TALKING ELECTRONICS®

THE LEARNING MAGAZINE

$1.20*
N.Z. $1.40

WIN A MULTIMETER!

. . . see our contest inside

Issue No 5.

4 DIGITAL PROJECTS

LM380 AMPLIFIER

Plus a new series on:

DESIGNING YOUR OWN POWER SUPPLIES

LED DICE

WITH REALISTIC 'TUMBLING' ACTION

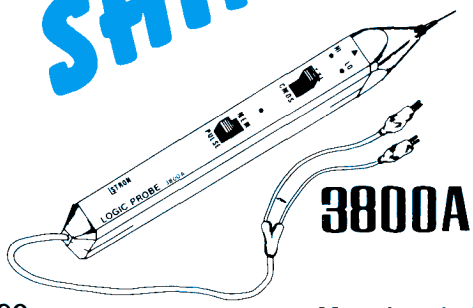
Save 25%

NEW SHIPMENT!

ELLISTRONICS

289 LATROBE ST., MELBOURNE 3000
602 3282 602 3836

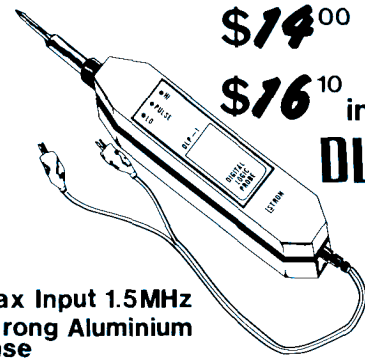
2 NEW PROBES



3800A

$22.00
$25.30 inc tax

Max Input 10MHz
Memory/Pulse Sw.
TTL/CMOS Sw.
Input Impedance 300k
Smart black plastic case
53cm leads

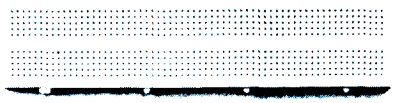


$14.00
$16.10 inc tax

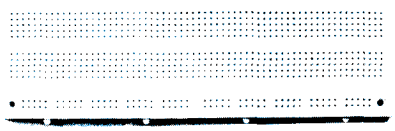
DLP-1

Max Input 1.5MHz
Strong Aluminium case
LEDs: HI - LOW - PULSE
80cm leads
KEY to LEDs on back of probe
Input Impedance 300k

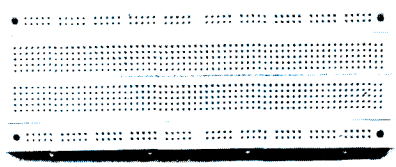
WB-DN 100 Holes
$1.98 $2.28 INC



WB-TN 640 Holes
$7.57 $8.70 INC



WB-2N-1 100 + 640 Holes
$9.65 $11.10 INC

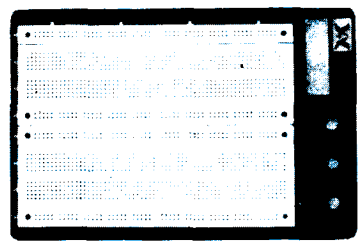


WB-2N 200 + 640 Holes
$11.21 $12.90 INC

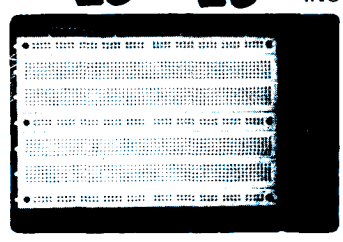
NEW! BREAD BOARDS

Now DIRECTLY imported at
½ cost of other breadboards!

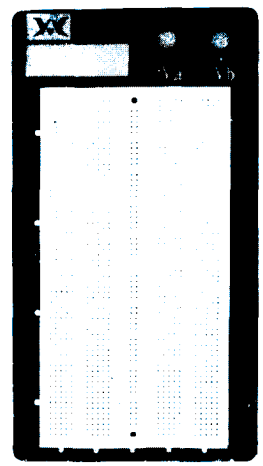
"Cut-away" view



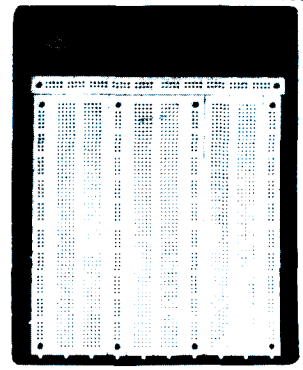
WB-4N 400 + 1280 Holes
$25.03 $28.78 INC



WB-4N-1 300 + 1280 Holes
$23.50 $27.03 INC



WB-4N-3 100 + 1280 Holes
$19.59 $22.53 INC



WB-6N 500 + 1920 Holes
$35.58 $40.92 INC

CJ

TALKING ELECTRONICS

Editorial... Vol.1 No.5

I'm happy to say our policy is working. We have penetrated the market very successfully with the magazine and reached a large percentage of schools and radio clubs. From some of our mail we have become aware of one major omission in the social side of electronics. There is a growing need for electronics clubs catering for hobbyists interested in ELECTRONICS IN GENERAL. Up to now you had to be interested in amateur radio or CB or computers and these clubs tended to exclude a large percentage of experimenters. Radio clubs in schools or Scout groups cater for the young but we are finding older people (even retired) are wanting to add to their knowledge. And they have no-where to meet. Electronics has a jargon all of its own and words such as "pf, mfd, cap and tranny" must be spoken to understand how they are sounded. Most electronic hobbyists are gregarious. They like to discuss their interests. But to date they have been denied this opportunity. With our voice and coverage I hope we can rectify this. Our initial task is to generate interest in group meetings all over the country. Beginning by postal contact we would like you to write in to us so that we can organise a CLUB ROLL. This has proved popular with other hobby clubs and I hope it can work for us. Let's see what develops.
Cheers,

Colin Mitchell.

Technical
-Craig Jones

Artwork
-Steven Babidge

Enquiries
10 Minute queries will be tackled on 550-2386

Our Cover Photo
A game of Monopoly is fun. It's a lot more fun when you play it with your own electronic dice. Our Photographer Kevin Poulter brought out his set from the back of the games cupboard when he heard we had a dice project this issue.

Registered by Australia Post
Publication Number VBP 4256

Publisher

TALKING ELECTRONICS is designed by Colin Mitchell of CPW Industries at 35 Rosewarne Ave, Cheltenham, 3192. Articles suitable for publication should be sent to this address. You will receive full assistance with final presentation.

Printed Web offset by Std News
Print Run 25,000.
Av. Sales issues 3 & 4 18,000.

Distributed in Australia by Gordon & Gotch.

*Maximum recommended retail price only.

Cumulative Index A-Z

CODE

eg 1-10 indicates ISSUE 1 Page 10

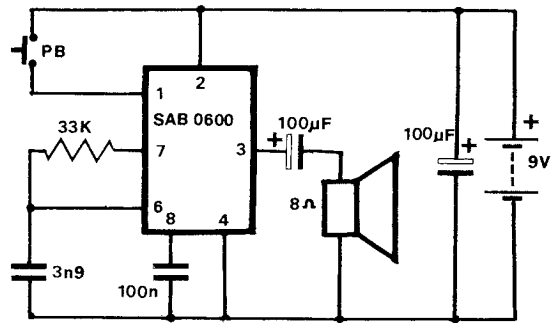
ADVERTISERS

This project is presented by SURREY ELECTRONIC COMPONENTS:

DOOR CHIME

Complete kit $11.30 plus $1.50p&p

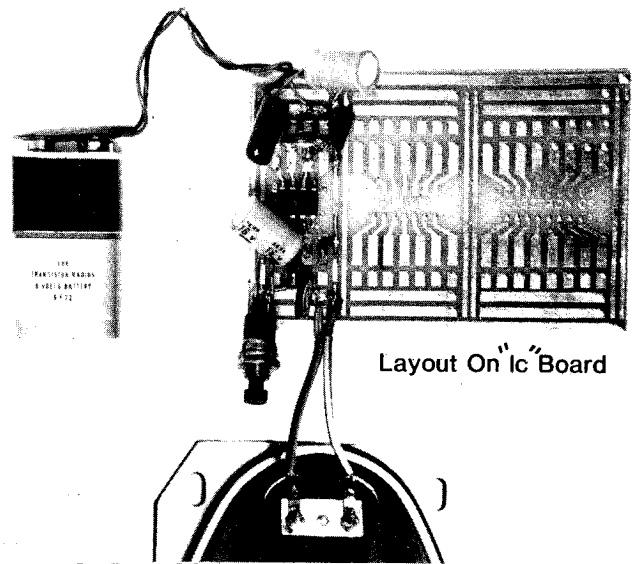
Siemens has recently released a door chime IC capable of producing three pleasant notes similar to "ding dong dell". Although it is fairly expensive for an 8 pin IC, it does contain a number of sections within the chip so as to reduce the number of external components required. Within the chip are six sections and countless transistors. The only internal circuit diagrams we were able to obtain are included in this article but as you can see, the manufacturers are playing very careful and have shown very little detail of its internal workings. Even so, they are still very hesitant to release even this much information. Accompanying both circuits are bold warnings about "releasing the contents thereof...."
Even with this scant information you can still get an appreciation of the internal workings and it is obvious that you could not possibly assemble the three tone circuit for the cost of the chip. The most ingenious part of the circuit is its shutdown capability. A push button is used to momentarily connect pin 1 to rail. This turns on the regulated power supply within the chip for about 4 seconds, during which time the clock oscillator runs through the three note generator. These are three separate tones and follow each other in an overlapping mode. This is passed to a simple audio amplifier which drives a push-pull output to give a very pleasant sound. The effectiveness of this as a door bell relies heavily on the speaker. Since the output is only 100 milliwatts, the speaker should be as large as possible and preferably be mounted on a sounding board. This simply means it should be housed in a box with a number of holes in the front to allow the sound to escape. An old fallacy which must be remedied here stems from people thinking that it takes more power to drive a larger speaker. This is completely false and in fact 100 milliwatts presented to a 15cm speaker will result in a louder sound than driving a 5 cm speaker. Although it is not a loud sounding bell, it is on par with other electronic door bells.



Door Chime Circuit

PARTS LIST

1	-	resistor 33K ¼watt
1	-	capacitor 3n9 greencap
1	-	" 100n "
2	-	electrolytics 100mfd 16v
1	-	integrated circuit SAB o600
1	-	loudspeaker 8ohm
1	-	battery snap
1	-	9v battery type 216
1	-	length of twin bell wire
1	-	bell push
1	-	box to suit speaker
1	-	DOOR CHIME PC board

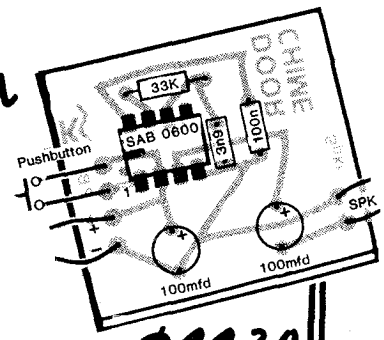


Layout On "Ic" Board

Surrey Electronic Components P.O. Box 23, Surrey Hills 3127.

DOOR CHIME

SPECIAL



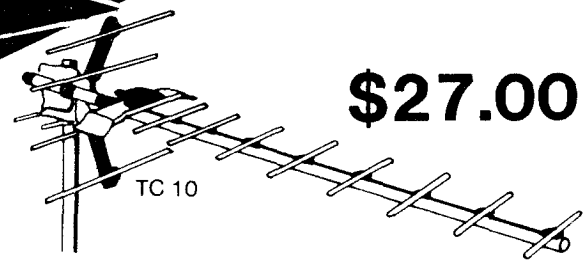
is presented by

SURREY ELECTRONIC COMPONENTS

PO Box 23,
Surrey Hills 3127
A Divison of
TELEVISION
REPLACEMENTS
Rear 139 Union Rd.,
Surrey Hills 3127

COMPLETE KIT $11.30
$1.50 p&p

COMING SOON
AUSTENNA UHF VHF ANTENNA



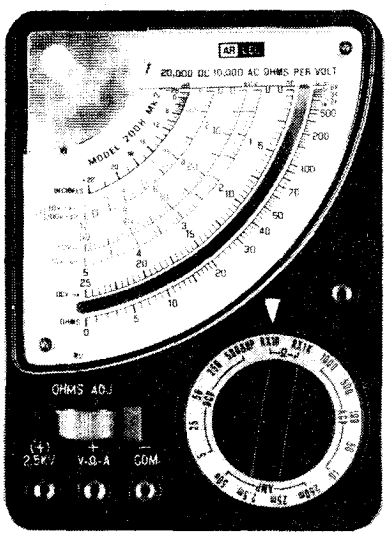
$27.00

Get the best UHF reception with TC 10
10 element UHF aerial including balun
Forward gain 10.6dB Front/back ratio 27.1dB
All antennas sent by rail. Please include your nearest railway station & $4.50

200H multimeter

as described in issue 4

$17.70 $2.50 p&p

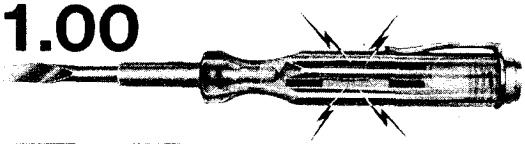


Neon screwdriver

WITH CLIP. For testing low voltage current of household electric wirings and electric apparatus.

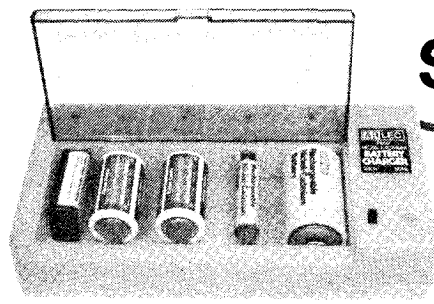
$1.00

60c p&p



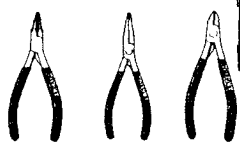
Universal Battery Charger from A&R.

Charges AA, C, D and 9 volt Nicad Batteries.
The charger is able to monitor if the battery is receiving a charge. It also tests batteries.



$15.28
$2.00 p&p

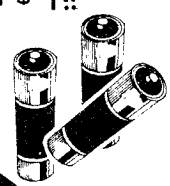
Tycraft Sidecutters Pliers 100mm



Beat the sales tax Buy NOW

$3.60 each
80c p&p

"AA" Nicad's
500maH
or 4 for $4!! $1.20



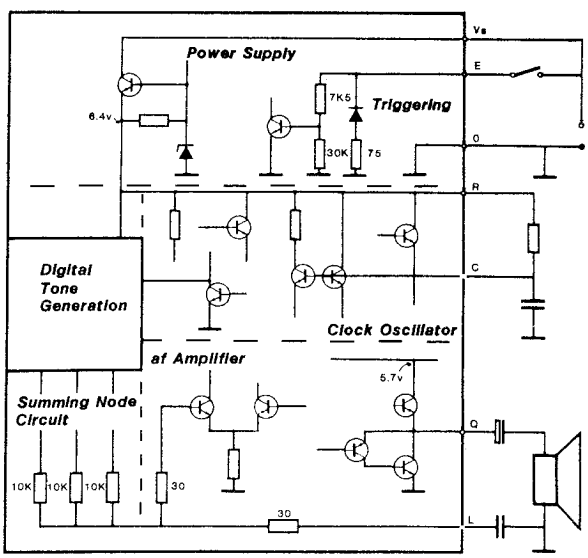
A REAL BARGAIN !!

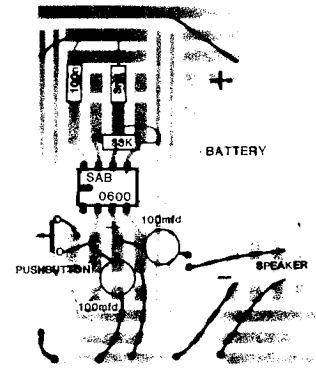
WE STOCK ALL TALKING ELECTRONICS PC BOARDS

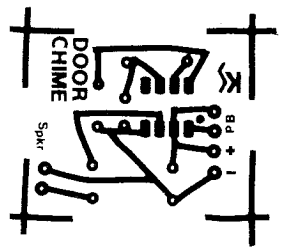
HOW THE CIRCUIT WORKS

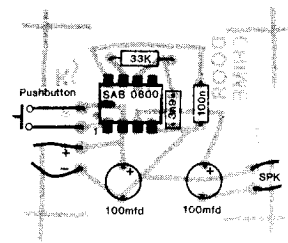
During quiescent (standing) conditions, the whole circuit takes about 1 microamp. This is equivalent to the normal deterioration of a battery and means any battery will last its full shelf life. When the push-button is pressed, the internal circuit turns on the power supply regulator to the other circuit blocks. A three note digital tone generator is scanned by a clock oscillator. Its frequency is set by the 33k resistor and 3n9 capacitor. If these are altered, not only does the scan rate alter, but the actual pitch of the note is changed also. We have chosen the most suitable values to give the door bell the longest operating time while still maintaining the best note frequency.

The electrolytic in the speaker line decouples the push-pull amplifier from the low impedance of the speaker. You can use any value from 47 mfd to 470 mfd without any change in volume. The electrolytic across the battery reduces the internal impedance of the battery and is absolutely essential. Reliable operation commences at just 10 mfd so you can see the wide range of values makes this project ideal for anyone wishing to use readily available components. For this value you can use anything from 47 mfd to 470 mfd. The 100n capacitor from pin 8 to deck produces virtually no effect on the quality of the sound and in fact the notes were louder with it removed. Our circuit worked quite successfully with only 4 components and a 15 cm speaker. Current drain during operation was 50 milliamps. This would give a 9 volt battery an operating life of 9 to 12 months if used 3 times per day.

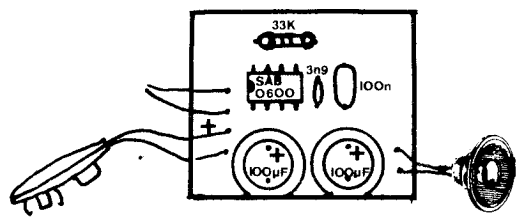








PC LAYOUT WITH PARTS OVERLAY



ASSEMBLY

Assembly of the circuit is very simple and you have the choice of using a special printed circuit board or the experimenter board. No one will know which one you select when it is mounted in a box. And since you will be donating it to the household, I suggest you economise as much as possible.

Use twin bell wire from the circuit board to the bell-push. This run can be as long as you like as it will not be carrying any current and thus no voltage drop will be present. For this reason the circuit is ideal for long runs; the bell-push may be positioned at the front of the house and the speaker with its circuitry, at the rear of the house or even in your workshop. You can even extend it a few hundred yards along a back fence if you own a large block of land or are on a farm. The only requirement is to use only one speaker as 100 milliwatts is the maximum driving capability. You will not get any increased sound intensity by using two speakers.

Rob's ELECTRONIC BARGAIN CENTRE

Dick Smith T.E & KITS!

COMPONENTS OLD VALVES ELECTRONIC SURPLUS

We Now have the Stock of UNITED TRADE SALES

NEW SHOP NOW OPEN

295 Thomas Street, Dandenong.

Ph. 791 2900

FULL RANGE OF **POLYKIT PRODUCTS**

SCREW PACK
Approximately 250 grams of assorted screws. Selftappers, Bolts etc $2·00

ELECTRO PACK
Contains approximately 50 assorted Electrolytics all new and useful values up to 1000 µf $2·50

HARDWARE PACK
Approximately 250 grams of assorted Mounting Brackets, Rubber Feet, Tag Strips, Lugs and Cable $2·50

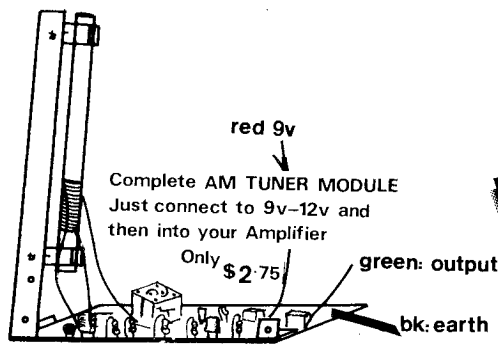
CERAMIC PACK
Contains approximately 50 assorted ceramic capacitors including High Voltage types $1·50

$9·50

FM WIRELESS MICROPHONE

FM WIRELESS MIC KIT as featured in issue 4

RESISTOR PACK
Contains approximately 200 Resistors of many different values. Including some 5 Watt Wire Wounds $1·50



SPEAKER CLOTH PACK
4 pieces of High Quality Speaker Cloth
55 x 50 cm Only $2·00

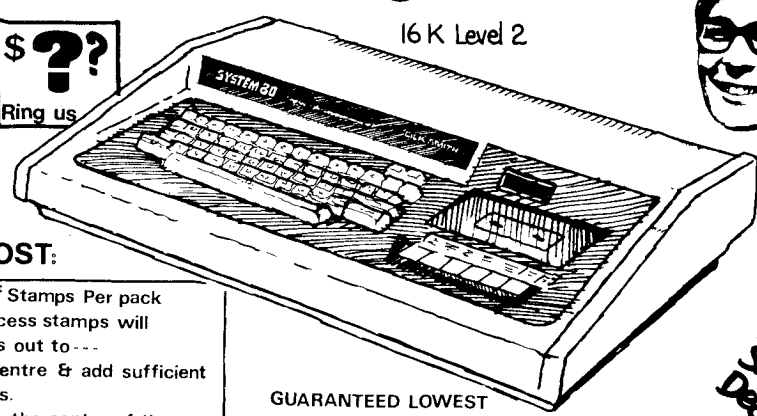
SUPER BARGAIN PACK
At least 250 grams of super goodies including a New Cassette motor, Switches, Capacitors, Resistors, Hardware, Semi Conductors
You won't be Disappointed
Only $5·00

SWITCH PACK
20 different switches including ROCKER, SLIDE and MULTI 'LEAF' $2·00

COMPUTER
Dick Smith SYSTEM 80

$??
Ring us

16 K Level 2



POT PACK
20 assorted Pots some with switches. Useful values $2·00

SPECIAL

PACK & POST:

Just include about Four 24¢ Stamps Per pack and we'll do the rest. Excess stamps will be returned. Make cheques out to---
"Robs" Electronic Bargain Centre & add sufficient for postage for heavy items.
Use the blank order form in the centre of the mag

GUARANTEED LOWEST PRICES IN MELBOURNE FOR COMPUTERS.
JUST RING & ASK: **791 -2900**

Dick Smith Dealer.

74163	.94	B
74164	.90	B
74165	1.02	B
74166	.98	B
74167	2.73	B
74170	1.82	B
74713	1.32	B
74174	1.05	B
74175	.83	B
74176	.86	B
74177	.98	B
74180	.87	B
74181	1.97	B
74182	.98	B
74184	2.78	B
74185	2.25	B
74189	1.57	B
74190	.97	B
74191	.97	B
74192	.97	B
74193	.97	B
74194	.97	B
74195	.76	B
74196	.85	B
74197	1.32	B
74199	1.30	B
74221	1.43	B
74251	.76	B
74279	.63	B
74283	1.15	B
74284	2.89	B
74285	3.71	B
74290	.87	B
74293	.87	B
74365	.63	B
74366	.63	B
74367	.57	B
74368	.57	B
8T20	4.62	B
8T26	1.89	B
8T28	1.62	B
8T80	1.75	B
8T96	1.65	B
8T97	1.92	B

9300	.67	B
9302	1.46	B
9307	1.82	B
9308	1.12	B
9310	.59	B
9311	.88	B
9312	1.12	B
9313	1.12	B
9314	1.20	B
9368	2.27	B
9370	1.80	B
96L02	.76	B

TTL/LS

74LS00	.28	B
74LS01	.24	B
74LS02	.20	B
74LS03	.30	B
74LS04	.27	B
74LS05	.30	B
74LS08	.24	B
74LS10	.20	B
74LS11	.25	B
74LS12	.30	B
74LS13	.48	B
74LS14	.66	B
74LS15	.29	B
74LS20	.30	B
74LS21	.30	B
74LS22	.30	B
74LS26	.32	B
74LS27	.32	B
74LS28	.40	B
74LS30	.24	B
74LS42	.77	B
74LS47	1.12	B
74LS48	1.14	B
74LS49	1.24	B
74LS51	.29	B
74LS54	.29	B
74LS55	.29	B
74LS73	.47	B
74LS32	.30	B
74LS33	.43	B
74LS37	.32	B
74LS38	.32	B
74LS40	.27	B
74LS74	.31	B
&4LS75	.48	B

74C20	.26	B
74C30	.26	B
74C32	.35	B
74C42	.96	B
74C48	1.70	B
74C73	.62	B
74C74	.70	B
74C76	.66	B
74C83	1.29	B
74C85	1.32	B
74C86	.30	B

Sales tax code:

A: 27½%

B: 15%

MINIMUM POST $2

HINTS FOR LOOKING UP THE SEMICONDUCTDR PRICE LIST:

CD is CMOS DEVICE
HEF is PHILIPS
MC 1 is NATIONAL
NE see LM, uA, SE, or RC.
LM340xx see also 78xx
LM350xx see also 79xx
uA is FAIRCHILD LINEAR
LM is NATIONAL LINEAR
NE is PHILIPS LINEAR
RC is RCA LINEAR
LF is NATIONAL LINEAR
LH is NATIONAL LINEAR
MM is NATIONAL MOS-LSI

74LS76	.37	B
74LS78	.39	B
74LS83	.95	B
74LS85	.70	B
74LS86	.43	B
74LS90	.60	B
74LS92	.93	B
74LS93	.48	B
74LS95	.83	B
74LS96	.98	B
74LS107	.48	B
74LS109	.46	B
74LS112	.48	B
74LS113	.46	B
74LS114	.46	B
74LS122	.43	B
74LS123	.82	B
74LS125	.58	B
74LS126	.58	B
74LS132	.92	B
74LS133	.30	B
74LS136	.45	B
74LS138	.74	B
74LS149	.82	B
74LS151	.60	B
74LS152	2.70	B
74LS153	.70	B
74LS154	1.30	B
74LS155	.98	B
74LS156	.98	B
74LS157	.55	B
74LS158	.67	B
74LS160	.89	B
74LD161	.73	B
74LS162	.86	B
74LS163	.86	B
74LS164	.75	B
74LS165	.70	B
74LD168	1.32	B
74LS169	1.32	B
74LS170	2.50	B
74LS173	1.18	B
74LS174	.72	B
74LS175	.65	B
74LS181	2.50	B
74LS189	3.59	B
74LS190	1.17	B
74LS191	.98	B
74LS192	.93	B
74LS193	.99	B
74LS194	.63	B
74LS195	.99	B
74LS196	1.18	B
74LS197	1.29	B
74LS221	1.09	B
74LS240	1.64	B
74LS241	1.29	B
74LS242	1.50	B
74LS243	1.50	B
74LS244	1.55	B
74LS245	2.45	B
74LS247	1.23	B
74LS248	1.23	B
74LS249	1.23	B
74LS251	.78	B
74LS253	1.00	B
74LS257	.64	B
74LS258	1.05	B
74LS259	1.86	B
74LS260	.35	B
74LS266	.44	B
74LS273	1.90	B
74LS279	.52	B
74LS283	.95	B
74LS289	3.59	B
74LS290	.98	B
74LS293	.98	B
74LS295	1.50	B
74LS298	.93	B
74LS347	1.57	B
74LS352	1.23	B
74LS353	1.33	B
74LS365	.50	B
74LS366	.50	B
74LS367	.50	B
74LS368	.50	B
74LS373	1.64	B
74LS374	1.64	B
74LS375	1.64	B
74LS377	1.96	B
74LS386	.48	B
74LS390	1.29	B
74LS393	.99	B
74LS640	2.85	B
74LS670	2.25	B
81LS95	1.54	B
81LS96	1.54	B
81LS97	1.65	B
81LS98	1.65	B
95H90	7.90	B
11C90	15.75	B
MC4024	3.83	B
MC4044	3.83	B
74F02	.77	B
74F32	1.21	B
74S00	.70	B
74S02	.70	B
74S04	.70	B
74S05	.70	B
74S14	.70	B
74S20	.70	B
74S30	.70	B
74S32	.70	B
74S51	.70	B
74S74	1.13	B
74S86	1.20	B
74S112	1.13	B
74S135	1.56	B
74S138	3.67	B
74S151	1.22	B
74S157	2.61	B
74S158	2.61	B
74S182	2.87	B
74S289	2.60	B

OPTO

TIL111	.85	B
TIL113	.85	B
TIL115	1.08	B
TIL116	1.10	B
MCT2	.85	B
MCT2E	1.00	B
MCT6	2.65	B
MCT275	1.54	B
4N25	.66	B
4N26	.60	B
4N28	.75	B
4N31	1.10	B
4N33	1.35	B
4N35	.95	B
MCC671	3.35	B
FCD825	1.00	B
MOC1005	1.88	B
MCS2400	2.18	B
FCD820	75	B
FCD820C	85	B

