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OCTOBER 1978 VOLUME 54 NUMBER 6 ISSUE 860

BRITAINS LEADING JOURNAL FOR THE RADIO & ELECTRONIC CONSTRUCTOR

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to Logic" has been held over due to pressure on

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coll, price **Clo 95**. (3) of the permittion mains driven motor, 2 walls also autable only for limers or other lightweight operations,

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30-80°F or fower or higher. 30p-44p each, 10 for 24 59+36p. Car Speakers. Two bargains this month both elliptical, both 4 ohm site price £1:56 plus 10p, post 60p. Immersion Meater thermastate made by Satchwell 7", 11" and 17" (ength slandard fit in most inmersion heaters, £2 10. Thermostat Pocket. To fit the above thermostat into a lank without heater then you need a pocket to hold this thermostat, 13" long threaded complete with nut and washer, price £1 42 -also evailable 3" long for 7" thermostat and price £1 42 -also evailable 3" long for 7" thermostat and price £1 42 -also evailable 3" long data bi-metalle strip causes without heat coil wound around a bi-metalle strip causes awitch on after a lime which is adjustable. The energiaing voltage varies belween 4y 5 7y time delay time-from a few aeconds upwards price £1 43. Boller 51al 50-90°C remote philal type capillary length approx, with control knob marked 20 to 80°C, price 57-14p.

Transition holder for TOS (OC 26 stc) allows (transistor to be replaced quickly, also threaded for holding screws. AC conaction 1 25ul for 40 volts rms. Atuminium can with to connections as new aquipment coverad by normal guarantee Do-100. 0+2

30p+2p. Mains operated Siren. Don't let intrudars get sway with your possessions-they will never stay in a house when one of these sitenes is going. Quite small bui very starming £313-59. Lever Switch as fitted to modern telephone switch boards. 8 pole changeover contacts made by PyerIMC biassed to return when pushed up, stays fown when pushed down, order £1 dop. price £1 dip

Puising Switch. Motorized unli which gives puises every 30 seconds, length of puise can be adjusted up to 30 seconds and the puise can be up to 20 amps at normal meins vollage. Made up by famous Cramer Company of America, the drive motor of this device is at 15% 50% but we aupply complete with aeriss voltage dropping device to make it suitable for our meins. This is in a cylindricel phasic case overall aits, wilh a knob on the front for adjusting the puise fongth. 20 amp switch "inside" is a changeover switch ao this device could size be used as a time sharing switch, when one circuit is on the other circuit would be off for a length of time determined by switch control setting, price 54-92.

Catemplaci by switch control setting, price 44-82. 16 Line Connecting Box. This is 16 way livin grub screw type connecting atting mounted in a standard 2 gang MK while surface box with cover made for Stichwell so ob-toward a good product. The cables, are brought in through numbered for save identification, price 51-92. This is a Satch-well thermostat using a sensor connected to the switch by a 26° irength of califary. The control setting data This is a Satch-well thermostat using a sensor connected to the switch by a 26° irength of califary. The control setting data This is a Satch-well thermostat using a sensor connected to the switch by a 26° irength of califary. The control setting adustable from 30° to 160° complete with control knob showing temperature setting 22-48. Twish 13 amp Rocker Switches (DOT) price 49g the pair. Pressure Gauge, clandard aritine thread. Reads 0-301bs per a, inch price 11p. Bargain for califars only. YOU with 18° CR Tube rather large 54 Sop. 4 Way Terminal Blocks twin grub acrew type, PYC covered to (or 55p.

to for 45p. Sparse for Dimplex Hexters. We have just laken delivery of a large quantily of various spars parts for Dimplex batters including slotage hesters, if you need any of these liken please let us have your enquiries. Heavy Duty Casters. Four of likes would carry a tan, set of 4 £2 45.

MULLARD UNILEX

MULLARD UNILEX A mains operated 444 sieres system. Rated and of the finast perior at the sieres field this would make a wonderful gitt for atmost enyone in essy-to-assemble modular form and complete with a pair of Pleasey speakers this should's est at the system complete with a pair of Pleasey speakers this should's est at the system complete with a pair of Pleasey buy this month we ofter the system complete at only £15 including VAT and postage, 10 watt amps to upgrede unifex £350 each.



UNISELECTORS

These are pulse operated switches as used in sulomatic telephone switchboards, sic. vilch The pulse moves the even through one post In pulse moves the evillon arm through one position, Except where indicated the selectors are 25 position types and 50 Y Coil is standard. 24 per switch. 3 position 25 5 0 1 4 pole 25 5 0 1 4 pole 25 5 0 1



24 HOUR TIMERS

The one Hiustrated is the 'E' conirol, this uses the Smitha mechanism as in their autoset. 2 onjoff's per 24 hours, 13 amp contacts, override switch £5 56. Smiths 100 amp model one onjoff per 24 hours file

Simiths 100 amp model one on ion of der 24 hours £19 30, extra contacts £1 40 per set. A£G 60 amb model with clockwork stand-by, one onioff per 24 hours £3 50, axtra contacts £1 90 per set.

B pole

RELAYS 12 volt two 10 smp changedver plug in 35p 12v three 10 smp changedver plug in £1:21. 12v two changedver miniature wire encod 35p. 12 volt open single scraw fixing two 10 smp change-over #15p 12 volt open three 10 amp changedver £1:25. Latching refer mains operated 2 c/o contacts £2:11. Mains operated three 10 amp changedvers open type one acrew fixing £1:25. Many other types with different coll volteges and contact strangements are in stock, enquirles invited.



£13 60 £15 88 £8 60 £11 40

ROTARY PUMP



RUIARY PUMP Self priming portable, fits drill or slectric motor, pumps up to 200 pailons per hour dupending upon revs. Virkuelly uncorredable, use to suck water, oil, petrol, fortiliser, chemicels, enything Ilquid. Hose connectors each end. £2 post peld.

DELAY SWITCH

Mains operated-delay can be ac-curately set with pointers knob for periods of up to 21 hrs. 2 contacts suitable to switch 10 amps-second contact opens few minutes effer fat contact #5p.

HUMIDITY SWITCH

HUMIDITY SWITCH American mide by Ranco, Ineir type No. J11. The sclion of this device depends upon the demoness causing a membrane to stratch and trigger a sensitive-mitive-breaking on the sensitive-breaking sensitive-breaking on the for instance will switch it on. Micro 3 amp at 250V a.c. Overall size of the device approx. 31 long. 1 wide and 13 deep 75p.

INDUCTION MOTORS

One illustrated is our reference MM11 made for ITT ½ stack 14 spindle £2:25, ½ stack model £1 75, 1 stack £2 75, 11 stack £3 25.

SMITHS CENTRAL HEATING CONTROLLER

HEATING CONTROLLER push-button gives 10 vertainan as follows (3) conlinuous hot waler and continuous central heating (2) continuous hot waler but central heating off at high (3) con-tinuous hot water but central heating on only for 2 perioda during the day (4) hot water and central heating on but day time anly (5) hot water and central heating only for 2 perioda during the day time only-then for summer time use with central heating off (7) hot water continuous (8) hot water and day the day that mater hot cally (10) everything off. A handsome looking unit with 24-hour movement and the witches and other parts necessary to solect the desired programme of heating. Supplied complete with wiring dia-prom. Originally add we believe at over £15-we offer these, while stocks last st £7 56 each including VAT & Postage.

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Super power 2N3055. RCA52360 In our triete this does all that the 2N3055 will do but very much batter—truly a remarkable

Super power 19395. RCA52360 In our triate this does all that the 203055 will do but very much better—iruly a remerkable transietor 850. 250 Watt Transformer (0x-0-d0x normal lype construction and primary wound for 230 50% r 45 85. Mich Vollage Rectiffers. Six working at 5mA, these are an unuad equiprient but have good length leads, ideal for use with the EHT (ransformer 11 joined in series, price 3D). Speaker Cabinets. Simulated tesk finish, nice handy size modern blutck spong etype front 13-75. In Car Speaker Cabinet. White with black edge very modern looking plastic with threaded stude for meuning apeaker complete with back, price 42-25. AC Capacitas for use on fluorescent lighting for power factor correction or as a valtage dropping device, these are very rugged end will stad DC voltages up to 3 times their RMS vollage. A big purchase enables us to offer these all about one third of the current memotacturors price, all are 300x RMS working of higher and are in aluminium cans with ings, and 780, 711 f20, 811 61-93. This for powers for the 21 state for the set is for the set is buries in the distingt of the set is a subendancy size where this d state works table for protecting awitch or a thermost are is subuiled for moster price, all are 300x RMS working or higher and are in aluminium cans with 175, this is a stdewnys viewing device which displays sit figures from 6-9, has wire leadouts, new in box 25 peach. Waterproof Discast Box very suitable for protecting a working rate hermost or a similar device where this is mounted outside or in a greenhouse, price £1-62. Wattitwey Switches GEC sitver finished mat box with cable knocksuts each complete with witch mounting grid and matching receased cover, suitable for conduit or TRS. Single switch 50, twin switch 60p, 4 switch 75p, 6 switch 71, 12 switches 13 50.

L1, 12 switch at 300. Modern toggle type miniature awitches by GEC to fit above boxos, mains tating 5 amp on/off 350, 15 amp on/off 459, 5 amp 2 way 300, 2 way and off 500, intermediate (potently) changeover 500) bell pueh 359 (avsiteble in several colours). Piesse add 5% VAT to total cost of boxes and awitches. Most of the above awliches can be supplied without togeles but operated by a special key, add 10p per switch and 25p per

but operated by a spectra nor, are recently acquired some very key. Can Any Reader help? We have recently acquired some very nice American made motors 50 cycle for 50hz 220v working obviously made for the British Market but thay have 5 lead out wires and we have not been able to find out the correct method of working. If is possible that they need a capacitor. The colours of the leadout wire are red, white, yellow and blue. The maker's name is Robbins and Myers and its model number of the motor is KS-PP30-601 rated at 1112 ho single phase 1425 rgm. Price of the motor KS-36p+45p. Post and packing £2.

packing £2. Boller Stal. Satchwell remote dial type with knob calibrated 20-90°C, price £2 42

Project Boxes. Nicely made in black plastic with threaded brass inserts to hold the lid which is fixed by four corner acrews. There are three sizes available 75 x 56 x 35mm, price 50p, 95 x 11 x 35mm price 70p and 115 x 93 x 36mm price **80p**. instrument Buzzers, made for the GPO ex unused equipment price 54p.

Klaxtan Type Alarm. Battery operated gives a good note with only a 1-5v battery, gets unbearable as vol increases, ideal for personal or car alarm, price 80p.

Stereo Heedphone Lead. Black curly 10th approx. temina-tions, elereo jackolug one end-miniature two in plugs the other. Price 56p

Storeo Decoder Kit uses latent techniques, size approximately S^{2} x 1" x $\frac{1}{2}$ " complete price £3.05 or made up and lested £1.50 extra.

Steres Beacon Light II required 45p extra.

Steren Bascon Light II required 43p extra. Cassett Microphone. Dynamic 600 ohm with onjoff switch and stand for desk lop work, price £1.42. Mains Operated Pomp. Most readers will know that we stock the Jebsco pump which was made to work with partable drills, the price is £2.66, now in response to demand for a mains operated pump we have coupled this to a 100 pp motor, mounted them on a metal chassis and offer this as a general purpose pump. If is suitable for most liquids and carlinity for water. The pump is self priming and will fill the liquid up to quite a head but naturally the delivery will fail off depending upon the Hit. Price £11 28.

upon the fill. Price £11 28. FiskUbs Conduits made from a thin but very tough plastic ribbed to give extra strength but very lightweight and very featible and can be bant through a very small radius. Deas in addition to carrying most fluids, these conduits can also be used for cable tidying and projection and even make do fieldible drive for a slow speed turning operation. Two slaves available 4° and 4° internal dismeters approximately. It is interesting to note that the 4° one is a reasonably good fit an the intellouties of the above mentioned Jabsco pump. Pice 7D new mote note that an the intel/ounets of the autor. Price 27p per metre, post 11p per metre.

The styp per metry, bust hip per metre. Double Ended Motor, mains operated, capacitor run approx. $\frac{1}{2}$ h.p., this has spindle coming out each side and should be very suitable for converting into a double anded poinsher or grinder, holes conveniently placed in the housing make if very easy to stand in the right position and the speed although not high is adequate. Limited quantity only, we are offering these with capacitor et £8-50.

H.P. Molors. Normal base mounting, ex computers but tested, 230-2409 50hz good length spindle mostly American make, £8-59,

13 Amp Rocker Switch made by Carr Fastener Co. (Dol) again available, price \$70.

Luminous Rocker Switch, suitable for 13 amps at mains voltage, these are illuminated with neon through amber panel, aneg-in fixing into hole size $1_1^{\prime\prime} \ge 1_2^{\prime\prime\prime}$ Special bargain 38p.

These position Rocker Switch. It amp chargeover with a centre off slandard size clip fixing pushes into hole area size approximately 1" x τ_x^2 which is standard for many rockers. Special barghia (high month, 10 tor ±1-82).

Special bargant into find, by the first sec. 34 Mircute Clockwork Trains Switch made by Smiths and as fitted to many lumble dryars, washing machines, etc. Vary useful for other limed applications, when rotated 15 double pole mein switch makes circuit and stars on for up to 1 hour depending on the amount you turn the spindle. Special ship usetu nole mai nole mai rice £1-23

Clockwork Alr or Gas Switch made by the famous Smithe Company, winding the clockwork opens the valve and leta the air or gas come through for maximum of two hours depending upon the amount the clockwork is rotated. Iniet and oullet are threaded normal gas size, price £3-78.

Connecting Wire Bargain 100 yards PVC Insulated con-necting wire 14/35 on a drum, conductors made by BICC, price necting win



EXTRACTOR FAN Es-computers made by Woods of Colchester ideal for fixing Ihrough panel-reasonably quiel running-very powerful 2500 rom. Choice of two sizes 5 or 61 dia £5 and £6.

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| VALVES | ECC831 0.55*
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ECC851 0.55* | EH90 1
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6N7 • 78*
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12AU7 8 45*
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12AV7 2 84*
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DF91† 0 40"
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ECC011 0 55*
ECC180 1 60*
ECF80T 0 60*
ECF82T 0 70*
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EL861 0
EL91 0
EL951 0
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128H7* 0 00*
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811A† 3.80
812A 8-35
813† 10.02
833A 30-00
805A 6.85
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ECH84 0 15*
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ECL82 + 0 60*
ECL82 + 0 60* | EM84 1
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PY801 0.01
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| E88CC1 1 00
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ECL8007 00"
EF37A† 2 50"
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EF40 1 15"
EF41 1 20" | EZ40 1
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EZ81† 0
EZ90† 0
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757 PCL0

