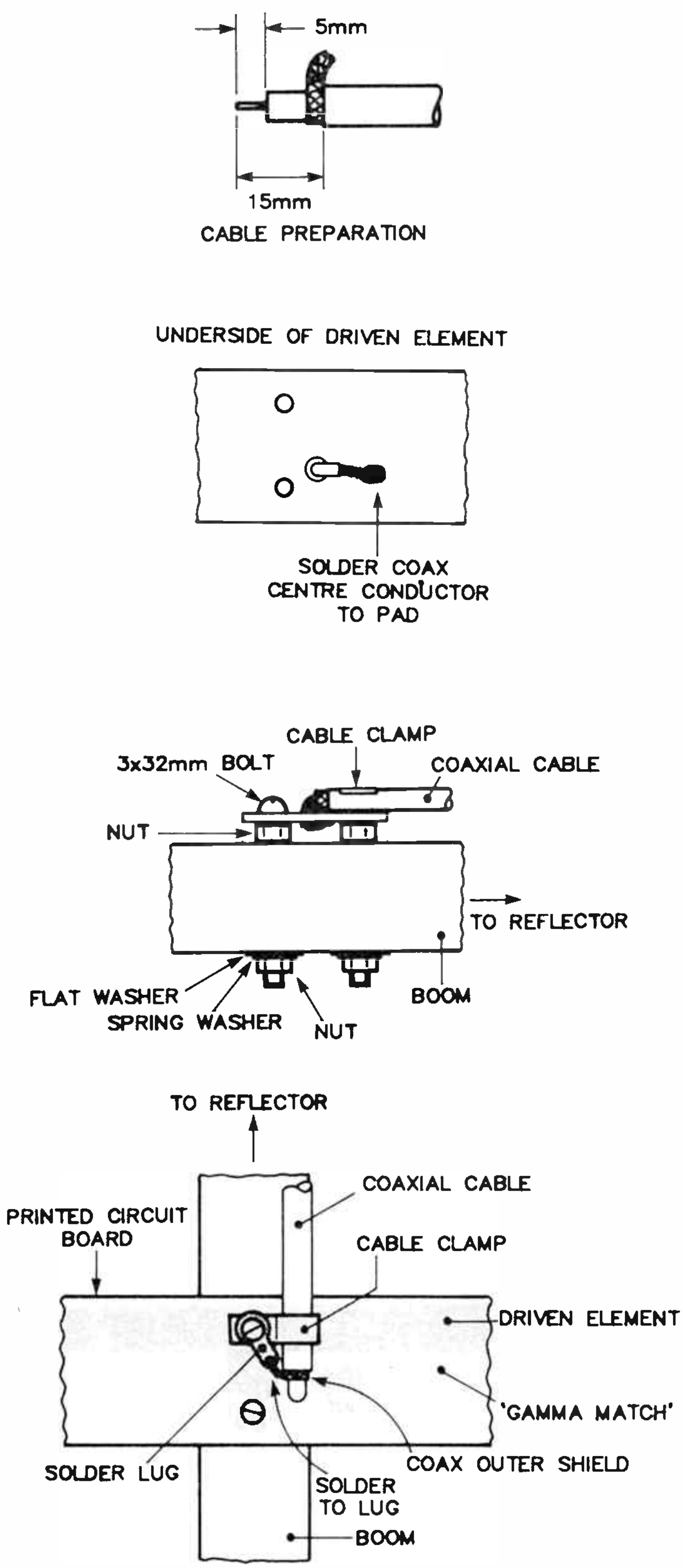

Figure 8. General detail of the driven element assembly showing also how the feedline is terminated.

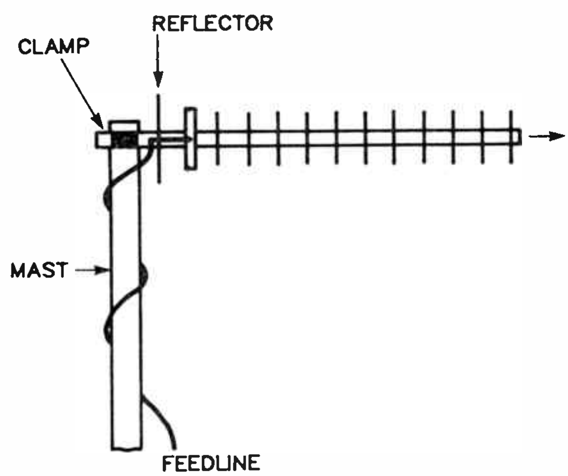

Figure 9. How the beam is to be mounted.

SPECIFICATIONS AS MEASURED ON PROTOTYPE

No. of elements	13
Gain	12.5 dBi* (17.8 x)
Front-to-back ratio	16 dB (1/40th)
Beamwidth ('top down')	15° approx. (E-plane)
('side on')	20° approx. (H-plane)

*Compared to an 'isotropic antenna' which theoretically radiates in all directions. Compared to a groundplane (a 'real' antenna), this antenna would have a gain of about 11 dB (12.5 x).

to p. 86. ▶

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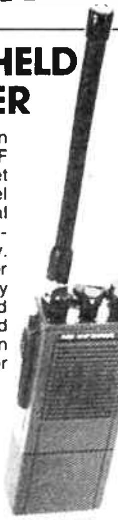

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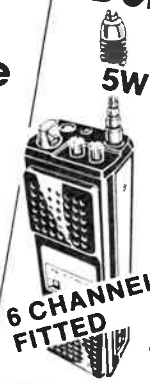

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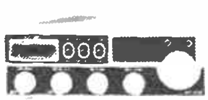

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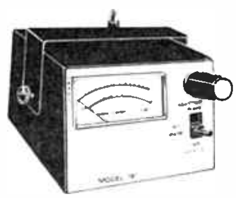

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Spare fuse (0.2A), 1 pce
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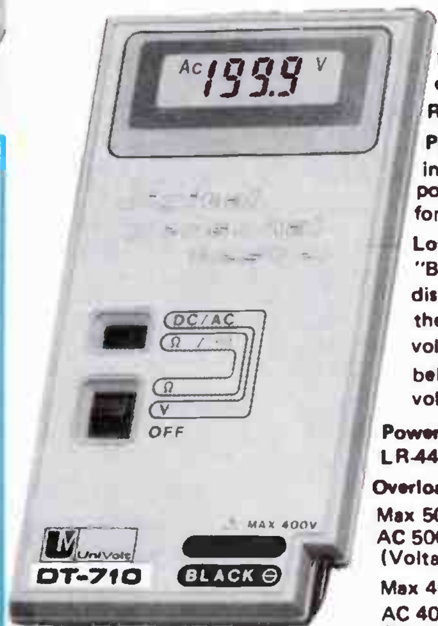
PD-1800

DT-710



Display 3-1/2 digit LCD max reading of 1999
Range Augo-ranging
Polarity Automatic no indication for polarity, minus (-) sign for negative polarity.
Low battery indication "B" mark is displayed when the battery voltage drops below operating voltage
Power Supply LR-44(1.55V) x 2
Overload protection
Max 500V DC or AC 500V RMS (Voltage)
Max 400V DC or AC 400V RMS (Resistance)

Accessories:

battery (LR44, 1.55V)	x 2
hard cover case	x 1
instruction manual	x 1
test leads	x 1

new

Model DT-710

DC Voltage	2,000mV, 20V, 200V, 400V	**Resistance**	200Ω, 2,000Ω, 20kΩ, 200kΩ, 2,000KΩ
(Accuracy)	±2% rdg ±2 dgt	**(Accuracy)**	±2% rdg ±2 dgt
AC Voltage	2,000mV, 20V, 200V, 400V	**Continuity Check**	Ohms of test circuit 200Ω ± 10Ω
(Accuracy)	±3% rdg ±5 dgt		

BENELEC Pty Ltd.

1 Greville St. Randwick NSW 2031 **PHONE: (02) 665 8211**

OM BENELEC MULTIMETERS

DT-860

Display: LCD max. indication 1999
Overrange Indication: "1" or "–1"
Polarity: "–" indication automatically
Input Impedance: 10 Meg Ω
Operating Temperature: 0° ~ 40°C, 80% R.H.
Power Requirement: DC 3V, 2 pcs. UM-3 battery
Battery Life: 300 hours typical
Dimensions: 145(D) x 82(W) x 28(H) mm
Weight: 180g, excluding battery
Accessories:
Safety test leads, 1 pair
UM-3 (1.5V) battery, 2 pcs
Spare fuse (0.2A), 1 pce
Instruction manual, 1 pce

DT-1000

Display: LCD max. indication 1999
Overrange Indication: "1" or "–1"
Polarity: "–" indication automatically
Input Impedance: 10 Meg Ω
Operating Temperature: 0° ~ 40°C, 80% R.H.
Power Requirement: DC 9V, 006P battery
Battery Life: 200 hours typical
Dimensions: 160(D) x 84(W) x 26(H) mm
Weight: 200g excluding battery

General Specifications:

- Display: LCD 4 1/2 digits reading of 24999 frequency (99999) and annunciators
- Range: Auto or Manual Ranging
- Polarity: Automatic no indication for positive polarity, minus (–) sign for negative polarity
- Sampling: 2 ~ 5 times/s
- Over range indication: "OL" mark indication
- Low battery indication: "BT" mark is displayed when the battery voltage drops below operating voltage
- Calibration: 1 year for specified accuracy
- Battery life: Approx 50 Hours (Manganese Battery), Approx 100 Hours (Alkali Battery)
- Power supply: 9V Battery or AC Adaptor (Option)
- Double fuse: 250V 0.5A, 600V 4A (DT-4500) or 250V 4A (DT-4600)
- Size: 177(L) x 88(W) x 43(H) mm
- Weight: Approx 360g
- Accessories:
  - Instruction Manual 1
  - Battery (6F 22) 1
  - Safety Test Lead .... 1 set
  - Spare Fuse (0.5A/250V) 1

DT-4500 DT-4600

Relative Test (Manual range)
Ranges: DV V, AC V, DC Current, AC Current, Resistance.
Displayed Value: Measuring value (Dx)—Relative value (Ds)
When the REL button is pushed, the input applied at that time is stored as a ZERO reference point.
Subsequent readings display deviations from the reference point.

Data Hold

Ranges, Functions: DC V, AC V, DC Current, AC Current, Resistance, Diode, dBm, Temperature, (DT-4600), Relative (DT-4500)

Peak Hold (Manual Range)
DT-4500 only
Ranges, Functions: DC V, AC V, DC Current, AC Current, Temperature.
Accuracy: (Each range accuracy) ± (2% + 100 dgt)
Temperature: ±1 dgt
DC Acquisiiton Time: 5ms
AC Acquisition Time: 250mS

Temp Test (°C or °F reading)

Sensor: K type sensor
Measuring range: –50°C ~ 1200°C or –58°F ~ 2192°F
Resolution: 1°C or 1°F
Accuracy: ±0.5%±3 dgt (°C)
±0.5%±5 dgt (°F)

UniVolt

▶ from p 81.

A variety of suitable mounting methods may be used. A U-bolt and clamp, commonly used to mount TV antennas, is one way, but requires drilling the boom, weakening it and encouraging corrosion. A better method is to use a special U-clamp, as shown in Figure 10. These clamps will be supplied with each kit. It will fit 40 x 40 mm square masts (i.e: dressed timber) or round-section mast of 40 mm diameter. The two thumb screws securely clamp the boom and mast together. The thumb screws, in turn, are secured by the locking nuts.

See that the boom sits horizontal once it's secured. If you so require, the antenna may be horizontally polarised by rotating it 90 degrees so that the elements are horizontal.

Feedline

As mentioned at the beginning, the feedline is an important consideration in station system performance. Hence, the best quality low-loss coax you can afford is recommended. In addition, you should keep the line length as short as possible, consistent with getting the antenna as high as practicable. Don't put the antenna mast 100 metres away from the rig's location, put it as close as practicable.

If you have a substantial run of feedline between the antenna and the rig, you'll have to spend proportionately more on the feedline to keep the losses down. The larger diameter cables have less loss than the common 6.5 mm cables (such as RG58). If you have to use any length of 6.5 mm cable, get a low-loss type and use the shortest possible length — preferably less than 300 mm.

Andrews FHJ4 is a solid (i.e: not flexible) line with very low loss at 477 MHz and relatively high cost as a consequence. Special connectors are required and are not easily fitted. Consider FHJ4 as the 'Rolls Royce' of cables. Belden 9913 is a semi-flexible coax that comes highly recommended and standard 'Type N' connectors can be fitted. If you have a run of less than ten metres, then RG213 *may* be used as it's quite economical, but 9913 would be better.

Rotators

Any light to medium duty rotator may be used for 'aiming' this beam. The height of unsupported mast above the rotator should really be no more than a metre. A length of flexible cable should run between the antenna and the main feedline with some slack to allow rotation without straining the feedline.