C-MOS

4000	.28	B
4001	.26	B
4001B	.29	B
4002	.28	B
4006	1.23	B
4007	.30	B
4008	1.08	B
4009	.41	B
4010	.45	B
4011	.28	B
4012	.20	B
4013	.49	B
4014	1.09	B
4015	.78	B
4016	.48	B
4017	1.20	B
4018	.80	B
4019	.58	B
4020	1.20	B
4021	.85	B
4022	1.04	B
4023	.26	B
4024	.76	B
4025	.33	B
4026	1.99	B
4027	.53	B
4028	.82	B
4029	1.26	B
4030	.43	B
4031	2.35	B
4032	1.30	B
4033B	1.30	B
4034	2.62	B
4035	1.50	B
4039	.78	B
4040	.81	B
4041	.91	B
4042	.86	B
4043	.82	B
4044	.66	B
4046	1.30	B
4047	.95	B
4048	.60	B
4049	.46	B
4050	.37	B
4051	.72	B
4052	1.03	B
4053	.95	B
4055	.89	B
4060	.99	B
4063	1.45	B
4066	.45	B
4068	.41	B
4069	.27	B
4070	.30	B
4071	.21	B
4072	.34	B
4073	.34	B
4075	.38	B
4076	1.30	B
4077	.38	B
4078	.29	B
4081	.28	B
4082	.35	B
4085	.74	B
4086	.74	B
4089	1.05	B
4093	.52	B
4094	1.25	B
4099	1.54	B
4160	.82	B
4161	.82	B
4162	.82	B
4163	.82	B
4174	.82	B
4175	.82	B
4194	.90	B
4404	.86	B
4408	11.86	B
4409	9/50	B
4410	13.38	B
4411	10.40	B
4412FP	12.45	B
4412VP	9.38	B
4415FP	6.68	B
4415VP	5.00	B
4416	.82	B
4419	4.48	B
4422	7.50	B
4426	1.50	B
4428	.86	B
4435FP	6.96	B
4435VP	5.22	B
4441	.96	B
4445	1.17	B
4446	1.20	B
4447	4.10	B
4449	.57	B
4457	3.99	B
4458	8.28	B
4460	10.34	B
4469	2.13	B
4490FP	3.38	B
4490VP	2.59	B
4495	1.60	B
4500	2.39	B
4501	.20	B
4502	1.46	B
4503	.72	B
4504	.90	B
4506	.55	B
4507	.44	B
4508	2.65	B
4510	1.20	B
4511	1.20	B
4512	1.13	B
4513	1.02	B
4514	2.35	B
5415	2.35	B
4516	.95	B
4517	3.20	B
4518	1.20	B
4519	.54	B
4520	1.05	B
4521	1.50	B
4522	1.11	B
4526	1.56	B
4527	1.15	B
4528	1.26	B
4529	1.40	B
4530	.53	B
4531	.90	B
4532	.95	B
4534	8.36	B
4536	4.30	B
4538	1.52	B
4539	1.12	B
4541	1.35	B
4543	1.38	B
4553	2.80	B
4555	1.05	B
4556	1.05	B
4557	2.24	B
4558	1.29	B
4559	3.09	B
4560	3.00	B
4561	1.50	B
4562	4.70	B
4566	2.25	B
4568	4.10	B
4569	2.40	B
4572	.55	B
4580	5.40	B
4581	2.63	B
4582	.90	B
4583	.80	B
4584	.68	B
4585	.90	B
4599	3.60	B
4723	1.30	B
4724	1.05	B
40097	.80	B
40098	.80	B
40106	.68	B
40160	1.08	B
40161	1.25	B
40162	1.25	B
40163	1.30	B
40174	1.08	B
40175	1.04	B
40192	1.37	B
40193	1.64	B
40195	1.22	B
45104	3.15	B
45106	4.05	B
45107	3.15	B
45109	3.15	B
74C00	.27	B
74C02	.25	B
74C04	.27	B
74C08	.32	B
74C10	.28	B
74C14	.68	B
74C89	6.30	B
74C90	1.08	B
74C93	1.07	B
74C95	1.25	B
74C107	2.18	B
74C150	2.65	B
74C151	2.20	B
74C154	2.18	B
74C157	2.03	B
74C160	1.08	B
74C161	1.25	B
74C162	1.25	B
74C163	1.30	B
74C164	1.27	B
74C165	1.55	B
74C173	1.29	B
74C174	1.08	B
74C175	1.03	B
74C192	1.37	B
74C193	1.64	B
74C195	1.22	B
74C221	2.05	B
74C373	2.31	B
74C374	2.43	B
74C901	.68	B
74C902	.68	B
74C903	.74	B
74C904	.78	B
74C905	8.38	B
74C906	.64	B
74C907	.64	B
74C908	1.49	B
74C909	2.52	B
74C910	9.70	B
74C911	8.67	B
74C912	8.70	B
74C914	2.05	B
74C915	1.42	B
74C917	11.05	B
74C918	1.64	B
74C920	9.69	B
74C921	7.34	B
74C922	4.65	B
74C923	4.95	B
74C925	5.85	B
74C926	5.65	B
74C927	5.85	B
74C928	7.46	B
74C929J	8.13	B
74C930J	8.13	B
74C932	1.33	B
74C936	13.35	B
74C937	11.85	B
74C938	11.35	B
74C941	2.28	B
74c948N	18.75	B
74C949	15.65	B
74C949N1	5.37	B
74C989N	7.80	B
80C95	.74	B
80C96	.84	B
80C97	.84	B
80C98	.84	B

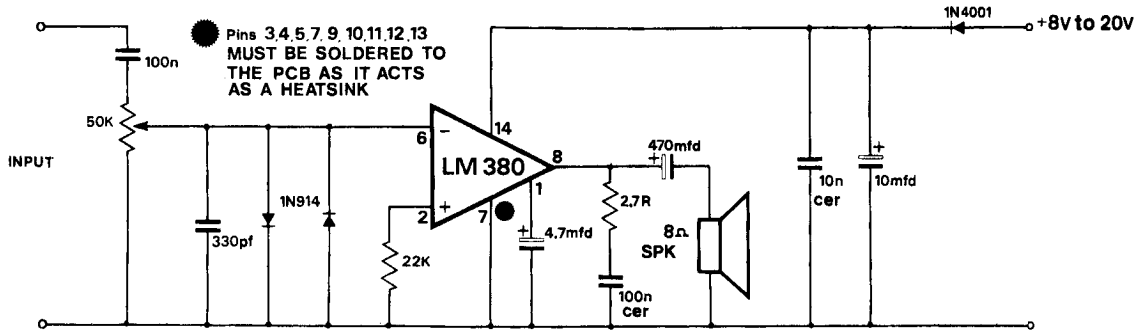
LINEAR & MICRO

REF 02CJ	6.60	A
LH0022CH	12.15	B
LH0022CN	6.85	B
LH0022CD	12.45	A
LH10CLH	4.40	A
LH0042CH	5.95	B
LH0044CH	13.85	B
TL061	.97	B
LH00701H	11.69	A
LH0C702H	15.00	A
LH00711H	11.69	A
TL071	.69	B
TL072	1.05	B
TL074	1.69	B
TL075	1.76	B
Z80CPU	10.76	B
Z80ACPU	13.50	B
Z80CTC	6.95	B
Z80ACTC	8.48	B

SIMPLICITY AMPLIFIER

ESTIMATED COST $6

By R. Mellor



As the name implies, this amplifier is simplicity itself. It requires only 13 components around a single chip to deliver about 2 to 4 watts into an 8 ohm speaker. It can be connected to a 1 amp power supply as described in issue 3 or powered by a couple of lantern batteries. Ideally it should be operated on 20 volts and the ratings are all determined at this voltage. As you will see by the table, the power drops off appreciably with voltage and becomes almost transistor-radio power at 9 volts. If you intend to use the amplifier as a "bench amplifier" on 9 volts, it may be feasible to incorporate a 216 battery into the case and keep the whole unit very compact. From our knowledge of the life of a 216 battery, you will be looking at about only 10 to 15 hours life. This will be OK if you intend to use the amplifier for test purposes or for trouble shooting other amplifiers or testing pre-amplifiers. For any other applications, we strongly recommend a regulated power supply.

THE LM 380 IC

The amplifier is based on National's LM 380 dedicated operational amplifier. The printed circuit board may seem unusual with the large amount of copper still left on the board. This copper acts as a very efficient heat sink. The heat generated in the chip passes through the centre pins and into the copper. This idea is a great improvement over the heat fin required by most other IC's and it is cheaper, simpler and creates a more comact module.

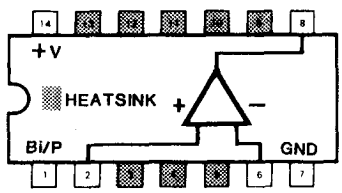
We have not described a case for the amplifier as it will fit into a number of boxes. With a little squeeze, one of our testing staff managed to fit it into a casette case. This means it will take up very little room and can be put away like an audio tape. If you intend to use the amplifier as a piece of test equipment this compactness will be appreciated. Depending on the size of case you choose, the attachment of leads can be either via wire-wrap pillars or direct soldering. The other ends of the leads should be fitted with alligator clips, colour-coded according to their function. The board is designed to fit into a UB3 jiffy box and in this case the 50k trim pot would be replaced by a regular 50k pot and the switch mounted on the end of the box. If a self-contained bench amplifier is required, a speaker can be fitted into the box leaving just enough room for a 216 battery.

HOW THE CIRCUIT WORKS

The 100n capacitor blocks any incoming DC from biasing the LM 380. The signal is then fed to a 50k pot which picks off a percentage of the input signal via the wiper and acts as a volume control. The two input diodes render the input virtually destruction-proof. You can attach the amplifier to virtually any unknown signal source without damaging the LM 380. The diodes conduct at about .6 to .7 volt and shunt any high amplitude signals to earth. The 22k resistor connects the non-inverting input to earth - approximating the input pot in its mid position. Internal stabilization is prodived by the 4.7mfd electrolytic

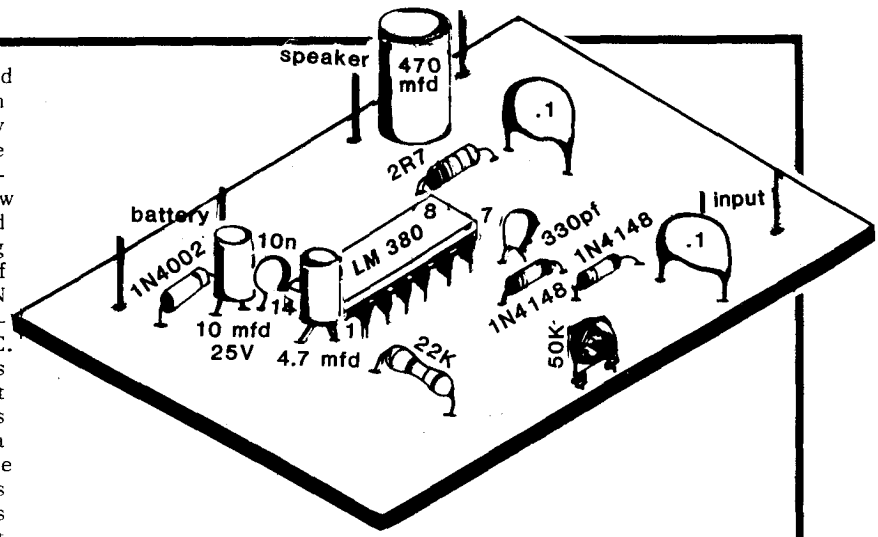
on pin 1. Across the output we have added a 2.7 ohm resistor in series with a 100n capacitor to shunt any high frequency oscillation to deck. DC blocking to the speaker is provided by the 470 mfd electrolytic. It has a high value to pass the low frequency signals. The 10n and 10mfd capacitors provide power supply smoothing and their value will depend on the type of power supply you intend to use. The 1N 4001 diode in the positive line will prevent reverse voltage from damaging the IC. Since about .6 volt is dropped across this diode, the amplifier will only see about 7.4 volt when the supply voltage has dropped to 8 volts. This will only give a very low output and may even create some instability. The ideal operating voltage is between 12 and 20 volts and this is where the output begins to deliver 1 watt up to a maximum of 4 watts without clipping. Referring to the performance table you will see these values represent power into the speaker and taking the efficiency of the amplifier into account, the wattage required to be dissipated by the chip is between 3 and 9 watts. Looking at the thin copper heatsink you may be wondering about the temperature rise to achieve this dissipation. We have omitted to say that the ratings only occur for very short periods of time under normal circumstances. This being during very loud passages of music. If the chip were subjected to a continuous high amplitude waveform, it would not last 2 minutes. So don't expect to amplify heavy passages without paying attention to the heat sinking requirements.

Our 1 amp (or 4 amp) power supply is capable of supplying a maximum of about 16-18v from the regulator and will be ideal for supplying the amplifier. We have already mentioned the alternate choice of



LM 380 Pinout

SUPPLY VOLTS	WATTS into 8 ohm spkr	RMS VOLTS at spkr	RMS millivolts at input	Average supply current
20	4	5.66	113.1	636
13.8	1.5	3.47	69.3	390
12	1.0	2.38	56.6	318
9	.35	1.77	35.3	200



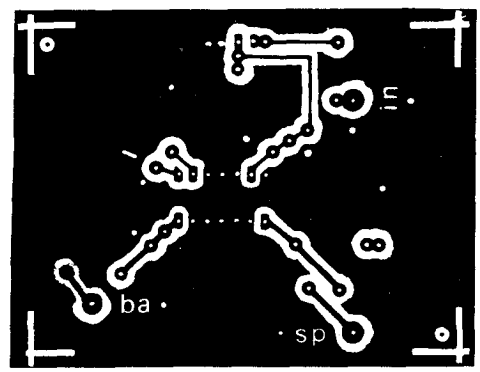
PARTS LIST

R1	resistor	22k ¼ watt
R2	"	2R7 "
RV1	trim pot	50k
C1	capacitor	100n ceramic
C2	"	330pf styro
C3	electrolytic	4.7mfd 16v
C4	capacitor	100n ceramic
C5	electrolytic	470mfd 16v
C6	capacitor	10n ceramic
C7	electrolytic	10mfd 16v
D1,D2	diode	IN 914, IN 4148
D3	"	IN 4001
IC1	Audio Amp.	LM 380

4 square wire wrap pins
SIMPLICITY AMP PC Board

Additional components:

1 - UB 3 Jiffy box
1 - 50k log pot and knob
2 - 3.5mm sockets
1 - 56mm mini speaker 4 ohm or 8 ohm
1 - length of single core shielded cable
1 - battery clip for 9v battery
1 - power supply @ 20v 1 amp
1 - set of alligator clips and leads



ELLISTRONICS

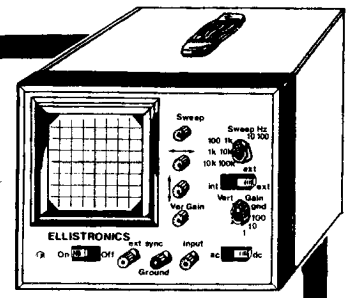
289 LATROBE ST MELBOURNE 3000
602-3282 602-3836

ALL COMPONENTS ARE PRIME SPEC AND ARE FULLY COVERED BY MANUFACTURERS GUARANTEE

Post, Pack CHARGES
UP TO $25——$2
$50——$3
$100+——$5

HOBBY CRO!

SPECIFICATIONS-
Weight:About 3.8kg
Size:202mm(w)x 160mm(h) x 306mm(d)
Usable Bandwidth: D.C. to 6.5 MHz plus.
Vertical deflection sensitivity: 10mV per division.
Horizontal deflection sensitivity:500mV per division.
Time base sweep frequency:10Hz to 100kHz in 4 ranges.
Synchronisation: internal and external.



$170.00 EXEMPT
+$25.50 TAX $6.00

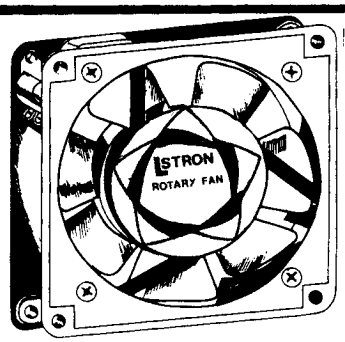
Special

From: ----------

To: STEVE ELLIS, ELLISTRONICS,
289 LATROBE ST, MELB., 3000.

Please use this order form or a photocopy to keep our records NEAT

P&P $2 min please
TOTAL $



COMPUTER COOLING FANS

$16.80 EX $19.32 INC
120mm, 4½" Diameter

SEMICONDUCTOR PRICE LIST

TTL

7400	.25	B
7401	.28	B
7402	.28	B
7403	.28	B
7404	.31	B
7405	.29	B
7406	.33	B
7407	.34	B
7408	.31	B
7409	.25	B
7410	.25	B
7411	.28	B
7412	.28	B
7413	.40	B
7414	.84	B
7416	.35	B
7417	.33	B
7420	.28	B
7421	.28	B
7423	.34	B
7425	.32	B
7426	.30	B
7427	.30	B
7430	.28	B
7432	.31	B
7437	.32	B
7438	.32	B
7440	.27	B
7441	1.03	B
7442	.59	B
7443	2.10	B
7444	1.60	B
7445	.97	B
7446	.98	B
7447	.98	B
7448	.86	B
7450	.27	B
7451	.29	B
7453	.28	B
7454	.28	B
7460	.28	B
7470	.36	B
7472	.36	B
7473	.36	B
7474	.36	B
7475	.48	B
7476	.38	B
7480	1.00	B
7482	1.01	B
7483	.79	B
7485	1.07	B
7486	.35	B
7489	1.74	B
7490	.53	B
7491	.67	B
7492	.49	B
7493	.51	B
7494	1.02	B
7495	.60	B
7496	.80	B
7497	3.08	B
74107	.36	B
74109	.41	B
74116	2.31	B
74121	.40	B
74122	.52	B
74123	.53	B
74125	.48	B
74126	.48	B
74132	.76	B
74141	1.05	B
74145	.92	B
74147	1.43	B
74148	1.32	B
74150	.78	B
74151	.78	B
74152	4.76	B
74153	.75	B
74154	1.18	B
74155	.79	B
74156	.79	B
74157	.79	B
74160	.91	B
74161	.91	B
74162	.86	B

supplies and the final decision will depend on portability and cost.

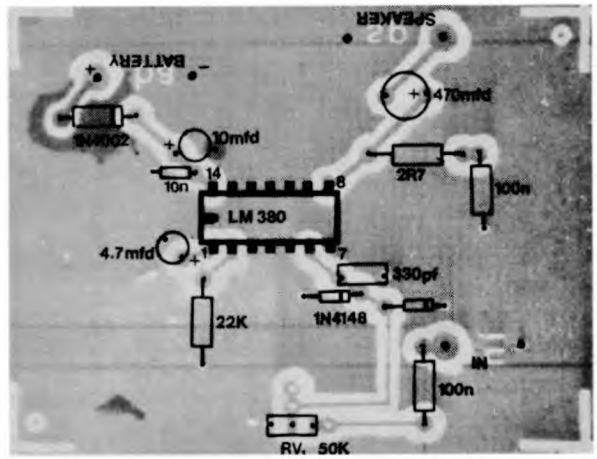
The LM 380 itself is very compact and lends itself to making a very low profile amplifier. By laying the electrolytics on their side, the amplifier will fit into a casette case.

4 watt delivery from a normal 14 pin IC is quite an achievement and National have produced a very versatile amplifier. It has been produced specifically for consumer products such as tape recorders and portable record players however it can be put into a circuit for experimenting as it requires no special external components.

MOUNTING THE PARTS

Construction must be carried out on the printed circuit board as designed by the author since it provides the necessary heatsinking. The printed circuit looks very simple but it can be deceptive. You have to be very careful when locating each component so that you get it in the right holes. With the large amount of copper on this printed circuit board, it will tend to heatsink the soldering iron at every connection. This means that you will have to be very quick when making a solder joint as the iron will cool very quickly. We suggest a high wattage iron (over 30 watt for this project so that no dry joints are created. Keep the soldering times short and wait for the soldering iron to heat up fully before making a connection. Start with the resistors, capacitors, diodes, electrolytics and finally the LM 380 integrated circuit. Use your fingers on each of the components to heat-sink them so that they do not get too hot. This applies especially to the IC. It will take any temperature providing you can hold your finger on the chip. Use either jumper leads or square wire-wrap pillars to connect the amplifier to the input, output and supply.

Use a 9v battery when setting the unit up. Switch the amplifier on and test the input with your finger to detect any stray hum. Once you are satisfied it is drawing the correct current, you can connect it to a larger supply. On full voltage you will be surprised how powerful this amplifier can be. Now let's hope it works for you.



Simplicity Amplifier layout.

Note the 6 wire-wrap pillars

74163	.94	B
74164	.90	B
74165	1.02	B
74166	.98	B
74167	2.73	B
74170	1.82	B
74713	1.32	B
74174	1.05	B
74175	.83	B
74176	.86	B
74177	.98	B
74180	.87	B
74181	1.97	B
74182	.98	B
74184	2.78	B
74185	2.25	B
74189	1.57	B
74190	.97	B
74191	.97	B
74192	.97	B
74193	.97	B
74194	.97	B
74195	.76	B
74196	.85	B
74197	1.32	B
74199	1.30	B
74221	1.43	B
74251	.76	B
74279	.63	B
74283	1.15	B
74284	2.89	B
74285	3.71	B
74290	.87	B
74293	.87	B
74365	.63	B
74366	.63	B
74367	.57	B
74368	.57	B
8T20	4.62	B
8T26	1.89	B
8T28	1.62	B
8T80	1.75	B
8T96	1.65	B
8T97	1.92	B

74C20	.26	B
74C30	.26	B
74C32	.35	B
74C42	.96	B
74C48	1.70	B
74C73	.62	B
74C74	.70	B
74C76	.66	B
74C83	1.29	B
74C85	1.32	B
74C86	.30	B

Sales tax code:

A: 27½%

B: 15%

MINIMUM POST $2

HINTS FOR LODKING UP THE SEMICONDUCTOR PRICE LIST:

CD is CMOS DEVICE
HEF is PHILIPS
MC 1 is NATIONAL
NE see LM, uA, SE, or RC.
LM340xx see also 78xx
LM350xx see also 79xx
uA is FAIRCHILD LINEAR
LM is NATIONAL LINEAR
NE is PHILIPS LINEAR
RC is RCA LINEAR
LF is NATIONAL LINEAR
LH is NATIONAL LINEAR
MM is NATIONAL MOS-LSI

9300	.67	B
9302	1.46	B
9307	1.82	B
9308	1.12	B
9310	.59	B
9311	.88	B
9312	1.12	B
9313	1.12	B
9314	1.20	B
9368	2.27	B
9370	1.80	B
96L02	.76	B

TTL/LS

74LS00	.28	B
74LS01	.24	B
74LS02	.20	B
74LS03	.30	B
74LS04	.27	B
74LS05	.30	B
74LS08	.24	B
74LS10	.20	B
74LS11	.25	B
74LS12	.30	B
74LS13	.48	B
74LS14	.66	B
74LS15	.29	B
74LS20	.30	B
74LS21	.30	B
74LS22	.30	B
74LS26	.32	B
74LS27	.32	B
74LS28	.40	B
74LS30	.24	B
74LS42	.77	B
74LS47	1.12	B
74LS48	1.14	B
74LS49	1.24	B
74LS51	.29	B
74LS54	.29	B
74LS55	.29	B
74LS73	.47	B
74LS32	.30	B
74LS33	.43	B
74LS37	.32	B
74LS38	.32	B
74LS40	.27	B
74LS74	.31	B
74LS75	.48	B
74LS76	.37	B
74LS78	.39	B
74LS83	.95	B
74LS85	.70	B
74LS86	.43	B
74LS90	.60	B
74LS92	.93	B
74LS93	.48	B
74LS95	.83	B
74LS96	.98	B
74LS107	.48	B
74LS109	.46	B
74LS112	.48	B
74LS113	.46	B
74LS114	.46	B
74LS122	.43	B
74LS123	.82	B
74LS125	.58	B
74LS126	.58	B
74LS132	.92	B
74LS133	.30	B
74LS136	.45	B
74LS138	.74	B
74LS149	.82	B
74LS151	.60	B
74LS152	2.70	B
74LS153	.70	B
74LS154	1.30	B
74LS155	.98	B
74LS156	.98	B
74LS157	.55	B
74LS158	.67	B
74LS160	.89	B
74LD161	.73	B
74LS162	.86	B
74LS163	.86	B
74LS164	.75	B
74LS165	.7D	B
74LD168	1.32	B
74LS169	1.32	B
74LS170	2.50	B
74LS173	1.18	B
74LS174	.72	B
74LS175	.65	B
74LS181	2.50	B
74LS189	3.59	B
74LS190	1.17	B
74LS191	.98	B
74LS192	.93	B
74LS193	.99	B
74LS194	.63	B
74LS195	.99	B
74LS196	1.18	B
74LS197	1.29	B
74LS221	1.09	B
74LS240	1.64	B
74LS241	1.29	B
74LS242	1.50	B
74LS243	1.50	B
74LS244	1.55	B
74LS245	2.45	B
74LS247	1.23	B
74LS248	1.23	B
74LS249	1.23	B
74LS251	.78	B
74LS253	1.00	B
74LS257	.64	B
74LS258	1.05	B
74LS259	1.86	B
74LS260	.35	B
74LS266	.44	B
74LS273	1.90	B
74LS279	.52	B
74LS283	.95	B
74LS289	3.59	B
74LS290	.98	B
74LS293	.98	B
74LS295	1.50	B
74LS298	.93	B
74LS347	1.57	B
74LS352	1.23	B
74LS353	1.33	B
74LS365	.50	B
74LS366	.50	B
74LS367	.50	B
74LS368	.50	B
74LS373	1.64	B
74LS374	1.64	B
74LS375	1.64	B
74LS377	1.96	B
74LS386	.48	B
74LS390	1.29	B
74LS393	.99	B
74LS640	2.85	B
74LS670	2.25	B
81LS95	1.54	B
81LS96	1.54	B
81LS97	1.65	B
81LS98	1.65	B
95H90	7.90	B
11C90	15.75	B
MC4024	3.83	B
MC4044	3.83	B
74F02	.77	B
74F32	1.21	B
74S00	.70	B
74S02	.70	B
74S04	.70	B
74S05	.70	B
74S14	.70	B
74S20	.70	B
74S30	.70	B
74S32	.70	B
74S51	.70	B
74S74	1.13	B
74S86	1.20	B
74S112	1.13	B
74S135	1.56	B
74S138	3.67	B
74S151	1.22	B
74S157	2.61	B
74S158	2.61	B
74S182	2.87	B
74S289	2.60	B

OPTO

TIL111	.85	B
TIL113	.85	B
TIL115	1.08	B
TIL116	1.10	B
MCT2	.85	B
MCT2E	1.00	B
MCT6	2.65	B
MCT275	1.54	B
4N25	.66	B
4N26	.60	B
4N28	.75	B
4N31	1.10	B
4N33	1.35	B
4N35	.95	B
MCC671	3.35	B
FCD825	1.DO	B
MOC1005	1.88	B
MCS2400	2.18	B
FCD820	75	B
FCD820C	85	B

C-MOS

4000	.28	B
4001	.26	B
4D01B	.29	B
4002	.28	B
4006	1.23	B
4007	.30	B
4008	1.08	B
4009	.41	B
4010	.45	B
4011	.28	B
4012	.20	B
4013	.49	B
4014	1.09	B
4015	.78	B
4016	.48	B
4017	1.20	B
4018	.80	B
4019	.58	B
4020	1.20	B
4021	.85	B
4022	1.04	B
4023	.26	B
4024	.76	B
4025	.33	B
4026	1.99	B
4027	.53	B
4028	.82	B
4029	1.26	B
4030	.43	B
4031	2.35	B
4032	1.30	B
4033B	1.30	B
4034	2.62	B
4035	1.50	B
4039	.78	B
4040	.81	B
4041	.91	B
4042	.86	B
4043	.82	B
4044	.66	B
4046	1.30	B
4047	.95	B
4048	.60	B
4049	.46	B
4050	.37	B
4051	.72	B
4052	1.03	B
4053	.95	B
4055	.89	B
4060	.99	B
4063	1.45	B
4066	.45	B
4068	.41	B
4069	.27	B
4070	.30	B
4071	.21	B
4072	.34	B
4073	.34	B
4075	.38	B
4076	1.30	B
4077	.38	B
4078	.29	B
4081	.28	B
4082	.35	B
4085	.74	B
4086	.74	B
4089	1.05	B
4093	.52	B
4094	1.25	B
4D99	1.54	B
4160	.82	B
4161	.82	B
4162	.82	B
4163	.82	B
4174	.82	B
4175	.82	B
4194	.90	B
4404	.86	B
4408	11.86	B
4409	9/50	B
4410	13.38	B
4411	10.40	B
4412FP	12.45	B
4412VP	9.38	B
4415FP	6.68	B
4415VP	5.00	B
4416	.82	B
4419	4.48	B
4422	7.50	B
4426	1.50	B
4428	.86	B
4435FP	6.96	B
4435VP	5.22	B
4441	.96	B
4445	1.17	B
4446	1.20	B
4447	4.10	B
4449	.57	B
4457	3.99	B
4458	8.28	B
4460	10.34	B
4469	2.13	B
4490FP	3.38	B
4490VP	2.59	B
4495	1.60	B
4500	2.39	B
4501	.20	B
4502	1.46	B
4503	.72	B
4504	.90	B
4506	.55	B
4507	.44	B
4508	2.65	B
4510	1.20	B
4511	1.20	B
4512	1.13	B
4513	1.02	B
4514	2.35	B
5415	2.35	B
4516	.95	B
4517	3.20	B
4518	1.20	B
4519	.54	B
4520	1.05	B
4521	1.50	B
4522	1.11	B
4526	1.56	B
4527	1.15	B
4528	1.26	B
4529	1.40	B
4530	.53	B
4531	.90	B
4532	.95	B
4534	8.36	B
4536	4.30	B
4538	1.52	B
4539	1.12	B
4541	1.35	B
4543	1.38	B
4553	2.80	B
4555	1.05	B
4556	1.05	B
4557	2.24	B
4558	1.29	B
4559	3.09	B
4560	3.00	B
4561	1.50	B
4562	4.70	B
4566	2.25	B
4568	4.10	B
4569	2.40	B
4572	.55	B
4580	5.40	B
4581	2.63	B
4582	.90	B
4583	.80	B
4584	.68	B
4585	.90	B
4599	3.60	B
4723	1.30	B
4724	1.05	B
40097	.80	B
40098	.80	B
40106	.68	B
40160	1.08	B
40161	1.25	B
40162	1.25	B
40163	1.30	B
40174	1.08	B
40175	1.04	B
40192	1.37	B
40193	1.64	B
40195	1.22	B
45104	3.15	B
45106	4.05	B
45107	3.15	B
45109	3.15	B
74CD0	.27	B
74C02	.25	B
74C04	.27	B
74C08	.32	B
74C10	.28	B
74C14	.68	B
74C89	6.30	B
74C90	1.08	B
74C93	1.07	B
74C95	1.25	B
74C107	2.18	B
74C150	2.65	B
74C151	2.20	B
74C154	2.18	B
74C157	2.03	B
74C160	1.08	B
74C161	1.25	B
74C162	1.25	B
74C163	1.30	B
74C164	1.27	B
74C165	1.55	B
74C173	1.29	B
74C174	1.08	B
74C175	1.03	B
74C192	1.37	B
74C193	1.64	B
74C195	1.22	B
74C221	2.05	B
74C373	2.31	B
74C374	2.43	B
74C901	.68	B
74C902	.68	B
74C903	.74	B
74C904	.78	B
74C905	8.38	B
74C906	.64	B
74C907	.64	B
74C908	1.49	B
74C909	2.52	B
74C910	9.70	B
74C911	8.67	B
74C912	8.70	B
74C914	2.05	B
74C915	1.42	B
74C917	11.05	B
74C918	1.64	B
74C920	9.69	B
74C921	7.34	B
74C922	4.65	B
74C923	4.95	B
74C925	5.85	B
74C926	5.65	B
74C927	5.85	B
74C928	7.46	B
74C929J	8.13	B
74C930J	8.13	B
74C932	1.33	B
74C936	13.35	B
74C937	11.85	B
74C938	11.35	B
74C941	2.28	B
74c948N	18.75	B
74C949	15.65	B
74C949N1	5.37	B
74C989N	7.8D	B
80C95	.74	B
80C96	.84	B
80C97	.84	B
80C98	.84	B