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08 1 44*
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31 6 92* | 210
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QQV05-40A1
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6084 65
60841 65
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7401 14p17491 AN 90p;7416	6 990p;4055 140p BC148	10 BF180 320 R2008E	2000 2N2221	20p 2N5245 40p	LM381AN 1459"	1050*	*
7401AN 15p 7492 58p 7419	0 120p 4056 130p BC149	10p BF181 32p R2010E	200p 2N2221 A	24p 2N5286 55p	LM732 125p°	TBA820 75p*	* Savers *
7402 18p1/493 46p /918	1 1290,4060 T300 / BC15/	10p* 8F182 32p, TIP29	50p 2N2222	20p 2 N5457 40p	LM733 100p	THA920 295p*	★ 741s Op/Amp 5 for £1 ★
7404 20p,7495 75p!7419	3 96p.4087 430p BC159	11p 8F194 10p T1P294	45p 2N2368	200 2N5458 400	LM748 35p	UA741 CP25p	★ 555s Timer 4 for £1 ★
7405 25p 7496 90p 7419	4 160p.4069 25p BC1690	14p* BF195 12p* TIP290	50p 2N2360	14p 2N5460 40p	LM3900 65p	ZN414 900*	* TIL209 LED 10 for £1 *
7406 40g 7497 295p 7479	5 110p 4069 27p 8C172	12p* BF196 12p* T(P30	49 p. 2N2369 A	16p 2N5485 44p	LM3911 125p	ZN424E 130p	AX 13 Diode 20 lor £1
7408 220 74104 750 7419	7 1300:4371 940 BC178	170 BF198 156" TIP208	41 p12122045	25D 2N6027 48p	ESA2510M 100*	326AJ 250	* 8v2 Zener 20 for Et *
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7410 16p/74107 36p/7419 7411 760/34100 60m/7429	9 250p.4073 30p 8C182	10p*/BF200 32p* TIP31/	58p 2N2905	25p 3N140 100p	MC1458 50p	Voltage	***********
7412 25p 74110 68p 74H	0 85p 4076 170p BC184	11g" BF240 18g" TIP316	56p 2N2905A	250 3N141 85p	MC1495 950	Regulators	Books
7412AN 28p 74111 75p 74H	5 45p 4082 250 BC187	30p BF241 18p* TIP32	66p/2N2905A	240 3N204 100	MC1103 15p	7805 5v+ 95p	IC SSS Projects
7413 40p-74116 220p-74H1	0 42p 4093 94p BC212	11p* BF244B 35p* TIP324	68p 2N2907	280 40347 650	MC3340 120p*	7815 15+ 850	50 CMOS IC Projects 85a
7417 40p:74119 2250 74H2	0 420 4096 120p BC213	110" BF258 320 TIP32E	70p 2N2907A	300 40348 100	MC7242 120p	7818 184 85p	52 Projects IC 741 75p
7420 18p(74)20 130p 7451	0 40p 4160 1055 SC213L	12p* 0F259 36p TIP39	S2p 2N2925	280 40360 40p	MFC4000B 120p*	7824 24 + 95p	50 Projects CA3130 #5p
7421 43p/74121 32p 7420 26 74129 64m	4161 195p BC214	13p 8F324 36p TIP334	90p 2N3055	55p 40362 45g	MFC6040 95p*	7912 12-120p	Digital IC Equivalents 250p
7423 38pi74123 75p cm	4162 1950 BC237	16p* BER29 30p TIP33E	99p 2N3702	129* 40407 45p	MP03795 15c*	7915 15 120p	Linear IC Equivatents 275p
7425 33p 74125 75p 4000	4153 1950 BC237A	16p" BFR40 30p" TIP34	95 p 2N3703	12p 40406 70p	MK50362 550p*	791E 18- 120p	50 Simple LED Circuits 75p
7426 43p;74126 65p 4001	10 4175 1000 BC237B	18p* 8FR41 300*1TIP344	110p.2N3705	120 40409 450	MK50398 75Pp*	Laza sa - isoti	First Book of Translator
7428 480-74130 1100-4006	95p 4194 105p BC238 4	16p* 85879 300* TIP34E	110p 2N3706	14p 40411 380p	NE556 650	Bridge	Equivalents 50p
7430 13p 74132 12p 4005	18p 4408 710p BC238B	16p SFR80 30p 11934C	155p/2N3707	140 40412 60p	NE560 320p	Rectifiers	Eoulvalents 110g
7432 38p174135 60p 7009	54g 4410 715p BC236C	28p* 8FR81 30p T1935	280 2N3709	140° 40430 65p	NE561 385p	50v 1A 20p	
7437 38p 74137 60p 4010	600-4419 280p BC317	16p* BFX29 TIP364	260p/2N381p	25p*,40595 99p	NE551B 420p	100v 1A 22p	DII Electrolytic
7438 38p 74141 85p 4011	180 4422 550p BC338	14p* BFX84 30p TIP360	330p 2N3820	50p* 40603 58p	NE565 125p	400v 1A 10p	Sockets Capacitors
7440 31p 74142 300p 4012	50D 4435 8000 BC516	Sep BFX85 30p TIP418	Min 2N3865	500 40673 99p	NE5654 125p	50y 2A 46p	8 pin 11p 63 Volt
7441AN 24147 210p 4014	110p 4450 290p BC547	180*18FX87 300 TIP410	780-2N3903	10p 40841 10p	NE567 1700	100v 2A 59p	14 pin 12p 1 SoF, 2 2, 3 3, 4 7,
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7442 75p 74150 130 14017	1000 4501 950 BC5478	16p 8FY50 22p TIP420	2p 2N 3905	200° 40872 90p	(133P101) 25p	40y 15A 170p	20 pin 24p ns whit footure attach
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7446 1100 74155 970 4021	1150 4507 550 BC556	15p* BRY39 45p 11543	34 p* 2N4058	12p* Linear ICs	5N72709AN	2A 100v 32p	40 pin 52p 1 to Valt 220F 80
744B 85p-74157 98p 4022	100p 4510 \$50 BC557A	140 85X20 200 1591	25 p* 2N4060	120" CA3014 1450"	SN72733N 1750*	2A 200V SUD 2A 400V 75p	Caramia Bista
7450 18p 74159 250p 4023	22p BC557B	16p*,BU105 180p* TIS93	30 p* 2N4061	18p* CA3018 70p*	SN76008N 175p"	A 100y 50p	THOOM MAN DAT 10-F
7451 18p 74160 110 4025	20p BC558	12p* BU108 254p* 21 X100	12p*2N4052	18P* CA3020 17ep*	SN76013N 140p*	6A 200v 65p	T(L2)3 13p 2pr - 108r 4p T(L2)1 200 120F + 470F 6p
7454 140174162 1000 4026	141p Transistors BC559B	180' BU205 2200 ZTX500	15g 2N4124	220 CA3028 85g*	SN76033N 1750	10 A 100v 75 A	TIL212 25p 100 Volta
7460 18p.74163 100p 4027	65p AC107 24p BC559C	180 BU208 2490 ZTX50	160*/2N4125	220* CA3046 70p*	SN76110 150p*	10A 200v 59p	Til216 18p
7470 38p.74164 120p/4928	1200 AC127 200 SCY10	18p 8U408 145p* 21X50	J0p 12N4126	22p* CA3048 220p*	"SN76115 1990"	10A 400v 129p	TU 220 160 resistors
7473 360174166 1640 4030	50p AD149 70p BCY59	22n MEO491 18n/2N765	35p 2N4236	150 P* CA3080F 74n	SN76560 75p*		TIL228 24p 5W 2p
7474 38p 74167 320p 4033	250p AD161 45p BCY71	22p MJE2955 100p 2N706A	20p 2N4239	140p CA3089E	TAA550 45p*	Thyristors	Cilps 3p 1W 5p
7475 43a 74170 260p 4034	240p AU152 49P BCY72	22p MJ2955 100p 2N708A	20p 2N4240	150 p*1 220 p*	TAA621A 200p*	1A 50v 32p	Dindot
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7462 90p/741/5 95p/4043	100p BC108 10p BD132	50p MPS A05 30p*12N1132	20 p 2 N4288	16p CA3140 96p	TBA1205 70p*	5A 100v 52p.	OA/0 5p IN914 4p
7484 110p 74177 120p 4046	14*p BC108B 12p BD135	180 MPSA12 450"2N1711	25g 2N4290	200" LM331AN 30p	TBA5:00 330p*	7A 400y 75o	CA85 15p IN4001/2 5p
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TTL	I BY T	EXAS		14/221	1409	74L5192	146p	74C157 290	LINEAR LC.		TRANSIST	DR6	TIP41C 71	p 2N3886	830010 1 q %
7400	130	1 7497	180p	74251	1400	74L5193	140p	74C160 155	A Y1-0212 600	*MC1498 100p	AC127/8 20p	BFY51/2 22p	TIP42A 70	p *2N3903/4	10p 'BY127 12p
7401	14p	74100	13#p	19250	2900	7415193	140 p	34G101 155	AT1-1313 166p	MC334G 160p	AD149 70p	BFY56 33p	TIP42C B2	2 12N3905/6	20p *OA47 9p
7402	14p	74104	65p	74205	100	141 6 201	1200	740102 133	ATI-5050 2120	MC3360 120p	AD161/2 45p	8FY96 80p	1122955 74	p 2N4036	050 "OA81 15p
7403	14p	74105	45p	74278	2000	141,5221	1000.	740103 135	AT3-1815 000	MFC4000B 120p	BC107/8 11p	BLY83 700p	TIP3055 70	p 2N4058/8	120 OA65 150
7404	17p	74107	34p	74219	1400	741.3240	2430	740172 400	A 10-1317 636p	MINSUSAN ISUP	BC109 11p	BRY39 45p	115.63 34	¢ 2N4060	12p 0A90 1p
2405	tip.	74109	55p	74794	100p	141 5940	64E-	74/2174 480	AY5-1320 120p	1300	*BC147/8 #p	8SX19/20 20p	11283 30	p 2N4G61/2	19p "DA91 9p
7400	33 p	74110	55 p	74706	400.01	741 0047	8420	740176 000	CASULA POD	NESCON ZOOD	BC149 10p	*BU105 1Mp	21 21 2108 12	0 204123,4	229 UA95 99
7407	32p	74111	700	74000	4400	741 6046	100-0	740100 444	CA5046 JBp	NESASA ZOD	*8C157/8 10p	*BU108 250p	212300 11	g 12N4125/6	220 0A200 90
7408	18p	74115	200p	74201	1500	741 \$051	200 -	740192 124	LA3048 225p	NE355 30p	*8C159 11p	*8U205 220p	21,000 13	2014289	205 0A202 10p
7409	190	74118	130p	74904	200 0	741 5257	120.0	140104 220	CASUADE 720	N±556 70p	*8C159C 12p	180208 240p	277 7 604 10	0 2/14407	210 11N914 40
7410	15p	74118	ZIEp	74208	200.0	745 5250	175	740105 510	CA3089E 2230	NE2018 4750	*BC172 12p	*8U408 145p	214304 30	P 2/144/2/	10 T111110 10
411	24p	74120	118p	74365	150 a	741.5298	249 0	74C291 175	CASOOAQ	NE3020 4230	BC177/8 17p	MJ487 175p	2N45/A 250	P 2046097	370 SN/60310 \$-
7432	200	14121	Zap	74788	480-	74LS373	200n		CA21105 100	NEGAC TER	BC179 14p	MJ 591 200p	214090 33	P 12N5080	170 1N(200214 60
1111	Sub	74)22	HP.	74367	1 Map	74LS374	1950	4000 SENTES	CA31405 70-	NESET 188-	*BC182/3 10p	MJ2001 2230	20097 25	P *2N5170	27n 1N4005 80
1.112	top top	74123	222	74368	15An	81L595	158.0	4000 150	CA3160E 710	004454 1355	*BC184 11p	W122923 1000	01208 4 70	2N5179	270 104005/7 70
1212	111	14123	soh	74300	200.0	811.596	164 p	4001 11	FX200 740	RC4151 408p	BC167 30g	10133001 AZ3P	21170PA 29	2N5191	430 1N5401/3 140
7420	120	1 24100	76.0	74383	200.0	81LS97	160 0	4002 113	CI 7108 925	SH10003N 173p	*BC212/3 11p	MIEDOCS 400-	01010 45	2N5194	90p 1N5404/7 19p
7495	100	74199	75.0	74490	225.5	BILSOB	1600	4001 435	JCLR038 340m	tentredant	*BC214 12p	M 152555 700	211010 43	*2N5245	400 ZENERS
7499	920	24126	750	7414	Presh P	BT28	2300	4007 195	2 14301 6 - 78-	311/00/3110	BC481 35p	*NIPE102 48m	QN11111/0 78	2N5295	55p 2.7V-33V
7423	340	74141	100	SEDICO		9301	160p	4000 40	LN311 100	19N78/22N 140-	BC477/8 30p	*MPENO3/6 440	2N1413 25	*2N5401	500 400 mW 90
7425	30 m	74142	2000	741 \$60	220	\$302	175p	4010 50	LM319 200m	15N78002ND	*BC316/7 50p	*MPE105/6400	2N1711 25	2 12N5457/R	400 1 W 150
7425	40.0	74145	90n	741 502	225	9308	318p	4011 17	M324 70p	\$200	*BC547B 16p	*MPS 406 30n	2N2102 50	P 2N5459	An SPECIAL
7427	14p	74147	199p	74L S04	220	9310	275p	4012 18	LM339 89-0	*SN75033N 1750	BC549C 16p	*MPSA12 50p	2N2160 120	0 *2N5460	400 OFFERS
7428	380	74148	150p	74L508	220	9311	273p	4013 50	LM348 \$50	*SP6515 750g	SC357B 16p	*MPSA58 32p	2N2219A 29	a *2N5485	44p 100+ 741
7430	170	74150	1000	74LS10	240	9312	169p	4014 84	41 41377 4755	*TBA641B11	*BC359C 16p	MPSU05 63p	2N2222A 20	5 2N8027	48p £17
7432	30	7415) A	70p	74LS13	45p	9314	165p	4015 840	*LM380 997	2250	BCY76 18p	*MPSU56 76p	2N2359A 16	p 2N8247 1	90p 100+ 555
7433	40p	74153	70p	74LS14	100p.	9410	223 P	4018 450	*LM381AN 150p	*T6A800 90p	BCY71/2 22p	OC28 130p	2N2484 30	p 2N6254 1	20p £20
7437	35p	74154	100p	74LS20	22 p	9322	199.0	4017 800	"LM388N 140p	"TBAB10 100p	BD131/2 50p	OC35 130p	2N2646 50	p 2N6290	85p 100+
7438	35p	74155	99p	74LS22	280	0300	200p	4018 890	LM709 34 p	*TBA820 90p	BDY66 200p	R20088 200 p	2N2904/5 25	p 2N0292	85p RCA 2N3055
7440	17p	74166	10p	74L\$27	38p	5274	2000	4019 45p	LM710 54m	*TCA940 175b	B-200 320	*R2010B 200p	2N2906A 24	p 2N126 1	200 638
7441	70p	74157	70p	74LS30	22 p	0601	in the	4020 1005	LM733 100m	TDA1022 400p	10COLED 200	TIP29A 40p	2N2807A 30	p 3N140 1	00p BRIDGE
7442A	60 p	74159	110p	74LS47	- 99p	9402	1756	4021 1990	LM741 22p	XR2208 499p	BE067/8 224	TIP20C 55p	2N2925	p 3/\201 1	10p RECTIFIERS
1443	11ZP	74100	1000	741.555	30p	9603	800	4022 109p	LM747 79p	XH2207 400 p	BE240 340	TIPSUA 44p	2113033 20	p 30/204 1	00p 11A 50V 21p
1448	1120	74101	100P	741.573	- XP	INTERE	ACEL	4023 720	LM748 35p	XR2216 075p	BERSO MIN	TIOSIA ERA	2113034 03	p 40290 4	300 11A 100V 220
7448A	etto	74183	1000	741 876	top	I.C.s		4005 00-	LM3800 78p	KRa240 408p	*8F840 100	TIPNC 470	2113030 10 140	40361/2	45 TRA 50V 300
74474	76.0	74184	1200	741 583	1100	MC1468	100 0	4025 1200	LM3911 130p	*ZN414 10p	Created date	Part and water			
7448	800	714.00	130 0		1 1 1 1 1 1						*RF941 20n	TIP32A Man	213553 240	n 40354 1	20n 1 2A 100V 35h
7450	170	64122		741 585	100.01	MC1489	100 p i	4027 50	LM4138 120p	ZN424E 135p	*BFR41 20p *BFR79 30g	TIP32A 88p TIP32C 420	2N3553 240 *2N3565 30	p 40354 1	20p 2A 100V 35p
7451		74103	144.6	74L585	100p	MC1489 75107	100p	4027 580	LM4136 120p MC1310P 150p	ZN425E 400p	*BFR11 20p *BFR79 30p *BFR80 30p	TIP32A 88p TIP32C 82p TIP33A 10p	2N3553 240 *2N3565 30 *2N3643/4 48	p 40354 1 p 40408 p 40409	20p *2A 60V 30p 70p *2A 100V 35p 70p *2A 400V 45p 65n *3A 200V 60p
	170	74166	148p 200p	74LS85 74LS86 74LS90	100p 40p	MC1489 75107 75182	100 p 160 p 230 p	4027 50p 4026 44p	LM4138 120p *MC1310P 150p MC1458 55p	ZN424E 135p ZN425E 400p ZN1034E 200p	*BFR41 20p *BFR79 30p *BFR80 30p *BFR81 30p	TIP32A 80p TIP32C 82p TIP33A 10p TIP33C 114p	2N3553 240 *2N3565 30 *2N3643/4 48 *2N3702/3 12	p 40354 1 p 40408 p 40409 p 40410	20p 2A 100V 35p 76p 2A 400V 45p 55p 3A 200V 60p 55p 3A 200V 72p
7453	170	74166 74167 74170	148 p 200 p 240 p	74LS85 74LS86 74LS90 74LS93	100p 40p 90p	MC1489 75107 75182 75450	100 p 160 p 230 p 120 p	4027 50p 4026 84p 4029 100p 4030 55p	LM4138 120p *MC1310P 150p MC1458 55p MC1495 400p	ZN424E 135p ZN425E 400p ZN1034E 200p 95H90 600p	*8FR41 20p *8FR79 30p *8FR80 30p *8FR81 30p 8FR81 30p 8FX29 30p	TIP32A 88p TIP32C 42p TIP33A 10p TIP33C 114p TIP34A 115p	2N3553 240 *2N3565 30 *2N3543/4 48 *2N3702/3 12 *2N3702/3 12	p 40354 1 p 40408 p 40409 p 40409 p 40410 p 40411 3	20p 2A 100V 35p 76p 2A 400V 45p 65p 3A 200V 60p 65p 3A 200V 60p 65p 3A 200V 72p 00p 4A 100V 95p
7453	17p 17p 17p	74166 74166 74167 74170 74170	148 p 200 p 240 p 720 p	74L585 74L585 74L590 74L593 74L593	100p 40p 90p 90p	MC1489 75107 75182 75450 75451/2	100p 160p 230p 120p 72p	4027 50p 4026 14p 4029 100p 4030 55p 4031 200p	LM4138 120p *MC1310P 150p MC1458 51p MC1495 400p	ZN424E 135p ZN425E 400p ZN1034E 200p 93H90 800p	*8FR41 20p *8FR79 30p *8FR80 30p *8FR81 30p 8FX29 30p 8FX29 30p 8FX30 34p	TIP32A 88p TIP32C 42p TIP33A 80p TIP33C 114p TIP34A 115p TIP34C 180p	2N3553 240 2N3565 30 2N3565 30 2N3543/4 48 2N3702/3 12 2N3704/5 12 2N3706/7 12	p 40384 1 p 40408 p 40409 p 40410 p 40410 p 40411 3 p 40594	20p *2A 100V 35p 70p *2A 400V 45p 65p *3A 200V 60p 85p *3A 200V 60p 85p *3A 200V 95p 97p *4A 400V 100p
7453 7454 7450	170 170 179	74103 74166 74167 74170 74172 74173	148p 200p 240p 720p 120p	74L585 74L585 74L590 74L593 74L5107 74L5112	100p 40p 90p 45p 100p	MC1489 75107 75182 75450 75451/2 75491/2	100p 160p 230p 120p 72p 01p	4027 50p 4026 84p 4029 100p 4030 55p 4031 200p 4033 100p	LM4138 120p MC1310P 150p MC1458 55p MC1495 400p VOLTAGE REC	ZN424E 135p ZN425E 400p ZN1034E 200p 95H90 800p	*8FR41 20p *8FR79 30p *8FR80 10p *8FR81 30p 8FX29 30p 8FX30 34p 8FX30 34p 8FX84/5 30p	TIP32A 88p TIP32C 82p TIP33A 80p TIP33A 10p TIP34A 115p TIP34A 115p TIP34A 115p TIP34A 225p	2N3553 240 *2N3565 30 *2N3565 30 *2N3702/3 12 *2N3704/5 12 *2N3706/7 12 *2N3706/7 12	p 40384 1 p 40408 p 40409 p 40409 p 40410 p 40411 3 p 40594 p 40595 1	20p 12A 100V 35p 70p 12A 100V 35p 65p 12A 400V 45p 65p 13A 200V 60p 85p 13A 200V 60p 85p 14A 100V 35p 67p 14A 400V 100p 05p 16A 50V 90p
7453 7454 7460 7470	170 170 179 179	74103 74166 74167 74170 74172 74173 74174	148 p 200 p 240 p 720 p 120 p 130 p	74L585 74L585 74L590 74L593 74L5107 74L5112 74L5123	100p 40p 90p 45p 100p 75p	MC1489 75107 75182 75450 75451/2 75491/2 C-MOS	100 p 160 p 230 p 120 p 72 p 96 p	4027 50p 4028 44p 4029 100p 4030 55p 4031 200p 4033 100p 4034 200p	LM4136 120p MC1310P 150p MC1458 55p MC1495 400p VOLTAGE REC Fixed Plastic T	ZN424E 1359 ZN425E 400p ZN1034E 200p 93H90 800p BULATORS 0-220	*8FR41 30p *8FR79 30p *8FR80 30p *8FR81 30p 8FX29 30p 8FX29 30p 8FX84/5 30p 8FX84/5 30p 8FX84/5 30p	TIP32A 88p TIP32C 42p TIP33A 80p TIP33A 10p TIP33A 115p TIP34A 115p TIP35A 225p TIP35C 280p	2N3553 240 2N3565 30 2N3565 30 2N3643/4 49 2N3704/5 12 2N3704/5 12 2N3706/7 12 2N3706/7 12 2N3708/9 12 2N3773 300	p 40384 1 p 40408 p 40408 p 40409 p 40410 p 40411 3 p 40594 p 40594 p 40595 1 g 40595 1	20p 12A 00V 35p 71p 12A 100V 35p 85p 13A 200V 65p 85p 13A 600V 72p 85p 13A 600V 72p 90p 14A 100V 95p 87p 14A 400V 100p 05p 6A 50V 90p 55p 6A 100V 100p
7453 7454 7460 7470 7472	17p 17p 17p 17p 30p	74103 74166 74167 74170 74172 74173 74174 74175	144 p 240 p 240 p 120 p 130 p 130 p	74L585 74L585 74L590 74L593 74L5107 74L5112 74L5123 74L5132	100p 40p 90p 45p 100p 129p	MC1489 75107 75182 75450 75451/2 75491/2 C-MOS 74C00	100p 160p 230p 120p 72p 96p .C.s	4027 50p 4026 14p 4029 100p 4030 55p 4031 200p 4033 100p 4034 200p 4035 110p	LM4136 120p MC1310P 150p MC1458 55p MC1495 400p VOLTAGE REC Fixed Plastic T 1A ± ye	ZN424E 1350 ZN425E 4000 ZN4034E 2000 93H90 8000 RULATORS O-220 1A	*8FR41 30p *8FR79 30p *8FR60 30p *8FR60 30p *8FR61 30p 8FX29 30p 8FX29 30p 8FX84/5 30p 8FX84/5 30p 8FX84/7 30p 8FX38 30p	TIP32A 80 TIP32C 42 TIP33A 10 TIP33A 114 TIP34C 114 TIP34C 114 TIP34A 115 TIP34A 115 TIP35A 225 TIP35A 225 TIP35A 270 TIP35A 270 TIP36A 270	2N3553 240 *2N3565 30 *2N3643/4 48 *2N3702/3 12 *2N3704/5 12 *2N3706/7 12 *2N3708/9 12 2N3708/9 12 2N3713 300 *2N3819 25	β 40384 1 β 40408 1 β 40408 1 β 40410 1 β 40410 1 β 40411 3 β 40594 1 β 40595 1 β 40503 1 β 40593 1 β 40573 1	22b 12A 100V 33b 71b 12A 100V 35b 55b 13A 200V 65b 85b 13A 200V 60b 85b 13A 600V 72b 91b 14A 100V 93b 91c 14A 400V 100b 95b 6A 50V 90b 55b 6A 100V 100b 55b 6A 400V 100b
7453 7454 7460 7470 7472 7473	170 170 170 170 300 300 340	74108 74166 74167 74170 74172 74173 74174 74175 74176	144 p 200 p 240 p 120 p 130 p 130 p 90 p	74L585 74L585 74L590 74L593 74L5107 74L5107 74L5123 74L5132 74L5133	100p 40p 90p 45p 100p 120p	MC1489 75107 75182 75450 75451/2 75491/2 C-MOS 74C00 74C02	100p 160p 230p 120p 72p 96p 1.C.* 25p 25p	4027 50p 4026 84p 4029 100p 4030 55p 4031 200p 4033 100p 4033 200p 4034 200p 4035 510p 4040 100p	LM4138 120p MC1310P 130p MC1458 31p MC1458 400p VOLTAGE REC Fixed Plastic T 1A + ve 5V 7800 10p	21424E 135 21424E 400 211034E 200 93H90 800 801LATORS 0-220 1A	*8FR14 30p *8FR79 30p *8FR80 30p *8FR80 30p 8FX29 30p 8FX29 30p 8FX29 30p 8FX84/5 30p 8FX84/5 30p 8FX84/5 30p 8FX84 30p 8FX88 30p 8FX80 90p	TIP32A Bp TIP32C Bp TIP33C Bp TIP33C Hip TIP33C Hip TIP33C Hip TIP33C Hip TIP33C Hip TIP33C Step TIP35C 25p TIP35C 200p TIP36C 200p TIP36C 200p TIP36C 200p	2N3553 240 *2N3565 30 *2N3563/4 49 *2N3702/3 12 *2N3702/3 12 *2N3702/3 12 *2N3702/3 12 *2N3708/9 12 2N3708/9 12 2N3708/9 12 2N3713 300 *2N3819 25 *2N3820 50	p 40384 1 p 40408 p 40408 p 40409 p 40410 p 40411 3 p 40411 3 p 40595 p 40595 p 40595 p 40593 p 40641 p 40841	************************************
7453 7454 7460 7470 7472 7473 7473 7474	170 170 170 170 170 300 340 340	74155 74166 74167 74170 74172 74173 74173 74174 74176 74176 74177	144 p 240 p 240 p 120 p 120 p 120 p 120 p 120 p 120 p	74L585 74L585 74L593 74L593 74L5107 74L5107 74L5123 74L5132 74L5133 74L5138	100p 40p 90p 90p 100p 100p 100p 100p 100p 100p	MC1489 75107 75182 75450 75451/2 75491/2 C-MOSI 74C00 74C02 74C04	100p 160p 230p 120p 72p 96p 25p 25p 25p	4027 50p 4026 84p 4029 100p 4030 55p 4031 200p 4033 180p 4034 200p 4035 519p 4035 519p 4040 500p 4041 80p	LM4138 120p 'MC1310P 150p MC13185 53p MC1495 400p VOLTAGE REC Fixed Plastic T 1A + Ve 5V 7805 10p 12V 7812 90p	2N424E 1350 2N424E 400p 2N1034E 200p 95H90 800p 8ULATORS 0-220 1A	*8FR14 30p *8FR79 30p *8FR60 30p *8FR80 30p 8FX29 30p 8FX29 30p 8FX84/5 30p 8FX84/5 30p 8FX84/7 30p 8FX84/7 30p 8FX84 30p 8FX90 22p	TIP32A Bip TIP33C J2p TIP33A Mop TIP33A Mop TIP33A Mop TIP33A Mop TIP33C J3p TIP33C J3p TIP33C J4p TIP33C J4p TIP33C J4p TIP33C J4p TIP33C J4p TIP33C J4p TIP34C J4p TIP34C J4p TIP34C J4p	2N3353 240 *2N3565 30 *2N3565 30 *2N3702/3 12 *2N3702/3 12 *2N3702/3 12 *2N3706/9 12 2N3773 30 *2N3619 12 2N3619 12 2N3619 25 *2N3820 50 2N3823 70	B 40384 1 P 40408 P 40409 B 40409 B 40410 P 40411 3 C 40595 1 B 40595 1 B 40595 1 B 40595 1 B 40673 P 40841 P 40871/2	************************************
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1	6/8	41 in	1 <i>4</i> in	£1 30*
8	\$io	5210	2310	E1-76*
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METAL FOIL CAPACITOR PAK

Containing 50 metal foil Capacitor-like Mullard C280 series. Mixed values ranging fram :01uf-2:2uf. Complete with dentification sheet O/N 16204 £1:20*

TRANSFORMERS

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1 AMP N No. 2026 2027 2028 2029 2030	IAINS Primary 240V Secondary 6V-0-6V 1 amp 9V 0-9V 1 amp 12V 0 1 2 mp 12V 0 1 2 V 1 amp 15V-0-15V 1 amp 30V 0-30V 1 amp	Price 62:50* 62:60* 62:60* 62:75* 63:45*	P. & P. 45p P. & P. 45p P. & P. 55p P. & P. 66p P. & P. 66p
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AUDIO LEADS