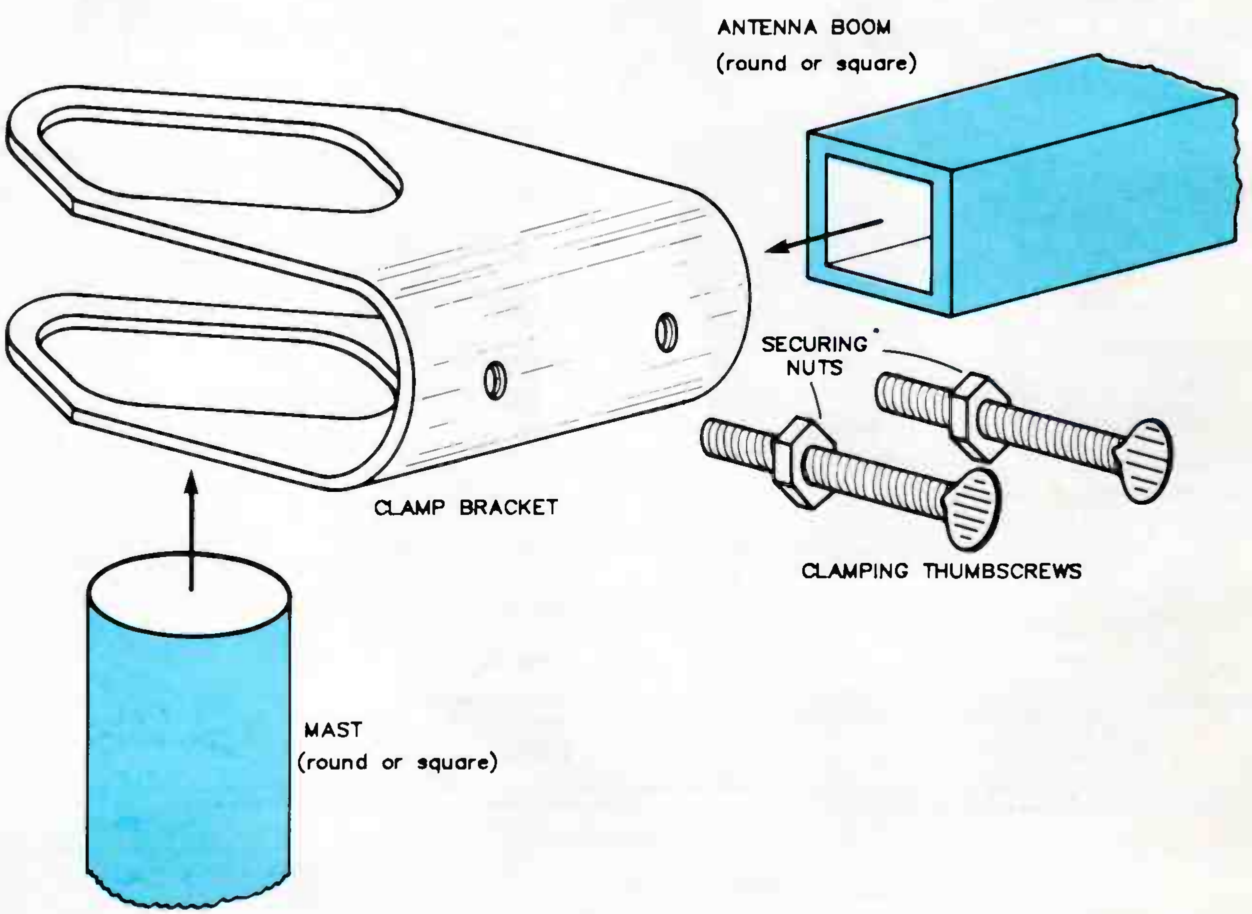


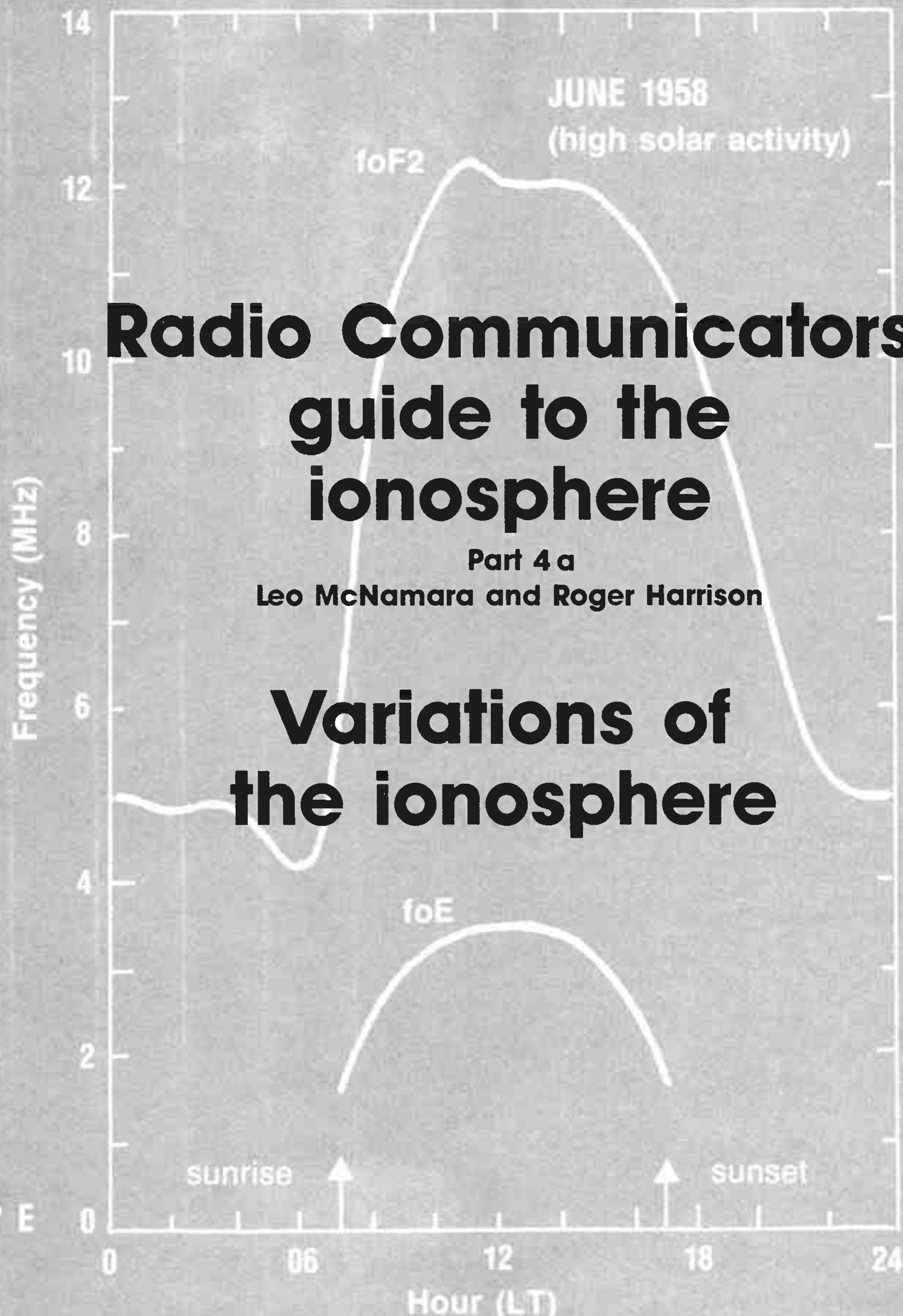
Figure 10. The beam is secured to the mast with this specially-designed U-clamp. Note that either round or square-section mast may be employed.

Radio Communicators guide to the ionosphere

Part 4 a

Leo McNamara and Roger Harrison

Variations of the ionosphere



WE HAVE ALREADY seen that the ionosphere varies with height, or altitude, ranging from the D layer at 50 to 90 km up to the F layer at 200 to 600 km. The fact that the ionosphere is created by the sun immediately suggests that it will vary with time of day, season and position on the surface of the earth. In fact, its variation is very similar to the air temperature which weather forecasters predict.

Generally speaking, the electron density in the ionosphere is greatest in summer, in the middle of the day and near the equator. This simple picture is not quite true as we shall see, but it will suffice for the present. The ionosphere also varies significantly with solar activity, as the amount of UV radiation from the sun waxes and wanes every eleven years or so. We shall consider the variations of the ionosphere in some detail because the frequencies available for HF communications have the same variations. The five main variations are illustrated in Figure 4.1.

VARIATIONS OF THE IONOSPHERE

1. **DIURNAL** (throughout the day)
   - Variation with solar zenith angle
2. **SEASONAL** (throughout the year)
3. **LOCATION** (geographic & geomagnetic)
4. **SOLAR ACTIVITY**
   - Solar cycle & disturbances
5. **HEIGHT** (different layers)

Figure 4.1. The five main variations of the ionosphere which must be taken into account in order to predict HF communication conditions successfully.

Diurnal variation

The word "diurnal" simply means "throughout the day". The diurnal variation of the critical frequencies of the D, E and F1 layers is very simple. These layers are not there at night, and during the day the critical frequencies depend almost exclusively on the zenith angle of the sun.

The zen*ith angle* of the sun (or any other object in the sky) is the angle between the observer to the position directly overhead (called the zen*ith*) and a line from the observer to the sun — see Figure 4.2. If the sun is vertically overhead, the zenith angle is zero, whereas at sunrise and sunset it is around 90° because the line from the observer to the sun is more or less horizontal. Because the surface of the earth is curved, it is a little messy to work out the zenith angles, but we do not need to worry about that here.

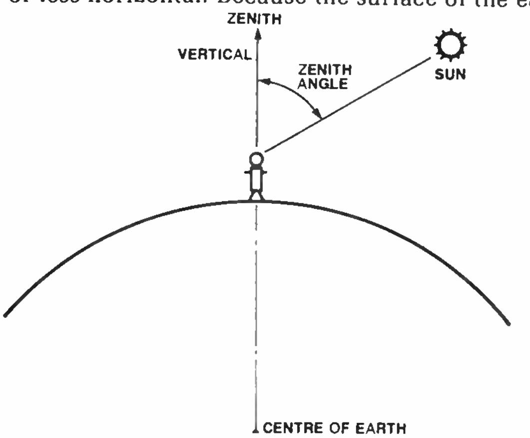


Figure 4.2. The zenith angle of the sun is the angle between the line to the point directly overhead of the observer (the zenith) and the line to the sun.

At midday on September 23 and March 21 (the equinoxes), the sun will be vertically overhead of an observer at the equator and the zenith angle will be zero. At midday on December 21, the sun will be vertically overhead at the Tropic of Capricorn, while at midday on June 21 it will be vertically overhead at the Tropic of Cancer.

We have belaboured the zenith angle because once we know it, or can estimate it, we can work out a pretty good estimate for the critical frequencies of the E and F1 layers. If the zenith angle is called "Z" and the level of solar activity is described by the sunspot number "R", then the critical frequencies for the E and F layers, foE and foF1, are given approximately by:

$$\text{foE} = 0.9[(180 + 1.44R) \cos Z]^{1/4} \text{ MHz} \qquad .... 4.1$$

and

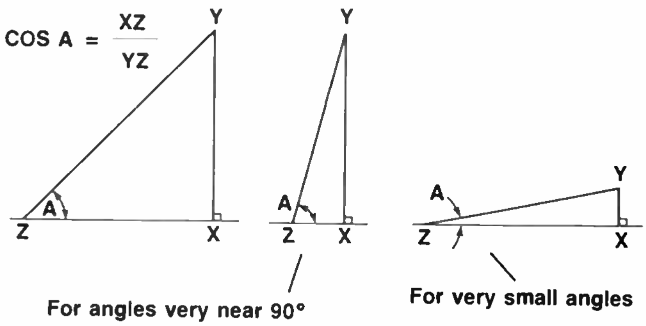
$$\text{foF1} = (4.3 + 0.01R) \cos^{0.2} Z \text{ MHz.} \qquad .... 4.2$$

These are empirical equations which fit the observations of foE and foF1 fairly well, and are included here mainly to illustrate how values of foE and foF1 may be calculated in practice. They are not as complicated as they may first appear — many simple electronic calculators can do the work for us without too much hassle. We do not even have to know what a "COS" is, since we can just press the COS button on our calculator. Actually, COS is a handy thing to know about because we shall encounter it again when we work out the relation between a critical frequency and the maximum frequency that can be used on a given circuit. The COS (short for COSINE) of an angle "A" in a right-angled triangle (see Figure 4.3) is defined as the ratio of the lengths of two sides:–

$$\text{COS A} = \text{XY / YZ.} \qquad .... 4.3$$

For example, cos 0 = 1, because the triangle collapses to a horizontal line and YZ = XZ. Again, COS 90 = 0, because the triangle collapses to a vertical line and ZX = 0.

$$\text{COS A} = \frac{XZ}{YZ}$$



$$\text{COS A} = \frac{XZ}{YZ} \approx \frac{0}{YZ} = 0 \qquad \text{COS A} = \frac{XZ}{YZ} \sim 1$$

ANGLE	COSINE
0°	1
30°	0.866
45°	0.707
60°	0.5
90°	0

Figure 4.3. The cosine of an angle A in a right-angled triangle is defined by the ratio of the length of the side adjacent to the angle, and the hypotenuse of the triangle. The hypotenuse is the longest side of the triangle and is opposite to the right angle.

LOCATION	LAT.	LONG.	HOUR	R12*	Z	cos(Z)	foE	foF1
LONDON	51.0	0.0	8	0.0	74.1	0.274	2.4	3.3
	51.0	0.0	8	100.0	74.1	0.274	2.8	4.1
	51.0	0.0	12	0.0	52.4	0.610	2.9	3.9
	51.0	0.0	12	100.0	52.4	0.610	3.4	4.8
	51.0	0.0	16	0.0	71.5	0.317	2.5	3.4
	51.0	0.0	16	100.0	71.5	0.317	2.9	4.2
MOSCOW	55.0	37.0	8	0.0	72.1	0.307	2.5	3.4
	55.0	37.0	8	100.0	72.1	0.307	2.8	4.2
	55.0	37.0	12	0.0	56.5	0.551	2.8	3.8
	55.0	37.0	12	100.0	56.5	0.551	3.3	4.7
	55.0	37.0	16	0.0	77.0	0.225	2.3	3.2
	55.0	37.0	16	100.0	77.0	0.225	2.6	3.9
NEW DELHI	29.0	77.0	8	0.0	65.0	0.422	2.7	3.6
	29.0	77.0	8	100.0	65.0	0.422	3.1	4.5
	29.0	77.0	12	0.0	30.4	0.862	3.2	4.2
	29.0	77.0	12	100.0	30.4	0.862	3.7	5.1
	29.0	77.0	16	0.0	64.7	0.428	2.7	3.6
	29.0	77.0	16	100.0	64.7	0.428	3.1	4.5
NEW YORK	41.0	74.0	8	0.0	71.1	0.323	2.5	3.4
	41.0	74.0	8	100.0	71.1	0.323	2.9	4.2
	41.0	74.0	12	0.0	42.5	0.737	3.1	4.0
	41.0	74.0	12	100.0	42.5	0.737	3.5	5.0
	41.0	74.0	16	0.0	66.6	0.397	2.6	3.6
	41.0	74.0	16	100.0	66.6	0.397	3.0	4.4
SYDNEY	-34.0	151.0	8	0.0	65.5	0.415	2.6	3.6
	-34.0	151.0	8	100.0	65.5	0.415	3.1	4.4
	-34.0	151.0	12	0.0	32.5	0.843	3.2	4.2
	-34.0	151.0	12	100.0	32.5	0.843	3.7	5.1
	-34.0	151.0	16	0.0	63.7	0.443	2.7	3.7
	-34.0	151.0	16	100.0	63.7	0.443	3.1	4.5
TOKYO	36.0	140.0	8	0.0	65.0	0.422	2.7	3.6
	36.0	140.0	8	100.0	65.0	0.422	3.1	4.5
	36.0	140.0	12	0.0	37.6	0.792	3.1	4.1
	36.0	140.0	12	100.0	37.6	0.792	3.6	5.1
	36.0	140.0	16	0.0	69.2	0.354	2.5	3.5
	36.0	140.0	16	100.0	69.2	0.354	2.9	4.3
EQUATOR	0.0	0.0	8	0.0	62.2	0.467	2.7	3.7
	0.0	0.0	8	100.0	62.2	0.467	3.2	4.6
	0.0	0.0	12	0.0	2.5	0.999	3.3	4.3
	0.0	0.0	12	100.0	2.5	0.999	3.8	5.3
	0.0	0.0	16	0.0	57.9	0.532	2.8	3.8
	0.0	0.0	16	100.0	57.9	0.532	3.3	4.7

*Sunspot number

TABLE 4.1:

The values of the critical frequencies of the E and F layers, foE and foF1, for March at 08, 12 and 16 local time, for low (R = 0) and high (R = 100) solar activities, and for seven locations. Also listed are the zenith angles, Z, and their cosines, cos(z).

The number 1/4 (= 1/2 × 1/2) outside the square brackets in equation 4.1 tells us to take the square root twice, once we have calculated the value of the term inside the brackets. Most school-level calculators also have a square-root button. When Z = 90 degrees, and R = 0 for low solar activity, we have

$$foE = 0.9\,[(180 + 0) \times 0]^{1/4}$$
$$= 0.$$

In other words, foE is zero at sunrise and sunset. When Z = 0 and the sun is vertically overhead, for R = 0, we have:

$$foE = 0.9\,[(180 + 0) \times 1]^{1/4}$$
$$= 0.9 \times 3.66$$
$$= 3.3 \text{ MHz.}$$

We do not have to worry very much about calculating foF1 because the F1 layer is not very important for HF communications. The calculation is a little messier, which is another good reason for ignoring the F1 layer here, although the interested reader may like to take advantage of the y^x button which many calculators have.

The F1 layer is, of course, taken into account in full prediction systems. Under some conditions, such as at high latitudes and during ionospheric storms (which we shall deal with later), the F1 layer becomes more important than the F2 layer.

Table 4.1 gives some values of foE and foF1 for different levels of solar activity and for different solar zenith angles. Figure 4.4 shows (among other things) the diurnal variation of foE and foF1 for Canberra, Australia, for two seasons and two levels of solar activity. While easy to calculate, foE and foF1 are not as important for HF communications as foF2, the critical frequency for the F2 layer. Unfortunately, foF2 is *not* easy to calculate, as we shall see later. However, foF2 also displays diurnal, seasonal, latitudinal and solar cycle variations, and it is these which are of interest in this article. These variations are illustrated in Figure 4.4, along with those of foE and foF1, and in Figure 4.5.

