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Australia's Top Selling Electronics Magazine

Electronics Australia

MAY 1985
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PLAYMASTER Series 200 AMPLIFIER

Construction details

RMS to DC VOLTAGE ADAPTOR

50V/5A POWER SUPPLY!

MUSICAL DOORBELL

Three compact DISC PLAYERS reviewed!

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Cat X-6005 .... $69

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Aquarius Colour Computer

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A-923

Electronics Australia

Volume 47, No. 5
May 1985

On the cover

The fisheye lens distorts the real picture of our new Playmaster Series 200 stereo amplifier. For an undistorted view, *turn to page 36.*

Playmaster Series 200

Here at last are the constructional details for our new Playmaster Series 200 stereo amplifier. Our article on page 36 has full wiring diagrams, colour photographs and the specifications.

What's coming

Next month we intend to describe an easy-to-build rally computer. The unit has all the features of commercial units but can be built for a fraction of the cost. *See also page 107.*

50V/5A lab power supply

The 50V/5A power supply featured in June 1983 has been a popular project. This upgraded version has substantially improved ripple performance. *Turn to page 64 for details.*

Features

Hifi, Video and Reviews

Projects and Circuits

Personal Computers

Columns

Departments

Sony CDX-5 car CD player

Sony is the first to market with a CD player for cars. The unit cuts no corners in performance as our review on page 34 reveals. Also reviewed are the Nakamichi OMS-7 and Yamaha CD-X2 home CD players.

Special note: we have been forced to hold over the book reviews from this month's issue due to lack of space.

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*Recommended and maximum price only.

Australia needs a manufacturing base

There is no doubt that, in the years since the Whitlam government reduced tariffs on a wide range of manufactured goods, consumers have benefited enormously. There has been a flood of electrical and electronic goods at prices considerably below what they would have been if we had still had our highly protected electronics industry. At the same time, the quality of the goods has improved greatly and the intense competition in Australia's relatively small but lucrative market has kept prices even lower. In real dollar terms, electronic goods such as television sets and hifi systems are only a fraction of the prices asked 10 years ago.

But while we have been blissfully partaking of the benefits, we have also been paying a high invisible price. Our manufacturing base has not unnaturally been badly eroded and the process is accelerating rather than decelerating. And the smaller our manufacturing base becomes, the more serious is any further erosion.

From a free trader's point of view, there is no real cause for alarm. While Australia keeps its market for electronic and other manufactured goods wide open, we benefit from readily available and cheap goods. They would say, "So what?", if all of it is manufactured off-shore. One serious outcome of this policy is that our balance of trade has been in deficit for several years. The consequence of this is that the Australian dollar has taken a dive and so we will now pay more for our manufactured goods.

Another consequence is that, as the manufacturing base has declined, so has our skill base. There is now virtually no industry to train our engineers and technicians. There is a serious and growing shortage of technicians who are badly required to install and service all the high technology that we are so gladly embracing. The way we are going, we are rapidly becoming little more than a "third world country", as far as technology is concerned.

Do we want this? Maybe the time has come to consider the alternative to a wide-open market. Maybe we should consider the re-introduction of tariffs for selected goods that we want manufactured here, both for local consumption and, eventually, for export. That would re-establish industry, help our balance of trade, increase employment and go some way toward regenerating our skill base.

These ideas have been advanced by Professor Gregory Clark in the *Australian Financial Review* (April 1st, 1985). He says that we should offer overseas or local investors the chance of a protected market in return for a large investment in manufacturing. Japanese electronics companies might just jump at the chance.

The problem with the concept of tariff protection for selected industries is that it requires the Government or some advisory body to select winners. But governments have never shown any ability to do that. And even where a reasonable decision has been made to support an industry, it can go completely off the rails. You only have to look at the motor industry where too many manufacturers have been invited in. We would have to be very selective. But the consequence of having no manufacturing base at all in a few years is cause for very serious alarm. It needs to be thought about very carefully.

Leo Simpson

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This offer is STRICTLY LIMITED to MAY ONLY. DO NOT ASK FOR THIS PRICE AFTER MAY. It is to celebrate our new store opening at GORE HILL in Sydney.

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Ref: ETI May 1985

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Ref: ETI May 1985

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DC Convertor This unit plugs into your car cigarette lighter socket and will provide up to 300mA at 6 and 9V DC. Ideal to power the Ghetto Blaster in your car! We only have just over 200 so hurry!
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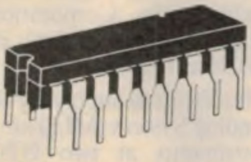

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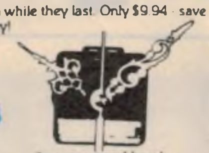

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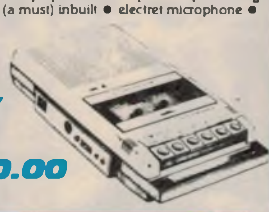

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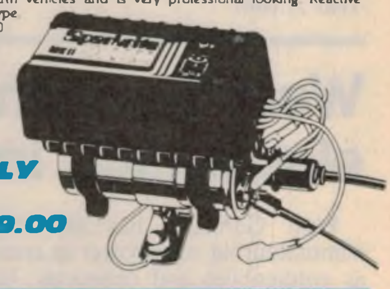

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News Highlights

15,000th BARRA SONOBUOY — the 15,000 Sonobuoy (an antisubmarine communications device) recently rolled off AWA's North Ryde assembly plant. AWA manufactures the Sonobuoy for both the RAN and the Royal Navy, and negotiations are under way to sell the system to Europe and North America. Pictured from left to right are Mr Peter Hamilton, Corporate Manager, Canberra; Mr Graham Darley, General Manager; the Hon Mr Brian Howe, Minister for Defence Support; Mr John Hooke, AWA Chairman; and Mr Graham Watt, recipient of the AWA Trainee of the Year Award.

Interscan for US airfields

Interscan Australia Pty Ltd and its US based partner, Northrop Corporation, have signed an agreement with United Technologies Corporation (UTC) to supply aircraft landing equipment for UTC's airfields in the US.

Interscan is supplying the Microwave Landing System (MLS) antennas and test instruments at two UTC airfields in Connecticut, and another in Florida. The airfields service UTC's Pratt and Whitney aircraft engine, and Sikorsky helicopter manufacturing facilities.

In announcing the contract, Mr John Drennan, Managing Director of Interscan, said, "this is the first overseas sale of Interscan equipment. After years of design and development work, Interscan Australia has now emerged as a commercial supplier of specialised high-technology hardware for the aviation industry."

Mr Drennan said that Interscan would work with Sikorsky to develop heliport procedures for MLS guided landings.

The Chairman of Interscan, Sir Gordon Jackson, said the support of a corporation of the calibre of United Technologies for a small Australian high-technology company would itself be a marketing plus for Interscan in the US and elsewhere around the world. He said he hoped this breakthrough would be a harbinger of more overseas successes for Australian technology in aviation equipment and many other fields.

West German electronics industry fights back

West Germany has long been a manufacturing superpower in areas such as automobiles and chemicals, but for the most part has been overhauled by the US and Japan in electronics. To counteract this, the West German government has agreed to fund key areas of research to the tune of $1 billion over the next four years.

In the past, most of the government money has been directed towards a few large companies such as Siemens AG. This time, the government is trying to support smaller companies, especially those in the computer field.

About $200 million is going to fundamental research into "fifth-generation" computer technologies such as expert systems and innovative architectures.

Optical fibre communication technology will receive about $100 million, and robotics development $200 million. Two-hundred-and-fifty million dollars, the largest chunk of the handout, will go towards the development of sub-micron IC manufacturing. A further $130 million is earmarked for research into chip-based sensors, actuators, and other "microperipheral" devices.

About $80 million will go toward the development of new semiconductor materials, including organic molecular technologies.

The government expects the total research expenditure to be about double the amount that it is contributing. Most companies are expected to match the government's contribution to each project from their own sources.

Strange bedfellows

In the next few months, Wang will announce a working relationship with Apple computers, a relationship which will affect the whole balance of power in the personal and business-computer industry, but neither company is telling just yet.

At the moment, Apple is extremely cash rich, but it has major gaps in its product line, especially in business machines. And the business market is where the profits lie in up-market personal computers.

Apple knows that this year there will be a flood of low-priced Macintosh lookalikes coming onto the market from Atari (taken over from Warner by Jack Tramiel who originally steered Commodore to success), and from

Commodore itself.

As well, Digital Research has recently announced a front-end package called "Gem" which can be lashed on to almost any IBM program/machine combination to make it work like a big Macintosh. Which means that this is the year when Apple will be running into some formidable opposition.

It is unlikely that Apple will launch any new business machines to counter this situation. Apple got it totally wrong when it tried to get into the business market with the ill-fated Apple III and it is unlikely to repeat that experiment.

At the same time, its top-of-the-line machine, the Lisa, is too expensive and too esoteric for most business applications, although it is adored by universities and scientists.

Logic tells us that Apple is about to get into bed with another company so that it can keep offering itself to the business market as a viable alternative to IBM.

There are several likely punters, but informed sources within the industry are quite certain it will be Wang.

Wang was founded by the redoubtable An Wang. He was born in Shanghai and came to the United States to build the biggest office automation company of them all.

Wang, like Apple, has always gone its own way which has frequently kept it well out of the mainstream of the computer world, frequently with great success. Again, for it the enemy is IBM. Wang is currently losing its percentage of market share in the United States and does not expect to meet its previously announced growth rates (in Australia the scene is different as Wang goes from strength to strength).

For Wang, this sort of alliance makes sense and the setting up of a tight Apple/Wang association now seems fairly certain.

Whether this will be formally announced at the Apple annual general meeting is open for debate. The last time Apple announced an alliance with another company (Cullinet, a Local Area Network company in 1983) it did not work out and everyone had egg on their faces.

What will definitely be announced by Apple is a new laser printer (a badge engineering job from Canon), a Local Area Network system for the Macintosh and other Apples which will suffer from dramatic speed problems (minimum acceptable speed for exchange of information on a local network is 1.1 megabits a second. The Macintosh can only manage two-thirds of this), and a combination of software and hardware which will let Apples talk to IBMs and vice versa.

There may also be an announcement of a 16-bit version of the Apple IIe — the industry's hardiest survivor — using both a new 16-bit version of the venerable 6502 chip and a 16-bit version of the Z80 which uses CP/M as an operating system. If these new machines use all of the software that exists for the standard Apple then the future of the IIe is assured.

Meanwhile Wang is about to announce a new lap computer which has a built-in disc drive, is IBM compatible, can hold three quarters of a megabyte of random access memory and has either an electroluminescent or a plasma screen.

Add all of this together with a Wang/Apple strategic alliance and suddenly there is a new ball game in the computer world.

Sydney Morning Herald

AWA to take over CSIRO's multi-project chip system

AWA Microelectronics is to take over CSIRO's highly successful Australian Multi-Project Silicon Chip system (AUSMPC).

Announcing this last March, the Director of CSIRO's Institute of Physical Sciences, Dr Neville Fletcher, and the General manager of AWA Microelectronics Division, Dr Lou Davies, said the transfer ensured continued supplies for prototype purposes of high quality, special purpose chips at a fraction of the normal production cost.

The AUSMPC system, which began with the establishment of CSIRO's Adelaide-based VSLI (Very Large Scale Integration) program in 1980, is designed to make high technology chips accessible to Australian industry and research institutions.

Under the three year agreement, CSIRO will give AWA all its rights, title and interest in the system and its current mailing list. In return, AWA has agreed to maintain the high technical standards and exacting schedules that characterised the CSIRO system. Initially AWA will offer the service at a reduced cost of $175 a square millimetre (previously $250 a square millimetre).

AWA has for 17 years been the only company in Australia to operate a fully integrated design and manufacturing facility for integrated circuits. Based at North Ryde and Rydalmere, NSW, the facility has established an enviable reputation.

Business Briefs

QUEENSLAND ELECTRONICS SHOW: Now in its third year, the Queensland Electronic Show will be held May 9-12 at the Crest International Motel, Brisbane. Products of interest at this year's show will include the new car CD players, portable CD players, the VHS answer to Betamovie, the MSX personal computers from Japan, and a host of other products in the hifi, video and home appliance area. An entire floor of the show will be devoted to demonstrations of top quality hifi and video equipment.

SWANN EXPANDS OVERSEAS: Swann Electronics International Pty Ltd has announced the completion of major extensions to their wholly owned facility in Singapore. The Managing Director, Mr David Swann, says that strong demand for Swann products in Asia, combined with new markets in America, led to the expansion.

The new plant includes automated plastic moulding, metal stamping, miniature welding and soldering stations and an extensive assembly area. Swann Electronics International Pty Ltd has its head office at the corner of Hardner and Forster Roads, Mt Waverley. Phone (03) 544 3033.

PROMARK ELECTRONICS has been appointed factory agents and distributors in Australia for Teledyne Relays and Teledyne Solid State Products. Promark has been the Australian agent for Teledyne's Semiconductor division since 1983.

The Relays division of Teledyne specialises in ultra-miniature relays based around the TO-5 package and the new low profile centrigrid pattern. The Solid State Products Division produces a wide range of switching modules, solid state relays and solid state computer I/O interface modules. Further information is available on request from Promark Electronics, 366 Whitehorse Road, Nunawading, 3131. Phone (03) 878 1255.

ARISTA ELECTRONICS PTY LTD has moved to new, larger premises at 57 Vore St, Silverwater, NSW 2141. The phone number is (02) 648 3488, while the telex number is AA72200.

Illegal amplifiers in Sydney taxis

Sydney taxi drivers with illegal linear amplifiers are causing interference to other broadcast services and making themselves liable to prosecution, according to a spokesman for the Department of Communications.

The spokesman said that a number of taxis in the Sydney area had been fitted with linear amplifiers in an effort to increase the range of radio contacts. Unauthorised use of a linear amplifier is illegal under the Wireless Telegraphy Act 1905 and operators can face severe penalties including confiscation of equipment and a fine of up to $1000.

Fines will increase to $10,000 under the new Radiocommunications Act which will take effect this year. Under this Act it will also be illegal to install such equipment without authorisation.

The spokesman said the amplifier problem had first arisen in the Sydney area about two years ago, but reports of interference to other services had increased significantly over the past six months.

Departmental officers, along with officers from the NSW Department of Motor Transport, are to begin inspecting taxis at depots and ranks to check for installation and operation of linear amplifiers.

Satellite TV system on schedule

Components for the radio and television elements of Australia's Homestead and Community Broadcasting Satellite Service (HACBSS) will start arriving in the country in May.

According to the Minister for Communications, Mr Michael Duffy, over 200 B-MAC (Multiplexed Analog Component) decoders worth over $A2 million were being supplied to Plessey Australia by Scientific Atlanta (USA).

The decoders form part of earth station equipment for HACBSS. They will be used to convert B-MAC signals from the satellite into television and radio signals for terrestrial transmission of ABC programs throughout Australia, as well as for direct reception.

Australia will be the first country in the world to use the B-MAC transmission system and, as such, has attracted the interest of the international broadcasting community.

DSE to sell Olivetti PCs

Mr Mike Wilson, Managing Director of Dick Smith Electronics (seated left), and Mr Peter Hatch of Olivetti Australia.

In a major market move, Dick Smith Electronics Pty Ltd has finalised an agreement with Olivetti Australia for retail distribution of the IBM-compatible Olivetti M24 (including the M21 Portable derivative).

The M24 is the machine on which AT&T is developing a Unix standard System V. According to DSE, it is one of the fastest growing systems in the world.

Sales will be made via the 60-store DSE network in Australia and New Zealand. DSE says that the agreement is an aggressive step into volume marketing of a most competitive product.

Prices are competitive, with the standard system selling for $3995. This includes the M24 base unit with 128K RAM and one 360K disc drive, a high resolution green screen monitor, an IBM-style keyboard, and a full MS DOS operating system with GW Basic. An expanded system with 256K RAM and two 36K disc drives is available for $4495.

A wide range of software is available including Lotus 123, Perfect Writer, Perfect Filer, Stock Control, General Ledger, Debtors Ledger, Credit Ledger and Payroll.

Please find listed below our special wholesale pricing for a fraction of the range of products we import and are distributors for. Please feel free to ring Peter Jones or Dean Wilson for competitive quotes on all your components and computer peripheral needs. New price lists and products will now be issued at regular intervals. Please note minimum account orders for these prices is $50 per order. Minimum Cash Sale or Mail Order is $20.

Best regards, Rod Irving

Northcote (03) 489 7099 (2 lines)
Clayton (03) 543 2166 (2 lines)

RITRONICS WHOLESALE

Incorporated in Victoria

MAIN WAREHOUSE:
56 Renver Rd., CLAYTON 3168.
Phone (03) 543 2166
HEAD OFFICE:
1st Floor, 425 High St., NORTHCOTE 3070.
Phone (03) 481 1923 Telex AA38897

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74F SERIES

Full range of Fairchild "Fast" series in stock!

	1-9	10-99	100+	1000+
74F00	0.64	0.60	0.56	PLEASE
74F02	0.64	0.60	0.56	PHONE
74F04	0.64	0.60	0.56	
74F08	0.64	0.60	0.56	
74F10	0.64	0.60	0.56	
74F109	0.88	0.83	0.77	
74F11	0.64	0.60	0.56	
74F112	1.30	1.22	1.13	
74F113	1.30	1.22	1.13	
74F114	1.30	1.22	1.13	
74F138	1.50	1.41	1.32	
74F139	1.50	1.41	1.32	
74F148	1.39	1.31	1.22	
74F151	1.50	1.41	1.32	
74F153	1.50	1.41	1.32	
74F157	1.50	1.41	1.32	
74F158	1.50	1.41	1.32	
74F160	3.34	3.14	2.93	
74F163	3.34	3.14	2.93	
74F164	1.88	1.77	1.65	
74F168	3.68	3.45	3.22	
74F169	3.68	3.45	3.22	
74F174	1.73	1.62	1.51	
74F175	2.34	2.20	2.04	
74F181	4.08	3.83	3.57	
74F189	7.15	6.69	6.26	
74F190	3.36	3.15	2.94	
74F191	3.36	3.15	2.94	
74F192	4.72	4.43	4.13	
74F193	4.72	4.43	4.13	
74F20	0.64	0.60	0.56	
74F219	6.78	6.36	5.94	
74F240	2.98	2.79	2.60	
74F241	2.43	2.28	2.13	
74F243	3.70	3.47	3.23	
74F244	2.98	2.79	2.60	
74F245	7.00	6.56	6.12	
74F251	1.64	1.54	1.43	
74F253	1.44	1.35	1.26	
74F257	1.60	1.50	1.40	
74F258	1.63	1.53	1.43	
74F280	1.34	1.26	1.18	
74F283	1.81	1.75	1.59	
74F299	6.94	6.51	6.08	
74F32	0.64	0.60	0.56	
74F322	5.80	5.43	5.07	
74F323	7.66	7.19	6.70	
74F350	3.00	2.81	2.62	
74F352	1.63	1.53	1.43	
74F353	1.63	1.53	1.43	
74F373	3.36	3.15	2.94	
74F374	3.36	3.15	2.94	
74F378	2.04	1.92	1.79	
74F379	2.14	2.01	1.87	
74F381	5.00	4.69	4.37	
74F382	5.20	4.82	4.55	
74F384	11.23	10.53	9.83	
74F385	9.82	9.21	8.60	
74F398	3.82	4.82	4.55	
74F399	2.33	2.19	2.04	
74F521	3.56	3.34	3.12	
74F524	10.69	10.02	9.35	
74F533	3.36	3.20	2.90	
74F534	3.36	3.20	2.90	
74F537	5.02	4.70	4.39	
74F538	5.02	4.70	4.39	
74F539	5.02	4.70	4.39	
74F543	7.06	6.62	6.17	
74F544	6.94	6.51	6.08	
74F545	5.39	5.05	4.72	
74F547	5.17	4.84	4.52	
74F548	4.47	4.19	3.91	
74F568	3.94	3.70	3.45	
74F569	3.94	3.70	3.45	
74F582	9.87	9.25	8.64	
74F583	7.33	6.87	6.42	
74F588	5.69	5.34	4.98	
74F64	0.60	0.57	0.53	
74F675	1.22	1.14	1.06	
74F74	0.64	0.60	0.56	
74F86	0.88	0.81	0.76	

Plus 20% tax where applicable

TRANSFORMERS

Cat No.		1-99	100+
M12851	2851	2.50	2.25
M12155	2155	4.80	4.20
M16672	6672	6.35	6.15

Plus 20% tax where applicable

MONITORS

Cat No.		1-3	4+
X14500	Ritron 1 Green	$140.00	$135.00
X14502	Ritron 1 Amber	$145.00	$140.00

WHILE STOCKS LAST
Plus 20% tax where applicable

RCA INSULATING SOCKETS

Cat No.	Desc.	1-99	100+
P10232	2 Way	0.25	0.21
P10234	4 Way	0.45	0.40
P10236	6 Way	0.75	0.60

Plus 32½% tax where applicable

RCA CHASSIS MOUNT METAL

Cat No.	1-99	100+
P10231	0.16	0.13

Plus 32½% tax where applicable

DIODES

Cat No.	Desc	10+	100+	1000+
Z10135	IN4148	0.03	0.02	0.015
Z10105	IN4002	0.04	0.03	0.03
Z10107	IN4004	0.05	0.04	0.02
Z10110	IN4007	0.10	0.06	0.05
Z10115	IN5404	0.18	0.14	0.11
Z10119	IN5408	0.20	0.16	0.13

Plus 20% tax where applicable

SOLDERING IRON STANDS

Cat No.	1-99	100+
T113023	3.25	3.00

Plus 7½% tax where applicable

75OHM COAX CABLE

Cat No.	100M	500M	1000M
W11222 3C2V	18.00	17.00	16.00
W11224 5C2V	23.00	22.00	21.00

(5C2V WHITE OR BLACK)
100M ROLLS
LINE LOSS PER 100' (33M 200MHz)
W11222 6.2dB (Approx)
W11224 3.9dB (Approx)
Plus 20% tax where applicable

COMPUTER CONNECTORS

Cat No.	Description	1-99	100+	1000+
P10900	DB25 Plug	1.30	1.20	90
P10901	DB25 Socket	1.40	1.30	1.00
P12210	Centronics Solder	3.50	3.15	2.95
P12200	Centronics Crimp	5.00	4.50	4.75
P10880	DB9 Plug	1.30	1.20	0.90
P10881	DB9 Socket	1.40	1.30	1.00
P10890	DB15 Plug	1.30	1.20	0.90
P10891	DB15 Socket	1.40	1.30	1.00

Plus 20% tax where applicable

NICADS

Cat No.		1-99	100+
S15020	AA	1.60	1.50
S15021	C 1.8AH	3.25	2.90
S15022	D 4.0AH	5.90	5.50

Plus 20% tax where applicable

HORN SPEAKERS

Cat No.		1-99	100+
C12010	5" Plastic 8W Max	4.80	4.70
C12015	5" Metal 8W Max	4.70	4.30
C12012	12V Siren	8.50	6.00

Plus 20% tax where applicable

RESISTORS

¼ WATT E12 CARBON BULK
PACKED $5.25/1000
TAPED AND BOXED $5.25/1000
$5.00/1000 10K LOTS
¼ METAL FILM TAPED AND BOXED
$13.00/1000 $12.00/1000/10K LOT
SUPPLY E24 VALUE
Plus 32½% tax where applicable

MEMORY

"Check for the latest memory prices!"

	10-99	100+	1000+	10K+
4164-15P	$2.70	$2.50	$2.20	$1.80
41256	$14.00	$12.00	$11.00	$8.80
6116P-3	$5.00	$4.90	$4.00	$3.00
2716	$4.90	$4.50	$4.25	$4.00
27128	$12.00	$11.00	$10.00	$8.00
2532	$7.50	$6.50	$6.40	$6.30
2732	$4.50	$4.10	$3.90	$3.50
27256	$45.00	$39.00	$37.00	20.00

Plus 20% tax where applicable

IC's

	1-9	10+	100+	250+
8035	3.90	3.70	3.50	3.00
8085	4.00	3.90	3.50	3.00
8088	25.00	23.00	19.00	17.00
8155	3.90	3.75	3.50	3.00
8156	3.50	3.30	2.90	2.50
8212	1.90	1.70	1.50	1.00
8224	2.40	2.00	1.90	1.50
8226	1.90	1.70	1.50	1.00
8253	3.90	3.70	3.50	3.00
8255	4.00	3.50	2.90	2.00
8257	3.90	3.50	3.00	2.50
8259	3.90	3.50	3.30	2.70
8279	3.90	3.50	3.30	2.70

Plus 20% tax where applicable

VERBATIM DATA LIFE DISKETTES

		10-99	100+	1000+
SS/DD	MD525-01	2.50	2.25	2.15
DS/DD	MD550-01	3.00	2.90	2.60

XIDEX DISKETTES

	10-99	100+	1000+
SS/DD	2.50	2.40	2.30
DS/DD	3.00	2.80	2.70

Plus 20% tax where applicable

BRIDGES

	10+	100+	1000+
6A 400V	1.00	0.80	0.75
W02	0.24	0.23	0.20
W04	0.25	0.24	0.21

Plus 20% tax where applicable

TRANSISTOR

	1-99	100+
2SJ49	3.90	3.70
2SK134	3.90	3.70

Plus 20% tax where applicable

MULTIMETERS

	1-99	100+
YF1100	47.50	45.00

Plus 20% tax where applicable

ELECTROLYTICS

Cat No.	Desc.	10+	100+
R1415	1uF 63V PCB RB	0.05	0.04
R15461	10uF 16V PCB RB	0.05	0.04
R15462	10uF 25V PCB RB	0.05	0.04
R15482	22uF 25V PCB RB	0.06	0.05
R15521	47uF 16V PCB RB	0.07	0.06
R15522	47uF 25V PCB RB	0.08	0.07
R15581	1000uF 16V PCB RB	0.21	0.20
R15582	1000uF 25V PCB RB	0.28	0.25
R15591	2200uF 16V PCB RB	0.39	0.33
R15592	2200uF 25V PCB RB	0.55	0.50
R15904	2200uF 50V AXIAL	1.50	1.00

Plus 32½% tax where applicable

RG CAN TYPE WITH LUGS

		1-99	100+
R164585	8000uF 75V	6.00	5.80
R16587	10,000uF	7.00	6.50

Plus 32½% tax where applicable

IDC CONNECTORS

		1-99	100+
P12114	14 Pin Dip Plug	0.60	0.50
P12116	16 Pin Dip Plug	0.65	0.55

Plus 20% tax where applicable

GREY FLAT RIBBON CABLE PER 100 FT ROLL

Cat No.	Desc	Per Mtr	1-3	4+	10+
W12616	16 Way	1.29	19.75	18.50	17.50
W12625	25 Way	1.40	29.50	27.50	25.50
W12626	26 Way	1.60	31.00	29.00	27.00
W12634	34 Way	1.80	40.00	38.00	36.00
W12640	40 Way	2.20	50.00	47.50	45.50
W12650	50 Way	2.75	59.00	57.50	55.50

EX STOCK
LARGER QUANTITIES NEGOTIABLE
Plus 20% tax where applicable

PANEL METERS

		1-9	10+
Q10500	MU45 0-1mA	5.95	5.75
Q10502	MU45 50-0-50uA	5.95	5.75
Q10504	MU45 0-100uA	5.95	5.75
Q10505	MU45 0-50uA	5.95	5.75
Q10510	MU45 0-5A	5.95	5.75
Q10518	MU45 0-1A	5.95	5.75
Q10520	MU45 0-20V	5.95	5.75

Plus 20% tax where applicable

FANS

		1-9	10+	100+
240V	4½"	10.50	10.00	8.00
240V	3½"	10.50	10.00	8.00
115V	4½"	10.50	10.00	8.00
115V	3½"	10.50	10.00	8.00

Plus 20% tax where applicable

CRYSTALS

Cat No.	Frequency	Can	10+	100+	1000+
Y11000	1MHz	HC33	5.50	4.75	4.50
Y11005	2MHz	HC33	2.25	1.95	1.85
Y11008	2.4576MHz	HC33	2.25	1.95	1.85
Y11015	3.57954MHz	HC18	1.20	.90	.65
Y11020	4.00MHz	HC18	1.30	1.00	.75
Y11022	4.194304MHz	HC18	1.40	1.00	.75
Y11025	4.75MHz	HC18	1.40	1.00	.75
Y11026	4.9152MHz	HC18	1.40	1.00	.75
Y11042	6.144MHz	HC18	1.40	1.00	.75
Y11050	8.00MHz	HC18	1.40	1.00	.75
Y11055	8.867238MHz	HC18	1.40	1.00	.75
Y11070	12.00MHz	HC18	1.40	1.00	.75
Y11072	14.318MHz	HC18	1.40	1.00	.75
Y11080	16.00MHz	HC18	1.40	1.00	.75
Y11085	18.432MHz	HC18	1.40	1.00	.75
Y11090	20.00MHz	HC18	1.40	1.00	.75

FULL RANGE OF CRYSTALS AVAILABLE ON INDENT
Plus 20% tax where applicable

POLYESTER 100V "GREENCAP" TYPE

Cat No.		1-99	100+	1000+
R15131	.001uF	0.06	0.04	.036
R15137	.0012uF	0.06	0.04	.036
R15138	.0015uF	0.06	0.04	.036
R15140	.0022uF	0.06	0.04	.036
R15142	.0033uF	0.06	0.04	.036
R15143	.0039uF	0.06	0.04	.036
R15145	.0047uF	0.06	0.04	.036
R15146	.0056uF	0.06	0.04	.036
R15147	.0082uF	0.06	0.04	.036
R15148	.01uF	0.07	0.05	.045
R15150	.015uF	0.07	0.05	.045
R15152	.022uF	0.07	0.05	.045
R15154	.033uF	0.07	0.05	.048
R15155	.039uF	0.07	0.05	.045
R15156	.047uF	0.08	0.06	.055
R15157	.056uF	0.08	0.06	.055
R15158	.068uF	0.08	0.06	.055
R15159	.082uF	0.08	0.07	.055
R15160	.1uF	0.09	0.08	.07
R15162	.15uF	0.11	0.10	.09
R15164	.22uF	0.15	0.14	.13
R15165	.27uF	0.16	0.15	.14
R15172	1uF	0.70	0.55	0.50
R15176	2.2u	1.20	1.10	1.00
R15178	3.3uF	1.50	1.20	

Plus 32½% tax where applicable

RING 489 7231 FOR OUR LOW PRICING ON THESE

Desc	Qty	Desc	Qty	Desc	Qty
7402	3K	74LS02	2K	74LS195	2K
7404	11K	74LS08	2k	74LS245	3K
7405	2K	74LS10	1K	74LS273	3K
7406	12K	74LS14	2K	74LS393	2K
7407	4K	74LS40	1K	UA774	4K
7416	2K	74LS74	12K	UA339	6K
7445	3K	74LS86	2K	1488	7K
7446	2K	74LS123	2K	1489	5K
7447	2K	74LS138	3K	7812UC	4K
7473	1.5K	74LS139	2K	7805UC	5K
7474	1.2K	74LS155	1K	UA555	4K

Plus 20% tax where applicable

VOLTAGE REGULATORS

	10+	100+	1000+
7805uC	.45	.44	.43
7805KC	1.50	1.40	1.20
7812uC	.45	.44	.43
7815KC	1.50	1.40	1.20
7818uC	.50	.49	.48
7818KC	1.50	1.40	1.20
7905uC	.50	.46	.44
7912uC	.50	.46	.44
uA323KC	4.50	3.90	3.75
78H12	7.00	6.00	5.90
78HGKC	7.50	6.50	6.00
79HGKC	16.50	16.00	14.00
78P05	11.50	11.00	10.50
78P12	14.00	13.50	13.00

Plus 20% tax where applicable

LOW PROFILE IC SOCKETS

	10+	100+	1000+	10K
8 Pin	.08	.07	.06	.05
14 Pin	.10	.09	.08	.07
16 Pin	.11	.10	.09	.08
18 Pin	.12	.11	.10	.09
20 Pin	.13	.12	.11	.10
22 Pin	.14	.13	.12	.11
24 Pin	.15	.14	.13	.12
28 Pin	.19	.17	.15	.14
40 Pin	.25	.24	.22	.20

Plus 20% tax where applicable

MITSUBISHI DISK DRIVES

		1-9	10+
4851	5¼"	$160.00	$150.00
4853	5¼"	$220.00	$205.00
4854	5¼"	$250.00	$220.00
2896	8"	$450.00	$420.00

Plus 20% tax where applicable

Minimum wholesale cash sale purchase $20

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DSE KITS

70cm Amateur Transceiver

The one that started it all! Now almost 1000 DSE UHF Explorer transceivers have been built and, from the reports we've received, very few problems have been found: most constructors are delighted with the ease of assembly and the performance.
It's definitely not a kit for the beginner (after all, you need an amateur licence to use it!) and we strongly advise both UHF and digital troubleshooting experence, as well as professional standard of construction (UHF is not kind to sloppy constructors!)
The result: you'll end up with a transceiver at least the equal of most commercial units, at a fraction of the cost(now that the dollar's gone through the floor)!
Cat K-6300

$199

2m Amateur Transceiver

The perfect mate for the UHF kit. The DSE Commander VHF transceiver has been developed in response to the huge number of requests from our customers; those who had the 'Explorer' under their belts and have been bitten by the old 'home brew' bug! (In fact,a number of customers said they didn't really need another 2m transceiver: they'd built it for the sheer fun of making something again!)
The 'Commander' has specs which more than match most commercial transceivers selling for two and three times the price. It covers the full 144-148MHz band in 10kHz channels (with 5kHz offset), with full repeater facilities built in, and it delivers around 10-15 watts with a receiver sensitivity of 0.5uV or better!
The DSE Commander comes complete with a very comprehensive step-by-step construction manual (including a 'Sorry Dick it doesn't work' repair coupon) plus microphone and mobile mounting bracket.
Nothing more to buy! Cat K-6308

$199

Repeater upgrade kit:

Add-on kit to give your Explorer full repeater operating capability, plus S-meter, an additional crystal filter and a new front panel to take S-meter and repeater switching. Cat K-6302

$24.50

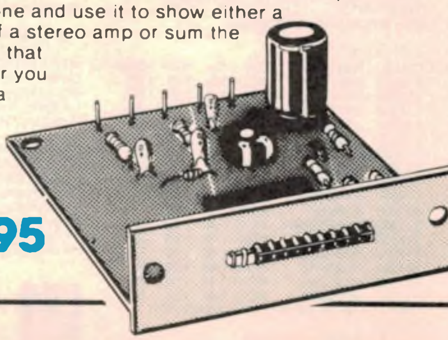
For the UHF or VHF transceiver 13.8V 2A Power Supply

Matching supply for the Explorer UHF or Commander VHF transceivers. Built in the same style, supplies 13.8 volts regulated at 2 amps continuous. The perfect way to complete your home brew station. Cat K-6310

$49.50

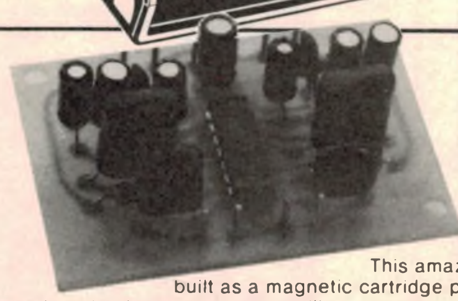
Led Level Meter

Here's the one the beginner can build — and add to a mono or stereo amplifier to give a level meter just like those found on $$$ imported amplifiers! You can build one and use it to show either a mono amp, one channel of a stereo amp or sum the channel outputs and show that (instructions show how). Or you can build a pair and have a true stereo level meter.
Cat K-3370



$16.95

General Purpose Stereo Preamp



This amazingly versatile unit can be built as a magnetic cartridge preamp (for upgrading your stereo), a tape preamp or auxiliary preamp with 40, 55 or 80db gain. It is extremely simple: uses only one special IC and is very small, all parts fit on a PCB less than 65mm square. It does not need a special power supply as any reasonable power supply from 10 to 40V will do. Frequency response is well beyond 20kHz. Full instructions are supplied.
Cat K-3427

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AND EVEN MORE! Everything is housed in a multi-division plastic tray, which is fantastic for housing components both now and in the future.

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Want an amplifier for your 'walkie' stereo or radio? Don't be tied to 'phones: use this project and listen in comfort! Or you can build this into a mini PA amplifier.
Cat K-2667 **$14.95**

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You can make a game — or make a real electronic 'lock' with this one. Use it to control an alarm, a door control, etc. You set the combination you want — or change it when you wish.
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It's a real beauty, this one: a real'live' musical synthesiser — and it's live because it uses YOU as the note generator! You get an amazing range of control over the sound.
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Australia's 'national game' has finally been converted to electronics. And you don't have to find any King George pennies! Simulates the throw, the spin and the final result. Come in spinner!
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C'mon, Guvnor - leave the auto alone. That's the Fun Way 3 Minder telling villians that it is looking after the car! It's actually doing much more — makes a great 'lights on' warning and 'door open' warning as well as a pseudo burglar alarm.
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You'll have a ball with this on — and you don't risk losing a ssingle cent! A digital project which not only shows how the one armed bandit works — it teaches you how logic circuits work, too.
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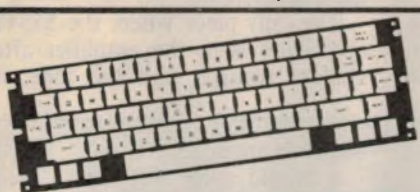
And when you've finished Fun Way 3???
You're ready to build just about any of the kits from the Dick Smith range.
You could even be ready for a career in electronics! And it all starts with Dick Smith's Fun Way Into Electronics.

Keyboard Kits



Standard 'QWERTY' typewriter layout keyboard with individually switched keys (no matrix necessary!) High tactile response, suitable for huge range of computers & allied projects. ● **60 keys.**
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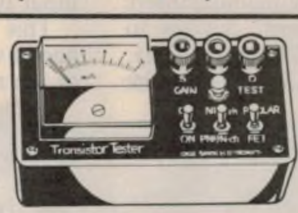

Not just another Transistor Tester! This one tests bipolar transistors, diodes, F.E.T.'s and even S.C.R.'s and P.U.T.'s This practical low-cost test instrument is simple enough to be built by a beginner and then provide him with a valuable piece of test equipment.
Requires 9V battery
Cat S-3006 85¢ extra
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Don't spend a fortune buying a tachometer — build your own and save! Displays engine speed in analogue form in an illuminated row of LED's. Instructions included — a great kit! Cat K-3240

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Brake Lamp Flasher

You've seen those snazzy lamps that mount on the parcel shelf and flash when you brake? A great idea for road safety, too: you cannot avoid the flashing! Now you can build your own with this simple kit - and save $$$ on the commercial units. Flashes the lamp three times before holding on. Uses our A-8525 Rear Window Brake Lamps (at extra cost)
Cat K-3245 **$14.95**

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See page 81 for store addresses

Letters to the editor

Time delay in compact disc players

Further to your discussions of several months ago regarding a time delay between the left and right channels of some compact disc players, I have uncovered a problem.

While it is true that a delay from one channel to the other of the order of 11.34μs would be inaudible, a problem arises when the two channels are combined for a mono signal such as would be received by an AM or FM mono receiver. (The value of using compact discs for AM broadcasting is questionable, but I digress!) The phase delay causes cancellations at high frequencies resulting in a notch at the Nyquist frequency of 22.05kHz.

This drop in high frequencies is quite noticeable, especially for musical instruments situated in the middle of the stereo spread. To counteract this cancellation, a number of manufacturers have developed "outboard" devices to introduce a compensating time delay. The alternative is, of course, for this time delay to be introduced in the compact disc player itself. Apparently most players referred to as "second-generation" are buffered so as to produce time coherence between the channels.

The above problem is not limited simply to players utilizing a single D/A converter, as unbuffered dual D/A players suffer the same fate. This information comes from the April 1984 edition of "Studio Sound".

A. L. Jones,
Lane Cove, NSW.

Playmaster Series 200 Stereo amplifier

I was casually reading the second article for your latest hifi amplifier, the Playmaster Series 200, when I came across the sentence "5534's are bipolar op amps so that they start out with higher input offset voltages than Fet-input types such as the TL071".

This statement is at best misleading and at worst false. A quick look at many of the more common op amps, Fet and bipolar types, will show that in fact the reverse is true. The true nature of the problem is the fact that the input bias currents of bipolar op amps is usually much higher than that for Fet input op amps, which leads to an increase in offset voltage in circuits where the (DC if you like) resistances presented to the op amp inputs are not identical. It is a feature of the circuit as much as of the op amp.

This is not surprising when one takes a look at your circuits. It is also less surprising when one considers the fact that to obtain greater speed from an op amp, one possible measure is to increase the quiescent current of the input stage, which naturally results in an increase in input current.

I might also point out that, in the RIAA amplifier section, the input offset voltage and the input bias currents are not likely to contribute significantly to the performance of this section. The offset voltage will be pretty well knocked out because of the gain contributed by the transistors in the input (ie, the 2SC2545's).

The input bias current will not be significant for two reasons: the DC circuits seen by the inputs are identical and, secondly, the collector bias current in the 2SC2545's is far in excess of the input bias currents of the op amp and would thus tend to swamp the effects of the bias current.

The only place where the 5534's may contribute is in the amplifier after the volume control, and the tone control

Commitment is important

It seems that your editorial has stirred every Tom, Dick and Harry to say a few (!?) words, so I might as well add my two-bobs worth. The heading and the contents were clearly designed to make readers sit up and take notice and it has worked!

Your quiz seems a reasonable basis for judging technical competence, but I put it to you that: commitment, personality, the ability to relate to colleagues and work effectively in a team, and a good command of English are also important criteria in assessing an applicant. If you were looking for an off-the-shelf team leader then I question your choice of an advanced student or a recent graduate.

In terms of formal engineering education, I suppose it is easy to be critical in hindsight, but the engineering course I completed was long on chalk and talk and the finer points of design theory but very short of nitty gritty emphasis on real world survival skills; communication techniques, personnel and business management and legal responsibilities.

The facts of life are that a new graduate is expected to have formed a sound technical basis for an engineering career, and will build on this as he goes. This rationale is the basis for the six year period before a graduate engineer can upgrade his standing from Grad IE to MIE. There is an assumption that he will have gained the practical skills I mentioned above in this period and this is supposed to be attested to by senior referees.

I am dismayed by the responses of Messrs Lubotzki (Oct), Flaherty and Lawrence (Jan) and to paraphrase Shakespeare: "methinks they protest too much" (ie, the remarks cut too close to the bone). They also appear to be so self-satisfied that I fear their employers will get poor value for money in future as these individuals blissfully stagnate.

I should point out that I receive both the Mechanical and the Electrical and Electronics Transactions of the Institute of Engineers Aust. and am usually impressed by the work published therein but, to be realistic, a large proportion of this work is only of academic interest to most practising engineers who are more interested in end-use applications than research for its own sake.

With regard to computer skills, surely you would agree that in engineering design and production, CAD and CAM are well and truly with us and a degree course which omits them is treading on dangerous ground. However, I must agree with you that there can be a giant chasm between keyboard proficiency and the ability to design and/or successfully connect peripherals and to come to terms with the dreaded but aptly named RS-232 connection.

N. S. Erbs,
Wagga Wagga, NSW.

Comments on car battery life

We have noted a letter to the Editor from Mr B. Hunt, Heathmont Vic, in your January issue. Mr Hunt has either received incorrect information from the unnamed Ford dealer or has misunderstood the information given. The facts are:

- Batteries in Ford vehicles carry a 12-month free of charge replacement warranty supported in turn by the battery manufacturer.
- The overwhelming field experience is that batteries which cease to function after 15 months contain no manufacturing defect and the "failure" can be shown to be due to some vehicle or customer inducement.
- It is demonstrably untrue to suggest that original equipment batteries are inferior to replacement market batteries and in the vast majority of instances the reverse is the case. The specifications of all of the vehicle manufacturer's ensure that only the best possible quality is acceptable.

E. T. Smith,
General Manager, Dunlop Batteries, Sandringham, Vic.

amp. The reason for this is the imbalance in the input circuits.

The reasons for this are fairly obvious — the need to provide a high input impedance (in the first case), and the variable nature of the feedback circuit (in the tone control amp), while at the same time keeping the resistance seen by the other input low, presumably for noise considerations.

The amplifier buffering the volume control could probably be replaced by a TL071, since the worst case load seen by this amp (both controls fully boosted) is about 2kΩ.

Anyhow, the circuit is really OK: the DC blocking caps are a good idea in any case. Another point worth noting is that I have noted that Fet-input op amps tend to be a bit less stable in terms of Vos, especially with temperature. A good bipolar op amp is hard to beat if you want good DC specs. The venerable 308 is a good example of a good op amp for DC, though not really suitable for your application.

P. Denniss,
Department of Plasma Physics, University of Sydney.

- *You are correct in your remarks about the offset voltage of the 5534. It is the imbalance of the bias networks to the inputs of IC4 which cause the output offset. We used a 5534 for IC4 instead of a TL071 because it gave better noise and distortion performance.*

Engineers are not supermen

It is not unusual to see an editorial that is slightly controversial bringing out a wide range of viewpoints and it is usually interesting reading.

The recent editorial on engineers was such an instance. However, I was amazed by some of the replies from engineers who, it would seem, regard themselves as some sort of supermen. The mere suggestion that they should concern themselves with such mundane things as knowing (even in an elementary way) how things work would, it seems, be insulting to their superior brains.

Fortunately, not all engineers are in this category. The ones I know personally are all well versed on how things work, whether it be an internal combustion engine or a radio set.

D. C. Logan,
Lenah Valley, Vic.

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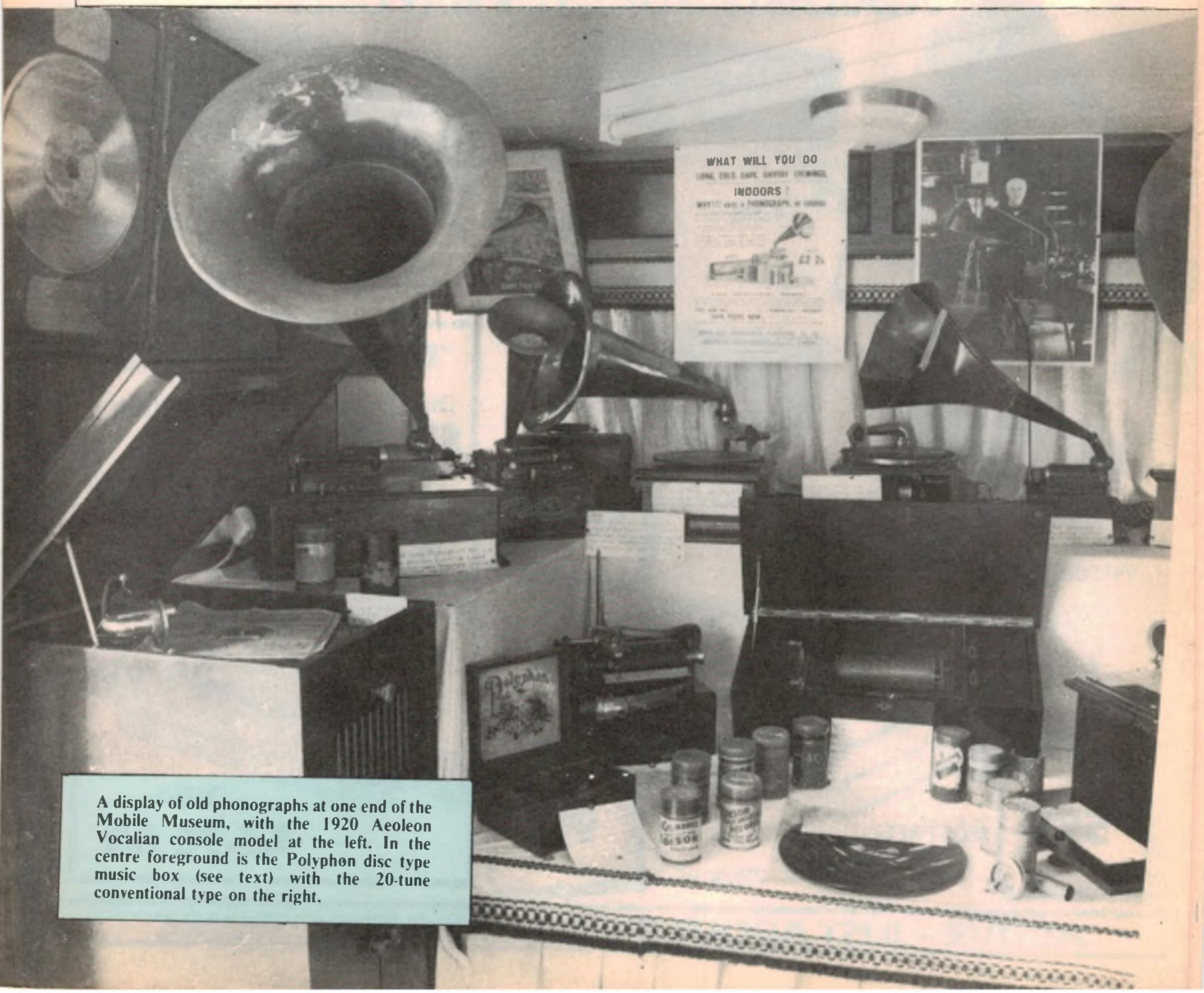
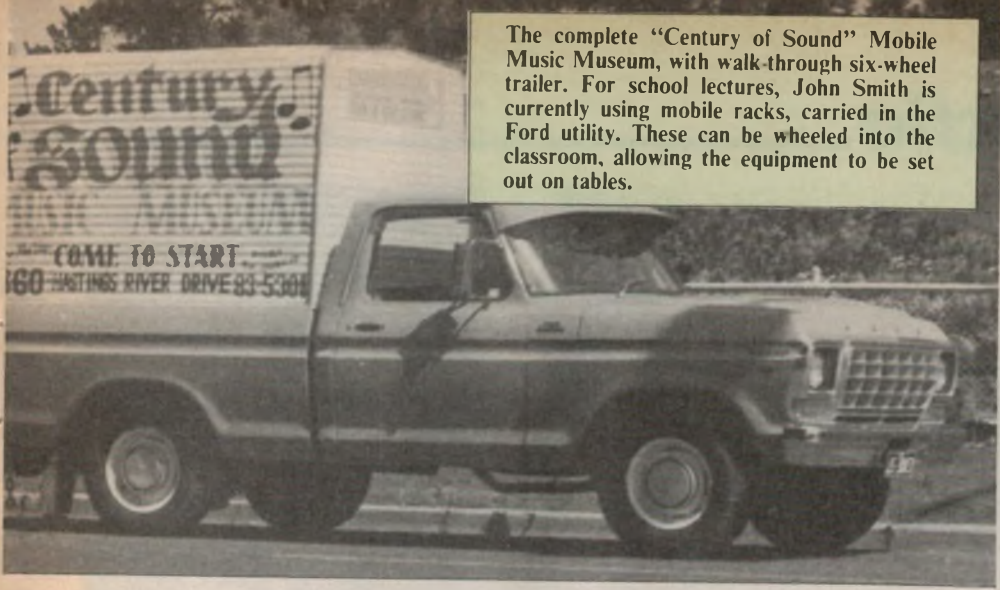
Old-time audio — Primitive



A display of old phonographs at one end of the Mobile Museum, with the 1920 Aeoleon Vocalian console model at the left. In the centre foreground is the Polyphon disc type music box (see text) with the 20-tune conventional type on the right.



The complete "Century of Sound" Mobile Music Museum, with walk-through six-wheel trailer. For school lectures, John Smith is currently using mobile racks, carried in the Ford utility. These can be wheeled into the classroom, allowing the equipment to be set out on tables.

but fascinating

Based at Port Macquarie in NSW is a mobile audio museum, which is presenting to thousands of schoolchildren in the state a history of sound in the home over the last century. What did their great-grandparents listen to before the days of radio, hifi and colour television?

by NEVILLE WILLIAMS

If we need to be reminded, the current generation of students — primary, secondary and tertiary — has never known anything but a world already provided with domestic radio, television and good quality microgroove recordings.

Their parents remember the introduction of the last two but, even for them, radio was always there, providing an accessable, never-ending variety of information and entertainment as a background to living and — some would say — as an impediment to thinking!

But, before that, there was little to add to the natural sounds around the average home, unless the occupants were among the fortunate few to own a musical instrument of some kind, or a primitive, scratchy phonograph, or perhaps a music box.

How primitive? How scratchy? And what on earth is a music box? Those are natural questions for at least two generations and they are being answered in a very practical way by John L. Smith, the man behind the "Century of Sound" Museum.

Nor is interest confined to the younger generations. Their grandparents often get quite a kick out of renewing nostalgic acquaintance with once treasured items from their own past.

I first became aware of the "Century of Sound" Museum in December of '83, during a visit to Port Macquarie, on the mid north coast of New South Wales. Listed among the many tourist attractions of the area was the "Century of Sound", billed as "Australia's First Music Museum", at 147 Bridge St West, Port Macquarie.

I had every intention of visiting the museum later in that week but didn't actually get around to it until my next visit to the area, in December last. In so doing, I met up with its enthusiast/owner, John L. Smith and wife, and spent two or three hours looking over the exhibits, taking photographs and chatting about radio and audio equipment as we remembered it.

Heaven alone knows how long ago it was when I first encountered or last handled one of those ancient, original Philips B-battery eliminators! And, for the first time ever, if memory serves me correctly, I saw and heard a rare 1916 "Diamond Disc" Edison Phonograph (more about that later).

John L. Smith turned out to be the complete enthusiast, if ever there was one — the kind that many of us might have become, had we responded to the urge to collect and display all those bits of radio and audio memorabilia that come one's way over the years. But few actually make the effort, with the result that most of our history ends up in the rubble of council rubbish dumps!

John Smith is one of the rare exceptions. Forty years ago, his main interest was in making music and, even today, he still enjoys a stint as a jazz drummer. But, in addition to playing instruments, he has long been interested in studying them, repairing them and giving them a home when they might otherwise have been abandoned. It's been the same with music boxes, record and tape players, "wireless" sets and a variety of other audio/radio gadgetry.

In the late '70s, John Smith put his collection on display in a cottage in Port Macquarie and his long-time dream of an historical sound museum became a reality: a "Century of Sound" set up in a cottage that had overnight become "Edison House" — a tribute to a man that John Smith personally regards as "The Father of Invention".

Unfortunately, in the highly seasonal environment of Port Macquarie in the late '70s, patronage of the museum was somewhat erratic and John Smith decided to supplement it with a separate mobile display, set up in a huge 6-wheel caravan, hitched to a husky Ford utility. Under the same "Century of Sound" banner, the "Mobile Music Museum" took to the road in 1980, visiting city and country shows, shopping centres, schools and community groups.

Apart from attending scheduled lectures, visitors to the Mobile Museum had the opportunity to see and hear sound equipment dating from about 1845 to the present time and to inspect a variety of associated gadgetry and memorabilia.

In March of '82 the Premier of NSW, Mr Neville Wran, presented the Century of Sound Mobile Music Museum with the Museum of the Year Merit Award on behalf of the Museums' Association of Australia. A further award followed in 1983 endorsed: "For excellence in presentation and work with school children".

In that same period, the Mobile Museum was covered in numerous newspaper articles and radio shows and featured on regional and national television, including a segment in a Leyland Brothers documentary.

At the time of our visit in December '84 the "Century of Sound" display was in the process of still further reorganisation, occasioned partly by nearby roadworks, which had robbed "Edison House" of much of its adjacent

Close-up view of the 20-tune Swiss Music box, manufactured around 1845.

parking space. The Mobile Museum was being re-planned as part of the fixed exhibition, while the Ford truck had been fitted out with displays on removeable racks and trolleys, intended to illustrate lectures to schools and community groups.

John L. Smith, musician and exhibitor, had become John L. Smith entertainer, historian and lecturer!

But he would seem to have lost nothing in the way of enthusiasm in the process. During 1983, he chalked up official visits to over 100 NSW schools, ranging in size from the tiny 12-pupil school at Pine Ridge, to an audience of 450 at Forbes, and a total student audience of just on 15,000.

Clearly, John's greatest reward is when his young listeners are so fascinated by their encounter with history that they elect to miss part of their lunch hour rather than the end of the lecture and demonstration.

As a back-up to his lectures, John L. Smith published a 108-page book in 1983 entitled "Sounds from Pythagoras to Laser" subtitled "4000 BC to 1983 AD". His practice is to place a copy of the book in the library of each school at which he lectures.

The book is not written at an engineering level, nor does it constitute anything like a complete historical record. However, it does provide many interesting glimpses of the history of sound that would not be everyday knowledge.

Why 4000 BC, for example? It's probably a round figure, but the author suggests that the Egyptian flute and harp probably date back to something approaching that date. Certainly, between 3500 BC and 2000 BC, trumpets were to be heard in Denmark, and bamboo pipes in China, while the "humble guitar was being played by the Hittites in 1500 BC, along with the lyre, tambourine and trumpet."

Music Boxes

At a practical level, the "Century of Sound" exhibition dates back to the 1845 era with a display of music boxes. They are still with us, of course, in the shape of musical novelties built into trinket boxes, ornamental dolls, etc but, in the 19th century, they served a more serious purpose.

In his book (and lectures), John Smith points out that they can be traced back officially to Antoine Farve in 1796, finding an important role as music sources in privileged homes, until displaced by the phonograph a century or so later.

What I hadn't appreciated personally, until I saw and heard one in the Sound Museum, was the degree to which they had been refined for such purposes. One model in the collection (manufactured about 1860) can play 20 different tunes in sequence, and then automatically repeat the performance, thereby providing 10 minutes or more of gentle, uninterrupted mood music for that special occasion!

Each tune is played by a sequence of hardened wire pins arranged around half the circumference of the central rotating drum, one complete revolution providing two complete tunes. At the end of the second tune, the drum clicks along the spindle by less than a millimetre, allowing other pins to pluck the tiny reeds to play a further two tunes. After 10 such movements, and 20 tunes, the drum returns to its original postition to begin the sequence all over again.

For music boxes of this general type, barrels were also available with simulated piano, simulated mandolin, or both, and harmony. There might be up to 10,000 pins on a single drum, each requiring to be very accurately positioned to ensure correct melody and tempo; they had to be heat treated to avoid brittleness, cemented firmly in position and dressed to a precise, uniform length.

A whole industry evolved around the production of such music boxes, working

Courtesy Radio-Electronics.

to (at least) "watchmaker" precision and involving specialists in marking, drilling and "pinning" the cylinders — right through to manufacturing the banks of plucked reeds, referred to in those days as "combs".

The Phonograph

By comparison, the mechanical precision subsequently required for Edison's phonograph in the 1880s might almost have seemed like a breeze!

Among other interesting music boxes in the Museum is a German "Polyphon", manufactured around 1890. Instead of a central cylinder, the Polyphon had a vertical, revolving spindle, on which the user could place a stamped-out zinc or steel disc, which actuated the mechanism. The discs or "Tunesheets", as they were called, could be mass-produced and were sold for a few pence each around the turn of the century.

The Polyphon and a similar American product, the Regina music box, may have done very well in the market place had they, too, not been overtaken by the phonograph, with its ability to reproduce the sound of the human voice, plus normal musical instruments.