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14 5 piň DIN plug to 3.5mm Jack connected f0 des 15 b pin DIN plug to 3.5mm Jack connected f0 des 15 b pin DIN plug to 3.5mm Jack connected f0 des 16 car aerial extension. Screened insulated fead. Fitted plug a kt. f1 10* 17 AC mains connecting lead for cessette f0 des f1 10* recorders & radius. Z metres f0 des f1 des f1 f10* 18 b pin DIN phono plug to stereo headphone jack socket f1 des f1 des 19 2 + 2 pin DIN plugs to stereo back socket f0 90* g3 des f0 90* 19 Car stered connection. Variable geometry plug to fit most car cessette, 8 track cartifidge & combination units. Supplied f0 90* 10 Gar stered connection. Variable geometry plug to fit most car cessette, 8 track cartifidge & combination units. Supplied f0 f5* 11 To Mono Jack Plug BLACK f1 f50* g3 pin DIN plug to 5 pin DIN plug. f0 f5* 11 cartifidge f1 f50* pin DIN plug. f0 f5* f0 pin DIN plug to 5 pin DIN plug. f0 f5* 11 rom plug to 4 Plong Plugs. f1 30* f0 f5* 12 f1 bin plug to 5 pin DIN plug. f0 f5*<	13	3.5mm Jack plug to 3.5mm jack plug. Length 1.5m	£0.75*
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The Stares 30 comprises a complete stares pre-am of a transformer or userwind will produce a high q quality ceramic pick-up, stereo tuner, stares tape d this unit is supplied with full instructions, black t mounting brackets.	plifler, power smpliflers and power sug- juality audio unit suitable for use with ack etc. Simple to install, capable of pro- ront panel, knobs, main switch, fuse	ply. This, with only the addition a wide range of inputs i.e. high duchog really first class results, and fuse holder and universal	TSSB Transformer. Features include on/off volume, Balance, Base and Trable controls. Complete with laps output FREQUENCY RESPONSE 20 Hz-20 kHr (-JdB) BASS CONTROL ± 12 dB of 60 Hz TOPER CONTROL ± 12 dB of 60 Hz
ALGO AUDIO AMPLIFIER MODULE 25 Wate RMS £4 · 55 + 300 MAD	OUTPUT POWER SUPPLY LOAD IMPEDANCE TOTAL HARMÓNIC DISTORTION FREQUENCY RESPONSE SENSITIVITY MAX. HEAT SINK TEMPERATURE	25 Watte RMS 30-50 V 8-16 ohms Less han 1 % (Typically 05% 20 Hz To 30 kHz x 2 0Bs 280 mV for Iuli output 60°C	INPUT IMPEDANCE 1 Meg. phm INPUT SENSITIVITY 300 mV CROSSTALK -60 dB SIGNAL/NOISE RATIO -65 dB OVERLOAD FACTOR ± 20 dB TAPE 001FUT IMPEDANCE 25 K ohms DIMENSIONS 152mm × 84mm × 25mm
+ 121% VAT This high quality audie amplifier module is for use in to 25 BWS with distortion levels below 0.1%	DIMENSIONS	nd provides sulput powers up	PS12 POWER SUPPLY
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The A180 is similar in design to the A1.60 above and distortion levels below 0 1%.	is of the same high quality but provider	output powers up to 35W with	The GE100 has nine 1 octave adjustments using integrated circuit active filters. Boost and Cut timits are ± 12dB. May Voltage handling 2 V RMS, T.H.D., 0 03%, Input impedence 100K. Output impedence less than 10 K. Frequency response 20 Hz-20 KHz (3dB).
ALZOU IZOW R.M.S.	OUTPUT POWER OPERATING VOLTAGE LOADS FREQUENCY RESPONSE SENSITIVITY FOR 100 WATTS	125 Walta RMS continuous 50-80 V 4-16 ohms 25 Hz 20 kHz measured at 100 Watta	400, 500, 5,600, 3,200, 6,400 and 12,800 Hz. The £22.000 suggested adin controls are 10 K LIN eliders (not + 35p pAp suggested with the module) See Packs S31 and 1612. + 1313, VAT 8639 POWER SUPPLY BOARD for GE100 15-0-13 VOLT 63-54 + 121% VAT + 35p pAp
£17.25* + 409 D&p + 8% VAT	DIP AT TENZ INPUT IMPEDANCE TOTAL HARMONIC DISTORTION 50 WATTS into 4 chms 50 WATTS into 8 chms	450 mV 33 K chms 0 1% 0 08%	SIREN ALARM MODULE American Police acreamer powered from any 12 volt supply Into 4 of 8 ahm speaker, ideal for car burglar niarm, freezer breakdown and other accurity purgoase. Order No. Sts. No. BP124
This unit, designated ALZCO, is a power amplifier pro	oviding an output of up to 125W RMS, it MAXIMUM SUPPLY VOLTAGE POWER OUTPUT for 2% THD TOTAL HARMONIC DISTORTION LOAD IMPEDANCE INPUT IMPEDANCE FREQUENCY RESPONSE SENSITIVITY DIMENSIONS	tto # 4 ohm load. 30 V 10 Waits RMS Least han - 25% 8-16 ohms 100 K ohms 50 Hz-25 kHz ± 3 dBs 75 mV for full autput 74mm - 68mm × 28mm	MA60 HI-FI AMPLIFIER KIT Build you own top quality amplifier, save yoursell pounds. The Ma60 kit comprises the following Bi-kits modules, 2 × A 50 amps, 1 × PA100 pre-amp, 1 × SPMB0 stab power supply, 1 × BMTB0 trans giving 17 watts RMS per channel STEREO. All in odules r ered by the Bi * 1K sar staction or monry back guarantee. els so it he showe modules are in this ad. Price £32 05 + 123% VAT + 52p p&p.
SPM80 STABILISED POWER SUPPLY £4.25 + 35p pLp + 12;% VAT Designed to power two AL60s at 15 Watts per cl	INPUT A.C. VOLTAGE OUTPUT D.C. VOLTAGE OUTPUT D.C. VOLTAGE OUTPUT CURRENT OVERLOAD CURRENT DIMENSIONS DANNE! SIMULTANEOUSLY. Circuit Technil	while being compact in size. 33 40V 33 4 nominal 10 mA-1.5 amps 17 amps approx. 105mm × 53mm × 20mm use Include full short circuit	TC60 KIT A beautifully designed genuine TEAK WOOD veneered cabinet to put the professional louches to your home built amplifier. Full set of parts Inci. Front & Back Panels, Knobs, Chassis, Fuses, Sockels, Noen, etc. ideal for the MASO. Size: 425mm 290mm × 95mm. Price £13 55 + 131 % VAT + 55p gép
Drotoction.	FREQUENCY RESPONSE TOTAL HARMONIC DISTORTION SENSITIVITY 1. TAPE INPUTS 2. RADIO TUNER 3. MAGNETIC P.U. EQUALISATION BASS CONTROL RANGE TREBLE CONTROL RANGE SIGNALINGUE BATO	20 Hz to 20 kHz x 1 dB Less than 1% (Typically 07%) 100 mV/100 K ohms 5 mV/50 K ohms 5 mV/50 K ohms 5 mV/50 K ohms 250 mV 10 to 20 kHz 10 to 20 kHz	TRANSFORMERS T538 For Use with 5.450 AL30A MPA30 Order No. 2004 Price: £3 20 + 55p påp + 123% VAT T2050 For Use with Stereo 30 Drder No. 2004 Price: £3 25 + 55p påp + 123% VAT BMT30 For Use with AL600 SPM80 Order No. 2004 Price: £5 49 + 85p påp + 123% VAT BMT30 For Use with AL600 SPM80 Order No. 2004 Price: £5 49 + 85p påp + 123% VAT BMT250 For Use with AL500 Order No. 2035 Price: £1 33 + £1 10 påp + 123% VAT
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Practical Wireless, October 1978



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Caveat Emptor

ET THE BUYER BEWARE!---a very old Latin tag, but one which is still sound, even with the advent of present-day consumer protection legislation. Perhaps not quite its usual application, but none the less important for the home constructor of electronic projects, would be in warning readers to make sure that they can still get the specialised bits and pieces used in a past design, before spending out money on the rest of the components.

Every few months we seem to get a spate of letters from readers who have suddenly decided to build something which we published five, ten or even more years ago. They have gone ahead and spent a considerable sum getting together the "easier" components, only to find that they can't find a source of one awkward one anywhere. Then they write to us for help.

If it's a semiconductor device, it's usually not too difficult to find an equivalent, though to replace some early audio i.c.s. will often involve modifying a printed circuit board layout. The real problem area is that of transformers, sometimes for power supplies for valved equipment. A careful check through the advertisement pages, or some suppliers' catalogues, will often reveal something suitable for these.

More difficult are audio transformers, particularly inter-stage coupling or push-pull output types for early transistorised power amplifiers. The coming of direct-coupled amplifier designs with complementary or quasi-complementary output stages, and the more recent single-chip audio power amplifiers, has meant that the demand for such transformers has largely disappeared, and as a result many manufacturers have stopped producing them. Obviously it's possible to use a more modern design if just a straightforward audio amplifier is involved, but if it's doing a special job, things can sometimes be more complicated.

While we will always try to help a reader in difficulty with a project (but do please send an s.a.e.) we simply do not have the manpower to research and produce modifications to past designs to accommodate new components. It is often tempting to store away a circuit for future use—I know, I have a box-file full at home which I have collected over the past ten years or so. To any reader contemplating building a project from previous years, I would say please, please check that you can still get the "difficult" bits and pleces before you invest many pounds in the remainder.

Ted Parratt BA—Technical Editor

Ted's entry into the world of electronics began with RAF service as a Wireless Operator, followed by spells as a Test Engineer in industry with GEC and Solartron.

During a period as a freelance Audio/Visual Aids Technician he studied for an Open University degree, graduating in 1974, and just before coming to PW worked as a contract technician with another university. Apart from active involvements as a musician (a classical and jazz guitarist with a quartet), he enjoys jogging and real ale, although not simultaneously! Ted is married (his wife has an unusual "mobile" museum of domestic items), with one daughter a Legal Executive in the City, and a younger daughter and son just beginning work.







Plymouth Radio Club, G3PRC are now meeting at their new venue, The TAVR Centre, Lambhay Hill, Plymouth, on alternate Mondays commencing 17th July. Visitors and newcomers are particularly welcome. Beginners and those who may feel uncertain are invited to phone or write to the secretary at the following address, Len England, 62 Fullerton Road, Milehouse, Plymouth, Devon. Tel: 0752 58841.

The Sully and District Amateur Radio Club formerly the Sully and District Short Wave Club, would like to extend a warm welcome to prospective new members. At the moment the club is quite small and although they have their own call sign there are not quite enough members to keep it operational, so, for the time being it is in 'cold storage'. The club meets fortnightly at The Sully Bowls Club at 7.30pm until 10.15pm. Those interested please contact the new secretary at, 13 Nailsea Court, Sully, Cardiff, S. Glam. Tel: 0222 530787.

Shine on

Amalgamated Wireless (Australasia) Ltd., has commenced work on a \$600,000 scheme to convert the entire trunk telecommunications network in Papua New Guinea from battery to solar power.

This is believed to be the first time such a project has been undertaken, and involves the installation of power cells at about 20 microwave repeater stations located at strategic points throughout the Territory.

Many outstations currently using mechanical generators will also be included in the scheme.

Long Distance TV

We have been asked to advise readers that Roger Bunney's book Long Distance Television, formerly available from Weston Publishing, Romsey, is now out of print. A revised and expanded version of the work is to be published shortly by Babani Press.

Practical Wireless, October 1978

Girls, Girls, Girls

The Caroline Haslett Memorial Trust and The Institution of Electrical and Electronics Technician Engineers have introduced an annual electrical and electronic engineering award valued at £250 for 'The Girl Technician Engineer of the Year'. With a closing date of 1st October for nominations, the announcement of the 1978 Award will be made in December.

The engineering industry needs to attract more young people of the highest calibre and the aim of the Award is to focus attention on electrical and electronic engineering as a worthwhile career for women. By selecting the most outstanding girl technician engineer-who will have successfully undertaken the necessary technical education and training, and have proved herself capable of holding a responsible job-it is the Award sponsors' express hope that she will, by her example, encourage more girls to enter the electrical and electronic engineering profession.

For further details and copies of the Award nomination form please apply to: Joan Ashton, IEETE, 2 Savoy Hill, London WC2R 0BS. Tel: 01-836 3357.

Diary Date

I am informed by Blackwood & District Amateur Radio Society that this year's Welsh Amateur Radio Convention will be held on Sunday, 24th September at the usual venue, Oakdale Community College, Oakdale, Blackwood, Gwent. The Convention will be opened by Dr D. S. Evans, G3RPE, President of the R.S.G.B.

Apart from a Trade Exhibition, demonstrations and advice on amateur TV (Gwent TV Group), RTTY (BARTG), satellite communication (AMSAT UK) and 'ORACLE', the I.B.A. teletext system, the programme will include a film of the 1978 Clipperton Island DXpedition, the ARRL film 'Ham's Wide World', an illustrated lecture by S. Cherry, G3SJK, of the Appleton Laboratory on 'Telemetry Communications from High Altitude Transatlantic Balloons Using Low Power h.f.', and a talk on R.S.G.B./ W.A.R.C. 1979' by Dr. D. S. Evans, There will be increased exhibition space this year and advice on overnight accommodation is available from *F. B. Davies GW3KYA, 16 Vancouver Drive, Penmain, Blackwood, Gwent NP2 0UQ. Tel: 0495 225825.*

RAE courses

RAE courses are available this Autumn at the following locations:-

Hemel Hempstead (Herts.)—Commencing Tuesday 12th September, enrolment on 4th and 5th September. The course lecturer will be C. Burke G3VOZ, tel: 0442 833300. Hemel Hempstead College of Further Education, Marlowes, Hemel Hempstead, Herts.

Knottingley (West Yorks.)--Commencing mid-September, enrolment on 11th September. Course lecturer G3HCW. Knottingly High School, Knottingly, West Yorks.

Birkenhead (Cheshire)—Commencing mid-September on Thursday evenings, enrolment from 4th to 11th September, or at class meetings. Course lecturer D. E. Owen G4GGB. Dept. of Electrical Engineering, Birkenhead College of Technology, Borough Road, Birkenhead, Wirral.

Openshaw (Manchester)—Commencing Tuesday 18th September, enrolment 4th, 5th and 6th September between 6pm and 8pm. Course lecturer A.B. Langfield G3IOA. Openshaw Technical College, Whitworth Street, Openshaw, Manchester 11.

Swinton (Manchester)—Commencing Thursday 28th September. Details from G8BFP, tel: 061-794 3706. Moorside High School, East Lancashire Road, Swinton, Manchester.

Gosforth (Newcastle upon Tyne)---Theory and morse classes to be held on Tuesdays and Thursdays respectively, between 7pm and 9pm, commencing in September. For further information telephone the course lecturer on 0632 668439. Gosforth High School, Knightsbridge, Gosforth, Newcastle upon Tyne.

RAE reprint

For full details of availability and price, see page 64.



The circuit to be described was developed as a simple and effective version of a more complex converter which has been in use at the Author's station for the past five years. It was decided that the new converter should use the most up-to-date circuit techniques in order to achieve low noise figures, good gain and good cross-modulation performance.

The previous converter employed cascode f.e.t. i.f. stages and performed well but it had been tricky to set up and therefore would not be reproducible by the newcomer to amateur radio. Replacing the cascode f.e.t.s with a new MOSFET r.f. stage made it possible to achieve a greater signal-handling capability, about the same gain but a slight degradation in the noise figure. The new stage presents no problems with regard to stability and is easy to tune. Although the noise figure for the converter is about 2.5-3.5dB this is perfectly adequate and not exceeded by many commercial units aimed at the amateur market.

The new stage was exhaustively tested using sophisticated equipment, including a spectrum analyser, to optimise its performance.

During the tests it was found that non-linearity did not become severe until a signal of 120mV r.m.s., (350mV p-p) was applied. The gain of the stage was about 18dB (x8), there were no signs of instability with or without the aerial connected, and it was simple to tune.

Principle of Operation

The signal arriving at the aerial is matched into the input of a MOSFET r.f. amplifier which magnifies its amplitude by 8 times and passes the larger signal to the mixer. Here the input signal is fed to the most sensitive electrode (gate 1) of another MOSFET, and a signal from the oscillator/multiplier chain is fed to the other control electrode (gate 2). These are then mixed together in the electron stream of the device emerging at the drain, together with the sum and difference of the two frequencies.

The biasing conditions for the mixer do not allow it to provide much gain but it does amplify the signal by a further two-and-a-half times. The signal selected from those present at the drain is the difference signal, which is 144-116=28MHz. This is now matched to a low impedance suitable for feeding via coaxial cable to the receiver.

The local oscillator signal is developed from an oscillator running at 38.6666 MHz as a reference, and a multiplier stage which produces multiples of this frequency. Then it selects the tripled frequency at 116MHz and filters it before injection into the mixer.

*Development Engineer, Electronic Laboratories Ltd., Poole.



Circuit Description

The 144MHz signal enters the input terminal at an impedance of 50Ω and is coupled via capacitor CI to a low impedance tapping point on Ll. This coil steps up the voltage in a manner which is proportional to the ratio of input turns to output turns. Similarly, the impedance is transformed up by the square of the turns ratio to provide a suitable match into gate 1 of Trl. The trimmer TCI tunes Ll to resonance in the 2 metre amateur band.

Resistors R1 and R2 provide bias at 33% of the supply voltage to the gain control electrode gate 2.



Practical Wireless. October 1978



Capacitor C2 decouples any variations of this voltage at radio frequencies to maintain constant gain conditions in the stage. Resistor R3 provides a voltage drop from the source/drain current flowing through it, making the source more positive than gate 1, or conversely, making gate 1 more negative than the source. This is the manner in which gate 1 bias is achieved and again this voltage is smoothed at signal frequency by the decoupling action of C3.

The amplified signal appears at the drain electrode and is developed across L2, this being tuned to resonance by TC2. The coil is closely coupled to L3 and draws off any signals that appear on it at their mutual frequency, other unwanted signals being heavily attenuated. Trimmer TC3 tunes L3 to resonance at the same frequency as L2 and TC2. The signal then passes into gate 1 of Tr2, as the impedance of L3/ TC3 presents a fairly good match to the gate. Bias for this gate is developed in a similar fashion to Tr1 by the operation of R7 and C7.

The bias for gate 2 of Tr2 is more critical than for Tr1, as this device, when acting as a mixer, must be driven well down on its characteristic curve for good mixing to take place. The bias voltage developed by the combination R5 and R6 should normally be 1/11th of the supply rail voltage but its precise value for good mixing is solely dependent on oscillator drive. For a mass-produced unit such as this one, it is better to bias the gate slightly higher than normal—i.e. 1/16th of the supply voltage—to take account of low gain devices in the oscillator strip and ensure that all units will work fairly well. For the perfectionist, it would be worth trying a 47k resistor for R6 to take full benefit of the low noise figures that can be obtained with this converter.

The r.f. choke in the drain circuit allows all the products of mixing to be developed across it whilst the pi circuit C8, C9 and L4 tune out the required difference signal at 28-30MHz for feeding to the receiver. One of the principal purposes of the pi arrangement is to match the signal to the low impedance coaxial output capacitor. Capacitor C11 separates the d.c. connection via RFC and L4 from the output terminal.

Supply line components C4, C6 and C10 decouple any r.f. signals leaving the unit and prevent undesirable interaction between the various stages.

Resistor R4 aids the decoupling whilst providing good isolation from large local oscillator signals appearing on its supply. The oscillator works due to feedback from the drain of Tr3 being passed back to the gate by virtue of the internal capacitance of the device, thus maintaining tuned gate/tuned drain oscillation in a similar manner to that developed by Miller for thermionic devices. To start and maintain the oscillation, the resonant circuit formed by L5, C13 and C14 must be tuned to the same frequency as the crystal.

Resistor R8 provides a d.c. path for the gate without damping the crystal, at the same time limiting the voltage across it to a reasonable level. This ensures that the f.e.t. works over a fairly linear section of its characteristic curve, to reduce the generation of harmonics.

The components Z1, C12 and R_{h1} stabilise the oscillator supply voltage to minimise frequency shift due to variations of the supply line voltage. The value of resistor R_{h1} is dependent on the I_{des} of the f.e.t. and may be determined by the expression shown in the components list.

e.g. $R_{ebt} = \frac{12 - 9 \cdot 1}{0.005 + 0.004} = \frac{2 \cdot 9}{0.009} = 322\Omega$

Therefore, in this case use a 330Ω resistor.

The I_{des} can be found by coupling the source of the f.e.t. to the gate and connecting the combination to the negative rail of a low voltage supply—say 6V. Wire the drain via a 50mA meter to the positive pole of the supply: the I_{des} can then be established.

The multiplier transistor Tr4 operates in the grounded-base mode and is normally non-conducting. This is because no forward bias is applied to the base/ emitter junction. The transistor requires 0.6V to switch on and thus does not conduct during negative half-cycles of the oscillator output signal; only for that proportion of the positive half-cycle which exceeds 0.6V. In this manner, only short-duration pulses arrive at the collector and these are transformed into a rough sine wave by the flywheel action of the tuned circuit L6/TC4. The composite waveform contains many multiples of the original or fundamental frequency, but usually the signal of greatest magnitude is that to which the circuit is tuned. The coil L7 extracts the required signal by mutual coupling at a specific frequency, rejecting, to a large extent, those frequencies which are unwanted. The trimmer TC5 tunes L7 to the same multiple frequency as L6/TC4. In this way the 116MHz signal has an amplitude 50dB (300 times) greater than any of the unwanted multiples, providing virtually a pure sine waveform to the mixer and a relatively clean mixing action.

Construction and Layout

The component layout provided puts the circuit into a small and stable form. Copper-clad chassis techniques could be employed, but would probably result in a reduction in overall performance. The board is easy to assemble and no problems should be encountered provided the coils are wound to the specified dimensions and the screens reproduced as shown.

The board may be mounted within the cabinet of a receiver, which will tend to reduce stray pick-up at the intermediate frequency of 28-30MHz. No difficulties should arise from internally mounting the unit unless the local oscillator of the receiver should happen to be poorly screened, and be producing harmonics which fall within the 2 metre band. Resistors 0 25W 5% Carbon Film 1000 R4 1 220Ω 2 R3, 7 390(2 R9 1 47kΩ 1 R2 **R8** 68kΩ 1 100kΩ 2 R1, 6 470k51 1 R5 Rht)----33012 if f.e.t. Idss 4mA 270Ω if f.e.t. Idss 8mA otherwise, 12 9-1 Rht -0.005 + 1dss Capacitors Sub-miniature Plate Ceramic 10pF 3 C5, 13, 14 68pF 1 C1 82pF C9 1 0.001 /r F 5 C2, 3, 4, 11, 15 0.01*µ*F 3 C6, 7, 12 Silver Mica 1 22pF C8 Tantalum Bead 10//F C10 1 Trimmers 👘 Miniature Single-turn Ceramic 3-9pF 2 TC1, 3 4-20pF 3 TC2, 4, 5 Semiconductors Transistors Tri, 2 2 40673 2N3819 1 Ťr3 Tr4 (2N2369 can also be used) BSX20 1 Diodes. 9V1 Zener 1 Z1 Crystal 38-6666MHz 3rd overtone 30pF series-resonant HC18U Coil Data L1 4t 6mm i.d. 8mm long 19s.w.g. tinned. L 2, 3, 6, 7 4t 6mm i.d. 8mm long 19s.w.g. enam. 17t on 5mm slug-tuned former, 30s.w.g. enam. L4 9t on 5mm slug-tuned former, 30s.w.g. enam. L5 RFC 4 7 µH choke (RS type 228-135). Hardware BNC Sockets 5002 2 ** Die-cast box. Bopal 102 or 103. ** Available from West Hyde Developments, Unit 9, Park Industrial Estate, Aylesbury, Buckinghamshire HP20 1ET Miscellaneous Switch, Miniature SPDT, if required

Another method of using the converter is as an out-board unit, connected to the receiver at its aerial socket and to a 12V supply line. In this case it would be ideal if the unit were fitted in a $111 \cdot 1 \times 60 \cdot 3 \times 27$ mm die-cast box, such as the Eddystone EDD 20, or West Hyde "Bopal" 102/103 with suitable coaxial connectors fitted and a supply input socket.