The diurnal variations of foE and foF1 are more or less what we would expect, the critical frequencies reaching their greatest values at noon. The F1 layer shows up as a separate layer only during the day, from about an hour or two after sunrise to an hour or two before sunset. The E layer does not *completely* vanish at night, usually staying at around foE = 0.4 MHz. However, such low critical frequencies are difficult to observe and have little consequence for HF communications, so we shall assume that foE drops to zero at night.

The diurnal variation of foF2 is often rather complicated. It reaches its lowest value just before dawn, recombination having eaten away at the electrons all night. Then the sun comes up, and foF2 rises rapidly as photoionization starts creating a supply of free electrons again. The F2 layer differs from the E and F1 layers in that it survives the night, albeit in a somewhat depleted state. This fact, together with the fact that the critical frequencies are highest in the F2 layer, makes the F2 layer the most important layer as far as HF communications are concerned.

Seasonal variation

The ionosphere varies throughout the year, partly because the solar zenith angle has a seasonal as well as diurnal variation, but also because of changes in the neutral atmosphere from which the ionosphere is created. In the winter, the zenith angle at noon is always greater than the corresponding angle in summer. We would therefore expect the critical frequencies of each of the layers to be greater in summer than in winter. This is found to be the case for the D, E and F1 layers, but not for the F2 layer at mid-latitudes.

The fact that foF2 at midlatitudes is greater in winter than in summer is known as the *midlatitude seasonal anomaly*. Figures 4.4 and 4.5 show how the critical frequencies foE, foF1 and foF2 vary with season. January is mid-summer at Canberra and mid-winter at Manila, while June is mid-winter at Canberra and mid-summer at Manila. Note that Manila is a low-latitude station, whereas Canberra is a mid-latitude station.

Latitudinal variations

As with the seasonal variation, part of the variation of the ionosphere with position on the earth, particularly latitude, is due to the variation with solar zenith angle. Once we get out of the tropical zone between the Tropics of Capricorn and Cancer, the solar zenith angle can never be zero, and for a given time of day increases as we go towards the poles.

However, even when this effect is taken into account, the ionosphere is found to have considerable variation with latitude. The extreme cases of the equatorial and polar ionospheres are found to bear little resemblance to each other, as we shall see shortly and in later parts. Matching panels of Figures 4.4 and 4.5 may be compared to determine the variations of the ionosphere from mid to low latitudes.

Variations from day to day

Just as the air temperature varies from day to day, so does the ionosphere. Our knowledge of the ionosphere is not yet▶

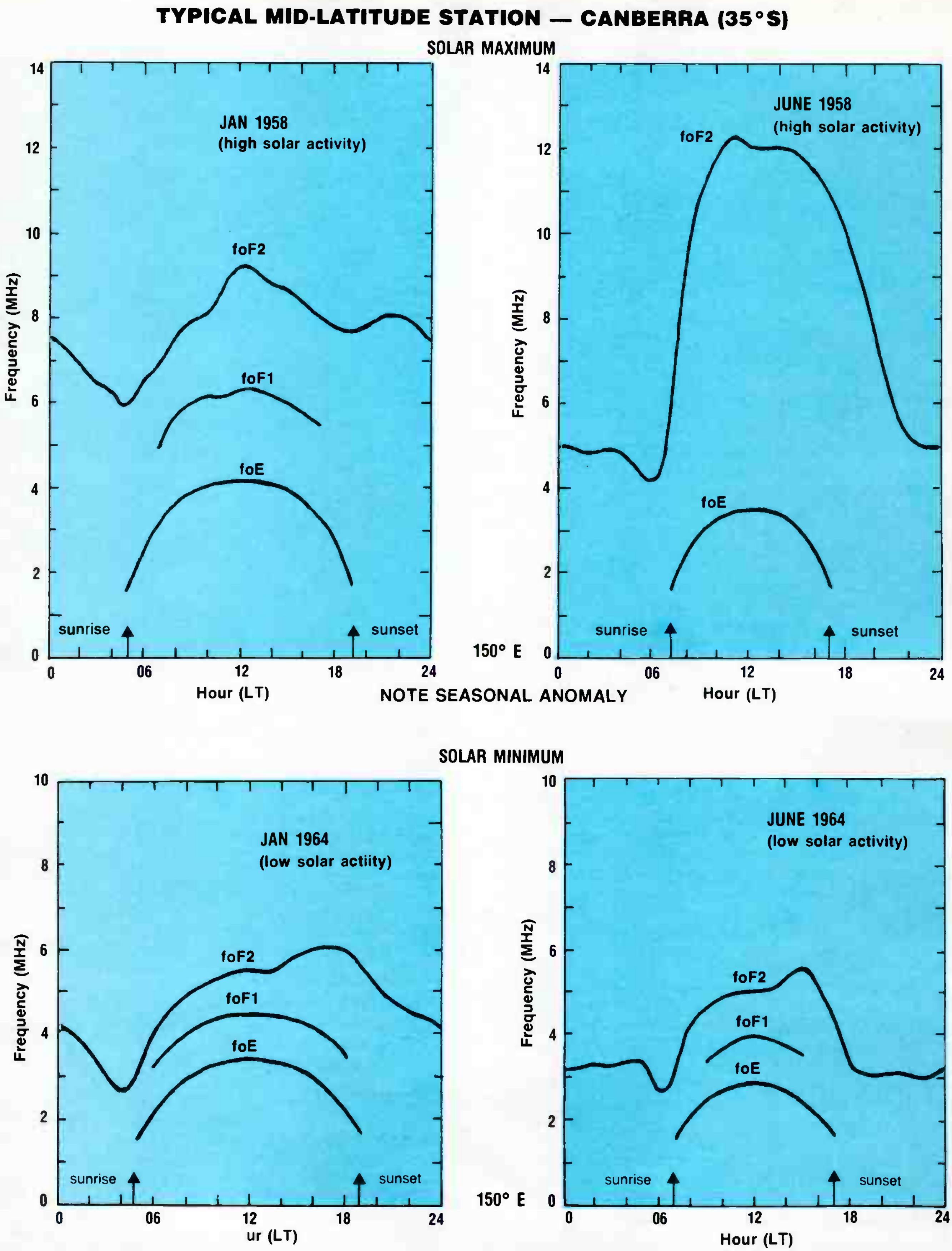


Figure 4.4. Variations throughout the day of the critical frequencies of the E, F1 and F2 layers, foE, foF1 and foF2, for Canberra for summer (January) and winter (June) and for two levels of solar activity (high, 1958; low, 1964). Note that there is no F1 layer for winter at high levels of solar activity, and that the winter values of foF2 during the day at high levels of activity exceed the summer values. The latter phenomenon is known as the mid-latitude seasonal anomaly. Critical frequencies are significantly higher at high levels of solar activity.

TYPICAL LOW-LATITUDE STATION — MANILA (13° N)

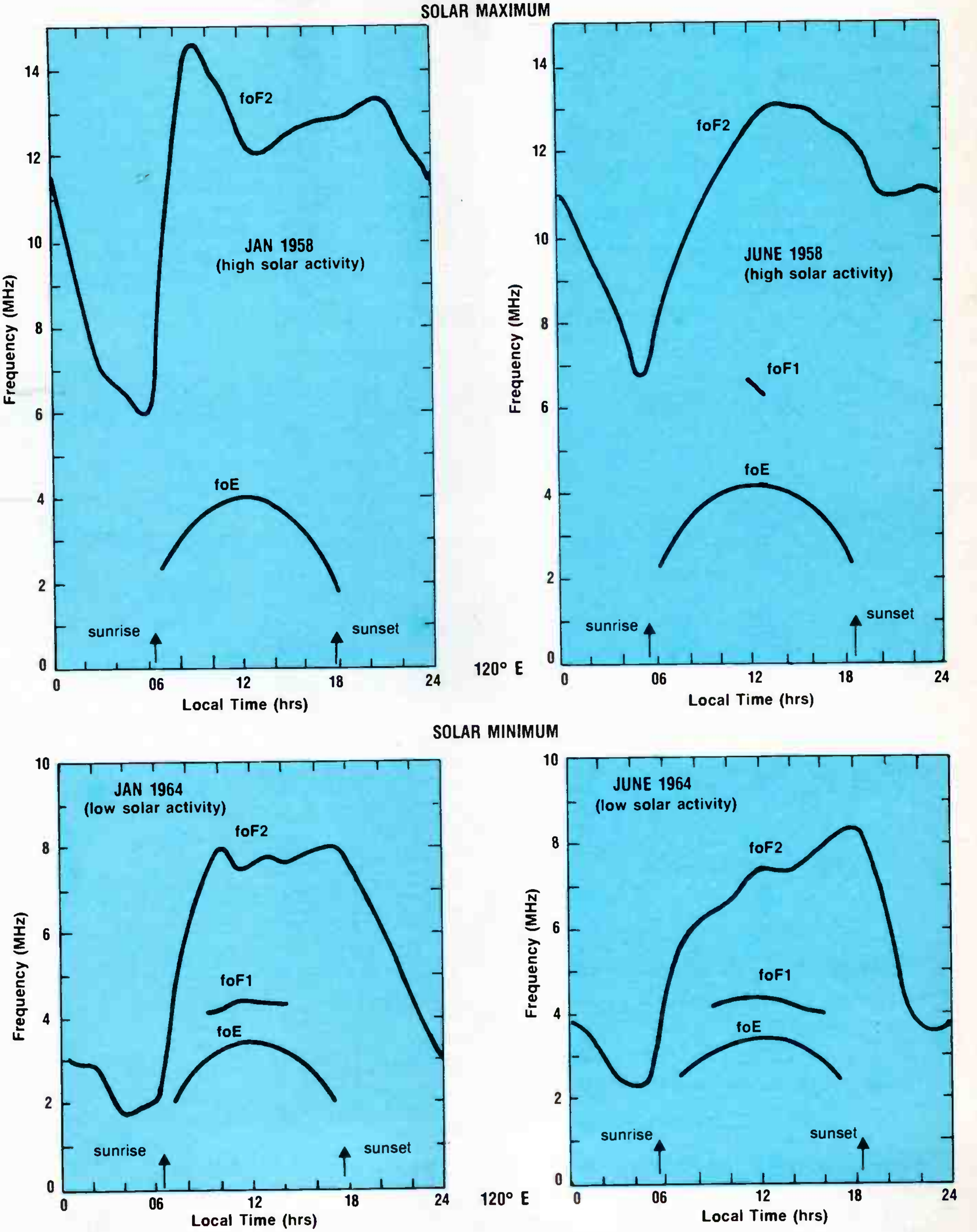


Figure 4.5. Variations throughout the day of the critical frequencies of the E, F1 and F2 layers, foE, foF1 and foF2, for Manila for summer (June) and winter (January), and for two levels of solar activity (high, 1958; low, 1964). Note that the F1 layer is not important at this low latitude station.

WIN WIN WIN

this fabulous Yaesu scanner from Dick Smith Electronics

Don't miss this opportunity to win a really top-line scanner — this Yaesu FRG-9600 scanner from Dick Smith Electronics. It has many functions and features not seen on other scanners — especially the ability to receive single sideband (SSB) signals. In reviewing the FRG-9600 in the September '85 issue of AEM, Roger Harrison said:

"The FRG-9600 is a well-thought-out unit, easy to use and with facilities and features that will appeal to many — whether newcomers to scanning on the VHF/UHF spectrum or 'old hands'."

Dick Smith Electronics, in conjunction with Australian Electronics Monthly, is offering a Yaesu FRG-9600 scanner as the prize in this simple contest. The unit provides continuous coverage from 60 through 905 MHz and features 100 memory channels. Five reception modes are provided — FM narrow and wide, AM narrow and wide, plus SSB (unique to the Yaesu). The unit can scan over the full frequency range, preset frequency limits or across the memory channels. Provision is made for 'priority' channel selection, which is momentarily tested every three seconds, when activated, while listening to other channels. Selectable tuning steps are provided on the different reception modes. A 24-hour clock/timer is incorporated. The large display shows frequency or time on a 7-segment fluorescent readout along with a channel and mode display, plus a digital signal strength meter. A special feature is the tuning knob, which is an index switch, but the unit can also be tuned using UP and DOWN channel-step keys. The FRG-9600 can be optionally computer controlled via Yaesu's CAT interface system. It operates from a nominal 13.8 V supply and may be bench (base) or vehicle (mobile) mounted.

All you have to do is complete the questions below and tell us in 30 words or less what it is about the Yaesu FRG-9600 scanner that attracts you.

☆ PRIZE WORTH $729 ☆

Send your entry to:

YAESU FRG-9600 SCANNER CONTEST
Australian Electronics Monthly
PO Box 289, Wahroonga NSW 2076

You may enter as many times as you wish, but you must use a separate entry form for each entry and include a month and page number cut from the bottom of this page. You must put your name and address on the entry form and sign it where indicated. That is, photocopies are acceptable but an original month/page number from a copy of this month's magazine must accompany each entry form. Please read the contest rules carefully, especially if sending multiple entries.

The winning entry will be drawn by the Editor, whose decision is final, no correspondence will be entered into regarding the decision.

Winners will be notified by telegram the day the results is declared and the winner's name and contest results published in the next possible issue of the magazine.

RULES Contestants must enter their names and addresses where indicated on each entry form. Photostats or clearly written copies will be accepted, but if sending copies you must cut out and include with each entry an original page number and month cut from the bottom of the page of the contest. This contest is invalid in states where local laws prohibit entries. Entrants must sign the declaration accompanying the contest that they have read the above rules and agree to abide by their conditions.

CLOSING DATE OF THE CONTEST is the last mail of January 31, 1986. Entries received within seven days of that date will be accepted if postmarked prior to and including the date.

Q1: What reception facility is unique to the Yaesu FRG-9600?
A1: ....

Q2: Does the FRG-9600 employ triple or double conversion, or both?
A2: ....

Q3: Who first imported Yaesu equipment into Australia in the early 1960s?
A3: ....

Q4: About how long has Dick Smith Electronics been selling Yaesu equipment?
A4: ....

Q5: What is the minimum tuning step of the FRG-9600 and in what mode?
A5: ....

Now tell us in 30 words or less what it is about the FRG-9600 that attracts you:

....
....
....
....
....

Name ....

Address ....

....

.... Postcode ....

I have read the rules of the contest and agree to abide by their conditons:
Signed ....

good enough to allow us to understand why it varies from day to day, except in a general hand-waving sense in which we attribute the changes to changes in the flux of EUV radiation from active regions on the sun, to changes in the neutral winds blowing in the atmosphere, and to changes in the electric currents flowing in the ionosphere. Because of this and because in practical HF communictions it's usually not necessary to worry too much about such details, we can ignore the day-to-day variations to a large extent and work in terms of the *average* behaviour of the ionosphere for the month, at each of the 24 hours of the day.

In a 31-day month, there will be 31 observations of foF2, say, at a particular hour. A very good representative value of these 31 observations is the value which is exceeded on 15 days, and which itself exceeds the values observed on the other 15 days. This is called the *median* value. We would also like some estimate of the range of observed values about the median. If the median is 10 MHz and the individual values range from 5 to 20 MHz, the median does not tell us very much since the range covers most of the HF band. If, however, the range is from 8 to 12 MHz, we can never be more than 2 MHz out if we take 10 MHz as the value of foF2 for every day of the month at the hour considered.

In practice, we represent the range of values by the third lowest and third highest values. The third lowest value is exceeded on 28 days or approximately 90% of the month, while the third highest value exceeds the other observations for 90% of the month*.

The value exceeded for 90% of the month is called the *lower decile* (lowest 10%), while the value exceeded for 10% of the month is called the *upper decile*. In the same sense, the median is the 50% decile.

Table 4.2 illustrates how the median and decile values are deduced for one set of foF2 observations. This set of observations is just one of the 24 sets of observations for Canberra, Australia, for midnight in December 1980. Figure 4.6 shows the complete 24 × 31 observations, with the values of the median and deciles at each hour. The diurnal and seasonal variations illustrated earlier in Figures 4.4 and 4.5 in fact correspond to *median* values of the critical frequencies. Figure 4.6 also shows that on some days foF2 is much lower than on the remaining days. These are called *disturbed days* and happen when the sun becomes disturbed, as we shall see in a later part.