I noted several cylinder type phonographs in the display, including the very compact Edison "Standard" (1898), the Edison "Red Gem" (1907) and the larger Edison "Home" model (1898). The only one I heard in operation appeared to have more than its share of wow, suggesting that the mechanism was rather tired and worn. And why not after 90 years?

Much more impressive was the Edison "Diamond Disc" phonograph (1916) of which John Smith is justly proud. It uses disc records, with a vertically modulated (hill and dale) groove, played with a diamond stylus. In a brief demonstration, it provided a quality of sound that must have been well above the standards of the era in just about every respect.

In fact, the Edison Company promoted its new Diamond Disc phonograph by arranging a series of demonstration concerts at which prominent artists were invited to alternate "live" voice with excerpts from Edison records — a demonstration which conventionally drew gasps of amazement and the verdict that it was impossible to tell one from the other.

Quality of this order did not come cheaply, however, with console models selling for at least $200 and up to $800 for "period" style cabinetwork.

But high prices, wartime material shortages, patents rivalry and odd marketing decisions all tended to limit the Edison initiative until it succumbed to still further competition from "wireless" in the '20s. However, the company continued doggedly to refine the basic format to the point where Edison Diamond Discs were taken up and featured by some broadcast stations in the '30s for their clean, crisp quality. (As I recall, they were much favoured by 2UW in Sydney).

Along with the Edison phonographs, the "Century of Sound" Museum has a range of conventional 78rpm (approx) disc gramophones headed up by a 1920 model Aeolian Vocalian "Graduola" console model. A shutter mechanism inside the internal horn, operated by a Bowden cable, provides the user with the means to adjust volume and tone — by remote control!

At the other end of the scale, John

John L Smith explains the operation of an old-time music box to an audience of primary school children. Once a source of mood music in the home, music boxes were displaced by phonographs early this century.

An Edison phonograph and some typical cylinder records in their cardboard boxes.

This "Hordernia" crystal wireless set cost around 25 shillings in 1925, a figure that respresented the best part of a week's pay!

Old-time audio

The battle for the domestic audio market was ultimately won by the disc. Pictured are two typical domestic gramophones with polished brass horns. At left is a German-made Polyphon disc type music box with punched disc in position.

Remember these "picture" records from the early days of microgroove LPs? Made in Australia, the design that would normally appear on the jacket was reproduced on the vinyl disc itself.

Smith demonstrated a hand-operated "cardboard" gramophone that Australian missionaries have for some years supplied to isolated villagers in Papua New Guinea, along with small records carrying Bible stories.

Not much larger but considerably more complicated is one of the original fold-up "Wondergram" record players, manufactured in England by Camp Bird Industries, under the chairmanship of Major C. Collaro, once a well known name in British audio. The Wondergram was announced in our September 1958 issue and mentioned again in October '83 with the release of an updated version by Audio-Technica of Japan.

To go with these and other players, John Smith has quite a collection of old-time cylinder and disc records, including one produced by the Edison Company in 1927 and said to be the first-ever long-playing disc. Curiously, the most vulnerable items in his display are the small tins of steel needles which once graced the top of every gramophone. They seem to hold a fascination for schoolchildren, says John, and he has to display them under a sheet of perspex.

While compact cassette tape decks are a familiar sight in modern homes, open reel decks are much less so nowadays, with magnetic wire recorders a rarity indeed. Typical open reel recorders are on display in the Century of Sound Museum, along with a couple of German Protona Minifon portable wire recorders. The steel wire is said to have a diameter of about 0.002in (about 44 gauge) with enough wire on the 2in. spool for about 2 hours of recording time.

Wireless sets on display include an old-time home-made crystal set, tuned by sliding a contact along the surface of the tuning coil, as was customary around 1920. But there are more elaborate receivers from about the mid '20s, with black bakelite panels and dials, plug-in coils and internal components supported on a wooden baseboard.

There's a variety of individual components to be seen, that once graced the wireless catalogs, and even some old-fashioned B-batteries. (I forgot to ask whether they had been de-gutted to get rid of the chemicals!)

But that's not the end of it. Hidden away under other gear in the house, for which there is no room in the display, I spotted a traditional church harmonium, a row of imitation pipes from a long-forgotten American "organ", an early model electronic organ, a 1951 jukebox and a guitar-like instrument from India, awaiting repair. Someone had inadvertently left it locked in a car in the hot sun and the "goo" that had held it together had melted.

Another job for John L. Smith!

Just as well he's the enthusiast that he is or there wouldn't be a Century of Sound Museum. Neither would there be the opportunity for a lot of young people to travel back into audio history!

Radio memories: at the rear, a home radio receiver from the mid '20s and, on the left, an AWA portable radio from the mid '40s. In the left front corner is an old Reiss microphone.

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These advertised items are all ex stock at pre-devaluation prices — this is definitely your last chance — so order now.

Regards, *Jack O'Donnell*

★ ★ ★ ★ ★ ★ ★ ★ ★ Major Competitor admits Altronics Mail Order Service "Consistently Excellent"

It appears that one of the "heavy weights" of the Electronics Industry has periodically placed anonymous "Test Mail Orders" with its competitors presumably to guage the quality of its competition. When tackled by me as to "how we fared" the "heavy weight executive" solemnly admitted Altronics service was consistently excellent.

No prizes for guessing who!!

DUBBING SET

ANY VIDEO TO ANY VIDEO

This has got to be the most comprehensive cable and connector set **ever sold!!** The Kit includes **a 2 x RCA to 2 x RCA** 1.5M audio lead and **5 pin din to 5 pin din** (reversed for video) 1.5M lead. The following adaptors are provided to mate with these leads. • **6 pin din to 4 RCA** female • 2 of **5 pin din to 2 RCA** female • **6.5mm Mono jack plug to RCA** female • 2 of **BNC male to RCA** female • UHF **PL259 male to RCA** female.

P 0830 **$19.95**

INSTANT SUPER TYPE GLUE

T3010 **$2.95**

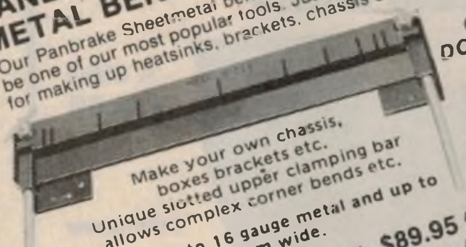
New patented easy flow Dispenser carry tube dispenses only when tube body is depressed-ensures no leaks. Many times the number of bonds over conventional tubes.

Sticks in seconds-1000's of uses

PANBRAKE SHEET METAL BENDER

OVER 1000 SOLD

Our Panbrake Sheetmetal bender continues to be one of our most popular tools. Just the shot for making up heatsinks, brackets, chassis etc.



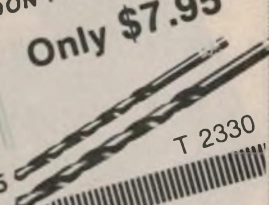
Make your own chassis, boxes brackets etc.
Unique slotted upper clamping bar allows complex corner bends etc.
Handles up to 16 gauge metal and up to 445mm wide.

T 2400 *Direct import price!* **$89.95**

13 PC SET OF DRILLS

Chrome Vanadium Steel
DON'T PAY $15 OR MORE

Only $7.95



T 2330

Pre-devaluation bargains —

Just compare the massive savings on what you would pay with the typical industry heavy weight competition

ALTRONICS COMPONENTS

2N3055'S SLASHED

Z1174

PRIME	SPEC	S.G.S.	
1 - 9	10 - 24	25 - 99	100+
95¢	90¢	80¢	70¢

NOW 1/2 PRICE ★ FAMOUS VOYAGER CAR COMPUTER

WAS $199

AS REVIEWED
EA OCT '82 P26-28
ETI NOV '82 P26

D 1000 **ONLY $99**

MADE IN ENGLAND! — QUALITY!

FEATURES: • Instant fuel consumption in litres/100km and MPG! (most others have only one of the above) just switch from one to the other as you drive along • Instant speed, time and other fuel data • Visual and audible excess speed alarm.

INSTALLATION: The Voyager comes complete with an unbelievable array of mounting configurations on dash under dash or stalk mount. All installation hardware is supplied (even a roll of insulation tape!) as well of course as the speed and fuel sensors. A lavishly illustrated installation manual is provided as well as a comprehensive operators manual.

NICAD RECHARGEABLE BATTERIES

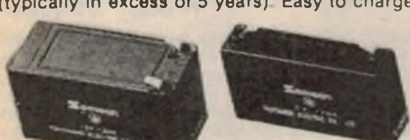
Premium Grade—good for up to 1000 recharges.
AA Size charge at 45-50MA
C Size charge at 160-180MA

AA Size 500 MAH
C Size 1.8 AH

		1-9	10-99	100+
S 5020	AA	2.45	2.00	1.80
S 5022	C	5.95	5.40	4.98

SEALED LEAD ACID

As used in security systems, battery backup for computers etc. Premium grade long life (typically in excess of 5 years). Easy to charge.



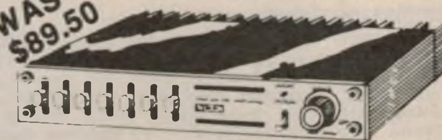
			ea.	5 Up
S 5065	12V	1.2AH	19.95	16.98
S 5067	12V	2.7AH	24.95	19.98
S 5069	12V	4.5AH	34.95	26.95

IDC CABLE

	Per M	10M +
W 0616 16 way	1.75	1.65
W 0624 26 way	2.75	2.55
W 0634 34 way	3.60	3.35
W 0650 50 way	6.50	6.00

SUPERB QUALITY SLIMLINE GRAPHIC EQUALISER/AMPLIFIER

WAS $89.50



Incredibly compact 22H x 145W x 132D. 7 Key 30W/30W Led Level meters/Qual. Japan Manf. Freq. Response 20HZ-30KHZ

C 9312 **ONLY $55**

PHONE YOUR ORDER — ALTRONICS TOLL FREE 008 • 999 • 007

FOR NEXT DAY JETSERVICE DELIVERY

BANKCARD HOLDERS—PHONE ALTRONICS TOLL FREE 008 • 999 • 007

High Grade

Purchase From Altronics with complete confidence—remember our famous 14 day money back guarantee

Stereo Mixers at Low Import Price

ATTENTION—Social Clubs, Schools, Churchs, Disco Operators, Entertainers, Hotels, Night Clubs and sporting Bodies. With Altronics low prices—here is your opportunity to install one of these outstanding sound control mixers. Both models include microphone "Soundover" facility—making either ideal for live entertainment use.

Stereo Audio Mixer

A 2550
$99.50

240V Mains Operated

This brilliant little mixing console is absolutely packed with features. Allows blending of Microphone, two Phono inputs and either two Tape or Turner inputs • Right and left VU meters • Separate Bass and Treble controls • 5 slide level controls • Fader control between Phono pickups for professional cueing • Headphone monitor switch • Talkover facility.

SPECIFICATIONS:
• **Input** Mic 0.5mV 600 Ohms Phono 3mV 50K Ohms Tape/Tuner 150mV 100K Ohms • **Output** 250mV • **Frequency Response** 20Hz to 20Hz (plus or minus 1db) • **Tone Control (Treble)** 10KHz (plus or minus 12db) • **Tone Control (Bass)** 100Hz (plus or minus 12db) • **Distortion** Less than 0.07% • **S/N Ratio** More than 60db • **Headphone Impedance** 4—6 Ohms • **Dimensions** 318 (L) x 217 (W) x 85 (H)

Pro-Quality Stereo Mixing Console

240V Mains Operated

AMAZING VALUE

A 2570 **$299.00**

Our sophisticated "NEW" Audio Mixing Console is ideal for 'live' recording • PA mixing • Fantastic Tape recordings • Even Stereo/Mono VCR recording. A truly professional deck that features separate R/L 5 band graphic equalisers • Echo and Peak LED level indicators • Talkover facility • Separate H/Phone level control • Patch switch bank • Individual microphone, Phono 1 Phone 2, Aux/Line 1, Aux/Line 2, and Master slide level controls. — Blend up to two magnetic or crystal turntables, two tape decks or tuners and two microphones all at once!!

SPECIFICATIONS:
• **Input** Mic 1—0.5mV 600 Ohms Mic 2—0.5mV 600 Ohms Mic 2—0.5mV 600 Ohms (low imp.) 2.5mV 10K Ohms (low imp.) Phono 1 & 2 (Mag) 3mV 50K Ohms Phone 1 & 2 (Cry) 150mV 100K Ohms Tape/Tuner 1 & 2 150mV 100K Ohms • **Equaliser** 5 frequency bands—60Hz, 250Hz, 1KHz, 4KHz, 12KHz—Boost Cut range-plus or minus 12db @ Centre frequency. • **Output** 1.5V/0.775V (Selectable) • **Frequency Response** 20Hz to 20KHz plus or minus 1db • **Distortion** Less than 0.05% • **S/N Ratio** More than 50db
• **Headphone Impedance** 4—16 Ohms • **Echo** B.B.D.System • **Delay Time** 30—200mS • **Echo Repeat Control** • **Delay Time Control** • **Dimensions** 480 (L) x 240 (W) x 110 (H)

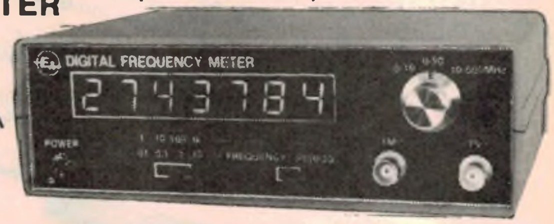
Build These Great EA Projects

Save a bundle on the price you would otherwise pay for a commercial equivalent.

FREQUENCY COUNTER

Measures to 50MHz (to 500MHz with optional Prescaler).

Why Pay up to $500 For Commercial Units?



UNBELIEVABLE 0.005% ACCURACY

• **Frequency and Period measurement to 500MHz (with optional prescaler)** • **High input sensitivity. Professional unit at a fraction of the cost of built up units.** • IC sockets provided throughout • Low age rate 10.000MHz XTAL • Quality ABS plastic case with deluxe front panel • Specified LSI.

K 2500		**$119.50**
K 2501	PRESCALER	**$26.00**
K 2502	DECIMAL POINT	**$7.50**

FUNCTION GENERATOR

With Digital Display sine, triangle and square wave outputs 15Hz—250KHz.

K 2505 **$85.00**

The most essential piece of test gear (second only to a good multimeter) on any hobbyist's bench is some kind of audio signal generator.

A truly versatile unit at a bargain price.

• 4 digit frequency readout (eliminates tiresome dial calibration) — typical accuracy +2% • 3 overlapping ranges x1, x10, x100 • 600 Ohm Nominal Output — continously variable 3MV — 2.5V P-P • Distortion—sinewave: less than 0.7% @ 1KHz • Linearity—triangle wave: better than 1% • 1KHz • Squarewave rise time— 6V/uS maximum output • Amplitude stability—better than 0.1db on all ranges.

With the exception of the display all components mount on a single PCB making this kit suitable for all constructors.

DIGITAL CAPACITANCE METER

Measures 1 pf to 99.99 uf in 3 ranges

K 2521 **$55.00**

This superb Test Instrument Kit now compliments our top selling Digital Frequency Counter and Function Generator Project Kit. Electronics Australia Project. Measures capacitance of both polarized and non-polarized capacitors from 1 picofarad to 99.99 microfarads in 3 ranges. Check values of unmarked capacitors, especially those little trimmers that are never coded. Select precise values for filters and timing networks with ease.

EXCLUSIVE TO ALTRONICS

Each Kit includes precision measured capacitors for accurate calibration of each range.

BANKCARD HOLDERS—PHONE ALTRONICS TOLL FREE 008 • 999 • 007 FOR NEXT DAY JETSERVICE DELIVERY

And 1985's Top Project

BENCH TOP POWER SUPPLY

3—30V to 1 amp Max. with variable current limit.

Electronics Australia have released this superb new supply kit in **our very attractive H 0480 Instrument case**—thus complementing the Frequency Counter, Function Generator projects etc.

FEATURES:

* Output variable between 3 and 30V
* Short circuit Protection
* Full I Amp output over entire voltage range
* Load switching
* Current limiting fully variable-twin selectable ranges * Dual Scale Meter
* Separate earth terminal provided
* Housed in our Deluxe "ABS" instrument case

SPECIFICATIONS:

* Output Voltage — 3 to 30 Volts
* Output Current — 0 to 1 Amp (fully variable)
* Load Regulation — Better than 0.2% from 0 to full load
* Output Ripple — Less than 2mV RMS

K 3210 ..... **Fantastic Value** **$55.00**

EA'S LABORATORY POWER SUPPLY

3—50 Volt at up to 5 Amps

Single Printed Circuit Board construction - dead easy to build.

EXCLUSIVE TO ALTRONICS:

* Deluxe instrument case.
* Attractive silk screened front panel.
* Fully drilled and punched chassis - no holes to drill.
* Front panel supplied to accomodate K 3325 option if required.
* Heatsink tubing supplied for critical component termination.

K 3300 **$139.50**

SPECIFICATIONS:

* Output Voltage = 3-50 volts
* Output current up to 5 amps (max 175W)
* Floating outputs isolated from ground
* Ripple less than 90mV p.p at Max.

Auxillary + /—12V Option

K 3302 .... **$12.50**

★ ★ ★ ★ ★ ★ ★ ★

Build this Fantastic New Kit

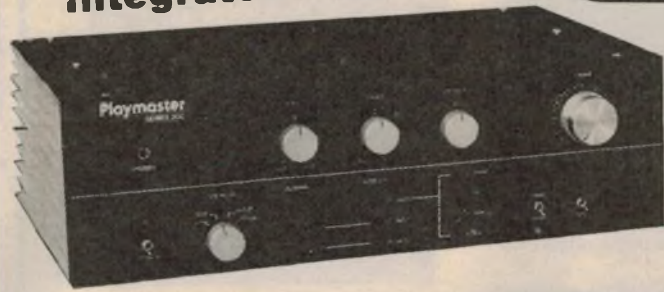
NO COMPROMISE DESIGN

Ultra Fidelity Series 200 Mosfet Integrated Amplifier

WARNING

Readers Please Note

This excellent design specifies a number of important components which cannot be substituted without affecting overall performance. **The Altronics Kit is based 100% on the Electronics Australia Design.** Beware of Kits offered by suppliers who do not conform to EA's Design.



K 5030

complete kit

$399

Incredible Value

*No Audiophile will now dispute that the **top end** High Fidelity Amplifiers are **all** Mosfet design. The reasons Mosfet output transistors deserve such acclaim are many and various—like incredibly fast response time (therefore even the most complex violin note will be reproduced with purity and realism that borders on "perfection") and of course with Mosfets thermal runaway is a thing of the past. Another handy characteristic of Mosfets is "self shutdown" when grossly over driven insufficiently heatsunk etc. So Leo Simpson and the Team set out many moons ago to create the ultimate in a fully integrated stereo amplifier*

ENGINEERING CONCEPT

The original October 1984 release date camo and went with no end in sight as to the mechanical format of the Amplifier. The initial bench tests were so outstanding it soon dawned on the EA Team that there would be potentially 10's of 1000's of Hi Fi buffs dying to get their clutches on such an amp especially at the surprisingly low cost of the 'Bits' or projected Kit set cost. However, as most of these potential owners would be relatively "Green" at Electronics construction—the EA Engineers have placed virtually all the components on a single (rather large) printed circuit board i.e. anyone with a reasonable "beginners" comprehension, and prepared to carefully study the instructions, should have little difficulty in building this project. Naturally for experienced Electronics enthusiasts—the task wil be straightforward.

The end result boarders on perfection and will last you a lifetime.

FEATURES:

This brilliantly designed stereo amplifier will equal or better just about any integrated commercial amp regardless of price. It is a no-compromise design capable of delivering 100 watts per channel at very low distortion. Four basic stereo inputs are provided for both moving magnet and moving coil cartridges. Also three high level stereo inputs are provided for compact disc players, AM/FM tuner and auxiliary input which could be from a stereo TV tuner of Hi Fi VCR. Input facilities are also provided for two stereo cassette decks and full monitoring facilities are available for either deck plus dubbing from Deck 1 to Deck 2 or vice versa.

* Full CMOS Analog switching (soft touch)
* Twist Type speaker lead binding posts supplied.
* De-thump muting in-built.
* All Hi-Spec low noise IC's used.
* Incredibly accurate RIAA equalisation.
* No control wiring whatsoever.
* Led indication of switch status (On/Off)
* All components mount on the PCB, even pots and sockets.
* Super efficient Toroidal Transformer—Low Hum.
* Uses Hitachi Mosfet Power devices.
* In-built over drive protection.
* Centre detents on Bass, Treble and Balance controls; multiple detents on volume control.
* Heavy Duty Heatsinks.

SPECIFICATIONS:

Power Output:	100W RMS into 8 Ohms (per channel)	**Hum:**	-100db below full output
Freq.Response:	8Hz to 20KHz +0 -0.3db 2.8Hz to 65KHz +0 -1db	**S/N Ratio:**	94db flat -100db A-weighted
Input Sensitivity:	0.775mV for full power	**Distortion:**	0.01% @ 1KHz
		Stability:	Unconditional

GO ANYWHERE 12—240V POWER

This great inverter kit enables you to power 240V AC appliances from a 12V DC power source. Tremendous for camping, fishing etc. Install into your car, Boat or Caravan.

300 WATT INVERTER

K 6750 **$199.50**

$10 DELIVERY AUSTRALIA WIDE

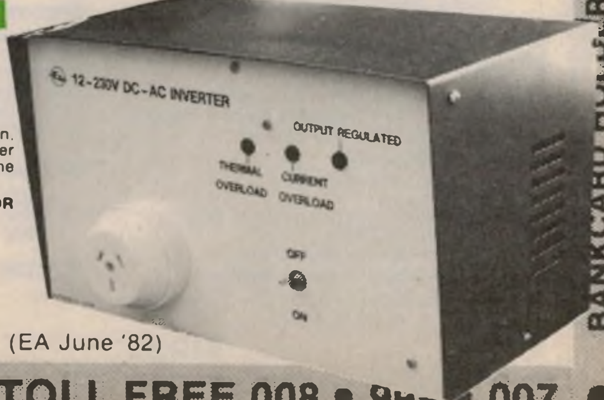
A fully regulated and overload protected design, featuring XTAL locked frequency use to power HiFi, TV sets, even electric drills for short time periods.

MANY OF THESE KITS ARE NOW IN USE FOR EMERGENCY LIGHTING PURPOSES.

ALTRONICS KIT FEATURES:

* Plated edge connector and PCB buss
* Low age rate XTAL
* Sockets for all IC's
* High Efficiency Transformer
* Pre punched and screen printed chassis
* High current switching relay supplied

(EA June '82)



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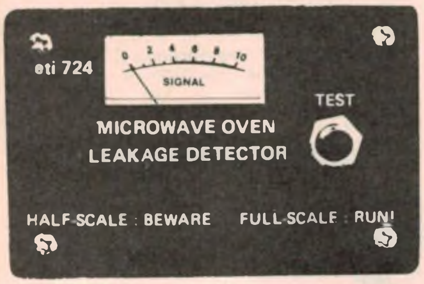
MICROWAVE OVEN LEAK DETECTOR



ETI PROJECT

Completely passive project receives microwaves via an antenna which develops a voltage across a detector diode driving the meter.

Monitor your microwave oven with this easy to build kit. All components mount on single PCB, including the meter.

"No Microwave oven should be without our Leakage Detector!"

K 1724 **Still Only $14.50**

NEGATIVE ION GENERATOR

CORONA DISCHARGE DESIGN

(See ETI April '81)

K 1501

Still Only

$39.50

"Negative" ions give a feeling of well being and relaxation, clean the air of tobacco smoke and bacteria, increase concentration powers and gives relief from asthma, allergies, migrains, sinus trouble and bronchitis.

Operates from 12-15V DC employing a DC-AC inverter and voltage multiplier rectifier to give a safe (HT) voltage of approximately 3kV DC to drive the emitter head.

Complete kit housed in a safe "ABS" plastic case

VOICE OPERATED RELAY

(See EA April '82)

Professional design—eminently suited to commercial applications

This versatile Vox Circuit does just that. Whenever a noise or sound is made it triggers the circuit causing a relay to close.

THINK OF THE USES:

- Controlling Tape Recorders
- Slide Projectors
- Eliminate the need for a press to talk button on transmitters
- Turning on external porch lights

AND MANY, MANY MORE

Reaction Sensitivity and "On Time" are fully variable

K 1824 .... **$12.50**

MOSFET POWER AMP MODULE 150 WATT

Studio Specifications

Here is a high power, general purpose power Amplifier module suitable for HiFi, guitar and PA applications employing sturdy, reliable **MOSFET's** in the output stage.

Easy to build with minimum components required

SPECIFICATIONS:

Power Output
150W RMS into 4 Ohms
100W RMS into 8 Ohms
(At onset of clipping)

Frequency Response
20Hz to 20KHz +0 - 0.5dB
10Hz to 60KHz +0 - 3dB
(Measured at 1W and 100W Levels)

Input Sensitivity
1 Volt RMS for full output

Hum
98dB below full output

Noise
114dB below full output

Total Harmonic Distortion
0.006% @ 1KHz 12W
0.03% @ 10KHz 12W

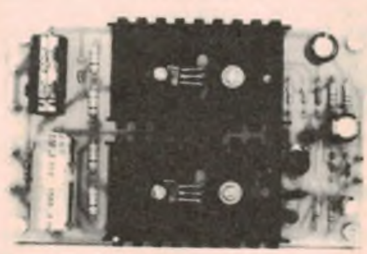
Stability
Exceptional
(Tested to full output driving 3.5uF short circuit at 10KHz).

K5100

$65.00

20 WATT UTILITY AMP MODULE

(See EA Nov '84)



Design uses discrete transistors and is very easy to build. In addition the Module presents an ideal opportunity for the Hobbyist to gain an understanding of how an Audio Amplifier works.

All components mount entirely on one printed circuit board, even the heatsinks!

SPECIFICATIONS:

Input Impedance	100K Ohm approx.
Output Impedance	0.1 Ohm approx.
Signal to noise ratio	58dB with respect to 1 Watt
Frequency Response	-3dB @ 45Hz & 68KHz
Load Impedance	4 Ohms or Greater
Quiescent Current	22mA with 8 Ohm Load

DC Supply	PWR Into 8 Ohms	PWR Into 4 Ohm
20V	4W	6.6W
30V	8W	12W
35V	15W	19W

K 5045 .... **$17.95**

Power Line Computer *Crashes Cured* with Arlec's New Line Conditioners

The very next Mains Power spike could cost your organisation $1000's in Hardware Damage and corrupted data.

3 Models — 250 watt to 1000 watt capacity — **and that will run very large Business Systems.**

TRUE SINE WAVE OUTPUT

Constant RMS voltage output
Isolted Output
Rapid response to load and line changes
Overload current limiting
Overvoltage proof
Static ferro-resonant operation
No maintenance necessary
Sine wave output
2 year guarantee

Arlec Line Conditioners provide a constant 240V output despite wide variations in mains input voltage. They have excellent noise reduction characteristics and low harmonic content in the output waveform and are therefore ideal for use with micro-computers.

They are designed for operation on 50Hz only and provide stable 240V RMS sine wave output within close voltage limits. This performance is achieved by a new (patent pending) core structure which produces a low cost design, low waveform distortion and very good input — output isolation to reduce electrical noise.

They will operate continuously at 275V input and take transients up to 1KV peak without damage.

Dimensions:

Type	Rating VA	Dimensions in mm A	B	C	Weight Kg	Fig.
D 8025	250	365	185	185	10.5	1
D 8050	500	470	250	246	21.5	2
D 8100	1000	470	250	246	33.5	2

Input voltage range:	190V to 260V RMS
Ouput voltage:	240V RMS at 240V input and full load. Unity power factor.
Operating frequency:	50Hz
Line regulation:	+ 1.5%, -3% at any load, for a change in input voltage from 190V to 260V or vice versa.
Load regulation:	+ 3% for a load change from no load to full load at any given input voltage within the specified range.
Response time:	2 cycles for any change of load and/or input voltage within specifications.
Frequency sensitivity:	Approx.+ 1.5% change output voltage for + 1% change in frequency.
Harmonic distortion:	Typically 3½%, maximum 5% at no load and 260V input (worst case).
Insulation:	Class B/130° C

3 MODELS

D 8025 250 watt **$460.00**
D 8050 500 watt **$690.00**
D 8100 1000 watt **$890.00**

FOR NEXT DAY JETSERVICE DELIVERY

BANKCARD HOLDERS—PHONE ALTRONICS TOLL FREE 008 • 999 • 007

BLOOD PRESSURE & HEART RATE MONITOR

Why Risk Unnecessary Heart Attack?

A simple (take the reading yourself) periodic check of your blood pressure and pulse provides an "inward look" into a vital aspect of your bodily health. Heart desease strikes down many people in their early 40's (or even 30's). The tradgedy remains that had such victims been alerted, remedial medical, physical and dietary action could have been prescribed to avoid illness and in many cases restore full bodily health.

A Superb Gift for the dedicated fitness enthusiast **Absolutely essential** for those over 40 and concerned with their health, or on Fitness Therapy. Use this **easy to operate** Monitor to measure your pulse (or heart rate) and Blood Pressure.

DON'T PAY ~~$150~~

X 3055

Now Only **$89**

Remember high blood pressure is in itself symptomless and the usual forerunner to future chronic heart disease. **Features** include "error" display warning of incorrect use. Handbook supplied will enable anyone in your family to be fully conversant with this monitor in minutes. Easy to read display of Systolic and Diastolic Blood Pressure and Pulse Rate.

BUILD THESE FABULOUS KITS

OSCILLOSCOPE SENSATION!

(See EA Oct '84)

K 2000

Only $249

Over the years many people have asked. "Do you have a CRO kit?"—Our answer— up until now— has been that built and tested units were not dearer than kits, if you could get a kit at all. The Altronic K 2000 Cathode Ray Oscilloscope kit has a guaranteed 5MHz band width but should go to around 6.5MHz. It also features 75mm (3") CRT Blue Phosphor with accurate graticule, separate vertical and horizontal BNC type input sockets etc. Remember, a 5MHz scope is usually adequate to troubleshoot most micro processor and other digital circuitry as well! This is a wonderful opportunity to learn electronics and end up with a valuable piece of test equipment as well. The Altronic K 2000 kit is absolutely complete. The chassis is prepunched and every component including nuts and screws are provided, along with instructions.

TRANSISTOR ASSISTED IGNITION WITH DWELL EXTENSION

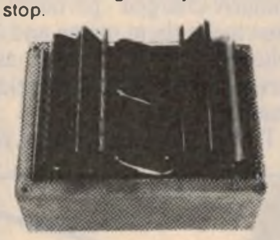
KEEP YOUR ENGINE IN TOP TUNE

Yes,it's bad enough paying $2.00 a gallon for petrol without wasting a fortune on an out of tune engine. Fit this transistor assisted ignition kit in minutes and start saving money from the very next petrol stop.

K 4010

$35.00

Value Plus



This unique electronic ignition system will easily double the interval between tune ups. Plugs and Points stay in top condition for much, much longer.

Greatly reduced plug breakdown at high rev's.

Dead easy to build and (even better) there are only 3 electrical connectors required to the car wiring system.

STATE OF THE ART

The Avtek MultiModem

a breakthrough in low cost modem design

Using state-of-the-art VLSI integrated circuitry, the Avtek MultiModem provides the highest standards of reliability for data communications on public phone lines. Digital signal processing is used to achieve functions normally requiring analogue filters.

MULTIMODEM NEVER REQUIRES ADJUSTMENT

MULTIMODEM WORKS RELIABLY ON LINES WHERE OTHER MODEMS CAN'T FUNCTION

Its digital filters are much sharper than on conventional modems. Line interference is screened out. You get error free data transfer, even on very noisy lines.

MULTISTANDARD OPERATION

CCITT and Bell Duplex and Half Duplex

AUTO ANSWER OPTION (MODEL D 1205)

Autoanswer is the ability of your computer/modem to receive when the phone rings. Some computer/software combinations do this. MultiModem offers the alternative for computers without this facility—hardware autoanswer. Leave your computer waiting for information.

TEST FUNCTIONS

DIG: This function enables the user to test the modem's operation over a line, testing both modem and line.

ANL: Provides testing of computer, software, cabling and modem.

SPECIFICATIONS

Data

Standards: CCITT V.21 & V.23 Bell 103 & 22

Data Rates: 300, 600 & 1200 BPS

Backward Channel: 75 BPS in conjunction with 1200 BPS

Computer Interface: CCITT V.24 (RS232C)

Power Requirements: 240 VAC Power drain—3 watts

TWO MODELS

D 1200 (Standard) **$349.00**

D 1205 with auto answer **$389.00**

ALTRONICS COMPONENTS

105 STIRLING STREET,PERTH

FOR INSTANT SERVICE

PHONE ORDER TOLL FREE

008 999 007

PERTH METRO AND A/HRS ORDERING SERVICE

(09) 328 1599

ALL MAIL ORDERS

Box 8280,Stirling St.Perth WA 6000

PACKING AND DELIVERY CHARGE

$3.00 DELIVERY AUSTRALIA WIDE -We process your order the day received and despatch via. Australia Post. Allow approx 7 days from day you post order to when you receive goods. Weight limited 10Kgs.

$5.00 OVERNIGHT JETSERVICE - We process your order the day received and despatch via overnight jetservice Courier for delivery next day Country areas please allow additional 24-48 hours. Weight limit 3Kgs.

$10.00 HEAVY HEAVY SERVICE - All orders of 10kgs. or more must travel Express Road - Please allow 7 days for delivery.

INSURANCE — As with virtually every other Australian supplier, we send goods at consignees risk. Should you require comprehensive insurance cover against loss or damage please add 1% to order value (minimum charge $1). When phone ordering please request "Insurance".

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Ion beams for nuclear fusion

Magnetic confinement of plasma and laser heating have long been the touted routes to commercial fusion reactors. Now a third contender based on ion beam technology has entered the race. Experiments are under way in the UK and West Germany.

by STANIFORTH WEBB

Controlled nuclear fusion has long held out the attractive prospect of a safe, clean and unlimited source of power. The fuel for it, heavy isotopes of hydrogen, are tritium and deuterium; they are present in vast amounts in the world's oceans and are relatively easy to extract. But physicists are still a long way from attaining the self-sustaining reaction required. The year 2020 is now being mentioned as a target.

Three routes to controlled nuclear fusion are being considered: the first is a so-called magnetic bottle, the second is the use of laser beams, and the third is through ion beams.

The magnetic-bottle technique has been furthest developed, as evidence by the formal opening this year of the Joint European Torus (JET), an experimental fusion device at Culham, near Oxford. Work is going ahead on similar experiments in the Soviet Union and the USA.

Laser-driven fusion is being developed rapidly. In the opinion of many physicists, is it likely to overhaul the magnetic-bottle approach and become the chosen technique for the commercial nuclear fusion reactor of the future.

So far, little has been heard of an approach using ion beams to drive fusion, and it is far less developed. There are, however, sound reasons to believe that it may prove to be the most efficient and simplest way to control nuclear fusion and bring it into commercial operation, if certain technical problems can be solved.

This year, important experiments will be performed at the UK Rutherford Appleton laboratory in conjunction with physicists from Birmingham University in the English midlands and the Federal High Energy Physics laboratory at Karlsruhe in West Germany. If they are successful, fusion by ion beam, the dark horse in the race for controlled nuclear fusion, may well come up from the rear and overhaul the two which are now the front runners.

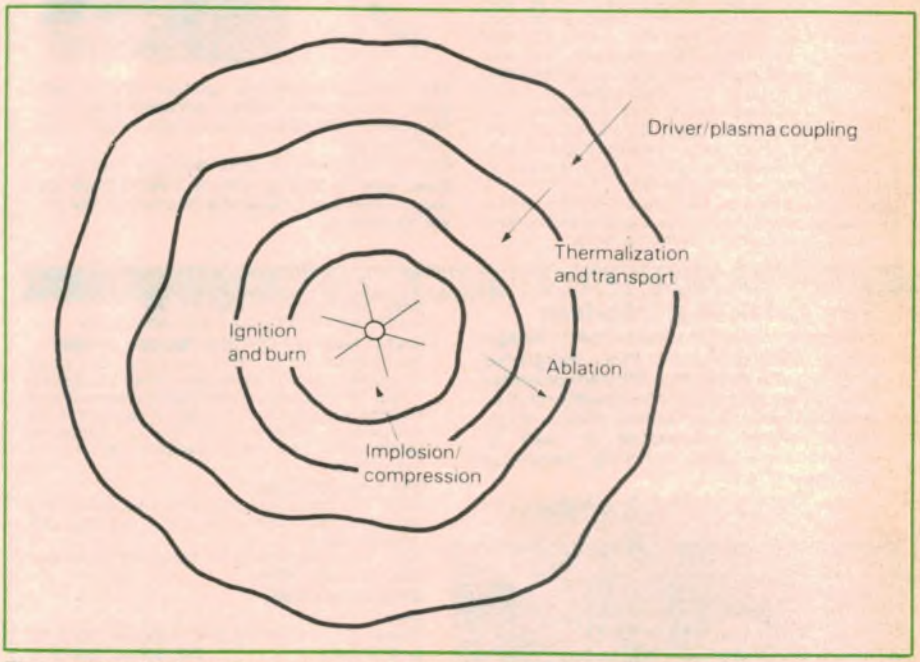
To control fusion, a nucleus of deuterium and one of tritium must be made to collide with one another with enough force to overcome the strong mutual repulsion that exists between similarly-charged particles. The force must make them merge and form a single helium nucleus, known as an alpha-particle, simultaneously releasing a free neutron.

The deuterium nucleus contains one proton and one neutron, and the tritium nucleus contains one proton and two neutrons. The alpha-particle that is formed has a helium nucleus with two protons and two neutrons; one free neutron is given off. It is the collisions of the free neutrons with other nuclei that generate heat as the reaction proceeds.

For this reaction to become self-sustaining, a temperature of a few hundred million kelvin is required. That it too hot for any physical container, but the charged particles in the superheated plasma can be contained by powerful magnetic fields as they are, for example, in the JET experiment with its magnetic-bottle approach: the plasma is a relatively low density, so the containment time has to be relatively long, of the order of 10 to 20 seconds, to take the reaction to the point where it sustains itself.

Laser Beams

The alternative approach is to freeze a mixture of deuterium and tritium into



The target pellet is a frozen mixture of deuterium and tritium. To ignite it, energy must be delivered to it at a rate of between five and ten megajoules in a few tens of nanoseconds. The outer regions of the pellet heat up rapidly and energy is coupled into the plasma that is thereby created. Heat energy is carried into high-density material to what is known as the ablation front, where hot, dense matter blows off to lower density regions. This imparts momentum to the rest of the material, accelerating it inwards so that it compresses the fuel. The aim is to raise the temperature to the point where nuclear fusion starts.

tiny, hard pellets a few millimetres in diameter, at a temperature of about four kelvin. They are then imploded by concentrating laser beams or beams of ions on each pellet in succession from various directions, so that the pellet is bombarded from all sides.

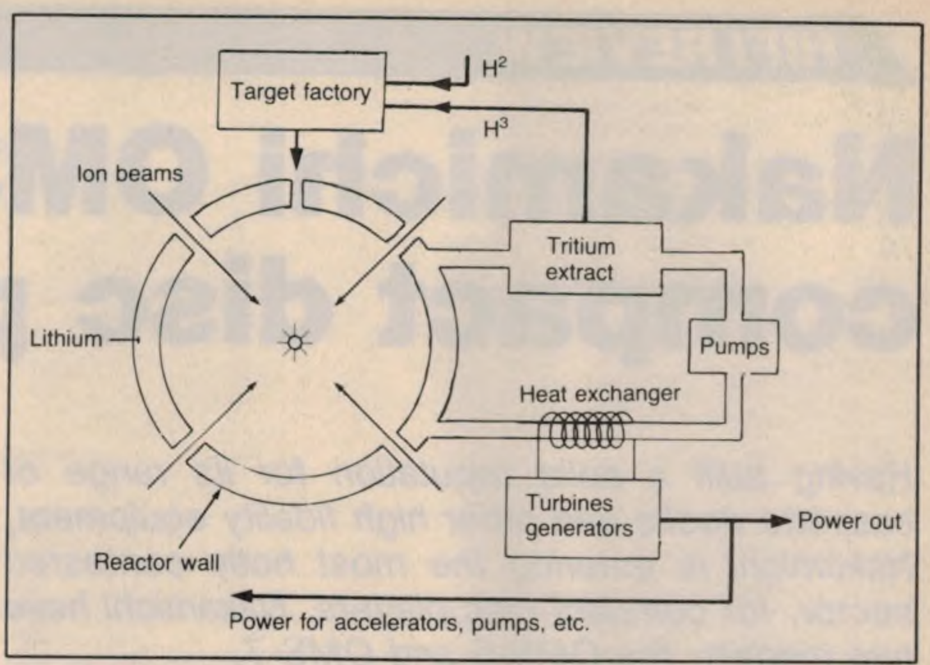
Enormous amounts of energy can be delivered in this way, causing the outer layer of the pellet to vaporize so violently that it behaves like a rocket motor, imparting powerful thrust inwards as well as outwards. The inward rocket effect is big enough to create very high densities, up to 100 grams per cubic centimetre or up to 1000 times the density of ordinary matter; it also generates tremendous heat. Because the density is much higher than in a magnetic bottle, the time of containment needed to achieve a self-sustaining reaction is very much less, of the order of one nanosecond.

In the UK and USA the laser beam approach has been developed far enough for results to be encouraging, though still a long way from what would be required in a commercial fusion reactor. Why, then, devote time and effort exploring yet another way to create the same effect by using beams of ions rather than beams of laser light?

There is good reason to hope that a reactor using ion beams to achieve fusion could be much more efficient, and so more economical to run, than one using laser beams. Only five percent of the energy that powers the most efficient laser that engineers can hope to design emerges in the laser's beam. This is an enormous obstacle to overcome before fusion can be commercially promising. With a beam of ions, by contrast, 30 percent of the energy pumped into the particle accelerator merges in the beam.

Another advantage is that because the ion beam is so much more efficient, the fusion reaction is a great deal less violent. In a power station of average size, producing 2000MW, pellets of deuterium and tritium would be imploded at a rate of 15 to 20 per second, each producing as much energy as several hundred kilograms of conventional plastic explosive. Anything tending to reduce the violence of the reaction, thereby making it easier to contain and control, is bound to look attractive to design engineers.

There is yet another advantage of using ion-beam fusion. The laser needed for a commercial fusion reactor would have to produce ultraviolet light at a shorter wavelength than the lasers now being used in fusion experiments can produce. Particle accelerators, by contrasts, are well-established tools in routine use by physics laboratories in many parts of the world.



Simplified block diagram showing the essential components of an inertial-confinement nuclear power station based on ion-beam fusion.

Why, then, does the development of fusion driven by ion beams lag behind? One reason is that a great deal of money, effort and prestige has already been invested in the magnetic-bottle approach, because it was the first to show promise. Another is that powerful lasers are already in use as laboratory tools; though particle accelerators abound, they are not always available for such experiments on fusion.

Vital Questions

Crucial experiments still need to be performed. Vital questions that must be answered are to do with focusing the beams of ions, which need to be concentrated from all directions on the tiny fuel pellets. For the self-sustaining reaction to ignite, the beams must be held steady on the target for about 30ns (nanoseconds). The power which would then be concentrated on each pellet, about the size of a pin-point, would be equivalent to all the sunshine falling on Britain on a sunny day, about 100GW (gigawatts). But as the ion beams draw close to focus, the identically-charged particles in each beam would have to be squeezed more and more tightly together and would repel each other more and more violently. Physicists do not yet know if it will be possible to control and focus such a beam well enough to light a self-sustaining fusion reaction.

A crucial experiment to investigate such problems will be performed this year in the UK Rutherford Appleton laboratory, using the new accelerator known as the Spallation Neutron Source (SNS). Scientists will investigate the feasibility of one approach to designing a commercial fusion reactor driven by ion beams. The idea is to use a conventional heavy-ion linear accelerator to feed its accelerated particles into other, large, ring-shaped accelerators (similar to the storage rings at CERN's laboratories at Geneva). When enough particles have accumulated in the SNS ring they will be extracted in short bunches by magnets and intensely focused on target pellets.

The SNS is uniquely suited to investigating the problems of bunching charged particles into beams. Its storage ring is normally used to accelerate protons to strike targets and produce beams of neutrons. In ion-beam fusion experiments, the protons themselves and the ability of experimenters to concentrate them into the tight bunches needed for fusion will be objects of study. Heavy ions, probably of uranium, are most likely to be used in a commercial reactor, but protons in the SNS storage ring can be made to simulate the behaviour of such heavier ions.

"The technological and scientific problems of heavy-ion fusion (HIF) are indeed daunting" says Dr Derek Beynon of Birmingham University Physics Department, one of the leading physicists among the UK team working on HIF. "But the reward, in terms of availability of controlled thermonuclear fusion, guarantees that the challenge is being met with enthusiasm."

With the huge efficiency advantage offered by ion beams over lasers, if this year's crucial experiments go well and encourage the setting-up of ion beam experiments on the present scale of magnetic-bottle and laser research, then the dark horse might rapidly forge ahead and win the race to gain unlimited power from the world's oceans.

Nakamichi OMS-7 compact disc player

Having built a solid reputation for its range of cassette decks and other high fidelity equipment, Nakamichi is entering the most hotly contested sector, for compact disc players. Nakamichi have two models, the OMS-5 and OMS-7.

Both models share the same performance specifications and the same transport and playback circuitry. The differences between the two models lie in the playback facilities and in the provision of an infrared remote control for the more deluxe model, the OMS-7.

We reviewed the OMS-7 which is an imposing machine by any standard. Finished in the traditional Nakamichi sombre black with fine gold lettering readable only by those with nocturnal avian vision, the OMS-7 is a suave-looking unit which will be an ideal match for existing equipment by this manufacturer. It has a comprehensive range of operating features but the styling is so subdued that no-one could claim that the unit is too "technical-looking". Dimensions of the unit are 435(W) x 100(H) x 308(D)mm while weight is 7.5kg.

The Nakamichi is a front-drawer loading machine. In the centre of the front panel is a dark window behind which is mounted the yellow vacuum fluorescent display (to match the gold lettering) and the infrared photodiode sensor for the remote control. There are six transport controls: Play, Pause, Stop, Fast Forward, Reverse, Forward Skip and Reverse Skip. The first four are self-explanatory and standard on any CD player. The last two enable you to step forward or back through the disc, track by track.

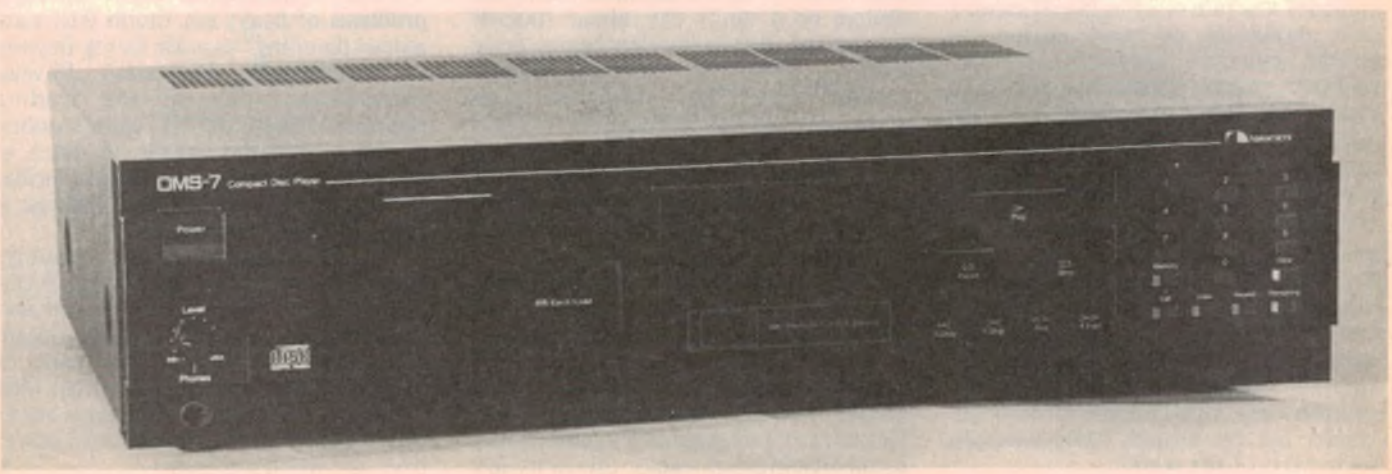
In addition, this player has audible fast forward and reverse whereby you hear rapid bursts of music, provided you go into these modes from Play. It is very similar to the Cue and Review functions on some cassette decks. If you go into Fast Forward or Reverse from the Pause mode, there is no audible effect but the time display advances or decrements in the following way: (1) holding the FF button for a few seconds moves the laser pickup a few seconds at a time so that the effective playback speed is about six times normal; (2) holding the button down for a longer period causes much bigger jumps.

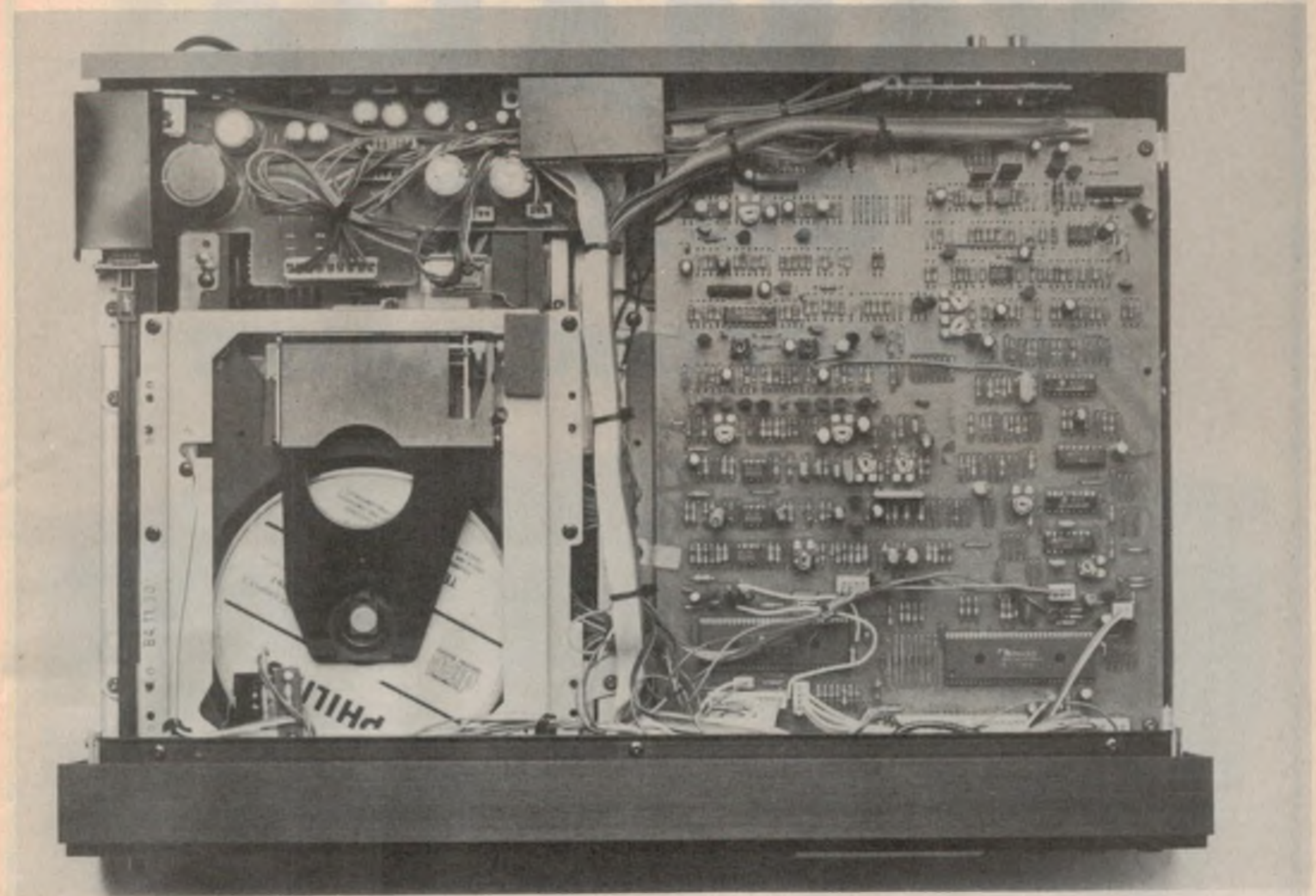
To the left of the transport controls is a numeric keyboard for track selection and four matching buttons labelled Call, Index, Repeat and Remaining. The numerical keyboard allows programming of playback, selection of next track to be played, nomination of sections to be played by index and repeat playback of whole tracks or musical phrases.

One task which must be performed before the unit can be used is to remove the transport-locking screws. This unit has three, two of which are captive and one which is removed entirely, leaving you to find a safe place to store it.

When power is applied, the display momentarily displays "standby" and shows a "1" for the track number, even though a disc has yet to be loaded. Pushing the eject/load button causes the drawer to slide out, ready for a disc to be dropped in. Pushing the same button causes the drawer to be withdrawn and the disc track information is loaded into the unit's memory while the unit now flashes "disc standby". When the operation is completed, "disc standby" is shown continuously. The display does

The OMS-7 is finished in traditional Nakamichi black with fine gold lettering.





A separate diecast chassis is used for the transport mechanism. Resistance to vibration is the best we have seen to date.

not automatically show the number of tracks and the total playing time. To display this, you press the "remaining button" which shows the relevant information for a couple of seconds.

Pushing the display button now causes the music to start and the elapsed time to be displayed. At the same time, a thin horizontal strip above the wide Play button glows discretely. The same thing happens when the Pause button is pressed.

It is also possible to initiate Play as soon as you drop a disc into the open drawer. Just press Play and it begins almost immediately.

All of the transport controls are duplicated on the infrared remote control which can operate at distances up to four metres from the machine. The control has a nice feature which reassures the user that the unit is working: whenever one of the buttons is pressed a minuscule green LED on the unit is lit. At the same time, a green LED on the machine itself is lit to indicate that the command has been received.

Also on the front panel, at the extreme lefthand side, is the stereo headphone socket and associated volume control for it. This enables most headphones to be driven to more than adequate levels for solo listening.

The rear panel of the OMS-7 is bare except for two gold-plated RCA sockets and an 8-pin DIN socket which is intended for a future Nakamichi master remote control. The unit appears to be of double-insulated construction and is fitted with a sheathed two-core flex and Australian standard mains plug, although the usual double-insulation symbol is not displayed anywhere on the rear panel.

Inside

Removing the covers of the OMS-7 reveals a large plated steel chassis with the separate diecast chassis for the transport mechanism floating within it. Most of the circuitry is accommodated on two large printed circuit boards, stacked one above the other. At the rear of the chassis is a large sealed module labelled "Direct Coupled Linear Phase Analog Signal Processor". This takes the form of a tubular aluminium extrusion which houses a printed circuit for all the analog circuitry which follows the digital-to-analog converters. Nakamichi claim to have made special efforts with the analog circuitry to ensure the best sound quality.

This effort involves the use of direct-coupled circuitry throughout, elimination of any contacts in the signal path, thorough shielding of the analog circuitry and even the use of oxygen-free copper signal wiring.

Nakamichi is one of the few CD player manufacturers to use dual digital-to-analog converters. Most use just one which means that there is a slight delay between the two channels. This delay is relatively insignificant but Nakamichi have judged it important enough to warrant the extra expense of the duplication.

Oversampling

As with Philips, Marantz and Yamaha, Nakamichi uses an over-sampling technique to convert the digital

Continued on page 31

Nakamichi OMS-7 CD player . . . ctd

information on the disc into an analog signal. This involves increasing the original sampling frequency by four times the original 44.1kHz to 176.4kHz. The sampled signal is digitally filtered, fed to the dual 14-bit D/A converters and then to sample-and-hold circuitry.

The recovered audio signal is then passed through a third order Bessel filter in each channel to remove most of the sampling noise at 88.2kHz and 176.4kHz.

The floating transport mechanism is not the swing-balance system seen in some other decks. Rather, it employs a wide carriage for the laser which traverses the underside of the disc in a straight line. The fact that the whole mechanism is effectively floating renders it less susceptible to jarring and vibration.

Performance tests

Objective measurements were made with the Technics SH-CD001 test disc and the Philips series of test discs.

Frequency response was notably flat, at 0dB all the way down to 20Hz, and only 0.3dB down at 15kHz. At 20kHz, it was 0.5dB down.

Signal-to-noise ratio was 97dB down on the 0dB reference level of 2V RMS, with respect to a noise bandwidth of 20Hz to 20kHz.

Separation between channels was excellent; −97dB at 100Hz and 1kHz; −90dB at 10kHz and back up to −92dB at 20kHz.

Harmonic distortion was much harder to quantify because of residual 88.2Hz and 176.4kHz signals. Depending on the nature of the audio signal to be measured, these proved to be about 53dB down on the 0dB reference. And even when we used a combination of notch and low pass filters, we were unable to remove these spurious signals sufficiently to verify Nakamichi's claims of .003% THD at 1kHz. We do not doubt the claim but we were unable to verify it. Frankly, we were surprised to find this relatively high level of sampling signal in a unit of this calibre although, admittedly, it has no audible effect.

We also made our usual checks for linearity which involve measuring a 1kHz signal which reduces in 10dB steps down to 90dB. This showed good linearity down to −70dB but the error at the 80dB level was +4dB, increasing to +6dB at the 90dB level. This is not a good result and indicates that the effective resolution is not much better than 14-bit whereas other makes using 14-bit D/A converters and 4-times over-sampling have achieved very close to 16-bit resolution.

On the positive side, the Nakamichi appears to have excellent error correction and tracking performance. It sailed through the Philips No. 4A defect disc without any problems and also loaded and played a very badly scratched disc that we keep on hand for this purpose. Many CD players cannot even load this particular disc let alone play it.

Resistance to vibration and jarring of the cabinet was the best we have seen to date for a conventional CD player (as opposed to the portable and car players). You have to give the OMS-7 a solid thump to make it mistrack.

In use, the Nakamichi is a delight to drive. It is mechanically very quiet and all the switches have just the right action. It also has superb sound quality (in spite of some of the negative results registered above) and the provision of the headphone socket with volume control makes self-contained solo listening possible without the need for a stereo amplifier system.

Recommended retail price for the Nakamichi OMS-7 is $2200 and for the related OMS-5 model, $1695.00.

Further information on Nakamichi CD players can be obtained from selected audio dealers or the Australian distributors, Convoy International Pty Ltd, 400 Botany Road, Alexandria, NSW 2015. (L.D.S.)

Yamaha CD-X2 compact disc player

Last year Yamaha broke new ground with the release of its second-generation compact disc player, the CD-X1 which sold for $599. Now that model has been superseded by the CD-X2 which will sell for just $499.

Yamaha's CD-X1 compact disc player was a very popular model because it brought together all the most wanted features at a very competitive price (see the review in *Electronics Australia*, June 1984). The new CD-X2 model uses the same transport mechanism but with a considerably revised circuit.