LINEAR & MICRO

REF 02CJ	6.60	A
LH0022CH	12.15	B
LH0022CN	6.85	B
LH0022CD	12.45	A
LH10CLH	4.40	A
LH0042CH	5.95	B
LH0044CH	13.85	B
TL061	.97	B
LH00701H	11.69	A
LHOC702H	15.00	A
LH00711H	11.69	A
TL071	.69	B
TL072	1.05	B
TL074	1.69	B
TL075	1.76	B
Z80CPU	10.76	B
Z80ACPU	13.50	B
Z80CTC	6.95	B
Z80ACTC	8.48	B

LINEAR & MICRO (CONT)

Z80PIO	6.95	B
Z80APIO	9.18	B
Z80S10/0	26.43	B
Z80AS10/0	36.43	B
Z80S10/1	26.43	B
Z80AS10/1	36.43	B
Z80S10/2	26.43	B
Z80sio/9	41.43	B
Z80AS10/9	53.46	B
TL082	1.13	A
TL084	2.10	B
LH0091CD	20.75	A
AF1D01CJ	8.47	B
SAK140	1.76	B
UAA170	2.78	B
UAA180	2.78	B
TCA220	1.80	A
LM301	.39	B
LM3D1H	.99	B
LM304H	1.89	B
LM305H	.64	B
LM307CN	.65	B
LM307N	1.40	B
LM308	.71	B
LM308H	1.00	B
LM309H	2.30	B
LM310N	2.10	A
LM310H	1.79	A
LM311-8	.75	B
LM311-14	1.50	A
LM311H	1.00	A
LM318	2.58	B
LM319N	2.34	B
OM321	9.60	A
LM322	2.95	A
LM324	.65	A
LM325	2.74	A
LM329DZ	1.14	B
LM334Z	1.21	B
LM335Z	1.37	B
OM335	11.72	A
LM336Z	2.54	B
LM339N	.67	B
LM339AN	1.90	B
LF347	2.57	B
LM348	1.25	A
LM349	1.75	A
OM350	6.57	A
LF351N	.76	B
LF353	.91	A
LF356BN	1.02	B
LF356H	1.47	B
LF357	.85	B
LM358N	.56	B
LM358H	.98	B
LM370N	1.18	B
LM373	4.00	A
LM374	4.25	A
LM376	.56	B
LM377	2.30	A
LM378	2.51	A
LM379-5	5.09	A
LM380-8	1.18	A
LM380-14	1.2D	A
LM381N	1.74	A
LM381A-N	2.98	A
LM382N	1.49	A
LM383	2.24	A
LM384	1.56	A
LM386N1	.80	A
LM386N3	1.22	A
LM387	1.23	A
LM389	1,01	A
LM391N-80	1.45	A
LM391N-60	1.37	A
LM393	.70	A
LF398N	4.25	B
LM398H	5.25	B
MC1456	1.29	A
TBA510	1.40	A
TBA530	2.12	A
NE530	.90	A
TBA540	3.15	A
NE543	4.50	A
LM555	.28	B
LM556	.74	B
NE558	1.47	A
LM565n	1.16	A
LM565CH	1.75	A
NE556	1.95	B
LM567CN	1.16	B
NE571	2.95	A
SAB0600	6.48	B
TBA641B11	2.35	A
UA703H	1.20	A
LM709-14	.54	A
UA710CA	.46	A
UA710CH	.66	A
LM711CN	.74	A
UA711H	.74	A
UA716HC	.80	A
LM723n	.60	B
LM723H	.70	B
LM725	2.98	A
LM733	.92	A
UA739	1.46	A
LM741	.26	B
LM741HC	1.19	B
UA747	.84	A
UA747HC	.92	A
UA748	.42	A
UA748HC	1.02	A
UA753	1.45	A
UA760HC	4.60	A
UA777	1.40	A
UA777HC	3.55	A
UA796HC	1.75	A
ADC0800PCD	13.20	B
DAC0800LCN	2.48	B
OM802	.74	B
ADC0808ccn	14.50	B
DAC0808LCN	2.23	B
TBA920	2.15	A
SAB1048	4.58	A
ADC1210HCD	44.00	B
DAC1220LCN	14.60	B
LM1303N	1.52	A
LM1310N	1.90	A
MC1406	4.72	A
MC1445	2.37	A
MC1456	1.29	A
LM1458N	.58	B
LM1488	.75	B
LM1489	.95	B
MC1494	6.93	B
MC1495	5.75	B
MC1496	1.06	A
FR1502-Fo2	15.86	B
LM1558H	1.23	A
LM1596	1.35	A
TR1602	6.00	B
MC1709	.74	A
FD1771B01	21.66	B
FD1791-B02	65.00	B
FD1793B-0R	65.00	B
LM1830	2.50	A
TR1963	8.00	B
LM1886	6.77	A
BR1941	12.60	B
TR1983	8.00	B
ULN2003N	1.50	B
2102-600nS	.95	B
2102-400nS	1.10	B
2102-250nS	1.60	B
2107	4.80	B
2112	3.20	B
2114-300nS	2.20	B
XR2206	4.50	B
2650	23.48	B
2708-450nS	4.50	B
2708CHIPOS	13.28	B
2716-450 5v	4.95	B
2809	6.95	B
LM290Z	1.40	A
LM2917-8	2.24	B
LM2917-14	2.24	B
MN3001	12.16	B
CA3028	1.23	B
CA3036	1.40	B
LM3039	.91	B
CA3046	1.36	A
LM3065	.40	A
LM3080	.87	A
UA3086	1.36	A
LM3089	3.13	A
CA3130E	1.00	A
CA3130T	1.00	A
CA3140E	.84	A
CA3140T	1.27	A
LM3401	.67	A
ADD3501	9.98	B
LM3524	4.46	B
LM3661	.92	A
ADC3711	13.35	B
LM3900	.68	A
LM3905	1.04	B
LM3909	.85	B
LM3911	1.28	B
LM3914	3.16	B
LM3915	3.30	B
LM3916	3.13	B
4116-150nS	7.95	B
4116-200 LP	1.95	B
4136	1.46	A
4156	1.72	A
LM4250	1.45	A
UA4558TC	1.08	A
S5101-800nS	4.50	B
5101-600nS	7.50	B
MM5203Q	14.60	B
MM5220	5.50	B
MM5303	4.46	B
MM5307AAN	15.80	B
MM5309	6.75	B
MM5312	8.00	B
MM5314	5.98	B
MM5315	6.75	B
MM5369	2.16	B
MM5387	2.56	B
MM5395n	5.52	B
NE5534	2.40	B
MM5740AAE	10.10	B
MM5387	1.18	B
M64021PL	7.47	B
6502A	12.91	B
6502	9.10	B
6505	11.34	B
6508	4.75	B
65X08	9.10	B
6520	4.78	B
6522	10.60	B
6522A	13.86	B
6532	14.70	B
6551	16.17	B
6561	4.22	B
6574	10.91	B
6674	10.60	B
6800P	9.10	B
68B00	14.70	B
6802	12.00	B
6808	10.50	B
6809	38.25	B
6810A	4.20	B
6820	5.50	B
6821	4.95	B
6840	7.84	B
6845	29.24	B
6847	13.50	B
68047	9.90	B
6850	4.40	B
68B50	15.53	B
6852	5.50	B
S6854	15.78	B
6875	6.65	B

LINEAR

ICL7106	10.50	B
ICL7107	16.62	B
TA7205	3.42	B
ICM7217A	13.80	B
ICM7218BI	16.60	B
LS7220	7.65	B
ICM7226B	30.13	B
DS7528	1.25	B
LM7555	1.48	B
ICM7556	2.84	B
ICL7632	4.84	B
ICL7660	2.87	B
Z8001	250.00	B
Z8002	195.00	B
8035	8.37	B
ICL8038CCPD	5.97	B
INS8060D	12.91	B
ICL8069CCQ	3.11	B
INS8080A	5.50	B
DM8085A	9.50	B
DM8121	.81	B
DM8124	1.60	B
DM8130	3.10	B
DM8131	3.05	B
8154	13.50	B
8155	8.85	B
8156	19.10	B
8205	4.35	B
P8212	2.63	B
I8212	2.85	B
N8233	1.98	B
8238	6.50	B
IP8238	7.50	B
8243	5.95	B
INS8245	4.65	B
INS8246	4.95	B
INS8247	8.67	B
8251A	7.25	B
8253	15.56	B
8255A	6.80	B
8257s-200	13.50	B
P8259A	12.97	B
D8279	9.80	B
8295	34.50	B
8303	1.20	B
DP8304	3.75	B
8414-250nS	7.50	B
8553	5.95	B
8554	5.95	B
DS8629	4.91	B
DS8678CAE	11.48	B
C8748	90.00	B
DS8820	1.98	B
DS8833	2.39	B
DS8836	1.35	B
DS8837	2.55	B
DS8881	5.88	B
S9900	49.00	B
S9902	5.95	B
MC10116L	.90	B
LM13088	1.15	B
LM13600	1.22	B
LF13741N	.52	A
LF13741H	.61	A
S50240P	5.35	B
AY-S-2376P	19.00	B
MM53200	4.46	B
MM58167N	12.53	B
MM58174	10.12	B
DS75107	1.55	B
DS75450	.57	B
DS75451	.57	B
DS75452	.46	B
DS75453	.45	B
DS75454	.45	B
DS754591N	.70	B
DS75492	.80	B
SN76001N	1.50	A
76477	3.28	B
SFF96364	41.76	B
91428	.46	B
MH0009CG	23.40	B

TRANSISTORS

2N301	3.05	A
2N657	.14	A
2N930	.61	A
2N1613	.90	A
2N1711	.81	A
2N2219A	.61	A
PN2222A	.18	A
2N2222A	.45	A
2N2483	.30	A
2N2484	.54	A
2N2646	.60	A
2N2647	1.03	A
2N2894	.68	A
2N2904	.43	A
2N2905	.53	A
2N2906	.39	A
2N2907	.38	A
2N2913	1.50	A
2N3019	.69	A
2N3053	.62	A
2N3054	1.20	A
2N3055	.55	A
2N3301	.25	A
2N3440	.86	A
2N3441	1.69	A
2N3502	.60	A
2N3503	.60	A
2N3563	.23	A
2N3564	.14	A
PN3565	.15	A
PN3566	.19	A
PN3567	.20	A
PN3568	.14	A
2N3569	.19	A
2N3568	.18	A
2N3568A	.20	A
2N3569	.18	A
2N3640	.18	A
2N3641	.18	A
PN3642	.15	A
PN3643	.14	A
PN3644	.18	A
PN3645	.20	A
2N3646	.24	A
2N3692	.28	A
2N3693	.30	A
PN3694	.20	A
2N3702	.26	A
2N3704	.18	A
2N3705	.18	A
2N3706	.18	A
2N3713	1.66	A
2N3731	5.76	A
2N3771	3.53	A
2N3772	2.85	A
2N3773	3.45	A
2N3819	.68	A
2N3866	1.60	A
2N3904	.20	A
2N3906	.20	A
2N4030	.88	A
2N4032	.78	A
2N4033	.78	A
2N4086	.82	A
2N4037	.73	A
2N4092	1.30	A
PN4121	.14	A
2N4235	1.55	A
2N4236	1.80	A
2N4248	.16	A
PN4249	.26	A
2N4250	.20	A
2N4258	.19	A
2N4292	.60	A
PN4342	.76	A
2N4354	.20	A
2N4355	.20	A
2N4356	.16	A
2N4360	.33	A
2N4398	4.38	A
2N4401	.14	A
2N4404	.23	A
2N4405	.20	A
2N4416	1.20	A
PN4888	.40	A
2N4906	2.45	A
2N5060	.53	A
2N5086	.22	A
2N5088	.14	A
2N5089	.21	A
2N5179	1.50	A
2N5190	1.15	A
2N5191	1.32	A
2N5195	1.67	A
2N5245	.65	A
2N5303	2.84	A
2N5320	.68	A
2N5401	.19	A
2N5408	.34	A
2N5459	.44	A
2N5461	.59	A
2N5484	.45	A
2N5485	.48	A
2N5486	.42	A
2N5550	.29	A
2N5589	4.65	B
2N5590	7.37	B
2N5591	8.57	B
2N5769	.14	A
2N5770	.23	A
2N5771	.28	A
2N5772	.28	A
2N5777	.75	A
2N5830	.22	A
2N5381	.25	A
2N5856	.27	A
2N5873	.94	A
2N5874	1.13	A
2N5885	2.68	A
2N5944	10.28	B
2N5946	17.19	B
2N5961	.24	A
2N5963	.90	A
2N6122	.62	A
2N6123	.59	A
2N6124	.62	A
2N6126	.62	A
2N6129	.63	A
2N6130	.70	A
2N6131	.77	A
2N6133	1.20	A
2SA353	.16	A
2SA354	.16	A
2SB187	1.00	A
2SC1060	1.45	A
2SC1061	1.45	A
2sc2166	1.59	A
2SK133	5.69	A
2SJ48	5.69	A
2SK134	7.34	A
2SJ49	7.34	A
3N201	.88	A
AC126	.51	A
AC127	.75	A
AC128	.67	A
AC187	.88	A
AC188	.88	A
AD149	1.96	A
AD161	1.16	A
AD162	1.16	A
AY6102	.50	A
AY6112	.50	A
AY6118	.50	A
AY6119	.50	A
AY6121	.50	A
AY8110	.50	A
AY8139	.64	A
AY9139	.64	A
B12-12	13.10	B
BC107	.23	A
BC107B	.28	A
BC108	.26	A
BC108C	.28	A
BC109	.25	A
BC109C	.27	A

TRANSISTORS (CONT)

BC147	.14	A
BC159	.14	A
BC177	.27	A
BC178	.31	A
BC179	.31	A
BC182A	.14	A
BC182L	.20	A
BC183L	.20	A
BC184L	.22	A
BC186	.47	A
BC204	.14	A
BC205	.14	A
BC206	.14	A
BC209	.14	A
BC212A	.14	A
BC212L	.20	A
BC213L	.20	A
BC214L	.20	A
BC287	.14	A
BC309	.16	A
BC317	.18	A
BC318	.14	A
BC319	.15	A
BC321	.14	A
BC322	.14	A
BC327	.12	A
BC328	.12	A
BC328B	.13	A
BC337	.11	A
BC338	.16	A
BC546B	.26	A
BC 547	.11	A
BC547A	.11	A
BC547B	.14	A
BC547C	.15	A
BC548	.08	A
BC548C	.15	A
BC549	.08	A
BC549C	.15	A
BC550	.12	A
BC557	.11	A
BC558	.08	A
BC558B	.14	A
BC559	.11	A
BC559C	.14	A
BC637	.28	A
BC638	.28	A
BC639	.35	A
BC640	.24	A
BCY70	.71	A
BCY71	.71	A
BD115	1.22	A
BD135	.48	A
BD136	.40	A
BD137	.42	A
BD138	.42	A
BD139	.39	A
BD140	.43	A
BD233	.48	A
BD234	.52	A
BD235	.43	A
BD237	.60	A
BD238	.49	A
BD262	.68	A
BD263	.66	A
BD301	.60	A
BD302	.60	A
BD433	.42	A
BD434	.44	A
BD435	.44	A
BD436	.46	A
BD437	.48	A
BD438	.48	A
BD439	.48	A
BD646	1.35	A
BD647	1.69	A
BD675	.70	A
BD678	.60	A
BD679	.62	A
BD680	.64	A
BD681	.66	A
BD682	.68	A
BDV64B	2.72	A
BDV65B	2.72	A
BDX64A	3.58	A
BDX64B	4.18	A
BDX65A	3.58	A
BDX65B	4.18	A
BDX66-P	8.64	A
BDX67B	9.50	A
BF115	.51	A
BF173	.70	A
BF180	.60	A
BF184	.50	A
BF195	.27	A
BF198	.22	A
BF199	.22	A
BF336	.68	A
BF337	.68	A
BF458	.82	A
BF469	.75	A
BF470	.87	A
BF494	.18	A
BFX29	1.02	A
BFX85	.63	A
BFX89	.98	A
BFY50	.78	A
BFY51	.78	A
BFY52	.69	A
BFY90	1.10	A
BSS68	.24	A
BSV17	.80	A
BSX20	.44	A
BU126	1.68	A
BU208	2.18	A
BU326A	1.92	A
BU426	3.54	A
BUX80	3.86	A
DX542CF	27.27	B
FT50	1.02	A
FT402	4.55	A
FT430	3.90	A
FT2955	1.22	A
FT3055	.96	A
MEL12	.70	A
MJ413	2.59	A
MJ802	2.99	A
MJ1001	1.90	A
MJE1091	2.45	A
MJ2955	.78	A
MJ4032	7.20	A
MJ4035	6.30	A
MJ4502	3.20	A
MJ15003	3.41	A
MJ15004	3.41	A
MJE340	.81	A
MJE350	1.50	A
MJE700	1.10	A
MJE800	1.02	A
MJE1100	1.84	A
MJE1101	2.10	A
MJE2955	.92	A
MJE3055	.92	A
MPF102	.45	A
MPF103	.57	A
MFE131	.93	A
MPSA05	.20	A
MPSA14	.24	A
MPSA42	.39	A
MPSA64	.45	A
MPSA70	.27	A
MPSA92	.43	A
MPSA4356		A
MPS6531	.45	A
MRF237	2.68	B
MRF238	12.27	B
MRF 450A	13.77	B
MRF454	31.22	B
MRF475	3.34	B
MRF901	1.88	B
OA675	.14	A
OC925	.14	A
OC9308	.14	A
OC955H	.31	A
OC9674	.31	A
PC208	.14	A
PE1010	.14	A
SE1002	.14	A
SE1010	.14	A
SE7055	.31	A
ST194	.14	A
TIP29A	.58	A
TIP29B	.63	A
TIP30A	.60	A
TIP30B	.63	A
TIP31A	.56	A
TIP31B	.60	A
TIP31C	.62	A
TIP32A	.56	A
TIP32B	.62	A
TIP32C	.79	A
TIP33A	.90	A
TIP33C	1.48	A
TIP34A	1.15	A
TIP34B	1.20	A
TIP34C	1.73	A
TIP41A	1.04	A
TIP42A	1.04	A
TIP42B	1.04	A
TIP42C	1.76	A
TIP110	.90	A
TIP115	.90	A
TIP120	1.17	A
TIP125	1.20	A
TIP127	1.18	A
TIP2955	1.06	A
TIP3055	.85	A
TT641	.12	A
U310	1.84	B
VMP4	24.90	B

DIODES

1N4001	.06	B
1N4002	.07	B
1N4004	.08	B
1N4007	.12	B
1N4148	.04	B
1N5060	.25	B
1N5404	.24	B
1N5408	.28	B
ST4/GT32	.22	B
P600G	.65	B
G.I.G.	.26	B
G.I.M.	.45	B
OA626-800	.52	A
BYX21L-400R	1.80	B
BYX21L-400	1.80	B
BYX21L-200	1.70	B
1N60	.08	B
1N914	.04	B
1S426	.10	B
ITT210	.10	B
BA102	.54	B
BA217	.04	B
BAV20	.30	B
MV104	.95	B
OA47	.30	B
OA90	.08	B
OA91	.15	B
OA95	.16	B
OA645	.14	B
MDA1010	1.00	B
BPW34	3.00	A
BPW50	1.50	A

BRIDGE RECTIFIERS

VM48	400v	1A	DIL	.99 B
W02	200v	1.5A		.51 B
W04	400v	1.5A		.54 B
W06	600v	1.5A		.60 B
KBPC102	200v	3A		.98 B
KBPC602	200v	6A		1.86 B
KBPC604	400v	6A		2.00 B
KBPC606	600v	6A		2.20 B
KBPC1002	200v	10A		2.78 B
VJ448	400v	10A		3.15 B
KBPC1004	400v	10A		3.05 B
KBPC1006	600v	10A		3.29 B
PK40F	400v	12A		2.60 B
MDA3501	100v	35A		2.73 B
MDA3502	200v	35A		3.00 B
MDA3504	400v	35A		3.30 B
KBPC35	600v	35A		3.50 B

VOLTAGE REGULATORS

78L05	+5v	100mA	.38	B
79L05	-5v	100mA	.70	B
7805	+5v	1.5A	.86	B
LM309K	+5v	1.5A	1.76	B
7805K	+5v	1.5A	1.76	B
7905	-5v	1.5A	3.22	B
7905	-5v	1.5A	1.54	B
LM323K	+5v	3A	5.42	B
78H05	+5v	5A	7.10	B
78P05	+5v	10A	13.19	B
78L06	-6v	100mA	.38	B
7806	+6v	1.5A	.90	B
7906	-6v	1.5A	1.70	B
7808	+8v	1.5A	1.05	B
7908	-8v	1.5A	1.54	B
7808K	+8v	1.5A	2.45	B
78L09	+9v	100mA	.38	B
78L12	+12v	100mA	.38	B
79L12	-12v	100mA	.80	B
LM342-P12	+12	.25A	.67	B
LM341-P12	+12	.5A	.75	B
7812	+12v	1.5A	.86	B
7912	-12v	1.5A	1.20	B
7812K	+12v	1.5A	1.87	B
7912K	-12v	1.5A	2.99	B
78H12	-12v	5A	6.10	B
78CBUC	+13.8v	2A	1.98	B
78CBK	+13.8V	2A	4.90	B
78L15	+15v	100mA	.38	B
79L15	-15v	100mA	.85	B
LM342-P15	+15v	.25A	.67	B
LM341-P15	+15v	.5A	.75	B
7815	+15v	1.5A	.90	B
7815K	+15v	1.5A	2.97	B
7915	-15v	1.5A	1.70	B
7915K	-15v	1.5A	2.82	B
78H15	+15v	5A	6.10	B
78L18	+18v	100ma	.38	B
7818	+18v	1.5A	.90	B
7918	-18v	1.5A	1.70	B
7818K	+18v	1.5A	2.95	B
78L24	+24v	100MA	.38	B
79L24	-24v	100mA	.70	B
7824	+24v	1.5A	1.30	B
7924	-24v	1.5A	1.70	B
LM317T	+var	1.5A	1.45	B
LM337T	-var	1.5A	1.75	B
LM317K	+var	1.5A	2.66	B
LM337K	-var	1.5A	3.13	B
LM317 Hi	+var	1.5A	5.20	B
LM337 Hi	-var	1.5A	8.33	B
LM338K	+var	5A	5.75	B
78HGK	+var	5A	7.15	B
LM350K	+var	3A	5.10	B
79MG	+var	0.5A	1.32	B

SCRS

C106A	100v	4A	.60	B
C106F1	50v	4A	.60	B
C106B1	200v	4A	.64	B
C106B	200v	4A	.65	B
C106D1	400v	4A	.66	B
C106E1	500v	4A	.91	B
C106Y	30v	4A	.60	B
C122D1	400v	4A	1.17	B
C122E	600v	8A	1.57	B
TIC146	100v	.6A	.65	B
EC1038B	200v	.84A	.48	B
EC103D	400v	.84A	.53	B
S2003LS	200v	3A	.60	B
Q6010S5	600v	10A	1.60	B
S4010LS2	400v	10A	1.67	B
S6010L	600v	10A	1.67	B
S2015L	200v	15A	2.80	B
S4015L	400v	15A	3.00	B
S6015L	600v	15A	3.43	B

TRIACS

S2025H	200v	25A	5.10 B
S4025H	400v	25A	6.40 B
S4006LS2	400v	6A	1.15 B
C122D1	400v	8A	1.17 B
C122E	500v	8A	1.57 B
S6008L	600v	8A	1.65 B
S6025	600v	25A	8.19 B
S2035H	200v	35A	5.50 B
S4035H	400v	35A	6.95 B
S6035	600v	35A	9.22 B
S6035H	600v	35A	7.25 B
AC02DT	400v	2A	.50 B
Q6010L5	600v	10A	1.60 B
2N6073	400v	4A	1.20 B
Q4004L4	400v	4A	1.20 B
Q2006L4	200v	6A	.95 B
SC141D	400v	6A	.95 B
Q4006L4	400v	6A	1.10 B
SC146D	400v	10A	1.50 B
Q4015L5	400v	15A	2.30 B
Q6015L5	600v	15A	2.90 B
Q4025H	400v	25A	5.50 B
Q6025H	600v	25A	6.75 B
Q4040D	400v	40A	8.64 B
Q4010L4	400v	10A	1.65 B
Q2015L5	200v	15A	1.80 B

LEDS+DISPLAYS

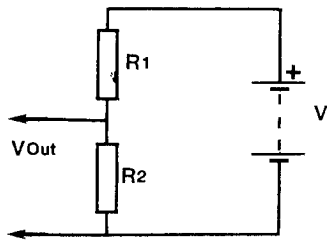
Red 5mm	.12	B
Green 5mm	.20	B
Yellow 5mm	.20	B
Orange 5mm	.20	B
MV5753 Red Wide beam	.34	B
MV5153 Orange Wide beam	.54	B
MV5353 Yellow Wide beam	.54	B
MV5752 Red Hi Intensity	.54	B
MV5352 Yellow Hi Intensity	.54	B
MV5152 Orange Hi intensity	.54	B
MV5252 Green Hi Intensity	.54	B
LD271 Infra Red	.59	B
Green 3mm	.20	B
Red 3mm	.11	B
Yellow 3mm	.20	B
FND357cc 7-segment	1.55	B
FND358CA 7-segment	1.22	B
FND500cc "	1.20	B
FND507 CA "	1.39	B
FND800CC "	2.86	B
FND807CA "	2.86	B
MAN2A dot matrix	5.46	B
Red rectangular	.21	B
Green "	.30	B
Yellow "	.30	B
ME7121 infraRed Emit	1.65	B
ME7124 " "	1.65	B
ME8020 " Detector	.83	B
SEL351 Green 7-segment	.89	B
SEL151 Red "	.76	B
MAN54A .3" CC 7-seg. Gn	3.05	B
MAN72A .3" CA DL707	1.47	B
MAN74A .3" CC DL704	1.47	B
MAN84A .3" CC 7-seg Yel	3.05	B
MAN3620A .3" CA 7-seg Or.	3.05	B
MAN3640 .3" CC " Or.	3.05	B
MAN6640 .56" Or	4.65	B
MAN6660 .56" CA Or.	2.94	B
MAN6680 .56" CC Or.	2.94	B
MAN6740 .56" CC Red	3.17	B
MAN6760 .56" CA Red	2.03	B
MAN6780 .56" CC Red	2.03	B
MAN8610 .8" CA Orange	3.05	B
MAN8630 .8" CA "	3.05	B
MAN82A .3" CA Red	3.05	B
MAN8640 .8" CC Orange	3.05	B
LT303 .3" CC Red	1.30	B
LT302 .3" CA Red	1.30	B

Basic Electricity

PART 3

THE VOLTAGE DIVIDER

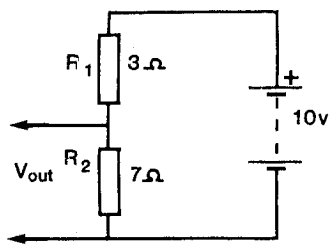
A voltage divider provides LOW voltage out from a HIGHER supply voltage.
A simple voltage divider uses two resistors as shown:



The voltage V_{out} is equal to the voltage drop across R_2

The formula for $V_{out} = \frac{V \times R_2}{R_1 + R_2}$

Example:



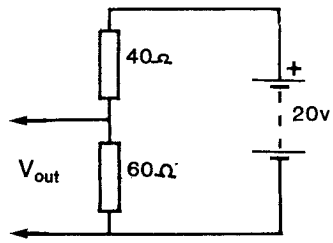
$$V_{out} = V \times \frac{R_2}{R_1 + R_2}$$

$$= 10 \times \frac{7}{7 + 3}$$

$$= 10 \times \frac{7}{10}$$

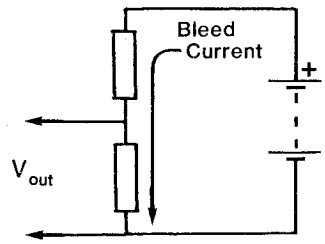
$$= 7 \text{ volts}$$

You can see that the 10 volts supply will create one volt drop across each one ohm. By using this same reasoning, follow through this next problem:



SUMMARY OF STEPS:

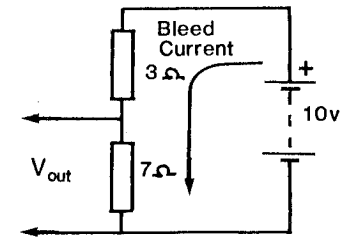
The total resistance is 100 ohms, so that the 20 volts must be divided into 100 parts. Each ohm will see 1/5th of a volt. This means the 40 ohm resistor will have 40 x 1/5 or 8 volts across it and the 60 ohm resistor will have 60 x 1/5 or 12 volts across it.
NOTE: The total of 8v + 12v must equal the supply.



NOTES: Voltage dividers draw current through the two resistors even though no components are connected to the V_{out} terminal. This bleed current flows all the time the battery is connected.

If any components are connected to the V_{out} terminal the voltage V_{out} will fall.

Voltage dividers are very wasteful with power. The "BLEED CURRENT" represents power lost.