Upper decile, median and lower decile

87	71	91	91	84	94	89	89	84	89
86	87	72	86	79	86	72	79	92	43
43	87	84	87	90	94	82	80	90	80
92									

31 daily values of foF2 recorded at midnight in Canberra in December 1980. Frequency unit = 100 kHz.

94	94	92	91	91	91	90	90	89	89
89	87	87	87	87	86	86	86	84	84
84	82	80	80	79	79	72	72	71	43
43									

Same set of foF2 values rearranged in order of decreasing value.

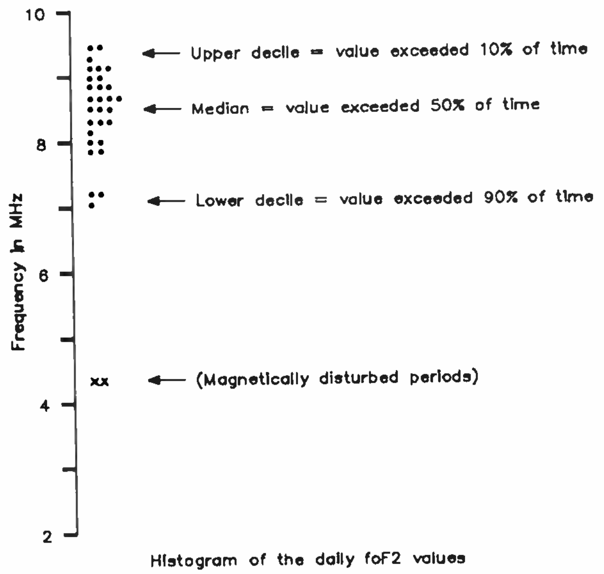


TABLE 4.2:

The decile and median values of the 31 values of foF2 observed at Canberra in December 1980. The data are first arranged in decreasing order. The values exceeded on 3 days (upper decile), 15 days (median) and 27 days (lower decile) are then determined by counting through the ordered array of values.

The use of this statistical description of the ionosphere reduces from 31 to three the number of parameters (or quantities) necessary to describe the behaviour of the ionosphere at a given hour of a given month at a given location. This 10-fold decrease is a very useful reduction in the enormous amount of data required to describe the ionosphere and all its variations.

— continued next month

**We will not worry about the details of what happens when several values are equal, or when there are 30 days in the month. The ideas are the same.*

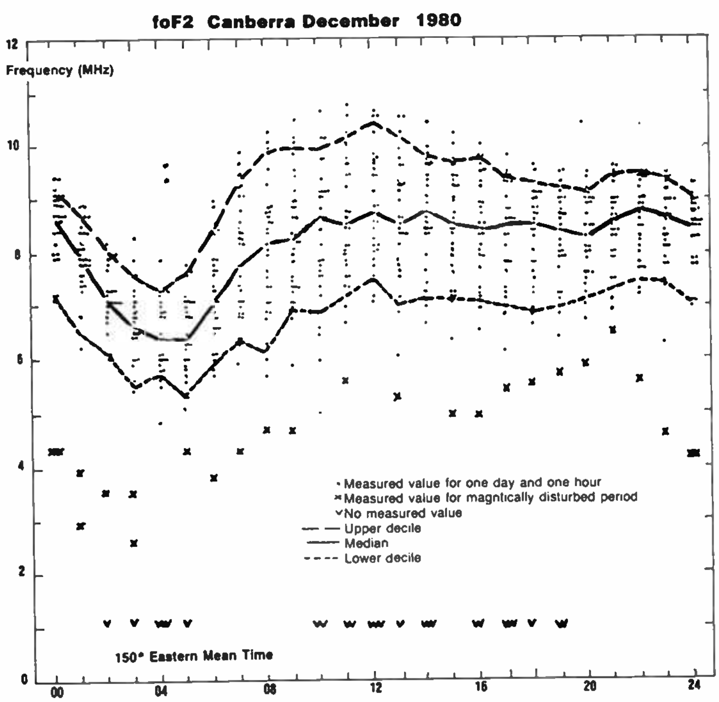


Figure 4.6. The variability of foF2 at a typical mid-latitude station, Canberra, for December, 1980. There are 31 observations at each hour, except for the occasional equipment failure. The solid curve is the median curve — at each hour, 15 points lie above this line while 15 points lie below it (or on the line). The upper dashed curve is the upper decile curve, and there are three points (10% of 31) lying above the curve, corresponding to the highest three observed values of foF2. The lower dashed curve is the lower decile curve, and there are three points lying below it.

The AUSTRALIAN ELECTRONICS Monthly

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If your local retailer or board manufacturer is unable to supply you an AEM board, we are carrying a limited number of rolled-tin over copper circuit boards complete with silk screen component over-lay.

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6510 4-Input Mixer	$20 40
6010LL	$19 06
6010MA	$23.10
6010F	$16.37
6010R	$16.37
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4600 Dual-Speed Modem	$22.42
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Note: The boards found in this issue are also available, price on application

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You can buy the boards at our offices if you wish, at any time during business hours. We're located at WB Building, Cnr Fox Valley Rd and Kiogle St, Wahroonga NSW, the entrance is in Kiogle St.

BWD's Powerscope II caters for every industry

Electronics grew up as an isolated, specialist industry, but today it has penetrated into — and is an integral part of — virtually every industry, from boilermaking to zookeeping.

Numerical control machines and robotics, power generation, transport and earth moving, all employ electronics in some form, so BWD designed the 'Powerscope II' as a multi-industry test instrument.

It is claimed to be the only instrument in the world that will simply, safely and accurately display multiple in-circuit power control measurements — voltage, current, power, phase and time — up to 1000 volts, while also providing normal oscilloscope functions.

The original Powerscope has already made an impact on world markets, with thousands in use. The new Powerscope II has greatly expanded versatility and specifications, with its capacity to provide precise visual display of waveforms associated with ac and dc power engineering.

Its advantage compared with general purpose oscilloscopes, BWD say, is the ability to display simultaneously four completely independent signals with levels from 20 mV to 2 kV from equipment operating directly in single or multi-phase power lines or at high dc levels. It can also handle digital or analogue signals to 50 MHz through its 5th channel. No other oscilloscope on the market today can do all this with the high degree of safety offered, according to BWD.

Special attention has been given to reducing any possible shock hazard. The panel, knobs and input sockets are deeply recessed and the probes are designed especially to provide safe connection to power lines and direct in-line equipment.

A four channel output plus four individual channel outputs are available for connection to any storage oscilloscope, distortion analyser, pen recorder, tape recorder or multimeter.

In the field of Robotics and NC Machinery the Powerscope II will simultaneously measure three plane XYZ, plus time signals of robotic controllers. Response times of input signals to output movement of controls are easily catered for.

The transport and mining industries are other important areas where its applications include the monitoring, testing, designing or commissioning of traction motors in transport systems, rail, electric cars cranes etc.

The computer industry also benefits. The Powerscope II can be used to fault-find single and 3-phase switchmode power supplies and present 4-channel digital/analogue signals with fifth channel triggering.

The 'phase marker' facility, unique to the Powerscope II says BWD, provides a means of accurately measuring phase angles from a known reference point in single or multi-phase power systems.

The Powerscope II is both a laboratory and portable instrument, and can be operated on normal ac power or any dc source, including rechargeable batteries.

Further information from **BWD Industries Ltd, 5-7 Dunlop Road, Mulgrave 3170 Vic. (03) 561 2888.**

British connections

We hear from Elmeasco of two ranges of products released by Coline Ltd of the UK. Firstly, their connectors: this range, numbering more than thirty, includes BNC plug and adaptors, elbow plugs, tee adaptors, BNC jacks, panel and bulkhead sockets, UHF plugs and sockets, type N plugs and jacks.

These are manufactured to conform to the relevant MIL, IEC and DEC standards. The bodies are made of brass, finished in bright nickel plate, while contacts are berillium copper or brass finished in bright silver plate. Gaskets are silicone rubber and insulation is PTFE.

Coline also announced the LTL1000 Test Lead Set. The leads feature a unique method of connection to the measuring instrument. After insertion of the plug, a locking screw is tightened, causing the contact to expand inside the instrument socket thus providing a secure and reliable connection with a reduction in unwanted thermal EMFs and very low contact resistance.

The leads are flexible copper conductors with a tough silicone rubber insulation and are provided with prods which have a threaded section to permit the addition of various accessories.

The LTL1000S is similar to the LTL1000 but includes shrouds over the 4 mm plugs to fit instruments with recessed sockets.

Elmeasco also inform us that their Adelaide branch has moved to larger premises with more convenient parking facilities. The new address is 241 Churchill Road, Prospect, 5082 S.A. (08) 344 9000.

The **Elmeasco** Sydney office is still at **15 McDonald Street, Mortlake. (02) 736 2888.**

New microswitches from Burgess

Play the usual word association game with many an electronics person and on saying "microswitch" you probably will hear the reply "Burgess".

This English firm, represented in Australia by **Email Limited Relays Division** at **Artarmon, NSW and Huntingdale, Victoria,** has announced a new low profile microswitch for pc mounting, available in single- and double-pole versions, and said to be only one-third the height of comparable units.

The LDSP single-pole and LPDP double-pole microswitches are under 8 mm high and measure 19 × 7 mm and 19 × 14 mm respectively. Both are capable of switching voltages up to 250 V ac or dc.

Actuators can be fitted at either end, and single-throw or changeover options can be supplied with either sequenced or non-sequenced operation. Terminals are pitched on the international standard 0.1" matrix.

Major UK defence contract for Phillips

Philips Test and Measurement at Pye Unicam, Cambridge, UK, has been awarded a Ministry of Defence contract to supply more than 3700 oscilloscopes over a period of three-and-a-half years.

The contract one of the largest ever awarded to Philips Test and Measurement in Europe, is for PM 3217 50 MHz general-purpose oscilloscopes. They will be used by the three British armed services.

JAYCAR MASSIVE KIT WAREHOUSE CLEARANCE - WE'RE DREADFULLY OVERSTOCKED ON MANY KIT LINES & HAVE NO ROOM FOR THE GREAT NEW RANGE PLANNED FOR 1986. RUSH IN NOW FOR THE BARGAIN OF A LIFETIME!

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Ref EA January 1986

Fades video signal to black and up again without loss of sync. PCB project. Plugpack and box extra.

Cat KA 1626

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Ref EA November 1985

Jaycar now has stocks of this superbly designed project. Call in and check it out now! Note: this unit is ORIGINAL to the design.

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NEW KITS FROM "AUSTRALIAN ELECTRONICS MONTHLY"

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Ref AEM Oct - Nov 1985

We now have stocks of this project in kit form including the original case, components etc. Nothing else to buy! Chassis is pre punched with original front panel.

Cat KM 3030

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AEM 4600 Dual Speed Modem

Ref AEM December 1985

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- see review in August 1985 Sonics

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AEM 3500 'The Listening Post'

Ref July 1985

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Cat KM 3015

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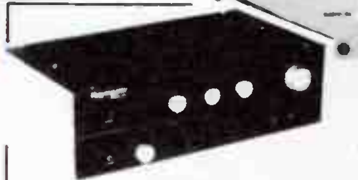

8 SECTOR BURGLAR ALARM

Ref EA Jan/Feb 1985

Why buy a commercially made up unit for more when you can buy this kit and SAVE money! A unique feature of this kit is the fact that you can wire N/O and N/C alarm sensors ON THE SAME LINE ★ 8 SECTORS ★ 2 delayed entry sectors ★ steel box ★ includes battery and siren driver in the price ★ variable exit and entry delays

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Ref EA Jan/Feb/March 1985

"... s stereo amplifier that will equal or better just about any integrated commercial amplifier, regardless of price". Leo Simpson, Editor of EA February 1985.

MAIN FEATURES

- Switchable phono input for MM and MC cartridges
- Electronic signal switching
- Full facilities for dubbing between two cassette decks
- Monitor loop for either of two cassette decks or a signal processor
- Click action pushbutton switches for selection of sources, dubbing and tape monitor with LED status indicators
- Centre detents on bass, treble and balance controls, multiple detents on volume control
- Heavy duty heatsinks
- Power transformer for low hum and noise
- Easy to build - all parts except power supply mount directly on the two printed circuit boards, wiring has been kept to an absolute minimum
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- Less than 0.01% total harmonic distortion

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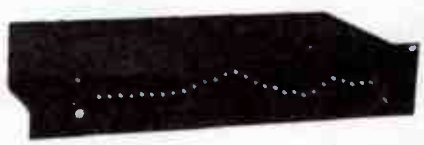

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ELECTRIC FENCE
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Ref AEM January 1986
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COMPLETE KIT VERSION
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Cat MI 5000
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ONLY $14.95

Bench Type Digital Capacitance Meter - Ref EA August 1985 - measure from 1pF to 99.9uF with this handy piece of equipment
Cat KA 1595
ONLY $79.95

DWELL/TACHOMETER
Ref EA Sept 1985
Tune up your car quickly and easily with this handy piece of gear. The Jaycar kit includes case, large meter and Scotchcal meterscale
Cat KA 1612
ONLY $34.95
Suits 4-6 or 8 cylinder cars

Jaycar ELECTRONICS

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NO. 6 WELLER CROSSWORD COMPETITION

SEND YOUR ENTRY IN BY LAST MAIL FEBRUARY 17

Our sixth Weller Crossword is much easier, we've even included quite a few letters to help. We didn't receive any correct or near correct answers to Crossword No. 4 so no one won the Weller Soldering Station. With this easier crossword now's your chance so get your answers in as soon as possible. Answers to our last crossword are on page xx. Our Crosswords are prepared using 'Crossword Magic' supplied by Edsoft Pty Ltd, 20 Blackburn Rd, Blackburn, Victoria.

CooperTools

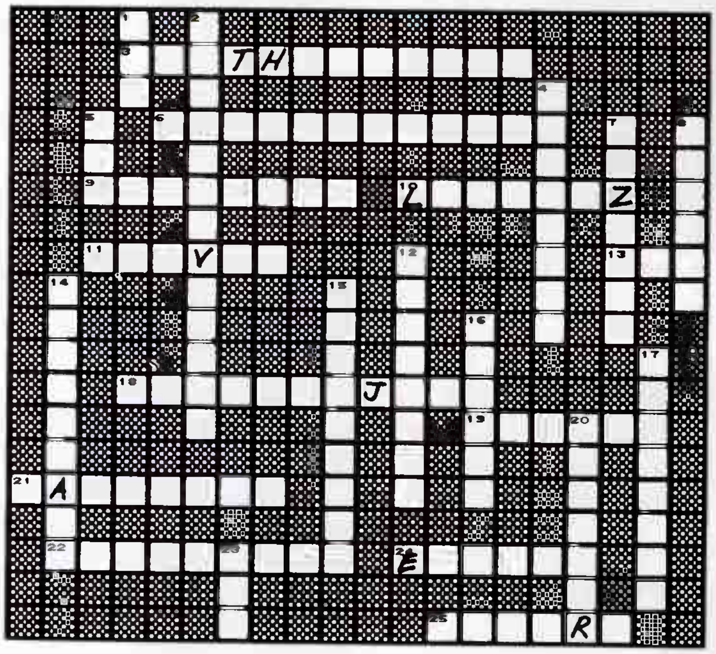
THE PRIZE

A transformer-powered soldering station complete with a low voltage, temperature controlled soldering pencil. The special Weller "closed loop" method of controlling maximum tip temperature is employed, thereby protecting temperature sensitive components, while the grounded tip and non inductive heater protects voltage and current sensitive components. The soldering pencil features stainless steel heater construction, a non burning silicon rubber cord and a large selection of iron plated tips in sizes from .8 mm diameter to 6 mm diameter with a choice of tip temperature of 315°C/600°F, 370°C/700°F and 430°C/800°F. The transformer case features impact resistant noryl for durability and protection against accidental damage, a quick connect/disconnect plug for the soldering iron, extra large wiping sponge, tip tray to store extra tips, plus an improved off on switch with a long life neon indicator light, a non heat sinking soldering pencil holder, and a 2 m flexible 3-wire cord.