While the CD-X2 uses the same transport and plastic chassis as the former CD-X1 model, the front panel presentation has been changed considerably, with completely different pushbutton controls, different readout and additional features such as a headphone socket with its own level control.

One feature which is still the same is the Yamaha drawer system which is one of the best thought out on the market. When you push the Open/close button the drawer slides out smoothly and promptly, without any of the annoying delay of some models. It is also virtually idiot-proof. For example, if you deliberately push against the drawer when it has slid out, it will simply retract again — it is not really necessary to push the Open/close button.

A nice feature which comes in handy if you are playing the unit in darkness is that the display indicates "Open" if the drawer is open. Then, if the drawer closes without a disc in it, the display flashes "disc". It does this at a fairly slow rate, so that it is not too obtrusive.

When a disc is loaded, the display momentarily shows the total number of tracks and then displays "100". This probably means that it is ready for action but it is not mentioned in the owner's manual.

Hitting the Play button then causes "Play" to be shown briefly, and then the track number. Pushing the display button once then shows the elapsed time in minutes and seconds.

The bright red LED display is a big improvement over the previous model

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The kit contains the following:

- 12 sheets of autopositive film.
- 6 double-sided fibreglass blank boards, all measuring 160 x 100mm (Eurocard size).
- Universal exposure and assembly frame.
- A Photoflood lamp.

All necessary chemicals:

- developers • fixer • film clearing solution • photoresist • copper etchant • and a combined soldering flux/protective lacquer

- A complete set of photographic dishes.
- A liquid measure.
- A retouching pen.
- A liquid-crystal thermometer.
- A couple of 1.1mm PCB drills.

And all extras like:

- Plastic gloves.
- A photoresist applicator.
- Cotton wool.
- Film clips.
- A scouring pad.
- And a full set of step by step instructions.

NOTE: The above competition does not apply to readers in Queensland or South Australia, due to the laws relating to lotteries in those states.
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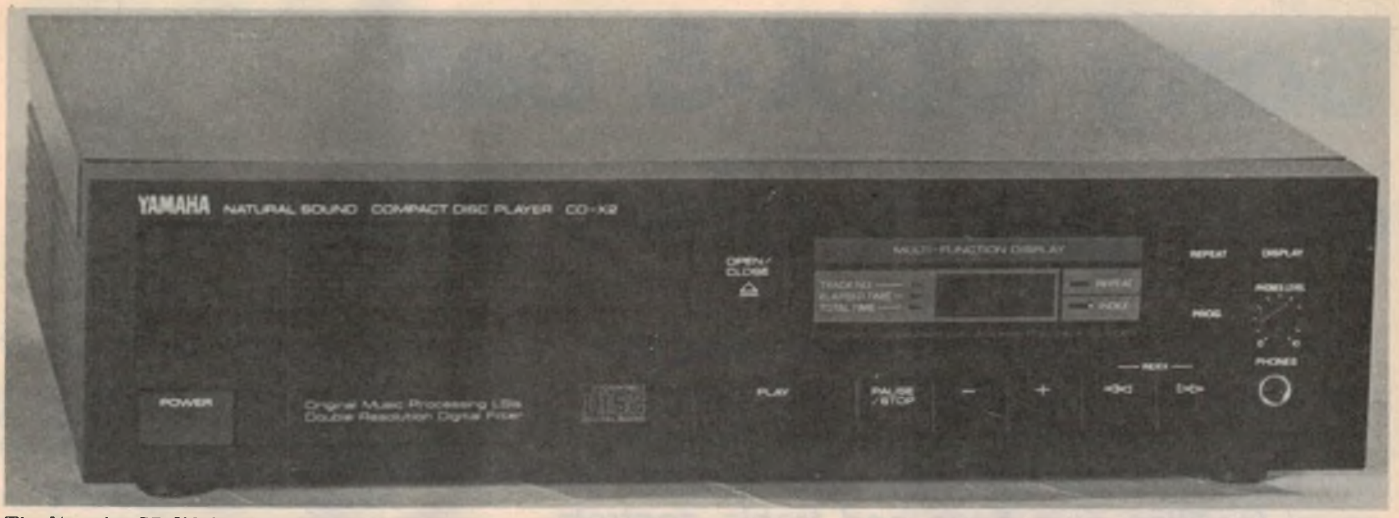


The Yamaha CD-X2 features attractive styling and is excellent value at $499.

and it is not necessary to stoop to read it. In fact, it is probably one of the best displays of any compact disc player on the market.

There are a number of other display modes which are useful but we have given enough detail on this feature.

Control legends on the new CD-X2 model are also much more legible than on the previous model.

There are six conveniently sized buttons below the display panel. From left to right, these are: Play, Pause/Stop, "−", "+", Fast Forward and Reverse. The first two controls are self-explanatory. The buttons with plus and minus signs are for stepping the laser pickup across the disc in a track-by-track fashion, either forward or backwards. These buttons are also used in the programming procedure.

The fast forward and reverse buttons give audible cue and review facilities, as follows: for the first three seconds, it moves forward in small rapid bursts; after that, it moves forward (or backward) in much bigger jumps. This happens at reduced volume to prevent the user from being deafened.

This cue and review facility makes it easy to quickly find any musical phrase within a track.

The fast forward and reverse buttons can also be used when the deck is Paused but you need the display in the elapsed time mode to tell what's happening because there is no sound.

According to the owner's manual, you can use the Repeat button to repeat the entire disc or given tracks on their own. We could even get it to repeat the disc but not particular tracks. Maybe we were not doing the right things but the manual was clear as mud on this and other aspects. Luckily, most aspects of the machine are more or less self-explanatory.

We would prefer an all-English manual. Multi-language manuals are seldom successful.

The rear panel of CD-X2 is bare except for the two RCA output sockets. The unit is double insulated and is fitted with a sheathed two-core mains flex and Australian standard 2-pin mains plug.

Dimensions of the unit are 340(W) × 92(H) × 290mm(D). Weight is a mere 3.5kg.

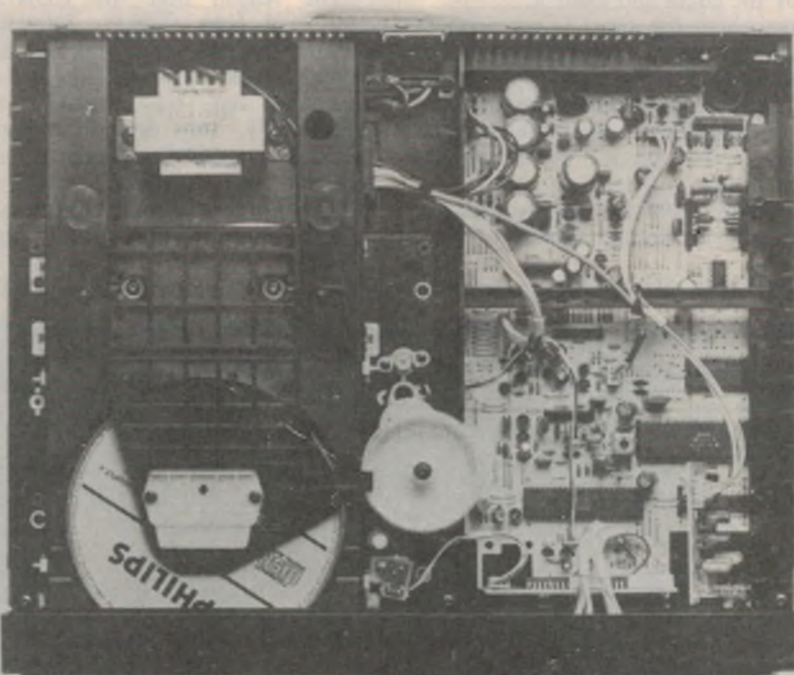
Inside

The CD-X2 uses the same clever plastic chassis as the former CD-X1. This has a steel base and top cover plates which make the finished product very rigid.

Inside, the disc transport mechanism is virtually the same as for the former model although there are a number of detail changes. The large printed circuit board, on the other hand, is completely new. Even the LSI chips are different. The major part of the conversion circuitry is contained in just three LSI chips.

Yamaha's method of signal conversion is to use a single 16-bit digital-to-analog converter with two times oversampling to 88.2kHz. Digital filtering is used but the 7th order LC filter used in the CD-X1 appears to have been omitted in favour of a simpler third order active RC

Continued on page 35



The CD-X2 uses the same chassis as the CD-X1 but the circuitry is completely new.

Sony CDX-5 car compact disc player

Sony has made it first to market with a CD player for cars. The CDX-5 player cuts no corners in performance while still managing to fit into the diminutive DIN size case. It offers all the usual facilities plus bass and treble controls.

How do they do it? After all, it is more difficult to get a CD player into the standard DIN car radio size package than into the manually opened and shut D-50 personal portable CD player. The extra degree of difficulty comes about because the CDX-5 has a fancy motorised disc loading system. It works similarly to the motorised loading of cassettes featured in some upmarket car stereo cassette players.

Just push the disc partly into the narrow slot (which is normally closed by a lightly spring-loaded door). The machine then gently takes hold of the disc by the edges and loads it.

From there on, the CDX-5 behaves virtually the same as a normal home hifi CD player. It has the usual Play, Pause, Stop, Fast Forward and Reverse facilities plus Audible Music Search which is the same as found on a number of CD players now on the market.

The CDX-5 also has an Eject button which pushes the disc about halfway through the front door. Then, if you don't retrieve the disc within 15 seconds, the machine swallows it again, so that it is safely out of harm's way.

Two controls not found on domestic players are Bass and Treble. On the CDX-5, these are retractable and normally almost flush with the front panel. Depressing them slightly causes them to protrude by about one centimetre, so that they can be manipulated. Then, once each has been set, they can be depressed again, so that the concentric Volume and Balance controls can be used.

The reason that the CDX-5 has individual Bass, Treble, Balance and Volume controls is that it is intended for use with a stereo power amplifier which normally has no controls at all. Presumably, Sony would be happy if buyers of the CDX-5 also opted for their XM-700 stereo power amplifier and XS-700 three-way loudspeaker systems which employ flat (and square) diaphragms for the tweeter, midrange and bass drivers.

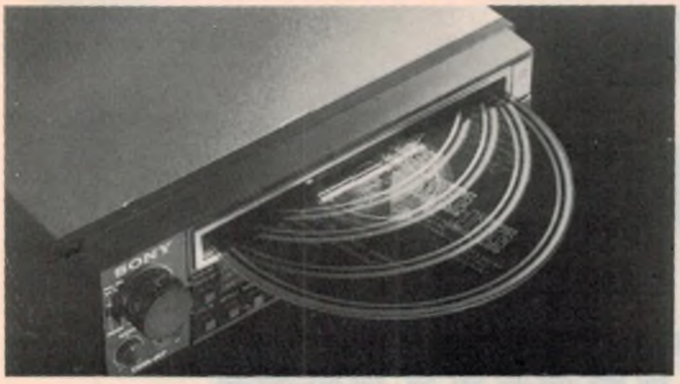
The XM-700 stereo power amplifier is an inverter-powered unit rated at 40 watts per channel into 4-ohm loads at 0.5% harmonic distortion.

The Sony CD player has a set of four RCA inline sockets, two of which are output lines to the said stereo power amplifier while the other two are for the signals from a standard car cassette/radio. When the CD function is not in use, the signals from the radio are automatically switched through to the amplifier.

The overall case dimensions of the unit are 178(W) × 50(H) × 165(D)mm. But that is not all there is to it because the unit employs a high frequency inverter power supply connected to it via a heavy cable about 45cm long. The power supply is housed in a compact steel box measuring 42(W) × 23(H) × 130(D)mm. Sony do not explain why they have found it necessary to have the power supply as a separate unit but we assume it is to prevent the high frequency inverter signals from being radiated directly into the CD player circuitry.

A look inside the case of the CDX-5 shows how Sony have managed to cram it all in. There are two relatively large PC boards which are sandwiched together and use surface-mounting and otherwise very miniature components. The transport mechanism itself takes a large

This is an actual-size view of the front panel of the CDX-5. Note the push-in Bass and Treble controls.



Above left is a view of CDX-5 showing how the disc slides in. Above right is the companion XM-700 power amplifier.

portion of the volume, as might be expected. For such a small unit it uses a surprisingly rugged-looking diecast frame and is pliantly mounted within the case using miniature rubber shock absorbers. The laser pickup is a very compact unit with a straight-line drive system, positioned diagonally within the case.

Suffice to say that Sony do not appear to have compromised at all with the engineering of the CDX-5 so that it should be capable of performance equivalent to normal domestic players.

Test results

As usual we put this player through the full battery of tests which all players go through. And not surprisingly, the unit bore up very well.

Linearity was good, showing a 1dB error at the 80dB level and a +7dB error at 90dB. This mainly reflected the background hash (at around 100kHz) level from the inverter at a level of −85dB. So really when the noise is taken into account, the linearity results are very good.

Harmonic distortion results were also right in the ball-park for typical CD players. At 1kHz and 0dB, harmonic distortion was .004%, rising gradually to .04% at 15kHz.

Separation between channels is rated at 85dB at 1kHz and that is what we measured, although the result was 100kHz hash rather than 1kHz residual. At 10kHz, the separation was −69dB, reducing to −63dB at 20kHz, which is still more than adequate.

But for a car CD player, vibration resistance is perhaps the most important parameter. We can report that the CDX-5 is exceptional in this regard and it has excellent error correction performance to boot.

Installed in a car it is difficult to imagine just how bumpy the road would have to be to make the unit mistrack. Perhaps it would be a case of "the car was destroyed but the CD player didn't miss a beat". We are most impressed with it.

Sound quality was assessed via the companion Sony XM-700 power amplifier and XS-700 loudspeaker systems. This is a potent combination in a car, producing sound quality that would rival that of many fine home hifi systems.

Recommended retail price of the CDX-5 is $849.00. The companion XM-700 power amplifier is $199 while the XS-700 loudspeakers are $399 a pair. (L.D.S.)

Yamaha CD-X2 compact disc player . . . ctd from p33

filter low pass filter to remove the residual 88.2kHz signal in the output.

Performance

As usual, the objective tests on the Yamaha were performed with the Technics SH-CD001 test disc and our Sound Technology distortion measuring equipment. We were able to substantially confirm the Yamaha's specifications. Frequency response was as flat as we have come to expect with CD decks: a mere 0.5dB down at 20Hz and 15kHz and 1dB down at 20kHz. Signal-to-noise ratio was 98dB unweighted with respect to 0dB level with a 20Hz to 20kHz noise bandwidth.

There is some residual 88.2kHz signal but it is at such a low level as not to matter. We measured it at around 79dB below 0dB reference level. At this low level it was easy to use an external filter circuit to remove it in order to make accurate measurements of distortion, separation between channels and so on.

Separation between channels was very good: 97dB at 100Hz and 1kHz; 91.5dB at 10kHz and 96dB at 20kHz (worse channel measurements). These results are considerably better than for the previous model which wasn't too bad anyway.

Linearity tests returned a fair result with a 1dB error at the 80dB level and a 3.5dB error at the 90dB level.

Total harmonic distortion results were quite good too, ranging from .004% at 1kHz to 0.2% at 10kHz and 18kHz. A measurement at 20kHz gave the usual spurious result involving the 24kHz aliasing signal which is at a low level and inaudible.

Checks of tracking performance yielded the same good result as for the previous CD-X1 model, which is not surprising. The Philips No. 4A defects disc caused no problems. Nor did our badly scratched sample disc cause any problems in loading or playing.

Resistance to jarring and vibration was also up to par and you would have to be quite deliberate in bumping the machine to cause it to mistrack. The final tests involved listening to the product and we can report without any qualifications that this is a very nice machine to listen to. There is no doubt that Yamaha have brought about quite a few improvements to this design and have still managed to reduce the price.

Recommended retail price of the Yamaha CD-X2 is $499.00. Our review machine was supplied by Len Wallis Audio, 43 Burns Bay Road, Lane Cove, NSW 2066. Phone (02) 427 1204. (L.D.S.)

Here are the full construction details

Playmaster Series 200 stereo amplifier

PART 3

Here are the construction details for the Playmaster Series 200 Stereo Amplifier. By carefully following the instructions detailed here, you can build an amplifier with performance equivalent to that of the prototype.

by JOHN CLARKE

Full circuit details for the Playmaster series 200 Amplifier were published in the March 1985 issue and, at the time, we planned to present the constructional details in April. So what went wrong?

To explain, we ran into a few problems with the phono inputs on the prototype (see p49 last month). Not to put too fine a point on it, transformer hum was being induced into the signal loop formed when a cartridge was connected to the inputs.

The problem was eventually solved by redesigning the earthing pattern on the main PC board for the phono preamplifiers. Unfortunately, we have had to omit the components for the moving coil (MC) mode. In this design, the transformer is positioned relatively close to the preamplifier stages and we found that, even after the earth pattern was modified, a high level of hum still persisted whenever the MC option was selected.

This problem does not occur in the moving magnet (MM) mode due to the considerably lower gain of this configuration. In fact, we've been able to achieve very good signal-to-noise ratios for the MM phono inputs as the specifications panel shows.

If you really want to use a moving coil cartridge with this amplifier, you will just have to add an external preamp. Since the vast majority of readers use moving magnet cartridges, omission of the MC mode is not serious. It also has the advantage that the circuit can be fully optimised for the moving magnet mode.

Fig. 1 shows the revised phono preamplifier circuit. In brief, the changes involved eliminating the 6-pole 2-position switch which altered the gain and input impedance of the circuit according to the mode selected.

Beginning with the input, S1a,b and its associated 100Ω resistor and .01μF capacitor have been deleted. Similarly, S1c in the feedback network has also been deleted since the preamplifier now operates with fixed gain.

At the same time, the feedback network (ie, the 82Ω resistor and 220μF capacitor) has been changed to reduce the MM sensitivity by half. The reason for this is to improve the input overload

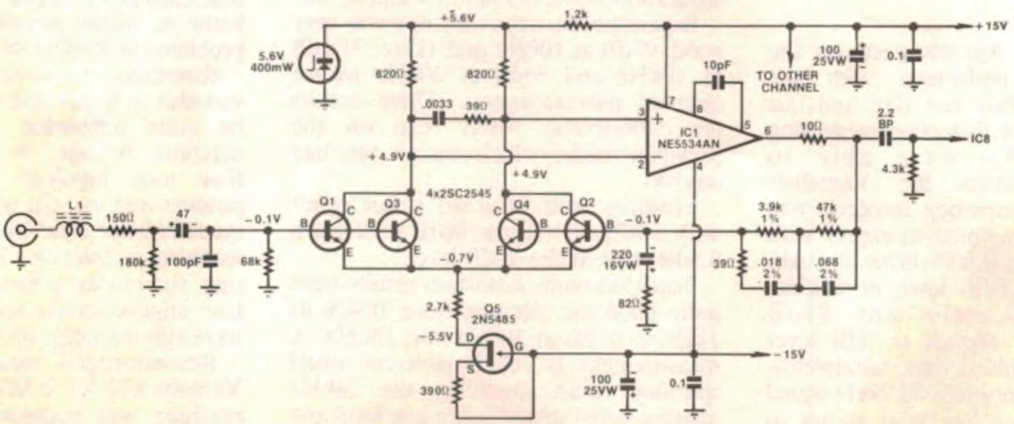
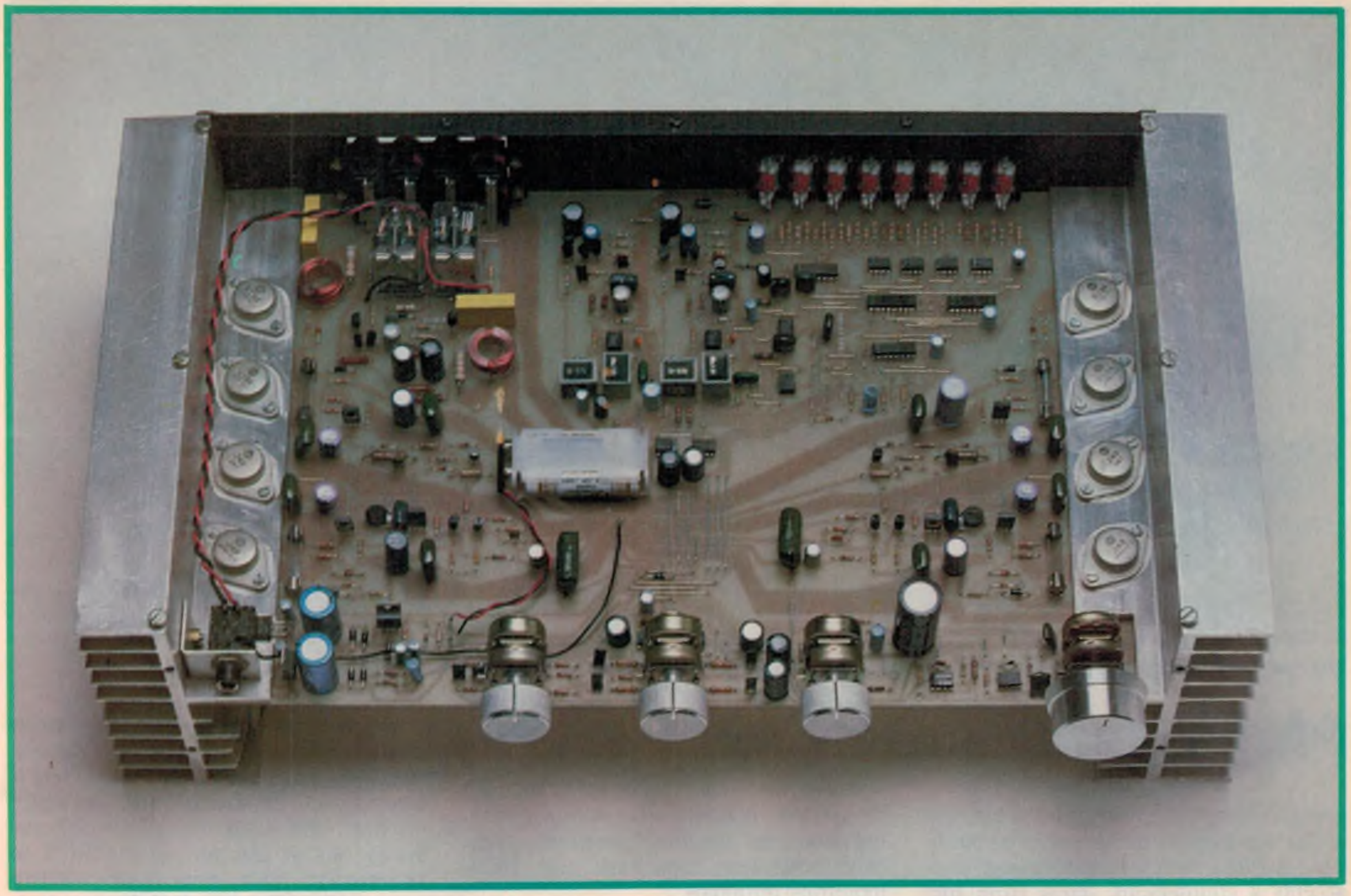


Fig. 1: revised phono preamplifier circuit. The moving coil option has been deleted.



This view shows the main PCB assembly with heatsinks and rear panel attached. Note cutout in right hand heatsink.

margin. In the original circuit (EA, March '85), the factor limiting the input overload margin is the maximum signal voltage which can be handled by the CMOS gate circuit IC8. This is limited to about ±7.5V which was equivalent to an input voltage of about 40mV RMS at 1kHz.

Clearly, this was inadequate and, by reducing the gain, we have doubled the input overload margin to just over 95mV RMS. Note also that the quiescent current through the differential pair has been reduced to 1.7mA to optimise the signal-to-noise ratio for typical moving magnet cartridges.

Switch-off thump

Another problem which we faced was a loud thump from the loudspeakers whenever the amplifier was switched off. After investigation, we discovered that the problem was caused by the rapid collapse of the +15V rail supplying the op amps in the preamplifier stages. This was due to the high current through the loudspeaker protection relays.

The solution was to isolate the op amp supply. This was done by installing a 1N4002 diode in series with the +15V rail to the preamplifier stages, and by increasing the decoupling from 10μF (pin 7, IC4) to 2200μF.

This modification ensures that the plus and minus supplies fall at a similar rate when the power is disconnected. As a result, the op amps now remain powered until the relays switch off and disconnect the loudspeakers. Thus, the switch off thump is effectively eliminated.

All of the above modifications, including those to the phono preamplifiers, are included on the new PCB. In fact, we have constructed an entirely new prototype amplifier in order to fully prove the design.

Mechanical details

The mechanical arrangement of the amplifier is rather unusual in that it employs two large heatsinks which support the main PC board. This arrangement also allows the Mosfet output transistors for each power amplifier to be bolted to the heatsinks and their leads soldered direct to the PC pattern.

Thus, the heatsinks perform two functions: they dissipate the heat from the output transistors and they form the left and right side panels of the amplifier chassis.

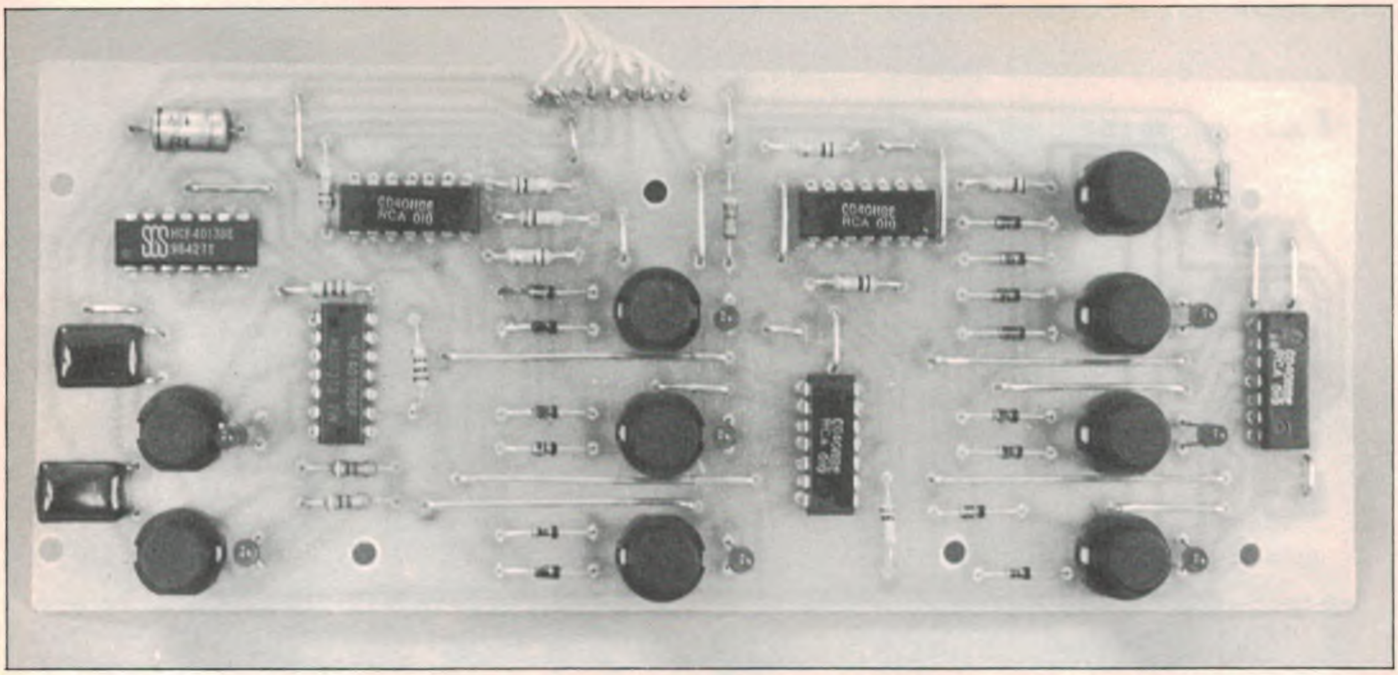
To complete the chassis, panels bolt directly onto the front and rear of the heatsinks while the top and base panels are similarly secured to the heatsink flanges. The rear panel also has 12mm folds at the top and bottom edges to allow self-tapping screws to further secure the top and base panels.

Unlike the rear panel, the front dress panel is completely flat. Consequently, the top and base panels have 12mm folds along their front edges and these each hold two captured nuts. The front panel is secured to the top and base panels and to the heatsinks using countersunk Allen screws.

The rear PC-mounting RCA input sockets and the speaker output terminals protrude through cutouts in the rear panel and also bolt directly to this panel. Similarly, on the front panel, the PC-mounting Bass, Treble, Balance and Volume control potentiometers protrude through their respective holes and are secured using nuts.

The Power, Speakers, Mono/Stereo and Mute switches do not solder onto the PCB. Instead, they are secured directly to the front panel and connected to the board using multistranded hookup wire (240V-rated in the case of the Power switch).

The small vertical PCB used for the pushbutton control circuitry and indicator LEDs is screwed to the back of the captured nuts located on the bottom



The control PCB carries the pushbuttons and LED indicators. It is secured to the captured nuts on the base panel.

Playmaster Amplifier

panel. A third mounting point is located at the top (centre) of the control board. This is fitted with a tapped spacer and accepts a countersunk screw from the front panel.

The major power supply components are mounted on the base panel of the amplifier, below the main PCB. These components include the toroidal transformer, the four 8000μF capacitors and the bridge rectifier. The capacitors are mounted on their side and are held in position with aluminium straps.

Due to the complex metalwork involved, we suggest that the amplifier be constructed from a kit of parts purchased from one of the usual retail outlets. These kits will include the printed circuit boards, predrilled heatsinks and metal panels, and screen printed front and rear panels.

In addition, they will supply all the necessary electronic components including the detented potentiometers, close tolerance capacitors and PCB mounting terminals.

This constructional article will assume that the metalwork is completed and ready to be bolted together.

Construction

Construction is straightforward and mainly involves installing parts on the two PCBs. The main PCB is coded 85sa1 and measures 405 × 261mm while the control PCB is coded 85sb1 and measures 186 × 72mm.

Begin construction with the assembly of the control PCB (85sb1). Before mounting any components it's a good idea to first inspect the board for shorted tracks or breaks in the copper pattern. Repair any faults that you do find immediately.

Follow the overlay diagram when installing the parts and check that the semiconductors and the 10μF electrolytic capacitor are correctly oriented. We used PC stakes for the 9-way bus at the top of the PCB to terminate the external wiring connections. The two .047μF capacitors must be laid flat against the board so that they do not foul the front panel.

The switches are oriented so that the "flat" of the switch body faces the bottom edge of the PCB.

Finally, the LEDs can be inserted. They stand high on their leads so that the top of the LED is at the same height as the top of the switch. Make sure that the LEDs are oriented correctly — the anodes go toward the top of the PCB. The anode is easily identified as this lead is slightly longer than the cathode lead.

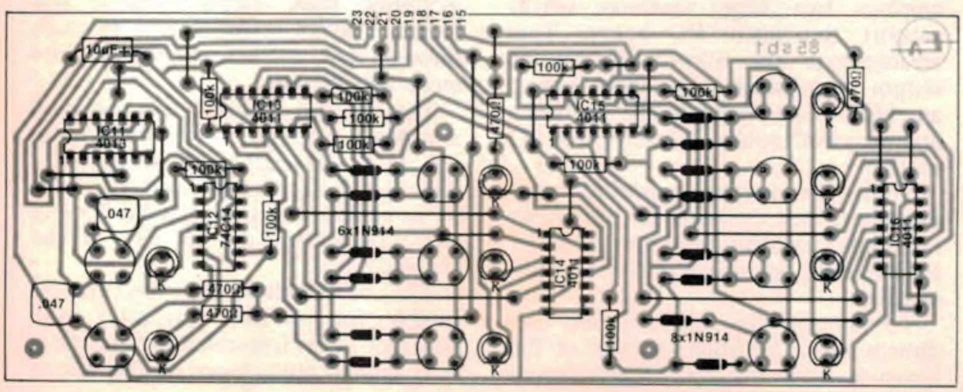
Main PCB

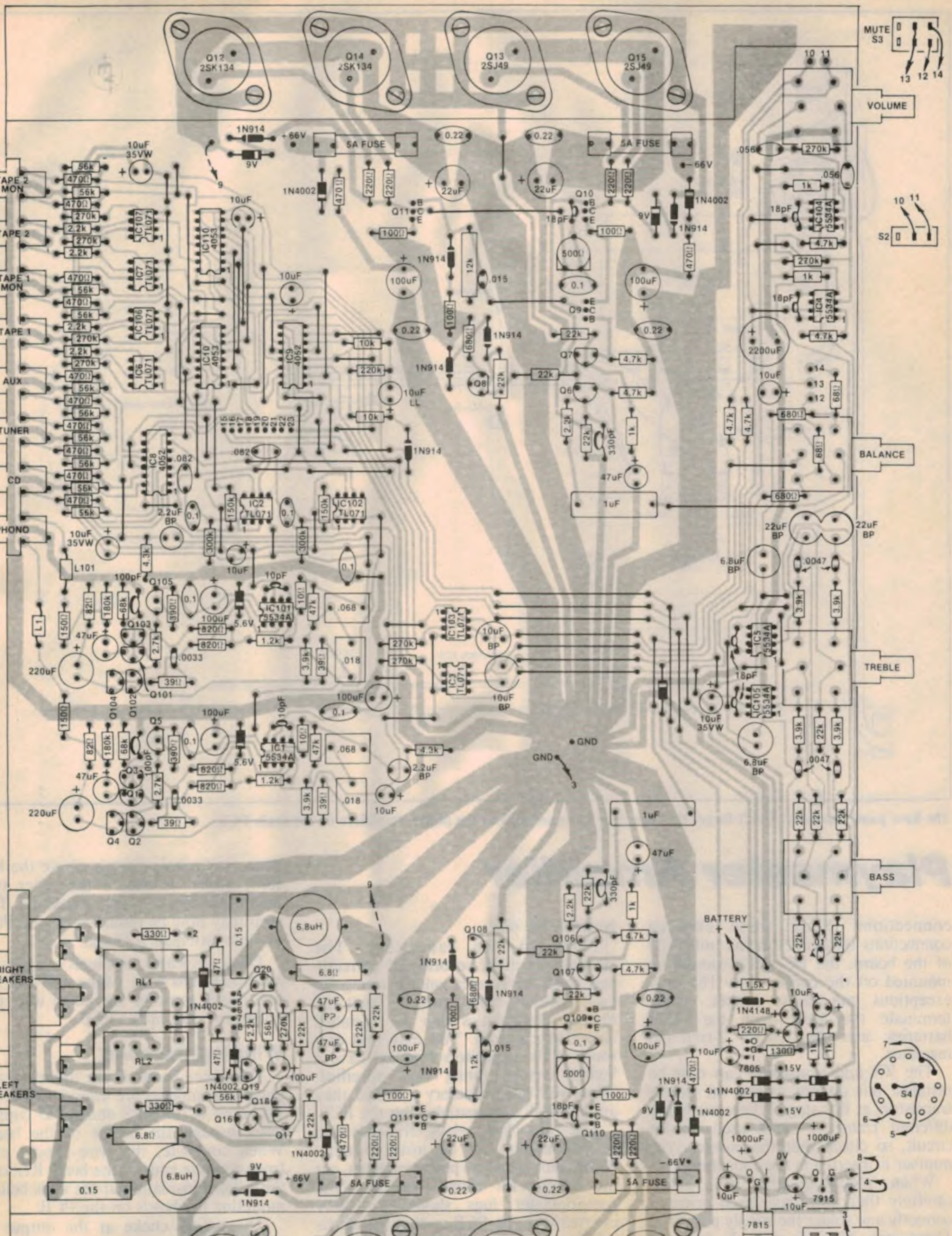
Construction of the main board will take considerably longer than the control board. Once again, make a visual inspection of the PCB to check for shorted tracks and open circuits in the copper pattern. A few minutes spent clearing any faults on the PCB now could save considerable frustration later.

Start with the links, resistors and diodes. Take particular care with the diodes. Don't confuse the 9V and 5.6V zeners and make sure that you install the 1N4002 1A diodes and 1N914/1N4148 signal diodes in their designated positions. Do not swap any of these diode types around, otherwise you'll run into problems.

As before, we used PC stakes to terminate the external wiring

Follow this parts layout diagram when wiring up the control PCB.




MUTE S3
VOLUME
S2
BALANCE
TREBLE
BASS
TAPE 2 MON
TAPE 2
TAPE 1 MON
TAPE 1
AUX
TUNER
CD
PHONO
RIGHT SPEAKERS
LEFT SPEAKERS
BATTERY
HEADPHONE SOCKET
S4
GND
5A FUSE
+66V
-66V
Q12 2SK134
Q14 2SK134
Q13 2SJ49
Q15 2SJ49
Q112 2SK134
Q114 2SK134
Q113 2SJ49
Q115 2SJ49
IC110 4053
IC10 4053
IC9 4052
IC8 4052
IC2 TL071
IC102 TL071
IC101 5534A
IC1 5534A
IC103 TL071
IC3 TL071
IC5 5534A
IC105 5534A
IC4 5534A
IC104 5534A
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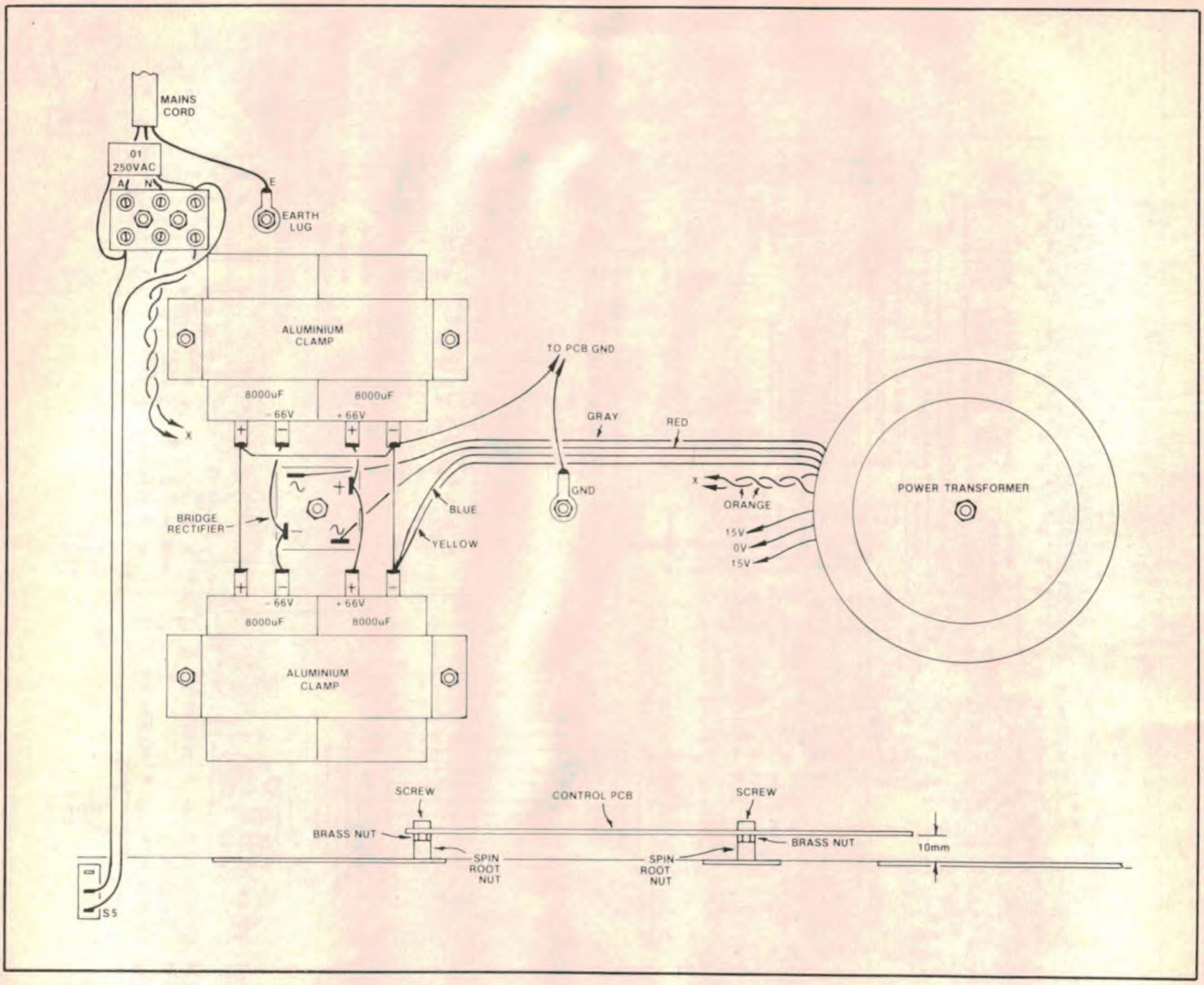


The base panel assembly. Don't forget the four ±66V connections to the power amplifiers on the main PCB.

Playmaster Amplifier

connections. Since these external connections terminate on the underside of the board, the PC stakes should be mounted on the copper side. The only exceptions are those stakes which terminate the leads from the NiCd batteries and the 7815 3-terminal regulator.

The ICs and transistors can now be installed but do not mount the power transistors at this stage. There are many different transistor types used in this circuit, so check that the correct type number is inserted at each location.

When mounting the ICs, check carefully that they have been oriented correctly and solder the supply pins first. These are pins 4 and 7 for the operational amplifiers (TL071, NE5534) and pins 7, 8 and 16 for the CMOS analog switches (4052, 4053). After soldering, check for solder bridges between the pins.

Now for the capacitors. The electrolytics must be oriented correctly and have the correct voltage rating for each position. Note, however, that the bipolar electrolytics can be installed either way around. You may find that some of the capacitors supplied have a higher voltage rating than specified. These will be satisfactory provided they are physically compatible with the PCB.

The fuse clips, relays, trimpots and potentiometers can be installed next. Before mounting the potentiometers, cut the shafts to 10mm lengths. The potentiometer lugs should be fully inserted into the PCB so that the shafts will line up with the front panel holes.

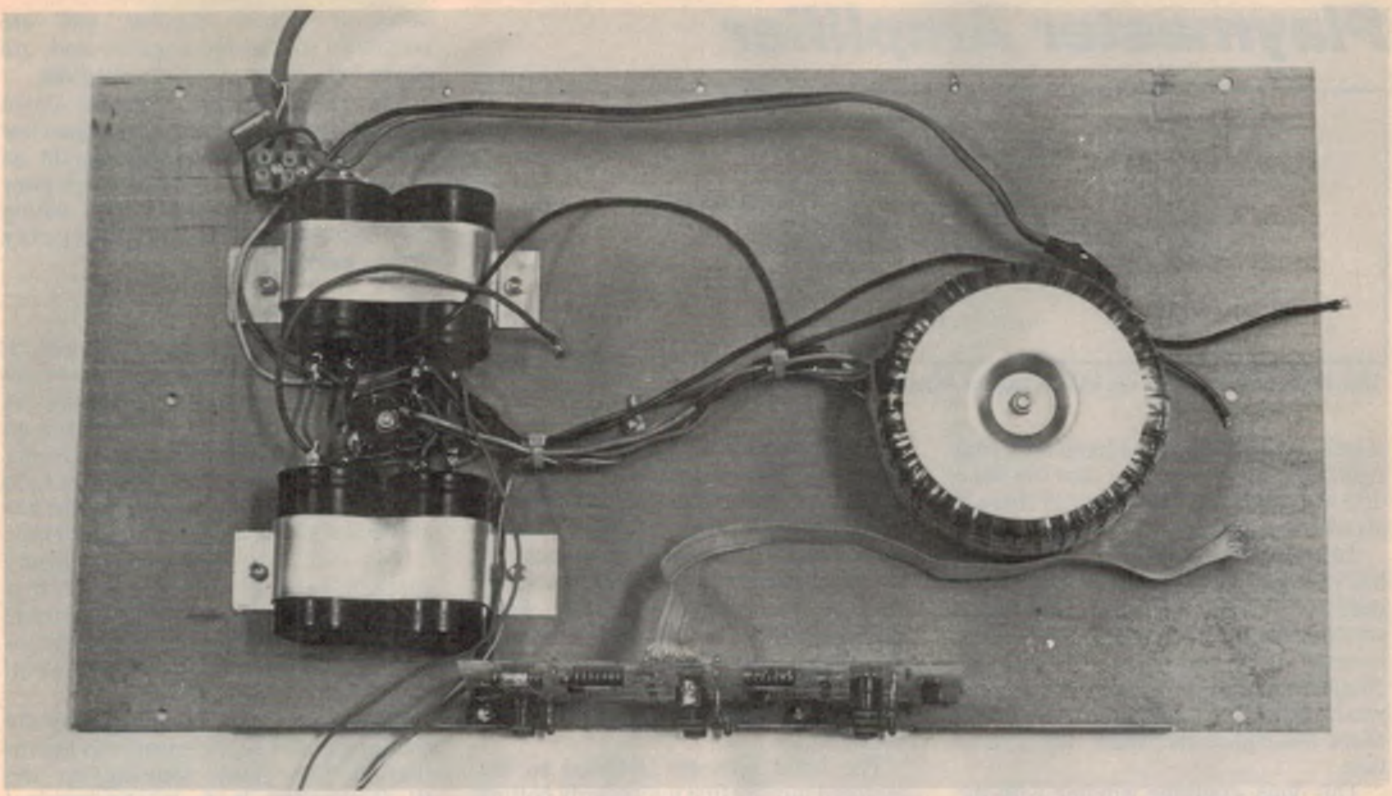
As supplied, the RCA socket strip includes an earth lug. This section must be removed by cutting the strip to a length of 121mm with a hacksaw. This done, drill a hole directly above the last RCA socket to match the other two mounting holes in the moulding. The strip may now be mounted on the PCB and the terminals soldered.

The loudspeaker terminals can also be installed at this stage. Make sure that the two plastic locating lugs mate with the holes provided on the PCB.

Winding the coils

The ferrite beads at the inputs of the phono preamplifier are wound by feeding 5.5 turns of 28 B&S enamelled copper wire through the centre of the bead. When complete, the wire should exit from opposite ends of the bead. Remove the enamel insulation at the ends before mounting the beads on the PCB.

The 6.8μH choke at the output of each amplifier is wound with 24.5 turns of 1mm enamelled copper wire on an 11mm plastic former. This will involve winding on three layers such that the wire ends exit from either side of the



The four 8000μF filter capacitors are secured using aluminium clamps. Keep all mains wiring neat and tidy.

former at the bottom edge. Bend the leads at 90° so that the chokes will mate naturally with the holes in the board.

Special capacitors

We have found it necessary to specify a particular type of capacitor for use in the output stabilisation network of the power amplifiers. Our prototype originally used 0.15μF metallised polyester capacitors but we have found that high power operation of the amplifier causes these types to fail very quickly. They become a short-circuit. The remedy is to use a dual dielectric (mixed paper and polyester) capacitor which is normally specified for mains interference suppression. The type we recommend is the Philips MKT-P series: 2222 330 40154.

Power transistor

Now for the Mosfet power transistors. These must be isolated from the heatsink using mica washers and insulation bushes, as depicted in Fig. 2. We used 5mm lengths of 3mm fibreglass tubing for the insulating bushes. Smear all mating surfaces with heatsink compound before assembly.

Note that the heatsink with the cutout on the transistor mounting flange supports the right hand side of the PCB. This cutout is necessary to clear the volume control potentiometer.

The power transistors are secured to the heatsinks using 12mm 6BA screws and nuts. The nuts should be soldered to the PCB to ensure reliable long-term contact between the case of each transistor and the copper tracks.

As each transistor is mounted, use your multimeter to check that its case has been correctly insulated from the heatsink. If the case is shorted, check the insulation around the screws by removing them one at a time. When everything is correct, the transistor leads can be soldered onto the PCB.

Construction of the main PCB may now be completed by installing the three voltage regulators and the headphone socket. The 7915 and 7805 regulators are soldered directly to the PCB as shown in the parts overlay diagram. The 7815 is bolted to the left hand heatsink and is electrically isolated from it using a mica washer and insulating bush.

Smear heatsink compound to both sides of the mica washer, then bolt down the regulator with the bush under the mounting screw. Once again, use your multimeter to check that the metal tab of the regulator is isolated from the heatsink. The regulator leads are soldered to three PC stakes mounted on the PCB.

The headphone socket is mounted on a small L-shaped bracket which is bolted to the left hand heatsink adjacent to the 7815. Two leads are run from this socket to points adjacent to the relays while a third lead runs to the central earth point on the PCB (GND). Note that the headphone socket must be an insulated type.

With the main PCB assembly now completed, the Speaker, Mono/Stereo and Mute switches can be wired to the appropriate external wiring points. A 270mm length of 5-way rainbow cable is used to wire in the speaker switch and to connect the loudspeaker protection circuitry to the adjacent +15V and ground pins at the front of the PCB. Either rainbow cable or light-duty hookup wire can be used for the wiring to the Mono/Stereo and Mute switches.

Finally, wire the lead from the output of the right hand amplifier to the output network located near the relays. This lead should be run using heavy-duty 510-strand wire and should be about 360mm long. When the chassis is ultimately assembled, the lead must be dropped straight down from the PCB and positioned so that it runs along the bottom of the base panel.

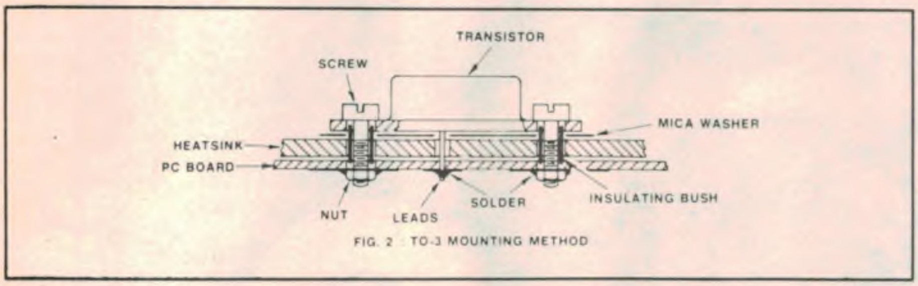
Note: do not mount the NiCd batteries at this stage. This step comes only after the amplifier has been tested.

Power supply assembly

Additional windings are required on the toroidal transformer to obtain the requisite 15V AC secondary voltages. These windings must be added by hand. The procedure is relatively simple as there are only 50 turns.

You will require 18 metres of 0.5mm enamelled copper wire. Fold this length in half to form a double nine-metre length and secure the two ends in a vice. The two leads may now be twisted

Playmaster Amplifier



This diagram shows how the Mosfet output transistors are mounted.

together with the aid of a hand drill. Pull tightly on the wires as you turn the hand drill and continue winding until there is about one turn every 20-30mm.

To wind the transformer, feed about half of the nine-metre length through the centre of the transformer and begin winding on turns. Leave a 7mm space between each turn at the outside circumference of the toroid and continue winding until only 300mm of wire is left. Mark this end as the "start" using some tape.

This done, continue winding with the other end of the wire until a total of 50 turns has been made. Leave 300mm free at this end of the winding also. This is the "finish" end and it should finish up adjacent to the "start" end on the toroid.

One end of the "start" winding is now connected to one end of the "finish" winding to form the centre tap. To do this, unwind the twisted pair of the start and finish windings and strip off about 10mm of insulation from the start and finish leads. Solder a start lead to a finish lead, twist the two wires together for a few turns and push a 290mm length of plastic sleeving over them.

Suitable 290mm lengths of plastic sleeving should also be pushed over the two remaining leads. These leads and the centre tap are secured to the toroid using plastic insulation tape. The tape should clamp the plastic sleeving to the transformer body to provide protection against lead breakage.

The accompanying wiring diagram shows the base panel assembly details. As shown, the control PCB mounts on this panel and is secured to the captured nuts at the front fold using 6mm machine screws. A brass nut is soldered to the back of each captured nut in order to provide the required 10mm clearance between the control PCB and the front panel.

The brass nuts are soldered to the captured nuts by first temporarily bolting them together. An alternative to soldering is to use epoxy resin adhesive.

Take care to ensure that the right hand mounting screw doesn't foul the copper track on the PCB. Use an insulating washer under the screw head if necessary. Don't tighten the screws too firmly as it may be necessary to make a minor sideways adjustment later on. The 9mm-long tapped brass spacer can also be secured to the top PCB mounting point at this stage. This should be built up to 10mm using a washer.

Work can now proceed on the power supply components. Bolt the transformer to the case using the hardware supplied. One large rubber washer is sandwiched between the transformer and the base, while the other goes between the top of the transformer and the metal disc. The four 8000μF filter capacitors are secured using aluminium brackets and are positioned so that the negative leads are to the left, as shown on the diagram.

The bridge rectifier is bolted down midway between the two capacitor banks. Heatsink compound should be smeared on the mounting surfaces prior to mounting. The power supply wiring may now be completed using heavy duty 510-strand cable.

Mains wiring

Secure the 3-way mains terminal block to the base panel and attach the active (brown) and neutral (blue) leads as shown. The earth lead is soldered to an adjacent solder lug bolted to chassis. Make the earth wire slightly longer than the others so that this lead will be the last to break if the mains cord is pulled out.

Note that if the mains plug is already attached, the lead will have to be first passed through the rear panel and cable clamp grommet. The rest of the mains wiring should be completed using twin-core 240VAC mains cable.

Follow the wiring diagram carefully since any power supply errors can lead to disaster. Use plastic sleeving on the .01μF capacitor leads on the terminal block and insulate the pins on the power switch with several turns of insulation tape or with heatshrink tubing.

Final assembly

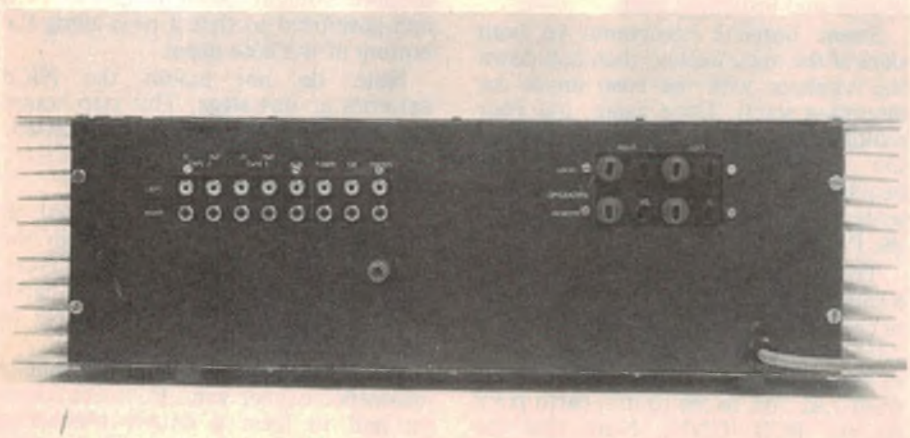
With the base panel wiring completed, wire a 9-way ribbon cable from the bus connection on the control board to the underside of the main PCB. This done, the power supply and earth connections can be run between the two assemblies. These connections include the 15V, 0V, 15V AC connections from the transformer; two ground connections; and the four +66V and −66V connections to the power amplifiers.

In addition, a 210mm lead should be soldered to the main PCB GND position for eventual connection to the rear-panel earth terminal.

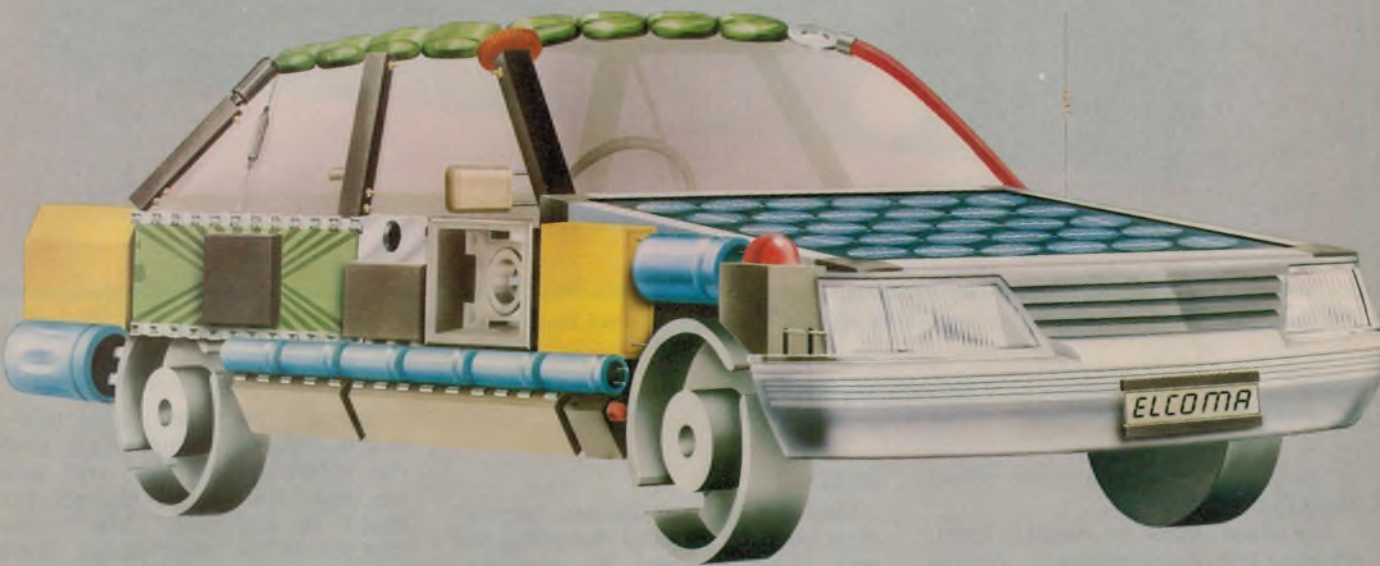
Use heavy duty 510-strand cable for the +66V and −66V leads. These leads are soldered direct to the capacitor terminals. The earth leads are run using 24/0.2 hookup wire. Note that the earth wiring must be followed exactly as shown in the wiring diagrams.

The metalwork can now be assembled. The first step is to secure the base panel to the heatsinks using the six machine screws supplied. The four adhesive rubber feet can then be fitted to the corner positions.

Before fitting the rear panel, mount the earth terminal banana socket in position and connect the previously prepared earth wire. Lock the mains cord in place using the cord clamp grommet, then fasten the rear panel in position. This panel is secured to the heatsinks and



The rear panel carries the speaker terminals (local and remote) and the RCA input connectors.


ELCOMA

The completed prototype. Most kit versions will be supplied with black anodised heatsinks and black control knobs.

Playmaster Amplifier

to the base panel using machine screws and self-tapping screws.

The front panel is mounted next. Secure the Loudspeaker, Power, Mono/Stereo and Mute switches, then offer the front panel to the main assembly. You will find that the Power switch fouls two of the internal fins of the lefthand heatsink. These fins will have to be carefully filed back to provide the necessary clearance (see photo).

Alternatively, a pair of pliers can be used to break the heatsink material away (if not already supplied suitably cut).

Once adequate clearance has been obtained, mount the front panel in position and check that the control switches, LEDs, potentiometers and headphone socket line up correctly. A few small adjustments may be necessary here. In particular, it may be necessary to move the control PCB sideways to ensure that the switches align with the holes in the front panel.

The front panel is secured using the special dress screws supplied with the kit. We used countersunk Allen screws for the prototype but at least one kit retailer will be supplying machine-finished cheesehead screws for the heatsink locations.