Have you ever wondered how manufacturers of high quality equipment manage to get their components arranged so neatly on their printed circuit boards, indeed just why do they go to such lengths to achieve such neatness?

With our free gift this month you too can mount your transistors neatly and evenly on your p.c.bs and reap the benefits.

What then are these benefits? Our mounting pads hold each transistor the correct distance away from the board allowing you to solder the leads with less fear of damaging the transistor itself. The very act of pushing the transistor leads through the holes in the mounting pad ensures that the leads are not twisted or touching each other.

Having a solid pad of plastic between the transistor envelope and the board surface provides a means of mechanically supporting the transistor, preventing it from being displaced with the consequent danger of lead fracture or short circuits.

Reliability of equipment is usually improved as a result of using such aids as transistor mounting pads. This comes about as a direct result of neatness assisting visual inspection as well as improving your pride in your work. This lifts the standard of work giving better joints with less damage to p.c.b.s and components.

A properly designed and constructed printed circuit board should be a work of art. Take care with mounting components and the reliability and operation of your projects should improve. To use our free transistor mounting pads carefully remove each one from the sprue to leave a disc of plastic with four holes and a small tab. Select the appropriate size of pad for the transistor you are fitting. The small pads fit TO18 size packages and can be used for the small plastic encapsulations as well although they cannot be seated right down onto the pad. The larger pads fit TO5 packages.

To help with feeding the leads through the pads the top of the holes are countersunk and the leads should be fed through from this side. Push the pad right up to the transistor envelope and then insert the leads into the appropriate holes in the p.c.b. Push the transistor right down so that the pad is sandwiched between the transistor base and the board surface and solder the leads to the copper pads, finally cropping off the excess leads. It is important that the pads do not just float around but are firmly sandwiched to ensure that the transistor is properly supported.

Using the small pads with plastic type transistors will help you to change the lead configuration to the same as a TO18 type without fear of the leads shorting together.

Mounting pads are extensively used in industry and are available in many different shapes and sizes including types to convert 10 lead TO5 can i.c.s. to d.i.l. configurations and types to cross transistor leads over. Ours are the simplest type which are designed just to hold the transistor correctly on the board.

Use them on your next project and see for yourself just how much better your board looks.







P BARKER

Slow-scan television is a method of transmitting video information within the bandwidth of a normal singlesideband signal. The video occupies the 800Hz between 1-5kHz and 2-3kHz, the former representing black level and the latter peak white.



Fig. 1: A typical grey-scale and its corresponding line waveform

Consider the picture suggested in Fig. 1. A 5ms pulse at a frequency of 1.2kHz is used to start the line scan, followed by approximately 18ms of 1.5kHz (black), 18ms of 1.9kHz (mid-grey) then a further 18ms of 2-3kHz (white). After 120 lines have been 'written' a frame pulse of 30ms replaces the line pulse and is used to return the beam to the start of its scan.

Each frame takes about seven seconds to complete and so, in order to retain the information contained in earlier lines, it is necessary to use a long-persistence cathode ray tube as the display. Radar tubes, such as the 5FP7, could be employed and these can often be obtained quite inexpensively from 'surplus' distributors.

continued on page 72



Fig. 2: Block diagram of a typical SSTV monitor



Main Amplifiers and Power Supplies

The input stages, power amplifiers and regulated d.c. power supplies are contained on one board, connections being made via plugs and sockets "out" to cassette unit, disc equipment and radio circuitry. Inter-unit connections will be dealt with in later instalments.

Circuit Description

The circuit configuration consists basically of a dual high gain pre-amplifier (LM387), passive tone control circuitry, a dual driver/output amplifier (LM378), and a complementary pair transistor output stage for each channel. Amplifier functions are identical throughout, and so only one channel will be described.

Initial amplification is effected by the use of the LM387, which is a later version of the LM381 although its equivalent input noise figure is an improvement at only 0.65μ V r.m.s., as is supply rejection (f=1kHz) at 110dB. In the description which follows, components prefixed "1" (i.e. R104) refer to the left hand amplifier, while prefixes "2" and "3" refer to right hand amplifier and power supply components respectively.

Each pre-amplifier is used in the inverting a.c. amplifier mode, signal input being applied via R101 and C101 to the inverting input of the LM387. Matching to high impedance inputs (crystal and ceramic cartridges) is direct at this point, although provision will be made later (in part 3) to match to magnetic cartridges (47k impedance), with consequent standard equalisation to the RIAA characteristic. R101 and R102 act as input voltage dividers, while R103 provides feed-back. This technique tends to raise the limits on input voltage, and thereby, produces virtual unity gain stability.

Tone Controls and Output Stage

Due to the fairly high gain of the stage, it is possible to make use of a passive tone control network, insertion loss being rendered less dominant than it mitht otherwise be. Tape "out" signal is taken from the output of ICI via C103/R104 and is virtually "ffat" in terms of frequency response. VR1 is the bass control, VR2 the treble control, and the R-C network R105 to R108 and C104/C105 provides "tailoring" to effect bass and treble boost and cut.

VR3 is the single balance control, and after balancing the signal is fed via the volume control (VR4) to the non-inverting input of IC2 which acts as a driver/output stage in combination with the complementary pair Tr1 and Tr2. C106 provides a degree of treble roll-off, and R112 provides d.c. feedback.







★ components

Resistors			
+ Walt 5% ca	rbon		
3.30	2	R113, 213	
14Ω	2	R114, 214	
.4712	1	R301	
150Ω(<u></u> \$W)	1	R302	
330:2*	1	R304	
2 2k	2	R109, 209	
3-3k	1	R303	
5-6k	4	R105, 205, 106, 206	
33k	2	R111, 2111	
39k	2	R108, 208	
68k	2	R104.204	
120k	• 4	R101, 201, 112, 212	
220k	4	R102, 202, 107, 207	
470k	1	R110	
680k	2	R103, 203	
* depends un	on casselu	A unit	
achering of			
Potentiomete	rs		
p.c.b. mountil	ng		
100k lin. dual	track	1 VR1	
100k fin. sing	ie track	1 VR3	
100k log, dua	I track	2 VR2, VR4	
Semiconduct	ors		
LM387	1	JC1	
LM378	1	1C2	
2N5296	2	Tr1, Tr4	
2N6103	2	Tr2, Tr3	
BD 131	Ť	Tr5	
BZY 88	1	701	
SKR9/09154	2	REC301, 302	
GROCIVELON	-	11200011 332	
Capacitors			
Polystyrene			
820F	2	C109, 209	
Polyester	-	4,	
1nF	2	C106 206	
2.2nE	5	C105, 205	
2205	4	C101 201 104 204	
100oF	4	C109 909 107 907	
200 n E	9 7	C102, 202, 707, 207	
Caramic	9	C103, 117, 203	
10 a E	4	C202 204 205 206	
funr finstatuta	4	0303, 304, 303, 300	
Electrolylic	0	C129 000	
4- //IF BUY	2	C108, 208	
4/41 5UV	1	C200	
10000/01 25 0	2	C110, 210	
1500µF 40V	7	C301	
4700jiF 40V	1	C302	
Fuser			
Fuses			
o aru≀oge	1	EC1	
14	1	ES0	
IA,	1	F JZ	
Mains Tracefe	umer		
240V primary	saconda	ries 22V(rms) contrastanced	
	2. 600 m A	and Francish reinte-mpped	
m . 341 34 (- ανύπιΑ		
Miscellaneous			
Aluminium heatsink, fuse holders (2) 6BA nuts and			

Aluminium heatsink, fuse holders (2) 6BA nuts and bolts, SW1 (ganged with VR4) d.p.d.t. Staver type heatsink for IC2 (fins), heatsink compound, mica washers

while R111 and C109 are responsible for a.c. feedback. C200 (47 μ F) and C111 (220nF) provide decoupling for the supply rails. C110 feeds the loudspeakers and prevents the establishment of high standing d.c. levels.

Power Supplies

Supply rails are provided by two mains transformer secondary windings from T1, 9V and 22V, (this must be 22V r.m.s. to maintain supplies at a safe level) being rectified by bridge unit REC301 for the 30V rail, and REC302 for the 12V supply to the cassette mechanism. Tr5 drops the 30V line and in combination with ZD1 regulates the 13V line to supply the r.f. board. Smoothing is effected by C301 and C302, the bridge rectifier technique providing good regulation overall The LM387 is supplied from the regulated 13V supply (Vcc pin 6), and the LM378 from the 30V rail (Vcc pin 14). Supplies are fused at a.c., i.e. the inputs to the bridge rectifiers REC301 and REC302.

On no account must the supply rail for the LM387 be allowed to rise above 30V, since the establishment of safe working tolerance demands that the maximum rating of 35V should not be approached too closely.



Fig. 3: Dimensions and bending details of the output stage heat sink

Construction

Component assembly on the printed board should present no problems, although it is worth noting one or two points concerning specific items.

While ICl can be pushed straight into the board and then soldered in, the heatsink for IC2 must be lightly bent onto the body of the device before fitting and soldering. The reason for this is that the large lugs on the heatsink could prove difficult to engage simultaneously with the i.e. pins, and it is as well to keep heating of the unit (from the soldering iron) at a minimum. The aluminium heatsink should be bent as shown.

The output transistors should be bolted in after applying heatsink compound. Tr2 and Tr3 are connected straight to chassis via the heatsink, while Tr1 and Tr4 are installed using standard mica insulating washers. In order to make a good electrical connection to each collector, a wire bridge is connected from the middle pin of each transistor to the relevant part of the track. These are shown as dotted lines on the layout illustration.



Fig. 4: The p.c.b. copper track pattern; the emitter resistor tracks (see text) are clearly shown at the top of the board Although not shown on the circuit diagram, the output stage emitter resistors are included on the p.c.b. as a part of the track, but where a different construction is employed, lengths of 32 s.w.g. shellac-covered wire approximately 150mm in length will suffice. Alternatively, if available, 0.5Ω wire-wound resistors may be employed.



Fig. 5: Component overlay, relating directly to the board details on the previous page

continued on page 59
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There are Heatbleit Electronics Centres at 233 Tottenham Court Road, London (01-636 7349) and at Bristol Road, Gloucester (Gloucester 29451). Practical Wireless, October 1978



DAVID GIBSON





Audio Oscillator'

The Basic Oscillator

Most circuits are designed to do one particular job. This month's "DeC project will do at least three jobs.

Basically, the 741 is made to oscillate and the exact frequency is set by C1/R3/VR1. Making the resistor variable means that by simply turning a single control we can alter the frequency of our oscillator. The output is a series of square waves and because of the very high gain of the op. amp, these have quite steep sides.

Two things to note. Don't forget the three jumper or shorting leads marked as "link wires". Secondly, the circuit requires two separate batteries to give a $\pm 6V$ supply. If you take the two 6V batteries and connect the $\pm 6V$ of one to the -6V of the other, then this junction becomes zero volts and is connected to hole Q23. The free $\pm 6V$ lead then goes to μ DeC hole Q1, while the remaining lead from the negative 6V terminal is plugged into hole G22.

Metronome

Let us now look at the three projects we can have with our circuit. The first is a simple electronic metronome. In this case, you should try a 47₁/F capacitor for Cl. If you have connected a light-emitting diode to the output as shown, this will flash on and off. The rate of flashing can be set by adjustment of VR1. Thus we have a visual metronome. This can be useful when no noise can be tolerated while playing—for example in a group with no drummer and where the "beat" is taken from one player, as in some folk groups.

If (an, audible output is' required, then this can be obtained very simply by connecting an earpiece across the diode or by plugging it in instead of the l.e.d. A cheap crystal earpiece works well. Purists may wish to leave the diode in to form a d.c. path but the circuit works well without it 'using only the earpiece. 'A series of clicks was obtained using a small crystal microphone although these are not really loud enough when playing a musical instrument at the same time, hence the need for an earpiece.

***** components

SECTOR DESCRIPTION	A LITER DAY DAY THE REAL PROPERTY OF THE REAL PROPE	with the strength of the strength of the balance and the strength of the stren
R1.	1100kΩ	ICI 741 op. amp. (8-pin d.i.l.)
R2	12kΩ	C1 see text
R3	100ks1	One 74DeC
R4	1ks2	One pDeC i.c. d.i.l. holder
VR	-1MΩ	one l.e.d.
// DeC	jumper lea	ids two 6V batteries (PP6 or similar)
H Sherrer (*)		27 - 소리가지의 가격에서 사람들이 관람을 가지 않는 것을 했다.







Fig. 2: The component layout of the completed unit

Signal Injector

By making the value of CI smaller (i.e. less μF) the pitch of the output waveform rises so that it goes above just clicks to being a musical tone or note. By setting VR1 to mid travel and substituting a 0.1μ F capacitor for Cl, a steady audio tone can be obtained from the earpiece. This tone can be used for injecting into audio equipment for test purposes. Things like loudspeakers, headphones, earpieces, amplifiers etc may be checked very quickly and simply in this manner. If this were to be the prime use of the circuit, then it would be simpler (and cheaper) to make VR1 a 470k Ω fixed resistor, $C1\!=\!0\!\cdot\!1_{l'}F,$ and transfer the whole project onto a piece of Blob Board which could then be stuck inside a suitable small case using adhesive on the blank side (no track side) of the Blob Board—switch on, inject signal, listen for tone.

Electronic Organ

By suitable choice of C1, the circuit can be made to oscillate over an extremely wide range; from well below 1Hz to well over 15kHz. To make a simple electronic organ one has only to select a series of fixed resistors and connect this string of components between holes P25 and P35 in the place of VR1. This idea is shown in Fig. 3. If really accurate notes are required, then it would pay to use 13 (for one octave) skeleton slot potentiometers. In this way each note can be individually adjusted spot on. Fig. 4 shows this plus a refinement of an octave switch and a set pitch pot. With none of the keys depressed all the skeleton pots will be in circuit and the lowest note will be obtained if the two pots (VR2/VR3) are set at maximum resistance. With the $1M\Omega$ pot shorted out, the 100k pot is adjusted to bring the lowest note to one octave above that required. The individual pots in the chain are tuned and the lowest note again checked

and adjusted by the 100k Ω pot. Now remove the short across the IM Ω pot and adjust it to bring the lowest note to one octave below the pitch which it was when the IM Ω pot was shorted out. The switch now becomes an octave switch and will take the whole keyboard *down* one octave when the switch is opened removing the short across the pot.



Fig. 3: Connection points for a basic organ



Fig. 4: A more "sophisticated" version of the organ

To give some indication of the range of the Fig. 1 circuit, a coverage from G below middle C to over three octaves above was obtained in the prototype using 0.01μ F for CI and a 1M Ω pot for VR1.

One word of warning. When using the circuit to inject audio signals, care should be exercised—especially in mains equipment. It would be prudent to use 0.1μ F JkV capacitors in series with each lead i.e. the audio inject output from μ DeC holes 043 and 023 should have a capacitor in series with each lead. These capacitors should be permanently connected into the circuit.



A REVIEW OF RECENT DEVELOPMENTS In general, the author does not have any more information on products than appears in the article.

Digital r.f. meter

Measuring voltage is a thing commonly carried out fairly easily with the aid of a simple meter. Measuring radio frequency voltage is a little more difficult. But it's no problem for a new instrument from Germany. This beautiful little box will give you an immediate digital readout of r.f. voltage from 300µV up to 1kV over the frequency range 10kHz to 2GHz. Besides the digital readout, an analogue readout is simultaneously given in dBs. This is effected by a single line of l.e.d.s which move a light point along and are calibrated in 1dB steps. The whole instrument can be run from a 12V battery (mains, too), consumes less than 4W, and weighs only 2-6 kilograms. Launched in the US it costs around 2,000 dollars. Wonder if the Germans run a Christmas Ciub?

Power!

For those who like to be "with it", the in word for Autumn is "Transcalent". This is the name for a comparatively new type of semiconductor. Basically it means that you can push extremely high currents through the device without arc-welding it to your collar stud. The wafer on which the business area is contained measures 50mm. The substrate is bonded to a heat pipe which will get rid of the generated heat efficiently. The devices will not suit miniaturisation enthusiasts. We're taiking about things weighing around 2 kilograms and measuring some 190 imes 150 imes 150mm However, these devices include 900A rectifiers, 1,400A thyristors, and 400A transistors. Pop groups will doubtless welcome the latter!

Stable resistors

How stable is stable, especially when it comes to resistors? A British company has just announced a range of resistors with values from 0.10 to $1.5M\Omega$ which have exceptional stability. The stability is claimed to be so good that it is almost impossible to measure any slight deviations reliably; typically they vary between 5 and 10 p.p.m. (parts per million) over several years. They also offer a resistance tolerance matching capability of 0.001%. Called NPRL21 resistors, they cost around 90p each.

Bubbles

Things are bubbling at IBMliterally. Some time back, bubble memories were a novelty. Then they became practicalities. One of the materials used for bubble memories is garnet. The IBM researchers have now discovered a way in which a 25mm square piece of garnet can be made to hold 100 million bits of informationinstead of the 3 million bits more common so far. But it doesn't stop there. From the same company comes news of mobile "light" bubbles which hide in magnesium-doped thin films of zinc sulphide. The current theory is that these light bubbles might be electrical analogues of the magnetic bubbles which are already well established.

Sonar Snooper

Mix microprocessors with submarines and you end up with a kind of sonar snooper. That's what French researchers have done. Their sonar transducer fires out low frequency signals, between 6 and 8kHz, which gives them a range of about 40km. But it's no ordinary transducer. The head consists of 48 arrays of piezoelectric transducer elements. These can all be powered in a single shot, or individually in sequence. The enormous amount of information coming back from this complex array is handled by the microprocessors and the net effect is that the system can electronically divide the sea around it into something like 500,000 little cells. The electronics processes the signals received from the transducers and can differentiate between the various echoes received.

Certain things give known echoes, and these are stored in a memory, so the system can compare anything it receives with all things in its memory for immediate check on identification. It also compares the echoes in time, checking if the same echo came from the exact same place for each sweep.

Look out little sardine; big brother is watching!

Invest in technology

Buy British was a cry not too long ago, and if you want random access memories you may soon be able to do just that. The National Enterprise Board, no less, may "invest" something like £50 million in a semiconductor manufacturing facility in the UK. This could be interesting because, starting from scratch, only the very latest equipment would be purchased so the new venture could be in the forefront of technology.

But I do remember another fantastic, latest, state-of-the-art semiconductor facility in Essex which cost a lot of money—and died. Watch this space!

Thin Television

Flat screen television time is booming again. The Japanese have a 16in colour display on the go which uses plasma techniques, while at the recent Chicago Consumer Electronics Show one exhibitor proudly displayed an electroluminescent screen which was just 50mm thick. Although the size was only 7 inches brightness has reached 15ft/lamberts with power consumption barely 7W. This manufacturer reckons that it will be marketing portable television sets using such a screen within two years.

Better Photocells

An American scientist from a University talked at a special conference on photovoltaics, and caused a very big stir among energy producers. He claimed thata teamat the university had produced a cadmium sulphide/copper sulphide cell, using thin film techniques, which produced an efficiency of well over 9 per cent. This represented an impressive increase on earlier efforts when efficiency stood at around 7.8 per cent.

By 1980, this scientist believes that the cost will be down to 30 cents/watt. A final shattering fact was the cost comparison of the materials. Silicon cells (single crystal) work out at around 150 dollars per square metre, whereas the cadmium sulphide/copper sulphide thin film approach costs just 3 dollars per square metre.



Practical Wireless, October 1978

The NORTON plifies

Introduction

Most readers will by now be familiar with the conventional operational amplifiers, such as the 741 and 709. In recent years a new type of op-amp has come onto the scene. This has received the title "Norton Amplifier", and it amplifies the difference between two currents rather than two voltages. The Norton amplifier is best suited to amplifying a.c. signals where the utmost precision is not required-in such situations its ability to operate from a single power supply is very useful. When used as an audio preamplifier, it can give up to 10dB more gain than a 741 before the bandwidth suffers. The ability to operate at supply voltages as low as 4V means that it can replace discrete component amplifiers in many situations. The four amplifiers come in a 14-pin DIL package, for around 80p, making it economical as well as space-saving. Its main disadvantage is the difficulty of designing d.c. amplifiers, since it is also necessary to consider the biasing of the amplifier in such cases.

There are at least three manufacturers of the Norton amplifier—Motorola (MC3401), RCA (CA3401), and National Semiconductor (LM3900). The Motorola and RCA devices are completely compatible. Specifications of the various devices are given in Table 1, and circuit diagrams of one amplifier in Fig. 1. For clarity the biasing circuitry has been omitted. The significant differences are the wider supply range and additional transistor Q5 of the National Semiconductor device.

TABLE 1-Typical characteristics of the LM3900 and MC3401

Parameter	L M3900	MC3401
Supply Range (V+)	4-36V	518V
Supply Current	6 2mA	6-9mA
Power Dissipation	570mW	625 m W
Operating Temperature Rang	ge 0-70 C	0-75 C
Open Loop Voltage Gain	70dB	66dB
Unity Gain Bandwidth	2.5MHz	5MHz
Output Voltage Swing	V+ -1	V + -1
Output Current-High	3mA min	5mA min
Low	0.5mA min	0.5mA min
Output Slew Rate	0.5V/us	0.6V/us
Output Resistance	8802	8kΩ
Power Supply Rejection	70dB	55dB
The output resistance figu value is maintained until tkH.	re is quoted at z, and then starts	100Hz. This to decrease,
reaching 200 ohms at approx	: 200kHz for the l	MC3401.

This additional transistor is useful for sinking large output currents—up to 30mA. Motorola also make the MC3301, which will operate with a supply of up to 28V, and is specified over a wider temperature range. For more detailed information the reader is referred to the manufacturers' data sheets, in particular the National Semiconductor application note AN-72, which gives comprehensive information on the amplifier itself and design requirements.