We will accept entries postmarked no later than February 18

ACROSS

3. The first mass produced calculator invented by Charles X.T. Colmar
6. An intermediate sized computer
9. British wartime code cracking machine that cracked the codes of 8 Down
10. Inventor of the Stepped Reckoner 1646-1716
11. Another name for the Universal Automatic Computer
13. World's largest computer company
18. Collaborator on the original Apple (not Eve)
19. Inventor of the Arithmometer
21. Early financial wizard behind Apple
22. Electromechanical device which facilitates the storage of data
24. Helped invent the ENIAC
25. The equipment or media used to hold machine language information



DOWN

1. Random Access Memory
2. Home of electronics manufacturing
4. The output of a computer program
5. Initials of a well known computer company started in 1957
7. Last name of collaborator on original Apple
8. Famous wartime German encoding machine finally cracked by 9 Across
12. Collection of keys for a calculator or computer
14. Machine readable card
15. The central processor of a large computer system
16. French born inventor of the mechanical calculator (1623-62)
17. A point of connection for two or more conductors in an electric circuit
20. A device used for checking signals.
23. Read Only Memory

SEND YOUR ENTRY IN BY LAST MAIL FEBRUARY 17

The competition is open to all persons normally resident in Australia or New Zealand, with the exception of members of the staff of Australian Electronics Monthly, the printers, Offset Alpine, and/or associated companies.

The winning entry will be drawn by the Editor, whose decision is final; no correspondence will be entered into regarding the decision.

Winners will be notified by telegram the day the result is declared and the winner's name and contest results published in the next possible issue of the magazine.

Cut out or photocopy the entry form, complete it and send to:

"Weller Crossword"
Australian Electronics Monthly
PO Box 289,
Wahroonga NSW 2076

We will accept entries postmarked no later than February 18

In case two or more entrants correctly complete the crossword, we'll have to judge who's best at waxing lyrically, in 30 words or less, over: ***"Why I think the Weller WTCPN is the soldering station for me".***

. . . .

. . . .

. . . .

. . . .

. . . .

Name . . . .

Address . . . .

. . . . **Postcode** . . . .

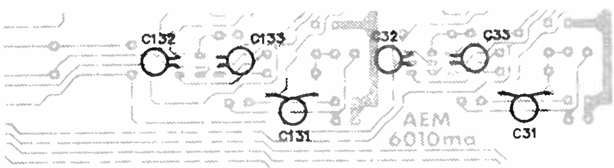
NOTES & ERRATA

V8 — the new 8 mm video tape technology, Nov. '85. The table on page 27 showing comparison of 8 mm video and current home VCR formats contains an error on the line dealing with "Head-to-tape speed". The speed is actually metres/sec, not mm/sec.

Meet Elami Jr, AEM Product Review, Dec. '85, p. 33. The last two lines went missing. Here they are: "Review unit kindly supplied by Captain Communications, 28 Park St, Parramatta, NSW. (02) 633 4007. Recommended retail price $199.00" Apologies to everyone for the omission.

Project 6010 An 'ultra-fidelity' preamplifier, Part 2. Nov. '85. There is a missing track on the 6010ma pc board which should link the emitter of Q128 to the common of resistors R171, R175, R176. The circuit diagram is correct. Fortunately, the missing track will only marginally affect the right channel's input noise performance. The various pc board makers have been issued new artwork.

Project 6010 An 'ultra-fidelity' preamplifier, Part 3. Dec. '85. In the diagram on the bottom of page 51, showing the placement of the capacitors on the rear of the 6010ma board, the printers misplaced the pc board track overlay. Here's what they meant to print —



Project 4600 'Dual-Speed' modem. Dec. '85. Under "circuit operation" on page 82, second column, third-last paragraph, the explanation as to which channels are used to transmit and receive in 1200/75 mode has suffered transposition in typesetting. Even the proofreader got consused! The last sentence of this paragraph should read: "Conversely, if we were receiving at 75 Baud and transmitting at 1200 Baud, this time we'd be using the main channel to transmit the data and the back channel to receive the data."

A short length of tape went missing from the board artwork, also, preventing transmission on 300 Bauds. Contact 'b' on SW2 should go to the junction of R7/R8. Just link 'b' on SW2 to '6' on SW4. A small number of initial boards were affected.

▶ from p. 53.

PARTS LIST AEM6103

Crossover components
(only required if pre-assembled unit will not be employed)

Resistors all 5W, 10%

R1	15R
R2	4R7
R3	6R8
R4	3R9
R5	8R2

Capacitors

C1	47u bipolar
C2	33u bipolar
C3	10u bipolar
C4	22u bipolar
C5	3u3 greencap
C6	33u bipolar
C7	6u8 greencap
C8	2u2 greencap
C9	6u8 greencap
C10	2u2 greencap
C11	680n greencap
C12	4u7 greencap

Inductors

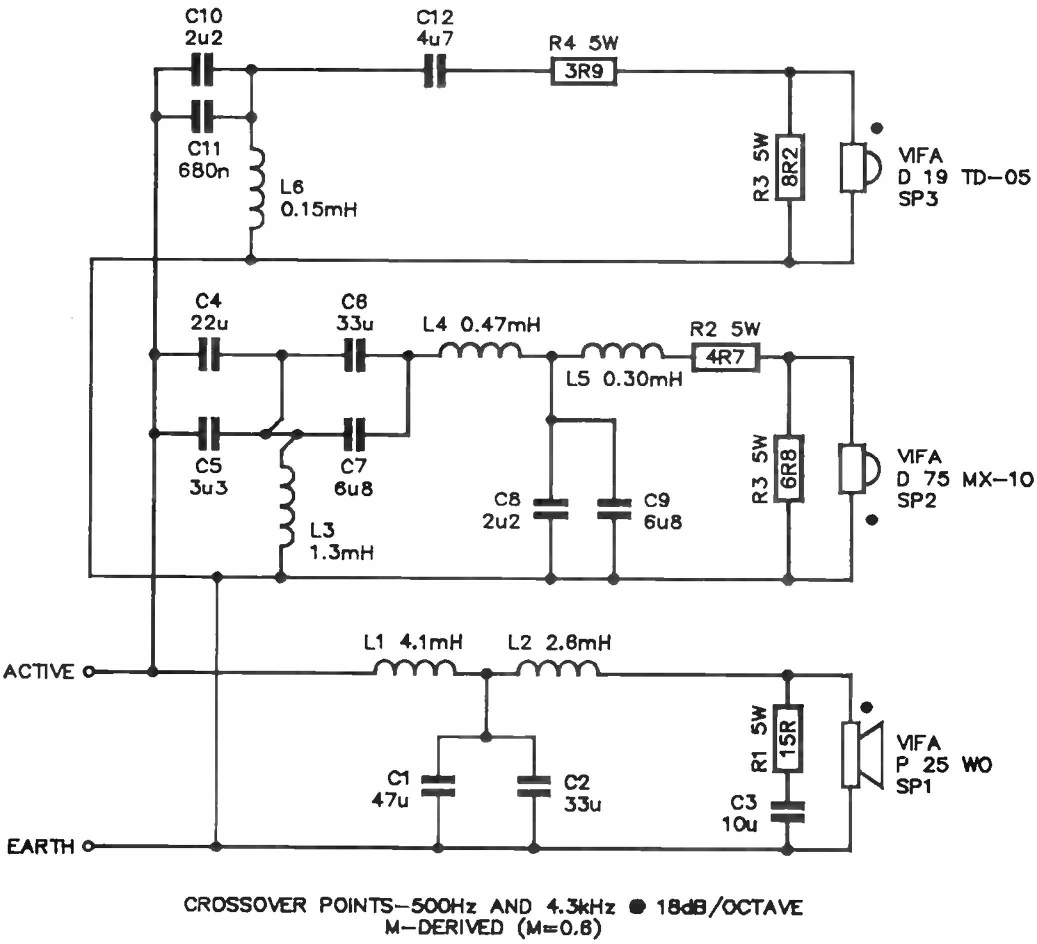
L1	4.1 mH, < 0.8 ohm
L2	2.6 mH, < 0.6 ohm
L3	1.3 mH, < 0.5 ohm
L4	0.47 mH, < 0.5 ohm
L5	0.3 mH, < 0.5 ohm
L6	0.15 mH, < 0.5 ohm

Drivers

SPI	Vifa P25WO
SP2	Vifa D75MX-10
SP3	D19TD-05

Miscellaneous
AEM6103 three-way bass-reflex enclosure (see text); length of PVC irrigation pipe (see text); loudspeaker terminal block and mounting screws (see text); medium density mattress overlay foam — 25 mm and 50 mm thickness; speaker mounting hardware; several metres of heavy gauge 'figure 8' cable; 'Silastic' or similar silicone sealant.

Expected cost: $550 - $800 depending on crossover and boxes and quality of components purchased.

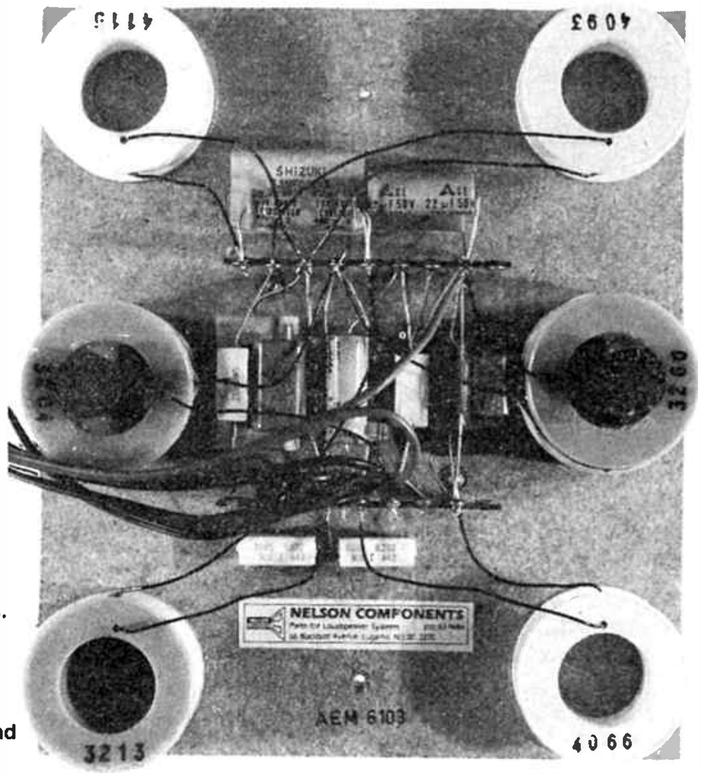


AEM6103 three-way loudspeaker.

SPECIFICATIONS AEM6103

Enclosure type	bass reflex
Frequency response	30 Hz-18 kHz, +/-3 dB*
Crossover points	500 Hz and 4.3 kHz
Crossover type	3rd-order, maximally flat
Nominal power handling	80 W RMS (DIN 45573)

*Measured on prototype, 1 m on tweeter axis, in room



The ready-assembled crossover from Nelson Components. All the wires to the speakers are individualy colour-coded with identifying stripe on the 'active' lead. Two of the inductors use ferrite 'slugs' to achieve the required inductance on a practical-sized former. These slugs are made of special audio ferrite, manufactured by Neosid, and are employed by KEF in crossover inductors for their speakers.

For those diehards who wish to wind their own coils and assemble the crossover themselves, complete component specifications are given in the accompanying parts list. For the coils, an appropriate wire gauge to give no mre than the required maximum resistance should be used. A construction method similar to the pre-assembled unit shown here could be adopted. Pre-wound coils may be available from some suppliers, or you could enquire from Nelson Components.

Once the crossover construction is complete, it should be positioned approximately in the box so that the required lengths of wire from the crossover to the various drivers can be determined. Cut the wires to the appropriate length and solder one end to the crossover (N.B. This step will not be necessary if the pre-built crossover is used). The crossover can then be mounted in place by screwing it to the rear panel inside the loudspeaker box. This can be a little difficult and I found it easiest to locate the crossover as closely as possible to the bass unit hole i.e: so that the crossover to the speaker input terminals, mounted on the cabinet rear.

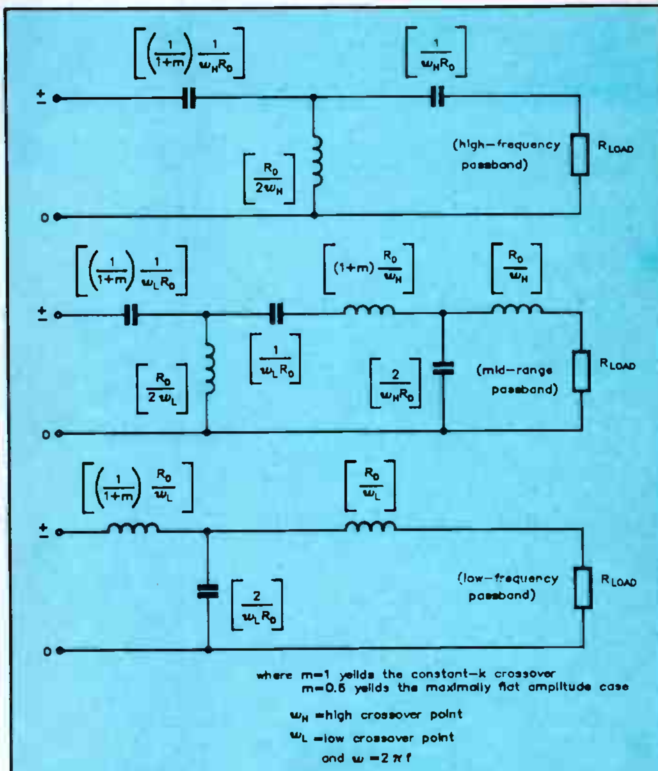
Once the crossover is mounted in place the box should be lined with the mattress overlay foam. You will need to cut a hole in the foam through which to pass the wires. The foam can then be glued to the sides of the rear panel, covering the crossover unit. I found spray adhesive, available in pressure pack cans, particularly useful for this purpose. The box should be lined on all sides and on the rear panel but not on the front baffle.

The wires to the mid-range and high-frequency drivers should now be passed through a small hole, previously drilled in the mid-range enclosure, which should then be sealed carefully with silicone sealant. This is particularly important since it is imperative that pressure from the main bass-driver enclosure is not applied to the rear of the mid-range driver. If this is allowed to occur the mid-range cone will be displaced from its equilibrium position by the bass pressure, resulting in degraded distortion performance.

The wires can now be soldered to the mid-range and high-frequency drivers, being careful to connect the drivers with the correct orientation. Each has one of its terminals marked by a dot or a positive sign (+). The wires soldered to the crossover should also be marked for polarity. The usual convention is to assign any distinguishing mark on the wires (e.g: a stripe) to be connected to the terminal marked in the drivers. If in doubt, study the wiring diagram of the crossover shown in this article and compare this to the actual crossover you have been supplied. It is particularly important to ensure that the drivers are connected right way round, otherwise severe frequency response errors will result.

The final stage in the construction is to screw the drivers into position. It is important, once again, to ensure that the drivers, when mounted, will form a good seal against the front panel. One of the best ways to accomplish this is to use foam tape, available from hardware stores. This material is adhesive on one side and is intended for use on windows and doors etc. The tape can be stuck to the front of the baffle so that it forms a gasket against which the driver chassis can mount. Once all three holes are lined with the foam tape, screw the drivers into position being careful not to overtighten the screws, particularly those for the mid-range and tweeter.