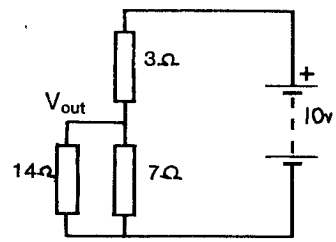


In the example above the BLEED CURRENT is:

$$I = \frac{V}{R}$$

$$= \frac{10}{7 + 3} = \frac{10}{10}$$

$$= 1 \text{ amp}$$



If we wish to use the output voltage to supply a 14 ohm load, V_{out} will drop and the current will need to be calculated using these 4 steps:

1. Calculate the "equivalent resistance" of the circuit
2. Calculate the current flowing.
3. Calculate V_{out}
4. Calculate the current in the 14 ohm load.

1. The resistance of the 14ohm:7ohm parallel combination

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$= \frac{1}{14} + \frac{1}{7}$$

$$= \frac{1 + 2}{14}$$

$$= \frac{3}{14}$$

$$R = \frac{14}{3} = 4^2/_3 \text{ ohms}$$

$$\text{Total resistance} = 4^2/_3 + 3$$

$$= 7\,^2/_3 \text{ ohms}$$

Current flowing:

$$= \frac{V}{R}$$

$$= \frac{10}{7^2/_3}$$

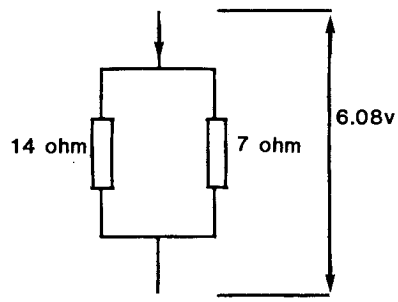
$$= 1.3 \text{ amps}$$

3. $$V_{out} = V \times \frac{R_2}{R_1 + R_2}$$

$$= V \times \frac{4.66}{3 + 4.66}$$

$$= 10 \times \frac{4.66}{7.66}$$

$$= 6.08 \text{ volts}$$



4. The current in the 14 ohm load:

This is a current divider circuit and is discussed in the next section.

The 1.3 amp splits into I_1 and I_2

$$I_1 = \frac{6.08}{14} = .433 \text{ amp}$$

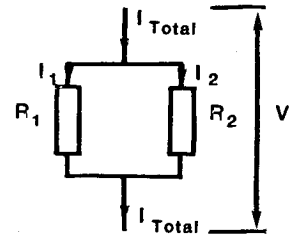
$$I_2 = \frac{6.08}{7} = .867 \text{ amp}$$

Remember the total of .433 + .867 must equal 1.3 amp.

You can see that current flow and voltage drop in a volt divider very soon becomes quite complex and the figures become involved. There is no regulation at all and this type of supply is only suitable for the most primitive of requirements.

A CURRENT DIVIDER

To find the current in R_1, the voltage V is common to both resistors so from ohms law.



$$I_1 = \frac{V}{R_1}$$

and $$I_2 = \frac{V}{R_2}$$

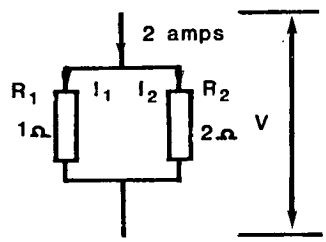
Since V=V

$$I_1 R_1 = I_2 R_2$$

$$\frac{I_1}{I_2} = \frac{R_2}{R_1}$$

thus the current divides in the inverse ratio of the resistance values.

Problem A Current Divider



What is the current in the 1 ohm resistor ?
Write down the known quantities.

I_T = 2 amps

Voltage across the combination = V

R_1 = 1 ohm

R_2 = 2 ohm

From ohms Law

$$I_1 = \frac{V}{R_1} \quad \text{---- (1)}$$

$$\& \quad I_2 = \frac{V}{R_2} \quad \text{---- (2)}$$

$$\& \quad I_1 + I_2 = 2 \text{ amps} \quad (3)$$

from (1) & (2)

$$I_1 R_1 = I_2 R_2$$

$$I_1 = 2I_2 \quad \text{---- (4)}$$

Substitute (4) in (3)

$$2 I_2 + I_2 = 2$$

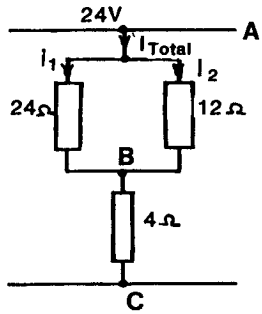
$$3 I_2 = 2$$

$$I_2 = {}^2/_3 \text{ amp}$$

$$\& \quad I_1 = 2 - {}^2/_3 = 1\,{}^1/_3 \text{ amps}$$

A Current Divider

When two resistors are placed in parallel, the current divides in the "inverse ratio of the resistance values". This simply means more current will flow through the 12 ohm resistor (neglecting the lower 4 ohm resistor). than the 24 ohm resistor



1. Determine the resistance of the 24 ohm/12 ohm parallel combination.

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\& \quad R_T = \frac{R_1 R_2}{R_1 + R_2}$$

$$= \frac{24 \times 12}{36}$$

$$= 8 \text{ ohm}$$

2. Total resistance of the combination

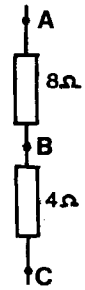
$$= 8 + 4$$

$$= 12 \text{ ohm}$$

3. Current flowing $= \frac{24}{12} = 2$ amps

Current in the 24 ohm resistor

The top two parallel resistors provide current splitting. The voltage across **AB**



$$V_{AB} = V_T \times \frac{8}{8 + 4}$$

$$= 24 \times \frac{8}{12}$$

$$= 16 \text{ volts}$$

So that the current in the 24 ohm resistor:

$$I = \frac{V}{R}$$

$$= \frac{16}{24}$$

$$= 2/3 \text{ amp}$$

Problems:

A 4 ohm resistor is placed in parallel with an 8 ohm resistor and this combination is in series with a 2 ohm resistor. Calculate the current in the 4 ohm resistor when the voltage across the combination is 12 volts.

What is the voltage across the above combination when the parallel resistors are 6 ohm and 18 ohm. The series resistor is 5 ohm and the current flowing in the 5 ohm resistor is 2 amps.

A 10 ohm and 30 ohm resistor are placed in parallel. In series with this is a 20 ohm resistor. If 1 amp is flowing in the 10 ohm resistor, what is the voltage across the circuit?

How many series and/or parallel combinations can be made from three resistors? And how many V_{outs} are possible with these arrangements? Take the resistor values to be 20 ohm, 30 ohm and 50 ohm with a supply voltage of 100 volts.

PRICE CHOP!

for TALKING ELECTRONICS...

UP TO 50% OFF

REGULAR PRICES ON SELECTED ITEMS

Philips TRIPLERS

FOR COLOUR TV
BEST QUALITY
SIEMENS/VARO

$9

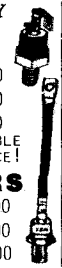
As used in Pye, Philips, Kriesler and most German colour TV's.

EHT Trans

Brand new Philips EHT Transformers, NOW REDUCED $1.50

$4 NT3100 NT3101 NT3122

HEAVY DUTY SCR's



200v...25A..$1.00
100v...60A..$5.00
200v..110A..$5.50

LOTS MORE AVAILABLE AT THE RIGHT PRICE!

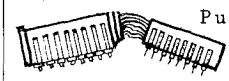
RECTIFIERS

100v....60A..$5.00
50v...250A..$6.00
200v...250A..$8.00

TV PCB'S

From AWA, these new circuit boards have over 80 parts incl. 8 trans. (2SC1014, 2SC711, 2SA673, 2SA628, 2SC620), 10 diodes, caps, resistors, trimpots, etc. GREAT VALUE HERE!

$1 EACH 10 FOR $8.00

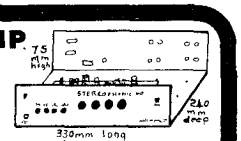


Push-Button **TUNER** BOARDS

$3 EACH 10 F $25.

Comprises 2 boards, one has 8xDPDT push-button switches, similar to Isostat - the other has 8xTOOK multi-turn trimpots with 3 position band-change switches. LTD. QTY.

PRE-AMP KIPS



$21.99

330mm long

BUILD YOUR OWN STEREO AMP AT "NEXT-TO-NOTHING" PRICES. We still have a limited quantity of these new SINCLAIR pre-amps with pre-punched chassis and lettered front panels. Featured are VOL/BASS/TREBLE/BAL. controls, an ON-OFF switch and PHONO/TUNER/AUX. inputs and it operates on 9-40V DC at about 20mA. You can build your own power amp and power supply or use it as a 3 input Disco Mixer or to improve an existing sound system. SAVE $3

STOP THIEF!

Ultra-sonic **BURGLAR ALARM**

$49

WAS $65, NOW SAVE $16

Ideal for your home, office or shop, the General Electric ultra-sonic alarm is small, self-contained and inconspicuous. The beam detects at up to 30ft, and emits a very loud, shrill tone which can be heard for over 100 metres A 5-digit push-button selector cuts off the alarm which resets after 5 mins, and a 35second test and exit delay and instant "ON" or delay "ON" (10secs) are included.

FANS

Ex-computer
5 inch
115v $8
220v $10

BNC PLUGS

High Quality **$2**

SOCKETS

PANEL MOUNT **$2**

TRIMPOTS

10 for $1 CHOICE OF- 100, 470, 1K, 10K, 25K, 50K, 220K, 500K, 2M

CERAMIC CARTRIDGE

POPULAR MODEL Similar BSR C-1

$2.50 5 FOR $10

ex-computer filter capacitors

TESTED AND GUARANTEED

27,000uF	5v	$1.50
25,000uF	10v	$2.00
90,000uF	10v	$3.00
15,000uF	15v	$3.00
35,000uF	15v	$3.75
84,000uF	15v	$4.50
10,000uF	20v	$3.00
46,000uF	20v	$4.00
72,000uF	20v	$5.00
22,000uF	25v	$4.00
50,000uF	25v	$4.75
71,000uF	25v	$5.50
5,200uF	30v	$2.00
12,500uF	30v	$3.50
30,000uF	30v	$4.50
43,000uF	30v	$5.00
15,000uF	35v	$3.75
8,300uF	40v	$3.00
60,000uF	40v	$4.50
8,000uF	50v	$4.00
15,000uF	50v	$5.00
5,000uF	50v	$3.00
15,000uF	63v	$5.50
4,500uF	64v	$3.25
10,000uF	75v	$4.50
22,000uF	75v	$5.50
900uF	100v	$2.00
4,800uF	200v	$6.00
1,600uF	350v	$6.00
200uF	500v	$2.00

HALF usual PRICE!

VALU ASSORTMENTS

LUCKY-DIP PACKS $2EA

500 ¼WATT RESISTORS
200 1WATT RESISTORS
50 1% HI-STAB RESISTORS
20 MIXED POTENTIOMETERS
25 PRESET POTS ASST.
30 POLY. GREENCAPS
100 CERAMIC CAPACITORS
45 ELECTROLYTIC CAPS
12 VARIOUS SWITCHES
40 RADIO/TV KNOBS
50 ASST TAGSTRIPS

$2 EACH PACK

SPECIALS

200 ¼ watt assorted resistors	$1.95
250 mixed-up resistors	$1.95
25 various RF, video, peaking chokes	$1.95
12 various trimmer caps, range 3-120pf	$1.95
25 mixed trimmer pots, range 100-2Meg	$1.95
20 various new pots, sgle,gang,switched,etc.	$1.95
15 inst. knobs,precision,black,for std ¼"shaft	$1.95
45 assorted valve sockets, 7,9 pin etc	$1.95
10 mixed switches, rotary,toggle,slider,DPDT.	$1.95
1 metre desoldering wick in dispenser	$1.95
20 assorted zener diodes, 40mW,1W,5W, etc	$1.95
4 3055 power transistors, TO-3 60V 115W	$1.95
48 electrical terminal connectors,blocks of 12	$1.95
2 DPDT mini toggle switches	$1.95
1 1.2V ni-cad pencell batteries 50mAH,gteed.	$1.95
6 metres grey 3 core mains lead	$1.95
25 silicon diodes 1N914 and 1N4148	$1.95
25 EM40I silicon rectifiers 100 PIV 1 AMP	$1.95
15 assorted types, colours, LED's 100% gteed.	$1.95
3 2 core mains power leads with 3 pin plug	$1.95
1 5 pin din to 5 pin din audi lead	$1.95
20 mixed 3AG fuses, in'range ¼A to 20A	$1.95
10 asst. types 3AG fuseholders, chassis,line	$1.95
30 metres hook-up wire, 5 asst cols	$1.95
1 ignition filter kit for CB, car stereo,etc.	$1.95
1 universal cable connector kit,for car hi-fi.	$1.95
1 1000uf 63VW pig-tail electro capacitors	$1.95
1 grey foam speaker grille	$1.95
4 8ourns 2Kohm 1W WW mini precision pots	$1.95
14 alligator clips, asst sizes, red & black.	$1.95
4 asst relays, various voltages, types	$1.95
10 ign noise suppressor resistors for HT cables	$1.95
1 24V DC 430 plug-in relay,3 pole 10A C/O	$1.95
4 500ohm 2W WW pots with knobs,tweeter con	$1.95
3 thermal cut-out switches,approx. 70°C oper.	$1.95
1 PCB etc resist Dalo pen for making PCB's	$1.95
1 set CB radio crystals, trans/rec,most chan.	$1.95
1 9D/200pf.MSP 2 gang tuning cap	$1.95
4 2uf non-polar polyester spkr x'over caps	$1.95

5" CRO (130mm) 6·5 MHz by Goodwill

★ ALL NEW
★ SOLID STATE
★ HIGH SENSITIVITY
★ COMPACT AND RELIABLE

SAVE $10.00

$249

- Retrace blanking: gives a much clearer display
- Lower threshold triggering: less than ½ division at 5MHz
- Sharper focus - especially at high frequencies
- Fibreglass pcb
- AND A USEABLE RESPONSE TO BEYOND 6.5MHz!

VERT. DEFLECT.- 10mV/Div
HORIZ DEFLECT.-500mV/Div
TIME BASE- 10Hz-100KHz
INT/EXT SYNCHRONIZATION

14 DAY TEST & PROVE, MONEY REFUNDED!

Dynamic stereo headphones

$12

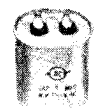
20-20KHZ
32OHM
ONLY 40GMS
6.5MM STEREO PLUG

WERE $18.00 SAVE $6.00

BONUS: DUAL-PURPOSE 3.5 TO 6.5mm ADAPTOR FREE!

High quality ex-computer gear!

OIL-FILLED capacitors



TESTED, GUARANTEED ALL FAMOUS MAKERS.

2uF	1,500VDC	$3.00
4uF	330VAC	$3.00
5uF	330VAC	$3.00
5uF	370VAC	$3.00
6uF	600VDC	$3.00
7uF	600VDC	$3.00
7.5uF	440VAC	$3.50
8uF	800VDC	$3.50
8uF	660VAC	$4.00
9uF	660VAC	$4.00
10uF	300VDC	$3.00
18uF	250VAC	$4.50
40uF	370VAC	$7.50

HEATSINKS

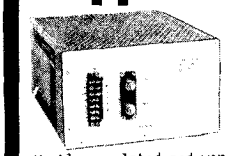
HUGE RANGE AVAILABLE!

3"x4" WITH 1xTO3 TRANS.	$2.50
6"x4" WITH 2xTO3 TRANS.	$3.00
9"x4" WITH 4xTO3 TRANS.	$4.00
12"x4" WITH 5xTO3 TRANS.	$5.00

WE HAVE LOTS MORE INCLUDING REALLY HEAVY DUTY 12"x8" FOR 10xTO3 TRANS. ($12.00), PLUS OTHERS SUITABLE FOR LARGE POWER SUPPLIES AND POWER AMPS - EVEN SMALL ONES, TOO!

power supplies

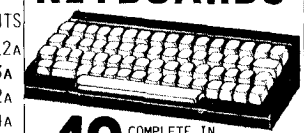
WIDE CHOICE OF OUTPUTS



50v 12A
36v 3A
28v 2A
24v 4A
20v 10A
18v 6A
12v 8A
5v 30A

Mostly regulated and working, we have too many to list here. The prices vary, from around $25 for sgle. output to a max. of $100.

KEYBOARDS

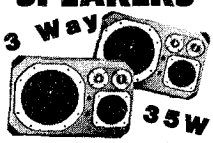


$49 COMPLETE IN SLOPEING METAL BOXES

Top quality keyboards from famous makers. Limited quantity avail. Standard typewriter layout with a few extra keys for your own use. They are assumed to be in good working order, however no warranty can be applied. The PCB includes all necessary electronics. We do not have specific data, sorry.

SPEAKERS

3 Way



35W

WERE $109 **$99**

New to our range, these MAGNIFICENT Speakers are ideal either for HOME HI-FI or CAR STEREO use. 35 watts power rating with 20oz magnets, woofer, mid-range and 2x tweeters plus mid and hi LEVEL CONTROLS and crossovers. Ready to mount in boxes or car!

RADIOS

AM/LW BATTERY/ELECTRIC WERE $18

$9

AM Portable

Several models avail. at HALF PRICE! WERE $5.99

$2.95 EA.

$1.95 EA. *SAVE $$$ PACK

LOOK!

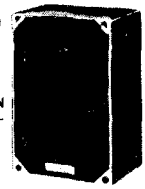
EDGE CONNECTOR

0.1"inch 35 Way

$4.50 LAST FEW Pye 0.1" pitch PCB edge Connectors with 70 Gold-plated contacts at about HALF the usual price! BUY 10+$3.90ea. 100+$3.50

23 WAY EDGE CONNECTOR 0.1 INCH GOLD-PLATED **$3**

MINI SPEAKER SYSTEM $99



New model, it's FANTASTIC 50W handling power (min. 30W RMS) 8 ohms, 60-20,000Hz Hi-Fi response, 4" driver with soft dome tweeter. Heavy duty cabinet, metal grille. Size210x130x130mm, 2.7Kgm

FM wireless mikes.

NEW MODEL 88-108MHz OMNI-DIRECTIONAL ELECTRET CONDENSOR MIKE. Ideal for stage, church, school, home-parties etc. Tune in on your FM radio. Save $5 on our regular $28.50 price.

$23.50

LED DISPLAY PANEL FILTER

68mm x 38mm size

WERE $2.99 **$1.99**

BLACK PLASTIC FRAME WITH RED PERSPEX FILTER FOR LED DISPLAYS - ALSO INCLUDES MOUNTING KIT - REAL VALUE WORTH TWICE THIS SPECIAL PRICE BUY 10+ $2.50 ea. 100+ $2.25 ea.

PRE-PAK electronics p/l

1a WEST ST, LEWISHAM, NSW

ALL MAIL ORDERS P.O. BOX 43 CROYDON 2132

569-9797 PACK/POST ADD TO ORDER VALUE

MON to FRI. 9.00 AM - 5.30 PM
SAT 9.00-5.00, SUN 10.00-4.00

OPEN 7 DAYS

DESIGNING *YOUR OWN* POWER SUPPLIES

-by Colin Mitchell E.E.(Hons.)

INTRODUCTION ALMOST ANY PROJECT CAN BE CONNECTED TO A POWER SUPPLY. THIS WILL SAVE THE COST OF BUYING BATTERIES BUT MORE IMPORTANTLY THE VOLTAGE AVAILABLE FROM A POWER SUPPLY WILL BE REGULAR & NOT "DROP OFF" AS THE BATTERY BECOMES EXHAUSTED. BATTERIES ARE IDEAL FOR PORTABILITY BUT FOR CONTINUED OPERATION A POWER SUPPLY IS THE ANSWER.

CHECK THESE FEATURES:

- DELIVERS A CONSTANT VOLTAGE
- CAPABLE OF DELIVERING HIGH CURRENTS
- " " " " VOLTAGES
- CHEAP TO RUN
- ABLE TO CHARGE RE-CHARGEABLE BATTERIES

FIRST CONSIDERATIONS A RANGE OF READY-MADE SUPPLIES IS AVAILABLE SO FIRSTLY DETERMINE IF THESE WILL MEET YOUR REQUIREMENTS. IF NOT, YOU WILL NEED TO BUILD YOUR OWN UNIT. SEE IF YOUR NEEDS FALL INTO ANY OF THESE CATEGORIES:

* Supply required to fit into or onto an existing project.
* Required as a "DESIGNERS" POWER SUPPLY with numerous voltage ranges.
* " " " HIGH-CURRENT POWER SUPPLY
* HIGH DEGREE OF SMOOTHING REQUIRED
* REQUIRED FOR A SPECIAL VOLTAGE

CURRENT RANGE POWER SUPPLIES FALL INTO 3 CATEGORIES ACCORDING TO THEIR CURRENT CAPABILITIES. YOU MUST FIRSTLY DECIDE WHICH RANGE YOU WISH TO HANDLE:

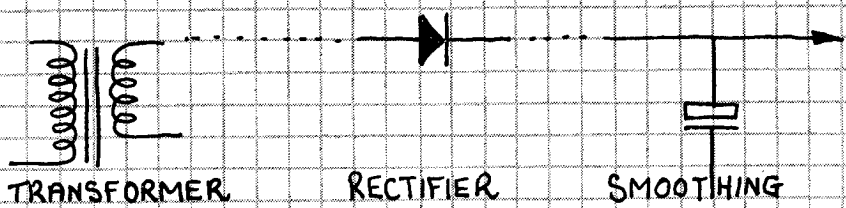
1. LOW POWER — USUALLY. 150mA 250mA or 500mA.
2. MEDIUM POWER — USUALLY 1 AMP TO 2 AMP
3. HIGH POWER — 3 AMP 6AMP 10AMP AND HIGHER

NOTE — THE VOLTAGE OF A POWER SUPPLY IS COMPLETELY INDEPENDENT OF CURRENT. AT ANY CURRENT RATING, THE VOLTAGE RANGE AVAILABLE IS:

1·5v → 110 VOLT.

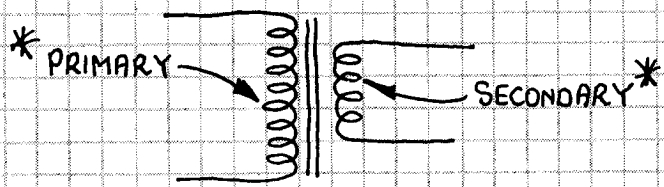
THIS MEANS WE CAN DESIGN A POWER SUPPLY FOR OUTPUTS SUCH AS:
3v @ 10AMP or 110v @ 150mA or 32-0-32v @ 6 AMP. or 9v @ 1 AMP
THE ONLY DIFFERENCE WILL BE THE PHYSICAL DIMENSIONS, HEAT SINKING AND COST.
THESE NOTES WILL COVER THE THEORY BEHIND THEIR DESIGN.
IT WILL INVOLVE VERY LITTLE MATHEMATICS, TO KEEP THE TEXT SIMPLE.
ONCE YOU DECIDE UPON THE CURRENT YOU WISH TO DELIVER, AND THE DEGREE OF SMOOTHING REQUIRED, YOU WILL BE READY TO ABSORB THIS EASY-TO-UNDERSTAND SET OF NOTES. DO NOT START CONSTRUCTION UNTIL YOU ARE ABSOLUTELY SURE WHAT TO DO AND THE SAFETY PRECAUTIONS REQUIRED.

A POWER SUPPLY CONSISTS OF 3 SECTIONS

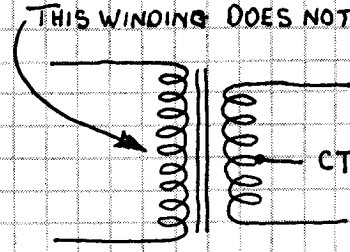


THESE NOTES WILL OUTLINE HOW THE 3 STAGES CAN BE COMBINED TO PROVIDE THE BEST AND CHEAPEST POWER SUPPLY FOR YOUR REQUIREMENTS

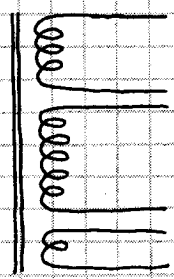
THE POWER TRANSFORMER



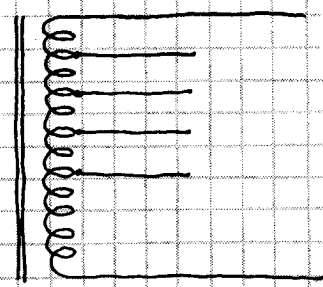
SINGLE OUT-PUT



CENTRE-TAPPED OUTPUT



2 OR MORE SEPARATE SECONDARIES



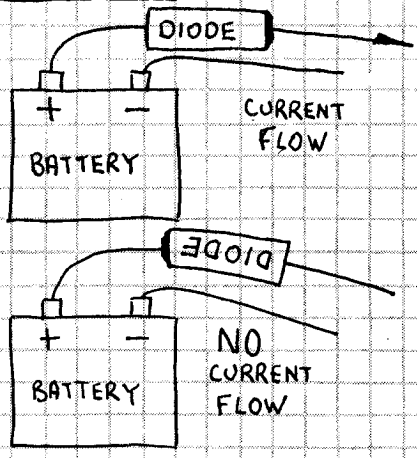
MULTI-TAPPED SECONDARY

THESE ARE THE 4 MOST COMMON TYPES OF SECONDARY WINDINGS. THE PRIMARY WINDING DOES NOT CONCERN US AND IT WILL USUALLY BE LEFT OFF CIRCUIT DIAGRAMS. WE ONLY DEAL WITH THE SECONDARY WINDING

NOTES:
* THE PRIMARY AND SECONDARY WINDINGS ARE USUALLY MARKED ON A TRANSFORMER. YOU MUST KNOW "WHICH IS WHICH".
* THE TRANSFORMER WILL NOT WORK IF YOU CONNECT THE PRIMARY TO THE MAINS. IT WILL GET TOO HOT AND "COOK".
* THE SECONDARY PRODUCES 1V AC FOR EACH 3 → 8 TURNS OF WIRE
* WHERE THERE ARE 2 OR MORE WINDINGS IN THE SECONDARY, THE THICKER WIRE SUPPLIES THE HIGHER CURRENT.
* A TRANSFORMER DOES NOT GIVE "DIRECT CURRENT" IT SUPPLIES ONLY "ALTERNATING CURRENT" (AC)
* YOU DON'T NEED TO KNOW WHICH SECONDARY LEAD IS "IN PHASE" WITH THE MAINS
* YOU CANNOT MEASURE THE RESISTANCE OF A WINDING TO DETERMINE ITS CURRENT OR VOLTAGE RATING.
* THE CIRCUIT SYMBOL FOR A TRANSFORMER DOES NOT INDICATE THE SIZE OF ANY WINDING OR THE CURRENT OR WATTAGE OR VOLTAGE.

ELECTRON FLOW

DURING EXPERIMENTATION EVERYONE MAKES MISTAKES
ONE UNFORTUNATE MISTAKE OCCURED 100 YEARS AGO (APPROX)
SCIENTISTS EXPERIMENTING WITH A RECTIFIER DIODE FOUND IT CONDUCTED IN ONLY ONE DIRECTION.



WHEN THEY PLACED IT IN THE POSITIVE LINE THEY FOUND THAT CURRENT WOULD FLOW WHEN IT WAS REVERSED, NO CURRENT WOULD FLOW THEY CONCLUDED THAT CURRENT FLOWS OUT THE POSITIVE TERMINAL AND THROUGH THE DIODE. THUS THEY GAVE THE DIODE AN ARROW SYMBOL SHOWING THE DIRECTION OF THE CURRENT FLOW:

THEY CREATED THE CONVENTION THAT ELECTRICITY FLOWS FROM POSITIVE TO NEGATIVE.

UNFORTUNATELY THEY WERE WRONG!

ELECTRICITY IS MADE UP OF ELECTRONS AND THESE FLOW FROM NEGATIVE TO POSITIVE. THUS ELECTRICITY DOES NOT FLOW IN THE DIRECTION OF THE ARROW.

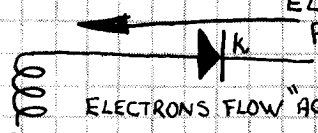
THIS HAS CREATED 2 SCHOOLS OF REASONING. ONE CALLED "CONVENTIONAL CURRENT" & THE OTHER "ELECTRON FLOW".
"CONVENTIONAL CURRENT" APPLIES TO ELECTRICAL WORK AND ELECTRICIANS

ELECTRICAL WORK:

"CONVENTIONAL CURRENT FLOW"

FOR LAMPS, SWITCHES MOTORS ETC.

ELECTRONIC WORK:

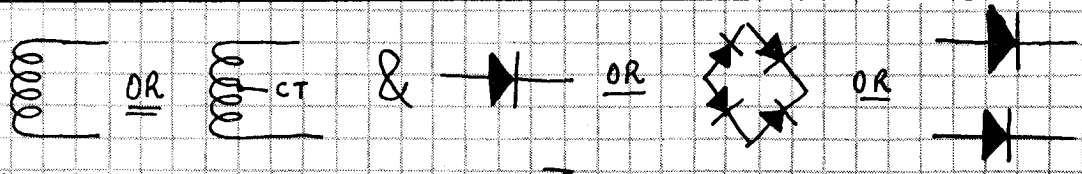


"ELECTRON FLOW"

FOR DIODES, TRANSISTORS ETC

WE USE ELECTRON FLOW IN OUR:

3 BASIC POWER SUPPLY CIRCUITS

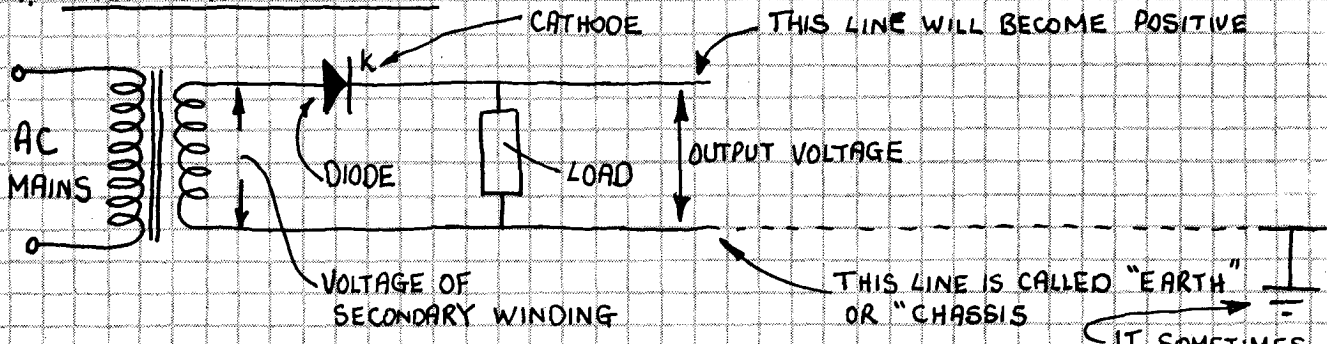


COMBINATIONS OF THESE WILL GIVE 3 DIFFERENT CIRCUITS.