Fig. 1: The Motorola and N. Semiconductor variations in type.

The Circuit

Consider first the circuit of Fig. 1(a), with Q3 and CR1 omitted for the present. It is then essentially an inverting amplifier with considerable current gain, the output voltage and current being controlled by I₁. The main limitation on output current is the current source CS2 at the output. The values of the current sources are set by biasing circuitry on the chip, and since they depend on diode voltage drops, are essentially independent of supply voltage. Cl rolls off the amplifier gain at high frequencies, giving the open loop voltage gain frequency characteristic of Fig. 2, where it is compared with that of a 741. This voltage gain is the gain between inverting input and output, and provides a useful comparison with conventional operational amplifiers. Thus, although the open loop gain of the Norton amplifier is lower than that of a 741 at d.c., it is about 10dB higher above 1kHz, making it more suitable for a.c. amplifiers.



Fig. 2: Essential gain and frequency response (openloop)

We now come to the operation of CR1 and Q3, which together form a "current mirror". The bulk of the input current I₃ will pass through CR1, causing a voltage drop across it, the same as the base-emitter voltage of O3. A small part of I₃ will enter the base of Q3, causing an emitter current to flow. If Q3 and CR1 are properly matched, this emitter current will be approximately equal in magnitude to l_{3} , as will the collector current of Q3 (provided Q3's current gain is high). It can then be seen that if the collector of Q3 is connected to the base of Q1, the current into the base will be the difference between I₂ and I₄, which is in turn equal to $I_4 - I_3$. Thus the amplifier will amplify the difference between the two input currents-the current mirror has effectively inverted I₃. It can also be seen from the circuit that the input potential will remain approximately constant at about 0.5V (i.e. one base-emitter junction voltage drop). The additional transistor Q5 in the NS amplifier is of little consequence until the output is required to sink large currents-then if Q1 is driven hard on, Q5 will turn on to provide the additional capacity.

A slightly different symbol is used for the Norton amplifier in order to differentiate it from the more common type. This is shown in Fig. 3, and will be used in future.



Fig. 3: Circuit symbols for the Norton Amp.

Biasing the Amplifier

The Norton amplifier requires particular attention to be paid to biasing—this unfortunately does not look after itself as with conventional op-amps. It will be assumed here that the amplifier is being used with a single supply rail.

When both inverting and non-inverting inputs are being used it is necessary to maintain a certain average current through the current mirror. This entails feeding equal currents into the two inputs, one of the currents being derived from the output in order to set the output voltage. The simplest and commonest way of achieving this is shown in Fig. 4(a). A current is fed into the non-inverting input via R1, from the positive supply rail. The inverting input is fed from the output via R2. Thus we have a feedback systemif the output voltage rises above its equilibrium value, it will increase the current into the inverting input. which will act to decrease the output voltage. This fact can be used to set the d.c. level of the output voltage-normally to half supply voltage to obtain maximum voltage swing. Since the currents into the two inputs must be equal, it is clear that in this case RI should be twice R2. The recommended bias current for the current mirror is in the range 10-100₀A, with 10μ A being a suggested value for many applications.

A disadvantage of the simple type of biasing described is that any ripple on the power supply is fed into the amplifier by R1, and appears on the output at half the amplitude. This can be eliminated by using the circuit of Fig. 4(b). Here the bias supply for the non-inverting input is derived from a potential divider which provides a well-smoothed supply at half supply voltage. Biasing resistors for all such amplifiers in a circuit may be taken from this one potential divider, so the extra cost is minimal. Needless to say, to maintain equal currents into the inputs, R1 and R2 should now be equal in value.

There is a third method of biasing, using only the inverting input, and therefore only really suited to inverting amplifiers. This method will be described later.



Fig. 4: Modification to provide better smoothing.

Practical Circuits

Having considered the biasing arrangements peculiar to the Norton amplifier, we are now in a position to consider some practical circuits. In most cases a marked similarity to circuits using conventional opamps will be noticed. The main difference is the more frequent need for d.c. blocking capacitors between stages, apart from the additional biasing circuitry.



Inverting Amplifier

The simplest inverting amplifier circuit is shown in Fig. 5. The voltage gain, as with the more conventional circuit, is R1/R2, or 10 with the values shown; the input impedance is equal to R2, or 47k here. The design procedure is to choose R1 and R2 to give the required gain and input impedance, and then make R3 approximately equal to twice R1. The d.c. blocking capacitors should be large enough to pass the lowest frequencies needed.



Fig. 6: Additional circuitry to raise imput impedance.

A disadvantage of this circuit is that it is not possible to have high gain and high input impedance simultaneously, since R1 must be low enough to pass at least 10μ A into the inverting input. With a 12-15v supply, this sets an upper limit of about 560k on R1. The problem can be overcome by using the circuit of Fig. 6. albeit at the expense of extra complexity. The d.c. bias is now provided via R1 and R3 in series, so R2 should be equal to twice their sum. No d.c. passes through R4, due to the blocking capacitor. A.C. signals, however, are attenuated first in the potential divider of R1 and R4, then passed to the inverting input as negative feedback via R3. Then, provided R3 does not load the potential divider (i.e. R3>R4), the voltage gain of the circuit is given by:

$$A_{v} = \frac{R1 + R4}{R4} \frac{R3}{R2}$$

and to satisfy the biasing conditions, R1+R3<560k (with 12V supply). The values shown in the circuit



Fig. 7: Simplification avoiding the use of the "current mirror."

should give a gain of around 105, which is about the maximum obtainable when used as an audio preamplifier.

A third possibility eliminates the current mirror and its associated bias current. The only bias current needed then is the actual inverting input current (I₁ in Fig. 1a), which is typically 30μ A. The circuit is shown in Fig. 7. Initially the values of R1 and R2 are chosen to give the desired values of gain and input impedance. R3 is then chosen to give the required output voltage V₀, using the relation:

$$V_0 = V_{BE} \left(1 + \frac{R2}{R3} \right)$$

where V_{BE} is the voltage at the inverting input, typically 0.5V. The main disadvantage of this circuit is that the output voltage depends on V_{BE} , which, being due to a semiconductor junction, is extremely temperature dependent. Output voltage drift will only be a problem, however, when large output voltage swings are envisaged.



Non-Inverting Amplifier

The Norton amplifier is not really recommended for use as a non-inverting amplifier, since accurate determination of the gain is not possible, due mainly to variations in the current mirror circuitry. Motorola state that the voltage gain of a non-inverting amplifier may vary by up to 20% from the calculated value. However the circuit of a unity gain buffer amplifier is given in Fig. 8 for completeness. One advantage of the non-inverting configuration is that the bandwidth of the amplifier depends only on the value of the feedback resistor R1, since the input resistor R2 is outside the feedback loop. In calculating the gain it is necessary to include the small signal resistance R₈ of the current mirror input, which is given by 26,000/I₃. (I₃ is the non-inverting input current, in μ A.) The voltage gain then becomes:

$$A_{x} = \frac{R1}{R2 + Rs}$$

This equation assumes that the gain of the current mirror is exactly unity—in fact it may vary between 0.8 and 1.16, which accounts for much of the uncertainty in the gain. As an example, with R1=470k, bandwidth will be over 200kHz for gains up to 100.

Oscillators

The Norton amplifier is not particularly suited to oscillator configurations. The only sinewave oscillator given in the application notes uses all four amplifiers on the chip, as well as considerably more discrete components than the very common Wien Bridge circuit used with conventional op-amps or individual transistors. With square wave oscillators the main limitation is the low slew rate of about $0.5V/\mu s$. Thus with a supply of 15V, the rise-time will be of the order $30\mu s$, which is too slow for most applications.



Fig. 9: Typical op. amp oscillators.

Two examp .s, based on the well-established op-amp circuits, are given in Fig. 9. The first is a square-wave oscillator, which will oscillate at about 1kHz with the values given. The output frequency is given by 0.6/ CR₁ approximately, and the output has good symmetry. The second circuit is the well-known triangular and square wave generator, and is an example of a circuit utilising the properties of the current mirror (in the integrator section) to give a circuit as simple as its op-amp counterpart. The values shown give a period for the waveforms of about 0.9ms. The timing depends on R1 and C1, and to obtain good output symmetry R2 should be half R1.

Various other oscillator circuits are possible—the most interesting is a complete phase-locked loop with linear voltage controlled oscillator, using only three of the amplifiers. However such circuits are not given here since they tend to need designs suited to the particular application.

Voltage Regulators

Some very simple voltage regulators are possible using the Norton amplifier. The simplest is shown in Fig. 10, and makes use of the fact that the input potential of the amplifier remains substantially constant with variations in input current. The output voltage is then $V_Z + V_{\rm HE}$, at currents of up to 1A. Bias current for the Zener is provided by resistor R—the



Fig. 10: A simple voltage regulator using a Norton Amplifier.



Fig. 11: Increasing current capability with an external transistor.



Fig. 12: Self-regulation circuit.

AD092

value of 470Ω specified will provide a bias of about 1mA. An additional transistor could be connected as in Fig. 11 to increase the current capability—outputs of up to 10A are then possible, provided the transistors will dissipate the power. An extension of this idea uses the voltage regulating circuit to regulate the supply to the amplifier chip itself—this is shown in Fig. 12.

Conclusions

It is unlikely that the Norton amplifier will ever be used extensively in mains-powered equipment, since in this situation it is relatively simple to provide a split power supply and use conventional op-amps, with their simpler design and generally lower component count. The most likely application is where the power supply is battery derived, in particular in cars and portable radios. The circuits described here give some of the more common applications—with a little ingenuity the Norton amplifier can be made to extend the range of a conventional operational amplifier.



Sillingham frequency Mitt SHORT-WAVE RECEI D2 12 V 222222222222 1N4001 FREQUENCY READOL 01 6V. 1N4001 o

There are many simple "communications" type of receivers in the hands of s.w.l.s which are single conversion types using an i.f. of 460 or 455kHz. These receivers are doing an excellent job, but how often have you wished for a digital readout of the frequency you are tuned to, instead of relying on the pointer and string method used?

The General Instrument AY-5-8100 m.o.s. integrated circuit gives you this readout on a 5 digit l.e.d. display, to an accuracy of ±5kHz, up to 29.95MHz. This allows you to find a net reasonably quickly if you know the frequency being used.

The AY-5-8100 was specifically designed for use in radio receivers. It accepts the receiver local oscillator frequency after suitable prescaling (\div 80 on s.w. range), subtracts the i.f. frequency from it, and outputs the frequency the receiver is tuned to the l.e.d. display, via suitable drivers. The receiver local oscillator must therefore be at a higher frequency than the receiver frequency and the short wave receiver i.f. must be 460kHz (or 455kHz with link changes on the p.c.b.). Many of the cheaper receivers around fall into this category.

* An Engineer with General Instrument Microelectronics, Glenrothes







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The unit has been designed as a free standing unit to be connected to the required receiver via coaxial cable. This allows you to multiplex the unit to more than one receiver and to use it for experimental work on home-brew receivers.

The unit should only be used on receivers which are isolated from the mains, i.e., using a double wound mains transformer.

A block diagram of the unit is shown in Fig. I. A simple power supply provides the necessary voltage of +5V and -12V. The receiver local oscillator is buffered by a 2-stage amplifier and fed to the $\div 80$ prescaler and then into the AY-5-8100 i.c. A 1.28MHz clock is also fed into the i.c. for system timing. The segment and digit outputs are fed via transistors to the display.

To consider the circuit in more detail refer to the circuit diagram Fig. 2. The two 6 volt windings of transformer T1 are connected in series to give 6V and 12V to feed the unit.

Components D1, C1, C2, IC5 and C3 provide a stabilised +5 volts for the unit and D2, C4, C5, R1, C6 and D3 provide the -12 volts. The input is fed to the 2 stage amplifier formed by Tr1 and Tr2 and the output of Tr2 is fed to the buffer, IC1c.

The output of IClc feeds IC2, $(a \div 8)$ and this in turn feeds IC3 $(a \div 10)$. IC3 output, pin 12 is either connected directly to pin 27 of IC4 by linking A to B on the p.c.b. (455kHz i.f.) or A is linked to C on the p.c.b. and D is linked to B (460kHz i.f.). ICla and b provides the 1.28MHz crystal controlled clock to the 8100. Pin 26 of IC4 outputs a 12ms positive pulse to reset the prescaler every 20ms and this is buffered by IC1e and f.

Pins 6-9 and 11-13 of the 8100 output the signals to drive the l.e.d. segments via the transistors Tr3-Tr9. Resistors R16-22 and R23 limit the current through the l.e.d.s. Pins 19-23 output the positive going multiplex signals to drive the digits D1-D5 with D1 as the least significant digit (l.s.d.).

As the digit outputs have limited drive capability emitter followers, Tr10-14 are used to increase the drive. Five common anode 7-segment l.e.ds are used for the display. The l.s.d. only displays a 0 or a 5, giving the \pm 5kHz accuracy.

Construction

The case is 2-piece all metal case approx. 200mm wide by 50mm high by 125mm deep. Commence construction by drilling the case as shown in Fig. 5 and carefully cut the rectangular slot for the display. Spray the front panel and put the case on one side to dry and await lettering.

Assemble the main p.c.b. using the component layout in Fig. 4 and parts list as a guide. It is advisable to use a socket for the AY-5-8100 and to fit this i.c. after the board has been completed and checked for correct assembly.





Fig. 3: Full size print pattern of the main p.c.b.



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***** components

Resistors		
+ W 5%		
1000	в	R16, 17, 18, 19, 20, 21, 22, 23
2700	1	R1
140	3	R3 5 7
0.740	1	85
6.966	1	Do
0-0412	1	
0.5821	-	R4
10852	1	
15811	1	K9, 10, 11, 12, 13, 14, 15
Canacitors		
Plate Ceran	w.	
47nF	2	C13 14
100-5	2	C10, 11
0.01.45	6	C5 6 7 8 9 19
0.01/11	°.	(3, 0, 1, 0, 5, 12
Polvester		
0 22//F	2	C1, 3
Electrolylic		
2200 // F 25 V	2	C2, 4
Semiconduc	tors	
Diodes		
1N4001	2	D1, 2
BZY88C12	1	D3
Transistors		
BSX20	2	Tr1, 2
2N3904	12	Tr3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14
Integrated C	Turcuit	S
SN7474	1	ICI
SN7490N	1	IC3
SN7493AN	1	IC2
AY-5-8100	1	IC4
7805	1	IC5
Displays		
RS 586-532	5	(7 segment l.e.d. green common
		anode:)
		(alternative red display RS 586-526.)
Miscellaneo	118	
1 280 MHz	crysta	al (McKnight)
Printed circ	uit be	pards (2 in set)
Transforme	er RS	207-194 0-6V, 0-6V (1)
Case Marst	all's	RB2
Mains pn-0	ffswi	tch
Fuseholder		
Coaxial sor	ket	
Display 6lb	er cut	from RS 586-677 for oreen display or
RS 586-548	for	ed display. Optional bezel for display
(renlaced	enlau	arb and filter) RS 587-002
fielares a	shias	preter and milety his sorrouz.

A logical building sequence is:

- 1. Fit all resistors and socket for IC4.
- 2. Fit all capacitors (note polarities of C2 and C4).
- Fit wire links.
- 4. Link A to B or A to C and D to B on the p.c.b. depending on the i.f. used. (A to B=455kHz i.f.)
- 5. Fit Veropins where indicated on Fig. 4.
- Fit diodes, transistors and IC5 (7805) taking care to orient them correctly.
- 7. Fit crystal.
- 8. Fit IC1, 2 and 3 observing correct orientation.
- Check board very carefully for solder bridges between tracks and for proper orientation of semiconductors.









Fig. 6 (left) and Fig. 7 (right): Full size print pattern and component layout for the display p.c.b.







Fig. 9: Signal take-off from a valved receiver local oscillator



Fig. 10: Adding f.e.t. isolation to the circuit of Fig. 9



Fig. 11: Deriving a stabilised 12V supply from a 150V h.t. line







Fig. 13: Some receivers incorporate an isolating emitter follower



Fig. 14: If the receiver local oscillator output is too small, this simple amplifier will raise it to the 50-100mV necessary to drive the "Gillingham"

- 10. Lay the main board to one side and start assembly of display board (Fig. 7).
- 11. Fit the eleven wire links to the display board.
- Fit the 7-segment l.e.ds to the display board noting that pin 1 is at the top left, looking from the front.
- 13. Check for any shorts between tracks on the display board.
- 14. When you are satisfied that both boards are correct fit 13 lengths of tinned copper wire through the holes at the bottom of the display board. Solder the wires to the board. Bend them down at right angles and fit the boards together as in Fig. 8, trimming off any surplus wire protruding through the holes.
- 15. Fit a small tinplate screen round the input amplifier. Take the completed p.c.b. assembly and lay it in the case, line the display up horizontally with the slot in the front panel and mark through the three fixing holes on the p.c.b. Drill 6BA clearance holes in the case. Mount the p.c.b. assembly in the case using 6BA bolts through the holes and adding 6BA nuts to pack the board up until the display lines up with the front panel slot. Fit a piece of filter material behind the slot and make up a small "picture frame" bezel to finish off the slot. As an alternative to the p.c.b. mounted display an R.S. Components bezel assembly (587-002) can be used with hard wiring instead of the p.c.b. Fit the mains transformer T1, fuse holder FS1 and mains on/off switch S1 to the case. Also fit a coaxial socket in the rear of the case for the input. Wire the unit up as shown in Fig. 4.

TABLE 1.

PIN CONNECTIONS OF AY-5-8100

1	OV (Gnd)	15	No connection
2	1-28 MHz clock input	16	ΟV
3	+5V	17	OV
4	No connection	18	ov
5	No connection	19	Digit 5 output (m.s.d.)
6	Seg. B output	20	Digit 4 output
7	Seg. A output	,21	Digit 3 output
8	Seg. Foutput	22	Digit 2 output
9	Seg. G output	23	Digit 1 output (l.s.d.)
10	No connection	24	No connection
11	Seg. C output	25	+5V
12	Seq. D output	26	Prescaler reset output
13	Seg. E output	27	Counter input
14	V\$\$ + 5V	28	VDD-12V

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An internal view of the completed unit

Testing

Testing the unit is fairly straightforward, but remember that it runs off the mains and requires a little more respect than battery powered equipment. Switch the unit on and check that the voltage across C3 is +5V and the voltage across D3 is -12V. If the voltages are correct and you have an oscilloscope available monitor IC1 pin 4 for the 1-28MHz clock. Switch off the unit, fit IC4 into its socket and power up again. The display should light up. IC4 pin 26 should now be outputting 12ms positive puls-s every 20ms, and these pulses should appear at IC2 pins 2 and 3 and IC3 pins 2, 3, 6 and 7.

To check that the unit is counting you can temporarily connect a wire from IC1 pin 2 to the amplifier input. This provides us with a signal which we can trace through the unit. Monitoring it at IC1 pins 5 and 6 we should have a continuous 1.28MHzsignal. At IC2 pin 8 we will have 8ms bursts of $(1.28 \div 8)MHz$ (i.e. 160kHz) every 20ms and at IC3 pin 12 we will have 8ms bursts of $(1.28 \div 80)MHz$ (i.e. 16kHz), which should also appear at IC4 pin 27. At this time the display should read around 820kHz.

If this checks out the unit is functioning and we can consider interfacing it to our receiver, using one of the methods indicated in Figs. 9 to 14.

If the unit is not functioning and we have +5Vand -12V available then check that -12V appears at IC4 pin 28. If this is so check that +5V is appearing at IC1 pin 14, IC2 pin 5, IC3 pin 5 and IC4 pins 3, 14 and 25, and also at Tr10 collector. If you suspect the crystal oscillator is not running you can listen for it on your receiver around 1.28MHz and harmonics of this frequency. Trouble with the display may be caused by shorts between the tracks on either of the boards causing extra segments to light up.

PRINTED CIRCUIT BOARDS SERVICE FOR PW PROJECTS

It has now been decided, commencing with our issue dated September 1978, to enlarge the facilities for the supply of p.c.b.s to readers by authorising additional suppliers. It is hoped that readers may benefit from being able to purchase boards as part of component kits, thereby reducing the number of separate orders for a project.

For some time, most p.c.b.s published in *Practical Wireless* have been available exclusively from Reader's PCB Services Ltd., P.O. Box 11, Worksop, Notts, who will continue to be a supplier and to whom we would wish to say thank you for helping us to get the service started.

Applications for permission to reproduce boards for resale must be made to the editor in writing.

PLEASE MENTION PRACTICAL WIRELESS WHEN REPLYING TO ADVERTISEMENTS



Hacksaw?

Recently introduced from Abrafile, Squarecut Hacksaw Files. Designed for the rapid cutting of a wide range of materials including tool steel.

When fitted into a hacksaw frame and tightened in the usual manner, these files can be used for straight cuts, internal and external slots and to follow limited profiles; in ferrous and non-ferrous metals (including stainless steel), ceramic tiles and plastics. These files will outlast and out-perform the well-known Abrafile tension files, but they do not have peripheral teeth nor can they be used for more intricate shapes and profiles; they are not suitable for wood.

Supplied in three widths and two lengths, each card contains one of each ot the three different width files (1.5, 1.8 and 2.5mm). Card SC25 contains 250mm (10") long files and costs £1.24, and SC30 300mm (12") long costs £1.46. Available from, Abrasive Tools Ltd., Abrium Works, Colne Road, Twickenham TW2 6QE. Tel: 01-894 1273.

POWer

At last an h.f. afterburner to complement the fine Trio range of transmitters and tranceivers.

The TR922 grounded-grid linear amplifier packs quite a punch from two husky Eimac 3-500Z tubes in class AB2, delivering a mighty 2kW p.e.p.— 1kW c.w. or r.t.t.y. for 80W excitation.

Covering all bands 160m-10m the amplifier matches other Trio equipment in both performance and appearance and must certainly appeal to those already using transmitters of this manufacture barefoot.

The price is £763 at the time of going to press and further details can be obtained from the importers, Lowe Electronics Ltd., 119 Cavendish Road, Matlock, Derbyshire. Tel. 0629-2817/ 2340.





Safe cutting

The new OK SAF 01 safety shears, which can handle hard or soft wires up to 1mm diameter, incorporate an adjustable clip to hold wire firmly after it has been cut. This prevents the hazard of clippings flying into the eyes or dropping into the workpiece.

A spring loaded scissors action ensures a clean cut, and the shears' handles have a bright orange padded covering which not only makes them comfortable during prolonged use but also enables them to be found easily on a cluttered workbench.