Before connecting the loudspeaker to an amplifier, first use a 1.5 V battery to check that the loudspeaker is working correctly. This is done by touching the two ends of the battery to a pair of wires connected to the loudspeaker. When the battery is connected a thump will be heard from the loudspeaker. Check that all three divers are contributing by listening to each in turn while touching one wire to the battery in turn. If the battery positive terminal is connected to the positive terminal of the loudspeaker, the woofer cone should move out. Similarly, if the battery connections are reversed the woofer cone should move in. Do not use a battery larger than 1.5 V or damage might result to the loudspeaker.



The crossover circuit, with the relevant circuit equations.

Conclusion

The overall result is evident from the measured response (Figure 8). But, as with all loudspeakers, you should audition a pair for yourself, preferably in reasonable surroundings so that they give of their best. I think you'll be as pleased with their performance as I.am, not to mention all those who heard the prototypes.

I would recommend an amplifier capable of 100-150 watts as a minimum, particularly if you have, or intend to have, a compact disc player. Even in the average-to-large domestic loungeroom, this power level is just adequate to handle the dynamic range at 'normal' listening levels. Ideally, a system capable of 350-400 watts would allow full reign to the sort of music dynamics now available on CDs. This is not to say the speakers are insensitive, I'm just indicating the sort of performance modern recordings require.

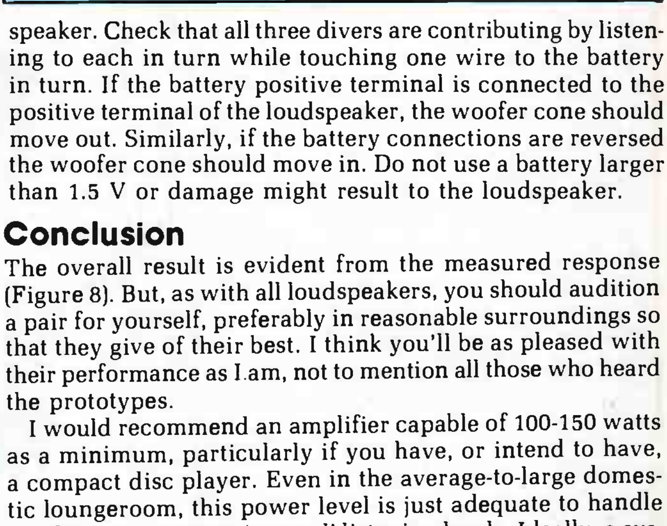


Figure 8. Overall frequency response of the AEM6103 three-way loudspeakers, measured in a room. The bass end response curve shown on the cover was measured outdoors (free-field response). The arrows show the crossover points.

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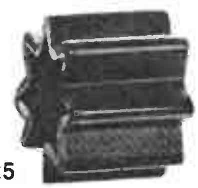
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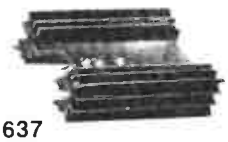
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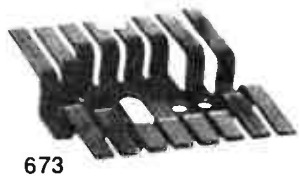
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aem data sheet

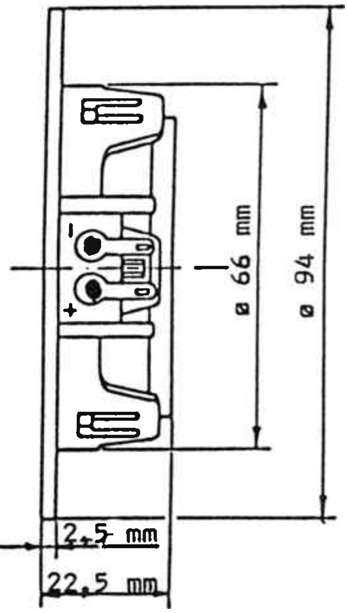
D19TD-05

3/4" (19 mm) Vifa dome tweeter with magnetic fluid

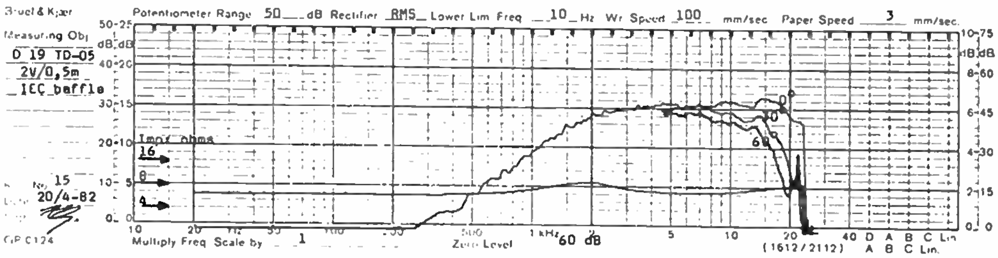
The D19TD-05 is a magnetic fluid version of the Vifa D19TD soft dome tweeter. The diaphram is formed from a special plastic with high internal damping which ensures a very smooth frequency response. The high frequency dispersion is excellent. This tweeter is also recommend for 2-way systems due to the excellent damping and cooling of the voice coil from the magnetic fluid.

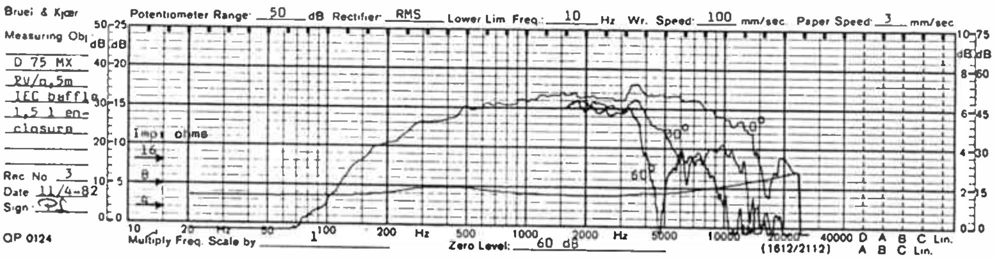
Technical Data

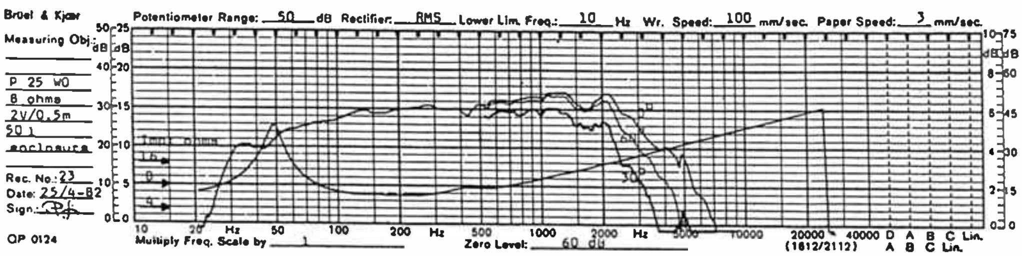
Nominal impedance	8 ohms
Frequency range	2.5-20 kHz (DIN 45500)
Free air resonance	1700 Hz
Char. sensitivity	89 dB (1 W, 1 m)
Nominal power	80 W (DIN 45573) (fo: 5000 Hz, 12 dB/oct)
Force factor (Bl product)	2.6 Tm
Voice coil diameter	19 mm
Voice coil height	1.5 mm
Air gap height	2 mm
Voice coil resistance	6.2 ohms
Effective cone area	4 cm²
Moving mass (incl. air)	0.2 g
Weight	0.28 kg



Vifa drivers are distributed in Australia by Scan Audio, PO Box 242, Hawthorn 3182 Vic. (03) 819 5352.

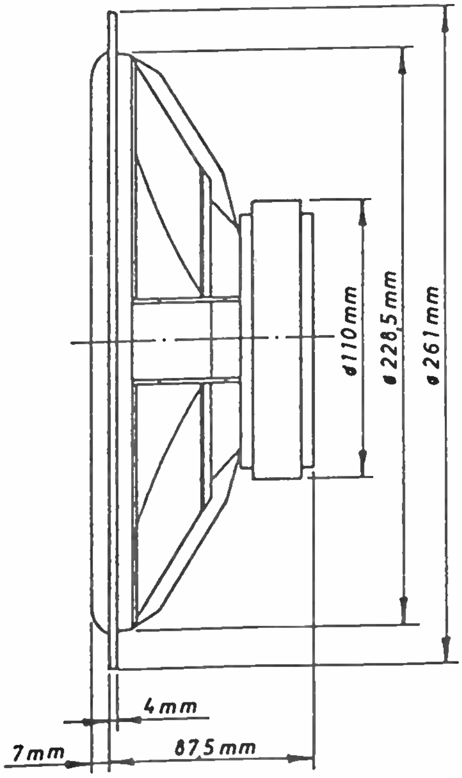






P25WO

10″ (254 mm) Vifa polycone woofer



The P25WO is a sturdy 10″ (254 mm) diameter woofer with a special Vifa 'polycone'. This cone material has high internal damping and increased stiffness in proportion to normal cone plastics, such as bextrene and polypropylene.

A high force factor and a progressive suspension means that this woofer is well suited for bass reflex enclosures.

Technical Data

Nominal impedance .... 8 ohms
Frequency range .... 25-3000 Hz (DIN 45500)
Free air resonance .... 25 Hz
Operating power .... 5.0 W (DIN 45500)
Characteristic sensitivity .... 89 dB (1 W, 1 m)
Nominal power .... 60 W (DIN 45573)
Music power .... 100 W (DIN 45500)
Force factor (Bl product) .... 9.4 Tm
Voice coil diameter .... 40 mm
Voice coil height .... 14 mm
Air gap height .... 6 mm
Voice coil resistance .... 5.7 ohms
Effective cone area .... 350 cm²
Moving mass (incl. air) .... 44 g
Thiele/Small Parameters
Qm: 3.15
Qe: 0.46
Qt: 0.40
Vas: 180 l
Weight .... 1.95 kg

D75MX

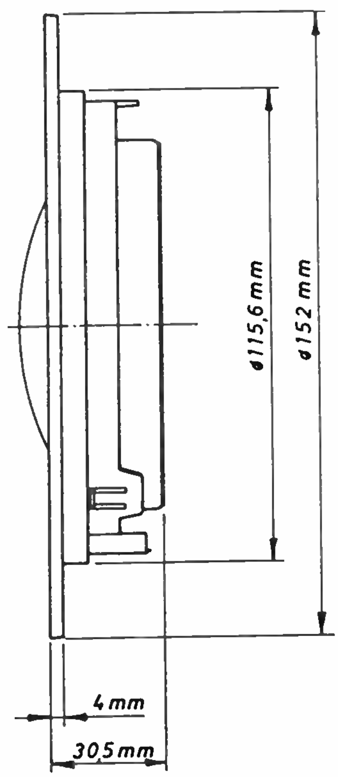
3″ (75 mm) Vifa dome midrange

The D75MX is a very high quality 3″ (75 mm) soft dome midrange drive unit. The diaphragm is formed from a special plastic with high internal damping which ensures a very smooth frequency response.

The driving system is very efficient due to an internal ferrite magnet. This allows a special venting leading to a very linear impedance characteristic.

Technical Data

Nominal impedance .... 8 ohms
Frequency range .... 350-5000 Hz (DIN 45500)
Free air resonance .... 300 Hz
Characteristic sensitivity .... 91 dB (1 W, 1 m)
Nominal power .... 80 W (DIN 45573)
(fo: 500 Hz, 12 dB/oct)
Force factor (Bl product) .... 4.7 Tm
Voice coil diameter .... 75 mm
Voice coil height .... 3 mm
Air gap height .... 2 mm
Voice coil resistance .... 7.2 ohms
Effective cone area .... 55 cm²
Moving mass (incl. air) .... 3.6 g
Weight .... 0.65 kg



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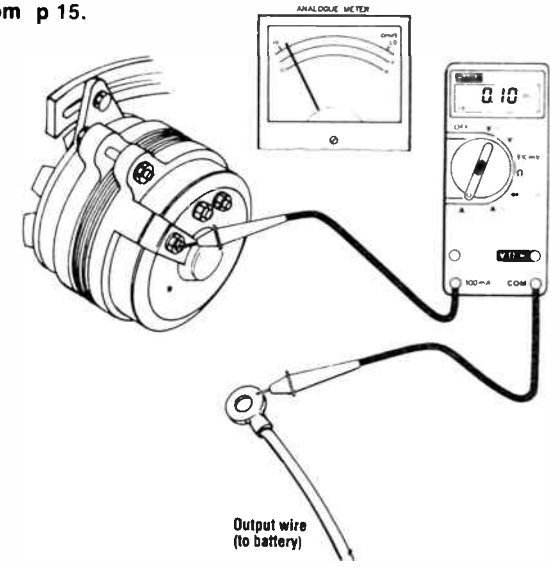

Figure 11. To check alternator diode leakage, connect the meter in series with the alternator output terminal (engine not running) and set the meter to read current. Use the 10 amp range unless you're sure the current is under 1 A. leakage should be no more than a few milliamps at most, often less than half milliamp.

Check the leakage current of the alternator diodes as shown in Figure 11. Once you have determined how much current the diodes draw, leave the alternator disconnected to avoid confusing its draw with that of another component. Remember that under-bonnet lights, trunk lights, dome lights (courtesy lights) and computers all draw current and are apt to be on while working on the car. A piece of tape over the door switch will keep the dome lights off.

Short circuits are usually caused by a defective component or insulation that has rubbed through. Note — the old practice of using the meter in series and setting it to volts no longer works very well. With new computer systems and other digital circuits there are some devices that are always "on"; the meter will show battery voltage when all is normal. It is difficult to sort out what is a normal current draw and what is not using the voltage method. So, for computer equipped cars use the method for locating current drains.

If you're working on a non-computer car, use the same process you use to find current drains in finding shorts, except set the DMM to the volts dc function, and hook it up in series with the battery. Doing so will limit the amount of current that can flow, saving many blown fuses, lots of time, and skinned fingers from changing fuses. Remember the alternator diodes leak some current, so disconnect it to avoid confusion.

As long as there is a current draw, for whatever reason, the meter will read battery voltage. As soon as the current draw is eliminated the meter will read zero.

High resistance grounds can be the most frustrating electrical problems you will face. They can produce a variety of bizarre symptoms that doesn't seem to have anything to do with the cause, when you finally find it. The symptoms include lights that glow dimly, lights that come on when others should, gauges that change when the headlights are turned on, and lights that don't come on at all.

With the new computer systems, high resistance in ground wires and sensor leads can produce all sorts of unpredictable symptoms. Apply conductive grease, available at electronics suppliers and some automotive parts stores, to connections before you re-assemble them. This will reduce corrosion.

Pay particular attention to ground terminals in the vicinity of the battery where acid speeds corrosion. Often a wire that is broken through except for a few strands will produce the same symptom as a corroded ground connection.

We would like to acknowledge the kind assistance of Elmeasco Pty Ltd for providing information and material used for the compilation of this feature.

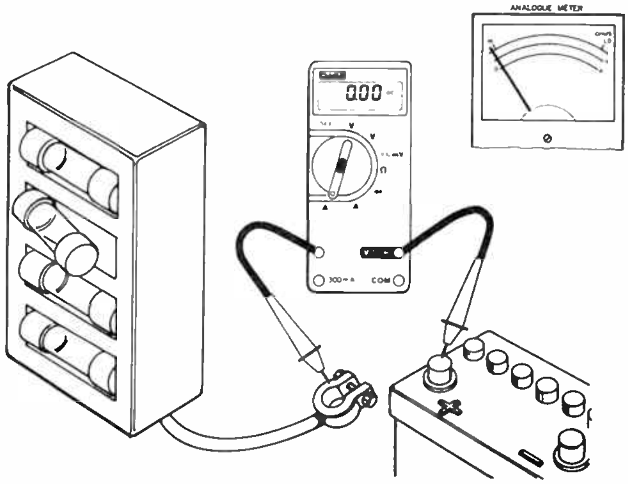

Figure 12. Isolating the circuit causing a current drain. In this sort of test, do not run or crank the engine and do not operate accessories, lights etc, that may draw more than 10 amps — you may irreparably damage your meter.