Finally, the nuts can be threaded onto the potentiometer shafts and the control knobs fitted. The amplifier is now ready for testing.

Testing

Stop! Before going further, carefully check your work against the wiring and parts layout diagrams. In particular, check that all semiconductors and electrolytic capacitors have been installed correctly, that the cases of the Mosfet output transistors are all isolated from chassis, and that the power supply wiring is correct.

Assuming everything checks out, remove the four 5A fuses and apply power (do not connect any signal sources or loudspeakers at this stage). One or more LEDs on the front panel should come on immediately power is applied.

Now, using your multimeter, check the +66V and −66V supply rails on the live sides of the power amplifier fuse clips. Check also that the +15V, −15V, +8V and +7.4V rails are present.

Pins 7 and 4 of the op amps should be at +15V and −15V respectively, while pins 7 and 16 of the CMOS switches should be at +7.4V and −7.5V respectively. The +8V rail can be confirmed by measuring the voltage at the output of the 7805 3-terminal regulator.

If any of the supply rails differ by more than 10% from the nominal value, switch off immediately and locate the fault. The output of the 705 regulator (nominally 8V) can be reduced if necessary by reducing the 130Ω resistor on its GND terminal to 120Ω.

Assuming the power supply rails are correct, begin measuring voltages around the phono preamplifier and power amplifier stages for each channel. These should be reasonably close to those depicted on the main circuit diagram (page 38, March) and on the revised phono preamplifier diagram.

In particular, check that there is about 4.8V across the 2.7kΩ resistor in the drain of Q5 and that the collector voltages of Q1, Q3 and Q2, Q4 are equal at about 4.9V. In the power amplifier stages, there should be 0.6V across the 680Ω emitter resistor of Q8 and equal voltages at the collectors of Q6 and Q7 (about −55.5V). There should also be about 0.6V across the 100Ω emitter resistor of Q11.

Now check that the relays operate correctly according to the Loudspeaker switch position. In the Off position, all relays are off; in the Local position, the righthand relay is on; and in the Remote position, the lefthand relay is on. Finally, in the Both position, both relays are on.

Quiescent current

When all the circuit voltages have been verified, switch off the power and monitor the +66V rail at the righthand power amplifier fuse clip. Wait until the voltage drops below +5V, then install a fuse at this position. Connect a multimeter set to measure up to 1A across the negative supply fuse clips.

The output stage quiescent current

can now be set. Rotate the 500Ω trimpot fully anticlockwise and apply power. The trimpot should now be adjusted for a 100mA reading on the meter.

Switch off the power and wait two minutes for the voltage to drop. The meter can now be removed and a fuse installed in the negative supply line.

That completes the quiescent current adjustment for the righthand power amplifier. The above procedure must now be repeated for the lefthand power amplifier.

Now check the control switch operation. The LED associated with each Phono, CD, Tuner and Aux input should turn on as each switch is pressed and the previous LED should extinguish. The same applies to LEDs adjacent to the Monitor switches.

The Dubbing switches have a lockout whereby when the Tape 1-2 switch is set, the Tape 2-1 switch is inoperative. To release the Tape 1-2 setting, press Tape 1-2 a second time. Similarly, Tape 2-1 disables the Tape 1-2 function.

Finally, the NiCd battery pack can be connected. We used double-sided adhesive tape to secure the battery pack to the PCB as shown in one of the photographs. With the batteries in place, check that the switch selections are stored when the power is switched off. Note, however, that the stored functions will change if the switches are pressed while the power is off, although the LEDs will not show this until mains power is reapplied.

Brief troubleshooting

If the controls do not operate correctly, check the power supply connections on the ICs. If these are satisfactory, then the problem possibly lies with the digital control lines (A and B). These control the analog switches (IC8, IC9, IC10 and IC110) and are simply a binary code to select the various internal switches.

For example, if IC8 has its A and B inputs both low (0,0), then the Phono input is selected. A (0,1) input selects the CD input, (1,0) the Tuner input and (1,1) the Aux input. IC9 uses these first three codes to select Source, Tape 1 and Tape 2 respectively.

IC10 and IC110 are used for tape dubbing of the right and left channels respectively. A logic 0 on the A input will select Tape 1 monitoring while a logic 0 on the B control input will select Tape 2 monitoring. When A is at logic 1, Tape 2-1 is selected; when B is at logic 1, Tape 1-2 is selected.

Finally, connect a pair of loudspeakers, apply power and listen for hum or other unpleasant sounds. All should be quiet with only a slight amount of hum audible when the Phono input is selected and the Volume control

Performance of prototype

POWER OUTPUT	One channel	Both channels
4 ohms	184W	160W
8 ohms	104W	95W

(measured with a 240VAC regulated supply)

HARMONIC DISTORTION

less than .02% for all powers up to 100W into 8Ω loads
less than .03% for all powers up to 180W into 4Ω loads

INTERMODULATION DISTORTION

less than .04% for all powers up to 100W into 8Ω loads
less than 0.1% for all powers up to 180W into 4Ω loads

FREQUENCY RESPONSE

Phono inputs	RIAA/IEC equalisation within ±0.5dB from 40Hz to 20kHz
High level inputs	25Hz to 70kHz within ±1dB

CHANNEL SEPARATION

with respect to 100W	10kHz	−50dB
	1kHz	−70dB
	100Hz	−75dB

(measured with undriven inputs loaded with 1kΩ)

INPUT SENSITIVITY

Phono inputs at 1kHz	5.5mV
Overload capacity at 1kHz	95mV
High level inputs	300mV

HUM & NOISE

Phono (with respect to 10mV at 1kHz)	83dB unweighted, with typical moving magnet cartridge
High level inputs (with respect to 2V	93dB unweighted, measured with a noise bandwidth of 20Hz to 20kHz

TONE CONTROL

Bass	±13dB
Treble	±13dB
Rumble filter	−18dB/octave below 18Hz

DAMPING FACTOR

at 1kHz	>50
at 30Hz	>50

STABILITY Unconditional.

PARTS LIST FOR THE PLAYMASTER SERIES 200

1 PCB, code 85sa1, 405 × 261mm
1 PCB, code 85sb1, 186 × 72mm
1 metal chassis, 485 (W) × 149 (H) × 280mm (D), including predrilled and pretapped heatsinks, top and base panels, screen printed front and rear panels, plus all necessary screws.
1 ILP toroidal transformer, type 72025, 90V centre tapped
1 PCB-mounting loudspeaker terminal block
1 8-way PCB-mounting stereo RCA socket panel
2 12V DPDT relays, type FRL264, 10A 250V AC, 160Ω
2 AA size NiCd cells and battery holder
1 snap-on battery connector
4 rubber feet
1 6.5mm insulated stereo headphone socket
2 plastic coil formers, 20mm OD × 12mm ID × 10mm
2 FX1115 ferrite beads
1 2-pole 4-way rotary switch
9 momentary contact PCB-mounting pushbutton switches, black or grey
2 SPDT toggle switches with paddle actuator
1 DPDT toggle switch with paddle actuator
4 black knobs, 28mm diameter
1 black knob, 40mm diameter
1 green panel-mounting banana socket
8 3AG fuseclips
4 5A 3AG fuses
1 cord clamp mains grommet
1 3-way insulated mains terminal block
2 earth lugs
8 TO-3 mica washers
1 TO-220 mica washer
1 insulated mounting bush
1 mains cord and plug
36 PC stakes
1 9mm tapped brass standoff
24 68A × 12mm screws and 24 nuts
6 4BA × 6mm screws and nuts
1 4BA × 12mm screw and nut
1 metre of spaghetti insulation, 3mm ID
2 metres 0.7mm tinned copper wire
4 metres 1mm enamelled copper wire
18 metres 0.5mm enamelled copper wire
200mm 28B&S enamelled copper wire
300mm 9-way ribbon cable
300mm 7-way rainbow cable
500mm 510-strand instrumentation wire (red)
500mm 510-strand instrumentation wire (black)
500mm 24/0.2 hookup wire (green)
500m 14/.012 hookup wire (red)
500mm of 14/.012 hookup wire (black)

Semiconductors

4 4011 quad NAND gates
1 4013 dual D flipflop
1 74C14/40106 hex Schmitt trigger
2 4052 dual four-to-one channel analog multiplexers
2 4053 triple two-to-one channel analog multiplexers
8 TL071/LF351 FET-input op amps
6 NE5534AN low-noise op amps
4 2SJ49 P-type MOSFET transistors
4 2SK134 N-type MOSFET transistors
4 BF469 NPN transistors
2 BF470 PNP transistors
6 BC556 PNP transistors
8 2SC2545 NPN transistors
2 2N5485 N-channel FETs
3 BC547 NPN transistors
1 BC557 PNP transistor
1 BC327 PNP transistor
1 7805 3-terminal +5V regulator
1 7815 3-terminal +15V regulator
1 7915 3-terminal −15V regulator
1 10A 400V bridge rectifier
10 1N4002 1A silicon diodes
25 1N914/1N4148 silicon diodes
4 9V 1W zener diodes
2 5.6V 400mW zener diodes
9 3mm red LEDs

Capacitors

4 8000μF 75VW electrolytic
1 2200μF 16VW PC electrolytic
2 1000μF 25VW PC electrolytic
2 220μF 16VW PC electrolytic
4 100μF 100VW PC electrolytic
4 100μF 16VW PC electrolytic
2 47μF 50VW bipolar PC electrolytic
4 47μF 16VW PC electrolytic
2 22μF 16VW bipolar PC electrolytic
4 22μF 100VW PC electrolytic
14 10μF 35VW PC electrolytic
1 10μF 16VW RBLL electrolytic
2 10μF 16VW bipolar electrolytic
1 10μF 16VW axial electrolytic
2 6.8μF 16VW bipolar electrolytic
2 2.2μF 16VW bipolar electrolytic
2 1μF metallised polyester
8 0.22μF metallised polyester
2 0.15μF 250VAC dual dielectric (Philips PKT-P)
8 0.1μF metallised polyester
2 .082μF metallised polyester
2 .068μF 2% tolerance
2 .056μF metallised polyester
2 .047μF metallised polyester
2 .018μF, 2% tolerance
2 .015μF metallised polyester
1 .01μF 250VAC
2 .01μF metallised polyester
4 .0047μF metallised polyester
2 .0033μF metallised polyester
2 330pF ceramic
2 100pF ceramic
2 10pF ceramic
4 18pF ceramic

Resistors

(0.25W, 5% unless stated)
2 × 300kΩ, 9 × 270kΩ, 1 × 220kΩ, 2 × 180kΩ, 2 × 150kΩ, 10 × 100kΩ, 2 × 68kΩ, 12 × 56kΩ, 2 × 47kΩ 1%, 12 × 22kΩ, 6 × 22kΩ 0.5W, 2 × 12kΩ 1W, 2 × 10kΩ, 8 × 4.7kΩ, 2 × 4.3kΩ 2%, 2 × 3.9kΩ 1%, 4 × 3.9kΩ, 2 × 2.7kΩ, 5 × 2.2kΩ, 1 × 1.5kΩ, 2 × 1.2kΩ, 6 × 1kΩ, 4 × 820Ω, 4 × 680Ω, 17 × 470Ω, 2 × 330Ω, 2 × 390Ω, 9 × 220Ω, 2 × 150Ω,1 × 130Ω 2%, 1 × 120Ω, 6 × 100Ω, 2 × 82Ω, 2 × 68Ω, 2 × 47Ω 1W, 4 × 39Ω, 2 × 10Ω, 2 × 6.8Ω 1W.

Potentiometers

2 500Ω miniature vertical trimpots
1 dual gang 50kΩ logarithmic PC-mounting potentiometer
1 dual gang 100kΩ linear PC-mounting potentiometer with centre detent
1 dual gang 25kΩ linear PC-mounting potentiometer with centre detent

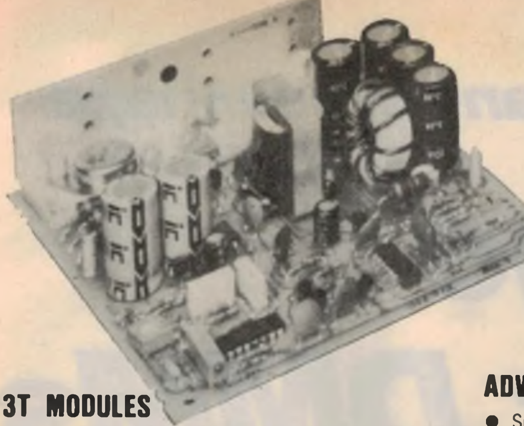
Miscellaneous

Solder, heatsink compound, insulation tape etc.

fully advanced.

Now for a listening session. Connect a suitable signal source (eg, tuner CD player etc) and check the Volume, Bass, Treble and Tone controls for correct operation. Similarly check the Speakers, Stereo/Mono and Mute switches.

Provided you've followed the wiring diagrams carefully, all should be well. For those who don't reach this happy state of affairs, a troubleshooting article will be featured in a later issue.



DC-DC SWITCHING REGULATORS

Boschert

3T MODULES

The wide-range input three-terminal 25kHz switching regulators are flexible, inexpensive, efficient design modules providing a single adjustable output from a raw positive DC source.

The 3T modules are complete, functional blocks whose input and output flexibility easily and quickly solve unique power system requirements. Seventy-five percent typical efficiency is an added advantage of the switcher which helps reduce transformer and heatsink requirements over an equivalent linear regulator. Also, efficiency is essentially independent of input voltage; hence output current need not be derated with increasing input voltage.

ADVANTAGES OF DC/DC CONVERTERS

- Smaller 60Hz transformer needed.
- No need for customary multiple transformer taps for multiple outputs.
- No extra components such as inductors or pass transistors needed.
- Lighter weight.
- Less heat.
- Smaller heat sinks.
- Higher input bus voltage means smaller rectifier diodes and input caps.
- Wider practical input voltage range.
- Lower design risk.
- Lower stock inventory.
- UL recognized.
- Shorter design cycle.

STANDARD FEATURES

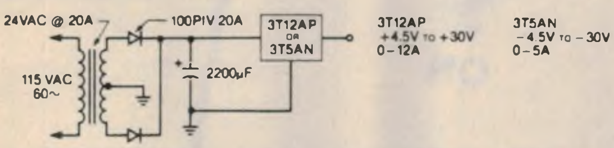
- + DC Input (3T12AP, 3T20AP, and 3T5AN).
- + DC Output (3T12AP, 3T20AP).
- − DC Output (3T5AN).
- 25kHz Switching Frequency.
- 75% Typical Efficiency.
- Overload Protection.
- Short Circuit Protection.
- Low Power Dissipation.
- Adjustable Output Voltage.
- No External Components Needed.
- Remote Sense.
- Inter-Module Sync.
- Parallelability.
- Remote On/Off.
- Application Note #4 Describing system construction and use of the 3T.
- Soft Start.

SELECTION GUIDE

Model	Input Voltage Range	Output Voltage Adjustment Range	Output Current
3T12AP-6130	+10V to +60V	+4.5V to +30V	0-12A
3T20AP-6115	+10V to +60V	+4.5V to +15V	0-20A
3T5AN-6030	+20V to +60V	−4.5V to −30V	0-5A

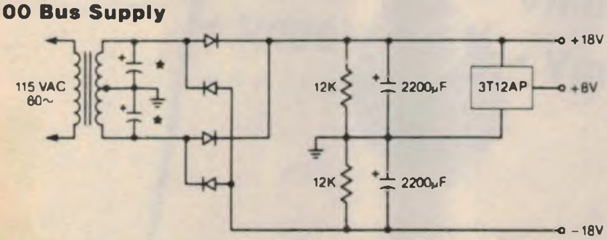
TYPICAL APPLICATIONS

Typical Connection



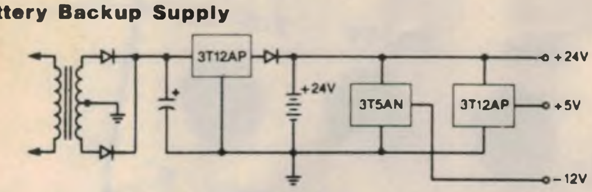
Higher input voltages to the 3T module will reduce stress on the rectifier diodes, input capacitor and 3T module.

S100 Bus Supply

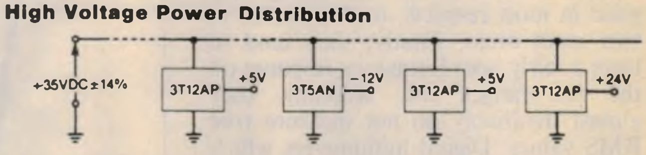


*1μF 100V Mylar capacitors improve RFI attenuation

Battery Backup Supply

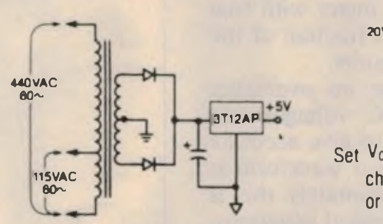


High Voltage Power Distribution



Minimizes IR drops, provides excellent local regulation, accepts wide input voltage range, including brownout.

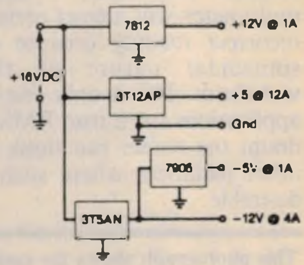
Supply with High Isolation



Set V_{OUT}-no load to 13.8V for float charging a 12V lead acid battery, or to 14.4V for a fast charge. 1_{lim} sets max charge current.

60Hz transformer provides low ground leakage current, high isolation — can conform to UL544 leakage spec.

Single Input Voltage — Multiple Outputs



7812 and 7905 are commercially available three terminal I.C. regulator circuits.

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RMS voltage adaptor for DMMs

Use this low-cost adaptor with your digital multimeter to make true RMS voltage measurements at frequencies up to 100kHz. The resulting performance will equal that of instruments costing $1000 or more.

Design by Phil Allison

by ANDREW LEVIDO

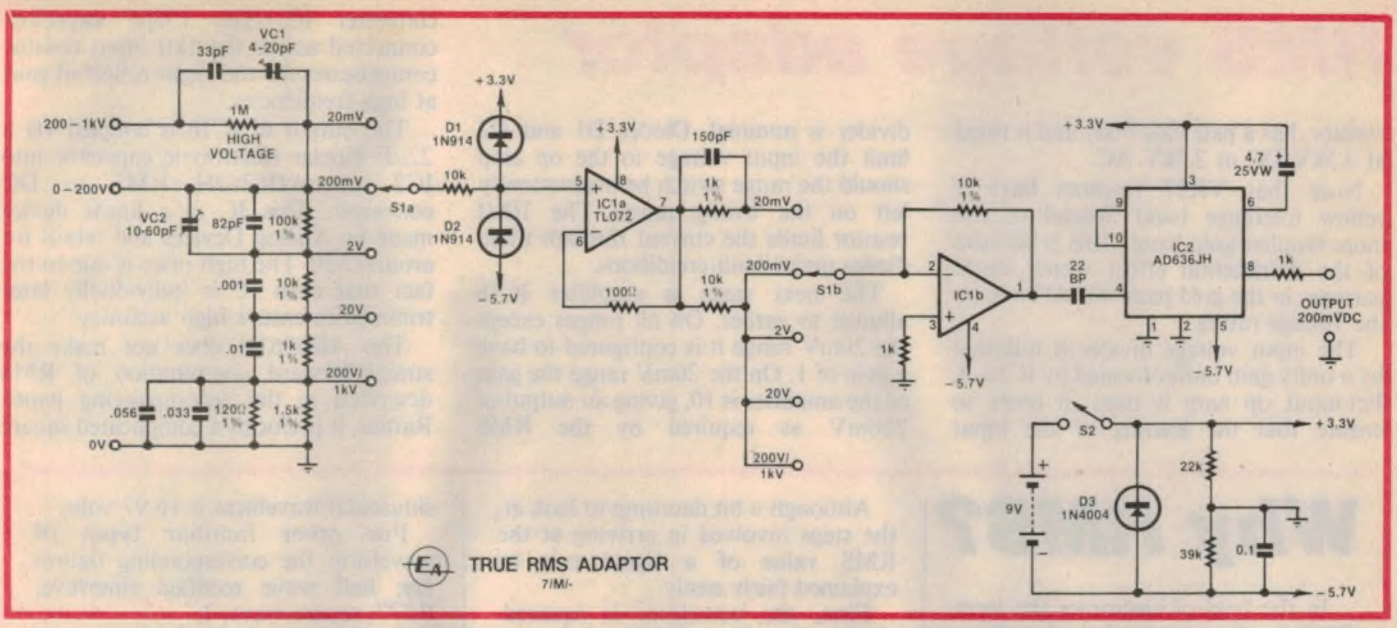
Digital multimeters have become very popular over the last two or three years. Falling production costs coupled with stiff competition between manufacturers has meant that very good meters are now available at reasonable prices.

These multimeters, while being very good in most respects, tend to suffer in two main areas. Firstly, they tend to have a fairly poor frequency response on the AC ranges and, secondly, they almost invariably do not measure true RMS values. Digital multimeters which do have this capability are available, but their price is considerably higher. The add-on described in this article is designed to provide any meter with true RMS-reading ability at a fraction of the cost of the commercial units.

Most multimeters use an averaging rectifier to measure AC voltages and currents. This is scaled to give accurate readings when the applied waveform is purely sinusoidal. Unfortunately this is often not the case in practical situations.

For example, when measuring the current drawn by a device which has a mains transformer followed by a bridge rectifier and filter, a normal digital multimeter will almost certainly give an incorrect reading because of the non-sinusoidal nature of the current waveform. This is only one of the many applications for a true RMS adaptor; no doubt the reader can think of plenty of other instances where such a device is desirable.

This photograph shows the completed prototype.



Here is the circuit diagram of the True RMS Adaptor. The AD636JH integrated circuit does most of the hard work.

RMS adaptor

The True RMS Adaptor will measure the RMS value of any shaped waveform, including noise waveforms. The only limitation is that of crest factor. The crest factor of a waveform is the ratio of peak to RMS values Most common waveforms, for example sine and triangle waves, have relatively low crest factors (<2), while waveforms which resemble low duty cycle pulse trains have high crest factors.

The RMS adaptor will give correct readings for input signals which have a crest factor of seven or less. This corresponds to a pulse train with a 2% duty cycle. For crest factors greater than seven, the output is in error by more than 1%.

Earlier we mentioned another limitation of modern digital multimeters — poor frequency response. Typical meters have a response of only 5 or 10kHz, severely limiting their usefulness in audio applications. The True RMS Adaptor described in this article has a frequency response of 100kHz.

This response, however, is a function of input level and is specified for 1% accuracy to 20kHz at 10% of full scale. To achieve this level of accuracy 1% tolerance capacitors must be used in the input attenuator network. Alternatively, individual capacitors which fall within this tolerance range can be selected from a batch of 10% types.

In use, the adaptor is connected to the digital multimeter which should be on the 200mV DC range. A cable with two banana plugs is provided for this connection. Three shrouded banana sockets are fitted to the front panel of the adaptor: a ground terminal, a 0-200V input, and a 200-1000V high voltage input.

Note that since the RMS to DC adaptor is AC-coupled, it will only measure the AC component of the applied waveform. It is possible, however, to calculate the actual voltage given if the input signal consists of an AC component superimposed on a DC level. The total voltage is given by:

$V_t = \sqrt{(Vrms)^2 + (Vdc)^2}$

Before moving on to the circuit description, we should mention that the circuit was developed by one of our readers. Phil Allison of Summer Hill, NSW. Our contribution involved designing the printed circuit board and constructing the prototype.

How it works

At the heart of the circuit is IC2, an AD636JH device which carries out the necessary true RMS to DC conversion for input to the multimeter. This IC requires an input of 200mV RMS or less for correct operation. This means that a voltage divider arrangement is necessary for input voltages greater than 200mV RMS, while a wideband amplifier is required for lower input levels.

The voltage divider network is a fairly conventional arrangement with one pole of a 5-position switch (S1a) used to select the appropriate division ratio. Compensation capacitors are included to ensure that accurate high frequency performance is achieved irrespective of the stray capacitance of the input circuit and test leads. Trimmer capacitors VC1 and VC2 are included to allow adjustment of this compensation.

Note that no attentuation takes place on either the 20mV or 200mV ranges. To compensate for this, the gain of one of the following op amp stages (IC1b) is increased when the 20mV position is selected. More on this later.

For readings in the range 200V to 1kV, S1a is left in the 200V/1kV position and the input attenuated by a 1MΩ resistor. This resistor must be a high voltage type, preferably a Philips VR37. This is about the size of a normal 0.5W

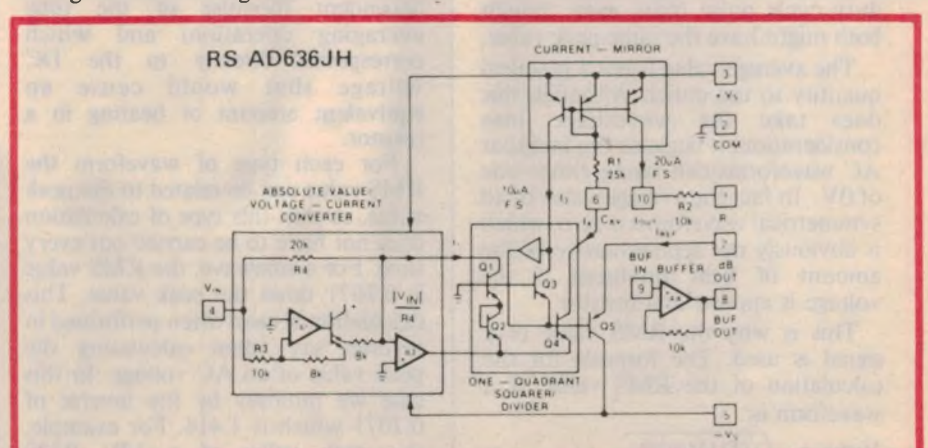


Figure 1: This is the block diagram of the AD636JH IC.

RMS voltage adaptor

resistor, has a pale blue body and is rated at 3.5kV DC or 2.5kV AC.

Note that VR37 resistors have a yellow tolerance band instead of the more familiar gold band. This is because of the detrimental effect which metal particles in the gold paint would have on the voltage rating.

The input voltage divider is followed by a unity gain buffer formed by IC1a. A Fet-input op amp is used in order to ensure that the loading of the input divider is minimal. Diodes D1 and D2 limit the input voltage to the op amp should the range switch be inadvertently left on the wrong range. The 10kΩ resistor limits the current through these diodes under fault conditions.

The next stage is amplifier IC1b alluded to earlier. On all ranges except the 20mV range it is configured to have a gain of 1. On the 20mV range the gain of the amplifier is 10, giving an output of 200mV as required by the RMS converter IC. The 150pF capacitor connected across the 1kΩ input resistor compensates for the slight rolloff in gain at high frequencies.

The output of IC1b is coupled via a 22μF bipolar electrolytic capacitor into IC2, an AD636JH RMS to DC converter. This IC is a linear device made by Analog Devices and retails for around $20. The high price is due to the fact that each IC is individually laser trimmed to ensure high accuracy.

The AD636JH does not make the straightforward computation of RMS described in the accompanying panel. Rather, it performs a complicated square

Why RMS?

In the field of elecronics the term RMS is often used when describing AC quantities such as voltage and current. RMS means "root mean square", a name derived from the actual processes involved in calculating it. Before explaining this in more detail it would be a good idea to look at why RMS values are used.

Measuring DC quantities is very easy — a DC voltage can have only one value independent of time. With AC quantities things become much more complicated. There are an infinite number of differently shaped waveforms and by definition, the value of the signal is not constant with time.

So how do we measure AC waveforms? Ideally, the measure we use ought to give an equivalent value to the DC voltage which produces exactly the same amount of heat in a resistor. Measuring the peak value of our AC waveform will not do this, because it does not take the waveshape into account. For example, a squarewave will produce more heat in a resistor than a low duty cycle pulse train, even though both might have the same peak value.

The average value is not a practical quantity to use either. Although this does take the waveshape into consideration, it neglects the fact that AC waveforms can swing either side of 0V. In fact the average value of all symmetrical waveforms is zero, which is obviously not representative of the amount of heat produced if the voltage is applied to a resistor.

This is why the RMS value of a signal is used. The formula for the calculation of the RMS value of a waveform is:

$$V_{rms} = \sqrt{1/T \int_0^T V(t)^2 dt}$$

Although a bit daunting to look at, the steps involved in arriving at the RMS value of a signal can be explained fairly easily.

First, the waveform is squared. This has the effect of ensuring that all values of the waveform are positive. The scaling introduced by this operation is reversed by taking the square root at the end of the calculation.

The next step involves taking the "mean" of the resulting voltage. An understanding of the integral term in the above expression is helpful in gaining an appreciation of this step.

An integration is effectively a summation. In the case above this is a summation over a certain period of time given by the limits of integration. These limits are shown at the top and bottom of the integration sign (the elongated S symbol). The upper case T in the expression stands for one period of the AC waveform. So, the summation over one period of the waveform squared is taken. This is divided by the time for one period to obtain a time average.

Lastly, the square root of the time-average is taken. This is done for the reason described above. The result is a figure which is no longer time dependent (because of the time averaging operation) and which corresponds directly to the DC voltage that would cause an equivalent amount of heating in a resistor.

For each type of waveform the RMS value can be related to the peak value, so that this type of calculation does not have to be carried out every time. For a sinewave, the RMS value is 0.7071 times the peak value. This calculation is most often performed in reverse, say when calculating the peak value of an AC voltage. In this case we multiply by the inverse of 0.7071 which is 1.414. For example, the peak value of a 12V RMS sinusoidal waveform is 16.97 volts.

For other familiar types of waveform the corresponding figures are: half wave rectified sinewave, 0.577; square wave, 1.

Conventional moving coil multimeters do not respond to the RMS value of a waveform, but rather to the average value of the rectified waveform. For a sine wave this is 0.636 times the peak value. The meter is scaled however, to indicate the RMS value of sinusoidal waveforms. This factor is known as the form factor, and is given by the ratio of the RMS value to the average of the absolute value. For a sine wave this is 0.7071/0.637 = 1.11

The problem comes when measuring signals that are not sinusoidal. The meter has been scaled to suit only one type of waveform. This is why there is a need for a true RMS adaptor.

When making measurements with a conventional multimeter it is possible to calculate the true RMS value of a non-sinusoidal waveform provided we are aware of the form factor of the waveform that we are measuring.

Consider a triangular wave. The form factor of this type of waveform is 1.154. Say for instance that a multimeter reads 10V when measuring a triangular wave. The form factor built into the multimeter is 1.11, so the actual average voltage of the triangular wave is 10/1.11 = 9.009 V. The form factor of the triangular wave is 1.154, so the true RMS value of the applied signal is 9.009 x 1.154 = 10.396V. The measurment error in this case would be just under 4%.

Putting this another way, the actual RMS voltage of a waveform can be calculated by multiplying the multimeter reading by the form factor of that type of waveform divided by 1.11.

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Standard System ONLY $3995

Includes Olivetti M24 base unit with 128K RAM, one 360K disk drive, high res. green screen monitor, IBM-style keyboard, full MS DOS Operating system with GW Basic.

Expanded system $4495

As above with an extra 360K disk drive and a total of 256K RAM.

MS-DOS and Flight Simulator are trade marks of Microsoft Corporation. Lotus 1-2-3 and Symphony are trade marks of Lotus Corporation. Framework is a trade mark of Ashton Taite.

Specifications

Basic Unit:
- ☐ 16-bit CPU (8Mhz)
- ☐ Socket for optional 8087 numerical processor.
- ☐ 16KB ROM for bootstrapping, power-on diagnostics and BIOS.
- ☐ Alphanumeric and graphic monochrome and colour display controller with 4 simultaneous "shades of grey" or colours from a palette of 16.
- ☐ Asynchronous serial port (RS232)
- ☐ Parallel port (Centronics)
- ☐ Sound circuitry
- ☐ Calendar/Clock with battery
- ☐ One expansion slot (7-slot bus optional)

Display:
- ☐ 80 x 25, 40 x 25 (col. x lines) characters.
- ☐ 640 x 400 pixel resolution

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A 927

RMS voltage adaptor

law operation that is easier to implement electronically and provides a greater dynamic range. The actual computation performed by the AD636JH is:

$$V_{rms} = \text{Average}\ (V_{in}^2/V_{rms})$$

The AD636JH does all its computations using currents, so the first operation performed by the IC is to convert the input voltage into a current. The voltage to current converter incorporates an absolute value amplifier so that the current produced is unipolar, through both positive and negative swings of the input voltage. The resulting current is shown as I1 on the accompanying block diagram (Fig. 1).

Next is a squarer divider circuit which squares I1 and divides it by another current, I3, which is derived from a current mirror — more about this later.

The result of these operations, I4, is averaged by the external 4.7μF capacitor and an internal resistor. The averaged current is used to drive the current mirror which produces two identical currents, I3 and Iout. As mentioned earlier, I3 is fed back into the squarer divider circuit. The output current, proportional to the RMS value of the input voltage, is converted back into a voltage and buffered. This voltage appears on pin 8 of the IC.

The power supply for the entire circuit is derived from one 9V transistor battery (216 type). S2 is the on/off switch, and the diode D3 is included to protect the circuit against accidental reverse polarity. A two resistor voltage divider is used to derive positive and negative supply rails either side of an arbitrary earth.

Non symmetrical supply rails were chosen to suit the converter IC. These cause no problems for the op amps because the output voltage required is comparatively small.

Construction

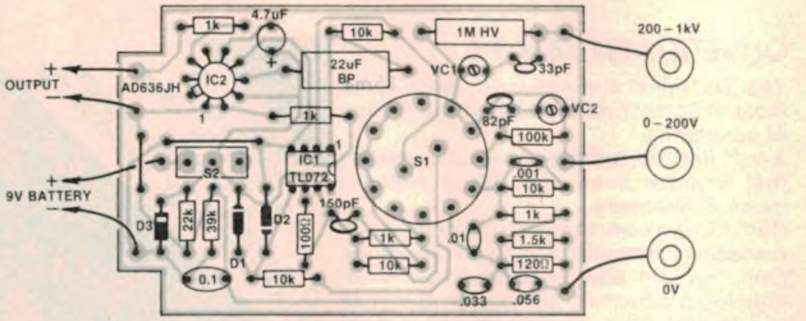
All the parts for the True RMS to DC converter mount on a single printed circuit board coded 85m4 and measuring 90 × 59mm. This board has cut outs in two of the corners to clear the mounting pillars in the plastic case.

The board has no mounting holes because it is intended to be attached to the lid of the box by means of the two switches soldered into it. Mount all of the components on this board except for the AD636JH IC. Note that there are two wire links.

The inside of the front panel must be lined with aluminium foil which is grounded, to minimise hum pick up. This foil must not be connected to the on/off switch, since it could float at 240VAC.

At this stage it is necessary to set up the compensation capacitors in the voltage divider network. To do this you will need an oscilloscope and a square wave source with a frequency of around 20kHz and an amplitude of 2-3V p-p.

Connect the battery to the board, and feed the square wave into the low voltage input. The CRO should be



Here is the PCB overlay diagram. Note that a high voltage 1M resistor must be used.

PARTS LIST

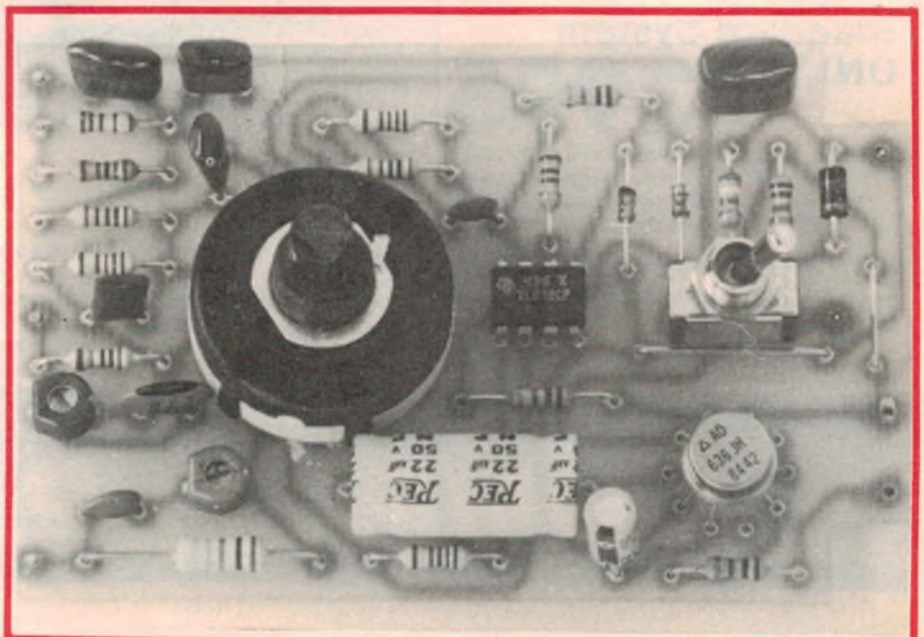
- 1 PC board, code 85m4, 89 x 59mm
- 1 plastic case, 120 × 65 × 40mm
- 1 SPDT miniature toggle switch
- 1 2-pole, 6-position rotary switch
- 3 shrouded banana sockets (red, black and green)
- 1 knob
- 1 9V battery and battery clip (type 216)
- 2 banana plugs

Resistors (0.25W, 1%)
1 × 100kΩ, 3 × 10kΩ, 1 x 1.5kΩ, 2 × 1kΩ, 1 × 120Ω

Resistors (0.25W, 5%)
1 × 39kΩ, 1 × 22kΩ, 1 × 10kΩ, 2 x 1kΩ, 1 × 100Ω, 1 × 1MΩ high voltage resistor (Philips VR37 or equivalent).

Capacitors
- 1 22μF 50VW bipolar electrolytic
- 1 4.7μF 25VW electrolytic
- 1 0.1μF polyester
- 1 .056μF 1% polyester
- 1 .033μF 1% polyester
- 1 .01μF 1% polyester
- 1 .001μF 1% polyester
- 1 150pF ceramic
- 1 82pF ceramic
- 1 33pF ceramic
- 1 4.2-20pF trimmer (red)
- 1 9.8-60pF trimmer (brown)

Semiconductors
- 1 AD636JH true RMS to DC converter
- 1 TL072 dual op amp
- 1 1N4002 diode
- 2 1N914 diodes



Both switches mount on the PCB, along with all of the electronic components.

connected to the output of the bipolar capacitor. Switch the adaptor to the 2V range and adjust VC2 for minimum tilt or overshoot.

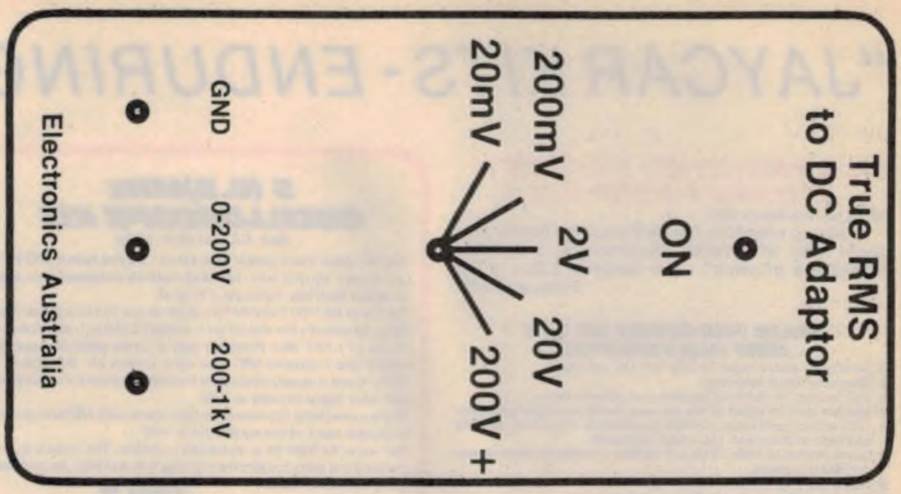
This done, feed the square wave into the high voltage input, set the range switch to the 200V position, and adjust VC1.

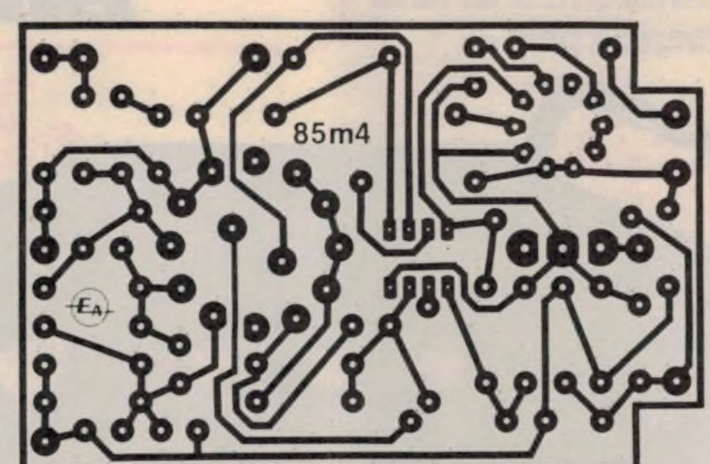
The converter IC can now be installed and the construction completed. Apply the Scotchcal label to the lid of the box and use it as a drilling template. You will also have to drill a hole in one end of the box for the output cable.

The PC board and input sockets can now be mounted on the lid of the case and the wiring completed as shown in the wiring diagram. The wiring is extremely simple so no problems should be encountered.

All that remains now is to reassemble the case and try the unit out. Check that it reads the same (within 1%) as your digital multimeter when measuring the amplitude of some sinewave source. If your signal generator will produce triangular waves you can check the converter using this. The true RMS amplitude of the signal should be about 0.577 times the peak value (as measured on a CRO).

Finally, a word of caution. The True RMS Adaptor has been designed to safely measure mains voltages, but only on the high voltage range. Exercise extreme caution when making measurements of this type — there is no room for mistakes.





Above are full size artworks for both the front panel and the printed circuit board.

"JAYCAR KITS - ENDURING VALUE FROM

PLAYMASTER SERIES II MOSFET AMP KIT

Ref: EA Jan/Feb/March 1985

"... a 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 OF THE NEW PLAYMASTER

- ★ 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
- ★ 100 watts RMS per channel into 8 ohm load
- ★ Less than 0.01% total harmonic distortion

5 (6.5)MHz OSCILLOSCOPE KIT

Ref: EA October 1984

Over the years many people have asked, "Do you have a CRO kit?" Our answer - up until now - has been that built and tested units were no dearer than kits, if you get a kit at all.

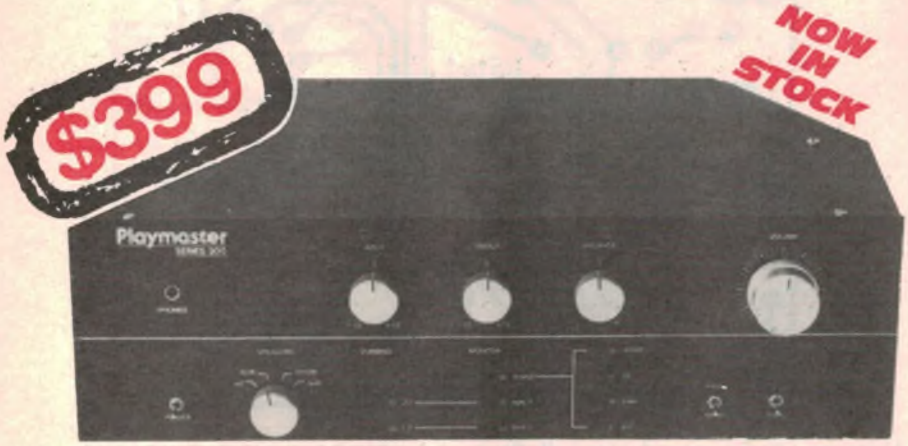
The Jaycar KJ-7050 Cathode Ray Oscilloscope kit has a guaranteed 5MHz bandwidth but should go to around 6.5MHz. It also features 75mm (3") CRT Blue Phosphor with accurate graticule, separate vertical and horizontal BNC type input sockets etc. Remember, a 5MHz scope is usually adequate to troubleshoot most microprocessor and other digital circuitry as well!

This is a wonderful opportunity to learn electronics AND end up with a valuable piece of test equipment as well.

The Jaycar KJ-7050 kit is absolutely complete. The chassis is pre-punched and every component including nuts and bolts are provided, along with instructions.

Cat. KJ-7050

ONLY $249



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.

BRAND NEW KIT FROM JAYCAR

Cat. KA-1580

$139.00

BUSKER AMPLIFIER

Ref: EA February 1985

Fantastic, portable amplifier kit for low level P.A. Buskers or for practice.

☆ Battery or mains operation ☆ Full control - bass, treble and volume ☆ 2 inputs (low and high) ☆ 17 WATTS RMS output ☆ Gel battery automatically recharged when mains used.

☆ INTRODUCTORY PRICE ☆

All electronics including GEL battery, 8" speaker, metal chassis etc.

Cat. KA-1592

ONLY $125

PRE-CUT WOODEN CABINET to suite Cat. KA-1593

ONLY $30.00

BUY BOTH AND PAY ONLY $149.00 A FURTHER SAVING

MOTORCYCLE INTERCOM

Ref: EA February 1984

What a great kit! This full duplex unit enables you to talk to your pinion passenger whilst driving with your helmets on! Powered by the bikes battery - you can both talk at the same time if you wish as there are no switches to activate. The Jaycar kit includes the special headphone inserts and all parts.

Cat. KA-1533

ONLY $39.95

"MICROSYNTH" Compact Music Synthesiser Kit

- ★ 2½ Octave Keyboard (30 notes) 16' to 1'
- ★ Two oscillators
- ★ Kit fully imported from the U.K.
- ★ Cabinet included
- ★ Switched routing system
- ★ As featured in Practical Electronics June 1982

Never before has a full-feature keyboard kit been offered at such a low price. Send SAE for a full data sheet by all means but HURRY! We have less than 10 at this price and they will not last!!

Cat. KJ-6602

NORMALLY $399 MAY ONLY $299 - SAVE $100.00

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12/230V - 300 WATT INVERTER

This unit provides up to 300VA of power at 235V from an ordinary car battery. It is ideal as a standby AC power supply. The output voltage is regulated and gives a precise 50Hz. The kit also has current limiting with ultimate thermal shutdown.
The Jaycar kit features quality conservatively rated components and is complete down to the case and front panel.
Ref: EA June 1982
Cat. KA-1574

$195.00

MUSICOLOR IV

Ref: EA August 1981
The ultimate lighting controller. Combines a four channel sound-to-light effect with a four channel chaser.

- Front panel LED display
- 4 different chaser patterns
- Auto and manual reverse chase
- Sound triggered chase
- Inbuilt electret microphone
- Safe, opto-isolated circuitry

Cat. KA-1010

ONLY $99.90

VIDEO AMP/BUFFER

Ref: EA August 1983
The answer to a maidens prayer? This device can be made to fit inside a TV set (or in a separate box if necessary). It basically enables you to connect straight into the video drive of your TV turning it into a colour monitor. This means that the video signal from your computer, VCR, TV game etc., does not need to be converted to RF and go through the TV IF strip. You will be amazed by the clearer, sharper signal that has less interference! Notes on how to fit to various TV sets included.
Cat. KA-1527

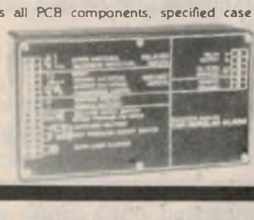
ONLY $14.95

DELUXE CAR BURGLAR ALARM

Ref: EA May 1984
This unit provides a very comprehensive array of facilities viz:

* Two delayed inputs, six instant
* 10 second delay exit, 10 second delay entry
* Provision for auxiliary battery
* Alarm trips for 2 minutes with automatic rearming
* No separate siren driver required
* 13mA current consumption; 500mA when alarm is triggered
* Flashing dash panel lamp, key operated on/off, provision for 2 way protection

The Jaycar kit includes all PCB components, specified case and Scotchcal front panel.
Cat. KA-1550



ONLY $69.50

EPROM COPIER/PROGRAMMER

Ref: EA December 1984
This unit enables you to program 2716 & 2732 EPROMs and copy 2708, 2716 & 2732's. It is easy to make and works well. The Jaycar kit includes all PCB components (inc. ZIF sockets) and panel.
Cat. KA-1557

ONLY $69.00

SUBWOOFER AMP KIT

State-of-the-art Mosfet technology combined with a low-pass filter. Around 100 watts RMS drive capability. Amp will take line level (1 volt) input or connect direct to speakers. The Jaycar kit includes all PCB parts, heatsink and power supply filter capacitors.
Cat. KA-1452

ONLY $79.00 for added power

DUAL TRACKING ±22V POWER SUPPLY

Ref: EA March 1982
This versatile dual polarity (dual tracking) power supply kit can provide up to ±22V at up to 2 amps. In addition the supply features a fixed +5V at 0.9 amp output. The supply is completely protected against short circuits, overloads and thermal runaway. Kit comes complete with case, meter, and front panel.
Cat. KA-1410

ONLY $99.50

Digital pH Meter

Ref: EA December 1982
SPECIAL FOR MAY ONLY
Buy the pH meter and probe for a total of $108 a saving of $30 on the normal price.
Cat KA-1492 & QP-3000

NORMALLY $138
MAY ONLY $108 for both - SAVE $30

MEMOCON CRAWLER SELLOUT

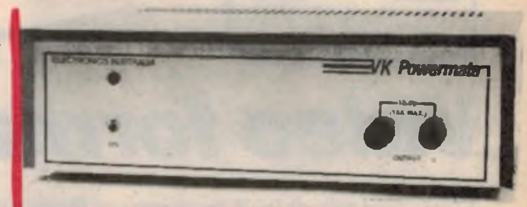
A little 3-wheel gremlin that can be programmed in on-board RAM through the detachable key pad.
Cat. KJ-6686

NORMALLY $79.95 MAY ONLY $59.95 SAVE $20

ETI 733 RTTY DECODER

Ref: ETI April 1983
Normally this kit costs $19.95. But it's a bargain this month at $15. We don't have space for a picture but it includes centre-zero meter and DB15 plug.
Cat. KE-4654

$19.50 NOW $15 WOW!



"VK POWERMATE"

Ref: EA Dec 1983
This kit enables you to build a power supply that will give 13.8 volts at up to 10 amps! (8 amps continuous). Ideal for running mobile transceivers at home. Kit is complete with box and front panel.
Cat. KA-1120

ONLY $89.95

DOUBLE DEAL: House and Car Alarm Package!!

Buy the ETI 582 House Alarm Kit (normally $59.95) AND the ETI 330 Car Alarm Kit (normally $29.50) for only $69! A saving of over TWENTY DOLLARS!
Make MAY the month that you protect your two most valuable assets house AND car!
(Horn extra on house alarm)
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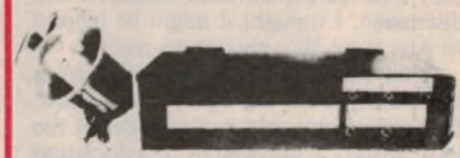
BOTH FOR ONLY $69.00



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(Note the special BBD cabinet is $10 extra)
BBD Unit Cat. KA-1522
Special Case Cat. HB-6445
Sustain Kit Cat. KA-1534

BOTH UNITS ONLY $89.00
SAVE A MASSIVE $14.50

ULTRASONIC INTRUDER KIT

This unit is basically a proximity detector for a burglar alarm. You receive a transmitter and receiver each fitted into a protective rubber boot. When installed in your car it sets up a sound pattern (ultrasonic) that will trigger your alarm if the car is broken into. It is virtually impossible not to trigger this device.
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The Serviceman

Video formats & burnt PC boards

How practical is it to copy a Beta video tape onto a VHS cassette? Can a video tape — in either format — made off-air in the UK be played on an Australian video machine? And how would you cope with a video tape made in Brazil? These, and similar questions, are some that I have encountered recently and which seem to be worthy of discussion.

In greater detail these thoughts were prompted by two incidents which occurred in quick succession and, since they both prompted some research and discussion, I thought it might be helpful to pass these thoughts on to readers.

It all started with a phone call from my colleague on the NSW south coast. One of his customers is a member of the local Rotary Club which, in association with an overseas counterpart, were helping to sponsor an exchange student for a 12 months' study period in Australia. The student had arrived recently and had brought with him a video tape (VHS format) which carried greetings and messages of goodwill to the Australian group, plus a record of a farewell ceremony for the student on his departure for Australia.

Naturally, the local club were keen to view the tape but were bitterly disappointed to find that all they could get out of it was some hopelessly garbled speech. It then transpired that the student was from Brazil and that the tape would have been made to the standards used in that country; standards which would be nothing like those used in Australia. At which point, of course, the customer wanted to know what, if anything, could be done about conversion.

And this was where my colleague wasn't sure, simply because he wasn't sure exactly what standard was used in Brazil. Most people would assume that South American countries would have adopted the US standard — 525 lines, 60 fields, and NTSC colour. But my colleague had a feeling that Brazil was the odd man out; that it had adopted a hybrid system involving, probably, the US line and field standards with PAL colour encoding.

Unfortunately, he had no reliable references by which he could confirm this, and was seeking my help. Strangely enough, I was able to confirm his suspicions immediately, at least in general terms. I remembered browsing through a book at the EA office several years ago and being surprised to find that one South American country had adopted some such strange combination of standards. Unfortunately, I could not name the country, or remember the exact standards involved.

But I did remember the reference; it was the "World Radio and TV Handbook", an annual publication which contains a wealth of information of this kind. After a couple of abortive enquiries, I finished up at our local municipal library.

I wasn't too hopeful that they would have such a specialised book, but the very obliging lady at the counter said she was sure they did and a few seconds reference to a very effective index system confirmed this. And, as she led me to the appropriate shelf, she recalled that the last person to refer to it was looking for the colour TV standards used in Kuwait! (But don't ask me what they are.)

Anyway, a few minutes with the book confirmed our thoughts on the matter. Brazil uses the CCIR "System M" line and field standards; ie, 525 lines, 60 fields accommodated in a 6MHz channel, with 4.2MHz vision bandwidth and 4.5MHz between vision and sound carriers. In short, the same standards as used in the US.

But the colour encoding is PAL — strange bedfellows indeed, though I have no doubt that Brazilian viewers enjoy the undoubted benefits of the superior PAL colour system. This was all very interesting, of course, but of little comfort to my colleague or his customer. Just how practical would it be to have such a tape transcribed to local standards in Australia?

The more we thought about it the worse the situation appeared. Had it been NTSC encoding I have no doubt that there would be at least a few firms who could do the job or, alternatively, have rental NTSC monitors available for just such situations. But how could we cope with the PAL colour encoding.

One suggestion was that, assuming that someone could cope with the line and field differences, it might just be possible to direct the video signal via a PAL decoder rather than an NTSC one. But a few moments' thought ruled this out. For one thing the chrominance sub-carrier would not be the same — it would almost certainly be to the US standard — and this, in turn, would mean that it would have to use a unique PAL delay line.

What a mess!

Possibilities

So far we have considered the following possibilities: (1) That it might be possible for a local firm to make a monochrome version in our standards, and that this might well be better than nothing. (2) That the tape be returned to Brazil where there would be a better chance that it could be transcribed. After all, they could at least play it there, and they must have experienced a need to convert to other standards. (3) If the tape is a copy of a master still available in Brazil it might be possible to have a new copy made to our standards.

However, we both agreed that all these ideas were, at best, clumsy and, at worst, may be quite impractical. And so it was that Yours Truly was commissioned to investigate those firms who specialise in tape copying and transcribing in the hope that someone may have at least heard of the Brazilian standards and be in a position to handle them.

At the time of writing I have been able to contact only a few firms who specialise in video conversions; 8mm film to tape, slide presentations to tape, US to European standards, etc. The reactions have been varied; some were clearly not interested, but a couple were prepared to try. However, one of these insisted that Brazil used a "modified NTSC" system.

The other firm readily admitted that they had never heard of the Brazilian standards, but were keen to have a go. They were quite prepared to try the tape on their available monitors in an effort to get a picture, without charge, then advise what could be done. Their price was also quite reasonable; $40 an hour assuming full colour could be decoded, less for monochrome only. (Some firms quoted up to $200 per half hour.)

And there the matter rests at the moment. I have advised my colleague and he is arranging to get the tape to me by the first available trustworthy traveller. Hopefully between now and my next notes we will have been able to achieve something and I will be happy to pass on whatever we find, for the benefit of anyone caught with a similar problem.

British standards

The second compatibility problem came to me via my amateur friend, presented to him, in turn, via another amateur. This second amateur is the proud owner of a video camera and associated portable recorder; more exactly a National WVP-A2NA camera and NV-180A recorder and which, by all accounts, deliver first class performance.

The owner had already made one overseas trip, to New Zealand, as a member of a conducted tour, and had brought home a lot of interesting video material. After some fairly drastic editing, this was used to provide a much shorter record of his trip for the entertainment of his friends.

But it was while he was on tour that the video system provided an unexpected bonus. At the end of each day our video photographer would feed his video recorder into the nearest available TV set — usually in the hotel lounge, if no one else was watching it — and check the result of his day's "filming".

Undertaken initially simply to check his work and learn from any mistakes, it soon became a source of entertainment for the rest of the tour group, who apparently derived a lot of pleasure from seeing the day's highlights repeated. And so it became a regular nightly ritual which everyone came to expect.

It didn't present any serious technical problems. The recorder delivers a signal on either channel 0 or channel 1 and, although the NZ channels are not exactly the same as ours, he had no trouble in finding one that was within fine tuning range of one or the other of these channels.

So what's the problem? Simply that he is planning a tour of the UK in a few months' time and would like to be able to pull the same trick, if only to monitor his own performance. Unfortunately, there are two compatability barriers; the fact that the UK colour system is on UHF, and that the sound/vision separation is 6MHz, rather than 5.5MHz as in Australia and most other 625 line countries.

So the discussion boiled down to whether these barriers could be conveniently overcome, without too much additional cost or, most important, weight penalty. Of the two, the VHF/UHF problem appeared to be the simpler. According to overseas technical literature — and backed by my south coast colleague's overseas experience — it appears that "up-converters" are quite readily available in the UK and are not unduly expensive.

One reason is a trick the local technicians have developed when fitting TV distribution systems to large blocks of flats, home units, hotels, etc. While it sounds like a clumsy arrangement, there apparently are advantages in changing the incoming UHF signals to VHF via a "down-converter," one of the main advantages being the much lower losses in long cable runs, plus the less critical nature of VHF signals in some other respects.

At each receiver one of two possible arrangements may be used. If the installation involves a large number of sets it is often worthwhile to use specially modified sets, fitted with VHF tuners. Alternatively, conventional sets may be used, with "up-converters" to put the signal back on UHF.

My colleague suggested that these devices may also be available in Australia, and produced the name of a likely firm. My amateur friend is currently following this up. However, unless there is a very attractive price advantage it is generally agreed that purchasing a unit in the UK would be a much more convenient arrangement. It might even be worthwhile to ditch it at the end of the tour, rather than carry it home.

So that should solve that part of the problem, but what about the 6MHz sound offset? Some confusion can occur here because there is a degree of compatibility between British and Australian made video tapes. Tapes made in Britain, either off-air or commercially, can be played without difficulty on Australian video machines, and vice versa.