Priced at £2.58 which includes VAT and P&P, the SAF 01 shears are available from OK Machine & Tool (UK) Ltd., 48 The Avenue, Southampton SO1 2SY. Tel: 0703 38966[7.



Safe time

Trying to read the time from one's watch whilst driving can be a dangerous operation, especially at night. So, why not install a car clock? W.K.F. Electronics can supply the 'Harvard', an inexpensive 12V electronic car clock with digital display.

The clock utilises a low power consumption circuit and a quartz crystal oscillator, with a claimed accuracy of ± 0.5 seconds per day.

Displaying hours and minutes on a dark blue display with brightness control, the display extinguishes when the car ignition is switched off, whilst of course the clock continues to operate.

Designed with a swivel mounting bracket the clock can be fitted either above or below the dashboard.

Priced at only £12.50 plus 50p P&P, the 'Harvard' is available as an optional 12 hour or 24 hour version and comes complete with supply leads, connectors and inline fuse. W.K.F. Electronics, Welbeck Street, Whitwell, Worksop, Notts. Tel: 0909720 695.

ECONOMICAL

J. B. DANCE

Vertical MOS (VMOS) power field effect transistors have been produced by Siliconix of Swansea for more than two years. The first VMOS devices were encapsulated in TO-3 or TO-39 hermetically sealed metal packages, but more recently similar devices in plastic packages have been marketed by the same manufacturer at about one quarter of the price. They can be used in many simple circuits and are equally suitable for use by both the amateur experimenter and by the professional engineer.

A VMOS power device incorporates the high input impedance of a field effect transistor and yet it can control a moderately high current. The devices under discussion have a maximum continuous current rating of 2A and voltage ratings from 40V to 80V. They can be used for audio or radio frequency amplification, as fast switches, etc.

VMOS Structure

The structure of the VMOS power device shown in Fig. 1 may be contrasted with that of the conventional f.e.t. shown in Fig. 2. In the VMOS device of Fig. 1 the current flows vertically through the structure from the drain to the source and this allows a much higher power dissipation than is possible in the



Fig. 1: General physical structure of a VMOS device

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ordinary f.e.t. structure of Fig. 2 in which the current flows horizontally along the layers at the top surface of the silicon.

EVICES

VER

TS:

An interesting feature of the VMOS devices is the V-shaped groove shown in Fig. 1 which produces two vertical channel regions bringing the advantage of a high current density.



Fig. 2: The physical structure of a conventional f.e.t.

Package

The plastic encapsulated VMOS devices are supplied in the type of package shown in Fig. 3. The device has the same electrodes as a conventional f.e.t., namely source, gate and drain; the metal tab at the back of the device is internally connected to the drain electrode. The internal circuit of a VMOS device is shown in Fig. 3; it can be seen that a Zener diode is connected between the gate and source electrodes. This protects the thin layers of silicon dioxide against the accumulation of any stray electrostatic charges which could produce a voltage great enough to puncture the thin layer. The Zener diode will break down when the voltage across it exceeds 15V positive with respect to the source electrode, causing the charge to leak away. Nevertheless, it is wise to take reasonable precautions when using VMOS devices; in particular, soldering irons should be well earthed. These devices should be kept in metal foil when not in use. The current into the gate should not exceed 2mA and the reverse current out of the gate should not exceed 100mA.



Fig. 3: Package, pin connections, and internal circuit of a VMOS device

Types

The main difference between the three types of VMOS device under discussion is the maximum voltage which can be safely applied to the drain relative to either of the other two electrodes. These voltages are shown in Table 1 together with the drain-source saturation voltage which is slightly higher for the highest voltage device.

Table 1: Differences between the three basic devices

Device type	Max. drain voltage	Maximum drain- source saturation voltage at V _{GS} == 10V and 4 _D == 1A
VN46AF	40V	3V
VN66AF	60 V	3V
VN88AF	80V	4V

The maximum dissipation in the device itself without any heat sink is 2W for temperatures up to 25° C, whereas the device can dissipate $12 \cdot 5W$ at a case temperature of 25° C or 6W at a case temperature of 90° C as shown in Fig. 4.

Advantages

VMOS devices have a very high input impedance and can provide an extremely high current gain of the order of a million or more. Another advantage over conventional bipolar transistors is the very short switching time of typically 2ns (maximum 5ns). This can be achieved because they are majority carrier devices in which only electrons contribute to the current flow. Their speed is not limited by minority carrier storage time effects found in bipolar transistors enabling them to be used in high efficiency voltage converters operating with a very small internal dissipation.

Conventional transistors are subject to a phenomenon known as "secondary breakdown" due to local temperature rises; VMOS devices do not suffer from this effect, since any local increase in temperature produces a fall of current in that region owing to the negative temperature coefficient. This also prevents the possibility of thermal runaway.

Applications

VMOS devices are very useful in the control of a device requiring an appreciable current using a high impedance signal source. For example, the circuit of Fig. 5 shows an oscillator using two gates of a CMOS 4011 quad NAND gate device; when the input of the left hand NAND gate goes high, the circuit oscillates at a frequency of around 2kHz. The output from the



Fig. 4: Power dissipation in relation to case temperature

gate can supply a square wave of about 5V amplitude, but only a small current. However, this output can be employed to switch the VN46AF device which can control enough current to produce a loud noise in the loudspeaker. Thus when the input goes 'high' (a few volts positive with respect to ground), the circuit emits the alarm sound from the loudspeaker.

The frequency of the alarm signal can be set by choosing suitable values of R1 and C1. The VN46AF device imposes a negligible load on the CMOS output circuit and does not affect its waveform.



Fig. 5: A circuit which uses a VMOS device as a "slave" current driver. The impedance of the speaker should read "4-16 Ω "

The high switching speeds of VMOS devices render them suitable for switching laser diodes. The type of circuit shown in Fig. 6 may be used, the values of R1 and R2 being chosen according to the bias and pulse currents required by the laser diode.



Fig. 6: A laser switching circuit

VMOS devices can be employed in voltage converters which enable a steady input voltage to be converted into a steady output voltage of another value. A typical basic circuit using a pair of VMOS devices is shown in Fig. 7, but the transformer design would depend on the input and output voltages concerned and on the power output level required. High efficiencies can be obtained with this type of circuit, since the rapid switching of the VMOS devices ensures that they spend little time in the intermediate voltage state where power is wasted.



Fig. 7: Two VMOS devices used as a steady voltage converter

It would be possible to use a VMOS device to control the brightness of a tungsten filament lamp by merely varying its gate voltage; however, this would result in much power being wasted in the device when the light output of the lamp is fairly low. A pulse-width-modulation lamp dimming circuit is shown in Fig. 8. The 4011 gates act as a square wave oscillator with a duty cycle which varies according to the setting of VR1. The VN46AF is either fully conducting or completely switched off at all times except during the very rapid switching transients, so

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little power is wasted. The brightness of the lamp can be controlled and one of the inputs of the left hand gate used as an ON/OFF switch.

Amplifiers

VMOS devices form excellent low distortion amplifying devices, since their characteristics are very linear at drain currents exceeding about 400mA. Simple VMOS device amplifiers such as that shown in Fig. 9 can have a response which is almost level to frequencies up to 10MHz.

High quality amplifiers and a transmitter/receiver for the 144MHz amateur band have also been produced using similar VMOS devices.



Fig. 8: A lamp dimming circuit which is economical in terms of power consumption. VR1 controls the duty cycle

Conclusions

VMOS devices have many advantages over conventional bipolar power transistors, including much higher current and power gain (better by a factor of about 10,000), faster switching, no secondary breakdown or thermal runaway and the ability to operate with several devices connected in parallel.



Fig. 9: A high impedance broadband amplifier circuit

Plastic packaged VMOS devices are available from Arrow Electronics Ltd., Leader House, Coptfold Rd., Brentwood, Essex CM14 4BN. The price of the VN46AF is £1.36, the VN66AF is £1.43 and the VN88AF is £1.58 including VAT, but 25p must be added to orders under £5 to cover packing and postage. A.M. RECEIVERS

DEVICES & CIRCUITS

M. J. DARBY

Last month we discussed simple tuned radio frequency receivers using the ZN414 device, but we now turn our attention to the more complex superheterodyne receivers which are able to provide much better selectivity and also higher gain over a wider frequency range.

Basic Circuit

The basic circuit of a typical superheterodyne receiver is shown in Fig. 12. The incoming signal from the aerial (which may be a ferrite rod) is coupled into an optional radio frequency stage which amplifies the signal at the same frequency as that at which it is transmitted. The signal is then coupled through another tuned circuit to a mixer stage.

If the radio frequency stage is omitted, the signal from the aerial is fed directly to T2 and the mixer stage. A high frequency oscillation is generated in this stage (or in a separate oscillator stage) and the incoming signal is "mixed" with this locally generated oscillation. The resultant output signal from the mixer-oscillator stage contains not only the input signal frequency and the oscillator frequency, but also the sum and difference of these two frequencies.

The transformer at the output of the mixer-oscillator stage, T3, is normally resonant at the difference frequency so that other frequencies are greatly attenuated. This required different frequency is known as the intermediate frequency (i.f.) and remains constant as the tuning varies; in most a.m. receivers the i.f. is in the range 455kHz to 475kHz, but other frequencies such as 1.6MHz are sometimes used.

The output from the i.f. stage is fed into a second pair of coupled tuned circuits resonating at the intermediate frequency, T4, so that good selectivity can be obtained. In many modern receivers T3 is replaced by a ceramic or a mechanical filter to obtain still better selectivity. The output is demodulated by the diode D1 and the resulting audio signal is fed to a power amplifier which in turn drives a loudspeaker.

PART 2

Advantages

The advantage of using the superheterodyne type of circuit is that the transformers T3 and T4 always operate at the same frequency and need not therefore be retuned each time the station being received is changed. It is thus possible to add further tuned circuits if required, and special types of filter.

In the circuit of Fig. 12, the capacitors C1, C2 and C3 are ganged together so that the transformers T1 and T2 are resonant at a frequency close to the wanted signal, whilst C3 controls the oscillator frequency. The so-called padder capacitor C_p and the value of the inductance L used for the oscillator coil are chosen so that the difference between the resonant frequency of T1 (or T2) and the oscillator frequency remains almost constant as one tunes through the band using the gauged capacitor. The three tuned circuits are said to "track" with one another.

The tracking cannot be made exact at more than about three points on the tuning scale. The selectivity of the four tuned circuits in T3 and T4 is much greater than that of the two tuned circuits in T1 and T2, and it is this which determines the frequency being received. A small variation of the oscillator circuit tuning will produce a large effect on the tuning of the receiver, whereas a small variation of the tuning of either T1 or T2 will only produce a small change in the gain of the circuit.

The disadvantages of the superheterodyne receiver, apart from its complexity relative to a t.r.f. receiver, are the generation of spurious frequencies which can



result in "whistles" in the output, plus the problems of aligning the receiver after construction so that the radio frequency and oscillator circuits track correctly.

One has to accept these disadvantages if one wishes to receive distant signals. One cannot increase the selectivity of a t.r.f. receiver by an adequate amount by using more and more tuned circuits at the incoming radio frequency, since the number of sections in a ganged capacitor which can be practically useful is limited. Tuned circuits using a ganged capacitor cannot be designed for optimum selectivity, whereas the tuned circuits of T3 and T4, which operate at a relatively low and constant frequency, can be designed so that they give optimum selectivity at that frequency. In addition, the use of a constant frequency makes the use of ceramic or mechanical filters possible.

The performance of t.r.f. receivers leaves much to be desired when one attempts to use them at high frequencies of, perhaps 30MHz, since the relatively low value inductances required to tune the circuits results in a low gain and poor selectivity

A.M. Devices

A number of integrated circuits are readily available from advertisers which contain all of the semiconductor elements required for the radio section of an a.m. receiver for use at frequencies of up to at least 30MHz. Some of them include a provision for a radio frequency input stage, whereas others do not. Although such devices contain many of the components required for the radio section of a receiver, all of the tuned circuits are separate components external to the integrated circuit used. A few a.m. superhet integrated circuits are now becoming available with a low power audio amplifier integrated onto the chip.

One of the best known a.m. devices has become an "industry standard" type and is available from National Semiconductor as the LM1820, from RCA as their CA3123E, from Fairchild as the μ A720, from Signetics as their NE546 and also as the HA1197, etc. Another somewhat similar device with an r.f. amplifier stage on the chip is the SGS-ATES TBA651 which provides a very good performance. The Siemens devices are their TCA440 for use at signal frequencies of up to 50MHz and the TDA1046 for use at up to 30MHz.

A number of manufacturers are introducing devices for use in a.m./f.m receivers. Apart from the semiconductor devices required for the radio section of the a.m. receiver, these also include the i.f. amplifier and demodulator for the f.m. section of the receiver. Examples of such a.m./f.m. devices include the Fairchild µA721, whilst other a.m./f.m. devices such as the SGS-ATES TDA1220 and TDA1230 and the Siemens TBA460 include an audio pre-amplifier on the chip. The Mullard TBA700 a.m./f.m. device incorporates a 1W audio amplifier. The circuits in which a.m./f.m. devices are used are relatively complex, since one has both the a.m. and the f.m. receiver circuits, so these devices will not be discussed further. However, some constructors may find the new Telefunken TDA1083 and the equivalent Sprague ULN2204 a.m./f.m. device with a 0.8W output attractive (available from Ambit International).

Some of the earlier a.m. devices (such as the Mullard TAD100 and the RCA CA3088) are still

available from retailers, but we will confine our attention to the more recent devices.

6V Superhet

The circuit of a simple 6V superheterodyne receiver is shown in Fig. 13. This employs the LM1820 device which has provision for a radio frequency amplifier before the mixer stage, but the radio frequency amplifier is not used in the simple circuit shown. A two-gang capacitor can therefore be used in this circuit for tuning.

The aerial TI is normally a ferrite rod type, the secondary winding consisting of a few turns of wire connected between the mixer input at pin 1 and the supply voltage at the lower end of R1. The oscillator operates at a frequency determined by the inductance of T2 and the value of the oscillator section of the ganged capacitor C1. The difference frequency appearing at the mixer output at pin I4 is selected by T3 and fed into pins 11 and 12. These pins are connected to what is normally used as the radio frequency amplifier stage, but in this circuit is used as an additional intermediate frequency amplifier.

The output signal from this stage appears at pin 13 and is coupled to the input of the intermediate frequency amplifier at pin 7. The output from this stage appears at pin 6 and feeds a transformer T5 also resonant at the intermediate frequency. Part of the signal from pin 6 is fed through C3 to the automatic gain control circuit incorporated in the LM1820 device.

The signal from T5 is also fed into the demodulator diode D1 which is connected to the i.f. filter components R4, C7 and C8. The resulting audio signal is coupled through C9 to the volume control.

A simple LM386 audio amplifier stage is used in Fig. 13. The gain of the audio stage is set by the value of R7. If R7 is completely omitted together with C12, the voltage gain will be 20 times, whereas if R7 is zero (C12 being connected directly between pins 1 and 8 of the LM386), the voltage gain will be 200 times. Values of R7 intermediate between these values of infinity and zero will produce intermediate values of gain, for example if R7 is 168 ohms, the gain of the audio stage is about 100 times.

The components C13 and R8 may be required to suppress high frequency instability in the audio amplifier stage, but should not be needed if the loudspeaker has an impedance of more than about 40 ohms. These components form the so-called Zouci network which compensates for the inductance of some loudspeakers and reduces the variation of loading on the amplifier with frequency.

In small radio receivers of this type a miniature loudspeaker is often employed for convenience, but it must be stressed that one cannot expect to obtain good reproduction unless one employs a speaker and a speaker enclosure which are of a reasonable size. This applies to all radio receivers; miniature speakers just cannot reproduce a good audio signal with good bass notes.

For simplicity no waveband switching is shown in the circuit of Fig. 13. However, arrangements may be made to switch the transformer T1 and the oscillator inductance T2 to provide the wavebands required. Obviously a better aerial than a ferrite rod will be required for the reception of very distant stations.





The R.F. Stage

A similar circuit employing a radio frequency stage before the mixer involves the use of a three-gang tuning capacitor and three coils for each waveband instead of two. What advantages does this bring?

One advantage of the use of a radio frequency stage is a lower noise level when receiving signals at high frequencies. The conversion gain of a mixer stage is considerably less than the gain of a radio frequency amplifier and hence the noise added to the signal by a mixer stage is greater than the noise added by an amplifier stage. If one has an amplifier before the mixer, the signal is brought up to such a level that the noise added by the mixer is less noticeable in the larger signal voltage. At long, medium and the lower short wave frequencies, however, the amount of noise entering the receiver from a good aerial is so great that the mixer noise is relatively insignificant, so one does not usually bother to include a radio frequency stage unless one wishes to receive relatively high frequency signals.

A further advantage of the use of a radio frequency stage is the greater rejection of signals at the "image" frequency which can interfere with reception of the wanted signal. Image rejection is also important only at the relatively high short wave frequencies. In order to understand the term "image" frequency, let us consider the case of a receiver tuned to a signal at 1000kHz with an oscillator circuit operating at 1455kHz so that the intermediate (difference) frequency is 455kHz. If a signal at 1910kHz is also present at the mixer input, this will mix with the 1455kHz local oscillator frequency to form a spurious difference signal at the 455kHz intermediate frequency which interferes with the wanted signal. If a radio frequency stage is used, the additional tuned circuit will attenuate the unwanted 1910kHz signal before it reaches the mixer and therefore the interference will be minimised. No amount of extra selectivity in the intermediate frequency stages will affect image interference; the additional selectivity is required before the mixer.

TBA651 Receiver

A receiver with an r.f. stage can be made using the LM1420, μ A720, NE546 or CA3123E devices, but as we have already considered the use of one of these 14 pin dual-in-line integrated circuits in the receiver shown in Fig. 13, we will now discuss a receiver using the TBA651 device which also incorporates a radio frequency stage.

A circuit using the TBA651 is shown in Fig. 14; no audio amplifier is included in this circuit, but the audio output can be fed into any standard type of





Fig. 14: A TBA651 receiver (no audio amplifier is shown)

audio amplifier circuit. The TBA651 is a quad-in-line device with the connections shown, quad-in-line devices having alternate pins bent so that their tips are at different distances from the body of the device.

In the circuit of Fig. 14, the radio frequency signal from the aerial is coupled to the amplifier input at pin 1. The signal at the input frequency appears in amplified form at pin 2, further selectivity being added by the parallel tuned circuit L3—VC2. The oscillator tuned circuit consists of L5—VC3, the three sections of the tuning capacitor (VC1, VC2 and VC3) being ganged together.

The output from the mixer stage at pin 5 is fed to an intermediate frequency filter. This may consist of an intermediate frequency transformer, a simple ceramic filter with suitable coupling or a more complex ceramic filter of the type indicated in Fig. 15. The selectivity (and hence the performance of the whole receiver) is mainly determined by the type of filter used between the mixer output at pin 5 and the input to the intermediate frequency amplifier at pin 13. This filter must be included before the amplifier, or unwanted signals may overload the amplifier.

The output from the intermediate frequency amplifier at pin 10 is fed to the transformer containing L6 and L7, the L6 circuit resonating at the intermediate frequency. The diode D1 and the following filter components demodulate the signal and provide the required audio output.

An a.g.c. reference voltage from pin 15 is mixed with the voltage obtained by demodulating the signal and the resulting voltage is fed through a 33 kilohm resistor to the a.g.c. input at pin 14 so that it can be used to keep the gain fairly constant.





Noise

The TBA651 employs a high gain, low noise radio frequency amplifier and this enables an excellent overall noise performance to be obtained This noise performance is conveniently shown by the type of graph of Fig. 16. The lower curve shows the noise output when no signal is present at the input, whereas the upper curve shows the output with a signal modulated to a depth of 30 per cent with a lkHz tone. The carrier test frequency is 1.6MHz.

It can be seen that the signal output is about 26dB above the noise under these conditions when the input voltage is only 10μ V, whilst an input signal of only 1μ V produces a 6dB signal-to-noise ratio.



Fig. 16: The typical noise performance of the TBA 651 device. The lower curve shows the output noise level without any input signal

The a.g.c. control range of the TBA651 is some 120dB, this being made up of about 50dB for the first stage and 70dB for the mixer stage. A variation in the input signal level of 80dB can be made to produce a change of less than 10dB in the output level. The a.g.c. voltage is applied to the first stage only when the input voltage exceeds $100\mu V$ so as to obtain optimum signal to noise ratio. The TBA651 will operate at supply voltages in the range 4.5V to 18V, the current required being of the order of 12mA.

The TCA440

The Siemens TCA440 is another high performance a.m. superhet device. It uses a multiplicative mixer so that few harmonic mixing products and therefore few "whistles" are formed.

A typical TCA440 circuit for medium wave use is shown in Fig. 17. The aerial input to L1 is coupled to the signal frequency amplifier at pins 1 and 2, but this signal frequency amplifier output is internally connected directly to the mixer stage without the use of any external tuned circuit. The oscillator tuned circuit is connected to pins 4 and 5.

An output from the mixer stage appears at pin 16, is coupled from the tuned circuit containing L6 to L7 and hence D1 which rectifies the signal and provides a.g.c. The other mixer output at pin 15 passes through the transformer containing L9 and L10 and hence to the SF 455D ceramic filter element. It then passes into pin 12, is further amplified and appears at pin 7. The audio signal is obtained from D2, the demodulator diode, whilst an a.g.c. signal is fed back into pin 9 for controlling the gain of the final amplifier stage.

When a 1MHz signal modulated to a depth of 30 per cent with a 1kHz tone is fed to the TCA440 circuit, input levels of 1μ V, 7μ V and 1mV will produce signal-to-noise ratios of about 6dB, 26dB and 58dB respectively.

The tuning meter, if used, may have a full scale deflection of 100μ A, in which case it should have a resistance of about 1500 ohms, but a 500μ A meter with an internal resistance of about 300 ohms may also be used.



J. 17: A TCA440 circuit for use as a medium way receiver



Varicap Diodes

Another circuit using the TCA440 for medium wave reception is shown in Fig. 18, but instead of a ganged tuning capacitor, semiconductor "varicap" diodes are employed. Tuning is carried out by varying the voltage applied to the terminal marked $+V_p$. In a typical case, a tuning voltage of +8.5V will result in the receiver being tuned to a frequency of 800kHz, whilst increasing the tuning voltage to +30V will change the tuning point to the uppermost part of the medium wave band at about 1620kHz.

The tuning voltage is applied to the BB113 triple a.m. tuning diode. Two of the three diodes are used in the radio frequency aerial circuit, whilst the third diode is used in the oscillator circuit where the required capacitance is considerably smaller.