Set the meter to read current (a high range initially) and connect it in series with the battery. You can isolate the circuit causing the current drain by pulling one fuse at a time while watching the meter reading. When the reading drops, you've isolated the circuit.

Put the fuse back and disconnect the individual components in that circuit one at a time to find the offender. Keep in mind that there may be computer circuits etc, that draw current normally all the time and such devices may not all be on the same fuse.

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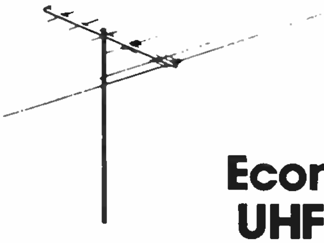

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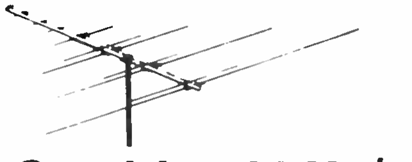

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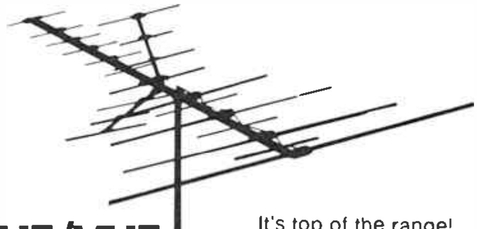

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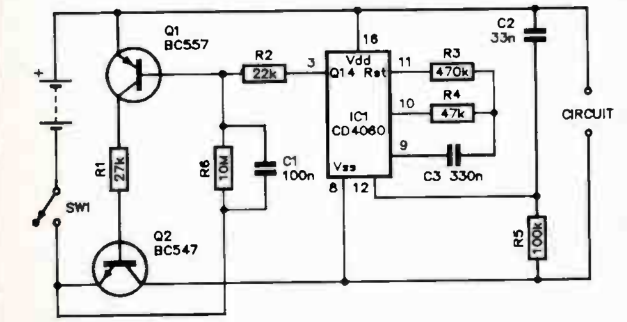


Auto-shutdown for battery gear

Here's a simple circuit to provide automatic 'power-down' for battery-operated equipment so that the battery does not go flat on you because the equipment was not turned off when last used.

It's connected between the usual supply on/off switch and the circuitry in the equipment. It takes about nine minutes to shutdown. Once it has shut down, all you need to do is turn the supply switch off, then on again.

A 4060 CMOS 14-stage oscillator-counter is at the heart of the circuit. This determines the equipment on time. The oscillator frequency is set by the values of R3-R4/C3. The values shown provide a frequency around 30 Hz. This is down-counted by 16,384. When the count finishes, the 14th stage output (pin 3) goes high, turning Q1 off which turns Q2 off. Only leakage current, via R6 (10M) flows then. It's about a microamp, or so.

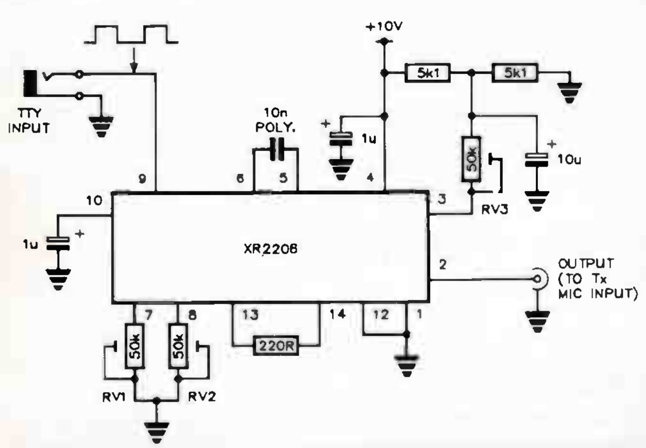
This circuit is intended for equipment drawing only modest current. However, equipment drawing high currents could be accommodated by using a power Darlington for Q2.

— G. Moss
Newtown, NSW

Low cost RTTY modulator

For those amateurs playing with the AEM3500 Listening Post as a RTTY demodulator and looking for a companion modulator to get on the air with RTTY, then this circuit offers great potential.

This RTTY modulator was originally written up in the excellent "RTTY Loop" column in 73 Magazine for August 1985, which is conducted by Marc Leavey WA3AJR. It employs the XR2206 function generator IC as an audio frequency-shift keyed (AFSK) oscillator to produce two tones when 'keyed' by a digital signal.



The oscillator's output is relatively low distortion sinewave from pin 2. The output is coupled directly to the transceiver's mic input. Most transceivers around have an ac-coupled RC input network, so no RC output coupling is really required. However, it would be wise to check first, before hooking up the modulator.

The keying voltage is fed to pin 9 (referenced to ground), and Leavey recommends this should swing from less than one volt to more than two volts.

The two tones produced are dependent on the capacitor between pins 5 and 6, and the resistance to ground from pin 7 and pin 8, RV1 and RV2, respectively. Thus, the latter who are 50k trimpots and, ideally, should be 10-turn cermet types. The capacitor between pins 5 and 6 should be a polyester or polycarbonate type for best stability and circuit repeatability.

When a 'high' is present on pin 9, the output frequency is determined by RV1. When a 'low' is on pin 9, it's determined by RV2. You can determine the output frequency from:

$$f = 1/(R_x \times C)$$

Where R_x = either RV1 or RV2,
and C = the capacitance between pins 5 and 6.

With a 10n capacitor and RV1 and RV2 around 45k, the output would be around 2200 H_z.

If you wish, you could drop RV1 and RV2 to 25k each and use a 27k resistor in series with each to give more restricted range of adjustment.

The actual 'mark' and 'space' frequencies will depend on whether your gear is 'mark high' or 'mark low'. Set it up to suit yourself.

The *actual* output frequencies are immaterial, so long as the shift (difference between them) is correct, except for FM VHF/UHF operation where they must comply with the 'standard' 2125/2295 (170 Hz shift) or 2125/2975 (850 Hz shift). Generally, 850 Hz shift is used on FM on the VHF/UHF bands. On HF SSB, it doesn't matter, so long as the shift is correct and you're within the transmitter's filter passband.

Output amplitude is controlled by RV3. According to the specs from Exar, you get about 60 mV of output per k-ohm of resistance here. The two 5k1 resistors simply give a 'half rail' supply point (two 4k7s would do). You should be able to get around 3 V peak-to-peak output with RV3 at maximum resistance.

Roger Harrison VK2ZTB

Benchbook is a column for circuit designs and ideas, workshop hints and tips from technical sources of the staff or you — the reader. If you've found a certain circuit useful or devised an interesting circuit, most likely other readers would be interested in knowing about it. If you've got a new technique for cutting elliptical holes in zippy boxes or a different use for used solder, undoubtedly there's someone — or some hundreds — out there who could benefit from you knowledge.

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▶ from p 31.

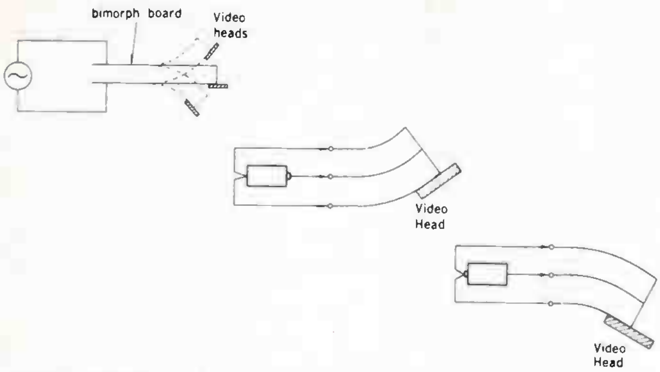

Figure 17. Dynamic track following is achieved by having the heads mounted on a 'bimorph' ceramic plate. This comprises two tiny slabs of ceramic that bend slightly when a voltage is applied, varying the head azimuth as required.

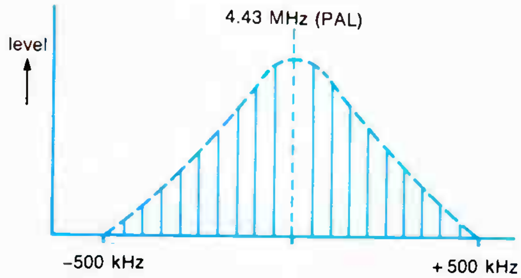

Figure 18. The chroma (colour) signal spectrum is centred on 4.43 MHz for PAL video, with significant components (sidebands) distributed on either side for +/- 500 kHz.

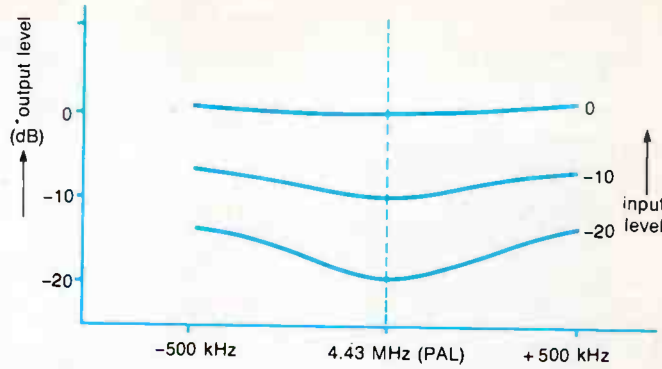

Figure 19. 'Emphasis' is applied to the chroma bandwidth extremes at lower levels to preserve fine detail in the image.

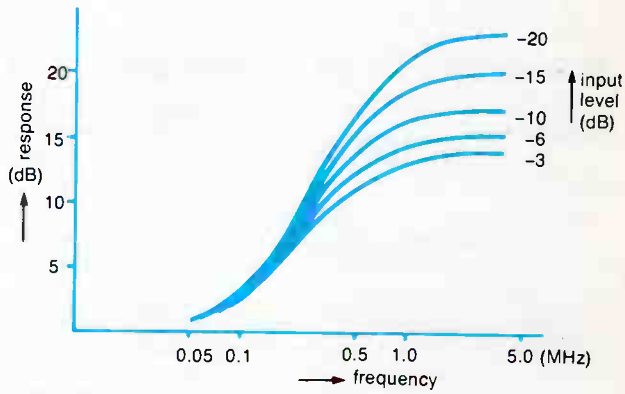

Figure 20. To avoid noise causing colour shifts, pre-emphasis is applied to the video at the high frequency end of the video bandwidth, the amount of emphasis depending on the input level.

pled to the ATF logic, the azimuth can be corrected for almost any type of playback azimuth. You may hear more about this.

Comb filter

In a home VCR, chroma (colour) information is recorded at a lower frequency (737 kHz on Beta) than the luminance signal. This ensures the S/N ratio is preserved, but the possibility of crosstalk from adjacent tracks is a real problem.

It can be overcome by phase shifting every second field by 90 degrees per line on record, and restoring on playback. Any crosstalk is cancelled by a line delay that adds any adjacent channel information with that received two lines earlier, and 180 degrees phase-shifted; thus cancelling incoming crosstalk. A sort-of 100% feedback, called comb filtering and part of the Sony CCD-V8 design.

Video "Dolby?"

Like subtle audio tones, the upper sidebands which provide fine colour detail tend to be lost in VCR record/playback. A professional type solution is included in the CCD-V8. Like the Dolby system, dependent on level, the upper sidebands are boosted and reduced again on replay. The scheme is illustrated in Figures 18 and 19.

Burst emphasis

Colour shifts can be caused in VCR by noise obliterating colour bursts. As the Sony CCD-V8 works at the upper limits of technology it is understandable that the format calls for comb filtering, chroma emphasis, and also, the doubling of the burst record level with a halving on replay. This is how the previously impossible is achieved with enough latitude to ensure the hope of reasonable performance in an old and worn V8 camcorder. Figure 20 shows the pre-emphasis applied over the video bandwidth.

Compatibility

This is the consumer's greatest concern. In the V8 format, can I a borrower and lender, be? Disregarding the audio and digital options in V8, Sony tell me that they are including in the PAL version all these enhancements, except the bipolar DTF which will not affect compatibility when it is introduced. What it must mean is a lack of cheap V8 format camcorders with minimal quality and without these sophisticated correction systems only possible through the use of LSI available to a "club" of big name manufacturers.

Although this may smell of a cartel, the assurance of a minimum standard by Philips and Dolby in the compact audio cassette has protected the consumer from buying useless rubbish that looks good, but may be cheap and misrepresented as the real thing.

If you buy any make of camcorder, VCR or a VC bearing the "V8" official stamp, they should be fully compatible if the 127 sponsors of the new format are on the ball.

However, a warning. The V8 format video on sale in NTSC areas is useless in PAL territory. Kodak tell me that it will be at least a year before their V8 video; first on the market over a year ago in the U.S., will be available in Australia in PAL. They talk about the V8 format on NTSC just reaching "Phase 2 with Phase 3 not far off."

Looking at the CCD-V8E

Having dealt with all the ways and means, what do they add up to in the finished product? Sony's CCD-V8 camcorder and accessories are probably the most sophisticated equipment that modern science and technology has produced for use by ordinary people of reasonable means and intelligence. It is a one-hand imaging device. The right hand goes through the prosthetic grip. Weight has been reduced to 2.3 kg including battery and VC. The (Betamovie camcorder, which does not replay, is 3 kg +). It is a small, well-balanced unit, easily carried for long periods. Bulk is 7768 cubic cm (Betamovie is 9817 cubic cam), and it weighs just 2.3 kg. Either hanging on the hand or balanced on the shoulder, it is no great burden to take it with you.

The CCD-V8 does not have auto focus and was left off, I understand, because it would add a lot of weight, bulk and cost. The removable EVF allows a clear image, so focus is instant by eye. White balance is automatic, merely a matter of pointing at a white subject and pushing a button. The lens cover has a white filter that will allow WB. Just as the Walkman and compact CD player have compact style, so does the whole CCD V8E.

In the hands, it has a comfortable feel about it. I like the large clear illuminated LCD panel at the back that tells you everything that is happening. The unit is built around a sturdy diecast chassis, and the head drum is machined to tolerances allowing headchanges without settings.

Sony designed and made their own LSI chips to achieve the miniaturization. Fast winding is good at 11 to 15 times play speed, in both directions; cue nine times, and review seven times. The lens system is good with a power zoom lens of 6xf = 12-72 mm, f1.4 tele 1.8, plus macro and filter. Diameter is 46 mm.

Light sensitivity is quoted as 22 Lux (2 ft-candles), which may be conservative as it is much less sensitive than other makes of video using picture tubes at 7-10 lux minimum, or the latest National CCD WVP F-2 camcorder which gives a brilliant pic at 10 lux. Recording/Playback times are: SP 90 min; LP 180 min.

The CCD-V8 must not be compared with the Betamovie. Beside its small size and lightness and an EVF, it will playback to a TV or VCR having UHF input (I am told a VHF output may be available soon), of any format. It only requires the small RFU-85 adaptor to turn video into a TV signal. It plugs into the CCD-V8 and then into the TV or VCR and is tuned like any TV station. Also, a battery pack, ac pack/charger allows mains operation; with an adaptor supplied it also charges up to three batteries. A Sony P5-30 VC is supplied.

There is a very wide range of practical accessories that can be purchased, carrying case, shoulder rest, camcorder jacket, special mikes, battery belt for 90 min sessions or camera light, automatic editor, power/charger/RF converter, and if you wish to use it as a home VCR for timeshifting TV, there is a docking unit to make it into a tuner/timer with remote control.