The reason is that the sound is recorded as a simple audio signal, with no regard to its original source and is thus totally compatible. But — and this is the important difference — an Australian video recorder will not work correctly into a British TV set, even via an "up-converter", because the recorder delivers its sound carrier 5.5MHz from the vision carrier, while the receiver is looking for a 6MHz signal. Result, picture but no sound.

This looked like a curly one for a while until my amateur friend suddenly had a brainwave. Most video recorders have both "video out" and "audio out" terminals as well as the RF link and the National NV-180A is no exception. In fact there is an earphone socket as well, so the sound can be monitored directly, at least by one person.

If a larger audience had to be accommodated then some form of simple audio amplifier and speaker would be needed, but this is looking a bit far ahead. Suffice it to say that the primary requirement, that of checking the day's work, does seem to be feasible without too much effort or expense. Let's hope it works out.

Beta/VHS transfer

And finally, arising out of these discussions — and I understand there were many, involving several other amateurs — came the question of Beta/VHS transfer. Assuming our video photographer wanted to make a copy of his efforts for a fellow tourist, how could this best be done?

One member of the group went so far as to suggest that the only way it could be done was optically; ie, by presetting the image on a TV screen, then photographing the image with the video camera which would be fed into the Beta recorder. He went on to suggest that the results might not be too good. (You can say that again!)

The truth is that this problem, as such, doesn't exist. Either format recorder will deliver a basic video signal (ie, video and sync pulses) at either the "video out" socket or superimposed on an RF carrier at the "RF out" socket. This basic signal carries nothing to indicate where it came from; nothing to indicate the size of the head drum, the speed at which it rotates, the path which the tape follows, the size and shape of the cassette, or any other characteristic which distinguishes one format from the other.

Thus, making a copy from one format to the other would involve no more hassle than making a copy within the same format. Both the video and audio signals, as such, can be fed from one machine to the other via the appropriate video and audio terminals or, if it is more convenient, transferred at RF. While this latter is not the preferred arrangement, results can still be very good.

So let's hope that provides some food for thought.

Back to work

Reverting to more everyday problems, my most unusual story from the work bench this month concerns a Toshiba model C812 colour set. This set is also sold under the Precendent brand as model GC181 and readers may recall that I described a couple of incidents involving these sets back in the August and September 1983 issues. The September story, in particular, sticks in my mind because it involved the use of spirits of salts as a soldering flux by a handyman repair artist.

Serviceman

However, another characteristic of these sets is that they use several double sided boards which are rather notorious for dry joints, particularly those involving through-board connections. This story is also similar to those two in that the main symptom was frame collapse, but there the similarity ended.

Against that background I went straight to the vertical amplifier board and gave it a visual once-over in search of any suspicious looking soldering. In fact, I found that someone had been there before me and that a number of joints had obviously been remade. Whoever had done it had done a good job, and the board was in good condition, but it had definitely been worked on. (I later learned that the set was an ex-rental model.)

On that basis I was less inclined to suspect dry joints; hopefully someone had already found and fixed any that there might have been. So I simply stoked up the CRO and began checking waveforms. This part of the circuit uses a rather unusual arrangement and, I must confess, it is not one that I completely understand.

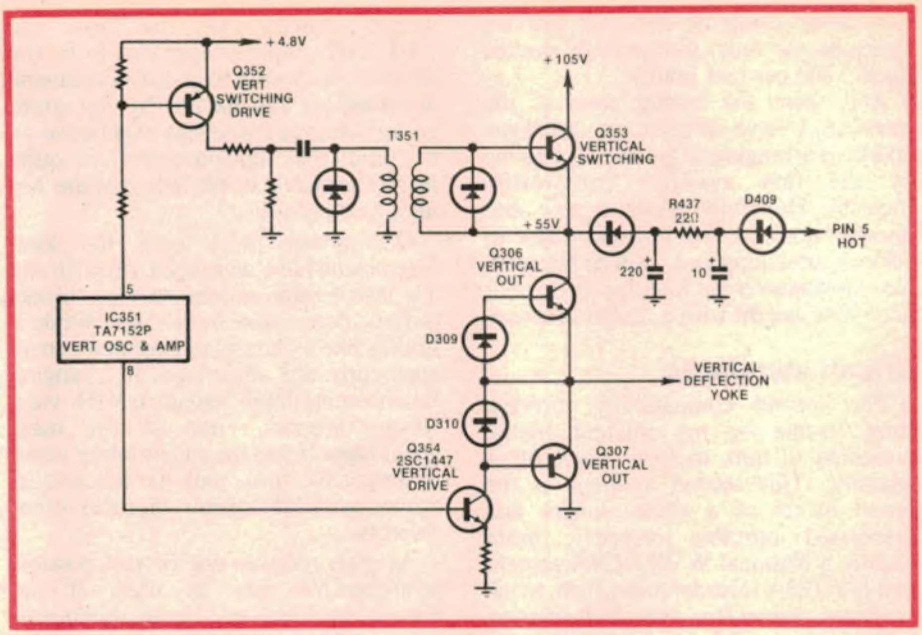
The vertical signals are generated in IC351 (TA-7152P), described as a vertical oscillator and amplifier. The vertical drive proper appears to come from pin 8, feeds the vertical drive transistor Q354 (2SC1447), and then the vertical output pair Q307 (2SA740) and Q306 (2SC1448A). But there is also a vertical output signal from pin 5 and this is fed to the base of Q352 (2SA495), described as the vertical switching drive stage.

Output from this stage goes via a transformer (T351) to Q353 (2SC1448A), described as the vertical switching stage. It appears to switch the main supply voltage for the output pair from 55V to 105V. The 55V supply is derived from a tapping (pin 5) on the horizontal output transformer and passes via diode D409, a 22Ω safety resistor, and another diode. Filtering is provided by the 10μF and 220μF capacitors.

As I have mentioned before, some of the details of this circuit arrangement are rather hard to follow. The best one can hope to do is check waveforms and voltages in the hope that they will provide a clue to the faulty component.

According to the CRO the output from pin 8 was according to the manual and remained correct through Q354 to the base of Q307. Similarly, the output from pin 5 was normal to the base of Q352 but from there on it deteriorated until, at the input to Q353, it had almost vanished.

At this stage I put the CRO aside and went over the board with an analog meter, testing as many components as possible in situ, but mainly the transistors and diodes. As nearly as I could tell, they were all OK. I did the same around the output stage, with similar results. (The output transistors are mounted remote from the board.)



Vertical output stage of the Toshiba C812 colour TV set.

That much established I started on a voltage check. All seemed correct until I came to the aforementioned 55V supply, which was down to about 30V. The 105V rail was correct and, assuming that my checks on the transistors had been valid, it looked like something in the supply line itself.

In fact, it was the 22Ω safety resistor which was the culprit, being open circuit. So that was easily fixed, even though the reason for its failure was not apparent. Significantly, it had not been overheated in any way, and I was inclined to the idea that it had simply failed within itself.

Anyway, I fitted a new one, switched on, and watched for any signs of distress. There were none and the set came good immediately with full vertical scan, perfect linearity, etc. This seemed to reinforce my theory about a faulty resistor, but I left the set running on the bench as a matter of course.

I let it run like this for some time, checked the safety resistor for any signs of distress, found none, and decided that the job was finished. I switched off, put everything back together, fitted the back on the cabinet, then switched it on for a final check. Everything worked as before — for about two minutes! Then suddenly I was back to square one with total frame collapse.

Naturally I went straight to the 22Ω resistor, convinced that there was some subtle fault associated with it which I had overlooked. And, as you've probably guessed, there was nothing wrong with it! That set me back somewhat, but there was nothing for it but to start all over again.

Only this time I was lucky. The first thing I did was to put the meter across Q307, the lower of the two output transistors and, lo and behold, it was short circuit, along with its associated diode, D310. With nothing to indicate why these components had failed, all I could do was replace them and see what happened.

It so happened that I didn't have a direct replacement for Q307 but I located what seemed to be a suitable substitute, plus another diode, and fitted them. Switching on again I found that I had vertical scan all right — a full 75mm of it! What the heck was going on?

My first reaction was that the substitute transistor I had fitted was less suitable than I imagined, but I quickly discounted that idea; there was no way it could be all that unsuitable. So it was back to the output stage to check the other transistor and its associated components, though I found it hard to imagine that both transistors had shorted.

And I was right; Q306 had not shorted at all — it had gone open circuit! So this was replaced, and I tried again. This time the set came good and stayed that way. I ran it for several hours before returning it to the customer, and a recent check, some weeks later, confirmed that it is still running.

Coincidence

So what was the story behind it all? Why did the 22Ω resistor fail in the first place, and why did the two transistors and the diode fail immediately after it was replaced? Were the two faults

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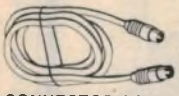

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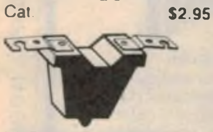

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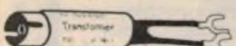

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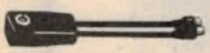

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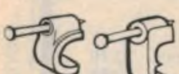

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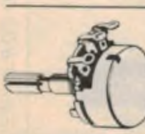

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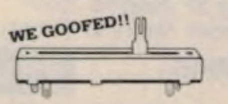

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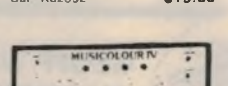
This 12/240 V inverter can be used to power up mains appliances rated up to 40 W, or to vary the speed of a turntable. As a bonus, it will also work backwards as a trickle charger to top up the battery when the power is on. (EA May'82) 82IV5
Cat. K82050 $49.50

COMPUTER DRIVEN RADIO-TELETYPE TRANSCEIVER
Here's what you've been asking for, a full trasmit-receive system for computer driven radio teletype station. The software provides all the latest "whizz-bangs" like split-screen operation, automatically repeating test message, printer output and more. The hardware uses tried and proven techniques. While designed to team with the popular Mircorbee, tips are avaialble on interfacing the unit to other computers.
(ETI Nov. 84) ETI 755
Cat. K47550 $139.00

ELECTRIC FENCE
Mains or battery powered, this electric fence controller is both inexpensive and versatile. Based on an automotive ignition coil, it should prove an adequeate deterrent to all manner of livestock. Additonally, its operation comforms to the relevant clauses of Australian Stnd 3129. (EA Sept. 82) 82EF9
Cat. K82092 $19.50



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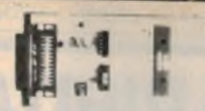
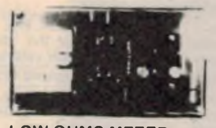
Add excitement to parties, card nights and discos with EAs Musicolor IV light show. This is the latest in the famous line of musicolors and it offers features such as four channel "color organ" plus four channel light chaser, front panel LED display, internal microphone, single sensitivity control plus opto-coupled switching for increased safety.
(EA Aug. 81) 81MC8
Cat. K81080 $89.00



MICROBEE SERIAL-TO-PARALLEL INTERFACE
Most microcomputers worth owning have an RS232 connector or port through which serial communications (input/output) is conducted. It is a convention that, for listing on a printer, the BASIC LLIST or LPRINT command assumes a printer is connected to the RS232 port. Problem is, serial interface printers are more expensive than parallel "Centronics" interface printers. Save money by building this interface. (ETI Jan. 84) ETI 675
Cat. K46750 $59.00



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How many times have you cursed your Multimeter when you had to measure a low-value resistance? Well with the "Low Ohms Meter" you can solve those old problems and in fact measure resistance from 100 Ohms down to 0.005 Ohms.
(ETI Nov. 81) ETI 158
Cat. K41580 $34.50

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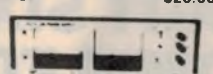
Have your computer print the latest news from the international shortwave news service. Just hook up this project between your short wave receivers audio output and the MicroBee parallel port. A simple bit of software does the decoding. Can be hooked up to other computers too. (ETI Apr. 83)
Cat. $20.00



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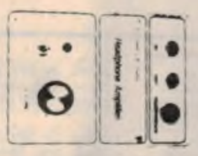
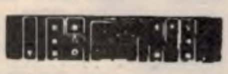
(Ea May June 83) 83PS5
Cat. K83050 $149



HEADPHONE AMPLIFIER
PRACTICE WITHOUT ANNOYING THE FAMILY!
If you play any type of electronic instrument, this headphone amplifier will surely interest you. It will let you practice for hours without upsetting the household or you can use it to monitor your own instrument in the midst of a rowdy jam session. (EA Feb. 84) 83MA11
Cat. K83011 $28.00



150W BASS AMP
This guitar amp for impeccable bass players features many facilities found on expensive "commercial" ones. It delivers 150 watts into 4-ohms, has a t-band graphic limiter, line out and bi-amp facilities.
(ETI Aug. 84) ETI 1410
Cat. K54100 $299

EFFECTS UNIT
An "effects unit" that can create phasing, flanging, echo, reverb and vibrato effects.
(EA June. 83) 83GA6
Cat. K83060 $75.00

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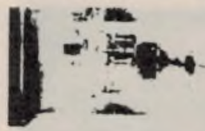
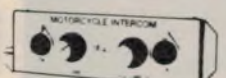
(ETI May 83) ETI 163
Cat. K41630 $175.00



CAR IGNITION KILLER
Most car burgular alarms are easily circumvented, but not this cunning "Ignition Killer". This sneaky antitheft device uses a 555 timer to place an intermittent short circuit across the points. Until disabled by its hidden switch the circuit effectively makes the car undriveable — a sure deterent to thieves! (EA Feb. 84) 84AU1
Cat. K84010 $16.95
(Our kit includes the box!)



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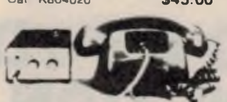
Cat. K804020 $45.00



PHONE MINDER
Dubbed the Phone Minder, this handy gadget functions as both a bell extender and paging unit, or it can perform either function separately. (EA Feb. 84) 84TP2
Cat. K84021 $24.00

MOSFET POWER AMPLIFIER
Employing Hitachi Mosfets, this power amplifier features a "no compromise" design, and is rated to deliver 150 1/2 W RMS maximum and features extremely low harmonic, transient and intermodulation distortion.
(ETI Jan. 81) ETI 477
Cat. K44770 $67.50

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A simple low cost add on for your multimeter. This checks zeners and reads out the zener voltage directly on your multimeter. It can also check LEDs and ordinary diodes.
(ETI May 83) ETI 164
Cat. K41640 $9.50

SLIDE CROSS-FADER
Want to put on really professional slide show? This slide cross-fader can provide smooth dissolves from one projector to another, initiate slide changing automatically from an in-built variable timer, and synchronise slide changes to pre-recorded commentary or music on a tape recorder. All this at a cost far less than comparable commercial units. (EA Nov. 81) 81SS11
Cat. K81110 $85.00

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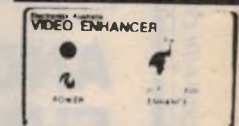
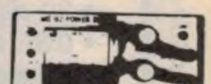
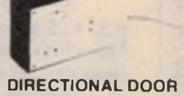


VIDEO ENHANCER
100's SOLD
Like tone controls in a hi-fi amplifier touch up the signal with this Video Enhancer. (EA Oct. 83) 83VE10
Cat. K83100 $35.00



30 V/1 A FULLY PROTECTED POWER SUPPLY
The last power supply we did was the phenomenally popular ETI-131. This low cost supply features full protection, output variation from 0V to 30V and selectable current limit. Both volatage and current metering is provided. (ETI Dec. 83) ETI 162
Cat. K41620 $49.50

ELECTRIC DUMMY LOAD
With this unit you can test power supplies at currents up to 15 Amps and voltage up to 60 Volts. It can "sink" up to 200 Watts on a static test and you can modulate the load to perform dynamic tests.
(ETI Oct. 80) ETI 147
Cat. K41470 $109



DIRECTIONAL DOOR MINDER
Most electronic door minders function by having a beam of light shinning across doorway interrupted, but are incapable of detecting whether the light beam is broken by a person entering or leaving the room, this project overcomes that problem with the aid of digital logic.
(ETI Nov. 84) ETI 278
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A TRUE RMS DIGITAL MULTIMETER FOR UNDER $200!!

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DC Voltage

Range	• 200mV, 2V, 20V, 200V, 1000V
Resolution	• 10uV, 100uV, 1mV, 10mV, 100mV
Accuracy	• 200mV – 1000V ± (0.05%rdg + 3dgt)

AC Voltage: (True RMS. AC coupled 10% to 100% of range)

Range	• 200mV, 2V, 20V, 200V, 750V
Resolution	• 10uV, 100uV, 1mV, 10mV, 100mV
Accuracy	• 200mV – 200V @45Hz 1KHz + (0.5%rdg + 20dgt) @1KHz – 2KHz + (1.2%rdg + 30dgt) @2KHz – 5KHz ± (5.0%rdg + 40dgt) (200V @2KHz – 5KHz not specified) 750V @45Hz – 1KHz ± (1.0%rdg + 20dgt)

DC Current

Range	• 2mA, 20mA, 200mA, 2A, 10A
Resolution	• 100nA, 1uA, 10uA, 100uA, 1mA
Accuracy	• 2mA – 200mA ± (0.3%rdg + 3dgt) 2A-10A + (0.75%rdg + 3dgt)

AC Current: (True RMS. AC coupled 10% to 100% of range)

Range	• 2mA, 20mA, 200mA, 2A, 10A
Resolution	• 100nA, 1uA, 10uA, 100uA, 1mA
Accuracy	• 2mA @45Hz – 400Hz ± (2.5%rdg + 20dgt) 20mA – 200mA @45Hz 400Hz ± (0.75%rdg + 20dgt) @400Hz – 1KHz ± (0.75%rdg + 30dgt) 2A-10A @45Hz – 500Hz + (1.2%rdg + 20dgt)

Resistance

Range	• 200Ω, 2KΩ, 20KΩ, 200KΩ, 2MΩ, 20MΩ
Resolution	• 0.01Ω, 0.1Ω, 1Ω, 10Ω, 100Ω; 1KΩ
Accuracy	• 200Ω ± (0.2%rdg + 5dgt + 0.04Ω) 2KΩ – 200KΩ ± (0.1%rdg + 3dgt) 2MΩ + (0.15%rdg + 3dgt) 20MΩ ± (0.5%rdg + 3dgt)

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Range	• 200mV, 2V, 20V, 200V, 1000V
Resolution	• 100uV, 1mV, 10mV, 100mV, 1V
Accuracy	• 200mV – 1000V ± (0.8%rdg + 1dgt)

AC Voltage

Range	• 200mV, 2V, 20V, 200V, 750V
Resolution	• 100uV, 1mV, 10mV, 100mV, 1V
Accuracy	• 200mV – 750V @45Hz – 500Hz ± (1.5%rdg + 4dgt)

DC Current

Range	• 2mA, 20mA, 200mA, 2A, 10A
Resolution	• 1uA, 10uA, 100uA, 1mA, 10mA
Accuracy	• 2mA – 200mA + (1.25%rdg + 1dgt) 2A-10A ± (2.5%rdg + 3dgt)

AC Current

Range	• 2mA, 20mA, 200mA, 2A, 10A
Resolution	• 1uA, 10uA, 100uA, 1mA, 10mA
Accuracy	• 2mA @45Hz – 400Hz + (4.0%rdg + 2dgt) 20mA – 200mA @45Hz – 400Hz ± (2.0%rdg + 3dgt) 2A – 10A @45Hz – 400Hz + (3.0%rdg + 4dgt)

Resistance

Range	• 200Ω, 2KΩ, 20KΩ, 200KΩ, 2MΩ, 20MΩ
Resolution	• 0.1Ω, 1Ω, 10Ω, 100Ω, 1KΩ, 10KΩ
Accuracy	• 200Ω ± (1.0%rdg + 4dgt) 2KΩ – 2MΩ ± (1.0%rdg + 1dgt) 20MΩ ± (3.0%rdg + 5dgt)

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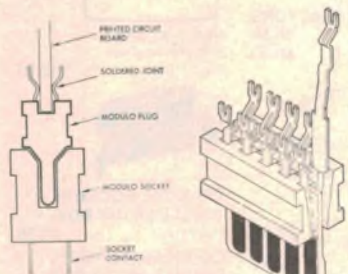

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related, or was it just coincidence?

My impression is that it was coincidence. The 22Ω resistor failed within itself and for no other reason. Similarly, I imagine that Q307 shorted for much the same reason; one of those unpredictable internal failures which occur in solid-state devices from time to time. The failure of Q306 is another matter; it could well have been the result of Q307 going short circuit. And D310? Sorry, I pass.

But all things considered the incident, frustrating though it was, could have been much worse. Suppose the second fault had waited just a few hours more; the set would have been back in the customer's home and would have failed in the middle of his favourite program. And no amount of explanation on my part would have entirely eliminated the suspicion that I didn't fix the original fault in the first place.

So I suppose you must win sometimes.

Burnt PC boards

And to finish off, one of my regular contributors, J.L. of Tasmania, makes a plea for better quality printed boards, supported by a practical example of how some boards turn a simple fault into a complex and very expensive one. He writes:

When printed boards were introduced we thought that most of our servicing problems were over. Board diagrams made it almost possible to trace a fault before the cabinet back came off. Then we began to learn about burnt boards — something unknown in the days of point-to-point wiring. Some of the early boards burnt up without a fault being present; a heavily loaded seven watt resistor was enough to carbonise the board material.

It's a pity that manufacturers haven't used fibreglass boards more often. The few dollars added to the cost of a TV set would be cheap insurance against future service problems. I've never seen a burnt glass board, but I've spent hours trying to clean up burnt phenolic boards.

These musings were inspired by a recent repair to a Sharp C1831X. This involved a burnt board, but with some unusual features. The customer complained that the set was producing intermittent black lines across the screen, and that there was a smell of something burning.

I took the back off, then switched on. The picture was certainly unstable. The black lines were anything from a couple of millimetres to 50mm wide and appeared randomly down the full depth of the screen. While I watched, a thin wisp of smoke rose lazily from the vicinity of the line output board.

Closer examination revealed a half watt resistor burnt into two pieces. It was R915, a 1kΩ unit in series with the end of the tripler overwind. It is located between test points 101 and 102. These test points are used for adjusting the beam current and have no other association with the line output board. Their connection to the relevant part of the circuit is through terminals K924 and K926 via two thin parallel tracks from one side of the board to the other. (The smoke, as I discovered later, was coming from the board.)

In this case the resistor had burned and charred the board underneath. I removed the remains of the resistor and started to clean the board. My scraper went right through and left a 6mm hole with nasty black edges. Further probing opened up one side of the hole into a gap between the two tracks. It finished up over 50mm long and about one and half millimetres wide. It was as neat as if it had been cut with a fret saw.

The unusual nature of the damage called for some explanation. Apart from the hole under the resistor the rest of the damage, apart from obvious carbonising, showed no signs of gross overheating. When resistor R915 opened, the track connected to the overwind went up towards 26kV and, not unnaturally, sparked across to the earthy track. It was the localised heat of the spark that carbonised the board.

Repair was going to be quite an exercise. I couldn't put too much pressure on the scraper for fear of cracking the rest of the board. Eventually I removed all the loose carbon and the remains of the two tracks, but the edges of the cut were still quite black. Then I replaced the resistor and fitted two lengths of insulated wire in place of the missing tracks.

Then I switched on, prepared for smoke and flames, but nothing unusual happened. As long as the new resistor holds together the burnt section of the board will be at ground potential and there should be no more sparks. And just to help things along I sprayed a liberal coat of "Corona-Stop" along the burnt edges on both sides of the board.

I explained to the customer that I had had to make a rather rough repair and warned him that any recurrence of the black lines will call for immediate attention. He is quite happy with this arrangement because the alternative, fitting a new board, would be a very expensive operation.

Thank you, J.L., for a most interesting story. I agree that better quality boards would be cheap insurance in many instances, particularly where high voltages are concerned.

TETIA Fault of the Month

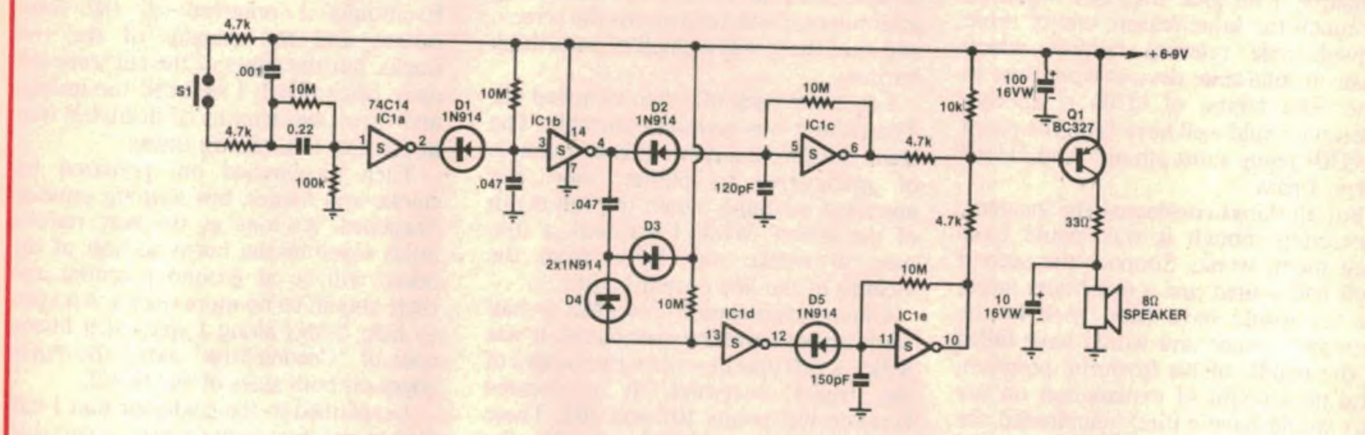
Antenna systems

Symptoms: Weak, snowy pictures (even after replacing antenna, balun and coax cable) in a known good signal area.

Cause: No connection between antenna and balun due to anodised finish on balun mounting lugs. It is thought that this problem only applies to baluns of Taiwanese manufacture.

Circuit & Design Ideas

Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. As a consequence, we cannot accept responsibility, enter into correspondence or provide constructional details.



Ding-dong doorbell

This circuit generates a ding-dong doorbell tone similar to the SAB0600 IC, but for less than half the cost. It also uses a readily available IC, a 75C14 hex Schmitt trigger inverter.

The RC filter network connected to the door button (S1) prevents false triggering. When S1 is pressed, pin 2 of IC1a is pulsed low and discharges the .0047μF capacitor on pin 3 of IC1b. The capacitor now charges via the 10MΩ resistor and, during this time, the output of IC1b will be held high for about 0.5s.

IC1c is wired as an astable but, because IC1b normally holds its input low via D2, it will only oscillate (at around 600Hz) for the 0.5s period when IC1b's output is high. IC1c switches transistor Q1 on and off to drive the loudspeaker at 600Hz.

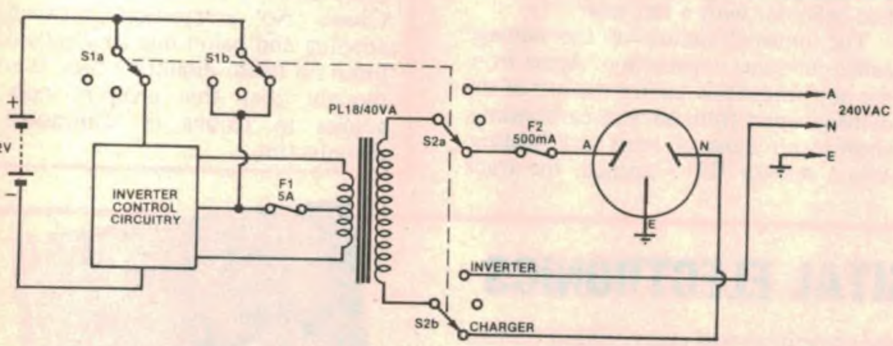
When IC1b's pin 4 goes high, it also discharges the .0047μF capacitor on its output via D3. When pin 4 goes low again, it pulls the input of IC1d low for the time it takes for the capacitor to charge via D4 and its associated 10MΩ resistor (0.5s). During this period, IC1e oscillates at around 400Hz and drives Q1 via a 4.7kΩ resistor.

Thus, the speaker receives a 600Hz signal for 0.5s followed immediately by 0.5s of 400Hz. The 120pF and 150pF capacitors on pins 5 and 11 determine the tone frequencies and could be varied as required. Note that the .022μF capacitor on pin 1 must discharge via its parallel 10MΩ resistor (approx 2s) before the circuit can be retriggered. This is to deter persistent button pushers.

The quiescent current consumption of the circuit is around 2μA, which should provide good battery life.

R. Dannecker,
Rockhampton, Qld.

$20



Inverter modification

This simple switching modification to the 40W inverter (EA, May '82) ensures that the mains input socket, used for the battery charger mode, is completely isolated from the inverter output during normal operation. Additionally, the inverter output can not ride on the mains active in the event of transposed input connections. This situation could occur with an incorrectly wired extension cord or mains outlet.

To perform the required switching, as well as interrupting the connection to the battery, two double pole switches were ganged together. The toggles were joined by folding a piece of 20g aluminium over them.

A. Griffin,
Dee Why, NSW.

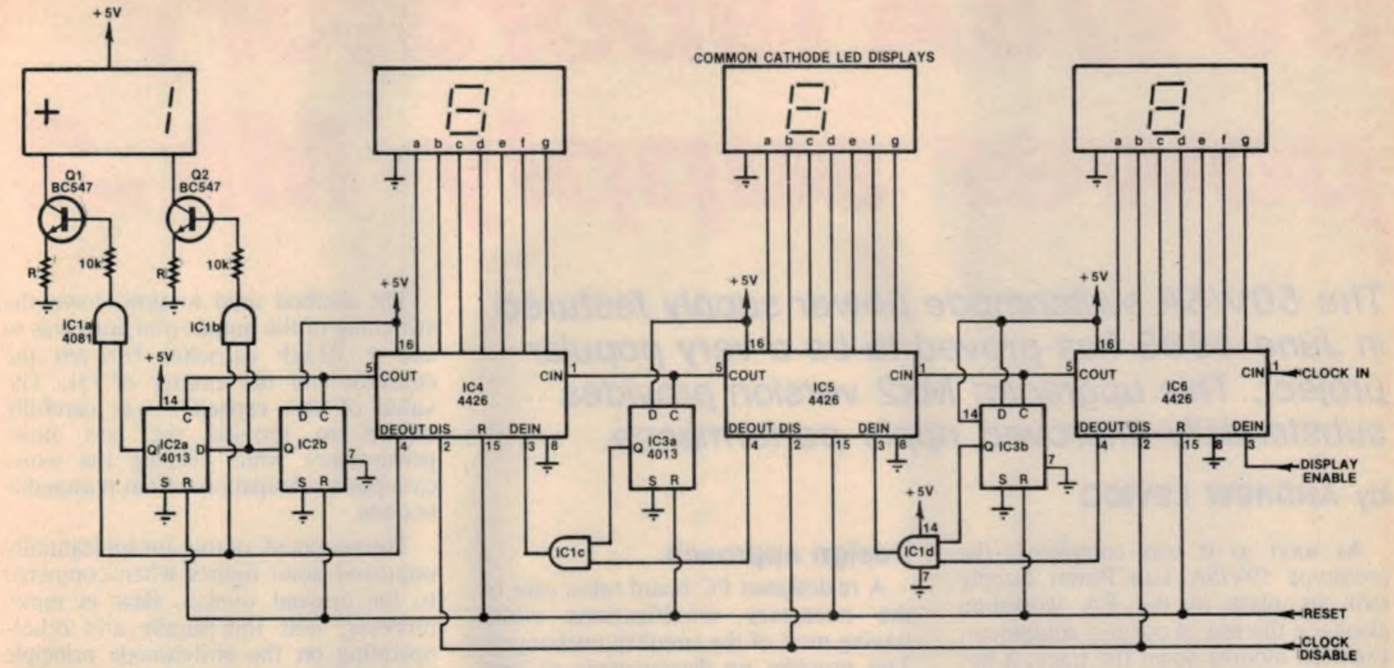
$10

Calibrating meter shunts

When a moving-coil milliammeter is used with a shunt resistor to measure direct current, it is really acting as a millivoltmeter to measure the voltage across the shunt. If the voltage required for FSD (full scale deflection) is known, this can be used to find the value of a shunt for any range.

The voltage required for FSD can be easily found by connecting the meter to a battery with a suitable resistance in series, and then measuring the voltage across the meter with a DVM. For a 1mA meter, a suitable circuit is shown at right.

Any sensitive and accurate DC millivoltmeter can be used instead of a DVM. Trimpot VR1 is used to adjust the meter under test for FSD.



General purpose counter timer

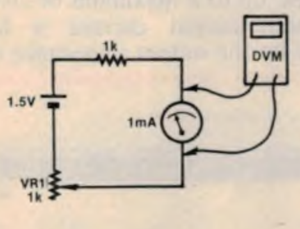
This counter module uses the popular 4426/4026 decade counters with 7-segment outputs. The counter features leading zero suppression, ½ digit count extension and overrange indication (by the + LED). The number of digits may be extended as needed by duplicating the second stage, including the flip-flop and AND gate. The four control lines are the standard counter interface lines.

With the addition of an accurate timebase, eg a 1MHz crystal and a minimum of control circuitry, this counter could be configured as a timer, a frequency counter, a pulse width counter, an event counter, or any other function where a digital counter is required.

The resistors marked R should be selected so that the brightness of the + and 1 indicator LEDs matches that of the digits.

S. Sims,
Darlington, NSW.

$15



Assuming that the voltage across the 1mA meter is 200mV then the shunt required for it to read up to 100mA can be calculated as follows:

Resistance of required shunt

$$= \frac{\text{FSD millivolts of meter}}{\text{(Required FSD — Meter FSD)}}$$

$= 200\text{mV}/(100\text{mA} - 1\text{mA})$

$= 200/99 = 2.02\Omega$

Final calibration should be made against a meter of known accuracy.

J. Emery,
Bull Creek, WA.

$10

Low-cost transistor tester

This simple transistor tester is used to identify the leads and determine the polarity of unmarked transistors.

With most transistor testers, the transistor leads are usually identified by inserting the device in all possible orientations and attempting to make sense of the readings obtained. One of the dangers of this approach is that, under some conditions, quite high currents can flow in the device under test. For the tester described here the maximum current which can flow under any conditions is less than 3mA.

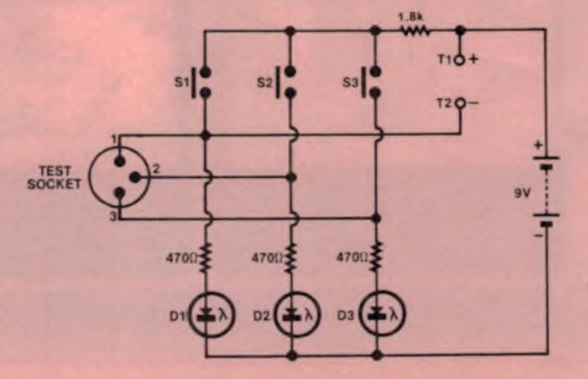
The unit is used as follows: the transistor is connected in any orientation and the switches are momentarily closed one at a time. If the transistor is a PNP type, all the LEDs will light when two of the switches are pressed and one will light for the remaining switch. In this last case, the switch is connected to the base of the transistor.

For NPN transistors, one LED will light when two of the switches are pressed and all three will light when the base switch is pressed.

The two terminals (T1 and T2) allow the unit to function as a simple continuity tester with D1 as the indicator.

W. Spencer,
Camp Hill, Qld.

$15



50V/5A laboratory power supply Mk.2

The 50V/5A switchmode power supply featured in June 1983 has proved to be a very popular project. This upgraded Mk2 version provides substantially improved ripple performance.

by ANDREW LEVIDO

As soon as it was completed, the prototype 50V/5A Lab Power Supply took its place in the EA workshop alongside the rest of our test equipment. Eighteen months down the track, it has more than proved its worth as a basic workhorse supply for project development.

Despite this, one drawback has become apparent. In common with many other switchmode designs, switching spikes on the output can cause problems in certain critical applications. In particular, it is not possible to use the supply with some low noise audio circuits or sensitive RF circuits which have poor power supply rejection.

Based on our experiences, we recently decided to take another look at the circuit to see if matters could be improved. This Mk2 version is the result of our efforts. It rivals all but the best linear designs in terms of noise performance while still retaining the dissipation and cost advantages of a switchmode design.

Design approach

A re-designed PC board takes care of the necessary modifications while leaving most of the circuitry unchanged. This provides no disadvantage to new constructors and, at the same time, allows those who built the original supply to upgrade at minimum cost. Most of the original components are merely transferred to the new board.

Briefly, three steps have been taken to minimise noise on the output. First, an additional low pass filter, consisting of a 120μH inductor and a 1000μF capacitor, has been added. Second, larger output decoupling capacitors have been used than before — 100μF between each supply line and chassis ground.

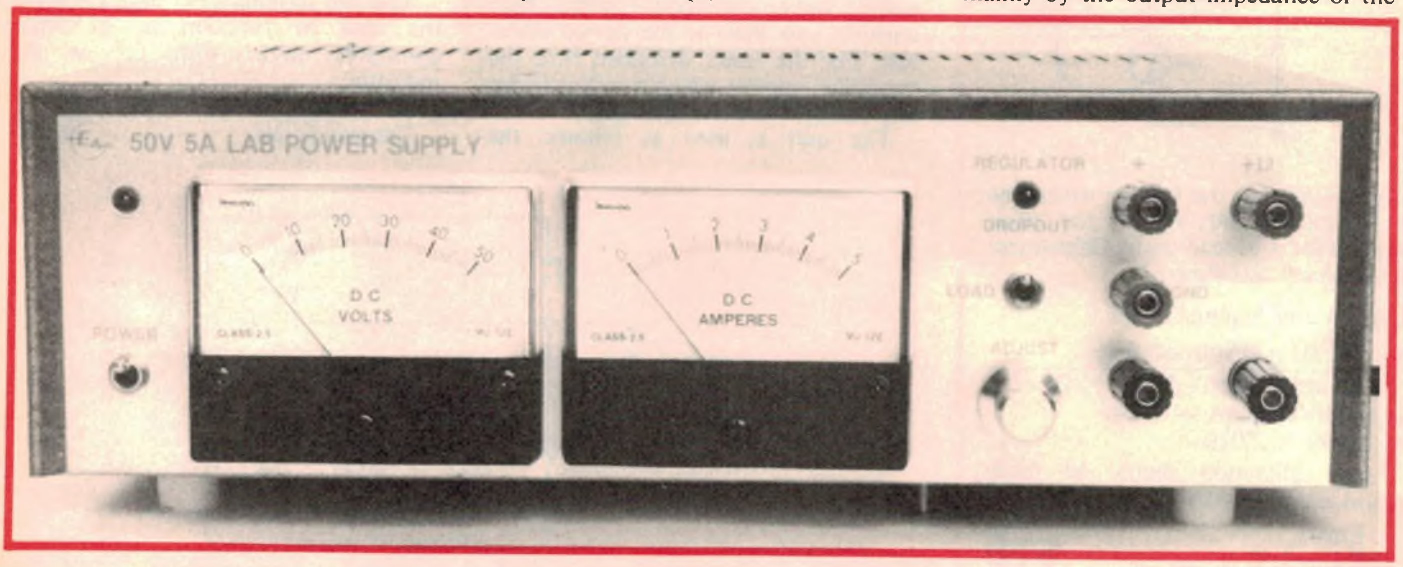
The third modification was an attempt to deal with the problem of switching spikes at the source. Here, the approach was to slow down the operation of driver transistor Q1. This involves something of a compromise between the level of switching spikes and dissipation in the output transistor (Q2).

The method used to slow down the switching of the output transistor was to add a .033μF capacitor between the collector and the emitter of Q1. The value of this capacitor was carefully chosen to provide the best noise performance while keeping the worst case power dissipation within reasonable bounds.

The results of all this are substantially improved noise figures when compared to the original version. Bear in mind, however, that this supply and others operating on the switchmode principle are generally not suitable for extremely critical applications. In particular, there is a possibility that you will have trouble with sensitive RF circuits because of the level of radiated noise emanating from the supply.

This aside, the performance of the Mk2 version is very good for a switchmode design. Under all conditions the noise on the output lines is below 5mV, a typical value being 2mV. For loads greater than about 1A, the noise is below the level of the mains ripple.

For those not familiar with the original project, the specifications panel shows all the relevant details. The supply can deliver anything from 3V to 30V at currents up to 5A. At higher output voltages, up to a maximum of 50V, the maximum output current is limited mainly by the output impedance of the



This front view of the 50V/5A power supply shows all the controls. A 10-turn pot is used to set the output voltage.

transformer and rectifier combined with the maximum duty cycle of the switching regulator. At an output of 45V, for example, the supply can deliver over 1A but this rapidly decreases at voltages up to 50V.

How it works

The first of the two original articles on this power supply, published in the May 1983 issue of *Electronics Australia*, featured a comprehensive explanation of the switchmode principle, as well as extensive details on the operation of the μA494 switchmode IC. That explanation still holds good for the updated version of the power supply and so has not been repeated here. However, a general description of the circuit operation is in order.

The basic "power plant" of the power supply consists of a 35V/5A transformer, a 10A bridge rectifier and a pair of 4000μF filter capacitors. These components are connected in the standard configuration, with the two transformer windings being connected in parallel to obtain the required current rating. A 5.6kΩ/1W bleed resistor is connected across the filter capacitors.

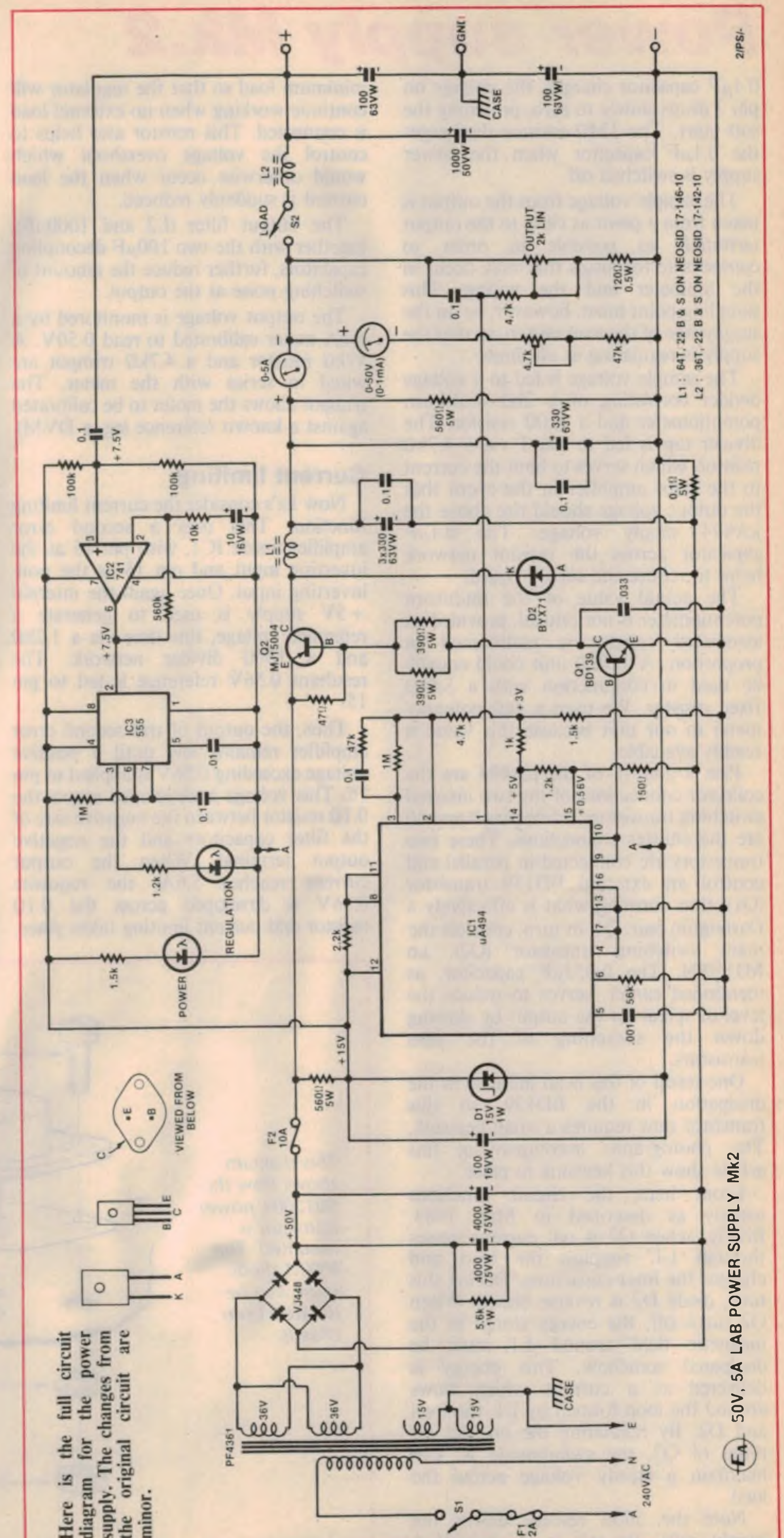
A 10A fuse protects this part of the system and is followed by a simple voltage regular consisting of zener diode D1 and a 560Ω resistor. This network provides a +15V rail for the integrated circuits used in the supply. The main positive line goes on to the switching transistor, Q2, then via a 0.7mH inductor, an ammeter and a 120μH inductor to the output terminal.

The heart of the regulator system is IC1, the μA494 switchmode regulator IC. This IC requires only two external components to set the frequency of an internal oscillator which provides the basic switching function. In this circuit a 56kΩ resistor and a .001μF capacitor are used to give a nominal switching frequency of 20kHz.

Pins 1 and 2 are the inputs for the internal error amplifier. If a reference voltage is applied to pin 2 and a sample of the output voltage to pin 1, the regulator will adjust the output until the two voltages match.

The reference voltage is obtained via the voltage divider consisting of the 1kΩ and the 1.5kΩ resistors from the +5V regulated source which appears at pin 14. The network between pins 2 and 3 is used to provide the power supply with a "soft start" facility.

This works as follows: at the instant of switch on, the reference voltage will be applied to pin 3 because the 0.1μF capacitor initially appears to be a short circuit. This voltage ensures that the switching transistor remains off. As the



Here is the full circuit diagram for the power supply. The changes from the original circuit are minor.

Power supply Mk.2

0.1μF capacitor charges, the voltage on pin 3 drops slowly to zero, providing the soft start. The 1MΩ resistor discharges the 0.1μF capacitor when the power supply is switched off.

The sample voltage from the output is taken from a point as close to the output terminals as possible in order to compensate for losses that may occur in the ammeter and the wiring. This sampling point must, however, be on the supply side of the load switch, so that the supply is regulating at all times.

The sample voltage is fed to a voltage divider consisting of a 2kΩ multiturn potentiometer and a 120Ω resistor. The divider tap is fed to pin 1 via a 4.7kΩ resistor, which serves to limit the current to the error amplifier in the event that the output voltage should rise above the μA494 supply voltage. The 0.1μF capacitor across the resistor network helps to reduce the supply ripple.

The actual value of the multiturn potentiometer is not critical, provided its associated resistor is maintained in proportion. A 100kΩ unit could equally be used in conjunction with a 5.6kΩ fixed resistor. We used a 2kΩ potentiometer in our unit because this value is readily available.

Pins 8 and 11 of the μA494 are the collector connections of the two internal switching transistors, while pins 9 and 10 are the emitter connections. These two transistors are connected in parallel and control an external BD139 transistor (Q1), thus forming what is effectively a Darlington pair. Q1, in turn, controls the main switching transistor (Q2), an MJ15004. The 0.033μF capacitor, as mentioned earlier, serves to reduce the level of spikes on the output by slowing down the switching of the pass transistors.

One result of this is an increase in the dissipation in the BD139, so this transistor now requires a small heatsink. The photographs accompanying this article show this heatsink in place.

From here, the circuit functions exactly as described in May 1983. Briefly, when Q2 is on, current passes through L1, supplies the load and charges the filter capacitors. During this time, diode D2 is reverse biased. When Q2 turns off, the energy stored in the magnetic field around L1 must be dissipated somehow. This energy is delivered as a current which flows around the loop formed by L1, the load and D2. By regulating the on and off times of Q2, the switchmode IC can maintain a steady voltage across the load.

Note the 560Ω resistor across the supply rails. Its job is to provide a minimum load so that the regulator will continue working when no external load is connected. This resistor also helps to control the voltage overshoot which would otherwise occur when the load current is suddenly reduced.

The output filter (L2 and 1000μF), together with the two 100μF decoupling capacitors, further reduce the amount of switching noise at the output.

The output voltage is monitored by a 1mA meter calibrated to read 0-50V. A 47kΩ resistor and a 4.7kΩ trimpot are wired in series with the meter. The trimpot allows the meter to be calibrated against a known reference (eg, a DVM).

Current limiting

Now let's consider the current limiting function. This uses a second error amplifier inside IC1, with pin 15 as the inverting input and pin 16 as the non-inverting input. Once again the internal +5V supply is used to generate a reference voltage, this time via a 1.2kΩ and a 150Ω divider network. The resultant 0.56V reference is fed to pin 15.

Thus, the output of this second error amplifier remains low until a positive voltage exceeding 0.56V is applied to pin 16. This voltage is developed across the 0.1Ω resistor between the negative side of the filter capacitors and the negative output terminal. When the output current reaches 5.6A, the requisite 0.56V is developed across the 0.1Ω resistor and current limiting takes place.

Loss of regulation

Another useful feature of this power supply is the loss of regulation indicator. Loss of regulation normally occurs as the power supply is approaching the limit of its current capacity, but before actual current limiting occurs. It is not possible to tell by meter readings alone that this state is being approached.

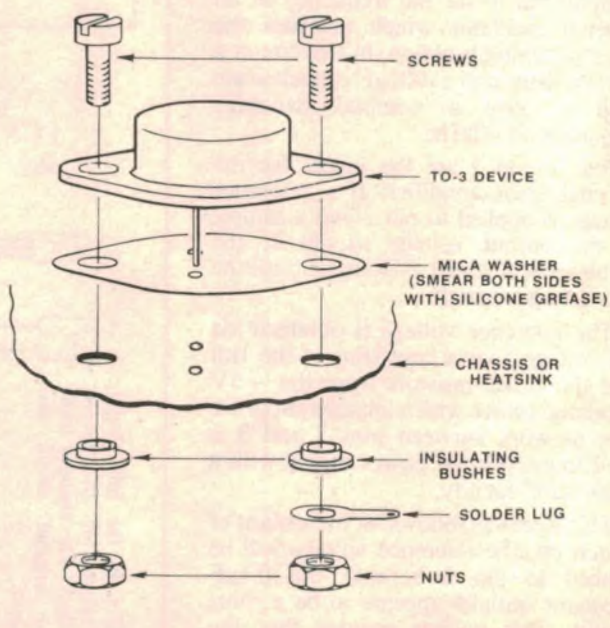
The indicator works by sensing the ripple content of the output voltage. When fully regulating, the ripple content is in the region of 20mV peak-to-peak at 100Hz. This increases quite dramatically and suddenly when the circuit drops out of regulation.

The regulation indicator consists of op amp IC2, monostable IC3, and a LED indicator. The amplifier is configured to have a gain of 56 and a low frequency rolloff at 10Hz. The input to the amplifier is biased at half the supply voltage by two 100kΩ resistors. This means that the output of the op amp will also be at half the supply voltage with the amplified ripple voltage superimposed on it.

When the ripple voltage is low, meaning that the supply is in regulation, the output of the op amp does not swing low enough to trigger the monostable. However, should the level of ripple exceed about 90mV, the monostable will be triggered and the LED will light. This will continue for as long as the high level of ripple remains.

A 1MΩ resistor and a 0.1μF capacitor set the monostable period to about 0.1 seconds. Thus, the LED will also flash briefly if the supply momentarily loses regulation when connected to a heavy load.

This diagram shows how the MJ15004 power transistor is mounted. The BYX71 diode must also be isolated from chassis.



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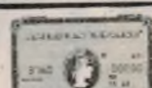


Power supply Mk.2

Construction

Construction details depend largely on whether you are building this supply for the first time or whether you are simply upgrading an existing supply. In either case, a new PC board will have to be assembled so this is a good place to start.

The new board is coded 85ps5 and measures 145 x 109mm which is slightly larger than the original board. Mount all the parts on the board in accordance with the wiring diagram, but do not mount the inductors at this time. Note carefully the orientation of the semiconductors and the electrolytic capacitors.

If you have already built this supply you can transfer the parts that you already have to the new board. You will, of course, have to purchase the additional components. Don't forget the heatsink on Q1. A 20 x 40mm piece of aluminium will do the job quite nicely.

Note that the four 5W resistors must be mounted two or three millimetres proud of the board to allow adequate air circulation around them.

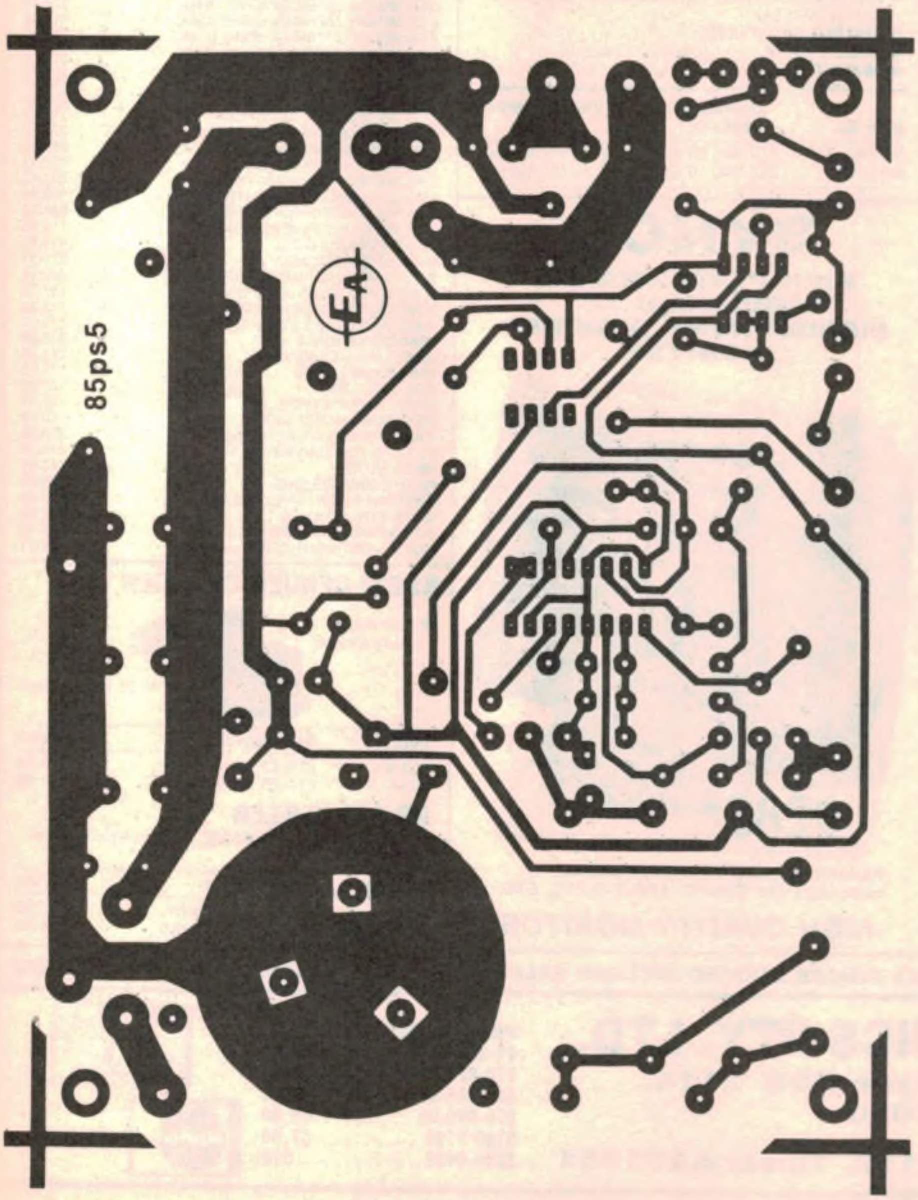
The two inductors are wound on iron powder toroids from the Neosid range. The main inductor, L1, is made by winding 64 turns of 1mm (22 B&S) enamelled copper wire onto the larger of the two toroids. This is designated 17-146-10. The other inductor (L2) consists of 36 turns of the same type of wire on the smaller 17-143-10 toroid. You will require about 3.5m of wire for L1 and about 1.5m for L2.

Terminate the start and finish of each winding by twisting the ends together for half a turn. The ends can then be trimmed and cleaned of insulation and the toroids mounted on the PC board. The toroids are secured using U-shaped pieces of tinned copper wire soldered to several pairs of anchor points.

If you have already built the power supply the next section of the constructional details can be ignored. Simply remove all the existing wiring after the main filter capacitors, mount the new PC board and move on to the wiring stage. Others will have to prepare the metalwork.

Spray the Scotchcal label with clear lacquer, then carefully affix it to the front panel. The chassis can now be drilled to accept the various parts using the wiring diagram and the Scotchcal label as a guide.

The meter cutouts can be made by drilling a series of small holes around the perimeter of each cutout and then filing to a smooth shape. Deburr all mounting holes before mounting the hardware on



PARTS LIST

- 1 K&W instrument case, 305 x 205 x 95mm (W x D x H)
- 1 Scotchcal label, 302 x 90mm
- 1 PCB, code 85ps5, 145 x 109mm
- 1 power transformer, Ferguson PF4361
- 2 SPDT toggle switches
- 3 binding post terminals
- 1 Minipa MU-52E 5A FSD meter, 75 x 65mm
- 1 Minipa MU-52E 1mA FSD meter, 75 x 65mm
- 1 0-50V meter scale
- 1 Neosid 17-146-10 iron powder toroid
- 1 Neosid 17-143-10 iron powder toroid
- 5 metres 1mm enamelled copper wire
- 1 mains cord and plug
- 1 3-way terminal block
- 1 cord clamp
- 1 grommet
- 2 3AG fuse holders
- 1 2A fuse
- 1 10A fuse
- 4 cable ties
- 2 heavy duty solder lugs
- 4 12mm tapped spacers
- 1 TO-3 mica washer
- 1 TO-220 mica washer
- 3 insulating bushes
- 1 TO-3 plastic cover

Semiconductors

- 1 uA494 switchmode IC
- 1 741 op amp
- 1 555 timer
- 1 BD139 NPN transistor
- 1 MJ15004 PNP transistor
- 1 15V 1W zener diode
- 1 VJ448 bridge rectifier
- 1 BYX71 fast recovery diode
- 2 red LEDs with mounting bezels

the chassis. We used red, green and black binding posts for the positive, ground and negative terminals respectively.

Heatsinking requirements for the MJ15004 transistor and the BYX71 diode are met by mounting them on the rear panel. Note that both components must be electrically isolated from the chassis using mica washers and insulating bushes. Before mounting each component, check that the contact area is free of metal burrs and smear both sides of the mica washers with heatsink compound.

Finally, use your multimeter to check that the transistor and diode are indeed isolated from the chassis. The accompanying diagram shows the transistor mounting details. We strongly recommend that you fit the transistor with a plastic TO-3 cover to prevent accidental shorts to chassis.