THE 3 POWER SUPPLY CIRCUITS ARE:

1. HALF-WAVE ..... WITH 1 DIODE
2. FULL-WAVE WITH CENTRE-TAP TRANSFORMER ..... WITH 2 DIODES
3. FULL-WAVE BRIDGE RECTIFIER ..... WITH 4 DIODES

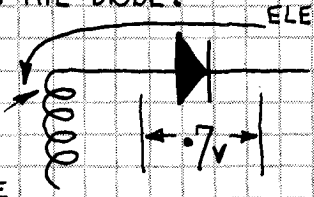
1. HALF WAVE RECTIFIER

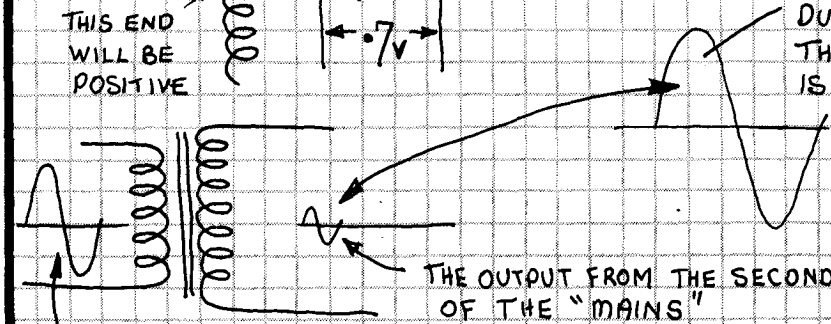


HOW THE CIRCUIT WORKS

WHEN THIS END OF THE DIODE IS RAISED ·7v HIGHER THAN THE OTHER END, IT BEGINS TO CONDUCT ELECTRONS IN THIS DIRECTION

DURING CONDUCTION THERE WILL BE A VOLTAGE OF ·7v ACROSS THE DIODE:

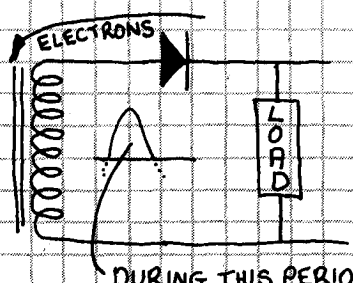




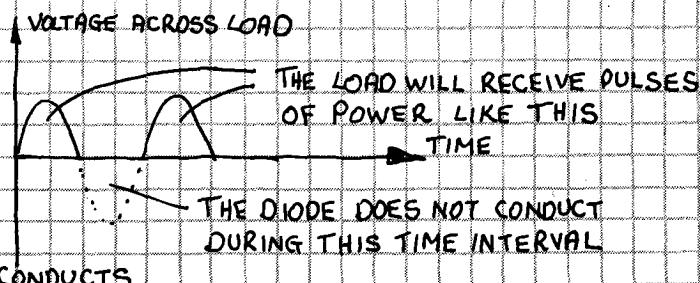
DURING THIS PERIOD OF TIME THE TOP OF THE SECONDARY WINDING IS POSITIVE & THE BOTTOM IS NEGATIVE THIS IS WHEN THE DIODE WILL CONDUCT.

THE OUTPUT FROM THE SECONDARY IS AN EXACT MINIATURE OF THE "MAINS"

THE INPUT WAVEFORM FROM THE "MAINS"



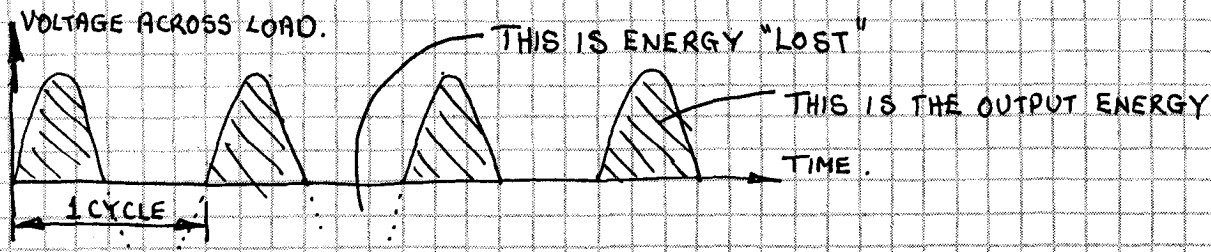
DURING THIS PERIOD, THE DIODE CONDUCTS



THE LOAD WILL RECEIVE PULSES OF POWER LIKE THIS

THE DIODE DOES NOT CONDUCT DURING THIS TIME INTERVAL

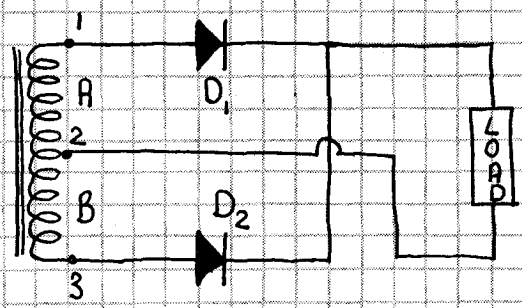
THE ENERGY FROM A HALF-WAVE RECTIFIER LOOKS LIKE THIS:



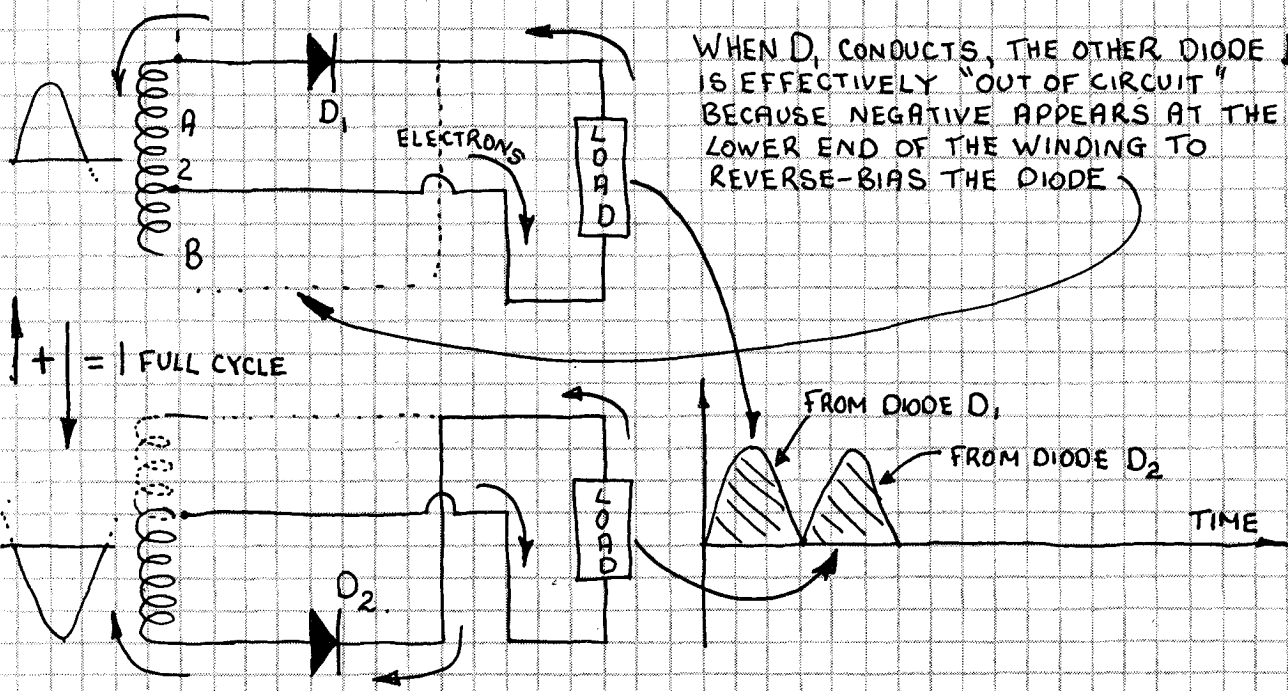
ONLY ENERGY FROM THE FIRST HALF OF EVERY CYCLE IS OBTAINED.

TO OBTAIN ENERGY FROM THE FULL CYCLE, WE NEED TO LOOK AT:

2. FULL-WAVE RECTIFICATION

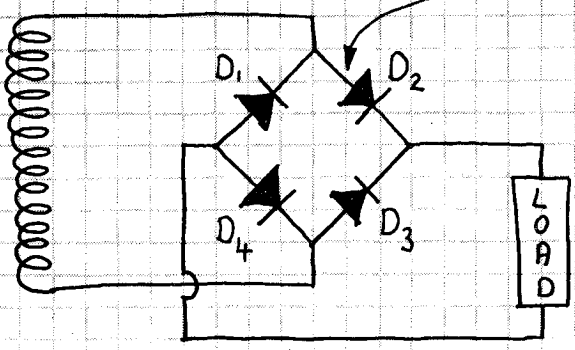


A CENTRE-TAPPED TRANSFORMER AND 2 DIODES FORM A FULL-WAVE CIRCUIT IT OPERATES AS 2 SEPARATE ½ WAVE CIRCUITS. WHEN THE TOP DIODE CONDUCTS, THE LOWER DIODE IS NON-CONDUCTING AND VISE VERSA.



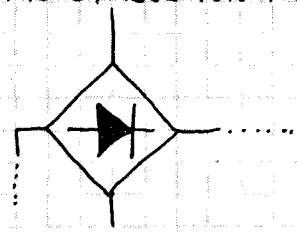
THE TWO DIAGRAMS REPRESENT 1 FULL CYCLE. NOTICE THE ELECTRONS FLOW THROUGH THE LOAD IN THE SAME DIRECTION FROM EACH HALF CYCLE. A FULL WAVE CIRCUIT DELIVERS 2 PULSES OF ENERGY DURING EACH CYCLE

3 FULL WAVE BRIDGE RECTIFIER



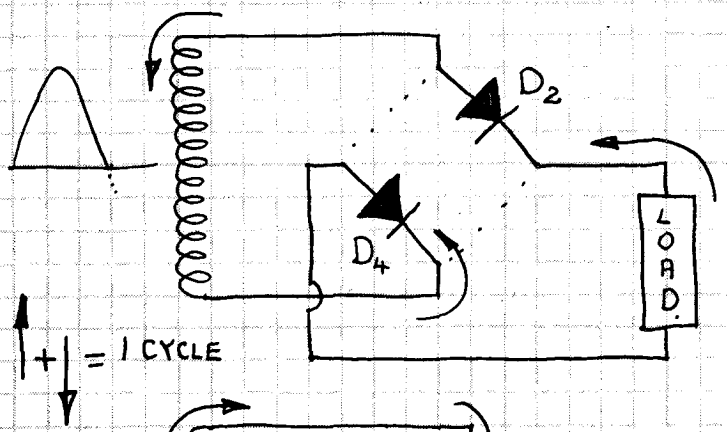
REMEMBER: ALL THE DIODES FACE IN THE GENERAL DIRECTION OF:

FOR THIS REASON WE SOMETIMES SEE THE SYMBOL FOR A BRIDGE AS:



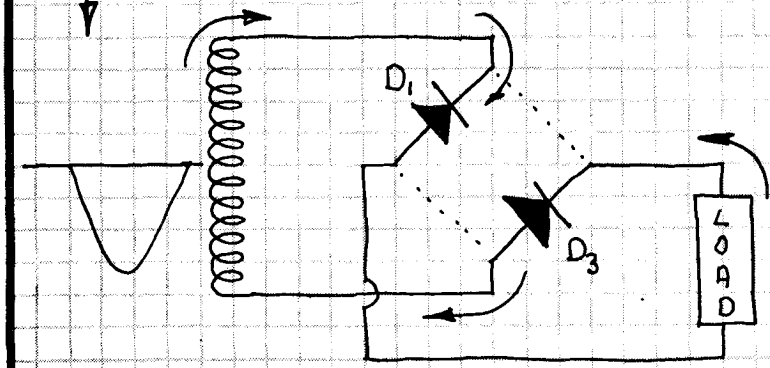
A FULL WAVE CIRCUIT CAN BE MADE BY USING A SINGLE SECONDARY WINDING AND 4 DIODES. THESE ARE ARRANGED IN A BRIDGE AS SHOWN.

THE OPERATION OF THE CIRCUIT IS BEST SHOWN IN 2 DIAGRAMS:

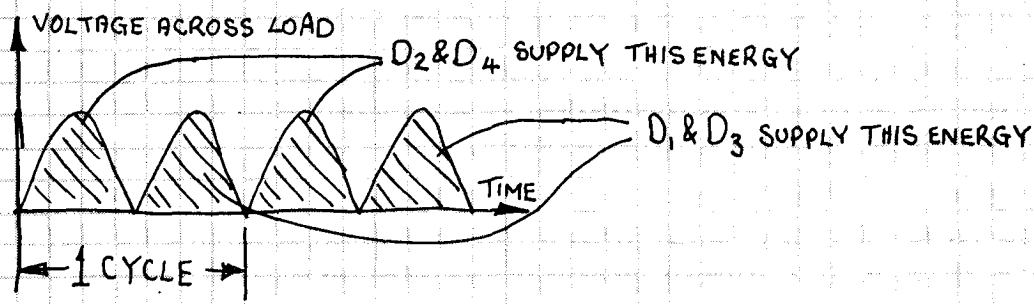


WHEN THE TOP OF THE WINDING IS POSITIVE, DIODES D_2 & D_4 ARE FORWARD BIASED AND SUPPLY THE LOAD WITH ENERGY.

DIODES D_1 & D_3 ARE REVERSE BIASED AND ARE EFFECTIVELY "OUT OF CIRCUIT".



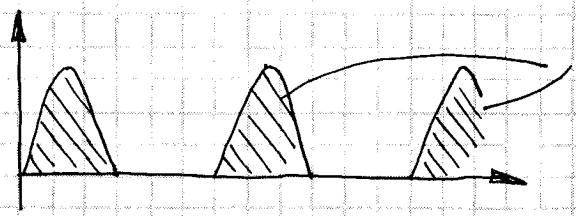
NOTICE: EVEN THOUGH THE POLARITY IS CHANGING FROM THE SECONDARY WINDING, THE ENERGY IS PASSING THROUGH THE LOAD IN ONLY ONE DIRECTION.



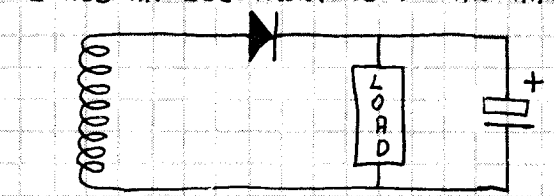
ALL THE RECTIFIER CIRCUITS 1, 2&3 PRODUCE PULSATING DC AND IT MUST BE SMOOTHED BEFORE IT IS SUITABLE FOR ANY ELECTRONIC CIRCUITS.

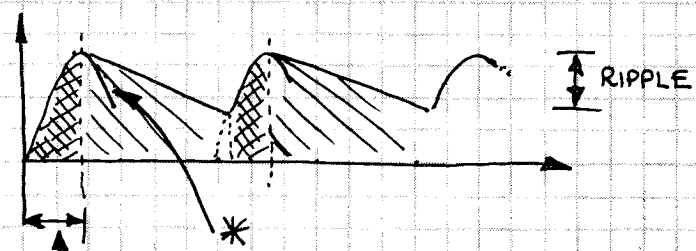
FILTERS

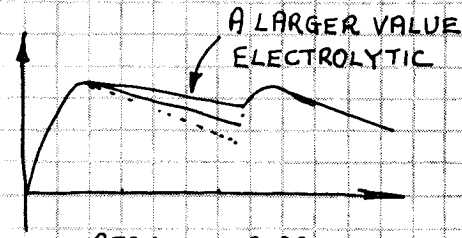
A FILTER SMOOTHS PULSATING DC FROM EITHER A HALF-WAVE RECTIFIER OR A FULL-WAVE RECTIFIER. IT IS BASICALLY A HIGH-VALUE ELECTROLYTIC WHICH IS CAPABLE OF STORING ENERGY DURING PART OF THE CYCLE THEN DELIVERING IT DURING THE "LOWS".



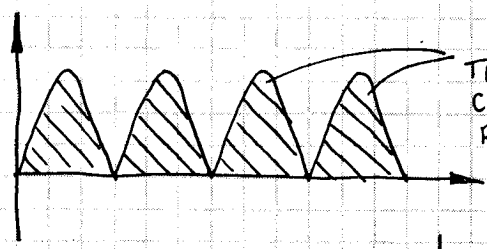
IF WE ADD AN ELECTROLYTIC TO THE HALF-WAVE RECTIFIER CIRCUIT:

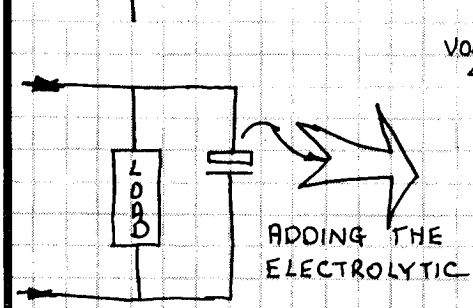


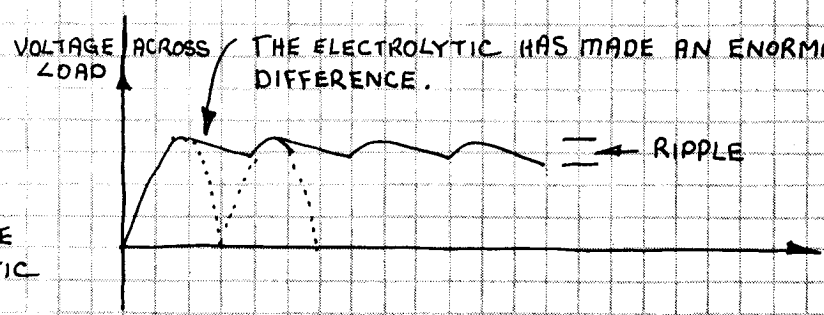




SMOOTHING A FULL-WAVE CIRCUIT







ROD IRVING ELECTRONICS

425 HIGH STREET, NORTHCOTE 3070. MELBOURNE. (03) 489-8131.

ELECTRONIC COMPONENT SUPPLIERS, DESIGNERS & MANUFACTURERS.
RITRONICS WHOLESALE (03) 489-7099. MAIL ORDERS (03) 481-1436.
TELEX: AA3897

For heavier items add additional postage. Extra heavy items sent Comet freight on. Prices subject to change without notice. Send 60c and SAE for free catalogues. Minimum pack and post $1.00. Bankcard Mail Orders welcome.

DISCOUNT COMPONENTS — SUPER SPECIALS

2732	$13.00	10 2708 at	$59.00
2114	$2.50	100 2114 at	$230.00
2716	$6.90	100 4116 at	$195.00
2708	$6.90	100 BC548 at	$9.00
4116	$2.50	100 Red Leds at	$9.00

ETI 8/81/4

CMOS

4000	.40
4001A	.40
4001B	.40
4002	.50
4006	1.10
4007	.50
4008	1.00
4009	.80
4010	.50
4011	.40
4012	.50
4013	.80
4014	1.70
4015	.90
4016	.70
4017	1.50
4018	1.50
4019	.60
4020	1.20
4021	1.10
4022	1.05
4023	.70
4024	1.00
4025	.50
4026	2.20
4027	.60
4028	.90
4029	1.20
4030	.60
4031	2.20
4034	3.00
4035	1.30
4039	.70
4040	1.70
4041	1.05
4042	.70
4043	.70
4044	.70
4046	1.20
4047	1.20
4048	.60
4049	.60
4050	.60
4051	1.00
4052	.80
4053	.80
4060	2.00
4066	.80
4068	.60
4069	.70
4070	.50
4071	.60
4072	.50
4073	.60
4075	.60
4076	1.20
4077	.50
4078	.60
4081	.60
4082	.60
4089	1.00
4093	.80
4503	.60
4510	1.50
4511	1.50
4512	1.10
4514	2.50
4516	1.40
4518	1.50
4519	.55
4520	1.60
4522	1.25
4527	1.20
4528	1.25
4529	1.60
4539	1.60
4541	1.60
4543	2.00
4553	5.50
4555	1.00
40097	.95
40098	.95
40175	1.00

74C SERIES

74C100	.40
74C02	.40
74C04	.40
74C08	.40
74C10	.40
74C14	.90
74C20	.40
74C30	.40
74C32	.40
74C42	1.10
74C48	1.55
74C73	.75
74C74	.70
74C76	.75
74C83	1.40
74C85	1.20
74C86	.80
74C90	.80
74C93	1.40
74C95	.95
74C107	.70
74C150	3.40
74C151	1.00
74C160	.90
74C192	.90
74C164	1.10
74C173	1.00
74C174	.80
74C175	1.00
74C192	1.20
74C195	1.00
74C221	1.90
74C373	1.80
74C374	2.00
74C901	.90
74C902	.90
74C905	11.20
74C906	.90
74C907	.80
74C915	1.50
74C922	3.80
74C923	5.00
74C925	5.50
74C926	5.90
74C927	5.90
74C932	5.50

80C SERIES

MM80C95	.90
80C96	.90
MM80297	.90
80C98	.90

LINEAR

LH0002	9.50
LH0022CD	16.60
LH0042CH	8.60
LH0070	12.70
LH0071	12.70
TL071	1.00
TL072	1.50
TL082	1.50
SAK140	2.20
UAA170	3.50
UAA180	3.50
TCA22D	2.20
LM301	.50
LM301-H	.50
LM304-H	1.70
LM305-H	.80
LM307-CN	.40
LM307-H	.90
LM308	.70
LM308-H	1.20
LM310-N	2.20
LM310-H	2.60
311	.60
LM311	.60
LM311-H	1.20
LM318	2.80
LM322	3.90
LM324	1.20
LM325	3.10
LM329-DZ	1.40
LM334-Z	1.30
LM335	12.40
LM336-Z	3.20
LM339	.90
LM348	1.10
LM349	1.80
LF351-N	.70
LF356-AN	1.10
LF357	1.10
LM358	.70
LM373	4.10
LM374	5.40
LM376	.70
LM377	2.90
LM379	5.70
LM308 8PIN	1.30
LM380	
14PIN	1.50
LM318A-N	2.40
LM318N	1.80
LM382N	2.00
LM383	2.70
LM384	2.40
LM386	1.00
LM387	1.30
LM391	1.80
LM393	.80
LF398	5.00
8038	6.00
NE530	1.10
OM350	9.90
555	.40
556	1.10
LM565	1.30
LM565CH	2.00
NE566	2.50
LM567	1.50
NE571	6.50
LM709 14PIN	.70
UA710CA	.60
LM710-CH	.90
711	.80
UA711-H	.85
UA716HC	6.25
723	.50
LM723CH	1.10
LM725	3.90
LM733	1.20
UA739	2.00
741	.25
LM741-H	1.20
UA747	1.00
UA747HC	2.20
UA748	.50
UA748HC	1.25
UA753	1.80
UA760HC	4.10
UA777	2.40
UA777HC	2.65
9334	1.70
UA743	1.80
UA760HC	4.10
UA796HC	1.70
LM8D2	1.10
LM131DN	2.40
1408	4.90
LM1458	.60
UA1488	1.50
UA1489	1.50
MC1495	7.30
MC1496L	11.40
LM1558	1.50
LM1596	1.40
LM1380	3.10
LM2902	1.40
LM2917	
8PIN	2.80
LM2917	3.10
CA3028	1.80
LM3039	.90
CA3046	1.70
3065	.45
LM3080	1.20
LM3089	3.90
CA3130T	1.40
CA3130E	1.80
CA3140	1.40
3401	.70
3611	1.10
LM3900	.90
LM3909	1.00
LM3914N	3.90
4136	1.40
LM4250	1.75
UA4558TC	1.40
MM5837	2.50
LM7555	1.80
Mc10116L	.95
LF13741	.60
LF1374-1H	.70
DS75452	.60
76477	4.90
75451	.60
75491	1.40
75492	1.40

TTL (s)

74S00	.80
74S02	.80
74S04	.80
74S10	.75
74S11	.75
74S32	.75
75S51	.75
74S74	1.20
74S86	1.40
74S112	1.20
74S135	2.20
74S138	3.20
74S157	2.95
74S158	2.95
74S182	3.30

7400 SERIES

7400	.40
7401	.40
7402	.40
7403	.40
7404	.40
7405	.50
7406	.50
7407	.50
7408	.40
7409	.40
7410	.40
7411	.40
7412	.40
7413	.50
7414	.70
7416	.50
7417	.60
7420	.40
7421	.40
7423	.50
7425	.45
7426	.40
7427	.40
7430	.40
7432	.40
7437	.40
7438	.50
7440	.50
7441	1.00
7442	.50
7443	1.40
7444	1.20
7445	1.10
7446	1.00
7447	1.00
7448	1.00
7450	.50
7451	.50
7453	.48
8T26	2.20
9300	.60
9307	1.80
9308	1.20
7454	.60
7472	.60
7473	.60
7474	.60
7475	.60
7476	.60
7480	.65
7482	1.80
7483	.80
7485	.80
7486	.60
7489	2.60
7490	.70
7491	.55
7492	.60
7493	.60
7494	.90
7495	.45
7496	.80
7497	2.50
74107	.80
74109	.60
74116	2.20
74121	.45
74122	.65
74123	.60
74125	.55
74126	.60
74132	.80
74141	1.10
74145	.85
74147	2.00
74148	1.40
74150	1.20
74151	.60
74152	4.90
74153	.70
74154	1.20
74155	.90
8128	1.60
9310	.65
9311	1.00
9312	1.35
74156	1.50
74157	.60
74161	1.00
74162	1.00
74163	.85
74164	.60
74165	.60
74174	.50
74175	.90
74176	1.10
74177	1.10
74180	.90
74181	2.30
74182	.90
74184	1.20
74185	1.20
74190	1.00
74191	1.50
74192	1.70
74193	.80
74194	1.10
74195	.65
74196	.85
74197	1.10
74198	1.10
74199	1.30
74221	.90
74290	.90
73293	.90
74365	.80
74366	.80
74367	1.00
74368	1.00
8T96	1.80
9314	1.30
9368	1.75
9370	2.00

74LS SERIES

74LS00	.40
74LS01	.40
74LS02	.40
74LS03	.40
74LS05	.40
74LS08	.40
74LS09	.40
74LS10	.40
74LS11	.40
74LS13	.50
74LS14	.90
74LS15	.40
74LS20	.40
74LS21	.40
74LS22	.40
74LS26	.40
74LS28	.40
74LS30	.40
74LS32	.40
74LS33	.40
74LS37	.50
74LS38	.50
74LS40	.50
74LS42	.75
74LS47	.85
74LS48	1.00
74LS49	1.00
74LS51	.40
74LS54	.50
74LS55	.55
74LS58	.65
74LS73	.55
74LS74	.60
74LS75	.45
74LS76	.50
74LS78	.50
74LS83	1.00
74LS85	1.00
74LS86	.50
74LS90	.70
74LS92	.90
74LS93	.80
74LS95	.65
74LS96	1.55
74LS107	.60
74LS109	.60
74LS112	.60
74LS113	.65
74LS114	.50
74LS122	.50
74LS123	.75
74LS125	.50
74LS126	.70
74LS132	.80
74LS133	.50
74LS136	.50
74LS138	1.20
74LS139	.85
74LS151	.75
74LS153	.60
74LS154	1.50
74LS155	1.00
74LS156	1.00
74LS157	.90
74LS158	.70
74LS160	.85
74LS161	.85
74LS162	1.00
74LS163	.85
74LS164	1.30
74LS165	.50
74LS168	1.90
74LS169	1.90
74LS170	2.80
74LS173	.90
74LS174	.90
74LS175	.90
74LS181	2.50
74LS189	3.80
74LS190	1.30
74LS191	1.10
74LS192	.85
74LS193	.85
74LS194	.70
74LS195	.80
74LS196	1.25
74LS197	1.00
74LS221	1.10
74LS245	2.35
74LS247	.90
74LS249	1.30
74LS251	.80
74LS253	.90
74LS257	.65
74LS258	.50
74LS259	2.45
74LS260	.90
74LS266	.98
74LS273	1.60
74LS279	.65
74LS283	1.15
74LS290	1.10
74LS293	1.15
74LS295	1.60
74LS298	1.00
74LS352	1.30
74LS353	1.30
74LS365	.50
74LS366	.70
74LS367	.90
74LS368	.90
74LS373	1.50
74LS374	1.70
74LS386	.50
74LS670	2.70
81LS95	2.10
95H90	11.50
11C90	19.50
81LS96	2.10
81LS97	2.10