For a recommended retail price of $2199.00, the Sony CCD-V8 must be a very attractive purchase for the videographer; serious or novice. It is however, an electronic movie camera and does not record and timeshift TV (it will dock into the TT-V8EC Tuner/Timer and do this) if you own a home VCR you can use if for video shots, wherever you may be. You can then edit, at very high quality, onto any half inch VC or other video medium. Although the video format is of no consequence, the TV and VCR must be PAL if the camcorder is PAL; both NTSC if it is NTSC.

The home version of the V8 format VCR is deeply involved in PCM audio recording/playback with timeshift; from both TV and FM audio. It is a long subject in itself and I will cover it in a following article.

The theory and practice of V8 format sound; both FM Multiplx and PCM is a lengthy subject of great interest and complexity.

The 8 mm cassette is not for video alone. In the wings are applications for computer data storage, and a 'video photoprinter' to deliver colour prints from video frames. For audio applications, the 8 mm format is planned to provide a hi-fi record/playback media giving six three-hour tracks with specs to challenge the compact disc.

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letters

Hi-Fi . . . where am I?

Dear Sir,

Developments in the electronic reproduction of music have moved so swiftly over the last 20 years or so that, had the average music lover held onto the various pieces of equipment and peripherals that he has bought or built, he would possess enough to furnish a small museum.

He would have a broadcast radio with terminals at the back to take a heavy magnetic pick-up, or perhaps a lighter piezo-electric head. He might even have a high quality AM valve tuner and a 10 watt Mullard amplifier with five valves and several enormous transformers. There would certainly be a collection of 78 rpm records, leading to 45s and 33⅓s with turntables to suit. He would have speakers in vented enclosures or folded exponential horns, perhaps some filled with sand if the house foundations would stand the weight. The birth of stereo meant another amplifier, another speaker and another enclosure, so add these to the list! There would be at least one tape cassette deck with cassettes and probably an old reel-to-reel recorder, surrounded by a collection of reels of various diameters. An early 'boxy' AM/FM stereo tuner would also be on display as a relic of the very recent past. There would be many stereo amplifiers.

Let us now pause in this recital of 'memorabilia in our time', before things really get confused by introducing compact discs and hi-fi video.

What has all this change done for us, apart from allowing us to start a museum of our own purchases?

The sound that we get from our speakers has undoubtedly got closer to that which goes into the microphone in the studio or concert hall. However, this sound is not always up to the quality of the equipment and many recent reproductions of music do not capture the 'presence' of earlier ones. So a good deal depends on the skill of the engineers doing the recording. And a good deal depends on how well we maintain our equipment. The cartridge, the stylus and the magnetic head all must be properly looked after.

Granted that sound is on the improve, how does one view the compact disc and hi-fi video?

Having built up our library of, for instance 78s and seen the means of spinning them disappear, will our 45s and 33⅓s go the same way? If we buy a CD player, will one that can make home recordings be released next year, or next week? Will the classical music catalogue of CDs be built up or will rock and popular music consume the disc manufacturing capacity? Pre-recorded-music tapes seem to be improving tremendously. Will high quality tape players come down to the price of CD players? Someone, sometime must market a reasonably priced AM/FM stereo tuner that has good AM reproduction. When?

So what is the present situation?

The answer is that there isn't one. That was yesterday. How do we poor people who reckon we have probably spent enough for a while on equipment, judge the best move to make to use these developments to increase our listening pleasure?

One viewpoint is to go where the music is. That is, if you see an LP that you want, buy it; or a tape that takes your fancy, buy it. However, how do you feel when the same performance comes out on a CD next month?

The answer to that is, buy the CD player now and the discs as they become available. But CD players are improving with each generation, why buy one before you can really use it? And what about pre-recorded tapes? They are improving. Why not save your money and buy a next-generation tape player?

So there we go, or rather, there we stand, still in a state of confusion.

There are a few signposts that can guide us through the Valley of Confusion and these probably point to keeping as close a watch as possible on developments. For instance, an AM stereo tuner is now being produced by a major manufacturer, so someone is thinking of us! Some retailers stock a much wider range of CDs than others and could be well worth seeking out, and so on.

Well-informed, appropriate magazines are a good way to help you spend money wisely. Retailers can be useful, but beware of those who are interested more in the fast sale rather than a continuing customer relationship.

So perhaps all is not lost. Perhaps there is a way to move carefully through the quick-sands that lie in the Valley of Confusion!

Congratulations on your magazine. You are catering for a wide readership and I have found a number of your articles have opened up new avenues of interest.

Don Richards
Eenezer, NSW

Active speakers

Dear David,

Some time ago I wrote to ETI to suggest future projects of interest to me. I then noticed AEM issue No. 1 at the newsagent and realised that you had left ETI. I also noted that you appear to be resuming the policy stated by Roger Harrison when launching the 5000 Series (1981).

This suits me, because my main interest is in audio projects of high quality. An important bonus is that your designs are flexible and allow the readers to use only the sections that interest them at that time and add later if desired. This enables us to have top quality equipment at minimum cost.

The other most important attraction of your projects is the manner in which you set out all the technical reasons for choosing various sections of your designs. You involve the reader in the same way the late John Moyle (Editor of Radio & Hobbies, later *Electronics Australia)* did years ago.

My particular problem at present is to choose a suitable mid-range amplifier for my existing three-way speaker system. I use a Series 5000 amp for my very efficient 15" Wharfedale bass unit, my old Williamson valve amps for mid-range and a 10 W valve amp for treble. I use the old ETI-433 active crossover, which I later altered to use NE5534ANs instead of the original TCA220s.

The problem is that, according to the review of John Bowers' Active 1 loudspeaker in the February '85 issue of Gramophone, the effects of signals generated by the moving coil speakers is much more audible when feeding a single speaker than with multiple drive units fed via passive crossover networks, which seem to absorb these signals. The effect is described as a "slightly brittle, aggressive mid-range".

John Bowers considered the choice of a very low output impedance using multiple, parallelled MOSFETs with little or no feedback, as in the highly regarded but expensive Sony Esprit, but settled for a less costly variation using vertical power MOSFETs (VFETs — Ed.). The review itself is well worth reading.

From this, I gather that I should choose an AEM6500 100 watt amp. (July '85 issue). But, is the feedback too high for my particular requirement? I am using KEF B110B 8 ohm mid-range speakers and don't use many watts for my normal listening.

Would it be an advantage to add 8 ohm heavy duty resistors or other load to help soak up these signals from the drive unit voice coil? Would higher bias current help? Could I use less feedback when it is for mid-range use only?

However, I also notice you will be publishing a new AEM6000 amp, which might suit my application.

I will eventually replace the treble amp when I find a high quality amp which will not damage my expensive KEF T52B tweeters. I feed the tweeters via 25 uF capacitors to avoid faults causing LF reaching them. This value is sufficiently high to avoid phase shift at 3 kHz and above. The amp has suitable load resistors connected to it.

I trust your new magazine will be very successful.

R. E. Ramsay
North Balwyn, Vic.

It sounds like you are developing a very interesting active loudspeaker.

I am in some doubt that the ratio of powers for the three amps is optimum at present. I imagine that the 15" Wharfedale would be somewhat more efficient than the B110B or T52B. So, I would suggest a 50-60 W amp for the mid-range and at least 40 W for the dome tweeter.

Having not read the review of John Bowers' active speakers as yet, it is difficult for me to comment on his findings. My work with active crossovers in the past, however, has led me to the opposite conclusion. In general, I have found that single drive units, driven from individual power amplifiers give substantially smoother results than when a passive crossover is used. The key of course is that the power amps used must be able to cope with the back-emf generated by the drivers without any trace of instability.

It is true that some manufacturers are adapting the "low or zero overall negative feedback" approach in power amplifiers in order to try to ensure that the output load does not cause amplifier instability. These designs obtain a low output impedance usually by employing a large number of parallel output devices rather than negative feedback to ensure output signal voltage integrity. In my opinion, the relative merits of this design approach is still unclear.

I would point out, for example, that at least one commercially manufactured "zero overall negative feedback" amp of which I am aware still uses the same amount of overall negative feedback within the voltage gain stages driving the output stage. The negative feedback takeoff point is simply moved to an earlier point in the power amp and is therefore buffered from the load.

Unless your Williamson valve amp is suffering from load-induced instability, I do not think the addition of 8 ohm series resistors will help performance. This would increase the effective output impedance as 'seen' by the driver and could have detrimental effects on sound quality.

The AEM6500 modules are highly stable units and ideally suited to this application. In fact, one of the reasons for their development was for use in an active loudspeaker, soon to be described in AEM. We will also be describing a new active crossover design that could be of interest to you.

Good luck with the project.

David Tilbrook
Geoff Nicholls

Satisfaction

Dear Roger,

Congratulations. You have done it for three issues now, with a great mix of articles. The field is so wide it would be easy to try to cover it all and please no one!

Your September editorial expresses amazement at the sophistication of all the electronic things we take for granted, but the real joy of these things is that they are so cheap once the initial demand has been met. The watch, calculator and computer are good examples. CD players and VCRs are currently displaying this downward price trend, now the "bells & whistles" stage has been left behind.

I have seen 'wonders of the age' that promised much and then quietly disappeared.

The real satisfaction of electronics remains with that band of people with not enough dollars and a hot soldering iron. My past has many memories of crystal sets and octal valves. My motto has been "never mind the theory — make it," then the theory becomes more understandable.

Bruce Huston
Wellington, NZ.

Headphones amp

Dear Mr Tilbrook,

Congratulations on your new publication!

At last I have acquired your Series 5000 power amplifier via Jaycar and am very pleased with it. However, I listen a lot through headphones late at night and no one has produced a circuit for a headphone driver.

After two hours playing at low level, you would not be able to keep your hand on the amp's heatsink for very long. Is this normal?

My preamp is a Marantz SC 500 which has an output of 1.5 volts/220 ohms @ 1000 Hz and feeds my Sennheiser 420 headphones adequately if I exercise the volume control close to maximum.

I would like to ask you for a properly designed circuit for a headphone driver to be fed from the preamp. Something similar to the ETI-462 is the type of thing I am after.

D. Griffin
Mossman, Qld

Regarding your Series 5000 heating problems, it sounds like you have the output stage bias current set too high. The on-resistance of power MOSFETs is somewhat higher than equivalent bipolars, so for the same output power from the power amp, the MOSFETs will dissipate more power and thus get hotter.

The heatsinking provided on the 5000 power amp is adequate to keep the temperature at a reasonable level. The prototype 5000 power amp, for example, runs at about 15°C above ambient after an extended period of operation. I suggest you re-check the bias current when the amplifier is hot to see what's going on. If the bias current is alright, the other possibility is that the amplifier is marginally unstable (caused by inductive MOSFET source resistors) and is bursting into oscillation. This is usually accompanied by noticeable distortion, however, so I would doubt that this is the problem in your case.

We have developed a headphone amplifier that will be described as part of the AEM6000 range of ultra-fidelity amplifiers. Initially, it is planned to use it in the "preamp extension" to accompany the 6010 preamp, but we will also plan to describe it as a separate project.

David Tilbrook

Back issues

Dear Roger,

Congratulations to both you and your staff for a very well prepared and presented magazine. Australian Electronics Monthly has demonstrated that good technical journalists are alive and well in Australia. Please add another three readers to your growing list of converts. Good luck to you and to AEM

PS: Could you please advise if back copies are available (we have from September, on) and if so at what price?

Paul Boekenstein
Sawtell, NSW

Back issues of AEM are available for $3.60, post paid anywhere in Australia, A$4.60 (airmail) to PNG or NZ. Note that the August 1985 issue (No. 2) has already sold out!

The Last Laugh

HAVE YOU STRUCK a talking lift yet? If not, then you're in for a treat. The National Roads & Motorists Association (NRMA) headquarters in Clarence St. Sydney has one. Having pressed the "up" button to call a lift, when one arrives, the doors open and a speaker announces in digital tones, "going up!" As you ride the lift, it announces each floor as well as announcing "going up" or "going down" before proceeding after taking on passengers at a floor. It's all much more sophisticated and "up-to-date" than those boring old flashing lights alone.

This particular lift seems to use a National Semiconductors Digitalker speech synthesiser, which produces quite creditable, though still obviously digital, speech. However, the surprising thing is — people actually talk back to it! Whether they believe, or maybe suspect, there's an animate or half-way animate 'thing' behind the machine, we don't really know. But, it's fun to observe people's various reactions.

There are a variety of reactions, actually. Not everybody talks back. Some travellers pretend it doesn't exist. Some nervously laugh in embarrassment and glance slightly either side — just checking out what's going on. The obviously gregarious folks strike up a conversation with it.

A colleague rang one day, having just rode up and down the NRMA lifts for an hour or so watching people's reactions, to ask if I knew technical details. Having satisfied his curiousity there, we then discussed our observations. Jokingly, we mused over a speculation of his as to what would happen if the machine actually appeared to be capable of holding an interactive conversation. After some hilarity, he rang off.

Weeks later, he burst into the office and grandly announced, "I've got it!" Naturally puzzled, "got what?", I enquired. "The interactive talking lift", he replied.

He had concocted a small piece of electronic wizzardry which made the voice sound just like the Digitalker speech synthesiser. Adding a throat mic, a small battery-powered amplifier and a loudspeaker concealed in his jacket's breast pocket, he was going to have some fun in the talking lift!

Being a keen observer of human behaviour, your correspondent decided to accompany said colleague on a 'test run'. He'd found a sizable, new downtown office block sporting a similar Digitalker 'talking lift' and suggested this would be a good place for a fun try-out.

Pretending an air of non-acquaintance, we entered an empty lift, pressed the button for the top floor, and retired to the rear of the lift. "Going up", echoed the two 'speech synthesisers' in unison. His timing was good, to say the least, I mentally noted.

Our first 'mark' got on at the second floor; a gentleman of some largish proportions. As the lift gently jerked into motion, after announcing "going up", my colleague followed with "my, we need to lose a little weight, don't we?" The victim looked up at the lift's indicator panel, looked quickly and nervously left and right and appeared distinctly uncomfortable.

"Not very tactful, is it?", my colleague enquired of the poor victim (in his speaking voice, having put his electronics on standby). "Damned computer things", the victim muttered, "bloody things are everywhere". He promptly punched a button and quickly got out at the next floor.

The next victim was a young lady of the 'outrageous punk' persuasion. She sauntered into the lift and pressed the ground floor button. "Going down", said the lift, swiftly followed by my colleague's comment — "What a lovely outfit, ma'am".

"Bullsh . . !", screeched the girl, aiming the invective at the indicator panel before whirling to glare at us. Genuinely, we managed to look suitably startled. She flung herself out at the ground floor muttering something about techno-capitalist plots to undermine and enslave the proletariat . . . etc, etc.

We had some amusing 'conversations' with little old ladies, startled staff members etc, apart from a few members of the 'stiff upper lip' brigade who pretended it wasn't happening, whatever the provocation.

Late in the afternoon a distinguished, conservatively suited gent strode into the lift which was then on the top floor. He gave us a cursory glance, a slight nod, then turned and pressed the ground floor button. "Going down", said the Digitalker. Leaving a slight pause, my colleague's 'synthesiser' burst forth with — "Going a little thin on top are we, sir?"

His head snapped back as he looked up for the source of the comment. Then he turned to us, his blushing and furious face taking us quite by surprise with the force of emotion. "That damned insolent engineer in R&D's behind this. I'll fix his bunny tomorrow!", he thundered. The lift then stopped at a floor, whereupon he stormed out, ignoring the Digitalker's "floor seven" incantation.

As the lift slid down from the seventh to the sixth floor, we could hear his furious hammering on the closed liftwell doors as he realised he'd disembarked too early.

We beat a purposeful retreat at the ground floor, heading for the relative safety of an uptown coffee shop.

Incidentally, we know of a somewhat puzzled electronics engineer looking for a suitable position in R&D. Any offers?

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