The mating surface of the VJ448 bridge rectifier should also be smeared

Capacitors

2 4000μF 75VW chassis mounting electrolytics
1 1000 50VW PC electrolytic
4 330μF 63VW PC electrolytics
2 100μF 63VW PC electrolytics
1 100μF 16VW PC electrolytic
1 10μF 16VW PC electrolytic
6 0.1μF polyester
1 .033μF polyester
1 .01μF polyester
1 .001μF polyester

Resistors (0.25W, 5% unless stated)
2 x 1MΩ, 1 x 560kΩ, 2 x 100kΩ, 1 x 56kΩ, 2 x 47kΩ, 1 x 10kΩ, 1 x 5.6kΩ/1W, 2 x 4.7kΩ, 1 x 2.2kΩ, 2 x 1.5kΩ, 2 x 1.2kΩ, 1 x 1kΩ, 2 x 560Ω/5W, 2 x 390Ω/5W, 1 x 150Ω, 1 x 120Ω 0.5W, 1 x 47Ω, 1 x 0.1Ω/5W, 1 x 4.7kΩ large vertical trimpot, 1 x 2kΩ multiturn potentiometer.

Miscellaneous
Rainbow cable or light duty hookup wire, heavy duty cable, mains rated cable, machine screws and nuts, scrap aluminium, sleeving, etc.

Parts to update existing supply

1 PC board, code 85ps5, 145 x 109mm
1 Neosid 17-143-10 iron powder toroid
2 metres 1mm enamelled copper wire
1 1000μF 50VW PC mounting electrolytic capacitor
2 100μF 50VW PC mounting electrolytic capacitor
1 .033μF polyester capacitor

Power supply Mk.2

with heatsink compound. It is then bolted directly to chassis using a machine screw and nut. Orient the bridge as shown in the wiring diagram.

One other component which needs to be mentioned is the 560Ω bleed resistor across the output capacitors. This will get quite hot at the higher voltage settings and should be mounted on the bottom of the box to give it some heatsinking. It is held in place using a simple clamp fashioned from scrap aluminium.

The PC board is mounted in the chassis using four 12mm tapped spacers. The spacers can be mounted, but the board should not be screwed down until the wiring is complete.

Heavy duty wiring

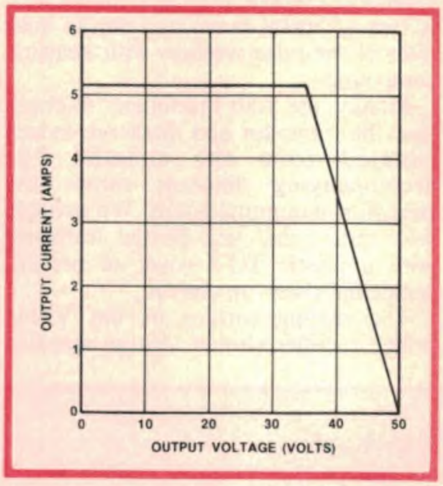
Rainbow cable or light duty hookup wire can be used for the following connections: to the LEDs, potentiometer and voltmeter; between the emitter of Q2 and the PC board; between the base of Q2 and the PC board; and between the load switch and the potentiometer. All other wiring must use heavy duty 32 x 0.2mm cable rated at 10A.

The mains cord passes through a grommeted hole in the rear of the chassis and is anchored with a cord clamp. Terminate the mains cable as shown in the wiring diagram, not forgetting to solder the earth wire directly to the solder lug near the transformer. Complete the mains wiring using cable rated for operation at 250VAC. Sleeve the switch terminals to reduce the possibility of accidental contact with the mains.

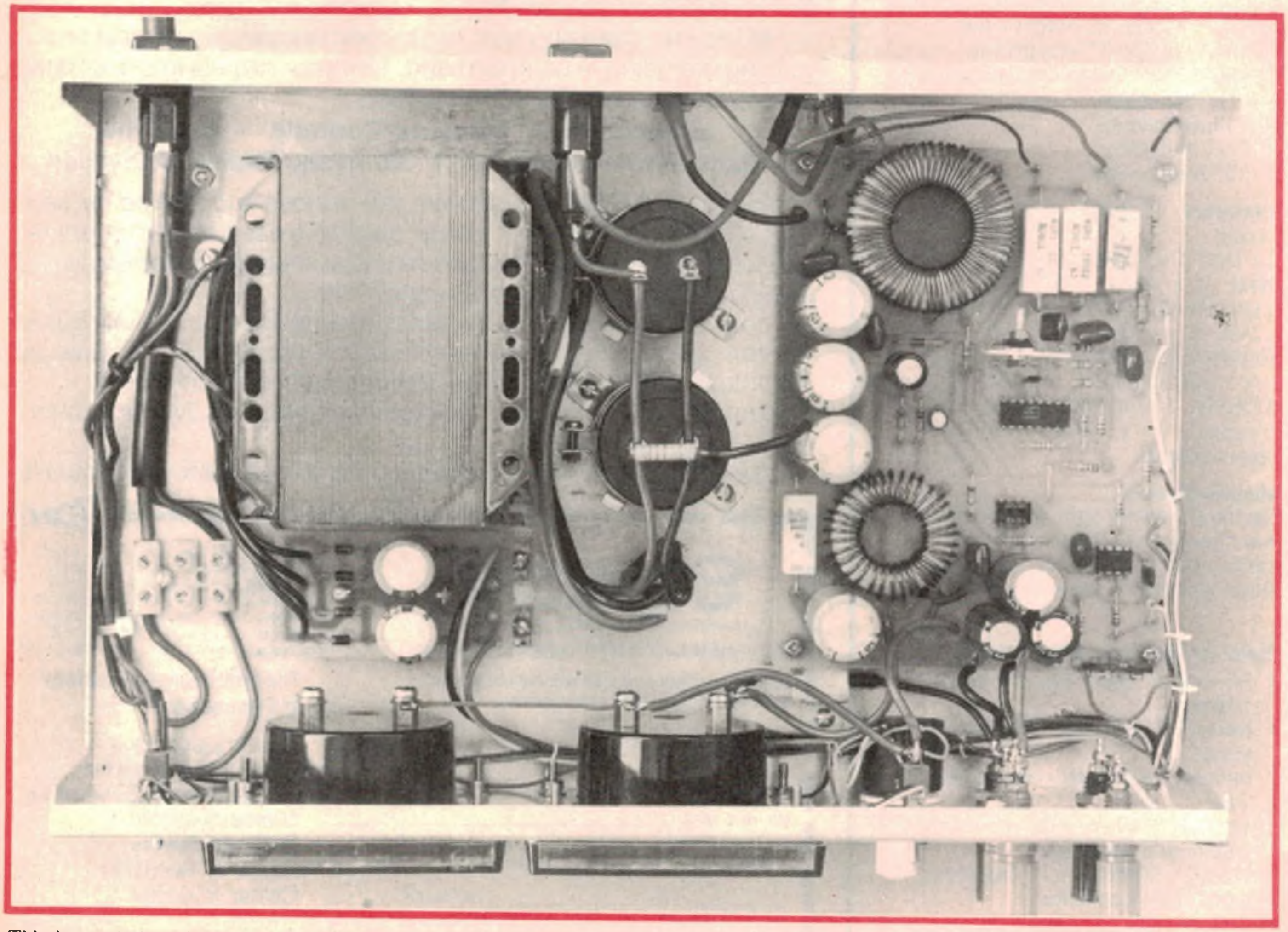
The transformer specified for this project is the Ferguson PF4361 and, in addition to the required 36V windings, also features two 15V windings. Since these windings are between the primary and the 36V secondaries, they are connected in series and the centre tap earthed to provide an electrostatic shield. This should lessen the possibility of supply "hash" being radiated via the mains wiring. It is also a useful safety measure in the unlikely event that the transformer should break down.

Testing

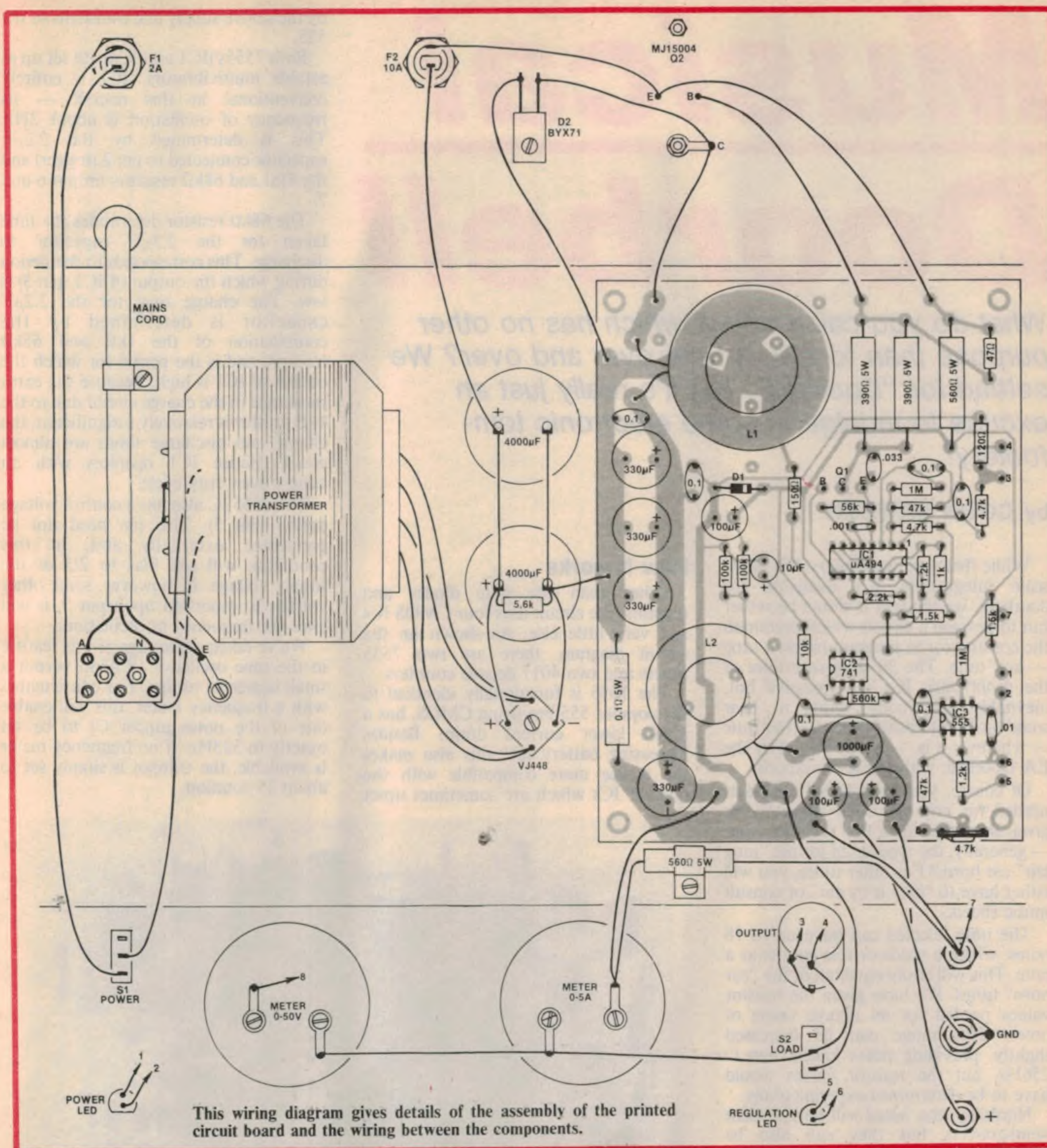
When the wiring is complete, make a final check that all is correct and apply power. Connect your multimeter across the output and check that the output voltage can be varied between 3V and 50V DC. Adjust the 4.7kΩ trimpot so that the voltage reading on the power supply corresponds with that on your multimeter.



The above diagram shows the voltage regulation curve.



This internal shot clearly shows the new printed circuit board. Note the new inductor and the heatsink on Q1.



This wiring diagram gives details of the assembly of the printed circuit board and the wiring between the components.

The current limiting function can be checked by connecting a 1Ω resistor across the output and slowly advancing the output control. The voltage across the resistor should limit at about 5.6V and the regulation LED should light. A 5W resistor should suffice for this short-term test, although it may become rather "red in the face".

Finally, it is possible to use the 15V windings on the transformer to provide additional fixed ±12V rails. Full details were published in the July 1983 issue.

Specifications

Output voltage	3-50V DC
Output current	5A max (0-35V)
Maximum output power	175W
Noise and ripple	Less than 5mV at all settings; 2mV typical
Regulation at full load	0.6% at 20V; 0.4% at 35V.

Musical Doorbell

What do you call a circuit which has no other purpose than to play a tune over and over? We settled for "Doorbell", but it's really just an excuse to indulge in some electronic tom-foolery!

by COLIN DAWSON

While there are proprietary LSI (large scale integration) ICs available for doorbells, we thought it would be rather fun to develop a circuit which permitted the constructor to program his own tune — any tune. The 30 song repertoire of the proprietary ICs is impressive but, inevitably, everybody wants to hear some tune that's not included. That tune — whatever it is — can be played by the EA Doorbell, with a few limitations.

Of course, you must know the notes needed for any particular tune. We've given the notes for a few popular tunes — generally, the types used for the "mug lair" car horns! For other tunes, you will either have to "play it by ear" or consult music sheets.

The tune selected can have up to 18 notes, where a space or rest counts as a note. This will easily cover all of the "car horn" tunes. We have given the resistor values needed for an octave range of notes. This range can be increased slightly, providing notes lower than C 256Hz, but the resistor values would have to be determined experimentally.

Normally, the notes will be half beat (semi-quaver), but they can also be extended to a full beat (quaver). Additionally, any note can be left blank, corresponding to a "reset" in the music. Each short note requires a diode to be inserted at the appropriate position and an extra diode is needed to extend a note.

The actual note played at each beat is determined by the value of a "note resistor" inserted at each position. Table 1 indicates the value of resistor needed to produce each note over the octave range. The tunes listed are most suitable for the strident (dare we say irritating?) sound of the Doorbell.

How it works

Other than the note diodes and resistors, the circuit uses four CMOS ICs and very little else. As shown on the circuit diagram, there are two 7555 timers and two 4017 decade counters.

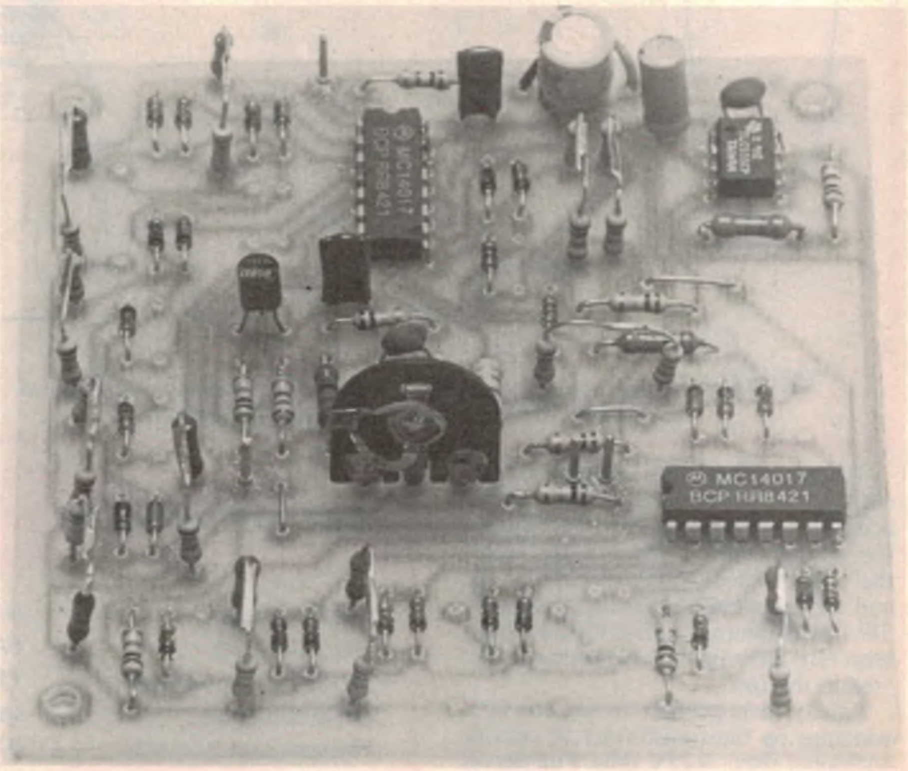
The 7555 is functionally identical to the popular 555 but being CMOS, has a much lower current drain. Besides increasing battery life, this also makes the device more compatible with the counter ICs which are sometimes upset by the severe supply line transients of the 555.

Both 7555s (IC1 and IC4) are set up as astable multivibrators. IC1 is entirely conventional in this respect — its frequency of oscillation is about 2Hz. This is determined by the 2.2μF capacitor connected to pin 2 (trigger) and the 1kΩ and 68kΩ resistors on pin 6 and 7.

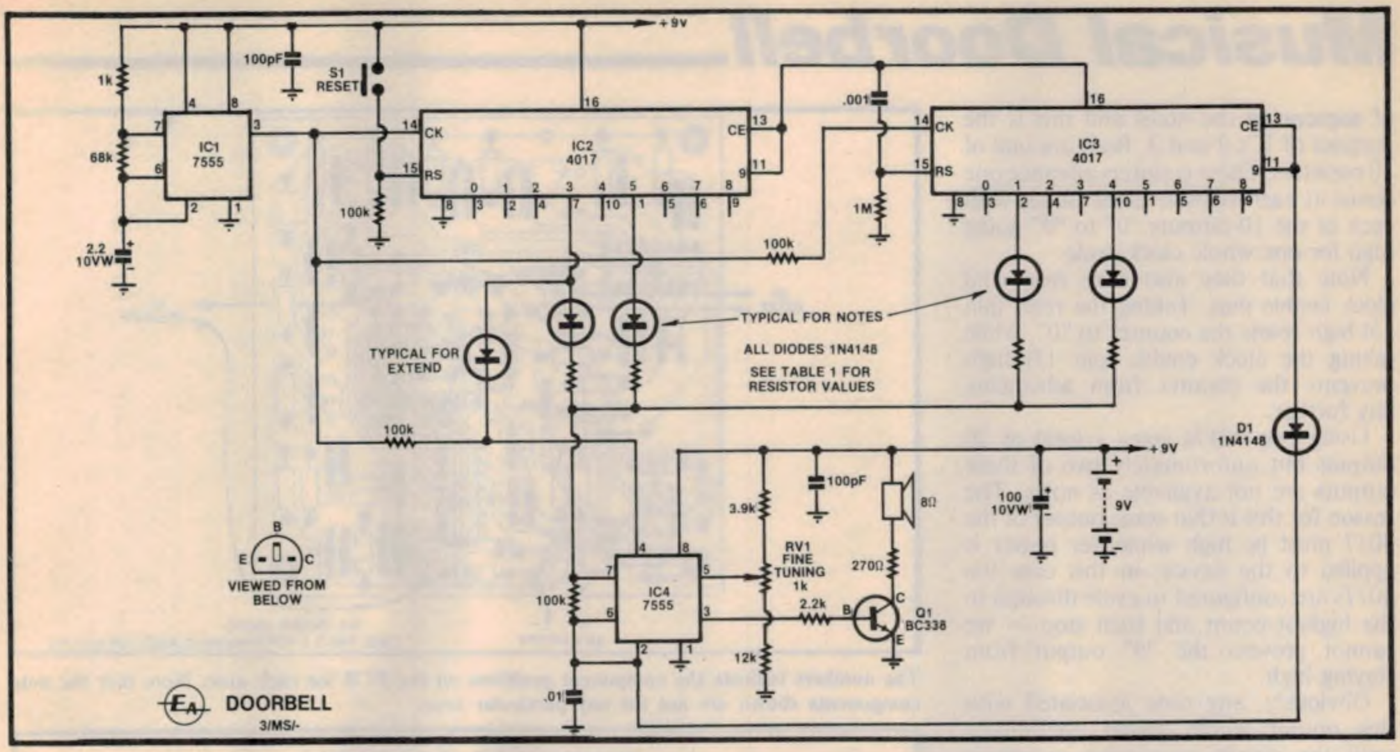
The 68kΩ resistor determines the time taken for the 2.2μF capacitor to discharge. This corresponds to the period during which the output of IC1 (pin 3) is low. The charge time for the 2.2μF capacitor is determined by the combination of the 1kΩ and 68kΩ resistors and is the period for which the output of IC1 is high. Because the extra resistance in the charge circuit due to the 1kΩ resistor is relatively insignificant, the charge and discharge times are almost equal. Hence IC1 operates with an almost even duty cycle.

The 7555 IC also has a control voltage option (pin 5). This pin need not be connected externally and, in this condition, will self bias to 2/3 of the supply voltage. If, however, some other voltage is impressed upon pin 5, it will alter the frequency of oscillation.

We've taken advantage of this feature in the tone oscillator (IC4) to permit a small degree of tuning. For constructors with a frequency meter, this will enable one of the notes (upper C) to be set exactly to 523Hz. If no frequency meter is available, the trimpot is simply set to about ⅓ rotation.



For some notes, two resistors will have to be connected in series to achieve the exact value.



Only four "note" components and one extend diode are shown here for clarity. Most tunes will need many more note components.

While it is not important for the various notes to be exactly on frequency, they must have the correct relationship. In fact, the upper C need only be set to somewhere between 510Hz and 535Hz. RV1 provides a range of about 480Hz to 540Hz but tuning to either extreme should be avoided.

Construction

Since the circuit is something of an experimenter's special, we've not bothered to mount it in a box. We'll leave it to readers to sort out their own details, although a standard aluminium case (127 x 102 x 76mm) should do the job quite nicely.

Most of the parts are mounted on a small PC board coded 85ms4 and measuring 92 x 94mm. Begin by installing all those parts not actually related to setting the tune. Take care when installing the semiconductors and the electrolytic capacitors.

The parts overlay diagram shows a sequence of numbers from one to 18. These correspond to the 18 possible notes which can be set using the diodes and the note resistor. In each case, the number is adjacent to the two diode positions. The resistor may be some distance away from the number but can be easily traced on the pattern.

Having decided on a tune, install the appropriate diodes and resistors at the numbered positions. To begin with, use only one diode for each note, even if you intend to "extend" the note later. Make sure that your test tune has more than 10 notes so that you can test IC3 as well.

Note that the diodes and resistors shown in position on the parts layout diagram are representative only.

The construction can now be completed by wiring in the speaker, reset switch and battery clip. Finally, set RV1 to one third rotation and connect a 9V battery — you should be greeted with the tune (or sounds) of your choice. For a replay, press the reset switch.

If you intend calibrating the circuit, insert a 10kΩ note resistor at the "1" position, along with both diodes. Now short the reset switch terminals together using a clip lead — this will hold the circuit permanently on the first note.

A frequency meter can now be connected to the output of IC4 and RV1 set for a reading of 523Hz. If you're really keen, swap the 10kΩ resistor for a 195kΩ (180kΩ + 15kΩ in series). This will give the lower C which should be 262Hz. If this value is incorrect by more than a few Hz, yet the upper C is correct, component tolerances have affected the tuning of your circuit. In this case, try changing the .01μF timing capacitor associated with IC4.

IC4 operates in the same way as IC1 except that its frequency is not fixed. It does not have a single resistor connected between pin 7 and the positive supply line. Instead, there are a number of resistors, with each selected in turn by the 4017 decade counters to provide the different notes.

Where the resistor value needed for a specific note is not readily available, it can be obtained by connecting two common resistors in series. Table 1 indicates the most practical values.

The output of IC4 (pin 3) is buffered by Q1 (a BC338) and then used to drive a loudspeaker.

Note the resistor connected in series with the 8Ω speaker. We have indicated a value of 270Ω, but this can be altered. For more volume, reduce the value but don't go below 100Ω. To increase the battery life and reduce the volume, the resistor can be increased.

Obviously, there has to be some way

Parts List

- 1 PC board, code 85ms4, 92 x 94mm
- 1 SPST momentary contact switch
- 1 9V battery, Eveready 216 or equivalent
- 1 clip to suit battery
- 1 8Ω loudspeaker

Semiconductors

- 2 7555 CMOS timer ICs
- 2 4017 CMOS decade counter ICs
- 37 1N4148 diodes (see text)

Capacitors

- 1 100μF 10VW PC electrolytic
- 1 2.2μF 10VW PC electrolytic
- 1 .01μF metallised polyester (greencap)
- 1 .001μF greencap
- 2 100pF ceramic

Resistors (0.25W, 5%)

1 x 1MΩ, 4 x 100kΩ, 1 x 68kΩ, 1 x 12kΩ, 1 x 3.9kΩ, 1 x 2.2kΩ, 1 x 1kΩ, 1 x 270Ω, 1 x 1kΩ 10mm vertical trimpot

Miscellaneous

Note setting resistors as required (see examples), hookup wire, solder, etc.

Musical Doorbell

of sequencing the notes and this is the purpose of ICs 2 and 3. Both are one of 10 counters. These counters advance one count at each positive clock pulse, with each of the 10 outputs "0" to "9" going high for one whole clock cycle.

Note that they also have reset and clock enable pins. Taking the reset (pin 15) high resets the counter to "0", while taking the clock enable (pin 13) high prevents the counter from advancing any further.

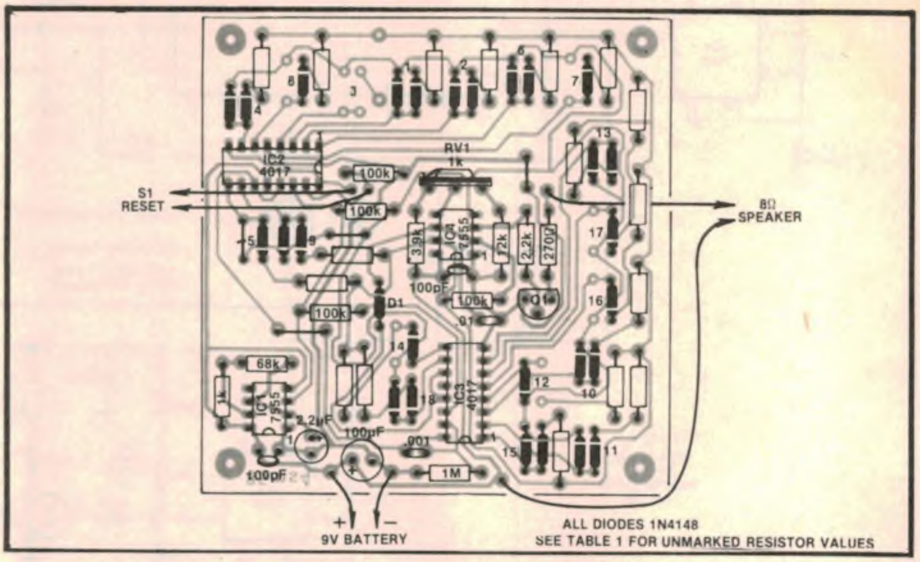
Using two 4017s gives a total of 20 outputs but unfortunately two of these outputs are not available as notes. The reason for this is that some output of the 4017 must be high whenever power is applied to the device; in this case the 4017s are configured to cycle through to the highest count and then stop — we cannot prevent the "9" output from staying high.

Obviously, any note associated with this output would sound continually until the circuit were reset or power removed. Hence the two "9" outputs are used as silent "wait" positions.

The two counters are arranged to count sequentially; ie, IC3 begins to count only after IC2 has finished its cycle. Since IC3 cannot reach the silent "9" count until the completion of its cycle, this creates another problem; how do we prevent the "0" count of IC3 from sounding a note until required? The solution is to prevent power from reaching IC3 until the appropriate time.

Rather than simply connecting pin 16 of IC3 to the positive supply line, we have connected it to the "9" output of IC2. This provides power to IC3 only after IC2 has completed its counting sequence. To ensure that IC3 is initially at the "0" count when power is applied to it, a "power on reset" circuit consisting

Continued on page 116

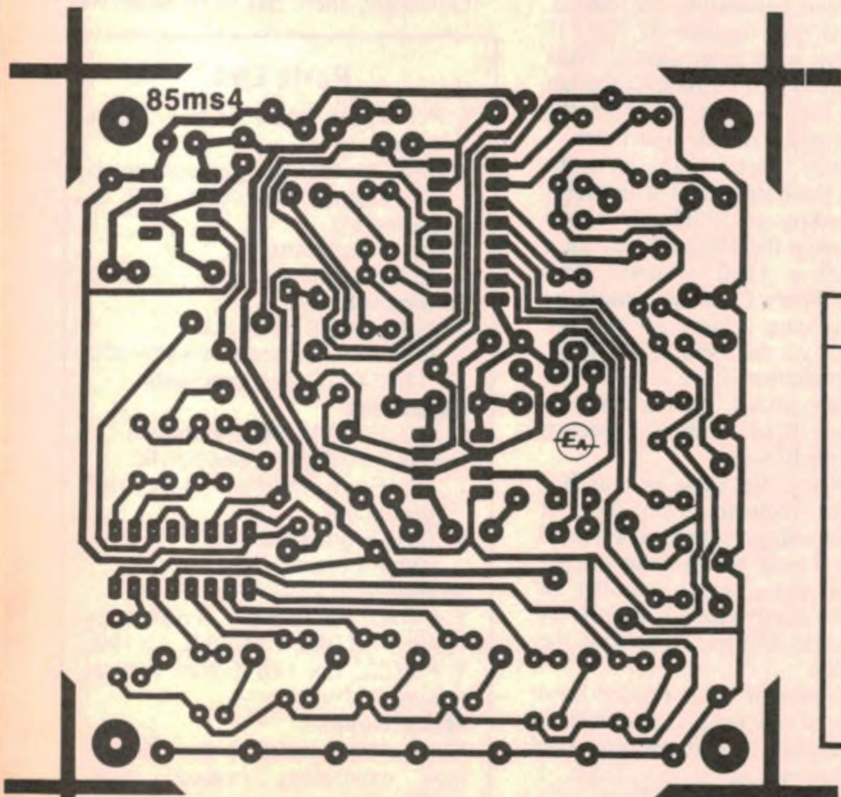


The numbers indicate the component positions on the PCB for each note. Note that the note components shown are not for any particular tune.

TUNES FOR DOORBELL

Beethoven's Fifth: F F F DX P E E E CX
Dixieland: G C E D C A CX P AX D AX D
La Cucarachia: C C C E GX P C C E E G
Colonel Bogey: D#X CX S CX C# DX C C G#X D#X CX S CX C# CX D# D# C#X
(P = pause, X = extended note)

Here are four tunes particularly suited to the doorbell.



Here is the actual size PCB artwork.

Table 1: Resistor values

Note	Frequency (Hz)	Resistor (kΩ)
C	262	195 (180 + 15)
C#	277	172 (150 + 22)
D	294	150
D#	311	135 (120 + 15)
E	330	120
F	349	100
F#	370	86.7 (82 + 4.7)
G	392	72 (50 + 22)
G#	415	56
A	440	43.7 (39 + 4.7)
A#	466	33
B	494	20
C	523	10

Right and wrong ways to

Many readers of this magazine must surely have had the experience of investing in a new piece of equipment, only to find that, for one reason or another, the user manual or instruction book supplied with it is difficult to read or comprehend. Much of the enthusiasm that prompted the original purchase can quickly give place to frustration and annoyance.

FORUM

Conducted by Neville Williams

Perhaps I should emphasise, right at the outset, that I am talking specifically about user manuals or instruction books (or pamphlets) — the kind of thing normally provided to help purchasers understand and use a particular product.

I am not concerned here with the provision or availability of service manuals, for use by servicemen or others in tracing technical faults. This matter was raised in an editorial some years ago by our then Editor, Jim Rowe, and it triggered an argument of which even Leo Simpson might, these days, have been proud! But that's another subject.

Getting back to user manuals or instruction books, if one had to list complaints about them under specific headings, those that come immediately to mind include:

(1) "Japanese" English;
(2) Over-use of jargon;
(3) Inaccurate information;
(4) Basically wrong approach.

The notion of "Japanese English" is now so familiar to readers of trade and technical journals, that the term might almost be said to have entered our language.

These days, it's probably a somewhat unfair expression, because (a) the Japanese are by no means the only offenders and (b) major Japanese suppliers to the consumer market seem now to have got their act together fairly well, not only in respect to English, but also (to them) an assortment of other foreign languages.

It would probably be fairer to think in terms of "Asian English". Even so, the Japanese manufacturer of a BICOH car cassette player/converter was responsible for the following effort, which can serve as an example of what I have in mind:

"After this converter was connected to your car radio, switch on your car radio to check if it is in good condition, having the broad-casting. The converter is condition that the louder sound is gotten by the operation of the volume control of the car radio. The same remarks will be applied for the tone controls.

"Having confirmed that the radio is O.K., push the red Marked Button of the converter (Power) to light on the pilot lamp."

While statements like that are odd, and certainly not uncommon, one can usually work out what the writer was trying to say, at least in respect to uncomplicated equipment. But what about the following paragraph, taken from a Matsushita publication giving background information on the relatively new — and revolutionary — NV-850 hifi VCR?

"Thus both the audio and video signals are recorded on the tracks in layers. Not only by varying the azimuth angles of the audio and video heads (see Fig.3), but also by effectively varying the FM-modulated REC frequencies, both the audio and video signals can be drawn out of the recorded tracks without causing any problem to occur practically."

One may need to read a paragraph like that a number of times in an effort to clarify what is being said. Fig.3, by the way, is the same Fig.3 as in the article on hifi VCRs in our March issue. Study the text and the figure together, and it becomes evident that the word "varying" has been misused twice in the key sentence. What the writer was really trying to say was: "by having **different** azimuth angles . . . and **different** FM-modulated REC frequencies . . . etc".

In this case, choice of the wrong word is not only confusing but potentially misleading. Indeed, I suspect that some may have taken the statement literally, resulting in the mistaken (and published) impression that the NV-850 features audio and video heads with variable azimuth gaps, presumably responsive to the respective tracking controls.

No way! Each head has a different azimuth angle, but precisely and rigidly fixed, as per the diagram and VHS/PAL system standards.

When we come across poorly expressed statements like those quoted above, there is a natural tendency to smile in a superior kind of way or to laugh out loud — depending on the circumstances. But have a care.

It might well be argued that, in so doing, we are unconsciously endeavouring to compensate for our own traditional lack of facility in foreign languages: making fun of someone who does imperfectly what we can't do at all!

Jargon

Jargon is typically defined as "words or phrases substantially peculiar to a particular trade, profession or other group". In turn, the particular words or phrases may be:

- Contrived as, for example, the names of many electrical and other units: ohm, Henry, farad, Maxwell, Newton, Tesla, etc.
- Commonplace but given a special meaning: bits, hand-shake, language, editor, trees, menu, AND, OR, NOR, etc.
- Acronyms or groups of initials: FET, ROM, EPROM, ASCII, CCU, CPU, I/O, J-K, TTL, UART, and so on.

In its most useful role, jargon can serve as a kind of "verbal shorthand", facilitating communication within the technical fraternity. Conversely, it can all too easily be used to excess, or thoughtlessly or even by design, in an effort to demonstrate how knowledgeable the writer is in a particular subject — thereby imparting to the term a certain malodour..

In a brochure, manual or instruction book to be read by the purchaser of a new — and often unfamiliar — piece of equipment, acronyms or initials should be used discreetly, with the meaning bracketed with their first appearance in the text, or else listed in a separate glossary.

In saying this, I have in mind a well educated but non-technical friend who recently set aside a holiday weekend to learn how to "drive" a word processor and printer that had been made available for the purpose. Overall, the exercise proved quite rewarding but it was needlessly complicated by having to stop

produce user manuals

and puzzle over abbreviations sprinkled randomly through the instructions. As he said later:

"When a newcomer encounters the letters LF or CR in running text, how is he supposed to know, off-hand, that they mean Line Feed or Carriage Return? And they're the simple ones! It would have made things so much easier if, the first time around, they had been shown as LF (line feed), CR (carriage return), etc."

Maybe, you've had a similar experience in the same, or other branches of technology?

Inaccuracies

Mistakes can occur in a variety of ways as, for example, wrong wording due to language difficulties, errors in diagrams or data, or plain old-fashioned carelessness. Many of these can be spotted because they are obvious.

Much less so are errors which result when the user manual is not up-dated in line with a modification to the product. The manual may look right and read logically but not correspond with the unit it describes.

The article which you are now reading was printed out, in the first instance, on BX-80 printer from Dick Smith Electronics. It does a good job but, when first connected up, it failed to operate as expected.

The reason? According to the user manual, the internal DIP switches were set in a particular way, ex factory. When all the evidence suggested otherwise, I took the top off and had a look. In fact, they were set up quite differently and had to be reset — a procedure which isn't necessarily as straightforward as it might seem.

A minor modification to a product or to its setting-up may not warrant the reprinting of a manual but it certainly does warrant the inclusion of a separate note, or an errata slip in the case of an error.

Wrong approach

In part, my ideas about "approach" in user manuals have been shaped by the experience of reviewing a succession of video cassette recorders, cameras, etc. and compact disc players, all of which, at the time, represented unfamiliar and emerging technology. But they were really crystallised when it fell to my lot to examine and review the Brother EP-44 "intelligent" portable electric typewriter cum-text-editor, as featured in the August 1984 issue.

Perhaps I should mention that the review was actually prepared early in that year, when the EP-44 was first exhibited but it was held over, partly because of marketing delays and partly because of lack of space in the magazine. It is sufficient to say that, at the time, it was a relatively new and novel concept.

Packaged with it was a physically well prepared manual, which I no longer have on hand; it had to be returned with the

Take your pick: the program or the publication?

A couple of years ago, an organisation, which should best remain nameless, invested in a word processing system involving a modest computer, programmed with Wordstar. The secretary directly involved duly sat down with the manuals, expecting to learn how to "drive" it. Two or three days later, she had to admit to frustration and defeat.

On subsequent inquiry, she was told that the only effective way to cope with Wordstar was to enrol for a special training course involving at least three full days — time away from the job that she could ill afford.

Puzzled, when I heard about this, I rang a Public Relations executive who I know to have recently equipped his office with word processors in place of electric typewriters. What system did he have and how had his staff coped with it? Had they needed to attend any special training course?

He said that he had deliberately avoided Wordstar for the sort of reasons I had outlined and had opted for a complete Apple system: hardware and software. His staff had adapted quickly to the word processing function, without any outside training. Said he:

"On the basis of our experience, I'd be prepared to say that, if your secretary friend were to join our staff on a Monday morning, she could be using our system fairly fluently for ordinary text before she finished work for the day!"

Then I talked to Peter Vernon, at that time the resident computer buff on the EA staff.

Peter assured me that Wordstar was a very powerful program, a good program, but not one that you could readily teach yourself from the manuals he had seen. A short course was more or less mandatory and even then, it would really only get you started.

In the event, the secretary concerned did the short course, got started and, I gather, became fluent in the system, with practice. I forgot all about it until just recently, when the EA staff had to move to a new work situation and from traditional typewriters to word processors — programmed with Wordstar!

Remembering past impressions, I inquired as to how they had coped with it.

"No special hassles", said Greg Swain. "I didn't think much of the manuals but someone came up with a chart, which we stuck on the wall, showing all we needed to know for ordinary text editing, disc storage and printout.

"There's probably a million things that I don't know about Wordstar, and don't need to know. But we all memorised quickly the functions that we use every day. We can look up other things if and when we need them."

Having just written this instalment of "Forum" the Wordstar episode had begun to sound suspiciously like my tale about the EP-44, but on a much larger scale. So I talked it over with Jim Rowe, a personal computer buff from way back. Was I imagining things? Said Jim:

"I don't think you are. Having had to come to grips with Wordstar myself, I've gained the firm impression that most of the literature on it has been written by programmers for programmers — not for people who just want to acquire expertise as they need it, in their own time."

How interesting . . . how very interesting!

FORUM — continued

unit. But my reactions to the manual were made quite clear in the review. I quote:

"It would be nice to be able to suggest that everything went smoothly but such was not the case. As with most keyboard devices, all the wonderful things you can do become things that go wrong when you don't do them correctly! It was some hours later, after many attempts, many errors and much searching through the manual, that the EP-44 began to respond in a reasonably predictable manner.

"You can teach yourself but it does involve a certain amount of time and patience.

"In fairness, Brother Industries have put a lot of effort into the preparation of the Instruction Manual and most of the information can be found, when you go searching for it. The problem is that so much has to be taken in at the first reading that essential clues to correct operation are not recognised as such in the 24-odd pages of how-to-type instructions.

"Our firm conviction is that, next time around, Brother Industries could make it much easier for new buyers if they were to re-design their manual along more tuitional lines."

What I was suggesting is basically that the sequence of information in a user manual should, as far as possible, match the natural learning process of someone who has just acquired a new and as yet unfamiliar product. Indeed, many manuals already follow this pattern.

The natural starting point parallels what you expect and encounter when you first open the carton: title, picture, brand, model number, general description, summary of features. The contents of the Manual are also appropriate up-front, plus any urgent warnings about handling, checking the supply voltage, etc.

On the assumption that the purchaser would next want to know about the physical details of the unit, photographs or line drawings can logically follow, with labels or numbers to identify individual controls, switches, indicators, connections, and such like.

With initial curiosity thus satisfied, further logical steps would be installation and switch-on, which could be matched by appropriate directions to do with transit screws, environmental precautions, leads, peripheral connections, control settings and so on.

The real crunch comes next: instructing the purchaser in how actually to use the device.

To me, the most logical first step is to encourage them to observe and use the equipment in its most basic role, progressing to other more complex functions as appropriate. In this way, knowledge and experience is progressively accumulated and reinforced and the risk of confusion minimised.

In respect to the EP-44 manual, I suggested in the review that:

". . . after a survey of the physical features — keyboard, batteries, mains supply, paper feed, etc. — the newcomer could be taken through a basic exercise in, say, Direct Printing of straight text.

"This could be followed by exercises in Correction Print mode and No Print mode, each exercise a little more advanced than the last. Against this background, it would be possible to introduce the more specialised facilities with minimal risk of confusion.

"No less important, any such manual should be tested with novices rather than simply being approved by experts, who know all the answers anyway!"

I cannot stress too much the importance of that last paragraph. An expert should certainly check user manuals to ensure their accuracy but, unless he/she is sensitive to the information needs of first-time purchasers of the equipment, that may be their only contribution.

If a user manual is to be of real use to buyers who are less than well informed, it is essential that it should provide all the information they need, without significant omissions. As mentioned in the review, the ultimate test is to submit the equipment and the manual to one or more relative novices in the particular technology, requesting them to make it work — and to keep detailed notes of any hang-ups.

With some of the manuals I've seen over the years, such notes might well prove to be more voluminous than the original text! It had either been cobbled together to look the part, or else written by an expert at a level to impress his/her peers.

The right way?

In the heading, I referred to the right and wrong way to produce user manuals. Summing up what has been said, the right way, in my opinion, is to ensure (amongst other things) that:

(1) They are written in good, readable English (ie. for the Australian market).

(2) They use terms and expressions (jargon) appropriate to the technology but bracketed with the meaning on the first appearance, or else listed in a glossary.

(3) They should be accurate and up-to-date.

(4) They should follow a practical "tuitional" approach designed to conduct the purchaser methodically through the attributes and operation of the particular unit.

Whose responsibility?

To my mind, the responsibility for producing an adequate user manual, or book, or brochure, rests initially with the manufacturer, as the organisation most familiar with the concept, design, behaviour and use of any given product. The basic information format can remain the same, irrespective of where the product is ultimately sold.

If the manufacturer lacks expertise in a particular foreign language, it is up to the importer or distributor to co-operate as necessary to produce a suitable manual.

If it is good enough for a manufacturer, importer and others collectively to market a product, it is reasonable to expect them, collectively, to provide suitable user information. An adequate User Manual or Instruction Book is a necessity and an obligation, not an option or a favour!

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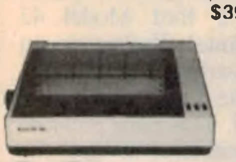

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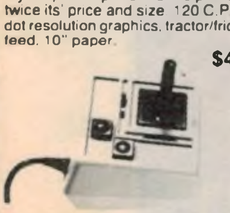

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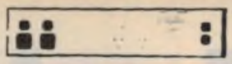

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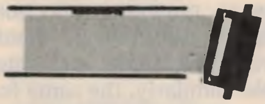

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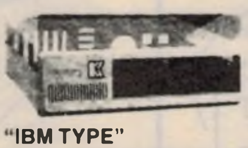

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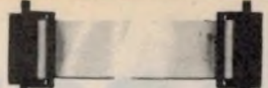

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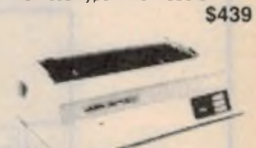

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An easy-to-build UHF wattmeter

Dick Smith Electronics has just released a UHF wattmeter kit suitable for use by amateurs and CB operators. Featuring stripline circuitry, the kit is easy to build and use, and allows measurements of forward and reverse power to be made. SWR can be calculated from these using a simple conversion chart.

This project was conceived early in 1984 by Gil McPherson and Garry Crapp of Dick Smith Electronics. It was prompted mainly by enquiries from people who had built the "Explorer" UHF transceiver kit. This very popular project was published in *Electronics Australia* in September, October and November, 1983. Over 500 of these transceivers have been built to date, so there is certainly a need for an instrument of this type. Naturally many other people could use such a device, amateurs and CB operators in particular.

Basically, the unit is an insertion type RF wattmeter, capable of measuring power in either forward or reverse directions, into a 50Ω load. These measurements allow for the calculation of VSWR. By making use of this ability to simply calculate SWR, the fiddly controls and complex scales normally required on an SWR meter have been done away with. There are only two scales on the Dick Smith UHF Wattmeter, a 10W scale and a 50W scale. There is a forward/reverse switch to select the measurement direction, and a range switch to select the appropriate power range.

The ability to measure reverse power directly is especially useful when tuning an antenna system. In this situation it is necessary to minimise reflections, and the ability to continuously monitor the power reflected from the antenna is invaluable. Similarly, the same feature is useful when testing a suspected faulty antenna.

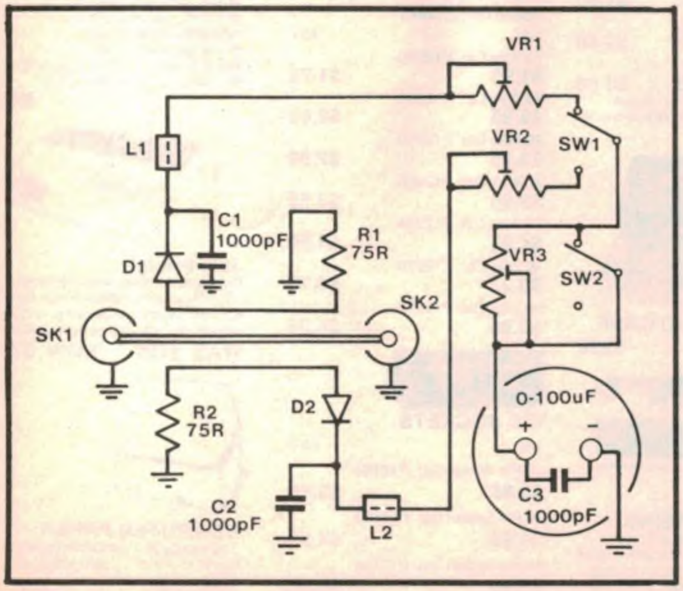
The accompanying circuit diagram shows just how simple the UHF Wattmeter is. The heart of the circuit is the stripline in which the coupling currents are sampled. These are rectified and used to drive the meter movement. The stripline is etched onto a printed circuit board, which holds the 75Ω resistors, the hot carrier diodes, and the feedthrough capacitors C1 and C2.

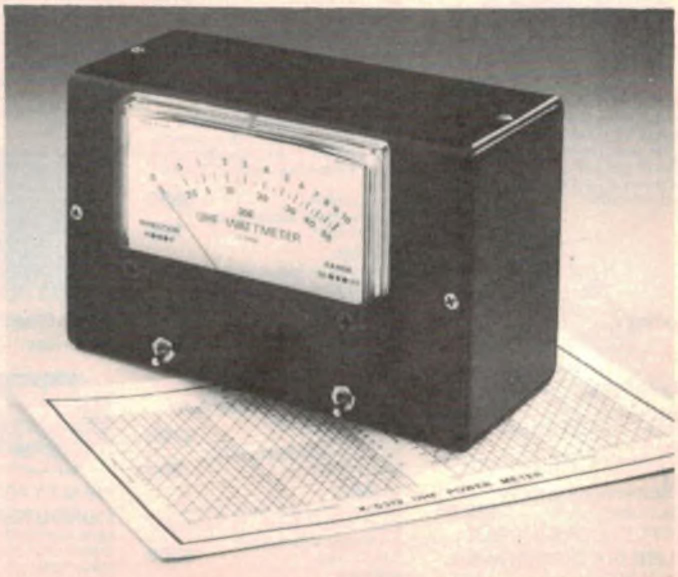
The trimpots and the switches are mounted on a second printed circuit board which is held in place in the case by means of the switches themselves.

As can be seen in the accompanying photograph, the UHF Wattmeter is housed in a black aluminium case. The input and output BNC sockets are mounted on the rear of this box.

This kit is available only from Dick Smith Electronics, who are supplying it complete with all parts and a comprehensive instruction and assembly manual. The manual sets out a detailed construction procedure, as well as a calibration procedure which requires no more equipment than a variable power supply, a multimeter and a 100Ω resistor. In addition, for a fee, Dick Smith Electronics will calibrate your completed wattmeter against a Bird Model 43 Throughline Directional Wattmeter, an industry standard instrument.

Retail price for the Dick Smith UHF Wattmeter is $49.95. This price includes all components necessary to get the wattmeter going, the instruction and assembly manual and a chart for the calculation of SWR from the forward and reverse power readings. The Dick Smith catalog number for the kit is K 6312. The charge for calibration is $15.00.





by BRYAN MAHER

OP AMPS Explained

Part 14

This month's article is devoted to a revision of the principles of negative feedback and a brief discussion of nested differential amplifiers which allow very large orders of negative feedback to be applied.

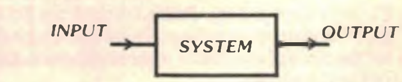


Fig.1: a simple open loop system.

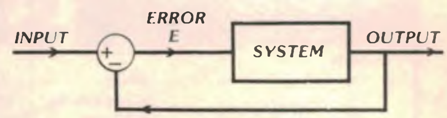


Fig.2: closed loop system block diagram. The circle represents the difference stage and Error E = input — feedback.

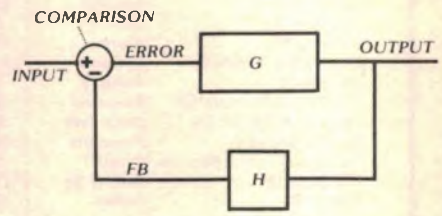


Fig.3: H represents any sample or function of the output fed back to the difference or comparison stage. G is the forward open loop gain or transfer function.

If your power operational amplifier is dedicated to driving motors, relays, heaters, lamps, vibration machines or any such industrial paraphernalia, a little distortion won't worry you. But, if you are a hifi buff, it's a different matter.

Realising that the complete absence of distortion is an impossible dream, you may nevertheless spend your waking hours searching for better designs, with ever lower percentages of harmonic content. You are aware that modern negative feedback amplifiers can be so good that the 2nd and 3rd harmonic content, generated by class B output stages, may be cancelled almost entirely by the negative feedback. Indeed, a modern class B amplifier may have no more 3rd harmonic content than some esoteric class A amplifiers, at least for low frequencies.

But if you analyse the harmonics on your prized class B amplifier, you may be puzzled to find that the 7th and 9th harmonics are predominant in the remaining distortion. You reason that your feedback system has succeeded in cancelling low order harmonics very well but, for some strange reason, cannot quite come to grips with those high order distortion components.

That of course disturbs your sensitive ear, for the 9th harmonic of 1kHz is a shrill 9kHz, and the 9th harmonic of the 1850Hz fundamental, ie, 16.6kHz, is audible. Why is that marvellous feedback system not cancelling high order harmonics completely? Certainly some cancellation is going on, as a class B amplifier without any feedback is awful!

To find the answer let's go back to basic negative feedback theory. You could, at this point, make a cuppa and quickly re-read parts 1 and 2 of this series, on gain accuracy, stability and a smattering of mathematics (EA March, April '84). In case someone has stolen your copies, a quick summary of this fascinating theory goes like this:

(a) A simple amplifier, as in Fig. 1, is not good enough as its gain varies widely as signal voltage or room temperature changes. Furthermore, each stage is likely to generate considerable non-linearity distortion.

(b) Vast improvements accrue from judicious use of negative feedback, wherein a sample of the output is fed back to the front end, as in Fig. 2. The difference stage subtracts this feedback signal, FB, from the original input to form the difference called Error E.

$$\text{Error } E = (\text{input} - FB) \quad \ldots\ldots\ldots\ldots (1)$$

The error signal E is then amplified by the high gain G of the amplifier of Fig. 3, to form the output. It is possible to feed back the whole of the output voltage, but usually only some fraction H of the output is used to form the feedback signal FB. The simplest method of achieving this fraction is by the voltage divider R1, R2 shown in Fig. 4, but other schemes are quite possible. This figure could abstractly represent any non-reversing negative feedback amplifier.

(c) Usually the error signal E is small while the "forward open loop" gain G is large. Most often H is a simple fraction, eg, in Fig. 4:

$$H = \frac{R1}{R1 + R2} \quad \ldots\ldots\ldots\ldots (2)$$

(d) The overall gain, called "closed loop gain," T, is very much smaller than G, and is given accurately by:

$$\text{Closed Loop Gain } T = \frac{G}{1 + GH} \quad \ldots (3)$$

However, in most operational amplifiers, G is so large that the "1" in the denominator is insignificant, hence:

$T = G/GH$ approx.

$$T = 1/H \text{ approx} \quad \ldots\ldots\ldots\ldots (4)$$

For example, to make an amplifier have an overall closed loop gain of $T = 25$, we just construct the voltage divider $H = R1/(R1 + R2) = 1/25$ in Fig. 4, using a high gain amplifier with a gain G

= 30,000 or more. We can call 1/H the "Demanded Gain" as it is the value we want. The actual value you get is T, which is nearly the same, at least for low frequencies.

(e) Just how well T approximates 1/H depends on the values of T, G and H. Let's call the quantity (1 + GH) the "Return Difference" or "Open loop/Closed loop gain ratio". From the equations it is clear that:

$$\text{Return Difference} = (1 + GH) = \frac{G}{T} = \frac{\text{open loop gain}}{\text{closed loop gain}}$$

Making (1 + GH) larger causes T to be a closer approximation to 1/H and as H is almost a constant, T should also be nearly a constant.

(f) The fly in the ointment is that (1 + GH) does not remain large at higher frequencies. H can be made almost independent of frequency but G cannot. Why? Because of time constants. How?

Casting aside our inhibitions, let us plunge into a little mathematics. (Fear not, gentle reader, we will not drown.) Consider, if you will:

The forward gain, G, of an amplifier decreases at higher frequencies because of inevitable stray and Miller capacitances and transit time delays in all transistors. Thus, gain G is not just a simple number but is some function of frequency. Thus we call G a "Transfer Function".

As well, some phase delay is incurred, as in Fig. 5, where a sine wave input V(A) is shown delayed by an angle Θ, about 53 degrees or 0.93 radians. Therefore the output sine wave V(B) should be described by stating its frequency and the delay angle Θ. Likewise, for G, we should state a pair of numbers.

A convenient way to express such a pair is by one complex number, such as Z. In Fig. 6, Z has value 5 at a delay angle of −53°, ie, polar co-ordinates. We say Z = (5, angle − 53°). Alternatively, we can express the same value Z in rectangular co-ordinates, as in Fig. 7, by saying Z = (3, −4) meaning 3 along the real axis and 4 down the imaginary axis.

If the symbol "j" is used to mean "rotate 90°" then we could equally say Z = 3 − j4.

It is common practice to regard signal frequencies as complex numbers whose two parts state the frequency as a number of radians per second and the delay in radians or degrees. (Radians per second = 2πHz.)

We use the symbol S for these complex frequencies. Being a low-pass

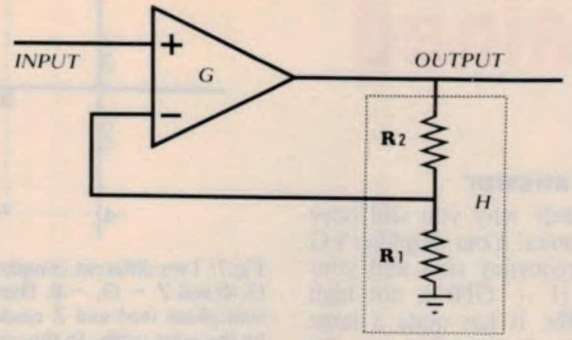


Fig.4: implementation of Fig.3, where H is a simple fraction of the output voltage.

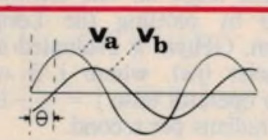


Fig.5: oscilloscope traces of Va, a sine wave input to amplifier G, and Vb, the output delayed through some angle Θ

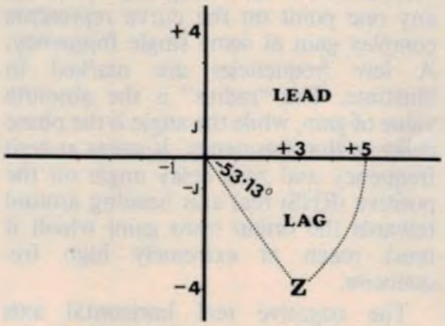


Fig.6: the complex number (5, angle −53°) is just real 5 rotated −53°. As (3, −4) and the origin form a right angle triangle, by Pythagoras $5^2 = 3^2 + (-4^2)$; also Tan (−53.13°) = −4/3. Alternatively, you could call this number (3 − j4) where j equals −1. The horizontal axis is called "real", the vertical axis "imaginary".

circuit, the gain G will be inversely proportional to complex frequency S, (at least for high frequencies, ie, large S).

The amplifier Transfer Function G must do three things:

(a) Contain a term like (1/S) for large values of S.

(b) Contain some reference to the circuit time constant, t (in shunt capacitive circuits, C = capacitance, R = resistance, t = CR seconds of real-time).

(c) We then revert to a simple number, A, for the "DC or low frequency gain", at very low frequencies, ie, very small S.

Now we can define the Transfer Function G for a simple single stage by:

$$G = \frac{A(1/t)}{[(S + (1/t)]} \quad \ldots\ldots\ldots\ldots (5)$$

$$= \frac{A}{1 + St} \quad \ldots\ldots\ldots\ldots (5A)$$

The gain of multiple stages is then the product of each stage G.

Notice in equation (5), when S is very large, division by (S + 1/t) is about the same thing as division by (S), so here is our term (1/S). Conversely at very low frequencies, ie, very small S, G = A, as it should.