TRANSISTORS

2N301	2.20
2N657	.60
2N930	.60
2N1613	1.10
2N1711	.50
2N1893	1.00
2N2219A	.60
PN2222	.20
PN2222	.30
2N2463	.35
2N2484	.65
2N2646	.70
2N2647	1.10
2N2894	.80
2N2904	.45
2N2905	.40
2N2906	.45
2N2913	1.20
PN2907	.30
2N3053	.60
2N3054	.90
2N3055	.90
2N3301	.40
2N3440	1.10
2N3502	.70
2N3503	.70
2N3563	.30
2N3564	.30
2N3569	.30
PN3565	.30
PN3566	.30
PN3567	.30
2N3568	.30
2N3638	.30
2N3639	.30
2N3640	.30
2N3641	.30
PN3645	.30
PN3642	.30
PN3643	.30
PN3644	.30
2N3646	.30
2N3692	.50
2N3693	.35
2N3702	.30
PN3694	.30
2N3704	.30
2N3709	.30
2N3713	2.20
2N3819	.80
2N3866	2.00
2N3904	.30
2N3906	.30
2N4030	1.10
2N4032	.55
2N4033	.90
2N4036	1.00
2N4037	.90
PN4121	.30
2N4233	1.60
2N4235	1.90
2N4236	2.20
2N4248	.30
PN4249	.30
2N4250	.30
2N4258	.30
2N4292	.70
2N4354	.30
2N4355	.30
2N4356	.30
2N4398	5.00
2N4401	.50
2N4402	.50
2N4403	.50
2N4416	1.00
2N4906	2.80
PN4868	.30
2N5088	.30
2N5089	.30
2N5179	1.90
2N5303	3.30
2N5320	.80
2N5401	.30
2N5458	.70
2N5459	.70
2N5461	.70
2N5484	.70
2N5485	.70
2N5486	.70
2N5769	.30
2N5770	.25
2N5830	.25
2N5831	.30
2N5856	.30
2N5873	1.10
2N5874	1.40
2N5961	.30
2N5963	1.10
2N6027	.60
3N201	.90
AC127	.70
AC128	.70
AC187	.70
AC188	.70
AD149	2.50
AD161	1.70
AD162	1.70
BC318	.30
BC319	.18
BC327	.15
BC328	.30
BC337	.30
BC338	.30
BC547	.15
BC548	.15
BC549	.15
BC549C	.40
BC557	.16
BC558	.16
BC559	.16
BC637	.25
BC638	.36
BC639	.40
BC640	.40
BCY70	.85
BCY71	.85
BD115	1.50
BD135	.70
BD136	.78
BD137	.70
BD138	.70
BD139	.70
BD140	.70
BD235	.65
BD234	.50
BD237	.50
BD262	1.20
BD301	.75
BD302	.75
BD263	1.25
BD435	.75
BD646	1.70
BD647	1.80
BD675	.80
BDV64B	4.50
BDV65B	4.50
BF115	.50
BF173	.70
BF180	.70
BF195	.30
BF198	.30
BF199	.38
BF336	.80
BF337	.80
BF458	.90
BF494	.40
BFX85	.75
BFY50	.90
BFY90	1.30
BSV17	1.00
BU126	3.00
BU208	3.00
BUX80	7.90
FT2955	1.40
FT3055	.75
MEL12	.90
BU326A	3.40
MJ2955	1.00
MJ4032	7.40
MJ802	3.40
MJ4035	6.90
MJ4502	3.70
MJE340	1.20
MJE350	1.70
MJE295	1.90
MJE8055	1.90
MJE3521	.60
MJ15003	4.00
MJ15004	4.00
QF102	.60
MPF131	1.40
MPSA05	.60
MPSA06	.60
MPSA12	.60
MPSA14	.60
MPSA42	.60
MPSA56	.80
MPSA92	.60
MRF475	4.40
TT31B	.90
TI3PIC	1.00
TIP32B	.90
TIP32C	1.00
TIP33A	1.10
TIP34A	1.20
TIP24B	1.50
TIP42B	1.10
TIP110	1.30
TIP120	1.80
TIP2955	1.50
TIP3055	1.50
VN88AF	2.50

MICRO CHIPS

ADCO 800	12.00
DACO 080	2.00
2012 200 NS	2.00
2102 350 NS	2.00
2102 450 NS	1.40
2102 650 NS	1.40
2111	8.60
2114 150 NS	11.15
2114 300 NS	3.90
2114 450 NS	3.50
8-31	3.30
32 up	3.10
2513	14.50
2516	55.00
2532	69.00
2650	23.00
2708	8.50
2716	12.00
4116	5.50
5101	9.00
MM5204	12.50
MM5220	7.20
MM5307	18.00
MM5309	6.50
MM5312	9.00
MM5369	2.60
5387	8.50
MM5395	6.50
6502	10.50
6508	5.50
6520	5.50
6522	10.00
6523	17.00
6551	17.00
MC6900P	9.00
MC6802	13.60
MC6808	12.50
6810A	4.90
6820	5.50
6821	6.00
6850	5.15
6852	6.40
7106	12.60
7107	15.80
7210	13.20
Z80 CPU	14.00
Z80A CPU	16.00
Z80 P10	13.80
Z80A P10	16.50
Z80 CTC	13.80
Z80A CTC	16.50
Z80 DMA	40.70
Z80 S10/0	56.90
Z80 S10/1	56.90
Z80 S10/2	56.90
Z80A S10/0	63.00
Z80A S10/1	63.00
Z80A S10/2	63.00
8035	27.00
INS8050	15.00
INS8080	8.00
P8085	25.00
8155	22.00
8165	22.00
8205	5.00
P8212	4.00
8214	8.00
8216	5.90
8224N	5.50
8224	7.50
8226	5.90
8228	9.50
8238	8.00
8243	8.00
8251	14.00
INS8251	6.50
8253	19.50
8255A	8.60
8257	99.00
8259	99.00
8275	99.00
8278	99.00
8295	25.00
DM8578	3.50
Ay-5-2376	19.56
MM5104N	10.00
MM55106N	10.00
MM57160	7.50
8748A	99.00
8755A	99.00
MCT2	.80
MCT6	3.30
MCT275	1.50
MCC671	3.00
4N28	.85
4N33	1.20
4N26	.85
MM80C95	.90
80C96	.90
MM80C97	.90
8098	.90

DPTDCOUPLERS

MCT2	1.00
MCT6	3.30
MC275	1.50
MCC671	3.00
4N28	1.00
4N33	1.20
4N26	1.00

VOLTAGE REGULATORS

78L05	.40
LM341P-5	.80
7805	1.80
7905	1.70
LM309K	1.20
7805K	2.10
LM323-K	6.90
78H05KC	8.50
LM341p-8	.80
78L12CP	.40
79L12	.65
LM341P12	.75
7812	1.00
7912	1.90
7812KC	2.15
7912KC	2.60
79H12KC	8.00
78L15	.35
79L15	.65
LM341P15	.80
7815	1.00
7915CT	1.80
7915KC	2.60
78H15KC	6.50
78L18	.35
7818	1.40
78L24	.35
79L24	.65
7824	1.10
LM371T	2.40
LM337T	3.80
LM317K	4.50
LM337K	5.90
LM350K	8.40
78HGKC	10.50
78PD5	16.50

BRIDGES

VM48	1.50
W02	.60
W04	.60
KHPC02	2.00
KBP602	2.50
KBP604	2.60
KBP606	2.80
KHPC1002	2.60
KBPC1004	3.20
KBPC1006	3.20
MDA3501	3.20
MDA3502	3.20
MDA3504	3.40

DISPLAYS

MAN2A	6.30
MAN72A	2.20
MAN74A	2.20
MAN52A	3.40
MAN82A	3.40
MAN84A	3.40
MAN6740	3.60
MAN8610	3.30
MAN8640	3.30
TIL306	12.00
DL704	2.20
DL707	2.30
DL747	3.40
DL750	4.00
FND357	1.80
FND500	1.80
FND507	1.80

DIP SWITCHES SPST

P/N	No. Switches	Price
SD3	3	1.60
SD4	4	1.70
SD5	5	1.90
SD6	6	2.30
SD7	7	2.40
SD8	8	2.50
SD9	9	2.70
SD10	10	3.00

WIRE WRAP 3-LEVEL

	1-9	10-25
8 Pin	.75	.65
14 Pin	.90	.85
16 Pin	1.00	.90
18 Pin	1.20	1.10
20 Pin	1.40	1.30
22 Pin	1.60	1.40
24 Pin	1.90	1.80
28 Pin	2.20	2.10
36 Pin	2.60	2.40
40 Pin	2.90	2.70

COMPUTER GRADE ELECTRO.

2900uf	40V	6.50
6800uf	16V	6.40
10,000uf	16V	9.00
10,000uf	25V	9.50
10,000uf	40V	11.90
15,000uf	40V	12.00
22,000uf	25V	12.90
22,000uf	40V	23.00
27,000uf	35V	23.50
33,000uf	16V	23.50
68,000uf	16V	21.50
100,000uf	10V	20.50

MULTISTRAND RIBBON CABLE
Price per metre

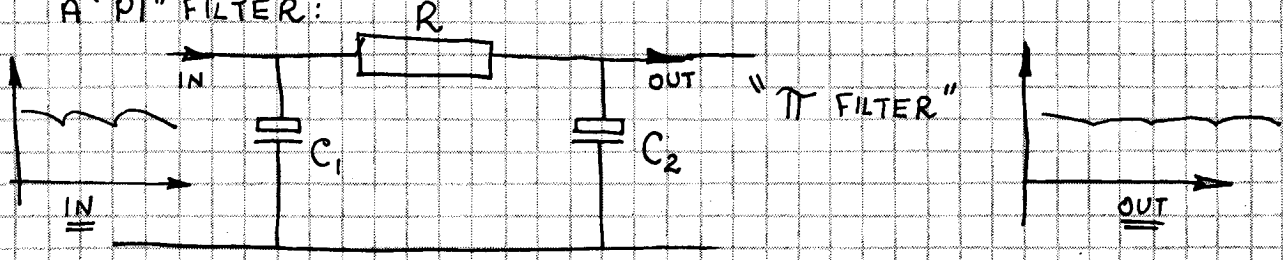
	1-9	10+
10 Way	.88	.75
12 Way	1.00	.95
16 Way	1.20	1.10
20 Way	1.60	1.50
40 Way	3.20	3.00

WE HAVE SEEN HOW AN ELECTROLYTIC WILL REDUCE THE RIPPLE TO A LOW LEVEL HOWEVER THIS SIMPLE FORM OF REGULATION IS NOT NEARLY GOOD ENOUGH FOR ELECTRONIC EQUIPMENT. WITH RIPPLE VALUES AS LOW AS 1V WE WILL BE ABLE TO HEAR AN ANNOYING HUM IN THE BACKGROUND OF AMPLIFIERS OR SEE A DISTORTED PICTURE GRADUALLY MOVE DOWN THE SCREEN ON VIDEO MONITORS AND IN COMPUTERS, EVEN THIS LOW LEVEL RIPPLE WILL GIVE INCORRECT OPERATION. SO WE MUST REDUCE THE RIPPLE EVEN FURTHER. HERE ARE 3 SUITABLE FILTERS:

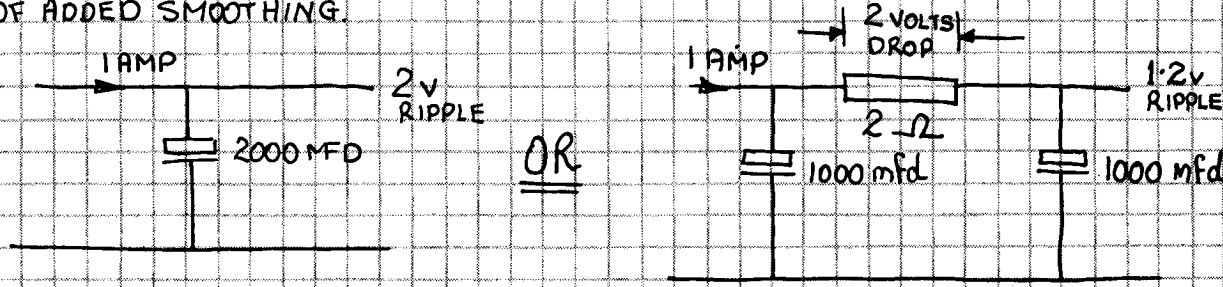
1. RC FILTER
2. LC FILTER
3. ELECTRONIC FILTER

1. RESISTANCE - CAPITANCE FILTER

THIS IS THE CHEAPEST FORM OF SMOOTHING. IT USUALLY TAKES THE FORM OF A "PI" FILTER:



THE MAIN DISADVANTAGE WITH THIS FILTER LIES IN THE HIGH LOSS FROM THE RESISTOR. WE RELY ON A VOLTAGE DROP ACROSS THE RESISTOR TO SEPARATE THE VOLTAGES ON THE ELECTROLYTICS AND THUS GET SOME DEGREE OF ADDED SMOOTHING.



COMPARE THE 2 CIRCUITS ABOVE. IN THE FIRST WE HAVE ONE ELECTROLYTIC OF 2000 MFD FOR SMOOTHING. IN THE SECOND CIRCUIT WE HAVE SPLIT THE ELECTROLYTIC INTO 2 PARTS AND INCLUDED A 2 OHM RESISTOR TO FORM A "PI FILTER." AT A CURRENT OF 1 AMP THE FIRST CIRCUIT WILL HAVE A RIPPLE OF ABOUT 2 VOLT WHILE THE SECOND CIRCUIT WILL HAVE A RIPPLE OF 1·2V. BY ACHIEVING A LOWER VALUE OF RIPPLE WE HAVE LOST 2 VOLTS ACROSS THE RESISTOR. THIS INDICATES AN RC FILTER IS NOT VERY EFFECTIVE FOR HIGH CURRENT SITUATIONS.

SIZE OF ELECTROLYTIC

THE SIZE OF THE ELECTROLYTIC IS DETERMINED BY THE CURRENT DEMAND OF THE POWER SUPPLY. THE NORMAL RULE IS 2,000 MFD / OUTPUT AMPERE, HOWEVER IT SHOULD NOT BE LESS THAN 1,000 MFD. GOOD SMOOTHING AT THE DIODES MAKES IT EASIER FOR THE NEXT STAGES OF FILTERING.

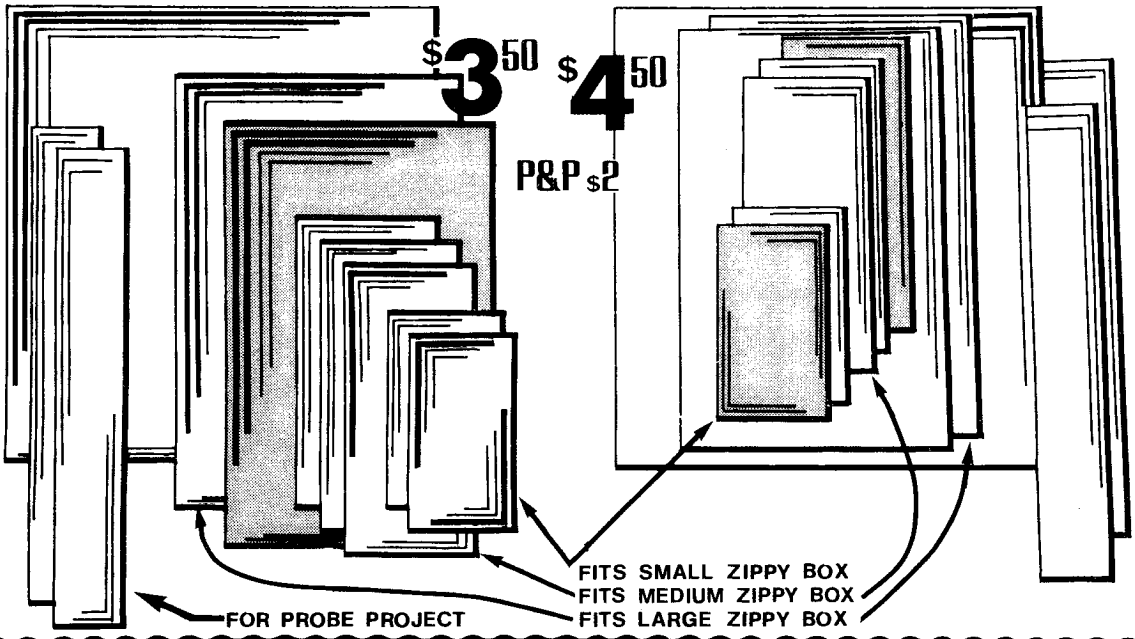
PRE-CUT P.C. BOARDS

Two new 10-board packs.
Pre-cut to fit jiffy and zippy boxes!

SINGLE SIDED KIT $3.50

DOUBLE SIDED KIT $4.50

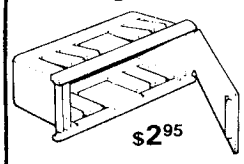
P&P $2



HELP!! It doesn't work!

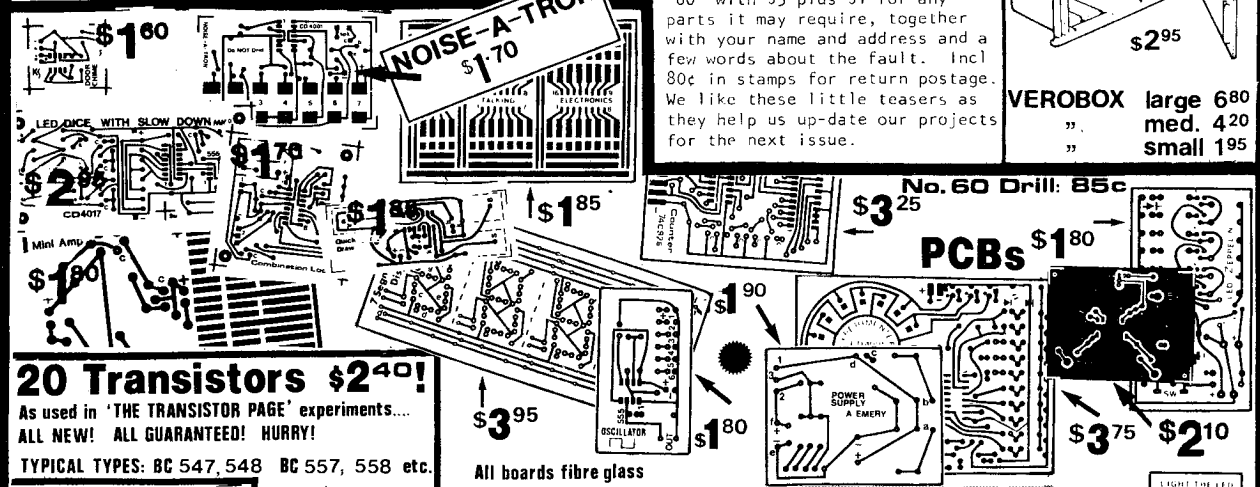
Don't forget, all the projects in the magazine are guaranteed to work. If they don't; don't despair! Try a little friendly persuasion on the circuit, check and double check everything. Ask a friend...get a little technical advice. If all this fails, try sending it to the man who designed it. Try sending it back to the magazine. For $3 we will look over your effort and try to get it going. If it is made on one of our PC boards, it will have a lot more hope. To avail yourself of this service, send the unit in a jiffy post bag size '00' with $3 plus $1 for any parts it may require, together with your name and address and a few words about the fault. Incl 80¢ in stamps for return postage. We like these little teasers as they help us up-date our projects for the next issue.

Vero battery box



$2.95

VEROBOX large 6.80
" med. 4.20
" small 1.95



20 Transistors $2.40!

As used in 'THE TRANSISTOR PAGE' experiments....
ALL NEW! ALL GUARANTEED! HURRY!

TYPICAL TYPES: BC 547, 548 BC 557, 558 etc.

All boards fibre glass

TV service transistors!

BU 126 - $2.20
BU 208 - $2.80

TALKING ELECTRONICS mag,

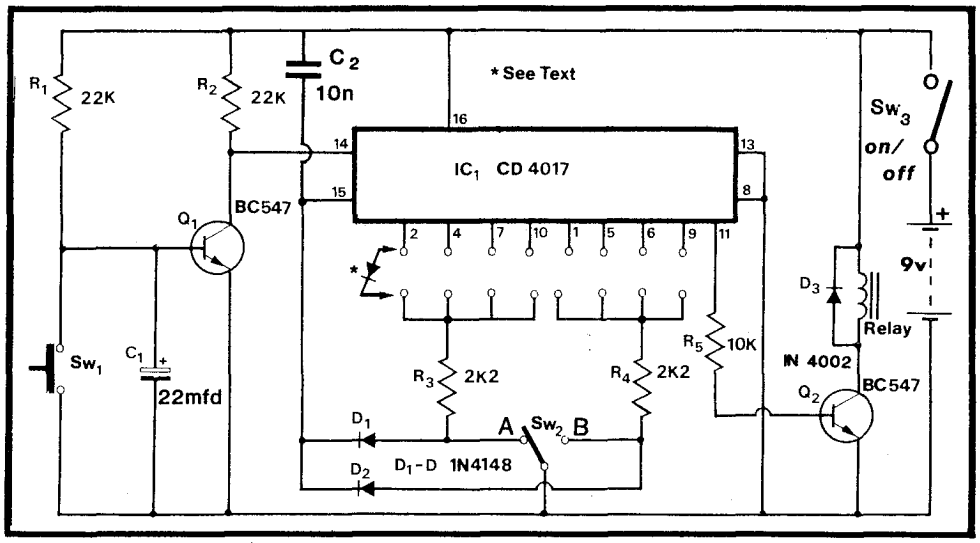
35 Rosewarne Ave., Cheltenham 3192.

Post & Pack:
1 board 60c
others 25c ea.

COMBINATION LOCK

by Tony Lines N.T

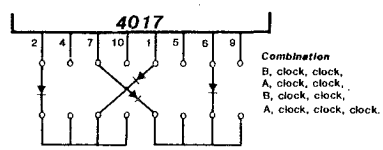
Yet another combination lock puzzle. This time it's alterable!



This project is an extension of LIGHT THE LED. It uses the same principle for clocking the decade counter, CD 4017 and in place of the LED we have a transistor and relay. But the main difference between the two circuits lies in the combination setting. LIGHT THE LED has a single combination which can not be easily altered. This circuit has moveable gating diodes which can easily be moved to pre-set a combination then be withdrawn from the Molex pins to set another combination. On the circuit we have shown only one gating diode however there is an allowance of up to 4 gating diodes. It is not possible to use more than 4 diodes as will be explained later. These diodes can be directed to either the left hand or right hand 2k2 resistors making the total number of possibilities quite large. Possibly the only problem with any combination lock is remembering the sequence once you have set a programme. It may be possible to remember it for one day, but memorizing the arrangement over a long period of time will need a memory code. Something along the lines of "U" for up and "D" for down could be written on or near the press-buttons, with the letters written backwards . . . anything to confuse prying fingers.

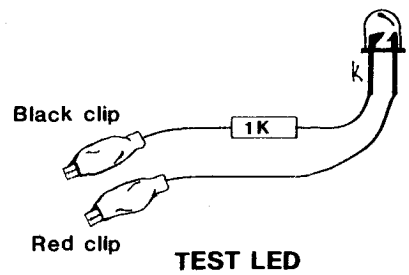
The first output of the decade counter is pin 3. It has not been shown on the circuit diagram since it will be sitting HIGH during standing or when first switched on and will not affect the circuit operation. Any clocking of Sw_1 will advance the HIGH to pins 2,4,7, etc and become capable of resetting the counter. You may choose any number of diodes up to 4 and fill the row of Molex pins in any sequence you desire. With the addition of the on/off switch, the chance of cracking the combination is pretty remote and you can be assured of safe, reliable operation. The advantage of being able to change the combination should be obvious. Suppose you are remote from the scene and wish to instruct someone else to open the lock. You will be able to relay the sequence over the phone, then change the combination to make the lock secure again.

A typical combination with 4 diodes would be set like this:



All diodes must have their cathodes as shown

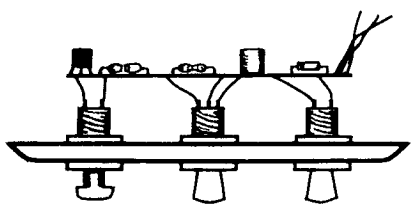
We have included 3 possible combinations and their "retrieval code". When making your own combinations remember to take each diode to an alternate 2k2 resistor to decrease the chance of solving the puzzle. You must also use only every alternate output of the CD 4017 so that you have sufficient time to alter the change-over switch ready for the next clock pulse.



TEST LED

MOUNTING THE SWITCHES

Mounting the switches will be up to your own individual choice and you can decide upon hiding them or openly exposing them. Quite often, if they are openly displayed, they are by-passed by the prowler as being non-important. As the old saying goes; if you want to hide a $50 note, place it in an obvious position. Nothing could be more obvious than a switch-plate with a couple of switches. (Actually 3 switches). These switches are designed for switching household lights and there is nothing preventing us from using them for this situation. They provide the perfect decoy. Most of the switch inserts are designed for two-way operation and one of them can be used for the change-over switch Sw_2. The PC board is kept in position behind the plate with lengths of stiff copper wire as shown. The first switch is the clocking switch Sw_1 the middle switch is the gating switch Sw_2 and the third switch is the on/off switch Sw_3. Every time the on/off switch is activated, the CD 4017 is reset via the 10n capacitor connected to the reset pin 15. This will make it virtually impossible for anybody to crack the combination as this switch will be activated some time during their attempt, setting them off to zero again. With the addition of this on/off switch, the life of the battery will be almost its full shelf life.



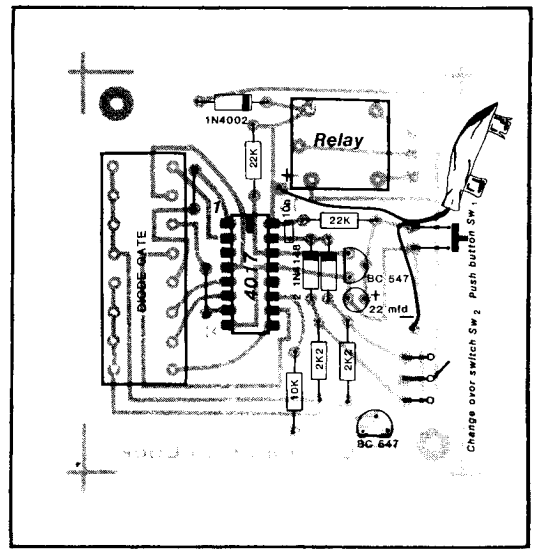
The 3 switches mounted on a plate

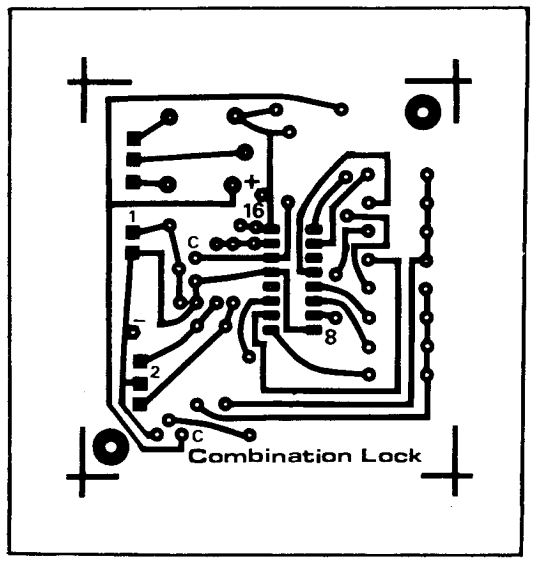
A pre-drilled printed circuit board is avaialble for this project and will make construction a lot easier. Firstly fit the relay and Molex pins to the board then the resistors and capacitors, diodes and finally the integrated circuit. The IC can be mounted on a socket if you wish. It will make testing a lot easier. Connect leads from the board to the switches with wire which is stiff enough to support the board and allow it to sit behind the switch-plate. A small 9v battery will be sufficient to power the project as it will be turned off most of the time and will only require power during its short operating periods.

The output from the relay is intended to operate a solenoid. Solenoid actuators are available from some of the larger hobby shops and they provide a push-pull motion when power is applied. They are a fairly inefficient use of enegry as they require a fairly high current for even the feablest output force. It is much more effective to use a small three-pole motor and gear-box. This will need a limit switch on the output so that it will be capable of inserting or withdrawing a bolt from the lock.

We are now breaking into a completely different field, that of ELECTROMECHANICS. We could devote a whole project to describing the mechanics of the actuating mechanism but one simple way out is to dismantle a battery operated toy and use the motor and gear-box for this project. A limit switch will be required on the output shaft and can be made from springy brass. One contact will have to insulated from any metal-work as this will go to one lead of the battery. The output of the relay connects across the limit switch so that the limit switch takes over from the initial closing of the relay. This means that when you hear the motor start-up, you must switch off the combination lock circuit so that the motor will stop after exactly half a turn of the output shaft. The out put shaft will need to be cranked so that it will be capable of moving a slider or bolt back and forth. It will give a forward motion during one half cycle and remove the bolt during the other half revolution.

I used this simple idea a number of years ago on our back door and it obviated the need for one of those old-style laundry-door keys.





TESTING

The project is tested BEFORE any gating diodes are inserted. Insert the battery and press the clock switch 9 times. The relay should energise. If the relay does not operate, you will need to follow through a number of steps. Here they are:

Firstly make up a test LED by connecting an LED to a 470 ohm resistor and fitting two leads connected to a red and a black alligator clip. This will be an invaluable piece of test equipment, even though it looks so simple.