The supply from which the tuning voltage for the BB113 diodes is obtained must be regulated. The use of a low current integrated circuit voltage regulator is convenient for this purpose, since it will stabilise the tuning voltage against drift with temperature or against mains voltage changes and will also reduce the mains frequency ripple to the very low level required for the supply to the tuning diodes. Tuning is carried out by using a ten-turn potentiometer to tap off the required tuning voltage.

Conclusion

We have looked at a variety of integrated circuit a.m. receivers; although these have not been discussed in any great detail, it should be clear that an excellent performance can be obtained at frequencies of up to at least 30MHz (corresponding to a wavelength of 10m). Fig. 18: A TCA440 circuit for medium wave use in which tuning is performed by varying the voltage+ V_D applied to the BB113 varicap diodes

PW WIMBORNE continued from page 34

Precautions Against Hum

As with the majority of audio amplifiers, care must be taken in the physical layout to avoid high levels of hum, especially where earthing at various points on the chassis is concerned. The emphasis placed upon "input earth" and "speaker earth" in the circuit diagram is no idle instruction; it is essential to take external earthing to only one of these points in order to prevent the creation of circulating currents ("hum loops"), and a consequent high residual hum level.

With the same aim in view, caution in the layout of current carrying conductors such as mains transformer secondary cables will help to prevent hum by routing them well away from sensitive points on the audio pre-amplifier layout.

One very important point is that the mains transformer itself can, by virtue of its high field intensity, radiate hum to the amplifier sections. This is especially true of the cassette unit, where the replay head will be very sensitive in this respect. As a result, it should not be permanently sited until after the cassette unit has been installed, at which point it should be swung in different directions while the cassette unit is switched to "play", noting the best position for minimum hum.

Succeeding instalments will cover the remaining circuit elements, which includes the r.f. board and tuner unit, along with the two optional magnetic cartridge pre-amplifiers, and notes on installation of the cassette unit.



The third Landsat satellite was launched from the US Western Test Range on March 5, 1978. It joins an earlier Landsat craft to scan the entire earth every nine days from an altitude of 500 miles. The satellites detect variations in sunlight patterns reflected from objects on the earth and even from subterranean materials such as mineral deposits and water.

Information thus provided is transmitted to earth stations and converted into photographic prints and tapes which can provide solutions to many problems in food, minerals and other critical resources. It has been estimated that the Landsat craft will save thousands of millions of dollars annually and cut the cost of obtaining data about environmental resources by a factor of about 20 times.

The imaging systems aboard Landsat-3 (weight 940 kg) are improved versions of the multi-spectral scanner subsystem and return-beam vidicon units employed in the two earlier Landsat craft. The developments in these infra-red sensors allow the detection of temperature differences in vegetation, bodies of water and urban areas, during either the day or night.

The Landsat craft have provided over half a million electronic images of the earth to over one hundred nations and are said to have affected more people than any other space programme. Information contained in the Landsat images is vital to the intelligent management of our natural resources.

The third Landsat spacecraft during its final checking at the General Electric Space Division Laboratory, Valley Ford, Pennsylvania. Although the prime contractor for the construction of each of the three Landsat craft was the US General Electric Company, the work required ground support equipment for the launch operations, satellite tracking and data-collection receiving site apparatus for NASA tracking and data stations. The initial ground data system at the NASA Goddard Space Flight Centre, Greenbelt, Maryland, USA decodes the Landsat data to the required form for distribution to the various user agencies.

Landsat-1 was launched in July 1972 and was operating successfully when its transmitters were turned off in January 1978 in preparation for the launching of Landsat-3. Both Landsat-2 (launched in January 1975) and Landsat-3 will continue to provide data in the coming years, but plans are well advanced for the launch of a Landsat-D craft in the early 1980's. The new spacecraft will provide more and better data at a faster rate; in addition, major improvements have been made to the ground datahandling system.

Although the Landsat programme was initially experimental, undertaken to ascertain the feasibility of the remote sensing of earth resources from space, more and more demands for information obtained by the spacecraft are being received from an increasing number of users. The Landsat observations have been employed as a vitally important part of the information required to estimate food crop yield, to aid oil and mineral exploration, to measure water quantity and quality, to make inventories of forests and to monitor land use. Indeed, the number of purposes for which the information is being used is growing at a rapid rate.



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This tuner can be used with end-fed or balanced feeder systems, either for reception or transmission. When used with a receiver, a substantial improvement in signal strength is obtainable. For transmission, it allows the usual pi-tank to be matched to endfed, Zepp, and other aerials.

Construction

L1 is wound with 20 s.w.g. tinned copper wire, and L2 is of well-insulated wire, on top of L1, as in Fig. 2. The former is 89mm x 44mm and 34 turns are used in all. Taps are equally spaced at six turns, two turns, four turns, and five turns from the centre tap. They are made by passing short lengths of 16 s.w.g. wire into holes in the former, and securely



Fig. 1: The circuit diagram of the aerial tuner

soldering these to the winding turns as required. Nine 6BA bolts with tags, mounted on a piece of paxolin about 102mm x 102mm (as in Fig. 2), support the coil. Below these taps fit three bolts for A, B and C. A to B is three turns, and B to C has four turns, so that three, four, or seven turns may be selected. Two further bolts are for E, E, Fig. 2.

Provided plenty of taps are available, other coils may be suitable.

Methods of Coupling

It is possible to find a suitable coupling method by trial only, especially for reception alone. Fig. 3 will help clarify some of the more usual configurations.

"A" is a pi-coupler, and adjustment of the capacitors allows a wide range of impedances to be matched, either to load the transmitter correctly, or to give best reception.

"B" is a popular method for high impedance aerials. With a transmitter, a co-axial lead is generally used, with outer conductor to the chassis. This, shown at "B" may be fitted for any circuit.

"C" employs the link for coupling. For low frequencies, the two capacitors may be put in parallel as shown, and this is useful if they are not of very large value.

F.G. RAYER G3OGR

"D" is a somewhat similar arrangement to using a centre-tapped coil and having the capacitors in series in this way is most appropriate for a high frequency band.

"E" shows the aerial tapped down, which is useful with parallel tuning when aerial loading prevents proper tuning with "B".

"B", "C" and "D" are appropriate for high impedance. "E" suits many intermediate lengths. "F" is for low impedance (quarter wave) with one capacitor used for series tuning.

Parallel tuning of balanced feeders is shown in Fig. 1. This is satisfactory when the feeder termination is high impedance. For low impedance feeders, "G" in Fig. 3 is necessary. The best balanced system is a tuned doublet. The top is divided into equal lengths, and the twin feeders are spaced about 102mm by spreaders. High impedance feed is expected if onehalf the top, plus the feeder, equals a half-wave or multiple of half-waves. Should one-half the top plus feeder be a quarter wave or odd multiple, lowimpedance coupling "G" is anticipated.

***** components

VC1 and VC2 350pF Jackson 5021/2 or similar. Ceramic or paxolin former, 100 × 100mm. Aluminium base 165×100 × 9mm, aluminium panel 203 + 152mm, Case 203 × 152 × 152mm. Tinned copper and insulated wire.



Fig. 2: General layout, showing connections to screw terminals



A view of the unit showing L2 (p.v.c. covered wire) wound over L1



Fig. 3: Coupling circuits A and B





Frequency

Circuits showing the whole of L1 in use, above, are for the 80m band. For higher frequencies, fewer turns are used. With "A" short out unwanted turns. Circuits such as "B", "C", "E" and "F" are used at higher frequencies by moving the aerial and capacitor connections down the coil.

With balanced circuits, Fig. 1, "D" and "G" in Fig. 3, move taps in equally from each end.

There is sufficient latitude to allow tuning up for reception on 25m, 31m and other broadcast bands, if required.

Fig. 5: Coupling circuits F (upper) and G (lower); details of all coupling circuits are given in the text

Reception

For reception purposes only, it is an easy matter to try various tappings or circuits, to find which peaks up signals best. This can be done with the aid of the S-meter, selecting a signal not subjected to fading. "B", "E" and "F" will cover most conditions likely to be met with a single wire aerial. The improvement is greatest when the original match with no tuner was poor.

Fig. 1 or "G" will be used with twin tuned feeders (doublet or Zcpp) or Fig. 1 with feeders tapped in equally from each end of L1.

Transmission

The points already mentioned apply, plus the fact that for correct operation and loading, suitable matching is essential. Mis-matching may in fact cause damage to the transmitter output stage.

An excellent method of matching is to place a standing wave indicator in the co-axial lead from tuner to transmitter, and adjust the tuner for minimum SWR, with reduced power. An indication of 1.5:1 or lower is normally satisfactory. Adjustment to a very low SWR (virtually 1:1) is generally simplified by placing a variable capacitor in series with the link or tap—e.g., between A and the co-axial inner conductor in Fig. 1. A 500pF component is suitable for h.f. bands, and 2×500 pF for 80m, receiver type capacitors having adequate spacing. "A" Fig. 3 does not require this item, and can generally provide virtually 1:1 SWR.

Capacitor settings and tappings used for each band should be noted so that re-tuning is possible with a minimum of trouble.



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2m MOSFET CONVERTER

continued from page 25

An internal supply using a PP3 battery could also be utilised if the Zener stabiliser in the oscillator is changed to a 6V8 type and $R_{\rm bl}$ suitably adjusted in value.

The converter would then be completely selfcontained and could be used with valve receivers where an internal 12V supply is not normally available.

Coil Winding Details

Coils L1, L2, L3, L6 and L7 are identical, with the exception of a tap at 1_4 turns on L1. They are all made using a 6.5mm drill as a winding mandrel.

All coils can be wound using 19 or 20 s.w.g. tinned copper wire and, with the exception of L1, may be constructed from enamelled wire for appearances sake. The turns are separated evenly until the coils are 9mm (0.3 inches) long.

Coil L4 is wound using 30 s.w.g. enamelled copper wire with a total of 17 turns on a 5mm slug-tuned former, which is then fixed to the board with cyanoacrylate adhesive.

Enamelled 30 s.w.g. copper is also used for L5, which is wound with 9 turns on a 5mm slug-tuned former and fixed in the same manner. Both the coils are close-wound, the windings being subsequently waxed to aid stability and to hold in place whilst fitting to the board.

Alignment and Operation

Once the unit has been completed and checked for faults, the battery or other supply may be connected and the current measured. This should be in the order of 20mA at 12V. If all is well the oscillator can now be adjusted with the core of L5, using a wavemeter to sense when oscillation occurs and to tune for maximum output. At this point, the supply should be switched off and on again to ensure that the oscillator re-starts. If it does not, then detune the coil slightly until instantaneous oscillation occurs at switch-on. Once correct, use a wavemeter to tune L6/TC4 to 116MHz and then tune L7/TC5; return to TC4 and peak, then TC5 again to achieve maximum output, as these coils will tend to detune each other.

Plug the converter into the aerial socket of a receiver and tune the set to 29MHz, now adjust L4 for maximum noise at the speaker.

Carefully tune the station receiver from 28 to 30MHz and try to find a signal. If a station is heard or a locally-generated signal is available trimmers TC1, TC2, and TC3 can be peaked for maximum output from the speaker or against a reading on the Smeter (which is usually much more accurate).

The trimmers TC4 and TC5 should now be carefully turned for optimum converter gain.

No further adjustments are required and the unit should give you years of satisfactory operation without the need for any further adjustment if a small drop of wax is melted into the coil cores to ensure rigidity.





by Eric Dowdeswell G4AR

Looking at the spate of reports on 10 and 15m activity it is fairly obvious that most are from readers possessing one of the relatively new types of receiver, such as the FRG-7. This is only to be expected, of course, but it leads me to wonder just how many readers are plodding away with older sets, which may not be very effective at these frequencies, not hearing very much, and frequently switching off, convinced that the bands are dead.

If you have such a set, don't scrap it but build yourself a converter from some published design. The set is probably quite effective at, say, 3.5 to 5.5MHz, with a good dial, so the converter is used to change signals on the 10 and 15m bands (28 to 29.7MHz and 21 to 21.4MHz) to a frequency within the range of the main receiver, which is used as a tuneable i.f. stage. The simple r.f. tuned circuits can be arranged to cover both bands without any switching.

A good line-up for the converter is an r.f. stage, mixer, and crystal oscillator/multiplier. If, for example, a 3.5MHz crystal is chosen, the oscillator output selects the 7th harmonic on 24.5MHz which is fed to the mixer, producing a difference frequency, on 28MHz, of 3.5MHz which is fed to the receiver. The dial calibration of 3.5MHz will now represent 28MHz and by tuning up to, say, 4.5MHz then signals on 29MHz will be heard, and so on, the converter r.f. circuits being peaked appropriately.

In practice a crystal just below 3.5MHz will be chosen or the receiver will be blocked by the fundamental. A frequency of about 3.490MHz should be suitable

If the fifth harmonic of the crystal is chosen, on $17 \cdot 5$ MHz, this will mix with 21MHz to produce $3 \cdot 5$ MHz again, thus covering the 15m band. The only switching involved is for the correct harmonic, the r.f. tuning covering both bands. There are no variable oscillators involved which means that the overall stability of the set-up is as good as the main receiver.

Crystals over a very wide range of frequencies can be chosen, different ones for each band if you like, and the i.f. tuning range can be other than that suggested. However, the use of 3.5MHz gives automatic fixing of the band edges. It is essential that the main receiver be well screened and that the converter is connected up with coaxial cable with proper fittings, otherwise signals may leak through at the chosen i.f. The converter should have a switch to change the aerial input direct to the receiver to avoid having to play around with cables. If solid-state, the converter may be powered by a 9V PP3 battery, or possibly from the main receiver.

I used a valved version of such a converter for some years, coupled to a much-modified HRO, and such a combination would be hard to beat. Remember that in a multiband receiver the necessary r.f. switching can only introduce losses at the higher frequencies.

Newcomers to the Column

From East Kilbride, Glasgow comes a letter from Greg Duffy who has been listening around the bands for only a few months. He has an FR50B receiver but has been worried about the type of aerial to use, and wants to improve on an indoor wire. I have sent him the PW Aerial Chart that was given away in October '72 and I have a few more copies for any other newcomers who have aerial problems. An 8 x 5in SAE would help, please. My other oft-repeated advice was to write to the RSGB for a copy of the Guide to Amateur Radio which costs £1.70 inc post and packing. Their address is 35 Doughty Street, London WC1 for those just starting in amateur radio.

I'm going to include Neil Clarke of Mexborough, S. Yorks here because although he has written to me before, he has only recently got going with a PCR receiver, although he was after an HRO or AR88. He comments on the very rapid overs that some chaps use so that he is unable to copy the callsigns. This, I'm afraid, is something that only experience, listening on the bands, will sort out, but be patient, Neil.

An appeal from Steve Donnelly of 25 Church Street, Adlington, near Chorley, Lancs, who would like to meet others of like interest in his district. He's been using another FR50B for over a year and if anyone wants to call on Steve and "have a go" they are welcome. Thanks, OM. Steve wants to know all the pros and cons of adding accessories to a set. It so happens that an article from me on the very subject is with the Editor now, so let's hope he looks on it kindly!

On the Bands

Dick Smith of Porthcawl (mid-Glam) is still plugging away with his little t.r.f. set, mainly on 20m where he found HP3AB on s.s.b., and A5JO ostensibly

in Bhutan, which is just too good to be true! **Bob Bell** (Blyth, Northumberland) reports that about a dozen people have come forward as a result of appeals in this column so it looks as if a local club there will materialise very soon. Any group thinking of starting a club but feeling a bit hesitant about it should write to the RSGB and see if they still have the leaflet which gives a suggested set of rules and general guidance on running a club.

Flat Holme Island was the QTH for the Marconi celebrations and special station GB3FI. Brian Smith of Barry, Glam. can see the island from his QTH but was determined to log the station. He found it eventually on 160m! Brian bought himself a typewriter, unfortunately for me, as his letters are now twice as long! He found DX on 80m at this time of year in the shape of ZP5YW, which is pretty good going.

Steve Turner BRS37620 kept away from radio while working on his O-levels but was amply rewarded on his return by catching the Rodriguez Island DX-pedition 3B9DA on 20m s.s.b., using his ex-Army R208 and 50ft wire. He's contemplating recalibrating his set and would like to hear from anyone else who has managed to do this successfully. So fellow R208 users are asked to drop a line to Steve at 9 Wallingford Road, Handforth, Wilmslow, Cheshire.

According to Ian Marquis A9140 the band with the sparkle has been 15m where he found VP2MZZ on Montserrat, VR4CF in the Solomons and YB0AB in Indonesia, Talking of VP2, I wonder how many people realise that it counts as nine different countries for DXCC purposes? The first suffix letter denotes the island, as shown with VP2MZZ above, and there are nine principal islands. Another one who is just relaxing after his exams is Pete Cockerell of Leigh-on-Sea, Essex. He's asking me when the peak of the current sunspot cycle is likely to be! My guess is as good as anyone's but I'd say around 1981, but there, half the fun of amateur radio is not knowing how conditions are going to turn out! Pete's problem is that he'd like something better than the PW Direct Conversion Receiver that has stood him in good stead, but can't decide whether to go on making up odds and ends of projects or to save for a proper set! Go for the set first OM and get some more listening time in. You can go for the bits and pieces later.

In far-distant Truro, Cornwall Bill Rendell has added a 15m folded dipole to his "elementary" valved Heathkit AR3 and his log seems to justify the work involved, with FP, KC4, KG4 etc appearing in the log, as part of Bill's quest for island calls. Bill comments on the sunspot wipeout in mid-July when the band was full of DX at 1730 but within a couple of hours all he could hear were G's working each other. He managed to bag GJ for a new one on 15m!

Club News

John Howard G4EVI, publicity officer of the Yeovil ARC G3CMH invites interested readers to two lectures. On September 14th Dud Charman G6CJ gives his famous talk and demo on aerials, and on October 12th the RSGB's Region 17 rep Les Hawkyard G5HD will discuss the World Administrative Radio Conference 1979. Club meetings every Thursday at 1930 in Building 101, Houndstone Camp, Yeovil. A club net operates on Sundays 1030 on 3660kHz.

I always thought that Shirehampton was one of those places mentioned in Crossroads! But now R. G. Ford tells me that the Shirehampton ARC meets on Friday evenings at Twyford House, High Street, Shirehampton, Bristol and that a new RAE course starts in September. The club has h.f. and v.h.f. gear plus a programme of lectures and films. Write to Hon. Sec. R. G. Ford, 2 Jersey Avenue, St. Annes, Bristol for details.

Log Extracts

W. Rendell:— 15m C5AAR EA8LD FP0AM HM1II HS1WR J3AH KA6KN KC4AAC (Anvers Is.) KG4FW KZ5ED SV1IW (Crete) TR8AC YB0ACB 9V1TG. I. Marquis:— 20m FC9UC OH0NA TA1ZB 15m

I. Marquis:— 20m FC9UC OH0NA TA1ZB 15m TU2GM FM7BA VP2MZZ VR4CF 3D6BP YB0AB 10m 3D6BP 8R1J (c.w.).

S. Turner:— 20m DUICLR HB0XAA YB1BF/7 3B9DA (Rodriguez Is.).

B. Smith:— 80m ZP5YW 40m CO2KK TI2RMA TG9IA 15m HS1WR.

R. Smith:-- 20m A5JO CO2FRC HP3AB VP2VEM.

R. Bell:--- 15m P29JS CP3AF 10m LU1NR.

All s.s.b. unless indicated otherwise.



MEDIUM WAVE DX

by Charles Molloy G8BUS

During the last war a number of specialist receivers covering the low frequency bands only, were produced and on the face of it, they should be the answer to the medium wave DXers' prayers. Unfortunately there are snags. The majority of these receivers are bulky and heavy. Some are unsightly with jacks and multiway plugs on the front panel, and many were designed to run from unorthodox power sources such as a 24 volt aircraft supply. Reader M. N. Button of 101 The Street, Holt, Trowbridge, Wiltshire, has acquired one of those receivers—the ex-USAF DF Receiver type R101A/ARN6 which covers 100kHz to 1750kHz in four bands and he would be very grateful for any information on it. All letters will be answered.

Low Frequency Communications Receivers

A general coverage receiver such as the CR100 or the AR88 must have a reasonably high i.f. in order to provide good image rejection at the h.f. end of its range, but the higher the value of the i.f. then the worse the selectivity becomes so usually a compromise is chosen around 460kHz. If the selectivity is not good enough then a crystal or mechanical i.f. filter has to be provided. A receiver for low frequency use only, can have an i.f. as low as 100kHz which provides excellent selectivity with a minimum of complication while at the same time the image rejection is acceptable. Stability is also easier to achieve and two r.f. stages and three i.f. stages are not uncommon. As



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Reports on the various bands are welcome and should be sent direct, by the 15th of the month, to:-

AMATEUR BANDS Eric Dowdeswell G4AR, Sliver Firs, Leatherhead Road, Ashtead, Surrey KT21 2TW. Logs by bands, each in alphabetical order.

MEDIUM and SW BANDS Charles Molioy G8BUS, 132 Segars Lane, Southport, PR8 3JG. Reports for both bands must be kept separate.

VHF BANDS Ron Ham BRS15744, Faraday, Greyfriars, Storrington, Sussex RH20 4HE.

I have used three of these receivers at one time or another for medium wave DXing I thought it might be useful to pass on what I know of them.

The Marconi Mercury is by far the best receiver I have used for MW DXing. It first came to my attention when detailed in an article on coastal radio stations in Practical Electronics November 1966 edition. At that time the receiver was still in use in these stations. This valved receiver, complete with separate power pack, can be plugged straight into the 240 volt mains and it is ready to use. There is even an internal speaker. The receiver covers 100kHz to 4.0MHz in four bands with an additional band from 15kHz to 40kHz. On the two higher bands, which include the medium waves, it is a double superhet with i.f.s of 4.5MHz and 85kHz. There is a three-position selectivity switch which is adequate and heterodynes can be removed with an external audio notch filter instead of the more usual crystal phasing control. The receiver, although presentable in appearance, is too bulky and heavy for use in domestic surroundings, at any rate in my QTH, and consequently it is temporarily in retirement.

The BC314 is a low frequency version of the well known BC312 and there is also a BC344 which has the same relationship to the BC342. The BC314, which I have used, covers 150kHz to 1500kHz in four bands using an i.f. of 92.5kHz and there are two r.f. stages and two i.f. stages with metal octal valves. The BC314 performs very well on the medium waves. It is heavy but not too bulky but it runs from a 12 volt battery with a consumption of about 5 amps. The one I used was converted to run off 240 volt mains but this is not too easy to do as internal space is limited. The BC344 runs off 110 volt mains.