Wasn't so bad was it? Now your author has not forgotten that it was 9th harmonic distortion we were on about at the start. Consider equations (3) and (4) and the fact that, if H is a simple attenuator of low value resistors, 1/H will be almost constant at any frequency in the range of interest. Hence in our audio power amplifier, if we can only make G large enough, by equation (4) the closed loop gain T will be a constant at all frequencies. The output will be proportional to T and input only, independent of G [as G does not appear in equation (4)]. Therefore, the output will also be independent of distortion and other errors which G may generate internally. And that includes all those ugly harmonics of the class B output stage. Sounds simple doesn't it? — just make G [and hence (1 + GH)] large enough and feedback will neatly cancel all harmonics generated by those transistors.

It can be shown that the amount of **reduction** of a distortion harmonic by feedback is approximately equal to the absolute value of (1 + GH) at **the frequency of that harmonic.** And the frequency of the relevant fundamental has nothing to do with it! For a particular harmonic:

$$\text{distortion with FB} = \frac{\text{distortion without FB}}{(1 + GH)} \quad \ldots (6)$$

approx (where G must be evaluated at that harmonic frequency).

OP AMPS Explained

Here is the answer

That is precisely why you still have those 9th harmonics! Your amplifier's G value falls as frequency rises and your absolute value (1 + GH) is not high enough at 18kHz. It has quite a large value at lower frequencies, so the feedback works well for the low order harmonics, but not for the high order. A Bode plot of the absolute value of (1 + GH) is shown in Fig. 8.

If you raise the gain G by adding more stages, the amplifier is sure to oscillate and scream its head off! Why? Back to the theory:

Those amplifier phase delays are always a danger because they also delay the feedback FB. Each time constant adds an extra delay of anything up to 90°, as can transistor base transit times. If at some frequency the delay is 180°, meaning phase reversal, feedback FB is no longer negative (as it should be) but reversed to become positive feedback.

If the gain around the loop, GH, is one or more when that feedback has turned positive, your amplifier will oscillate. Such oscillation will be at a frequency S which will make the denominator zero in equation (5). These values of S are called "poles" of the circuit. For each time constant or transit delay there exists a pole.

You can forecast how much phase rotation occurs in your amplifier at any frequency by plotting phase rotation as a function of frequency as in Fig. 9 where the example is for a system of one time constant (single pole). H. W. Bode (Ref. 1) showed in 1945 that, subject to some conditions, Fig. 9 is completely predictable from Fig. 8 and that Fig. 8 will have a down-slope (beyond the knee of the curve) dictated by the number of poles, thus:

Downslope of Bode Gain Curve
= (−6n)dB per octave ....(7)
= (−20n)dB per decade ....(8)
where n is the number of poles.

The knee of the curve Fig. 8 occurs at whatever frequency causes the output to be reduced down to half power. We name this special frequency 1/to. (Because t is a time, then 1/t must be a frequency.)

In a system with one time constant, at frequency 1/to the phase delay angle is 45°, as in Fig. 9. H. Nyquist in 1932, (Ref. 2) showed how to plot both the gain and phase angle on one drawing as in Fig. 10 by plotting the Loop Gain Function. GH(jw) is evaluated at many frequencies (jw), where j is our 90° rotation operator (also $j = \sqrt{-1}$) and $w = 2\pi f$ radians per second.

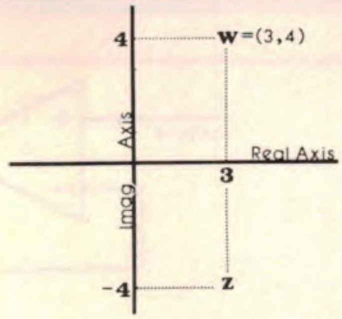


Fig.7: Two different complex numbers: W = (3, 4) and Z = (3, −4). Here, W could represent phase lead and Z could mean phase lag by the same angle. In this case, Z is called the conjugate of W.

In a Nyquist plot, GH is a complex function when evaluated at frequencies jw. In Fig. 10 the horizontal axis is the real part of this complex gain, the vertical axis is the "imaginary" part and any one point on the curve represents complex gain at some single frequency. A few frequencies are marked to illustrate. The "radius" is the absolute value of gain, while the angle is the phase delay at that frequency. It starts at zero frequency and zero delay angle on the positive (RHS) real axis heading around towards the origin (zero gain) which it must reach at extremely high frequencies.

The negative real horizontal axis means 180° phase delay and if the absolute value of gain is one or more at the corresponding frequency then the amplifier is unstable.

The test for instability of a design is thus to draw the Nyquist Contour and simply observe if it encloses the point gain = (−1,0) ie −1 on the horizontal axis. If the curve encloses this point that amplifier will be unstable and oscillate. If not, such an amplifier will be stable.

Now we can answer your question. You asked before: "to reduce harmonic distortion why can't you just raise the gain G, hence raise the Return Difference (1 + GH)?" If your amplifier looks like Fig. 10(d) and you double the gain it will look like Fig. 10(c) which does enclose (−1,0) which is unstable. That's why you just cannot double the gain.

But what if Fig. 10(a) describes your system? No multiplication of gain will ever take the curve anywhere near the vital point (−1,0). The catch is, raising the gain means adding another stage, hence another time constant and another pole.

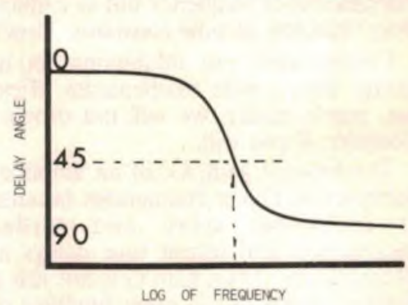


Fig.9: Bode phase diagram for a feedback system with one time constant, hence one pole. The delay angle at the frequency which causes output power to drop to half is 45°.

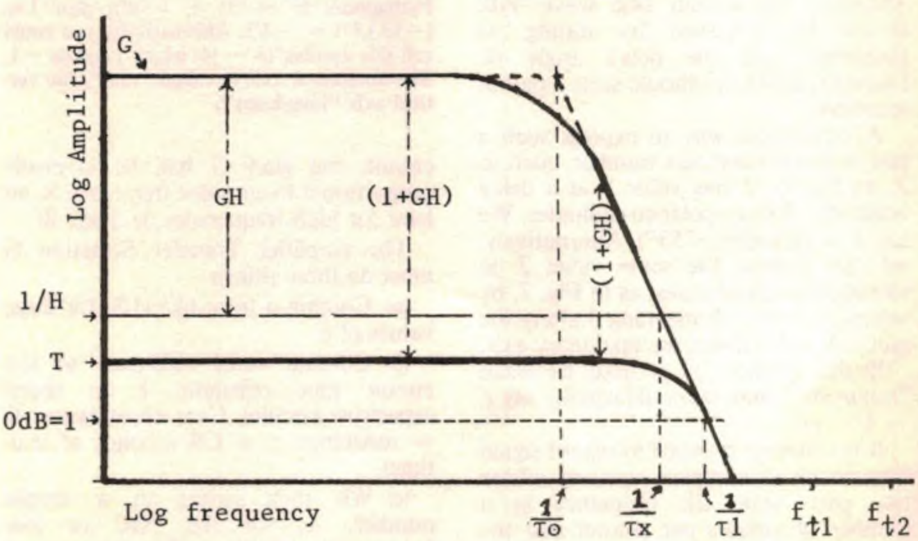
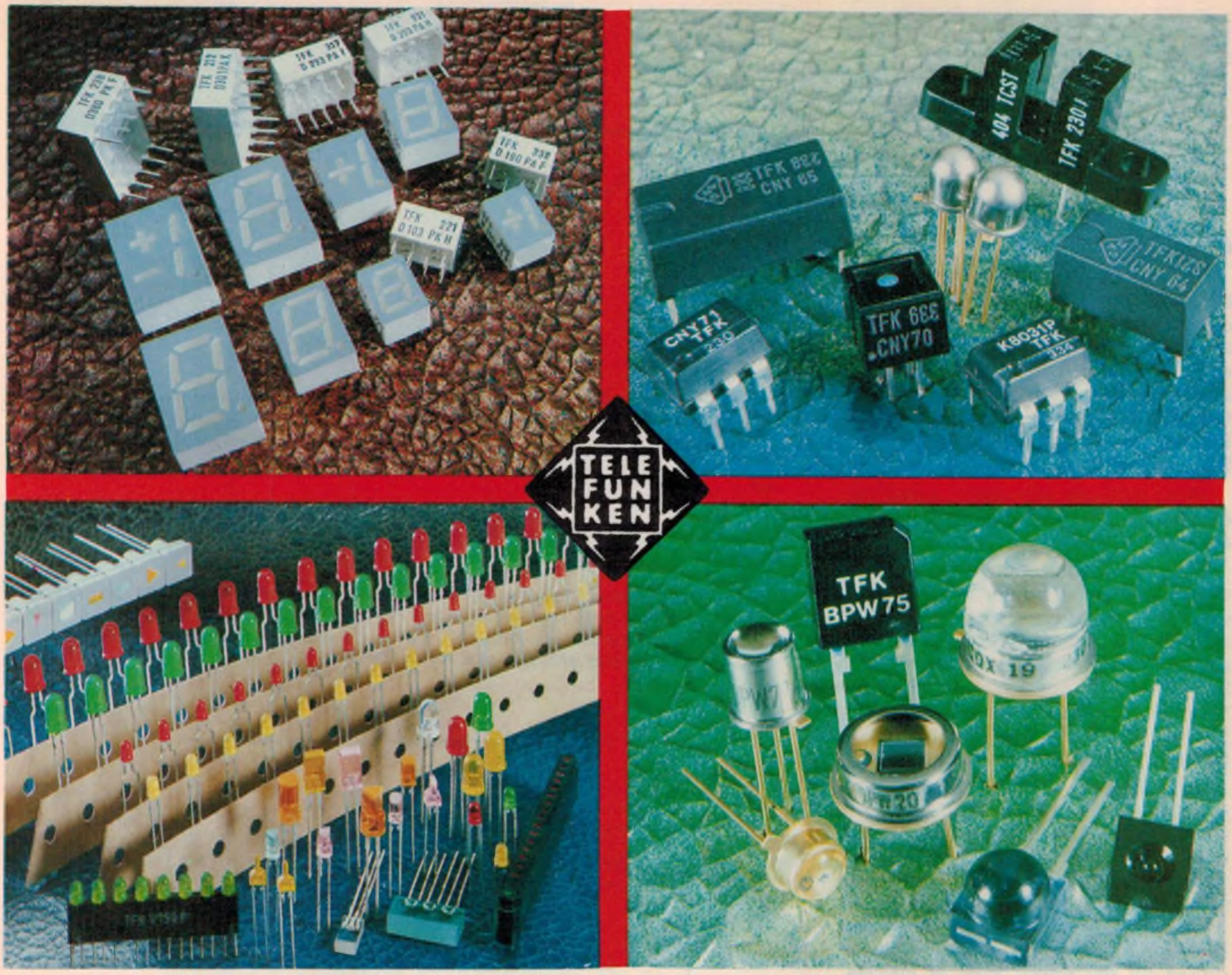


Fig.8: Bode gain curve of a feedback amplifier showing absolute values of G, T, (1/H) and (1 + GH) as functions of frequency. 1/to is the pole frequency caused by C in Fig.11; 1/tx is the frequency where G has fallen to 1/H; 1/t1 is the frequency at which T = 1; Ft1 is the Ft value for the output transistors; and Ft2 is the Ft value for the other smaller transistors.


TELE FUN KEN
TFK BPW75
TFK 633 CNY70
CNY71 TFK
404 TCST
TFK 230J

OP AMPS Explained

Oversights

We have glibly overlooked a few details like speaker cable inductance and capacitance, complex speaker impedance and stray capacitance of wiring. These add extra time constants and poles to the system and what you may think will be a two-pole system [Fig. 10(b)] could be a three-pole, Fig. 10(c), (or even more) at high frequencies.

How then are any audio amplifiers ever stable? The answer puts nearly all amplifiers into one type.

Take the highest gain stage, usually the high-gain middle stage. Add capacitor C, as in Fig. 11, to sacrifice the speed of this stage, slowing it right down until it is the slowest stage in the system. So slow that now the amplifier is virtually a one-pole system, with a safe Nyquist plot as Fig. 10(a). Now it must be stable, as all one-pole systems are.

But what about the other poles corresponding to the output transistor delay times? And other stages' Miller capacitance? Table 1 shows some transistor types, cost and value of F_t, the gain-bandwidth product. Transistors are useful at frequencies much lower than F_t. Also F_t is the frequency of a pole caused by the transit time of charges through the base. Observe that for likely first and second stage small power transistors like LM115A, 2N2905A and 2N6556, F_t is very high, but not so for the usual run of output transistors, with 2N3055 about the worst.

In Fig. 8, 1/tx is the frequency where G has fallen so much it is now equal to 1/H, the demanded gain. (Our system is just not a feedback system above this frequency.) Ft1 is the gain-bandwidth product of the output transistors; Ft2 is the gain-bandwidth product for the other smaller transistors.

We can ensure our feedback system operates like a one-pole system if and only if 1/tx is much lower than all of Ft1, Ft2, etc. So we must choose frequency 1/tx suitably:

$$\text{Choose } 1/tx = \frac{Ft1}{5} \quad \ldots\ldots\ldots (9)$$

For example, if we must use a 2N3055 whose Ft1 = 1MHz then choose 1/tx to be 200kHz.

A system having one dominant pole means the slope of Fig. 12, (a simplified version of Fig. 8) must be −20dB per decade. Take the case of 1/tx = 200kHz (for 2N3055) and demanded gain 1/H = 10 = 20dB. Then Fig. 12 shows that GH (at DC) = 60dB, implying that the sloping portion falls 60dB at −20dB per decade. Voilà: 1/to must be 3 decades of frequency below 1/tx!

Thus 1/to = 200Hz.

So we must choose C in Fig. 11 to implement this 1/to value.

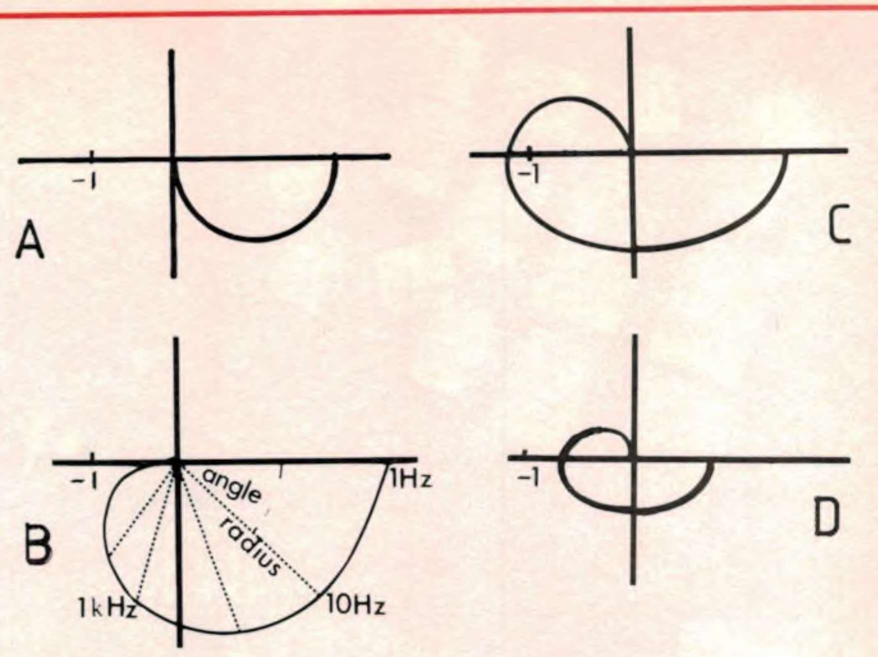


Fig.10: Nyquist plots are mappings of Loop Gain GH with radius = absolute value of gain and angle = phase delay at some frequency. The one pole system is always stable; two pole system (B) can approach instability; the three pole system at C encloses (−1, 0) and is unstable; and the three pole system at D is stable.

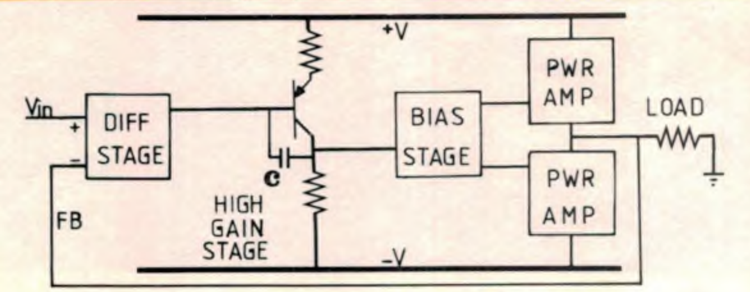


Fig.11: block diagram of a typical audio amplifier. Capacitor C is inserted to deliberately increase the time contant of the high gain stage until it is the slowest in the system, thus making the circuit a predominantly single-pole amplifier.

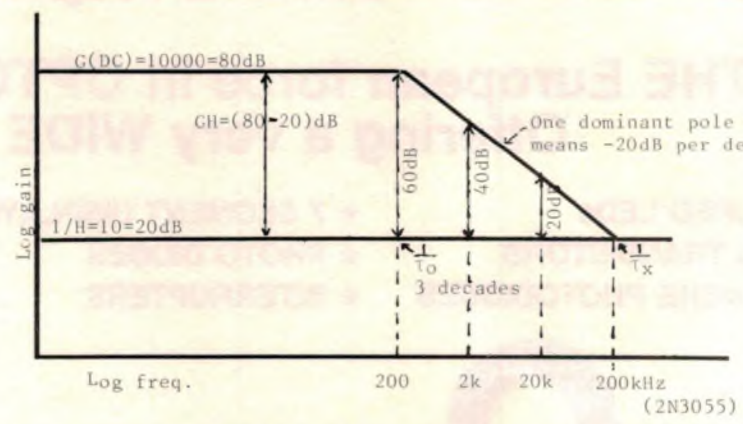


Fig.12: simplified version of Fig.8. Having chosen 1/tx = 200kHz, if G(DC) = 80dB then 1/to must occur at 200Hz.

TABLE 1

Type	Polarity	Peak Values			Ft MHz min.	Manu-fact-urer	Price Aprox.
		Power Watts	Volts	Current Amps			
LM115A	NPN Dual	1.8	60	0.02	450	NS	\$20-\$50
2N2905A	PNP	3	60	0.6	200	Ti,M	\$1.00
2N3503	PNP	3	60	0.6	200	Ti,M	\$1.20
2N3053	NPN	10	60	0.7	200	Ti,M	\$0.60
2N6556	PNP	10	100	2	75	M	\$0.50
2N6379	PNP	250	120	50	30	M	\$40
2N6277	NPN	250	180	100	30	M	\$40
PT4500	NPN	350	300	150	10	PT	≈\$1,000
MJ2300	NPN	25	100	2	6	M	
MJ2305	PNP	25	100	2	6	M	
2N3902	NPN	100	400	3.5	2.8	C	\$5
2N5684	PNP	300	80	50	2	Ti,M	\$28.50
2N5686	NPN	300	80	50	2	Ti,M	\$28.50
MJ802	NPN	200	100	30	2	M	\$3
MJ4502	PNP	200	100	30	2	M	\$9.45
2N3055	NPN	115	100	15	1	C	\$2.30

NOTE: Manufacturers: C = common; M = Motorola; PT = Power Tech. Ti = Texas Instruments; NS = National Semiconductor

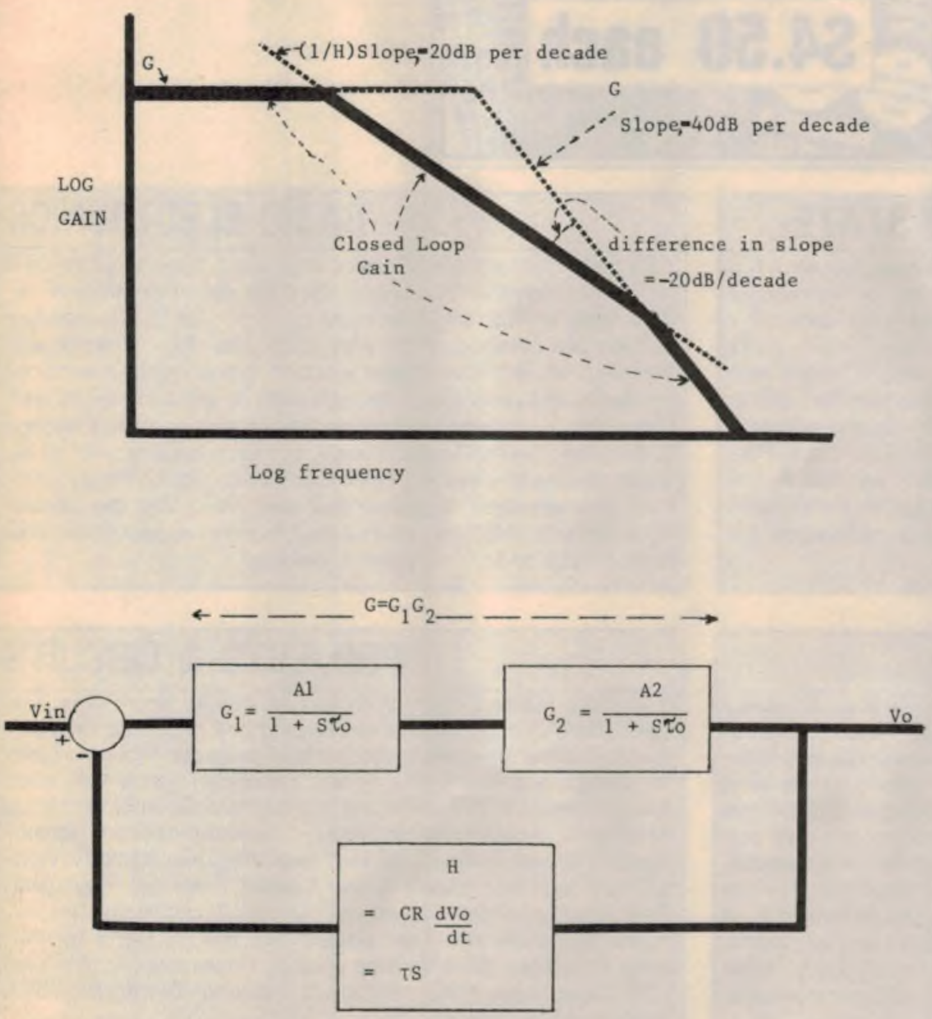


Fig.13: a stable two-stage sub-system and its Bode gain plot. The heavy line shows the closed loop gain, which cannot exceed G. Stability is decided by the slope difference (between G and 1/H) which is 20dB/decade in this case because of the coupling capacitor and time constant chosen for H.

How nice; we have designed an amplifier, but what are the consequences? Partake of some refreshment and dive back in again!

From Fig. 12 it is clear that:

$GH \leq 20dB = 10$ at 20kHz
$(1 + GH) \leq 11$ at 20kHz
$(1 + GH) \leq 12$ at 18kHz

Inserting this value, $(1 + GH) = 12$ into equation (6) gives for this amplifier for 9th harmonic of a 2kHz fundamental:

distortion of 9th harmonic with FB = distortion of 9th harmonic without FB × 1/12

A poor reduction indeed!! You would like a reduction of about 12,000, not just 12! What to do? Start by raising the value of 1/to. Change the design so that 1/to is 20kHz, giving (1 + GH) full value for all harmonics up to the limit of human hearing, and so reduce distortion by a very large factor. If it does little for harmonics above 20kHz, who cares? How to do that and still obey the rules we have stated?

We have two clear choices: (a) find a faster output transistor, with a higher value of Ft or (b) use a different design approach, such as that of E. M. Cherry (Ref. 3).

Choice (a) is limited by cost as in Table 1 but Professor Cherry's design, choice (b), gives us a second alternative in which inexpensive transistors like BD236/BD235 or MJ802/MJ4502 [200 watts, f(T) = 2MHz] may be used while still reducing all harmonics below 20kHz down to a few parts per million. Using a generalisation of our previous statements about stability:

(a) "One-pole feedback systems, Fig. 10(a), are always stable." That's true.

(b) "Slope is −20dB per decade in the one pole case" as Fig. 12. Also true.

The enormous contribution to the science made by H. W. Bode is his claim that those two statements are equivalent, that we need not look at the Nyquist plot, just at the **slope** in Figs. 12 and 8.

E. M. Cherry has generalised thus: "if the difference in slope of the forward-path gain and the demanded gain does not exceed 20dB per decade that system or sub-system will be stable."

Clearly Figs. 12 and 8 obey this rule, but, and this is the secret, so does the two-pole sub-system depicted by Fig. 13, even though it has two stage forward gain. Being two stage it could have high gain but to achieve stability of the sub-system, H must be of the form of a capacitive differentiator with transfer function:

$$H = \frac{CR\ dV(out)}{dt}$$

$$H = tS$$

where t = CR and multiplication by S is

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OP AMPS Explained

also equivalent to differentiation. So H increases at higher frequencies, thus demanded gain (1/H) **decreases** with frequency, giving (1/H) itself a −20dB per decade down-slope. Because the slope **difference** is only 20dB/decade, this sub-system is stable within itself.

Complete amplifier

Repeating this procedure, as in Fig. 14, assembles an amplifier of many stages with each stage individually stable. Therefore the whole amplifier is stable despite the high gain! The outside envelope has large slope but is still stable as each sub-system with its Nested Differentiating Feedback Loop is stable. Because of the large open loop gain (G = G1, G2, G3, G4) and steep outside envelope slope, it is easy to design for 1/to = 20kHz without breaking the above criterion.

Therefore overall (1 + GH) remains at full value all the way up to 20kHz, so all harmonics within the human hearing range are fully reduced. Results which can be achieved by this approach (Ref. 3) show all harmonics from the 2nd to the 19th less than 6 parts per million (−104dB).

Open loop gain is high and so is overall feedback factor (although the latter is slightly difficult to define), and TIMD is non-existent, leading Cherry (Ref. 4, 5) to flatly contradict opinions (vehemently held by some others) that some nominal limit should be placed on loop gain and feedback factor.

That's our story for the month. Readers overcome by intrepidity may now zealously read references cited below (and there are more). We have used up the allotted space so the other designs mentioned last month must be held over till another day. Until next month, Bye.

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6. E. M. Cherry, "Audio Amplifiers Using Nested Differentiating Feedback Loops", ETI, Oct, Nov, Jan, 82/83.

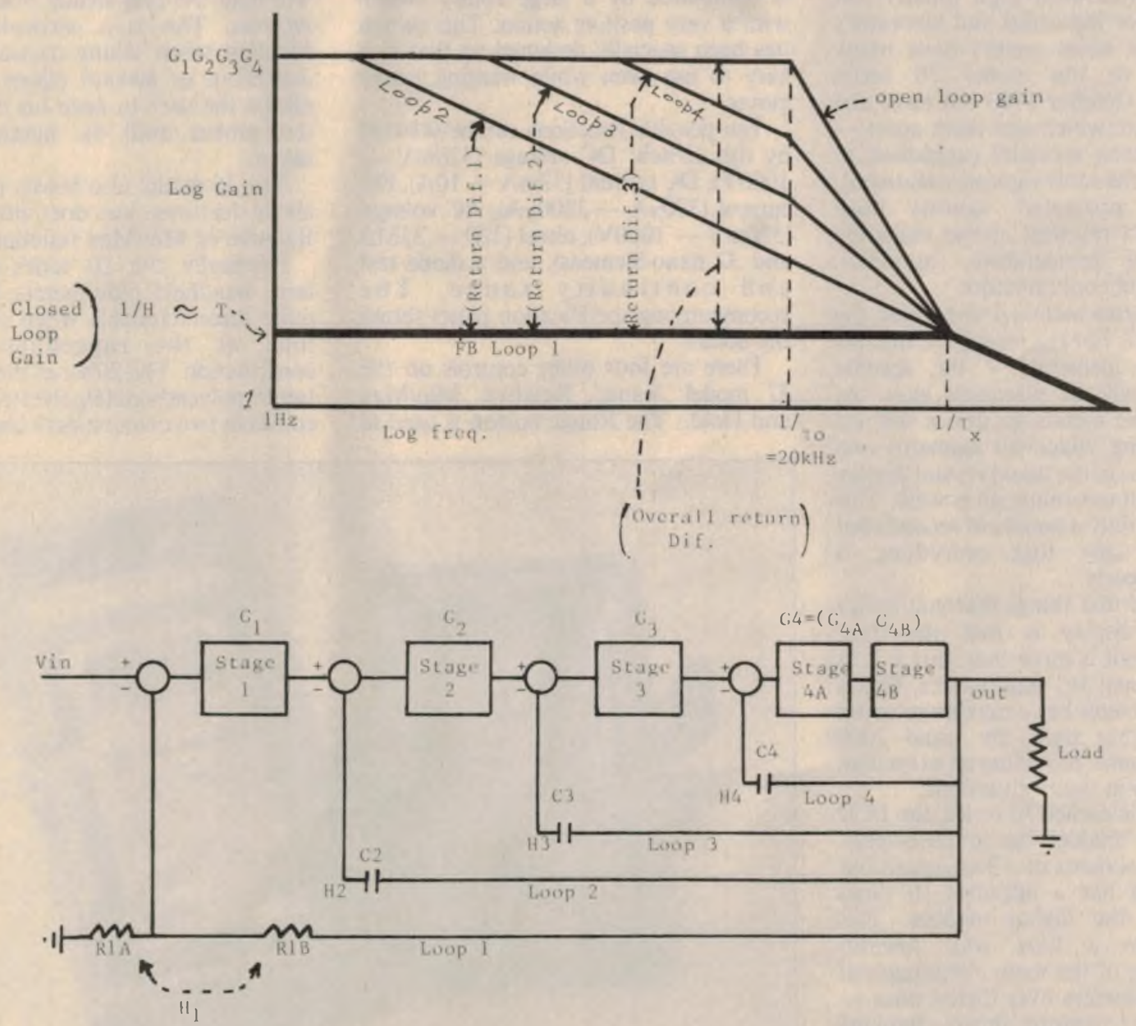


Fig.14: four stage nested differentiating feedback loop amplifier block diagram and its Bode gain plot. This is the Cherry method for keeping overall return difference high at all audio frequencies, thus substantially reducing all unwanted harmonics.

New Products...
Product reviews, releases & services

Fluke Series 20 3½-digit industrial multimeters

Recently released by Fluke is the new Series 20 range of rugged 3½-digit multimeters. Designed for use in harsh industrial environments, they include the latest features and have very respectable specifictions.

by ANDREW LEVIDO

For many years the name Fluke has been associated with high quality test equipment for industrial and laboratory use. The 20 series meters have many similarities to the earlier 70 series reviewed in October 1983 but have one special feature which sets them apart — they have been specially ruggedised to stand up to the most rigorous treatment. They are protected against both electrical and physical abuse, including extremes of temperature, humidity, chemicals and contaminants.

There are two meters in the series, the 25 and the 27. For the most part, the two models are identical — the specific differences will be discussed later. At switch-on, the meters go into a self-test routine during which all segments and annunciators on the liquid crystal display are turned on (assuming all is well). This test lasts for only a couple of seconds but shows the user that everything is working properly.

One of the first things that you notice about the display is that the most significant digit is more than just a 1, as on conventional 3½ -digit meters. This is because the meter has a maximum count of 3200 rather than the usual 2000 maximum count, providing an extra digit of resolution in many situations.

As with the earlier 70 series, the LCD features an "analog" bar graph display. This display consists of a 31-segment bar graph which has a response 10 times faster than the digital readout. This feature goes a long way towards reversing one of the main advantages of analog multimeters over digital ones — their ability to measure slowly changing signals and respond to transients.

Another desirable feature is full autoranging. This has a fast response, but manual ranging can be easily selected when required. The front panel is dominated by a large rotary switch with a very positive action. This switch has been specially designed so that it is easy to use even while wearing heavy gloves.

Ten possible functions can be selected by this switch: DC voltage (320mV — 1000V), DC current (32mA — 10A), DC current (320μA — 3200μA), AC voltage (320mV — 1000V), ohms (320 — 32MΩ and 32 nano-Siemens), and a diode test and continuity range. The accompanying specification panel shows the details.

There are four other controls on the 27 model: Range, Relative, Min/Max and Hold. The Range button is used to manually select the range required. It is repeatedly pressed to step through the available ranges on each function. Annunciators on the display indicate the range selected.

The Relative button allows relative measurements to be taken. The button is pressed to store the displayed reading, and the display then reverts to 00. Each subsequent measurement is then displayed as a relative quantity referred to the stored reading. A new base reading can be stored at any time, while holding the Relative button down for two seconds returns the meter to the normal mode.

The Min/Max button is used to record either the minimum or maximum reading, and hold it. The bar graph continues to display the actual input reading.

The final button, the Hold button, allows the user to make a measurement without having to look at the meter itself. If this button is pressed the meter will hold the first steady reading that it receives. This is a particularly useful function when taking measurements in dangerous or awkard places because it allows the user to keep his eyes on the test probes until the measurement is taken.

The 25 model also boasts most of the above features, but does not have the Relative or Min/Max functions.

Physically the 20 series are rather large handheld multimeters, but this is quite understandable when one takes a look at the ruggedness of the construction. The 20 series meters have a tough polycarbonate/polyester case that comes in two colours: dark charcoal grey

This photograph shows the Fluke model 27, 3½-digit multimeter in the hard carrying case.

and safety yellow. The case is sealed against the ingress of water and other contaminants, to the extent that, after removing four retaining screws, it is necessary to prise the lid open with a coin to gain access to the battery and fuse compartment.

Internally, the meter is very well constructed, with one large main PC board containing the switching, protection and signal processing components. A second board accommodates the display and the pushbutton switches. The two boards are interconnected by means of a plug and socket arrangement.

We were very impressed with the overall quality of construction which appears to be of a very high standard indeed.

As mentioned earlier, the 20 series meters are also electrically rugged. All voltage ranges are protected to 1000V (DC + AC peak) and the resistance and continuity ranges will withstand an applied voltage of 500V. The current ranges are fuse protected, the μA and mA ranges by a 630mA fuse in series with a 3A fuse and the 10A range by a 20A fuse.

The 20 series meters are supplied complete with test probes, an operating manual and a spare 630mA fuse (located in the battery compartment). The test probes are of good design and feature finger guards and right angle banana plugs. Two alligator clips for attachment to the test probes are also supplied.

A wide range of optional extras is also available, most being general accessories designed for other Fluke multimeters. In addition, Fluke has available a hard carrying case for the 20 series meters and this is designed to provide maximum protection from knocks and bumps. The case also includes provision for the storage of leads and features brief operating instructions on the inside of the cover.

In summary, the 20 series meters are versatile, high quality test instruments aimed at the industrial market. While the average hobbyist may have trouble justifying the cost of these meters over those in the 70 series, most industrial users and tradesmen will have no such problems.

Recommended retail prices of the Fluke 20 Series multimeters are $440.80 for the Model 25 and $493.00 for the Model 27. These prices include sales tax. The hard carrying case is priced at $38.20, while a soft carrying case is also available for $29.00.

For further information contact Elmeasco Pty Ltd, PO Box 30, Concord, NSW 2137. Phone (02) 736 2888. Offices also in Melbourne, Brisbane, Adelaide and Perth.

Specifications

DC voltage

10MΩ input impedance, 1000V overload protection, 500V overload protection on 320mV range. CMRR 120dB at DC.

Range	Resolution	Accuracy
320mV	100μV	1% + 1 digit
3.2V	1mV	1% + 1 digit
32V	10mV	1% + 1 digit
320V	100mV	1% + 1 digit
1000V	1V	1% + 1 digit

AC voltage

AC coupled average sensing, calibrated for sine wave. 10MΩ impedance. Overload protection 1000V, 500V on 320mV range.

Range	Resolution	Accuracy 40Hz-2kHz	Accuracy 2kHz-10kHz	Accuracy 10kHz-30kHz
320mV	100μV			
3.2V	1mV	0.5% +	2% +	4% +
32V	10mV	3 digits	3 digits	10 digits
320V	100mV			
1000V	1V	1% + 3 digits	3% + 3 digits	Not Specified

DC and AC current

DC accuracy: 0.75% + 2 digits. AC accuracy (40Hz — 1kHz): 1.5% + 2 digits. Overload protection: μA/mA ranges, 630mA fuse in series with 3A fuse; 10A range 20A fuse.

Range	Resolution	Burden voltage
320μA	0.1μA	0.5mV/μA
3200μA	1μA	0.5mV/μA
32mA	10μA	5.6mV/mA
320mA	100μA	5.6mV/mA
10A	10mA	50mV/A

Resistance

Open circuit voltage < 2.8V. Overload protection 500V

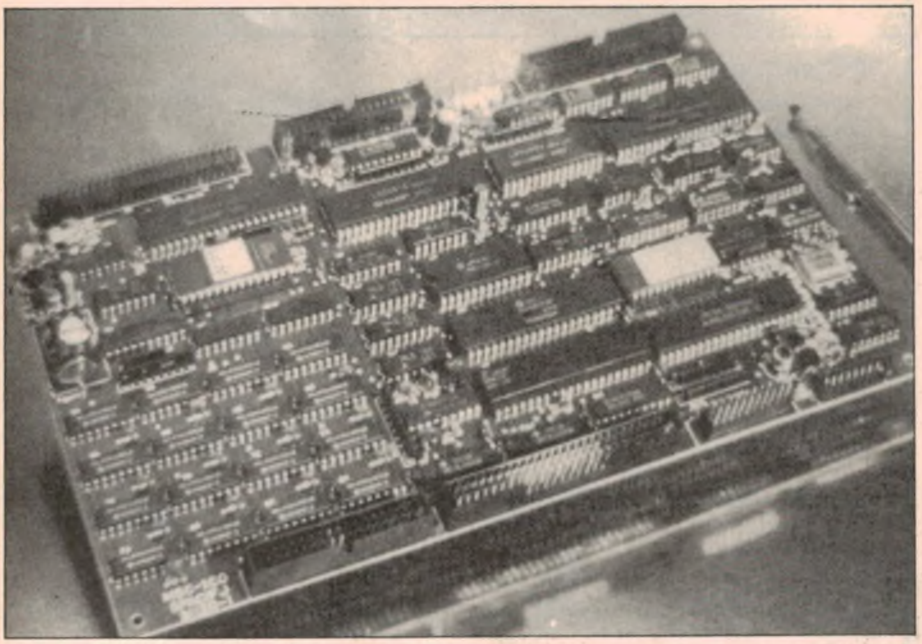
Range	Resolution	Accuracy
320Ω	0.1Ω	0.3% + 2 digits
3.2kΩ	1Ω	
32kΩ	10Ω	0.2% + 1 digit
320kΩ	100Ω	
3.2MΩ	1kΩ	
32MΩ	10kΩ	1% + 1 digit
32nS	0.01nS	2% + 10 digits

Diode test

Test current 0.5mA nominal. 2.08V full scale. Overload protection 500V.

General

- Operating temperature: −15 to 55°C (−40°C for 20 minutes).
- Shock, vibration and water resistance: per MIL-T-28800, for style A, class 2 instrument.
- Power requirements: single 9V (216 type) battery, 1000 hours life.
- Instrument size: 56 × 153 × 262mm (H × W × L)
- Weight: 0.75kg



Single board Z80 computer

The MSC-ICO is a powerful Z80-based computer designed for industrial, business, control and consumer applications. It contains many features normally only found in multi-board machines costing much more.

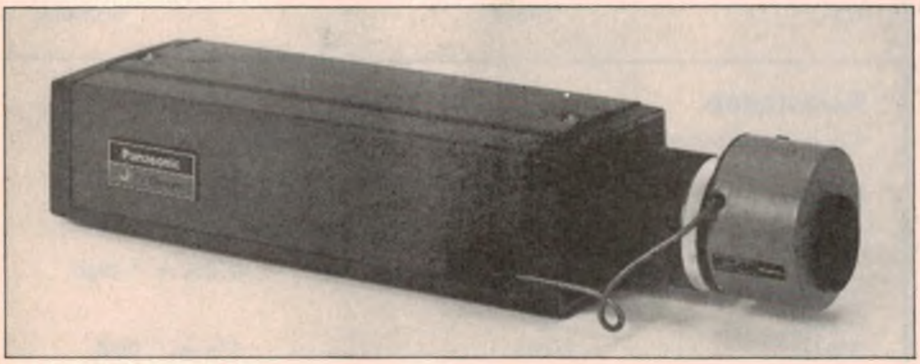
The system is designed around a 4MHz Z80 CPU and has 128K of onboard RAM. One bank of 64K is devoted to CP/M and its disk cache blocks while the remaining 64K is used by the application programs.

The design includes a high speed 80 x 24 line CRT controller which supports both composite and TTL video outputs. Floppy disk controllers for 3.5, 5.25 and 8-inch drives are also supported.

Interface is via two RS232C ports and a Centronics parallel port. Additional ports are a 16-bit TTL I/O port, relays, LEDs, DACs, ADCs and many other devices.

The MSC-ICO is supplied with a fully implemented version with CP/M Plus which is compatible with CP/M 2.2 and provides access to thousands of application programs.

Lamron Pty Ltd, PO Box 438, Ryde, NSW 2112. Phone (02) 808 3666.



New camera sees by moonlight

Security cameras that "see" in the dark — even when light levels are no better than average moonlight — have been released by the Video Systems Division of GEC Australia.

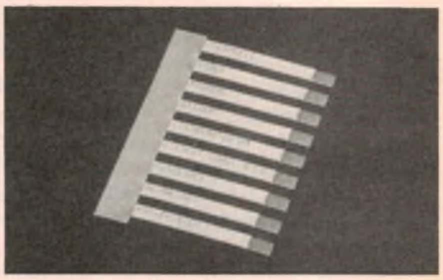
The WV-1900 "Moonlight" camera incorporates a highly sensitive 1-inch Newvicon tube with fibre optics and an image intensifier. It is ideal for security locations where the cost of extensive lighting is prohibitive.

Tests of the camera have shown that it can clearly reproduce the detail on a belt buckle 50 metres away in moonlight conditions.

The Moonlight camera also has automatic internal/external sync switching, built in protection circuitry for the tube and image intensifier and a rugged diecast chassis to protect it from rough handling in normal usage.

GEC Australia Ltd, Video Systems Division, 2 Giffnock Ave, North Ryde, NSW 2113. Phone (02) 887 6222.

Heat-shrink markers for cables



Gilbert Lodge & Company Ltd has just released the Raychem range of Thermofit Marker System products.

The Thermofit Marker System (TMS) is a proven method of producing permanent marker sleeves for identifying wires, cables, harnesses, connectors, pipes and panels.

TMS heat-shrinkable sleeves are supplied already expanded on reels in bandoliered form for ease of handling. Once the sleeves have been printed with the desired legends they are made permanent with the use of an automatic infrared heater (permatiser).

After permatising, the sleeves can be easily removed from the bandolier comb and slipped onto the relevant wire. Manual installation tools are available to aid this process. An automatic installation tool which further reduces labour costs by installing the sleeves on the wires at a rate of two seconds per sleeve is also available. The flat shape of the sleeve ensures that it remains in position for shrinking. Upon the application of heat the installed sleeves recover to a pre-determined diameter.

The sleeves have outstanding chemical resistance. They are not attacked by solvents normally used by the marine industry, such as lubricating oils and cable water blocking compounds, nor are they affected by aviation fuels such as JP-4 or Skydrol, etc.

Gilbert Lodge & Co Ltd, 1048 Dandenong Rd, Carnegie, Vic 3163. Phone (03) 211 7511.

Plus/4

Introducing Software That Comes With Its Own Built-In Computer

Word processing, electronic spreadsheet, graphic plotting and file management certainly need no introduction.

But a computer that has them all built-in certainly does.

Especially for under $600*.

You could easily say the built-in software alone is worth a lot more than the price.

But then again you could easily say the Commodore PLUS/4 computer alone is worth a lot more than the price. With 64K of memory, 60K fully usable, full size typewriter keyboard, four separate cursor keys, high resolution colour graphics, extended BASIC, split screen and windowing capabilities.

Turn on the power and judge for yourself. Write and edit letters, reports, papers and novels with the built-in wordprocessor. Do the books, the budgets, the projections, profit/loss statements with the built-in spreadsheet. Draw circles, boxes, complex shapes, images and combine them with text with the graphics program. Collect, store, organize and retrieve information such as mailing lists, inventories, personal files, business files and recipes with the file management program.

Go from one program to another at the touch of a key. For not only are they built into the computer, they're built into each other. So, for example, in one document, you can go from words to numbers to graphs to names and addresses. In just a matter of moments.

The Commodore PLUS/4. The first new computer that doesn't have one new thing about it. It has four.

For further information contact your nearest Commodore Dealer.

*Recommended retail price

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Victoria/Tasmania/South Australia: (03) 429 9855 Western Australia: (09) 389 1266 Queensland/Northern Territory: (07) 393 0300

BMS/CC365

New Products...

16/32-bit Unix-based transportable

The Integral personal computer, a 16/32-bit Unix based system, has just been released in Australia.

HP claim that the Integral is the first PC designed to provide the performance benefits of a ROM-based Unix operating system (HP-UX) in a package combining full integration, power and ease of use.

The Integral PC is believed to be significantly less expensive than other Winchester disk-based Unix systems and comparable in price with MS-DOS personal computers that lack the powerful capabilities of the Unix operating system, such as multi-tasking.

Main features of the computer include a transportable package with a built-in printer, a 3½-inch double sided disk drive, a 23cm electroluminescent display and a full sized keyboard. The Integral is based on the Motorola 69000 processor which provides fast response to user commands, including graphics.

Hewlett-Packard, 31-41 Joseph St, Blackburn, Vic 3130. Phone (03) 895 2895.

This Unix based computer from Hewlett-Packard features an electroluminescent display.

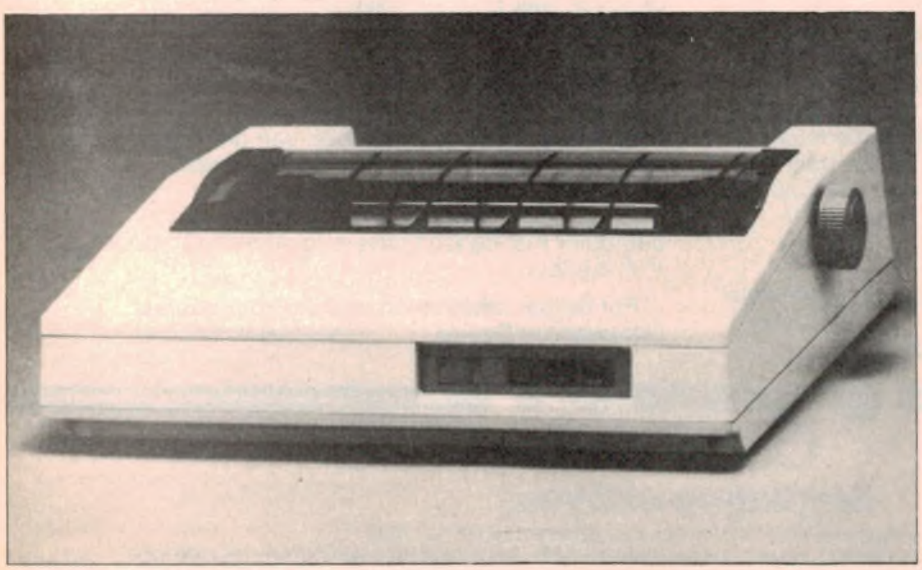
Dot matrix printer for PCs

C. Itoh has released a new low-cost dot matrix printer, the model 7500, for PCs. This embodies the same technology as their M8510/M1550 models.

Although print speed is rated at 105cps throughput is claimed to rival many printers with higher speed ratings. Operational features include code compatibility with the M8510/M1550 family, a proportional spacing mode, full graphics and a Greek character set.

Full character attribute versatility is provided, with bold, underline, double width, superscript and subscript available. Various fonts and character sizes are also available.

Warburton Franki, 7 Birnie Avenue, Lidcombe, NSW 2141.



The model 7500 printer features proportional spacing and a versatile character set.

The Welz coax switch from Dick Smith Electronics has low insertion loss.

Coaxial switch: Welz CH20A

Coax switch: Dick Smith Electronics now has available the Welz CH20A coaxial switch. This is a single pole, two output switch which features a double cavity layout, negligible insertion loss and crosstalk, wide frequency range and a low standing wave ratio.

BUILD IT YOURSELF & SAVE!

With the exchange rate through the floor and imported goods rising in price, it really makes sense to build your own gear!

You save a fortune because you supply the labour. And you get the satisfaction of home brewing all over again!

(1) 70cm amateur transceiver

Nearly 2000 now built: one of our most popular amateur kits. 40 channels on the 430-440MHz band. Everything supplied, including mic and full step-by-step instructions. Cat K-6300

$199

Upgrade kit for above:

Gives you repeater capability 'S' meter. Cat K-6302 **$24.50**

UHF Antenna Kit:

Suits above transceiver. Magna-base with co-axial mount, whip & cutting chart plus UHF grade co-ax & PL-259. Cat D-4014 **$28.50**

(2) amateur transceiver

The worthy 'brother' to the above set. Similar construction, (same case) with huge savings over the commercial rigs of the same standard. 40 channels & 5kHz offset. Cat K-6308

$199

VHF Antenna Kit

As above but with longer whip to suit 2m band (1/4 wave), and standard VHF antenna mount. Cat D-4024 **$28.50**

Matching Power Supply

To suit either UHF or VHF transceiver. 13.8V at 2A regulated. Cat K-6310 **$49.50**

(3) 'Glass RTTY for the VZ-200/300

$69.50

The low cost way to get into RTTY! Easy to build kit gives you full transceiver control and all 'wanted' RTTY features including WRU buffer, quick brown fox, etc. Works with the new VZ-300 too! Cat K-6318

(4) VK Powermaster (short form) Supply

$99

What a supply! Used with M-2000 transformer, you can get a massive 14A continuous or 25A pk from this monster! Build it with the transformer you want for the power you want. Cat K-3448

14A cont. Transformer: Cat M-2010 $54.50

6A cont. Transformer: Cat M-2000 **$24.95**

(5) 70cm preamp kit

Get more from your 70cm receiver. Preamp is easy to add, takes up minimal space and can be diode or relay switched. Cat K-6306

$19.95

(6) UHF Power Meter

A brand newey! Build a power meter for the 70cm band (also goes up to the CB band!) for top performance out of your UHF rigs. Cat K-6312 **$49.95**

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Yes please! I missed out (or someone has already pinched it!) Please send me a copy of the new Dick Smith Electronics Catalogue. I've enclosed a dollar and understand you'll give me the dollar back with a bonus coupon. Send to DSXpress PO Box 321, North Ryde, NSW 2113.

A-938

New Products...

TWT amplifiers for relay stations

Siemens has introduced two new high-linearity travelling wave tubes for radio relay applications. RW 1136 (10.7 to 11.7GHz) is designed for digital systems, while RW 1127 (11.7 to 13.25GHz) is suited for handling amplitude modulated TV signals. The tubes incorporate a power supply and a control unit, and operate with output powers up to 38dBm.

Siemens Ltd, 544 Church St, Richmond, Victoria 3121. Telephone (03) 429 7111.

New Siemens travelling wave tube.

Specialised ICs from Promark

Promark now have available several new special purpose ICs from Teledyne. Included are the ISC500 integrating converter; the TSC826 A/D converter with bar graph display output; and the TSC805 A/D converter with 3½-digit display with auto ranging. Both the TSC826 and TSC805 are supplied in 60 pin quad flat packs.

Promark are also importing a 30-point LED bar graph driver, manufactured by Telefunken. This IC is housed in an 18-pin DIL package and produces a moving spot display. Telefunken are also manufacturers for a series of high power IR diodes capable of providing output powers of up to 900mW.

Promark, PO Box 381, Crows Nest, NSW 2065. Phone (02) 439 6477.

Focus and grid potentiometers

Designed for colour TV receivers and monitors, the Philips MFV + Vg2 unit consists of focus and grid-2 potentiometers assembled together into an easy-to-mount plastic case. Resistors integrated on the shared cermet substrate ensure optimum accuracy in setting the potentiometers.

Mounting is quick and efficient — the unit is simply pressed onto a specially designed PC board. Four snap-locks ensure secure mechanical assembly while pins mounted on the PC board penetrate pads of conductive rubber to achieve the electrical connections.

The high-tension input and focus output are connected by pressing the cable, guided by a wire carrier, into another pad of conductive rubber. The grid-2 potentiometer may be connected via board-mounted pins or by the same method as the high-tension input and focus output.

Philips Electronics Components and Materials, 11 Waltham St, Artarmon, NSW 2064. Phone (02) 439 3322.

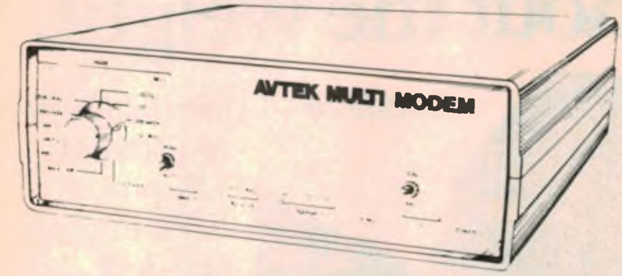
Monolithic power switching regulator

A cost effective replacement for costly hybrids, the SGS L296 power switching regulator delivers 4A at output voltages adjustable between 5.1 and 40V. The maximum input voltage is 46V and the device can be operated at frequencies as high as 200kHz provided some reduction in efficiency is acceptable.

The L296 is mounted in a multiwatt plastic package with 15 pins. The thermal resistance is 3°C/W between junction and case and 35°C/W between junction and ambient. This is comparable to that of the more costly metal TO-3 packages.

Ellistronics Pty Ltd, 797 Springvale Rd, Mulgrave, Victoria 3170. Phone (03) 561 5844.

ALL JAYCAR MATERIAL



AVTEK MULTIMODEMS

State-of-the-art multimodem - has the following data standards CCITT V21 & V23, BELL 103 & 202 · Data rates 300, 600 & 1200 BPS · Backward channel 75 BPS in conjunction with 1200 BPS · Computer interface CCITT V.24 (RS232C) · Power requirements 240V AC 3 watts. Talk to the world with this fine Multimodem.
Cat. XC-4820

INCLUDES PHONE

$349.00

MiniModem

★ 300 Baud full duplex ★ Answer/originate ★ Plugs straight in (hardware phone ★ Superior VLSI chip performance (identical to Multimodem) ★ Telecom approval C84/37/1173
Cat. XC-4825

ONLY $199.00
INCLUDES PHONE

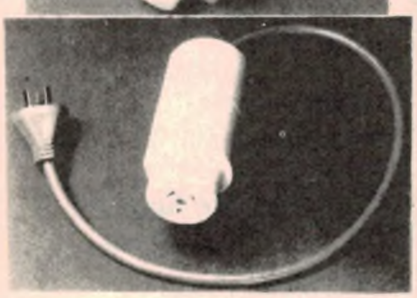
SQUEAKY CLEAN MAINS FILTERS

Two fantastic low cost models. MS-4010 will supply up to 4 appliances. Each 240V socket is isolated from the other, i.e. interference from disc drives is de-coupled from the CPU power supply etc. It will supply up to 4 outlets with a total load of 6 amps (unswitched).
Cat. MS-4010

ONLY $99.00

Single 10 amp line socket type filter (unswitched).
Cat. MS-4012

ONLY $29.95



UV EPROM ERASER

Erase your EPROMs quickly and safely. This unit is the cost-effective solution to your problems. It will erase up to 9 x 24 pin devices in complete safety, in about 40 minutes for 9 chips (less for less chips).

- *Erase up to 9 chips at a time*
- *Chip drawer has conductive foam pad*
- *Mains powered*
- *High UV intensity at chip surface ensures thorough erase*
- *Engineered to prevent UV exposure*
- *Long life UV tube*
- *Dimensions 217 x 80 x 68mm*
- *Weight 670 grams*

Cat. XE-4950

ONLY $79.50

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Hands-free 10 Memory Desk/Wall Telephone

- Loud and clear fully duplex handsfree 2 way speaker
- 10 direct access memories
- Telephone line powered
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- Adjustable speaker volume control
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- Ringer Hi-Lo control
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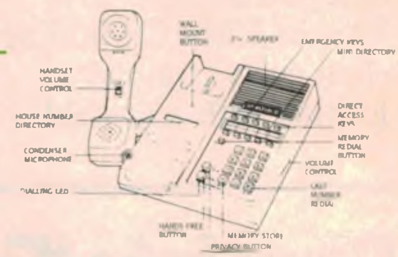

ALARM STICKER

Durable, self-adhesive sticker that clearly tells would-be thief that there is an alarm fitted. Sticker does not refer to a specific alarm which creates further doubt.
Cat. LA-5100

ONLY 95¢ each
10 or more 85¢ each

ONLY $4.95 each

ROBOT WATCH

Just what every child would love. It's a military look digital watch, which breaks away from the band to form a Robot. The robot has movable legs and arms with pop-out hands.
Cat. XW-0340

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FM TRANSMITTER MODULE

FEATURES:
- ★ Ultra low noise output (−60dB or better attainable with suitable tuner)
- ★ Excellent frequency stability
- ★ NOT a kit - ready for immediate use
- ★ Connections required: (A) Power supply or battery (B) Antenna (C) Audio input
- ★ Full instructions supplied
- ★ Suits any application where a stable low noise FM link is required

SPECIFICATIONS:
- Frequency 88 - 108MHz
- Useable range - 50 metres
- Supply - 6 to 9V @ 20mA
- Input sensitivity - adjustable - max. 30mV
- Pre-emphasis - 50us standard
- Dimensions 90 x 22 x 15mm (approx)

Cat. DT-5450

ONLY $59.95

SILICON VALLEY POSTER

This is a full colour caricature poster measuring 760(W) x 575(H)mm and is a full map of the famous 'Silicon Valley' area south of San Francisco.
The entire area spans from Mountain View thru Sunnyvale, Cupertino, Los Gatos, Santa Clara, San Hose, Fremont, etc!!
Famous semiconductor factories such as Fairchild, Hewlett-Packard, Intersil, Siliconix, NEC, Signetics, American Micro Systems and dozens you have not even heard of! Each factory is in its correct location.
The poster is full of cartoon characters and statements. You could stand in front of it for an hour and not take it all in!
We are convinced that you will be delighted with this poster. It is printed on very heavy art quality paper and is not cheap. Each one is supplied in a cardboard mailing tube. (No room for a picture) Cat. BP-9220

WALL MOUNTED PUSH BUTTON PHONE

This phone may look like those cheapies you see everywhere, but this one is different. It's Telecom approved and is supplied complete with plug. The sound quality is superb. It doesn't sound like you are talking into a shoe box, like some do. It's supplied complete with wall bracket and has a memory redial. Great as a second phone.
Cat. YT-7090 **ONLY $24.95**
approved

An Electronics Australia review

by PETER VERNON

Epson PX-8 lap portable computer

Want a portable computer with the CP/M operating system, built-in WordStar and spreadsheet programs and a host of add-ons and options? The Epson PX-8 may be for you.

Epson actually introduced the first briefcase-sized portable computer, the HX-20, in 1982, but its small 20 column by four line display and non-standard software quickly put it out of the running as more powerful machines appeared. The PX-8, Epson's newest offering, more than compensates, with a more versatile configuration and standard software running under the popular CP/M operating system.