PARTS LIST

R1	resistor	22k ¼ watt
R2	"	22k "
R3	"	2k2 "
R4	"	2k2 "
R5	"	10k "
C1	electrolytic	22 mfd 16v
C2	capacitor	10n 100v
D1	diode	1N 4148
D2	"	1N 4148
D3	"	1N 4002
D4	"	1N 4148
D5	"	1N 4148
D6	"	1N 4148
D7	"	1N 4148

Relay 6v coil with c/o contacts

Q1, Q2 transistor BC 547

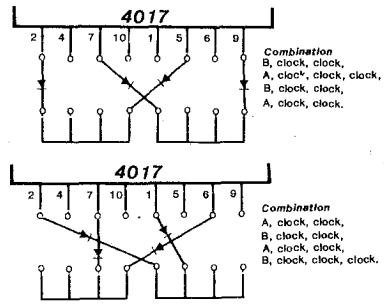
IC1 Counter CD 4017

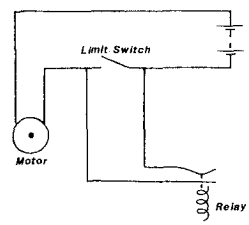
Sw1 push to make switch
Sw2 change-over switch
Sw_3 on/off switch

Battery snap
9v battery

COMBINATION LOCK PC BOARD

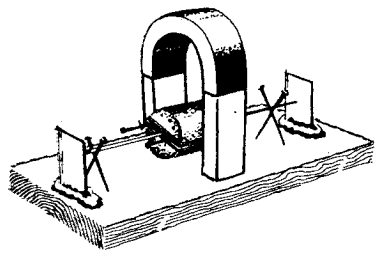
Begin by re-setting the CD 4017 IC and check pin 3 for a HIGH. This is done by clipping the red alligator clip to pin 3 and the black lead to earth, or negative rail. If pin 3 is not HIGH, check all the outputs one at a time to determine which output is HIGH. Reset the CD 4017 via a 10k resistor from the positive rail to pin 15. Pin 3 should now be HIGH. If not check that pin 8 and 13 are grounded and that the input clock pin 14 is not receiving spikes from some unknown source. Pin 14 can be decked for this test. The first requirement is to get a HIGH on pin 3. Once this is achieved, clock the IC one cycle and test pin 2 with the test LED. If pin 2 is not HIGH, go through the outputs in the order 3,2,4,7,10,1,5,6,9,11, and locate the output which has gone HIGH. This will reveal if the IC is receiving one clock pulse or more than one clock pulse for each push of the button. If the counter advances two or three outputs, the clocking circuit will need to be checked for de-bounce. Some IC's are very prone to noise and will not be suitable for this simple de-bounce network. The 22mfd electrolytic is responsible for controlling and eliminating much of the switch noise and this is further reduced by the action of the transistor. It may be necessary to add an electrolytic across the battery or even a small capacitor across the supply line to reduce line pulses. When you are satisfied that the IC is clocking one output per clock pulse, reset the IC and supply it with 9 pulses. The relay should activate. Next insert a diode as shown in the circuit diagram and close switch Sw_2 so that line A is decked. Run through the counting sequence to confirm that the switch is firstly decking the pulses, then passing the pulses when the switch is changed over. Remove the diode and confirm similar operation on line B. Once all these points are confirmed, they can be brought together by inserting one diode on the left hand output and one on the right hand output. Work out the sequence needed to avoid resetting the chip and try your first sequence. The relay should operate after 9 clock pulses.





EVEREADY® BATTERY SCIENCE

13
Building an Electric Motor (continued)



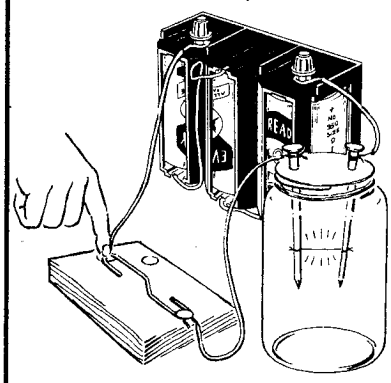
Steps (continued)

2. **Build a Mounting.** Set up two sets of crossed pins. Place the armature on the pins so it revolves freely. Set cards in place with clay to hold armature in place. Set up wire leads so they *brush* firmly against the armature pins. Pin the "brush" wires to the wood base with thumb tacks. Connect the other ends of these wires to your batteries in series. Place a magnet over the armature. Spin armature to start motor.

14
Making an Electric Light Bulb

Materials

Glass bottle/Insulated wire/Cardboard/Thin picture wire/2 nails/714 "Eveready" Adaptor/ 3 x No. 950 size "D" "Eveready" Batteries/Switch



Steps

1. Place two nails into cardboard as shown. Connect a 2" picture wire filament and insert your cover into the bottle as shown.
2. Remove insulation from ends of wire and connect wire leads from the nails to the two batteries in series (connected from + to −, as illustrated).

Explanation

The thin wire should glow red hot and burn away. Do not touch it until it cools. In real bulbs a tungsten filament becomes white hot to give bright light. Special gases prevent the filament from burning away.

15

Caution: The materials used in these experiments can be harmful, if you are not careful. Observe science safety rules on p. 3 and special precautions found in each experiment.

Discovering Electro-Chemistry

In all batteries, chemical reactions produce electric currents. The study of chemical reactions which produce or use electricity is called *electro-chemistry.* One of the earliest electro-chemists was Alessandro Volta, who perfected the first battery in 1800. Electro-chemists today blend electricity and chemistry to produce such products as aluminium, abrasives, fertilizers, chlorine and, of course, batteries. The process of decomposing a chemical compound when electricity is passed through it is called electrolysis.

19
Electrolysis of Salt

Materials

Same as page 16, substitute 4 teaspoonfuls of table salt for baking soda.

Steps

Caution: Work in well ventilated area. Dissolve salt in clean water. Immerse carbon rods connected to the battery, in the solution. Notice bubbles forming. Again hydrogen will form on the negative rod. Chlorine, which you can detect by its strong odor, forms on positive rod.

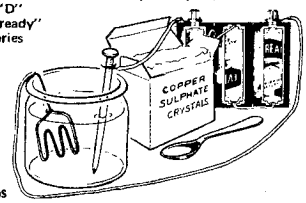
Explanation

Salt is sodium chloride (NaCl). During electrolysis, sodium first forms on the negative carbon rod and disappears instantly. It reacts with water to produce sodium hydroxide, setting hydrogen free. Some of the chlorine forms on the positive carbon rod and is liberated as bubbles. Some of it reacts with sodium hydroxide to form sodium hypochlorite.

20
Electro plating

Materials

Drinking glass/Pyrex saucepan/Water/Vinegar/ Blue vitriol (copper sulphate)/Insulated wire/ Heavy copper wire/714 "Eveready" Adaptor/3 x No. 950 size "D" "Eveready" Batteries



Steps

1. Clean object to be plated with a hot solution of vinegar and water. Air dry, (Aluminium or galvanized material does not plate well. For best results, use stainless steel, or a carbon rod).
2. Add 2 teaspoonfuls of blue vitriol to 1 cup of hot water in a drinking glass. Stir until dissolved.
3. Hook up adaptor. Item to be plated should be connected to the negative (−) terminal with hook-up wire. Hook the heavy copper wire to the positive terminal (+) to form a grid and dip in the solution.
4. To remove copper plating, reverse adaptor leads.

Danger: Blue vitriol (copper sulphate) solution can kill you if swallowed, or cause eye injury if splashed in your eyes. In case of swallowing, drink warm salty or soapy water until you vomit. If it gets in your eyes, wash them with plenty of water for 15 minutes. Call your parents or teacher. Call a physician immediately.

21
Exploring the Science of Light

Light is a form of radiant energy. It is made up of small entities called *photons.* Light is measured by scientists in terms of wave lengths. Light color varies from red to violet depending on light wave length. White light has all colors in it. Light waves travel at 186,000 miles per second. *Transparent* objects let light pass through them. *Translucent* objects let light pass through them but scatter rays. *Opaque* objects do not let light pass through them.

( ) SIMPLICITY AMPLIFIER

1 - 2R2 ¼watt
1 - 22k "

1 - 50k trim pot

1 - 330pf
1 - 10n
2 - 100n

1 - 4.7mfd
1 - 10mfd
1 - 470mfd

2 - IN 4148
1 - 1N 4001

1 - LM 380 IC

Enclose $3.20 plus $1.00 P&P.

( ) QUICK DRAW

3 - 1k
4 - 2M2
1 - 2.2mfd 16v

1 - CD 4001

2 - Red LEDs
1 - green LED

1 - battery snap

Enclose $1.20 plus 80c P&P.

( ) SUPER BUG

1 - 270R
1 - 470R
1 - 1k
1 - 1k5
1 - 2k2
1 - 4k7
1 - 10k
1 - 33k
1 - 56k
1 - 100k

1 - 2.2mfd 16v
1 - 10mfd
2 - 22mfd
2 - 100mfd

4 - BC 547
2 - BC 557

2 - speaker 8 ohm
1 - battery clip

Enclose $5.00 plus 80c P&P.

( ) BINARY HIGH LOW

Project 8
1 - 74C85

1 - 470R

6 - Molex pins

Enclose $1.80 plus 80c P&P.

( ) COMBINATION LOCK

2 - 2k2
1 - 10k
2 - 22k

1 - 10n

1 - 22mfd

1 - CD 4017 IC

2 - BC 547

6 - 1N 4148

1 - 1N 4002

1 - 6v relay

1 - push-to-make switch
1 - battery snap

Enclose $4.80 plus $1.00 P&P.

( ) LED DICE

3 - 330R
1 - 1k
9 - 10k
1 - 3M3
1 - 4M7
1 - 10M

1 - 100n
1 - 1mfd 16v

3 - BC 547
2 - BC 557

1 - CD 4017 IC
7 - 5mm LEDs
1 - push-to-make switch
1 - battery snap

Enclose $5.00 plus $1.00 P&P.

TALKING ELECTRONICS MAGAZINE,
35 ROSEWARNE AVE., CHELTENHAM, 3192.

( )	"VERO-TYPE" board 100mm x 150mm	2.00	( )	Pkt of 20 transistors	2.40
( )	"10 PC board kit" 1 sided	3.50*	( )	100 transistors: 50 BC 547,50 BC557	9.00
( )	" " " " 2 sided	4.50*	( )	8 pin IC socket	20¢
( )	1 PC board blank 200 x 200mm	2.00*	( )	14 pin IC socket	25¢
( )	1 PC board " " 400mm	3.50*	( )	16 pin IC socket	30¢
( )	10 " " " " "	30.00*	( )	2¼" speaker 8 ohm	1.00
( )	No 60 drill	85¢	( )	Pkt of 50 assorted LEDs	5.50
( )	PC kit to make your own boards	7.50*			
	*post and pack:	2.50			

TO_____ FROM_____

	TOTAL $		

OUR COMPLETE RANGE OF PC BOARDS

All boards drilled as required and roll tinned on fibreglass

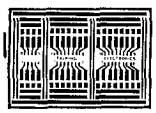
Check your local electronics supplier or send directly to TE

These boards make your project look really first rate

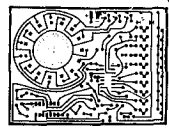
( ) Light the LED
A CD 4017 puzzle
95c

( ) LED Zeppelin
A game of skill
$1.80

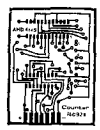
( ) Experimenter Board
fits an 8 pin 14 pin & 16 pin IC
for breadboarding
$1.85



( ) Experimenter Deck
10 projects on 1 board
$3.75

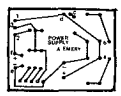


( ) Counter Module
A complete Counter
on 1 PC board
$3.25

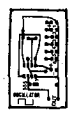


( ) 7 Segment Display
A 2.5cm readout
$3.95

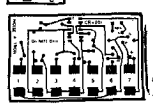
( ) Power Supply
1 Amp regulated supply
$1.80



( ) Square Wave Oscillator
6 ranges from 1Hz to 100KHz
$1.80



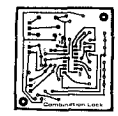
( ) NOISE-A-TRON
Star Wars type noises
$1.70



Issue 5 Projects

( ) Quick Draw
Reaction tester for 2 players
$1.85

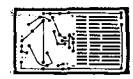
( ) Combination Lock
Another CD 4017 puzzle
$1.70



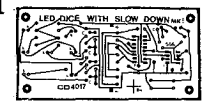
( ) Door Chime
Ding Dong Door Chime
$1.60

( ) Simplicity Amplifier
4 Watt amplifier
$2.10

( ) Super Bug
Picks up faint noises in another room
$1.80



( ) LED Dice with Slow Down MK II
Real dice readout with rolling action
$2.95



Name_____

Address_____

Post Code_____

Please find enclosed
MO/cheque for $_____

TALKING ELECTRONICS
35 Rosewarne Ave., Cheltenham, 3192.

Note: Your requirement is to make one major project per month.

Post & pack 1st board: 60c
each additional " 30c

Subscription

( ) $7.50 FOR ISSUES 6-11 NZ Seamail $11 Aust

( ) $14 FOR 12 ISSUES NZ Seamail $20 Aust

Name_____

Address_____ Post Code_____

( ) ISSUE 1 _____ $1.20 + 60¢ P & P
( ) ISSUE 2 _____ $1.20 + 60¢ P & P
( ) ISSUE 3 _____ $1.20 + 60¢ P & P
( ) ISSUE 4 _____ $1.20 + 60c P&P

( ) Magazine binders $5.70 plus $1.30 p&p

( ) I enclose cheque/M.O. for $___

NOISE-A-TRON

( ) 1 - 15R ¼watt
1 - 2k2 "
2 - 10k "
1 - 33k "
1 - 220k "
1 - 2M2 "
1 - CD 4001 IC
1 - BC 557
1 - 1n 100v
1 - 3n9 "
1 - 10n "
1 - 22n "
2 - 47n "
1 - 100mfd 16v
1 - Speaker 8 ohm
1 - battery clip

Enclose $2.80 plus 80¢ P&P

SUPER-BUG

( ) 1 - 270R ¼watt
1 - 470R "
1 - 1k "
1 - 1k5 "
1 - 2k2 "
1 - 4k7 "
2 - 10k "
1 - 33k "
1 - 56k "
1 - 100k "

1 - 2.2mfd 16v
1 - 10mfd "
2 - 22mfd "
2 - 100mfd "

4 - BC 547
2 - BC 557

2 - speakers 8 ohm
1 - battery clip

Enclose $5.00 plus 80¢ P&P

SHOOT GAME Extras

( ) 1 - 1k ¼watt
5 - 10k "
1 - 100k "
1 - 470k "

2 - 47n 100v

1 - 10mfd 16v
1 - 100mfd "

2 - BC 547

15cm Ribbon cable

2 - pushbuttons

Enclose $1.60 Plus 80¢ P&P

TALKING ELECTRONICS
A New Magazine for Experimenters

POWER SUPPLY

( ) PARTS LIST:
Parts for PC board:

1 - 39R ¼watt
1 - 150R "
1 - 270R "
1 - 470R "

1 - 500R trim pot

1 - .1mfd 100v
1 - 2500 25v

4 - EM401
1 - 7805 regulator
1 - 5mm red LED

Enclose $3.50 plus $1 P&P.
All other parts from your local electronics supplier.

☐ WAVE OSCILLATOR

( ) PARTS LIST:

1 - 1k ¼watt
1 - 3k9 "
1 - 68k "

1 - 100pf
1 - 1n
2 - 10n
1 - 100n

1 - 1mfd 16v
1 - 10mfd "

1 - 5mm red LED

1 - 555 IC

battery snap
6 molex pins
hook-up flex

Enclose $2 plus 60¢P&P.

BINARY COUNTER

( ) PARTS LIST:

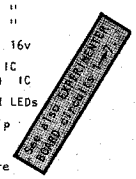
7 - 680R ¼watt
1 - 3k9 "
1 - 22k "
1 - 100k "

1 - 2.2mfd 16v

1 - NE 555 IC
1 - CD 4024 IC

7 - 5mm red LEDs

battery clip
switch
molex pin
hook-up wire



Enclose $3.45 plus 60¢ P&P.

Name: _____

Address: _____

_____

_____

_____

Maximum P&P $3 per order

Please find enclosed
MO/cheque for $ _____

TALKING ELECTRONICS
A New Magazine for Experimenters

COUNTER MODULE

( ) 7 - 100R ¼watt
7 - 180R "
7 - 220R "
7 - 270R "
7 - 330R "
4 - 3k3 "
4 - 1M "

4 - BC 547

1 - 74C926 IC

1 - AN0 4145R display

Enclose $15.50 plus $1 P&P.

7 SEGMENT DISPLAY

FOR ONE DIGIT:
( ) 15 - 3mm Red LEDs
enclose $1.50 plus 60¢ P&P.

FOR FOUR DIGITS:
( ) 60 - 3mm Red LEDs
enclose $6.00 plus 60¢ P&P.

LIGHT THE LED

( ) PARTS LIST:

2 - 22k ¼w
2 - 2k2 "
1 - 1k "

1 - BC 547

1 - 4.7mfd 10v

6 - 1N 4148

1 - Red 5mm LED

1 - CD 4017 IC

1 - Battery clip

1 - Springy brass strip

Enclose $3.00 plus 60c P&P.

LED ZEPPELIN

( ) PARTS LIST:

1 - 270R ¼w
1 - 330R "
1 - 390R "
3 - 470R "
1 - 560R "
3 - 1k "
2 - 2k2 "
1 - 3k3 "
1 - 4k7 "
1 - 10k "
1 - 22k "
1 - 56k "
1 - 470k "

1 - 4.7mfd 16v
1 - 470mfd 16v
7 - BC 547
1 - BC 557

1 - CD 4001 IC

6 - Large red LEDs
1 - Mini red LED

2 - 1N 4148
1 - Push-on switch
1 - battery clip

Enclose $5 plus $1 P&P.

TALKING ELECTRONICS
A New Magazine for Experimenters

EXPERIMENTER BOARD

( ) PARTS LIST:
For circuits 1-5

1 - 1k ¼w
1 - 2k2 "
1 - 10k "
1 - 100k "

1 - .01mfd ceramic
1 - .1mfd ceramic
1 - 10mfd electro 10v

1 - 555 IC
1 - CD 4017 IC

1 - PE cell ORP12
or similar
2 - Red LEDs
1 - Push-on switch
1 - battery clip

Enclose $5.30 plus $1 P&P.

( ) Circuit 6:

2 - 10M ¼w
1 - 1mfd 16v
1 - BC 557
6 - 5mm Red LEDs
30cm hook-up wire

Enclose $1.05 plus 60¢ P&P.

( ) Circuit 7:

7 - 680R ¼watt
1 - 3k9 "
1 - 22K "
1 - 2.2mfd 16v
1 - CD 4024 IC
7 - 5mm red LEDs

Enclose $2.80 Plus 60¢ P&P.

EXPERIMENTER DECK

( ) Projects 1 - 10

1 - CD 4001 IC
1 - CD 4017 IC

1 - 15R ¼w
1 - 22R "
1 - 120R "
1 - 3k3 "
2 - 4k7 "
5 - 10k "
1 - 47k "
1 - 100k "

1 - 1n 100v
1 - 3n3 "
1 - 3n9 "
3 - 6n8 "
2 - 22n "

1 - 4.7mfd 10v
1 - 22mfd 10v

6 - 1N 4148 diodes

1 - 100k cermet VTP
1 - 500k " "

24 - Red 5mm LEDs
1 - Green 5mm LED

1 - BC 557
3 - BC 547

1 - 22" spkr 8 or 15Ω

30cm of 10-core ribbon
30cm tinned copper wire
Roll of fine solder

Enclose $11.50 plus $1 P&P.

TO _____

_____

_____

FROM _____

_____

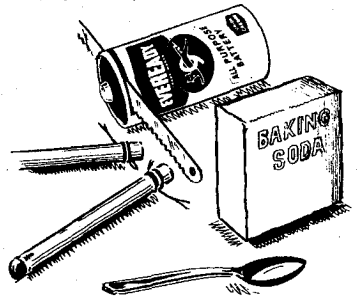
_____

		TOTAL $	

16
Forming Oxygen and Hydrogen

Materials

714 "Eveready" Adaptor/5 x No. 950 "Eveready" Batteries/Insulated hook-up wire/Ordinary drinking glass/Water/Baking soda/Teaspoon/ Knife or hack saw/Pliers



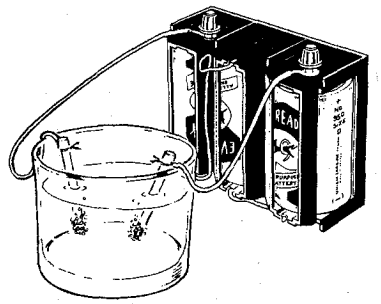
Steps

1. Remove the carbon rods from two No. 950 size "D" "Eveready" batteries. Cut batteries apart with knife or a hack saw just below top. Twist out carbon rod with pliers.
2. Wash rods with soap and warm water and dry with paper towel. Since batteries contain caustic materials, throw out other battery parts.
3. Remove insulation from both ends of 2 12" pieces of hook-up wire. Solder or twist one wire end to the caps of the carbon rods.
4. Fill a glass 2/3 full of hot water. Add four teaspoonfuls of baking soda. Stir until soda is dissolved.

17
Forming Oxygen and Hydrogen (continued)

Steps (continued)

5. Place the carbon rods in the solution. Do not let them touch each other. Do not let the solution touch the wires or caps of the carbon rods. Bend the wire over the edge of the glass to hold the rods in place.
6. Connect the loose wire ends from the carbon rods to the other (+) and (−) terminals on the adaptor.



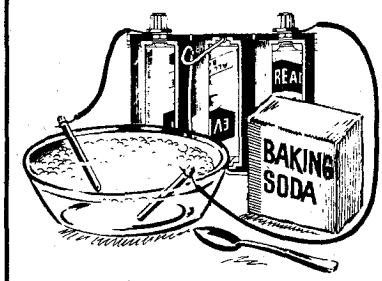
Explanation

Notice how the rods in solution become grey . . . covered with tiny bubbles. The bubbles slowly rise to the surface. The bubbles (Oxygen) formed on the rod connected to the positive terminal on the battery are smaller. Hydrogen bubbles form on the rod connected to the negative terminal. Twice as much hydrogen as oxygen is released. Can you see why the formula for water is H2O? Disconnect the wires to stop the experiment.

18
Testing for Hydrogen

Materials

Same as Page 16, plus Cake of soap, Toothpicks, Matches.



Steps

1. Repeat the experiment shown on pages 16 and 17.
2. Add a few shavings from a cake of soap to the solution. Stir until dissolved. Add soap until bubbles form on the surface while stirring.
3. Place carbon rods in the solution as before. Rising gas should form bubbles around the top of the rods.
4. Light the end of a toothpick and move the flame near the top of the carbon rods. What happens?

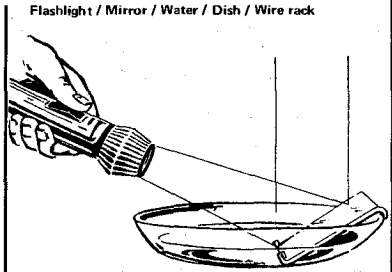
Explanation

Oxygen, on the rod connected to the positive terminal, supports combustion but does not itself burn. Hydrogen, on the rod connected to the negative terminal, burns rapidly, using the oxygen in the air, and causes a small "pop" when ignited.

22
Forming a Spectrum

Materials

Flashlight / Mirror / Water / Dish / Wire rack



Steps

Place a mirror in a shallow dish, half filled with water, on a wire rack, at a 30° angle. Darken the room. Shine a flashlight in the mirror. Notice the spectrum of colors on the ceiling. Blow on the surface of the water, over the mirror. Why does the rainbow disappear?

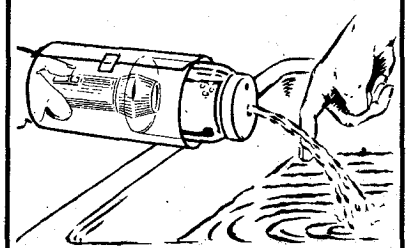
Explanation

An experiment like this was first performed by Sir Isaac Newton with a beam of sunlight passing through a prism to form rainbow colors on a wall. This experiment shows that light is composed of many different wave lengths, each of a different color. The water surface and the mirror act as a prism to refract (bend) each light wave at a slightly different angle to form the colors you see. When you blow on the water surface and it is no longer smooth, you destroy its prism effect. A spectrum includes all colors from red at one end to violet at the other end in this order: red, orange, yellow, green, blue and violet. A rainbow is an example of a spectrum found in nature.

23
Bending Light Waves

Materials

Flashlight / Glass jar with metal cap / Brown paper bag / Can opener / Rubber band or cellophane tape



Steps

1. Fill a glass jar with water. Punch two round holes in the metal cap and screw on jar.
2. Wrap a folded brown paper bag around the jar so that it extends below the bottom as shown. Secure with a rubber band or cellophane tape.
3. Hold the jar over a sink. Darken the room and place a flashlight under the dark cover against the bottom of the glass jar. Tilt the jar so that the water flows out of the centre hole. Put your finger in the stream close to the hole. Move your finger down the curved stream. Does the light follow your finger?

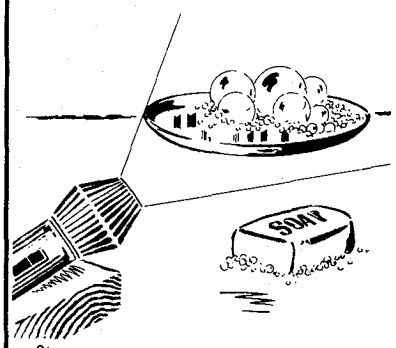
Explanation

A stream of water bends light in a curve. The water surface acts as a reflector, just like a mirror. Reflection occurs when a light ray hits a surface and is thrown back into the medium from which it has come.

24
Colour Interference

Materials

Soap bubble mix / Shallow pan (or wet glass plate) / Flashlight / Bubble wand



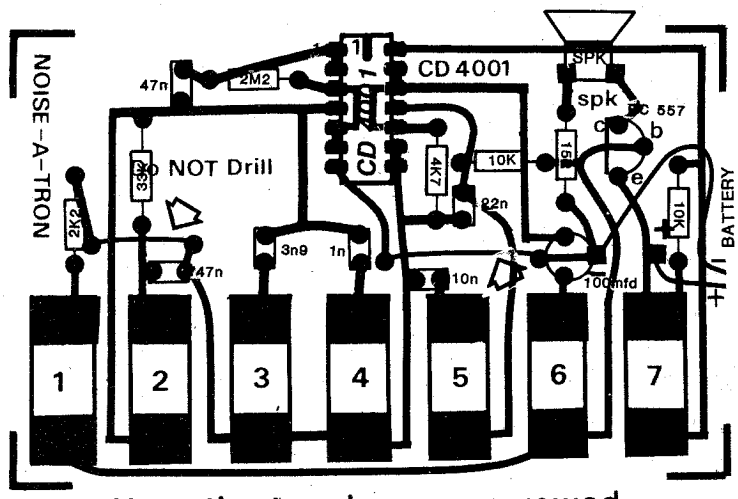
Steps

1. Set up your flashlight and shallow pan as shown. Place the flashlight 30" from the pan.
2. Form soap bubbles. Try to place a large bubble in the pan. Do you see color bands on the bubble's surface? These bands are called, "Newton's Rings." The bands slowly sink and new ones form.

Explanation

Soap bubbles consist of many thin layers. Gradually these layers break away until the bubble disappears. This thinning or break down of bubble layers causes different wave lengths of light to be reflected. This effect is known as interference. You see it all the time in oil slicks, the sheen of metal and in pearls.

OOPS . . .



Note the two jumpers arrowed

Five small discrepancies crept into the NOISE-A-TRON in the last issue. And dozens of readers wrote in to ask for the corrections. We have re-drawn the layout diagram to make the parts location easier to follow. We must point out that the choice of components in this circuit will take wide tolerances. The idea of the circuit is to select from a ranges of values to make the various noises. In fact you can use a BC 547 in place of the BC 557 provided it is wired correctly. See also our readers contribution of a Noise-A-Tron on the letters page.

PARTS LIST

R1	10k	C1	47n
R2	2M2	C2	1n
R3	33k	C3	3n9
R4	220k	C4	47n
R5	10k	C5	22n
R6	2k2	C6	100mfd
R7	15R	C7	10n
		Q1	BC 557
2¼" speaker		IC1	CD 4001
battery clip			
9v battery			
NOISE-A-TRON PC Board			

SHOP TALK

Another 8 weeks has flown by and I can honestly say we are gaining ground with the publication. We are getting a lot more enquiries from experimenters asking about circuit design improvements and substitutions for the projects we are describing. Although all the projects are constructed by two or three different people, we do not make a point of specifying substitute values. In general, most of the circuits are so non-critical that almost any passive components would suffice so long as they are only one value either side of that specified. It's only when you get integrated circuits that the exact same device must be used. Sometimes TTL can be substituted for CMOS but only after the supply voltage has been changed, and the biasing arrangements looked into. At this stage I would not like to see anyone become involved with major circuit re-design and so try to specify only CMOS devices when ordering. The only disadvantage with CMOS is the possibility of damage during handling due to static electricity. Once they are in circuit, their advatages far outweigh the older Transistor Transistor Logic series.....especially for operation off batteries.

The most interesting portion of the mail has been the incredible interest in the project book we mentioned in issue 4. These booklets are designed around a central theme and contain a Printed Circuit Board on which the main project is constructed. We have been literally swamped with requests for the first issue. This has led us to re-consider the print run and we have decided to increase the quantity to enable all the requests to be fulfilled. This will mean we will produce a few extra copies for those who forgot to send in last month. If you are quick off the mark this time you will be included in the mailing list. The main limitation to the production quantities is the printed circuit board. This accounts for the major portion of the cost since they are top quality, roll-tinned fibre-glass boards. Needles to say, the production of additional ideas like this is sorely needed and your encouraging response has given us impetus to extend into further issues. The first issue describes a MINI FREQUENCY COUNTER. The book and board costs $3.95 and shows you how to construct a frequency counter for about $25.00 Further issues are in the planning stage. The five-issue series is discounted to $19.50 and so far has proven to be the most popular chioce. The printing of the first issue will be in a few weeks after you receive this issue so don't despair! It's a very large indertaking.

WHAT ABOUT THE FREE ISSUE OF TE?

As an inducement to buy TE, we had 20,000 extra copies of issue number 1 for insertion into issue number 3. But since we printed 35,000 copies of issue 3, some of our readers had to miss out. It was not possible for us to interleave the thicker issues with the normal issues. This meant that some states had to miss out completely on the promotion. The idea of the free issue was for you to pass it on to a friend. We thought you would not have any use for two copies of the same issue. But we were wrong. Most of you are hoarders! You have kept the free issue and not passed it on as intended! Our penetration depends on you. Tell your friend about TE and keep enquiring at your local electronics shop for kits and PC boards. For who have already done this...thanks. The word is getting around slowly.

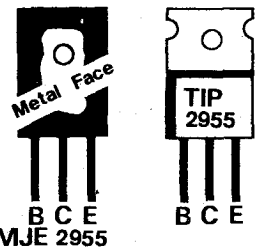
This brings me to two stories

The first comes from an acquaintance in the printing and electronics industry. He expressed some considerable dislike in the format of the magazine, saying the third issue was "unreadable and ugly". I don't know what basis he used for his comparision..... maybe a glossy architects magazine or an overseas Woman's Journal. Realistically speaking, he should have used a club magazine, duplicated on a hand-cranked machine, for comparison. Without any qualifying points for his claims, I did not take them very seriously and let the criticism pass. A few weeks later I heard through the grapevine that his 14 year old son thought the same issue was the best to date! So if we get this diversity within the one household, what hope have we of pleasing everyone? We can't! ... and I think it would be an impossibility to try to do so.
We aim to instruct. This should be obvious by now as we include many hand-written pages in the magazine. Nothing could be simpler than a hand-written page. But do you realize that you learn 5 times more facts from hand written notes, than printed notes. It has a lot to do with the novelty and partially the photographic retention of you mind but mostly it is to do with the association with black-board writing. From the feed-back we are sure it is the most successful method of presenting the digital course. About one in four letters specifically mention how much they have learnt from it. So we must be doing something right!