Older DXers will remember the Medium Wave Command Receiver which at one time was popular as a car radio. The official name is the R24/ARC5 or the BC946. It is compact and light, it has one r.f. and two i.f. stages using metal octal valves and the i.f. is 239kHz. The three i.f. transformers have push-pull rod adjustments for changing selectivity and in the "narrow" position this receiver is excellent for DXing. The frequency range is from 520kHz to 1500kHz in a single band. The tuning scale which rotates, is surprisingly accurate but there is no tuning knob as the receiver was designed for remote control by Bowden cable. It is fairly easy to fit a tuning control. The Command receiver works from 24 volts but the dynamotor can be removed to make space for a mains transformer etc. The heaters are unfortunately wired for 24 volts.

Other l.f. receivers that I know of are the Radio Compass MN26 with the suffix A, C, CA or W for medium wave coverage and the RBM which tunes from 140kHz to 2MHz with an i.f. of 140kHz. Although all of the receivers mentioned here have long since disappeared from the surplus market many are still in private hands and are sometimes on offer in the small ads columns of specialist radio amateur magazines such as *Radio Communications* (RSGB) and the *Short Wave Magazine*. When available, these receivers can usually be obtained for a modest outlay, for apart from the medium wave DXer and perhaps collectors, few people have any use for them.

Crystal Calibrators

"The crystal calibrator you mention presumably applies to your particular set and valves" writes R. E. Steele from Swanley, referring to the notes in the June issue about the gear at my QTH. This is not so. A crystal calibrator is connected to a receiver in place of the aerial and one can be used with any receiver, even a crystal set. A 100kHz calibrator generates a 100kHz carrier plus harmonics at 100kHz intervals. Harmonics are multiples of the fundamental, which in this case is 100kHz. This means that there will be 11 such harmonics or markers across the medium waves starting at 600kHz, then 700kHz and so on up to 1600kHz. Although useful, such a calibrator has limitations on the medium waves and a more complicated model with an additional alternative output of 25kHz or 10kHz will be more useful. My calibrator has switched outputs of 100kHz, 50kHz and 10kHz which are used as markers on the medium waves, enabling me to set my receiver onto any of the North American "channels" which are spaced at 10kHz intervals between 540kHz and 1600kHz. A calibrator with a single output of 10kHz would have its own problems as it would then be difficult to identify the individual 10kHz markers from one another. There would be 107 of them across the band.

These remarks apply to the medium and long waves only. A different approach is required for the short waves where the 100kHz markers become difficult to identify on the higher frequencies and an additional marker of 500kHz or 1MHz is then an advantage. For general DXing a calibrator with three outputs is adequate. One output of either 500kHz or 1MHz, a second of 100kHz and a third of either 25kHz or 10kHz, will cover most requirements.

DX

The implementation of the new (Geneva) band plan for the medium and long waves on the 23rd November 1978 will make Asiatic, African and Near East DXing more difficult from the UK. The new plan applies to these areas as well as to Europe! At the moment broadcasts from outside Europe are to be found in some of the gaps between European stations. For example, Kabul in Afghanistan can be found on 1280kHz which lies between Europeans on 1276 and 1285. Under the new plan, Kabul moves to 1278kHz which will be a European channel and this station may then become a rarity. So now is the time to have a look around before the change occurs. Listen as darkness approaches in the gaps between the European channels and refer to an up-to-date list, such as the 1978 World Radio and TV Handbook for possible DX. Rivadh in Saudi Arabia is on 587kHz. Kermanshah Iran is on 895kHz, Egypt on 1155, Enugu Nigeria on 1320, Kuwait on 1345, Kirkuk 1360 and Ahwaz 1390 both in Iran and Ban Pachi Thailand on 1580 with sign-on at 2230 GMT.

Pirate Radio Stations

A number of readers, the latest being Richard Casey EI9BL, send in logs of Pirate Radio stations. These stations operate outside the ITU regulations and they ought to be illegal in any country that belongs to this international organisation. It is also illegal in the UK to publicise these stations and consequently details of them cannot be included here. In any event, pirates are seldom DX. To the serious DXer they are just an unwelcome addition to a band already overloaded with QRM.



SHORT WAVE BROADCASTS by Charles Molloy G8BUS

A reference to the MCR1 receiver in this column prompted John I. Brown of South Ockenden in Essex to write "I designed the MCR1 early in 1943 and it was produced by Philco in Perivale reaching a rate of 500 per week before Christmas that year. The set was packed in Huntley and Palmer biscuit tins, complete with two dry batteries, an a.c./d.c. power pack for 110-240V, earphones and coil boxes for all bands from 150kHz to 15MHz. The tins were solder sealed and 'delivered' in parachute containers, mainly by Halifax and Stirling bombers." John goes on to say that altogether 30,000 of these receivers were made, the majority being used to provide links to resistance movements in occupied countries. John, who has been a PW reader since he was a boy, thinks that many people would regard attempts to modify the MCR1 as vandalism! Strong words, but it does seem rather a pity to muck about with such a famous piece of equipment,

Time Signal Stations

A request for detailed information about the various time signal stations that can be heard on the short waves comes from Findon Vicarage in Wellingborough where the **Revd J. P. Beaumont** thinks this could be helpful to DXers for receiver alignment and calibration checks.

Time signal stations are to be found on 2.5MHz, 5MHz, 10MHz, 15MHz and on a number of other frequencies as well. In the UK, station MSF located at the National Physical Laboratory at Teddington transmits on 2.5, 5.0 and IOMHz, and the 5MHz transmission which is within the 60m broadcast band is a strong signal at my QTH, The "programme" which lasts for 10 minutes is repeated throughout the 24 hours. At 30 seconds before the hour the callsign MSF is sent in Morse code. Then there are second and minute pulses for a period of five minutes and during the following 412 minutes the station is off the air. As well as providing an accurate time check, MSF also provides an accurate frequency check and the DXer will find it useful for locating 5MHz on his receiver and hence the 60m band. He can use MSF as a frequency standard against which to calibrate equipment such as a wavemeter or crystal calibrator (where

Practical Wireless, October 1978

an adjustment is provided). MSF is also a good signal on $2 \cdot 5$ MHz which marks the upper limit of the 120 metre tropical band. Clock pulses can also be heard from various stations throughout the world on 10MHz (30m) and 15MHz (20m) which lie within the unofficial limits of the 31 metre and 19 metre bands respectively.

Perhaps the most useful and interesting feature of these stations is the guide they give to propagation. Station VNG in Lyndhurst, Australia transmits on 4.5MHz, 7.5MHz and 12MHz, all three transmissions being audible in the UK when propagation is favourable. Others from Taiwan, China, India, Italy, Japan, Argentina, USSR, USA, Hawaii and South Africa are on 5MHz and 10MHz and some of them can be heard in the UK. Identification can be a problem but some information is included in the World Radio and TV Handbook. Full details of all known time signal stations, including a breakdown of each programme which in some cases gives a propagation forecast, are contained in a booklet, printed in English called List of Time Signal Stations, which has been compiled by a German DXer. It is obtainable from Gerd Klawitter. Ochtrupper Str 38, D-4430, Steinfurt, FRG (West Germany) in return for five International Reply Coupons.

Aerials and Trees

Following the comments in the July issue about using a tree as an anchorage for an aerial in place of a mast, E. C. Rowland has written in with some details of his own experiences. He says that if the tree is likely to move a lot then make sure that the pulley is able to move freely and is of as large a diameter as possible. Use stranded wire instead of rope as the latter will absorb moisture and freeze in cold weather. A spring between the end of the rope and the weight is also a help. His first attempt to use a tree was in the early days of wireless when he had a crystal set and the "weight" was an old-fashioned type of cooking pot designed to hang on a hook in a chimney. This rested on the ground when the tree was not in motion. An attempt was made to fit the pulley at the house end of the aerial but this caused problems with the lead-in and the idea was abandoned.

Receivers

Phil Grainger (South Shields) has moved from a Trio 9R59DS to the new Yaesu Musen FRG-7 but he says "I can't say this receiver is that much better than my trusty Trio". Do not expect spectacular results if you swap a good receiver for one that may be better. The law of diminishing returns also applies to receivers and quite a large outlay may bring only a marginal improvement which is not apparent except when listening to a weak or difficult station.

From South Africa regular PW reader Francois Steyn writes to ask if any reader could help him with some information, including a circuit diagram, about a rather old valve receiver which is marked SAJ Geloso Gruppo No 1988 Micro. Replies direct to 26 Voortrekker St, Villiersdorp, 7170, RSA. When connected to a 150ft inverted "L" aerial via a MOSFET (40673) preselector, this receiver pulled in JJY, the time signal station in Japan on 10MHz at 1640, the CBC Northern Service on 11720 SIO 333 at 2104, FEBC Philippines in English on 15440 at 1430 SIO 433 and SLBC Sri Lanka with a test transmission on 17850 at 1850 SIO 433. The Newport Amateur Radio Society is looking for new members, enquiries should go to Martin Liezers, 32 Barrack Hill, Newport, Gwent NPT 5FR. Martin, who looks after the interests of SWLs, uses a Realistic DX160, a home-brew aerial tuner and a large medium wave loop in series with a 200ft long wire. On 60m, DX heard included two Venezuelans, Radio Universo in Barquisimeto on 4880kHz at 2245 and Ecos del Torbes in San Cristobal on 4980 at 2240. Conakry, Guinea on 4910 was also heard at 2305.

Martin is having difficulty identifying Latin Americans and he mentions hearing "Colo Santa Araba" and "Radio Baraba" on 4950kHz approx. This. is probably a reference to Santa Barbara del Zulio which is a medium wave station which may well be linked up in a network, such as Radio Rumbos, with a short wave outlet. The Rumbos network has the habit of announcing the names of all its stations, including the towns, which is very confusing for the DXer. Martin asks for the address of Radio Clarin which is AP 205, Zona 2, Sto Domingo, Dominica. John Dennis Court of Birmingham reports hearing Radio Clarin on 11700kHz (25m) between 2230 and midnight using an Eddystone EC10 and 10ft outdoor aerial. while thirteen-year-old David Wyatt of Oswestry heard Radio Clarin at 2300 in English also on 11700 using a home-brew receiver and 100ft of wire "tangled up" in the loft. From David's penpal in Indonesia comes news of RRI Jakarta on 9710 and 11790 from 0900-0930 and on 11790 from 1100 to 1200.

S. Donnelly suggests that the Radio Ping Pong mentioned in the July issue may be Radio Pyongyang in Korea while David Wyatt asks if anyone has reported recently to Radio Pyongyang. This station sent David a QSL card, a pennant, schedule, letter, set of postcards of Wonsan, a badge, a book about Pyongyang Zoo and two IRCs, as the latter are not valid in North Korea.



by Ron Ham BR\$15744

We all know that the v.h.f.s are full of surprises, but, how many of us would have expected to see adverts on Hungarian television, cartoon films from Italy, sport from Poland, hear east-European and Italian broadcast signals dominating Band II, and UK amateurs working their Italian counterparts on 2m with comparative ease. It was all this, in one 3-hour session which set the telephones buzzing among our readers and disrupted the Saturday evening plans in many of our homes.

Sporadic-E

Around 1700 on July 8th, the v.h.f. bands were relatively quiet, but, by 1800 my R216, monitoring Ch. R1, 49.75MHz, was receiving strong television sync pulses which were heralding the start of the biggest sporadic-E disturbance for many years. It was soon obvious that frequencies between 30 and 150MHz were wide open and it was amazing to hear the chaos, as signals from a wide variety of international broadcast transmitters, which share the same frequencies throughout Bands I and II, mixed together.

Between 1810 and 1930, Ian Rennison, Horsham, Sussex, using a JVC 3040 UKC, fed by a dipole. received strong pictures from ORF Austria, DDR East Germany, RAI Italy and the USSR. At 1930, Guy Stanbury, Chelmsford, counted 37 Italian stations between 87 and 104MHz, as did Ian who writes "I was also monitoring Band II and it was cluttered with Italian f.m. stations, some were so strong that stereo reception was a 'piece of cake' ". I rang Alan Baker, G4GNX, Newhaven, Sussex, who demolished his piece of cake and rapidly humped his 2m gear up to his loft shack (it had been out for v.h.f. field day), and was rewarded for his immediate efforts, because between 1849 and 1930 he worked IGWJB, I0HKD, 10JFE on 2m s.s.b. and heard Mike Hearsey, G8ATK, Farnham, Surrey, along with several other G stations, in QSO with the Italians. Clive Atlowe, Blofield, Norwich, using three Sony sterco receivers, heard many private stations among the multitude of Italians in Band II and Bob Dewick, Bradwell-on-Sea, Essex, reckons that this event had been brewing up since early morning because during the day he received strong signals from Italian, Portuguese and Spanish broadcast stations in Band II. While most of us were concentrating on the v.h.f.s, Harold Goble, G4FDQ, Lancing, Sussex, used the short skip on 10m to work into GI, ZE and 5N2.

Throughout a similar event during the evening of July 10th, the German beacon, DL0IGI, was very strong and G4GNX had a half-hour QSO with DF2RQ, both on 10m. Guy Stanbury reports that Band II was disturbed early in the evening, and so was 2m, because Peter Henley, G81QO, Eastbourne, Sussex, and John Matthews, G3WZT, near Horsham, worked stations in Greece. Later in the evening Alan Baker and Roy Bannister, G4GPX, Lancing, worked YU00M, on 2m s.s.b. and John Cooper, G8NGO, Cowfold, Sussex, heard similar signals from II, HG, and YU with an indoor 4-element Yagi. Duncan Groves, Chelmsford, described the opening as being like Pandora's box. . "things appeared everywhere" and William Poel. G8CYK, Brentwood, Essex, heard Yugoslavian stations in Band II with only a piece of wire in the aerial socket of his Ambit International Tuner.

During the morning of the 11th, DL0IGI was pounding in on 10m, TV pictures were coming from Sweden and the USSR on Band I and I counted 48 strong signals from east-European broadcast stations between 65 and 73MHz, some of which were heard by **Harold Brodribb**, St. Leonards-on-Sea, Sussex, using an indoor dipole to a home-brew receiver. Important, but much less severe sporadic-E disturbances occurred on June 19th, when I received good pictures from Finland, Iceland and Sweden, 20th, 22nd, and 29th and July 1st, when Ian Rennison received pictures from Austria, Hungary, Italy, Norway, Spain and the USSR, and July 2nd, 7th, 15th and 16th.

Solar Activity

Radio noise from the "active" sun was recorded at 136/142MHz by Cmdr Henry Hatfield, Sevenoaks, Kent, John Smith, Rudgwick, Sussex and myself on 18 of the 25 days from June 21st to July 16th, during
which time there were two major noise storms, June 24th to 28th and July 9th to 12th, both disturbing the ionosphere and causing radio blackouts on many occasions. On June 26th, John Branegan, GM8OXQ, Saline, Fife, heard solar bursts at 29MHz, while Alan Baker received one at 144MHz and, on July 9th and 12th, many of us heard them at 28, 50 and 70MHz.

On July 7th, Henry Hatfield, using his spectrohelioscope, saw the first appearance of the giant sunspot which reached the Central Meridian Passage on the 14th. Despite overcast skies, Henry did get a look at it on the 10th and noticed its unusually large penumbra. Charlie Newton, G2FKZ, London, tells me that the largest known Xray burst lasting 11 minutes took place on the Sun during the early days of this sunspot, and sent all recording instruments off scale. The thinning cloud during the evening of the 13th enabled Barry Ainsworth, Eric Dowdeswell, G4AR, Ashtead, Surrey, and Mike Rowe, G8JVE, East Preston, Sussex, to see this giant spot with only a filter in front of their eyes. It is not advisable to look directly at the sun under any circumstances unless as Henry Hatfield says, you have a special and carefully designed filter to protect your eyes.

Tropospheric Openings

To add to the turmoil the atmospheric pressure rose above 30.0in on July 6th and was still high on the 16th during which time there were several tropospheric openings. At 2218 on the 11th G4GNX worked ON5QW on 2m c.w., on the 13th G8JVE worked DK7KO and 4 French stations on 2m s.s.b., at 0130 on the 14th G8NGO had a QSO with DF1JC, first via the French repeater on R9 and then direct on s.s.b. G4GNX and G8JVE both contacted stations in southern France on the 15th and Ern Hoare, G8BDJ, Brighton, heard an OE on 2m.

Microwaves

Ern Downer, G8GKV, Worthing, Sussex and Ern Hoare, G8BDJ installed their 3cm gear at Chanctonbury Ring, a high spot on the South Downs, to compete in the 2nd round of the RSGB 10GHz Cumulative contest on June 25th. Despite the atrocious weather conditions, both Erns worked G3JHM/P, near Petersfield, G3JVL and G8DIC, in Hayling Island, and G3IFF/P on Portsdown Hill, all in Hampshire. During a contact between G8BDJ/P and G3KSU/P, Isle of Wight, a rain storm was seen crossing the path and the signal strength dropped from S9 down into the noise and came up again when the storm cleared the path.

CB Down Under

M. A. Penfold, ZL1TUI, Dunedin, New Zealand, read about the American CB stations being heard in the UK in our April issue, and asks if our readers would periodically listen around $26 \cdot 5$ MHz for CB signals from New Zealand. M. A. Penfold also has a CB call, R0575, and would like to know if their $0 \cdot 5$ watt signals ever reach the UK.

OSCAR-8

John Branegan, assisted GM8NXW on the OSCAR stand at the Scottish Mobile Rally on June 10th, and says "I talked OSCAR-8 solidly for five hours, we had about 300 people there and a continuous stream of

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groups of 4 or 5 asking questions the whole time". At 2213 on July 8th John worked WICRL, Maine, his first W contact via the satellite's mode-J. At 2317 on the 9th he contacted VE2LI, Montreal on s.s.b. and the VE replied on c.w. Two minutes later he had an s.s.b. QSO with WA3ZHW in Pennsylvania.

Club News

One of the attractions at the Worthing and District Amateur Radio Club's mobile rally held at Whiteways, near Arundel, Sussex, on June 20th was the Radio and Television interference detector van belonging to the Brighton area of the Post Office. The officer in charge, **Bob Taylor**, G8JZZ, demonstrated the vehicle's equipment. More than 150 attended the event which was organised by Barry Ainsworth. The talk-in station on 145MHz, operated by G8GKV worked more than 100 stations.



Bob Taylor G8JZZ beside his Post Office interference detector van

The Mid-Sussex Amateur Radio Society had stations on 4m G3XUP/P, 2m G3ZMS/P (the club call), 70cm G3VQN/P and 23cm G3RXJ/P (the club chairman), during the RSGB VHF NFD on July 8th. They were situated 700ft a.s.l. near Brighton and are very pleased with their results, especially on 23cm where they worked 10 stations in 5 counties using RXJ's home brew transmitter and a Microwave Modules converter.

Readers' Equipment

G8NGO now has a 12ft dish and hopes to use it in the future for moon-bounce on 23cm.

Gordon Goodyer has completed the *Practical Wireless* Audio Filter and is delighted with its performance.

Clive Atlowe, a keen TV/FM DXer has 12 TV receivers installed at his home, nine are fixed channels for sporadic-E and meteor scatter on Bands I, II, and III and the others, Sony 9-306UM, Luxor Colour set, and a German Philips Bellini are for u.h.f. reception. All are fed by a wide variety of aerials and pre-amps.



FRANK LUMAN

by RON HAM



American-born Frank Luman began seriously DXing on the medium wave band, with a Hallicrafter SX-110, when the family moved from Cumberland, Maryland, to Denver, Colorado. The medium waves interested Frank because he could often hear stations some 3000 miles apart (i.e. KNX, Los Angeles and WNBC, New

AMATEUR SSTV

continued from page 29

One interesting feature of SSTV is that it can be stored on conventional audio recording tape. This is due to the low frequencies employed, which fall well within the 'audio' spectrum. Consequently, a readily available cassette or reel-to-reel recorder can also double as a storage and retrieval system for your SSTV pictures.

Slow to fast-scan converters are available which will display an SSTV picture on a conventional television monitor or receiver; designs by active amateurs such as DL2RZ are already well known. Alphanumeric information and colour transmissions have also been proved possible.

The accepted UK standards for SSTV are given in Table 1, and are the references to which any wouldbe constructor should work. There is, of course, a variety of commercially produced equipment available for those without the necessary facilities. The typical block diagram for a monitor, for example, is given in Fig. 2, and provides an indication of its complexity. York), and was kept updated with the news as it happened as well as getting a different perspective on the music that was being played.

When Frank came to study in the UK (Pharmaceutical PhD) his hi-fi system, cassette deck, loudspeakers, stereo receiver and turntable came too. Through using the receiver, a Sherwood S-7100 A, at his present QTH in Glasgow, he fell for v.h.f. DX in a big way and began experimenting with aerials. In 1976, he was told that it was next to impossible to receive transmissions from the new station, Downtown Radio, (Belfast, $96 \cdot 0$ MHz) in Glasgow, so, typically Frank, he mounted a Jaybeam FM9s aerial on his AR40 rotator, built an f.e.t. pre-amp and received the station loud and clear. What's more, with a little help from the troposphere, he heard signals from BBC Radio Carlisle, Radio Cleveland, and Metro Radio, along with Radio 4 from Holme Moss, Pontop Pike, and Sandale.

It was Roger Bunney's column, Long Distance Television in our sister magazine Television, that decided Frank to add DXTV to his radio activities. This meant two more Yagis on the rotator to feed a Hallicrafter S36-A for Band I sound carriers, and an early, dualstandard KB Victor VV-10 for v.h.f. and u.h.f. TV reception.

Frank's regular contributions to my v.h.f. column have shown some of the problems facing a DXer in Scotland and it was his enthusiasm for the subject that moved him to instigate the Scottish VHF and SW DXers Club, which currently meets fortnightly at his home. The members are making plans for a club shack where they can test a variety of aerials and equipment. Already they have an early warning system between them for auroral, meteor shower, sporadic-E and tropospheric events.

Frank Luman gets the most from his radio by coupling his interests in current affairs and music to an urge to receive programmes from stations at almost impossible distances.

Table 1

Line Frequency 16-66Hz	
Frame Frequency 0-142 (1/7)Hz	
Lines per Frame 120 4 8	
Aspect Ratio 1:1	
Horizontal Pulse Duration 5ms	
Vertical Pulse Duration 30ms	
Sub-carriér Frequencies:	
Sync. 1-2kHz	
Black 1 5kHz	
White 2 3kHz	

The normal amateur licence permits the holder to use SSTV and no special dispensations are required, provided the standard requirements are observed. The accepted frequencies on which transmissions are made are 3640%Hz, 3740kHz, 7040kHz, 14230kHz, 21350kHz, 28680kHz and 144.230MHz, the bulk of DX traffic being on 14230kHz.

Several publications on this subject are available to those interested and can be obtained from BATC Publications, 64 Showell Lane, Penn, Wolverhampton, Staffordshire.

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