Epson's PX-8 is a complex system, with many features and accessories and a range of options which can be confusing to the inexperienced user. Externally, it is one of the most compact portables available, measuring just 297 x 216 x 48mm when closed for transport, and weighing 2.3kg. A detachable plastic cover clips over the keyboard for protection while traveling and the 80 column by eight line liquid crystal display flips up and can be locked at any angle between 90 and 180 degrees in 15 degree steps. A slide-out carrying handle is fitted to the front of the console

The PX-8 is a true portable, easy to carry and able to be used anywhere thanks to internal rechargeable batteries which provide about 15 hours of operation between charges (less with extensive input/output operations). The batteries are charged by a 6V, 600mA plug-pack adapter which connects to a socket at the rear of the console, and it is possible to charge the batteries while continuing to use the system on mains power. A separate internal battery provides a backup facility which retains the contents of memory for a short time even though the main battery is discharged.

Applications software is provided in Read Only Memory modules, two of which can be installed in sockets on the bottom of the unit. As standard the PX-8 comes with MicroPro's WordStar (modified to use the PX-8 storage and communications facilities under the name "Portable WordStar"), a spreadsheet program called "Portable Calc", and a clock/calendar program for displaying reminder messages, called "Portable Scheduler". Two communications utilities TERM and FILINK, are included in the system software and a version of Microsoft Basic is also supplied.

A microcassette recorder is built-in, and up to 24K of main memory can be configured as a RAM disk emulator with battery back-up. Additional permanent storage is provided by battery powered 60K and 120K RAM modules, which are fastened to the bottom of the machine case, increasing the size and weight of the system.

The Keyboard

The keyboard of the PX-8 is comfortable and convenient to use. Fifty nine keys are provided, colour-coded in brown, tan, red and orange, with an additional nine programmable and special function pushbuttons above the main keyboard. The keys are large, with a firm, positive action and are arranged in a standard typewriter format except for the location of the CAPS LOCK and CTRL keys on either side of the space-bar.

Small folding legs on either side of the console can be used to change the angle of the keyboard to suit the user, but if a

This photograph shows the review model of the Epson PX-8. Note the built-in micro cassette drive and the flip-up display panel.

external RAM pack is fitted, the legs are superfluous. The RAM pack itself is sloped on the bottom to give the same effect, permanently.

On the left of the keyboard is an "inverted T" cluster of orange cursor control keys , a large red RETURN key and the NUM/GRPH key which acts as a second shift key to allow graphics codes to be entered from the keyboard and also (when pressed with SHIFT) re-defines a section of the alphabetic keyboard as a numeric pad for faster data entry. A small LED above the keyboard lights to show that the NUM key is engaged, and two more LEDs indicate CAPS LOCK and the Insert mode of the editor.

Five programmable function keys are available, which when used with SHIFT allow up to 10 pre-defined operations. The PX-8 is programmed with a default set of definitions which allow the most common CP/M commands to be entered with a single keystroke, while BASIC re-defines these keys to allow the entry of common BASIC statements. Other key definitions can be created by the user with the CONFIG system configuration utility program supplied, and optionally displayed on the last line of the LCD screen. Four other function keys are dedicated to particular operations, such as the HELP key, which (used with CTRL) produces a system status display. Other uses of the HELP key depend on applications software written to provide HELP functions.

An interesting feature of the PX-8 is that the keyboard layout can be changed by software, or by selecting a pre-defined format using DIP switches located beneath a cover on the bottom of the console. English, French, German and Scandanavian layouts can be selected. Most users will be content with the standard ASCII format supplied, so this feature is of limited value, but it does indicate Epson's determination to be all things to all people.

The Display

The PX-8 has a built-in 80 column by 8 line liquid crystal display which produces upper and lowercase text and 480 x 64 resolution dot graphics. The display quality is good, with an adequate range of contrast adjustment provided by a sliding control under the display, although the absence of lowercase descenders is a peculiarity. Lowercase letters with descenders (the tails of characters such as "j" and "p") are displayed as smaller capital letters in the middle of otherwise normal text.

Flexibility of the system is increased by a "virtual screen" arrangement which allows the text display format to be changed. The eight line display of the PX-8 can be set up as a "window" on a virtual screen of up to 48 lines. Normally the screen scrolls as the cursor is moved up or down, but a combination of keys (SHIFTS and INS) "freezes" the window over a particular portion of the display screen, regardless of movements of the cursor.

Other display options are also available, including formats of 16 lines of 40 characters each, displayed side by side in two groups of eight which scroll together, and two independently scrolling columns with widths defined by the user (to a total of 79 characters). Graphics are also possible, with a horizontal by vertical resolution of 640 x 64 dots and pre-defined symbols available from the keyboard.

The Hardware

The specifications of the PX-8 are impressive. No less than three microprocessors are used in the system, with a Z80 type main processor and two separate slave processors to control the display, I/O and keyboard.

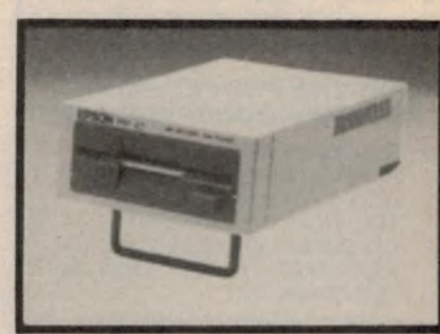
The standard system provides 64K of RAM and 32K of ROM, although the size of the programmable memory is reduced by the optional RAM disk feature and can be restricted further if the user chooses to set a size for the "User BIOS" area. This option is intended for programmers who wish to add their own functions to the system software, and create a protected area of memory to store custom operating system programs.

A battery-powered clock and calendar is provided, together with a wide variety of interface connectors and expansion options. A loudspeaker is built-in for sound effects, and there are two serial ports, a barcode reader port and a 6-bit analog to digital converter, plus a 50-pin expansion connector which brings out the full Z80 bus at the rear of the console.

Mass Storage

Storage on the PX-8 is a "belt and braces" approach. There are a number of ways of permanently storing programs and data in the system, some of which overlap.

The built-in microcassette drive is designated drive H by the operating system and stores files in the sequence they are written. Commands to handle the slower, sequential file access have been added to CP/M to cover the mounting and initialisation of a tape.



The disk drive uses 75cm 360K floppies.

Because files are stored sequentially along the tape and the file directory is stored at the beginning of the cassette, it is not feasible to update the directory on the tape each time a file is saved. Instead, the directory is updated in RAM, and only transferred to the tape during the "dismount" procedure used to change tapes. The CP/M commands for mounting and removing a tape cassette are intended to prevent problems which will occur if the tape is changed over at the wrong time. Because of the limitation on the size of the directory, a maximum of only 12 files can be stored on each microcassette tape.

Programs for the PX-8 can also be stored on "ROM capsules" which also appear on the PX-8 as if they were (write-protected) disk drives. Two 32K ROM modules can be plugged into the base of the PX-8, although only one is provided in the standard system, with BASIC and some CP/M utilities. ROM socket 1 appears as drive B and ROM socket 2 and drive C under the CP/M operating system. Portable WordStar, Calc and Scheduler are available in ROM modules as part of a separate "Software Library".

The third form of storage available for the PX-8 is a battery powered RAM disk. The standard system allows the user to allocate up to 24K of the internal 64K memory for use as a disk emulator, although the default value is 9K. This memory appears to the CP/M operating system as drive A. Use of internal memory as a disk emulator obviously reduces the size of memory available for data and program operation under CP/M, but does not provide enough space in the RAM disk for extensive file storage. Even the maximum 24K represents only six pages of text with one working file and one backup

Epson overcomes the problem by making available two external "intelligent RAM disks", one of 60K and the other of 120K. One of these optional modules can be connected to the bottom rear of the PX-8 console and fastened into place with four screws to form a self-

Epson PX-8 lap portable

contained unit. An external RAM disk module adds about 800g to the weight of the system and increases the height at the rear to 70mm.

When an external RAM disk is connected it appears as drive A and the internal RAM disk is disabled, making the full 64K of internal RAM available for use as programmable memory. The intelligent RAM disk unit has its own battery to maintain the contents of the memory when the PX-8 is not in use. Backup power is controlled by a switch on the rear of the RAM unit, which should remain ON unless the unit is disconnected from the PX-8 for a long time and the stored data is no longer required. A separate switch allows the RAM disk to be write-protected so that important data is not lost accidentally.

RAM disks are not a reliable way of transferring data between two PX-8s however. According to the manual "The battery does not allow the Intelligent RAM Disk unit to be disconnected and then used on a different PX-8 while still keeping the contents of the memory intact".

Additional external floppy disks drives can also be added to the PX-8. One drive was supplied with the review system. Known as the PF-10, this unit uses 75mm Sony "microfloppy"disks and provides 360K bytes of storage on each double-sided disk. A maximum of two external disk drives can be connected to the PX-8 and configured as drives D and E under CP/M.

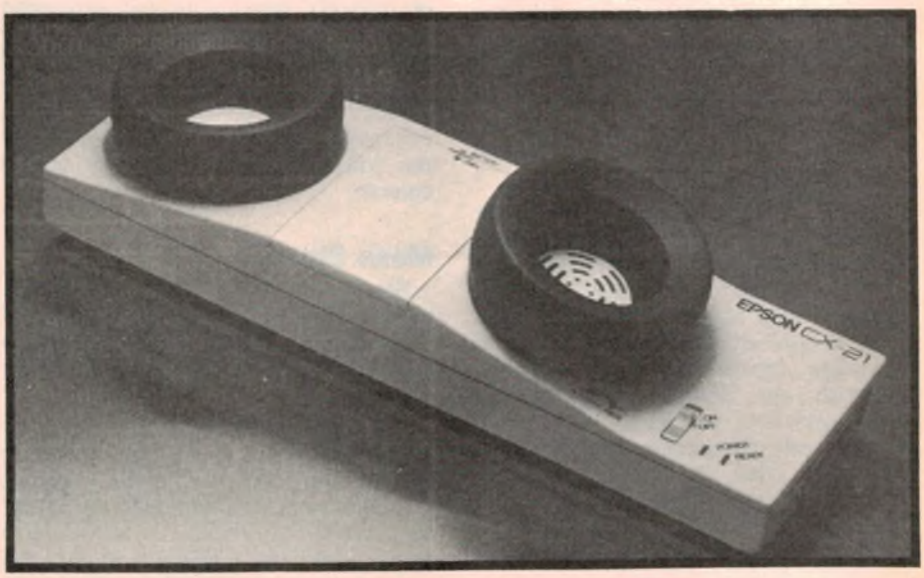
The PF-10 disk drive unit is very compact, measuring just 12 x 21.3 x 6cm (W x D x H) and contains its own batteries so that it can be used anywhere the PX-8 can be used. The batteries provide 90 minutes of continuous operation, and like those of the PX-8, can be recharged through a plug-pack adapter.

Connection of the disk drives is by way of a serial port, with a second drive connected to the serial output of the first disk drive unit. Because the serial link operates at 38,400 bps, data transfer from the disk drives is considerably slower than for normal, parallel connected disk drives.

There is a reference in the manual to applications programs which use data in ROM form. Such programs, according to the manual, "will have a command or specifically prompt you to change the ROM". The instructions require you to load BASIC and then switch the computer off, holding down the CONTROL key. The ROM is then changed, and on switching the power back on the system will automatically return to BASIC because the CONTROL/power off sequence restores the previous status of the machine. We were not supplied with any programs which required this procedure, but it is worth mentioning because of the potential for disaster for careless or inexperienced users.

The P-40 Thermal Printer

The Epson P-40 is a compact battery-powered portable printer that produces text on 112mm wide thermal paper. Normal, condensed, double-width and emphasised text is available in both 40



The CX-21 portable modem has been designed to team with the PX-8.

computer

and 80 column modes, with dot matrix characters formed on a 5 x 7 grid. Graphics can also be produced in two modes, with a resolution of 256 dots per line or 480 dots per line with a maximum line length of 89.6mm. Print modes and other operational parameters are selected by control codes sent to the printer by software.

Like the disk drive units, the printer is connected to the PX-8 by a serial line, although with a data transfer rate of 4,800 bps. The printing speed is a respectable 45 characters per second (normal print mode), and the P-40 is almost silent in operation.

Communications

In addition to the serial port used for connecting optional external disk drives or a printer, the PX-8 is provided with an RS-232C communications port which is well supported by the system software.

The port is normally set up to communicate with a printer, but parameters can be changed with the CONFIG utility prgram to allow data transmission speeds of up to 19,200 bps and various communications formats for different modem services.

TERM, the PX-8's terminal emulation program, allows the system to be used to transmit information from the keyboard and display information on the screen as it is received, and to transmit and receive files, although without any of the error checking and automatic re-transmission protocols of standard CP/M file transfer programs. The operating parameters of TERM cannot be changed once a session has begun — it is necessary to leave TERM and go to the CONFIG program.

A second, more sophisticated file transfer program is also provided, called FILINK, which supports specific communications protocols and is designed solely to transmit and receive files. The communications protocols supported, however, are not standard, and are apparently intended for use with Epson's larger QX-10 desktop system.

Epson's "Portable WordStar" has also been modified to use the RS-232C port to transmit and receive files. Two new commands (T for transmit and C for Receive) have been added to the WordStar opening menu to transfer text files from storage to a remote system, connected either by a serial cable or a modem. WordStar files are sent using the same parameters as the TERM program.

An acoustic coupler modem, the CX-21, is available for use with the PX-8. This battery-powered unit is a 300 baud, answer/originate modem styled to match the PX-8. Other Telecom approved modems could also be used, as the manual goes into great detail on connector pin-outs and exact requirements for the connection of accessory devices. Unfortunately, the communications programs of the PX-8 limit the usefulness of the system as an adjunct to a larger computer. The portable can be used as a "dumb terminal" for accessing dial-up data bases and other modem services, but the lack of support for standard file transfer protocols means that sending information to any computer except the QX-10 requires special software, which you may have to write yourself.

Software

Epson's CP/M has been modified, and at least does not just display the anonymous A> prompt when first loaded. When the PX-8 is switched on the first screen display lists the files available on drive B, a ROM module. These files include various CP/M commands and the applications programs WordStar, Portable Calc and Portable Scheduler. The first file name in the list flashes on and off, and pressing RETURN will select this file. Usually this is PIP, CP/M's file transfer utility. Other programs are selected by moving the flashing highlight with the cursor control keys, or the user may press ESC to enter the CP/M command mode (producing the A> prompt).

There are also many other options, including automatic start up based on the setting of the internal calendar and clock. With the powerful ARLARM and WAKE functions, the PX-8 can be turned on under software control and can be made to display a message or run a program without further intervention from the operator. Passwords can be added to the operating system so that the PX-8 cannot be used without entering the correct code.

Experienced users of CP/M can really go to town on the PX-8. In addition to a full implementation of CP/M and the usual utilities, Epson have added a User BIOS area, which allows skilled programmers to add their own routines to the CP/M command handler, completely customising the system to their requirements. Other additions include a complete tape operating system for the microcassette drive (called MTOS — Microcassette Tape Operating System) and extensions to support the unit's automatic power on feature, alarm

Epson PX-8 computer

and clock functions, high resolution graphics, a bar code reader and an analog input device port.

For new users, or those not interested in programming the PX-8, many of these features will be wasted except as they are used in coming applications programs. Inexperienced users may not even realise that the standard ws.com label on the display activates the WordStar word processing program, and the PX-8 provides no assistance other than this rather cryptic listing of available files. There is no self-explanatory start-up menu, as for the HP-110, for example.

We were provided with a copy of the "Software Library" mentioned previously. Apart from Portable WordStar, these two ROM modules also contain Portable Calc, a spreadsheet program, the Portable scheduler, which uses the built-in clock facilities of the PX-8 to allow the user to maintain a diary of appointments and schedule a reminder at the appropriate time and date.

The Basic of the PX-8 is fairly standard Microsoft, with enhancements to support the microcassette drive, RAM disk and RS-232C port. A variety of graphics statements and functions are provided to take advantage of the PX-8's abilities in this area, as well as statements to control the clock and calendar and supply of the computer.

The Basic program area is divided into five sections, allowing up to five different programs to be held in memory simultaneously, and a versatile screen editor makes entry of programs easy.

Expansion

The PX-8 provides a number of expansion possibilities. In addition to the serial ports for printer and modem and the external memory modules and disk drives already mentioned, there is an analog interface and a bar code reader interface. Using the analog interface, voltages from any other attached device can be converted into digital form for use in a machine language program, while the bar code reader interface supports standard reading wands as used in supermarkets, etc. The interface is not supported by BASIC or the PX-8 operating system however, and special software would be required to make use of this feature.

A 50-pin connector on the rear of the PX-8 console gives access to the system bus, including all processor address, data and control signals and battery status

This photograph gives an idea of just how portable the Epson PX-8 really is.

signals. The external RAM disk module is connected to this interface, but also mentioned in the manual is a "Universal Unit", which apparently is a printed circuit prototyping board which allows other circuits to be connected to the system bus. If you fancy a portable computer for experiments with hardware, the PX-8 maybe for you.

Conclusion

For CP/M users and experienced programmers the PX-8 is a powerful, versatile portable computer system. If you use WordStar, in particular, then you'll like the PX-8, although you'll need an external RAM disk if you plan on producing documents more than about six pages long.

If you are looking for a portable computer as such, then the availability of CP/M is less of an advantage and you'd be better looking at the presentation and ease of use of the software. Unless you want to learn the intricacies of a disk operating system, many of the features of the PX-8 will be wasted. Even the availability of thousands of programs under CP/M is no advantage unless you can acquire the programs in a format suitable for use with the portable, which means either down-loading over a communications link or transferring copies to a microfloppy disk drive in PX-8 format.

The communications capabilities of the PX-8 also fall short of the ideal. The emphasis on use with the QX-10 is understandable, since this system is Epson's desktop flag-bearer, but not a lot of them are in use. If you want to do more than access established dial-up services and bulletin boards, you'll need an experienced programmer to write file transfer programs to suit your requirements.

Prices

The standard PX-8 costs $1,300 plus sales tax. A 60K RAM disk is $404 and a 120K RAM disk is $570. Add-on disk drives are available for $720 and Epson's acoustic coupler is $209. The P-40 battery-powered thermal printer is $193.

Epson PX-8 Specifications

Processor: T84 (Z80 equivalent), slave 6301 for I/O and 7508 sub-processor controlling the keyboard and A/D interface.
RAM: 64K programmable, or less depending on the size of the internal RAM disk emulator. 60K and 120K external RAM disk available, 6K screen RAM.
ROM: 32K plus 2 x 32K plug-in modules.
Keyboard: 59 typewriter style keys, nine special and programmable function buttons.
Display: 80 x 8 line liquid crystal display screen with various text display formats, 480 x 64 dot graphics.
Interfaces: Two serial ports, A/D port, bar code reader port, expansion connector.
Power Supply: Nicad batteries mounted internally, rechargeable by external AC adapter. 15 hours operation per charge is claimed.
Dimensions: 297 x 216 x 48mm (w x d x h closed); add 30mm for external RAM disk height. 120mm height for display in working position.
Weight: 2.3kg console only, extra for external RAM disk if added.
Software: CP/M 2.2 disk operating system, BASIC, Portable WordStar, Portable Calc, Portable Scheduler and communications utilities in ROM modules.

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TECHNICAL SPECIFICATIONS

Operating System: DOS 2.0, 2.1, or 3.0.
Memory Requirements: Free memory is reduced by approximately 35K.
System Requirements: One hard disk and one backup drive (floppy, hard, or disk emulation tape).
Display Requirements: Standard 80x25 monochrome or color display.

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50 and 25 years ago...

"Electronics Australia" is one of the longest running technical publications in the world. We started as "Wireless Weekly" in August 1922 and became "Radio and Hobbies in Australia" in April 1939. The title was changed to "Radio, Television and Hobbies" in February 1955 and finally, to "Electronics Australia" in April 1965. Below we feature some items from past issues.

Wireless Weekly 3d

May 1935

Bone phone, 1935 style: Dr O. H. Caldwell, director of the American League for Noise Abatement, says that a radio armchair is being developed which has a bone oscillator in the head rest so that a listener has only to lean his head back to hear music or speech inaudible to anyone else in the room. The bone oscillator was invented in the first place for the deaf but Dr Caldwell suggests how useful it might be to businessmen, to pick up outside information without the knowledge of a caller, or for entertaining clubs the victims of bores.

Yankee know-how: American listeners can hear almost anything on the new "Stratosphere" receiver, which has 25 valves, three loudspeakers including a horn type "tweeter", a tuning scope from the top of the medium to 4.75 metres, five wave ranges, switch for "high fidelity" and costs 750 dahlars (sic).

Pedal-powered radio: natives pedal bicycles for two hours daily so that there will be enough electricity to keep the Peshawar station on the north-west frontier of India on the air. The bicycles drive a 12V generator.

The programs include news bulletins, talks on hygiene, agriculture, music and readings from the Koran.

Penance for radio listeners: the Archbishop of Prague was told by the Pope that religious transmissions were to be encouraged, provided that it was clearly stated that listening did not absolve the listener from attending mass.

Harbour Bridge interference: since the erection of the North Shore Bridge, there has been much controversy regarding its effect on radio reception in the locality. In some instances where the radio receivers failed to give the performance expected, "The Bridge" has been the standard explanation.

The definite proof as to whether the bridge does interfere with reception would naturally be obtained by moving the Bridge and noting the difference, if any. However, this procedure was decided against. The next best method was to take field strength readings in the locality concerned, and so obtain evidence of absorption, reflection, or any other effect.

After perusing the field strengths shown in decibels on the maps it is quite apparent that the Bridge does not throw any appreciable shadow on transmissions and that variations in the field strength are far more likely to be caused by topographical irregularities.

RADIO TELEVISION AND HOBBIES 2/6

May 1960

Electronic navigator: aerial navigation has in the past tended to be a rather hit or miss affair, owing to the unpredictable forces acting upon the aircraft.

Wind speed and direction may be constantly changing. A sudden wind change may take the aircraft miles off course before the pilot becomes aware of it. Naturally, his navigation instruments will show the true position at the next fix, but when he alters course to correct the error, a new set of conditions may arise.

Doppler navigation equipment provides the answer to this problem in a unique fashion. When fully correlated with flight data, the equipment displays the following information directly on the Instrument panel: aircraft position, distance to go, wind speed and direction, ground speed and drift angle, true airspeed.

Radar angels: in the frequently picturesque language which radar engineers have inherited from their wartime predecessors, an "angel" may be defined as an indication on a radar screen of an echo from some unidentified object.

For the past year radar engineers at the Marconi Research Establishment at Essex have been studying a new form of angel which is as puzzling to explain as it is impressive in appearance.

Starting like any other reflection as a spot of light, it spread outwards in the form of a ring, as a ripple spreads on a pond. No completely satisfactory explanation of these "ring angels" has yet been found. Observations over several months have established that they occur only half an hour before or after sunrise.

The confinement of the occurrence to the hour around sunrise suggests two possible lines of investigation: flocks of starlings and thermal activity.

Electric screwdriver: electricians and radio workers frequently have the need to determine whether a particular line is "live". Where a meter can not be used, a simple screwdriver and neon indicator recently released by Philips should prove invaluable.

The unit is a handy pocket sized screwdriver fitted with a pocket clip. It is capable of indicating voltages from 110 to 380V, AC or DC.

In use, the screwdriver blade is touched on the circuit to be tested and one finger placed on the cap at the opposite end. The body capacitance is sufficient to complete the circuit.

Television in 3D: three dimensional television for use in industry will be shown at the Instrument, Electronic and Automation Exhibition.

Developed by Pye, this new 3D system can be attached to any existing closed circuit TV installation. This is the first time in Britain that a 3D television picture has been made possible when using only one chain of closed circuit TV equipment.

The three dimensional effect is obtained by a mirror beam splitting system at the camera position and an arrangement of mirrors at the monitor end.

Next month in Electronics Australia

Rally Computer

This easy-to-build Rally Computer features three independent distance counters, 10-metre resolution, and a quartz clock/stopwatch. The clock and the distance counters can be set to count either up or down, and an alarm sounds when any count reaches zero. Details in June *Electronics Australia.*

Insulation Tester

Check the insulation quality of mains appliances, transformers, capacitors and other components with this handy tester. It uses a 500V DC to DC inverter running from a 9V battery.

Bridge Adaptor

Use this simple circuit to adapt any stereo amplifier for bridge operation. It allows a stereo amplifier to deliver four times its single channel power into an 8-ohm loudspeaker.

Hifi Reviews

Next month, we intend to review the Mitsubishi DP-205 compact disc player and the Kenwood 780(B) cassette player.

**Although these articles have been prepared for publication, circumstances may change the final content.*

REVIEWS OF RECENT

Records & Tapes

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TCHAIKOVSKY

Symphony No. 4 in F Minor. Chicago Symphony Orchestra conducted by Sir Georg Solti. Decca Digital Disc 414 192/1

The Decca Company recently issued a brochure setting out the number of recordings made by Solti. I did a Freddy Blanks and counted 32 including many complete operas and Wagnerian music dramas. And despite his balding greyness (see picture at right) records are still coming while their maker retains a freshness of outlook and plenty of fire. Some are issued here, others are not.

His Tchaikovsky Fourth offers much to admire. Tchaikovsky himself wrote to his friend and patron Nadezhda von Meck a fanciful account of the "meaning" of the symphony to which no special attention need be paid. But in the work itself, especially in the first movement, there is no disguising the mood of confused depression that filled his mind at that time.

Confused his thoughts may have been but there is no confusion in the way he constructs his symphony. There is a clamorous opening on the brass followed by a drooping waltz taken by

Solti with just the right languor which never lacks vigour. His reading goes direct to the mind and emotion and always without exaggeration. Some subordinate parts get more than their share of attention though whether this is due to the digital process or the conductor's direction is not clear.

His contrasts are unshakeable as evidenced in the beguiling daintiness of the second proper. Here the security of the attack and release make one look foward to the delights of the scherzo.

The second movement opens with a most expressive phrase so beautifully played that the player almost makes his instrument weep. I might mention here that the playing by the Chicago is of the very highest standard all through, the result of many years under Fritz Reiner and later Solti.

The Pizzicato scherzo with its multitude of Lilliputian accents goes marvellously without a note out of place; the recording technique makes every variety of tone and timbre shiningly clear.

Then comes the brilliant finale, its most important and oft-repeated theme accompanied mutely by most English musicians who play it with the words "Don't have any more more, Mrs. Murphy" or another very obscene few words that I cannot publish here.

Solti's tempo is very brisk indeed, almost tempestuous. It's a wonder everyone concerned doesn't become breathless. One gets the sense of it being rushed through for lack of time to finish. Here again Solti makes abundant use of contrasts. A well worth-while investment.

A new CBS complete set of Wagner's Lohengrin will be reviewed in the next issue of EA. (J.R.)

CHARLES IVES

Symphony No. 3. Orchestral Set No. 2. Concertgebouw Orchestra under Michael Tilson Thomas. CBS Digital Disc IM 37823.

The eccentric well-off New York insurance broker Charles Ives was a strange man to be writing music in the latter part of the 19th century. In his late works he used polyrhythmic and polytonal combinations as horrendously as the members of the Second Vienna School — Schonberg, Berg and Webern — some years later.

Much of his material was based on popular songs and revivalist hymns he had heard during his youth in Connecticut. The dissonance might have come from his father's habit, whenever a band played outside their house, to make young Charles play simultaneously the same tune on his cornet in a different key. His religious music was influenced by his organ playing in churches, finishing up in the leading New York Presbyterian congregation.

His compositions were seldom heard during his lifetime but interest revived some 20-odd years ago when Europeans heard with amazement music reminiscent of the 12-tone school which it had anticipated so many years earlier. Today it is much copied by trendy noise-makers, too many of which are encouraged in Australia.

It has little sense of design and a lot of it could be truthfully but briefly described as incoherent. It has however considerable historic importance.

The influence of his churchly activities can be found in the chromatic titles he gave to the items in his Orchestral Set No. 2 which accompanies his Third Symphony on the record under review. They read: An Elegy to our Forefathers, The Rockstrewn Hills Join in the People's Outdoor Meeting, From Hanover Square North at the End of a Tragic Day the Voice of the People Again Rose.

The Third Symphony is a middle period work written just between his early and mature styles. The church again shows its influence in the titles he gave its three movements — Old Folks Gatherin', Children's Day and Communion. None of the hymn tunes used are known to me. I failed to distinguish one despite the admirable sleeve notes by Paul C. Echols.

The first movement is only mildly dissonant and stately in a sort of religious way. And it is strange to hear an enharmonic structure underneath such dissonance as there is. There is little in the way of formal development though this might have gone unnoticed by me in such a strange environment.

The rest of the symphony follows much the same pattern. The fine Concertgebouw Orchestra play it under Michael Tilson Thomas without any great show of enthusiasm — dutifully is perhaps the best description. If you can spare the modest cost the record is well worth getting as a chronological curiosity. (J.R.)

POGORELICH

Chopin Recital. Ivo Pogorelich (piano). Items see below. DGG Analog Disc 2531 346.
Ravel: Gaspard de la Nuit.
Prokofief: Piano Sonata No. 6. Ivo Pogorelich (piano). DGG Digital Disc 2532 093.

I recently wrote of a great new young talent, pianist Cecile Licad. This month I have found another, Ivo Pogorelich, a Yugoslav still in his middle 20s. But where Licad has an Apollonian purity of style Pogorelich tends, whenever possible, towards self-indulgence. But he compensates for this youthful waywardness with a technique that is almost unbelievably brilliant.

I have had this Chopin recital of his lying around for some time but, when I started to play it, I disliked his reading of the first movement of the B Flat Minor Sonata so much that I didn't continue with the rest and put the record aside in case I needed one in an emergency. Then, on January 13 this year, Channel 2 broadcast a session of Pogorelich practising and later performing Ravel's Gaspard de la Nuit that impressed me so much that I went back to the Chopin and found many moments that delighted me.

His playing of the horrifyingly difficult Scarbo of the suite was almost incredibly brilliant. In fact, I feel justified in calling it inspired. The most formidable passages streamed away with ease under his magical fingers. I then sought some information about him.

He was born in Belgrade in 1958 and at the Warsaw competition in 1980 attracted much attention by his attire and mannerisms that he was placed second, much against the opinion of one of the judges, Marta Argerich, a pianist of considerable achievement herself. I can attest to his oddity of style by the January broadcast when he played in an ill-fitting suit and with his off-white bow tie all awry.

But his playing was marvellous. In Le Gibet he projected an image of a gallows at a lonely crossroads, the distant tolling of a bell and a corpse hanging from the gallows moving pendulum-like in a light breeze. In Ondine — the water nymph — the sound seems to acquire substance and become liquid while his performance of Scarbo, certainly one of the most difficult piano pieces ever composed, held me astounded. His evocations were both visual and tactile.

In his Chopin recital Pogorelich plays the B Flat Minor Sonata, the C Sharp Minor Prelude (Op 45), the C Sharp Minor Scherzo (Op 390), the E Flat Major Nocturen (Op 55, No. 2), and Three Studies, the F Major (Op 10, No. 8), A Flat Major (Op 10, No. 10) and G Sharp minor Op 25, No. 6). All have their great moments, even the Sonata after the unsatisfactory first movement.

When I write of Pogorelich's self-indulgence in this movement I do not mean the restaurant violinist's style I noticed recently in a recital by Cho-Liang Lin's Bravura disc. Pogorelich never descends to this sort of gush. There are just moments of distortion of tempo and over-interpretation. In the Gaspard disc Ravel makes such compelling demands on the player's technique that he hasn't the time to indulge in such whims.

By the way, after the TV broadcast the announcer stated that the record would be released the next day. I subsequently learned that it has been on sale for some time. (J.R.)

PUCCINI

Turandot. Complete opera in three acts. Eva Marton (Turandot); John-Paul Bogart (Timur); Jose Carreras (Calaf); Katia Ricciarelli (Timur) and others with the Orchestra and Choir (with the Vienna Boys' Choir) of the Vienna State Opera conducted by Lorin Maazel. CBS Masterwork Digital Discs (3) Sefel Records 13M 39160.

I was disappointed with this set. It was years since I had seen the opera so I thought I would read the first act libretto to refresh my memory. My first thought was how was it possible to set music to such utter rubbish. Yet Puccini had done it, sometimes eloquently.

Thus warned against this process I played the second act without looking at the libretto. This time, without the accompanying stage spectacle the seams in the music showed up noticeably. The last act is in itself unsatisfactory. Puccini had planned to finish the opera with a magnificent love duet. He died before he could accomplish this and the work was completed by a musical hack named Alfano. The result is a complete anti-climax.

Toscanini used to make a melodramatic affair about this. When he reached Puccini's last bar he would lay down his baton, turn to the audience and say "This is where the great composer died. I will not conduct further," whereupon he left the orchestra and let the leader finish the performance. One of the most magniloquent gestures I ever saw in a lifelong experience in the theatre.

But to get back to the recording. The dynamic range in this live performance in Vienna is so wide that it goes from the inaudible to the insufferable. There is hardly a steady voice in the cast, at any rate, among the principals.

Eva Marton who has acquired a reputation for her performances in the title role is here satisfied to scream her way through the part at ear piercing volume. Her character is meant to be icily repellant and in this she succeeds admirably. Even in her quiet passages she seems to be screaming.

Tenor Jose Carreras often comes close to bleating, without any heroic sense in his vocal characterisation. Much the same could be said about the rest of the cast. An added burden to the listener are the outbreaks of applause after each act in the live performances and sometimes at the end of arias. The opera over, one is left wondering how anyone could be bothered to have anything to do with such a frigid monster as Princess Turandot.

VIRTUOSO PERFORMANCE

Stravinsky: The Soldier's Tale. Principals of the Los Angeles Chamber Orchestra.
Shostakovich: Piano Concerto No. 1. Carol Rosenberger and the Los Angeles Chamber Orchestra, conducted by Gerard Schwarz. Digitally mastered stereo LP, Delos DMS-3014. [From P.C. Stereo Pty Ltd, PO Box 272, Mt Gravatt 4122. Phone (07) 343 1612].

If you are at all likely to enjoy a chamber/orchestral recording with bright, virtuoso playing throughout, this one is for you. Side 1 features seven principals of the highly regarded Los Angeles Chamber Orchestra, while side 2 features the full orchestra, with well known pianist Carol Rosenberger and trumpeter Stephen Burns.

In her detailed jacket notes, Laura Kuhn points out that "Histoire du Soldat" was composed in 1917, at a time when Igor Stravinsky was virtually a refugee in Switzerland. In a conscious effort to break from the lavish orchestral tradition of his native Russia, he teamed up with French speaking poet Charles

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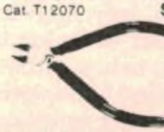

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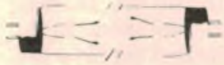

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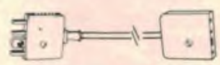

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Ramuz, with the idea of producing "something simple" that would not require the facilities of a large theatre, or the services of a full orchestra.

Inspired by a collection of Russian folk legends, his "Histoire du Soldat" is the story of a soldier on leave who encounters the Devil in disguise and trades his beloved violin for a worthless "magic book". Later, he manages to make amends and to win the hand of a beautiful princess, only to lose everything when he allows himself, once again, to be ensnared by the Devil.

Complementing the story are nine thematic miniature "movements", totalling 24 minutes of playing time and involving violin, clarinet, bassoon, trumpet, trombone, bass and percussion. But, if the story is legendary and moralistic, the music is (1917) contemporary French, Spanish and American, and marked by the composer's highly ingenious use of rhythm.

The Shostakovich Concerto on side 2 is also notable for its use of rhythm, plus colourful contrapuntal effects and frequent touches of humour. In separate jacket notes, Carol Rosenberger quotes the composer: "I hoped to write good entertaining music, which would be pleasant or even amusing . . . It gives me pleasure to see my audience laugh or at least smile".

My tip is that you'll thoroughly enjoy this recording — the music itself, the standard of the playing, the precision of Gerard Schwarz' direction, and the clean, clear sound of the digitally mastered recording. Recommended. (W.N.W.)

"PASTORALE" ON CD

Beethoven Symphony No. 6, "Pastorale". The Y Symphony Orchestra of New York, conducted by Gerard Schwarz. Compact disc, DMS Delos D/CD-3017. (From PC Stereo Pty Ltd, PO Box 272, Mt Gravatt, Qld 4122. Phone (07) 343 1612).

I reviewed this performance for the September '83 issue, before the compact disc version had become available and, in the main, my earlier observations still apply.

In his notes, Gerard Schwarz defends his use of a smaller than usual orchestra, on the basis that the Beethoven First, Second, Fourth, Sixth and Eighth symphonies "work" particularly well with an orchestra of between 39 and 42 players.

Historically, the No. 6 "Pastorale" symphony was composed around 1807/8, at a time when the composer's natural affinity for the woods was being heightened by his progressive loss of hearing and the embarrassment it tended to cause him in social situations. The symphony had its first performance in December 1808, at a concert in the Royal Imperial Private Theatre-An-Der-Wien, Vienna.

A mood of relaxation prevails in the first movement which in English, can be

titled (rather clumsily) "Awakening of Cheerful Feelings Upon Arrival in the Country". Duration is 10 minutes and 10 seconds (10'10").

The second movement "scene by the Brook" (12'25") continues the mood of relaxation, as the composer lingers by the mountain stream, translating into an impression, rather than into programmic sound, the setting which he could by then appreciate only with his eyes.

Movement three (5'06") is in quite a different mood, being inspired in part by Austrian tavern bands, which intrigued the Composer not a little: "Merry Gathering of the Country Folk".

This is followed by an even shorter fourth movement "Thunderstorm" (3'46"). In my earlier review, I speculated as to what Telarc might have made of this, with their penchant for musical drama. But while Swhwarz on Delos treats it more or less as a symbolic storm, rather than a sonic cataclysm, the modest orchestra still manages to "drum up" some very convincing thunder and lightning, with dynamic peaks flicking up towards 100W per channel.

Then, as all this fades into the distance, it leads naturally into the final movement (10'01"): "Shepherd's Song — Happy and Thankful Feelings After the Storm".

In my review of the original digital LP, I remarked on its transparent, clean sound and wide dynamic range. The first still applies by reason of the somewhat smaller but very capable orchestra; the other two qualities can be taken for granted, these days, on almost any well produced compact disc — this one included. (W.N.W.)

SUPURB ORGAN

The Ruffatti Organ in Davies Symphony Hall. A recital of works by Bach, Messiaen, Dupre, Widor & Franck. Organist Michael Murray. Telarc compact disc, CD-80097. (From PC Stereo Pty Ltd, PO 272, Mt Gravatt, Qld 4122. Phone (07) 343 1612).

For classical organ buffs, this new release has the potential to become the most played disc on all counts — instrument, content, performance and technical quality.

Built by the firm of Fratelli Ruffatti of Padua, Italy, the organ in the Davies Symphony Hall, San Francisco, made its public debut in April of last year, with Michael Murray featured during a week of concerts, both solo and in conjunction with the San Francisco Symphony Orchestra under Edo de Waart.

And what an instrument it is, to judge by this recording. Statistically, it has 7,373 pipes in 132 ranks but, more importantly, it has the control and tonal flexibility necessary to provide "transparency" for early compositions, massive climaxes for music of the "romantic" period, and the "different" sound required by the modern European school.

Those who have been delighted by the transparency of the organ in the Sydney Opera House, or have alternatively thrilled to the massive power which can be unleashed by the organ in the Sydney Town Hall, will hear evidence of all this

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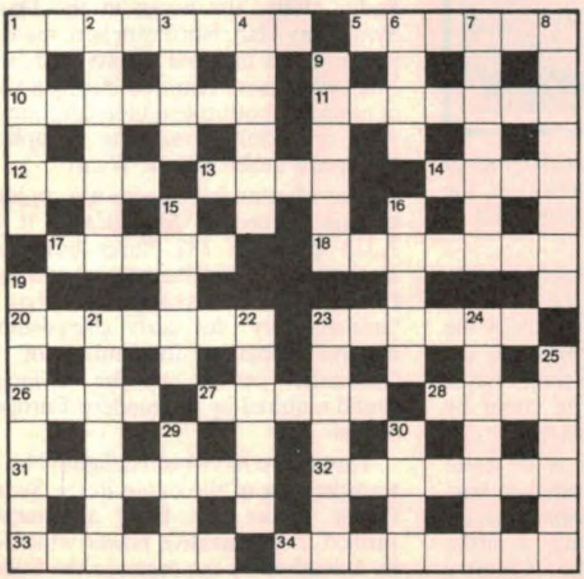

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26. *Oxide layer on molten solder. (4)*
27. *Positive ion. (5)*
28. *Form of energy propagation. (4)*
31. *Logic circuit. (3,4)*
32. *Passage of heavenly body. (7)*
33. *Circuit arrangement. (6)*
34. *Low temperature switch. (8)*

DOWN

1. *High level computer language. (6)*
2. *Loss of charge. (7)*
4. *Type of transformer. (6)*
6. *Extract information from memory. (4)*
7. *Crystal structure. (7)*
8. *Hearing aid. (8)*
9. *Computer malfunction. (4,2)*
15. *Prefix indicating a factor of 10^{-15}. (5)*
16. *Boot— circuit. (5)*
19. *Oscillator components. (8)*
21. *Noise of natural electric discharge. (7)*
22. *Determined distance by radar. (6)*
23. *Amplifier. (7)*
24. *Less fine-pitched. (7)*
25. *Generic title for electrons and positrons. (6)*
29. *Transistor terminal. (4)*
30. *Saintly light. (4)*

SOLUTION FOR APRIL

Records & Tapes

and more from the new Ruffatti in San Francisco.

The program selected by Michael Murray for his generous 67-minute recital is obviously designed to show off the qualities of the instrument.

Tracks 1 to 8, from the music of Johann Sebastian Bach combine his prelude and Fugue in C (BWV545) with seven preludes to old Lutheran chorales, each the subject of a brief note in the booklet but, no less to the point, each providing an appropriate opportunity to demonstrate different stop combinations and solo voices.

But, suddenly, after 30 minutes of traditional Bach, Olivier Messiaen bursts on the scene with his Dieu parmi Nous (God among Us) which reveals the organ in its full, awesome acoustic power and complexity.

This is followed by the Prelude and Fugue in G minor by Marcel Dupre (under whom Michael Murray studied) and by two other eloquent items: Adagio, Symphony No. 6 (Charles-Marie Widor) and Final in B-flat (Cesar Franck).

Throughout the whole lengthy and varied recital, Michael Murray gives the impression of being completely at one, both with the music, and with this most modern of concert organs, with its enormous power and dynamic range.

As for the disc, it handles it all without any hint of distress. Whether your loudspeakers will be able to cope, particularly in the bass register, you will have to find out the hard way! Highly recommended. (W.N.W.)

OLD TIME HYMNS

Best Loved Inspirational Hymns, Vol II. Stereo LP, Word SPCN7-01-892310-7. [From Word Records Aust, 18-26 Canterbury Rd, Heathmont, Vic 3135].

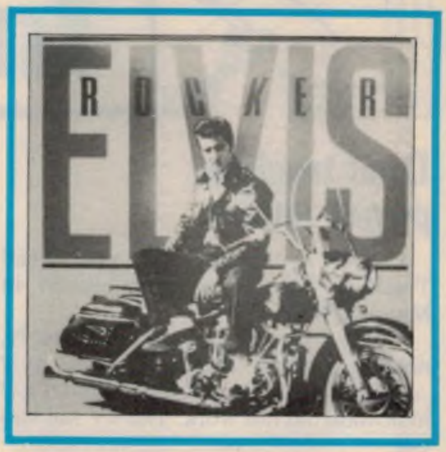
Here's another album intended for those for whom contentment is a quiet room, an easy chair and the sound of timeless inspirational melodies.

In this case, they are provided, not by a vocalist or a choir but by a full (although un-named) orchestra. The arrangements provide variety, with a predominantly string sound but never stray far from the basic — and familiar — melodies.

There are no words but who, in the intended audience would need them for the following titles, as selected by Kurt Kaiser?

The Old Rugged Cross — I Love to Tell The Story — Swing Low, Sweet Chariot — Be Still, My Soul — May the Good Lord Bless and Keep You — What A Friend We Have in Jesus — I Surrender All, I Need Thee — Just a Closer Walk — Jesu, Joy of Man's Desiring — How Great Thou Art.

If you're a hifi buff, you may notice a touch of "zizz" on the high strings in the loud passages but, generally speaking, the sound is full and well balanced. Worshippers from way back should enjoy each and every track. (W.N.W.).



ELVIS RE-ISSUE

Rocker Elvis. Digitally re-mastered stereo LP. RCA Victor APL1-5182.

A small note on the cover warns the purchaser that this album "Contains previously released material" — scarcely a matter for surprise, with unissued Elvis recordings as scarce as gold nuggets at the end of the rainbow, and just about as valuable!

According to another note, all tracks have been digitally re-mastered from the original tapes — a process that should ensure sound quality off disc about as good as it can be. However, there is little evidence of any attempt to simulate stereo spread.

Originally recorded in the 1956/57 era, the track titles are: Jailhouse Rock — Blue Suede Shoes — Tutti Frutti — Lawdy Miss Clawdy — I got a Woman — Money Honey — Ready Teddy — Rip It Up — Long Tall Sally — Baby I don't care — Hound Dog.

Technically, the sound is quite good and to my inexpert ears (in such matters) there is no lack of the requisite Elvis vibes. (W.N.W.)

Information centre

Dual tracking power supply

I have a problem with your Dual Tracking Power Supply published in March 1982.

When I first built this power supply, nothing worked. The +22V was only +11V and the regulator drop-out LED indication did not work. The 5V rail was OK.

On checking components I discovered that the low +22V was due to two of the 2% resistors being the incorrect value. The 100kΩ 2% resistors on IC1 were 1MΩ, not 100kΩ as they should have been.

The remaining problem is that the regulator dropout LED does not work. All resistor values have been checked and I have tried changing the 1kΩ resistor in series with the LED of IC2 without results.

I used 6V light bulbs for the load and tried series and parallel combinations to check the regulator dropout operation. (G.H., Tuart Hill, WA).

● Op amp IC2 is used to monitor the voltage across the LM317 regulator. When the voltage between input and output falls to less than 3V, the output of IC2 goes low to light the dropout indicator LED.

To test for regulator dropout indication, the output voltage should be set to maximum and the output loaded to about 1A. Two 10Ω 10W resistors connected in series will provide a suitable load.

If the dropout LED does not light, check that there is 3V across the power LED and series diode combination. You should also check the op amp supply on pin 7 and the indicator LED.

Note that altering the 1kΩ resistor in series with the LED only changes the LED current. Similarly, changing the 22kΩ resistors at the inputs to IC2 has little effect on the comparator operation.

Problem with the digital engine analyser

I have a problem with my Digital Engine Analyser (EA, October 1980). It has been working quite well for a couple of years until just recently when it suddenly failed. When the unit is connected to the battery and set to read "battery", the display shows all zeros.

When set to "dwell", it also reads zero for 4, 6 and 8-cylinder settings (points lead connected to chassis). On the "tacho" range, the readout changes from 0 to 160 at approximately 0.5s intervals. In each case, the decimal point is correct.

Can you please tell me which component is faulty? (L.B., Mourilyan, Qld).

● From your description of the symptoms, it appears that there is a problem with that part of the circuit concerned with generating timing signals. The clock itself (IC3) is working correctly, as evidenced by the changing digits when in the "tacho" mode.

We suggest that you check the divider IC (IC1) and also ICs 4 and 5 which generate the reset and latch signals for the 74C926 counter. These are all low-cost CMOS devices, so replacing them is probably the way to go (assuming a close visual inspection reveals nothing amiss).

No stereo from AM decoder

I recently constructed the AM Stereo Decoder (October, 1984) and have tried unsuccessfully to obtain a lock condition using the IF signal from a communications receiver and from an RF signal generator.

In both cases, the voltage on pin 19 of the IC rises to a maximum of 3.6V when the slug is adjusted. When viewed on an oscilloscope, there is a very erratic high frequency component present on the pin at this voltage. Pin 10 shows erratic voltage fluctuations at the same slug setting and cannot be settled anywhere near the prescribed voltage of 4.3V.

I have tried adding and subtracting one turn at a time from the coil with no better result, although I am suspicious of the number of turns you quote (50) as this is impossible with the 200mm length of wire specified. I have double-checked the value of every component on the PCB and have replaced the 0.47μF electrolytics with tantalum capacitors as per the Notes and Errata. (P.S., Carlingford, NSW).

● The number of turns specified for the coil is correct. The parts list should have specified 800mm of 0.125mm enamelled copper wire, not 200mm.

Digital Capacitance Meter

My particular problem is the Digital Capacitance Meter. I eventually got it working, but as the display switches on and off very quickly, I sought assistance from someone who undertakes part-time work. This person told me this was normal, but he had thought out how to freeze the display. This consists of another switch, above the power switch, and the track is cut between Pin 5, IC2 and pin 5 IC4. There is a link on the PCB which supplies the break.

From the unused solder lug on the switch, a 4.7kΩ resistor is taken to chassis earth. Unfortunately, I forgot the resistor, and though it was installed later, from that point the display started going haywire. Finally, it broke down completely.

The trimpot for setting the nF range can be turned back and forth, full range, but the display just stays on 0000. It would seem something has broken down, but I have traced voltages right through the circuit.

Since the purpose of using this meter is to select 1% capacitors in the nF range, and I have reference capacitors in the nano and pico ranges, at 0.5%, I am most anxious to have this problem solved. For your information the display does freeze when the switch is switched on to "freeze", or did before break down.

The pF range shows display figures which vary when the meter is switched on; the μF range has the last figure changing while the first three figures are 000. However, adjustment to the calibration could give the μF range an entirely different set of numbers in the display. (M.R., Surry Hills, NSW).

● From your description it appears that there is a fault in the latch enable circuitry (pin 5) of IC4. It is likely that the IC itself is damaged. We suggest you restore the circuit to the original condition. If it still does not work, IC4 will have to be replaced.

Since you have an oscilloscope, check the frequency of the LC oscillator at pin 17 and compare this with the IF input. The LC oscillator should run eight times faster than the IF. If your oscilloscope is a dual trace type, use the XY selection for Lissajous comparison of frequencies.

It should be possible to vary the frequency of the LC oscillator by adjusting the slug. If the oscillator does not appear to be in lock, check that the IF signal level is somewhere between 500mV and 1V peak-to-peak. You should also check the phase detector, components on pin 19 and, in particular, the polarity of the 33μF capacitor.

It should not be necessary to alter the number of turns on the coil.

Finally, the VCO can lock with pin 19 anywhere between 3V and 5.5V (typically 4V in this design). Once locked, pin 10 should be at 4.3V or above.

Two-terminal breakerless ignition

Having read your article on the Breakerless Ignition for Aussie Cars (September, 1984), I note that a Siemens Hall effect sensor was used. This device has three leads and so do all of the magnetic pickups used in commercial electronic breakerless ignition systems.

I would like to point out that the Kawasaki 500cc 3-cylinder 2-stroke motorcycle of 1969 had breakerless CDI. The magnetic pickup coil had only two leads. It seems a bit strange to me that every type on the market uses the special Hall effect sensor. Perhaps it would be possible to publish a circuit with a two-lead pickup? (D.S., Newtown, Qld).

● A breakerless ignition circuit using a two-terminal Hall effect sensor was published in December 1983.

Speed control for motors

In the December 1984 issue of Electronics Australia, I noted a Speed Controller for electric drills with a 3A rating. I would like to construct such a device and apply it to a 1HP 240V single phase brush motor with an inbuilt starting circuit and a rating of 3.8A.

Could you please advise if the circuit can be used with this motor and, if not, what modifications are necessary. (C.K., Sawtell, NSW).

● From your description of the motor, there is a possibility that it is not a universal brush-type motor. The problem is that you say that it has an inbuilt starting circuit. You can gain a few clues about the motor by looking at its rating plate. For example, if its speed is close to 1500rpm (eg, 1480) then it is almost certainly an induction motor, which is not suitable for this circuit. Only if you are sure that you have a brush-motor can you use this circuit, provided a heatsink is fitted to the SCR. The most convenient method of providing heatsinking is to bolt the SCR to the bottom of the metal case and to solder its leads to the underside of the PCB. The metal tab of the SCR should be isolated from the chassis using a mica washer and an insulating bush (see diagram July 1984, p83).

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Ignition killer for Commodores

In reference to the project "Ignition Killer for Cars", February 1984, I am very interested in this article as I think that, together with an alarm, this is the ideal protection for the car.

But, my big problem is the fact that I own a VH Holden Commodore with the electronic ignition. I hope that the

Ignition Killer can somehow still be adapted. If so could you please inform me of the correct connections. (W.M., Belmont, Vic).

● The Ignition Killer was compatible with previous model Commodores which had electronic ignition and we are not aware of any reason why it could not be used with the VH model. The unit should be wired as suggested in the original article, with the relay connected to the negative side of the coil. This is marked on the Commodore coil with a moulded negative sign. We suggest you also incorporate a 10Ω resistor in series with the relay to prevent any possibility of coil damage.

Digital readout for shortwave receivers

I recently purchased a kit for your Digital readout for Shortwave Receivers, as it appeared in your October 1982 edition. Unfortunately, it does not work.

The kit works partially in that it displays the "9545" as described, but this does not change upon the application of a signal. The signal I have been using is the 4MHz signal from the on-board oscillator fed to the external preamplifier described. Toggling the range switch produces the required display, but the unit still does not register a signal.

The 4MHz oscillator works correctly as I have connected its output to my receiver, a strong carrier being noted. I have replaced the transistor on the outboard preamplifier but this yielded no results. I have also replaced the 74LS196 ICs without success.

My construction of the kit has been as described in the article, with the exception that sockets were used for the ICs. I have made limited tests with a multimeter (my only piece of test equipment) but am unable to locate the fault. (S.A., Sylvania, NSW).

● First the good news. The fact that the unit shows "9545" indicates that the counter circuitry (IC5-12) is functioning correctly. Now the bad news: the fault lies either in the input preamp/divider stages (IC1-4) or in the reference frequency divider chain (IC14-19).

To diagnose the problem, try feeding the 4MHz signal directly into pin 8 of IC2 (disconnect pin from collector of Q2 first). If the unit now operates correctly, the fault lies in the preceding preamplifier stage. One of the transistors in the preamplifier could be faulty, or the PCB pattern could be open or short circuit.

If the unit still does not work, check that the CO of IC19 (pin 12) is oscillating. A voltmeter connected to this pin should read 2.5V (ie, 5V, 50% duty cycle). Similarly, the outputs of the preceding ICs should also read 2.5V. Note also that pins 2 and 7 of IC19 should read 0.5V.

If any of the outputs are permanently high or low (ie, 0V or +5V), then either the IC is faulty or there is no signal from the preceding stage.

Railmaster train controller

I recently built up the Railmaster Train Controller featured in your September 1984 issue for my son. The controller is excellent and the train runs much cooler than it did on the controller supplied with it, not to mention the advantages of better control.

I have one problem. The remote control will not operate. When the Local/Remote switch is switched to remote the overload buzzer sounds in a rather gruff, husky tone but the overload LED does not light. This happens whether the remote unit is plugged in or not. When the track is shorted out, the buzzer gives a clear high pitched sound and the overload LED lights normally.

Was there a mistake in the circuit diagram or circuit overlay? I have checked and rechecked my wiring etc. I have not been able to check the October issue of EA for any modifications in Notes and Errata but I have checked every issue since then. Can you please assist me? (G.R., Donnybrook, WA).

● As far as we know there is no mistake in the wiring or circuit diagrams for the Railmaster Train Controller. If the remote control is not plugged in, the output of the unit will quickly rise to maximum when switched to remote. This should also cause the track LED to glow brightly. We can only suggest that you carefully check the wiring of the remote socket.

Notes and Errata

HEE-HAW SIREN (March 1985, File 3/MS/115): There is an error in the text at the bottom of the second column on page 68. The text should read: "all the inputs must be high before the output will go low".

AUTO-CHIME MODIFICATION (September 1984, CDI): The circuit incorrectly shows a 150Ω resistor in series with the collector of the BD140 output transistor. This resistor should go in the emitter lead.

BRAKE LAMP FLASHER (November 1984, File 3/AU/42): in some circuits, there may be a reset problem with the 4017 (IC2). If this happens, the accessory lamps will not flash but will stay on whenever the brake pedal is depressed. This problem may be cured by connecting a 150kΩ resistor across the 22μF capacitor.

Musical Doorbell . . . *continued from page 74*

of a .01μF capacitor and a 1M resistor is connected to pin 15 (reset).

One aspect of IC4's operation bears further discussion. As the output of IC4 would normally shift immediately from one frequency to another, it is necessary to impose a brief delay between notes. This is particularly important where two adjacent notes are the same. Without a pause, the result would be one long (double count) note. The necessary pause is achieved by utilising the reset (pin 4) of IC4.

Taking the reset of the 7555 low inhibits the oscillatory mode of operation and causes the output to stay low. Notice that there is a connection from the output of IC1, via a 100kΩ resistor, to the reset of IC4. Since the output of IC1 has a 50% duty cycle, IC4 is enabled for only 50% of each note. The remaining 50% of the note is thus muted, thereby providing the pause.

Actually, the pause can be defeated by the insertion of an extra diode with any note. This diode connects the respective 4017 output to the reset pin of IC4, thereby preventing this pin from being pulled low. Should this option be used, the extended note will continue until the beginning of the following note.

One disadvantage of using the reset of IC4 is that it tends to produce a click from the speaker at the beginning of each note period. Where a note is actually played during that period, the click will not be apparent. Once the tune has finished, though, there will be no sound to mask the click and so it must be suppressed. This is the purpose of diode D1 connected between the "9" output of IC3 and the pin 2 (trigger) of IC4. Once the circuit has cycled through the 18 notes, pin 2 of IC4 is pulled high causing pin 3 to stay low. ●

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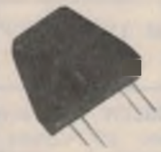

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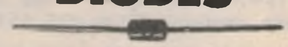

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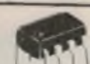

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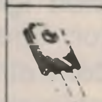

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- 19 range timebase • Triggers to over 30MHz • 17nS risetime

2 BS810 - 100MHz/1mV with 4 Channels and 8 Traces

- 2nS/div max sweep time
- Alternate time base with B ends A mode • Variable trigger hold-off
- Independent position controls
- Signal delay

3 BS625 - 45MHz/1mV with Signal and Timebase Delay

- Single sweep • Trigger delay
- 7.7nS risetime • X, Y, Dual, Chop, Add, Subtract etc

4 BS310S - 15MHz/2mV Battery Portable

- Ideal for field service use
- 2 hour operation from built-in NiCads • Automatic re-charging
- Auto trigger free run • TV sync

5 BS320 - 15MHz/2mV with Digital Storage and DMM

- Built-in 3½ digit multimeter
- Digital storage mode • Trigger delay • X-Y mode component tester • 3 channel operation for 3-phase measurements

6 BS635 - 35MHz/1mV with Alternate and Delayed Timebase

- 21 range timebase • 100mS-1uS trigger delay • Front panel trace rotate • Multi-mode display

Optional carrying cases available for all 'scopes.

Coline Probes

A comprehensive range of probes and accessories is available. Modular types have pencil slim heads and detachable earth leads. They offer excellent pulse responses and very wide bandwidths. A comprehensive catalogue is available on request.

SP100 - 100MHz Probe

With x1, ref, x10 positions. 1.5m lead, BNC connector and selection of tips in heavy duty pouch.

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