Our other story highlights another extreme. Remember the number of letters we received from readers criticizing the requirement to cut out coupons from the magazine when there is an informative article on the reverse side. Here is our answer:

About a fortnight ago, we had a visit form one of our regular customers who drives 100 kilometers just to buy our latest printed cirucit boards. Under his arm he had a neat stack of manilla folders. He didn't need any persuasion to show us what he had been doing. In each folder he had a separate article from Talking Electronics. He said he bought three copies of each issue. One he kept intact. The other two he cut up for the articles. What organization! Now I know why the newsagent in his town sold out of their allotment of three issues!

CORRECTIONS TO ISSUE 4



The MJE 2955 does not have the same leadouts as the TIP 2955. This is the correct pin-outs:

P 19. Basic Electricity.
Example 6.

Power = V x I
= 3 x 2 watts
= 6 watts

P 28 Noise-A-Tron R_2 should be 2M2

P 66 The caption beside the Advertising Sign should read: The square solder land indicates the anode connections.

LETTERS...

Dear Sir,

Congratulations on a superb magazine. I am really pleased to see that somebody is talking about digital electronics, as this is what the 80's is all about. I am currently doing year 10 at Technical College and as yet not one teacher is teaching us about digital electronics, so this new magazine is a real help to me, being a newcomer.
The 10 MINUTE DIGITAL COURSE is an excellent idea and the hand-written notes make it easy to follow. I have enclosed an article and circuit for an AM transmitter having about the same range as the FM transmitter described in issue 4. I have built both units and they operate very successfully.

F. Capagna, 3171.

Thanks for your project. We will include it in a forthcoming issue. Maybe if you showed the magazine to your instructors, you may start something in the digital field. I know the problem. It's not the lack of digital information, it's the lack of easy-to-understand information. That's the very reason for the introduction of the magazine. We have already had an incredible response from schools all over Australia for copies, copying rights and kits of parts. Many schools are still un-aware of the magazines existance and if you are really interested in the subject of digital electronics, you can ask you teacher to send for a free copy.

Dear Sir,

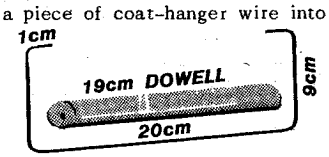
I am just a hobbyist. The hours I've wasted in search of a 10 ohm resistor, or whatever, from a box of 350 various values is beyond recall. Sure, let's sort them into their values and store them into jars or boxes but think of the room taken up by 70 odd boxes or jars.
Now the purpose of my letter is to show how I solved this annoyance. I obtained a number of plastic bags (very similar in size and shape to the coin bags supplied by the trading banks) and this is what I did·

1. Sort R's into values and place into bags.

2. Bought some stick-on labels (2cm x 2cm @ 75c per 500) from our local newsagent.

3. Printed the value on the label and stuck it onto the top right-hand side of the bag.

4. Bent a piece of coat-hanger wire into this shape



5. Cut a piece of 3/4" dowell approx 19 cm long and drilled a hole into each end to take the wire.

6. Threaded the bags onto the wire in correct numerical order and fitted the wire into the dowelling.

Hey Presto! One "El cheapo" resistor store. Total time about 3 hours. Time to find a particular resistor: 3 seconds.

Try this idea yourself, see if you can spill the resistors when you hold the dowelling handle. Beauty, isn't it? "Back Murphy - Back".

J.M. Burnell, 3121.

Thanks for this handy idea. The only point which concerns me is - where are you going to get 100 or so money bags? I realize they want to be fairly strong and need the closing seal along the top for strength as well as sealability. But I don't know where they available other than a jewellers supply store. This is where we obtain our thousands of bags for assembling the kits. The minimum number of any one size is 1,000 and this would be too many for the average hobbyist. I will leave it to you - your an enterprising lot.

Dear Sir,

I recently purchased 2 Noise-A-Tron kits with PC boards and upon building the first kit, found it had only minimal volume. I then hooked it up to a 4 transistor push-pull amplifier, which built up the volume a bit, but still not enough. Then I decided to experiment on the second and substituted 120n caps for the 47n, 22n for the 2n2, 15n for the 10n and also substituted a BC 558 transistor for the BC 547. Then I installed variable resistors in place of some of the fixed ones. This resulted in earsplitting tones from the horn speaker. I was so pleased with the result that I shot inside for a Polaroid camera. I have enclosed a quick shot of my achievementsable. Fitting the variable resistors has negated the need for most of the keyboard and as you can see, I did not have any brass strip so I had to resort to the next nearest thing: a beer can. Now, out of all the kits I have built, the kids and I enjoy this one the most. Now they want me to fit it to the car and go down the street sounding like the "Empire Starship".

L. Turner 3518.

(Editors note: Don't place too much strength on altering the value of the components to increase volume. Most of the gain in the writers project came from the power amplifier added to the output of the Noise-A-Tron. In fact changing the transistor from an NPN to a PNP will make virtually NO difference to the output of the Noise-A-Tron itself. Most of these changes would merely alter the frequency of the oscillators and not their output amplitude. Even so, don·t think I am decrying the writers efforts. This is exactly what I want to receive. It shows the enormous potential for each and every project we describe. More ideas like this will help other readers and constructors.)

Just in case you want to duplicate my circuit, I have enclosed a list of components I have used.

R1 - Variable pot - 10k
R2 - " " - 2M
R3 - " " - 30k
R4 - " " - 250k
R5 - " " - 10k
R6 - " " - 2k
R7 - - 15R

C1 - .12mfd
C2 - 1n
C3 - 3n9
C4 - .12mfd
C5 - .022mfd
C7 - .015mfd
C6 - 100mfd 10v

Q1 - BC 557
IC1 - CD 4001

Power supply 6 - 9v

NZ PARTS PROBLEMS

I am most impressed with your new magazine and its appropriate level for junior electronics hobbyists. Electronics Clubs in school have been waiting for something like this for years, as the levels in other magazines tends to get more advanced.

One problem exists for us over here in New Zealand, however, is that quite often PC's and chips in overseas magazines are not always readily available for public purchase, or if indented become expensive.

I would suggest that you consider running some NZ advertisements and information pages and possibly engage an Auckland firm such as, Orbit Electronics (Kitset Shop) 161 Hobson Street or John Gilbert (Wholesale and retail shop) Tasman Building, Anzac Avenue, to collate New Zealand mail orders and get components over from Australia in bulk in conjunction with each issue of Talking Electronics. Perhaps such a firm could keep orders open until the end of the current magazine month and then import and post components the following month. This of course would introduce delay but create a convenient line of supply.

Finally I could see many schools that have hardly ventured into electronics, such as ours, being interested in hearing about your magazine. I wish you well with your magazine.

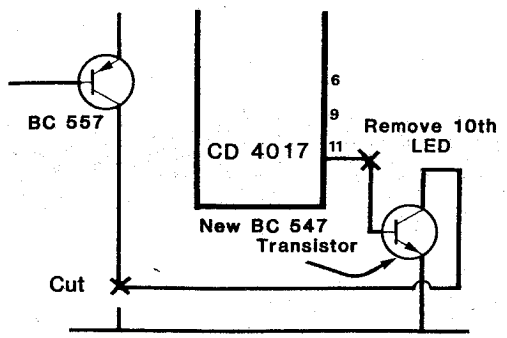
R E Francis
H O D Science

EXPERIMENTER DECK MOD

I really enjoy your magazine and have found it very interesting and informative. The hee haw siren was actually the first project I have built that works. The rest of the family enjoy the cricket game and have told me it is the only useful thing I have made. I have incorporated two small modifications with the experimenter deck.

First I removed the final LED and soldered the base lead of a BC 547 transistor into the anode hole on the board. Next I removed the collector lead of the BC 557 and soldered it to the collector of the BC 547. I then soldered the emitter lead of the 547 into the space formerly occupied by the collector lead of the 557. The process is a simple method of adding sound effects to the cricket game. Instead of lighting the tenth LED when a player is bowled, the modified circuit sounds the siren. The second modification was "suggested" by my Mother. It was simply the addition of a 500 ohm switched pot to act as a volume control. I placed this in series with one speaker lead. The enclosed circuit shows how the extra transistor is wired into circuit to provide this additional function.

G. McLean
Gore. NZ



EXPERIMENTER DECK DRIVES COW

I really must protest. I first became interested in your magazine when I discovered a copy of Issue No. 2 in my local bookshop.

Realizing that I required Issue No. 1 to find out more about the projects I started the big hunt. After many calls to bookshops in my own town and Auckland, I finally discovered a copy just three days before Issue No. 3 arrived.

What do I find? You guessed it. a nice copy of Issue No. 1 included. Needless to say a regular order has now been placed.

Now that I have all copies, the projects are all coming along nicely, and for a relative newcomer to electronics I feel that I have learnt a lot in a very short time.

In fact I have already "jumped the gun" and included the musical section of the experimenter deck and sound effects from "Blakes Reach" to Scottish Bagpipes are easily obtainable.

I understand that one of your readers could not get the LED ZEPPELIN to work and yet mine has worked satisfactorily from start and leads to many frustrated attempts to light up LED 6.

The basis of the experimenter deck has been used by myself and my friend to illuminate a full sized hardboard cow at our recent NZ agricultural field days.

A 555 timer driving four CD 4017's at different rates, in turn "firing" 30 2N 3055 transistors which in turn lit up 300 yellow red and green LEDs in different sequences and patterns to simulate, heart beat, hormone let-down, electrical stimulus and blood flow. Our cow was a good eye catcher and quickly earned the name R2-Moo2.

So you can see that from a passing interest your magazine has given me the incentive to go to further heights. Displays appeal to me and I can now see my way clear to carrying out some more complicated experiments.

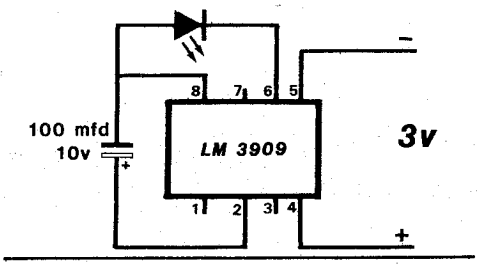
R. Barker
Hamilton. NZ

LM 3909 FLASHER

I was reading Issue 1, Page 16 and realized that a flashing light can be obtained by using an LM3909 integrated circuit. Although this IC is fairly expensive, it has the advantage of operating on a very low supply and consumes very little current.

I have used it on one of my radio control models and the unit weighs less than 1oz. It consumes less than .8ma and can be left connected to a couple of penlight batteries for the full extent of their life. The secret of the low current drain is in the slow charging of the capacitor then releasing its energy into the LED for a very brief period of time. This not only increases the LEDs efficiency but provides long life for any power source.

D. Wadham
TeAtatu South, NZ



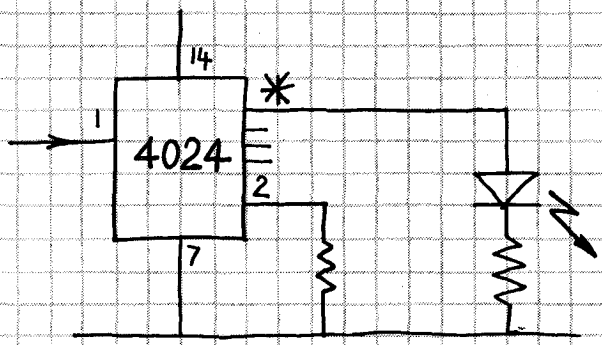
"I do not know what I may appear to the world, but to myself I seem to have been only like a boy playing on the sea-shore, and diverting myself in now and then finding a smoother pebble or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me."

Isaac Newton

33

IN BLOCK 32 I MENTIONED DECODING. WHAT IS DECODING? HOW IS IT PERFORMED?

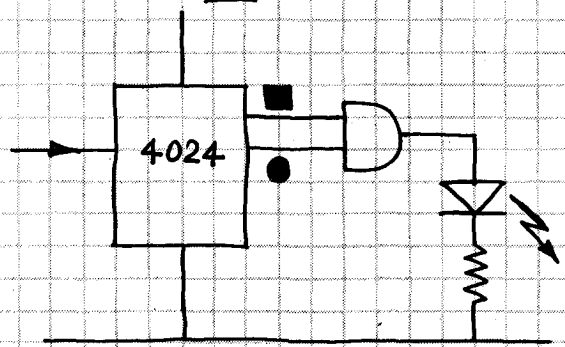
TAKE A CD4024 IC. IF WE REQUIRE A TIME DELAY FROM THIS IC, WE CANNOT SIMPLY CONNECT A LED (OR OTHER DETECTOR) TO THE LAST OUTPUT. FROM THE BINARY TABLE WE SEE THAT THE LAST OUTPUT (2^7) GOES HIGH ON THE 64th PULSE AND REMAINS HIGH UNTIL THE 128th PULSE. THUS BY USING ONLY THIS SINGLE OUTPUT THE MAXIMUM DURATION IS ONLY HALF OF THE FULL COUNT. TO ACHIEVE THE FULL TIME DELAY WE NEED TO ATTACH A DETECTOR TO ALL THE OUTPUTS AND DETECT WHEN THEY ARE ALL HIGH. IF WE DETECT ONLY ONE OUTPUT AT A TIME WE CAN OBTAIN VALUES SUCH AS THE 2ND COUNT 4th 8th 12th 16th 32ND & 64th BUT NOT THE 127th. BY GATING A PAIR OF OUTPUTS WE CAN DETECT THE 3rd PULSE 5th 6th 9th 10th 12th 17th 18th 20th 24th 33rd 34th 65th 66th 68th 72nd 80th 96th BUT STILL NOT THE 127th. BY DETECTING 3 OUTPUTS AT ONCE WE CAN OBTAIN ANOTHER SET OF NUMERS THIS METHOD OF DETECTION IS CALLED DECODING THE 4024.



DECODING ONE OUTPUT

* FROM THE BINARY TABLE IN BLOCK 32 WE SEE THE LED WILL LIGHT ON THE:

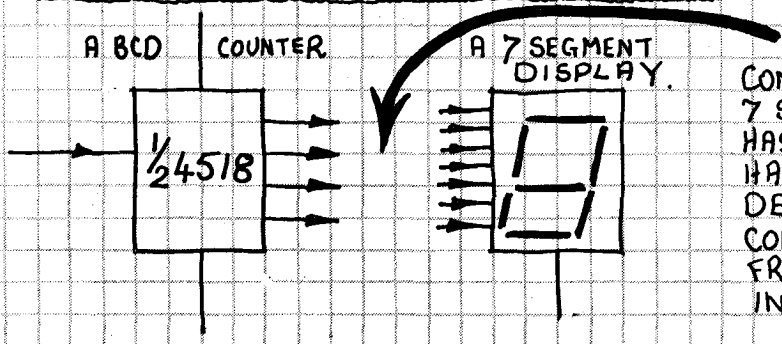
1st	PULSE	IF WE CHOOSE	PIN		12
2ND	"	"	"	"	11
4th	"	"	"	"	9
8th	"	"	"	"	6
16th	"	"	"	"	5
32ND	"	"	"	"	4
64th	"	"	"	"	3



DECODING TWO OUTPUTS

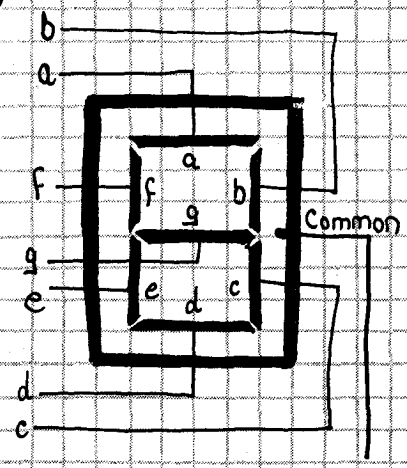
BY CHOOSING OUTPUT PINS FOR ■ & ● WE CAN LIGHT THE LED ON THE 3rd PULSE 5th 6th 9th 10th 12th 17th 18th 20th 24th 33rd 34th etc.
THE LED WILL LIGHT WHEN ANY TWO OUTPUTS DETERMINE A BINARY NUMBER. THIS DECODING CAN BE EXTENDED TO 3 OR MORE OUTPUTS.

DECODING A BCD COUNTER

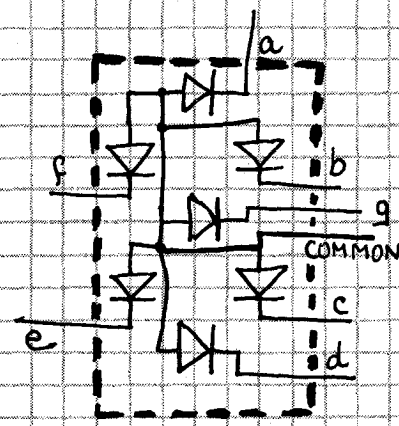


IT IS NOT POSSIBLE TO CONNECT A 4518 DIRECTLY TO A 7 SEGMENT DISPLAY AS A 4518 HAS 4 OUTPUTS AND THE DISPLAY HAS 7 INPUTS. WE NEED A DECODER, AN IC WHICH WILL CONVERT THE HIGHS & LOWS FROM A 4518 AND FEED THESE INTO A DISPLAY.

34 A 7-SEGMENT DISPLAY

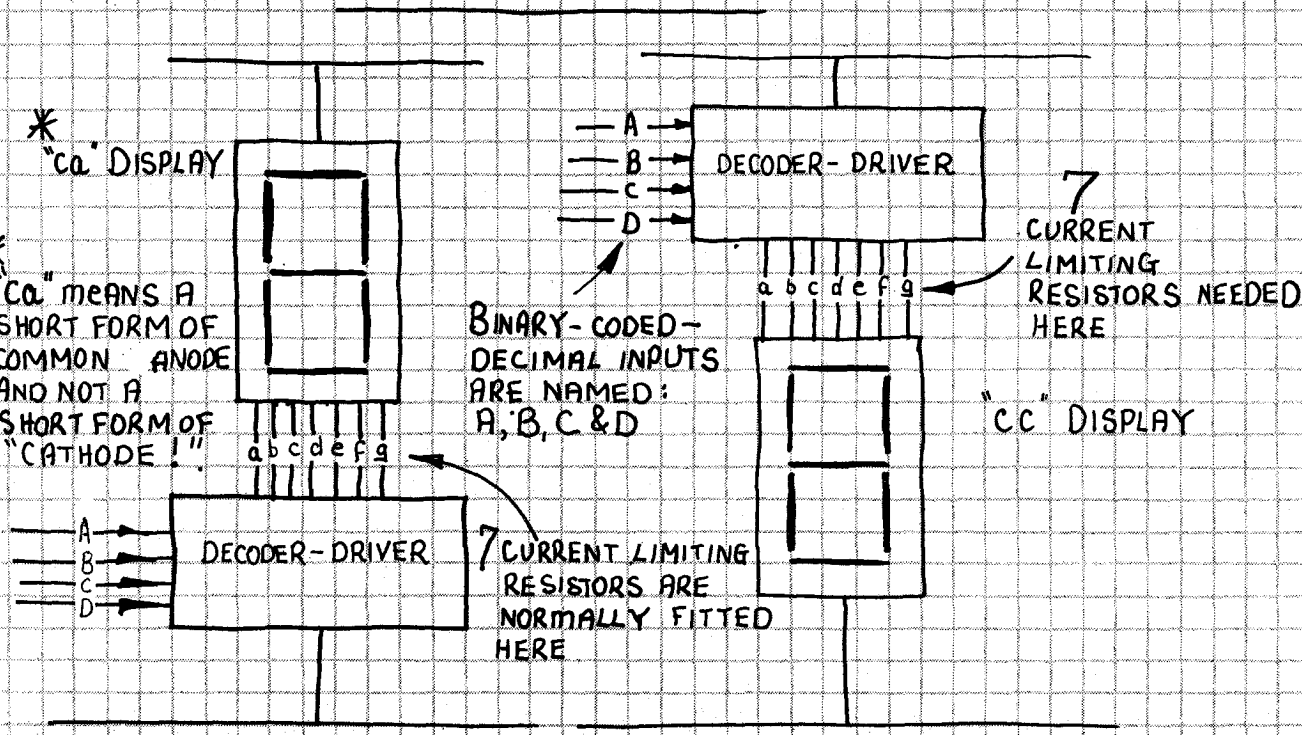


A 7-SEGMENT DISPLAY CONTAINS SEVEN RECTANGULAR LEDS
IF ALL THE ANODES ARE CONNECTED TOGETHER IT IS CALLED A COMMON ANODE DISPLAY.



HOW THE DIODES ARE ARRANGED TO GIVE A COMMON ANODE DISPLAY.

IF ALL THE CATHODES ARE CONNECTED TOGETHER IT IS CALLED A COMMON CATHODE DISPLAY. ONE CANNOT BE CONNECTED IN PLACE OF THE OTHER.

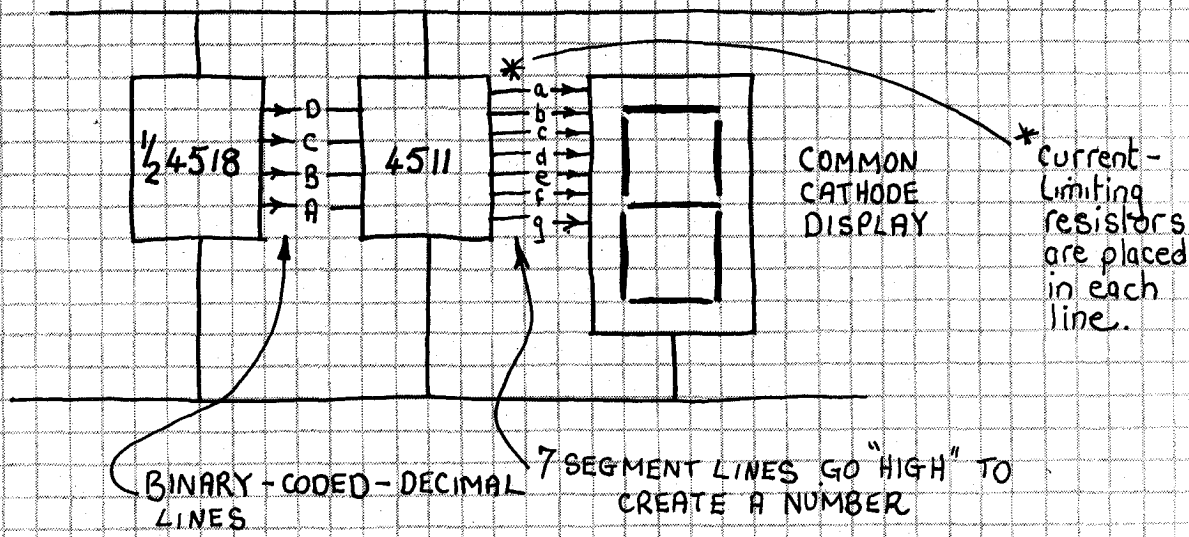


COMMON ANODE DISPLAY. COMMON CATHODE DISPLAY.

A COMMON-ANODE DISPLAY WILL NOT TAKE THE PLACE OF A COMMON CATHODE DISPLAY. IT WILL EITHER NOT WORK AT ALL OR INCORRECT SEGMENTS WILL LIGHT UP. ALTERING THE WIRING WILL NOT BE SUFFICIENT AS THE LEDS ARE CONNECTED IN OPPOSING DIRECTIONS INSIDE THE DISPLAY ITSELF.

35

A SUITABLE IC TO FIT BETWEEN THE COUNTER AND DISPLAY IS A CO 4511. IT IS CAPABLE OF TAKING ONE CODE (BCD) AND CONVERTING TO ANOTHER CODE (7 SEGMENT DISPLAY CODE)



LINES DCBA REPRESENT THE BINARY LOGIC LINES FROM THE COUNTER TO THE DRIVER IC.
LINES a,b,c,d,e,f,g REPRESENT THE SEGMENT LINES FROM THE DRIVER TO THE DISPLAY.

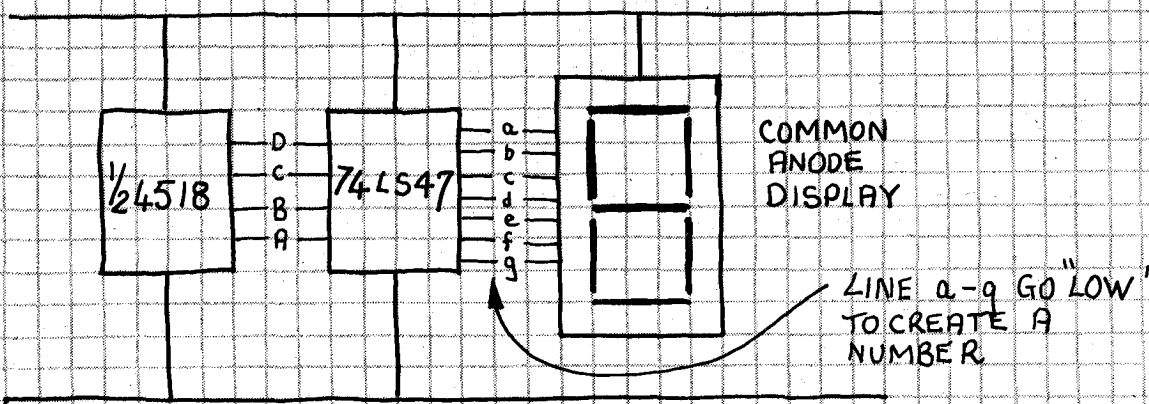
TO CREATE A 5 ON THE DISPLAY WE KNOW ITS BINARY NUMBER IS: DCBA 0101 THIS MAKES D=0 C=1 B=0 A=1

THE 4511 WILL ACCEPT THESE INPUT LEVELS AND SUPPLY THE 7 OUTPUT LINES THUS:

a=1 (HIGH) b=0 (LOW) c=1 (HIGH) d=1 (HIGH)

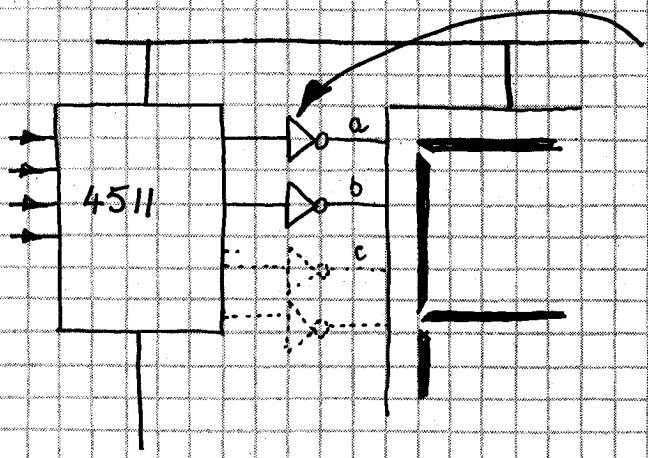
e=0 (LOW) f=1 (HIGH) g=1 (HIGH) & THE NUMBER 5 WILL BE DISPLAYED.

IF YOU WISH TO USE A COMMON ANODE DISPLAY, IT WILL BE NECESSARY TO CHANGE THE DECODER/DRIVER



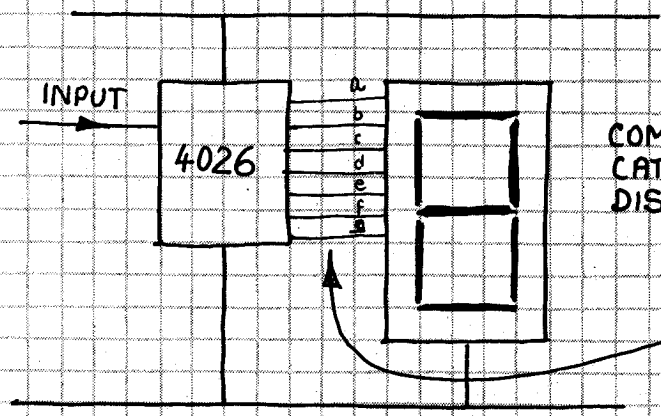
36

ALTERNATELY THE 4511 WILL DRIVE A COMMON ANODE DISPLAY VIA 7 INVERTERS AS SHOWN:

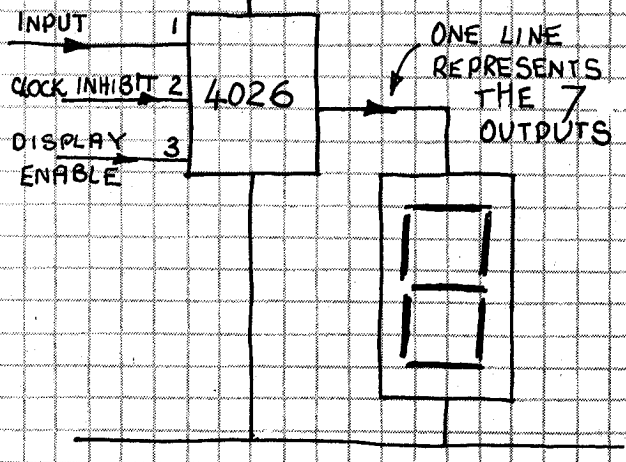


THIS ARRANGEMENT CAN OFTEN BE IMPRACTICAL AS INVERTERS COME "SIX IN A CHIP" AND WE NEED 7!

WE CAN REPLACE THE ABOVE COMBINATION OF ½4518 & 4511 WITH A SINGLE IC. A CD4026. IT IS A COMBINATION COUNTER, DECODER AND DRIVER IN A SINGLE CHIP. IN ADDITION IT HAS BUILT-IN CURRENT LIMITING TO PERMIT DIRECT DRIVE TO A DISPLAY WITHOUT THE NEED FOR SEVEN CURRENT-LIMITING RESISTORS.



THIS CIRCUIT WILL COUNT 0→9

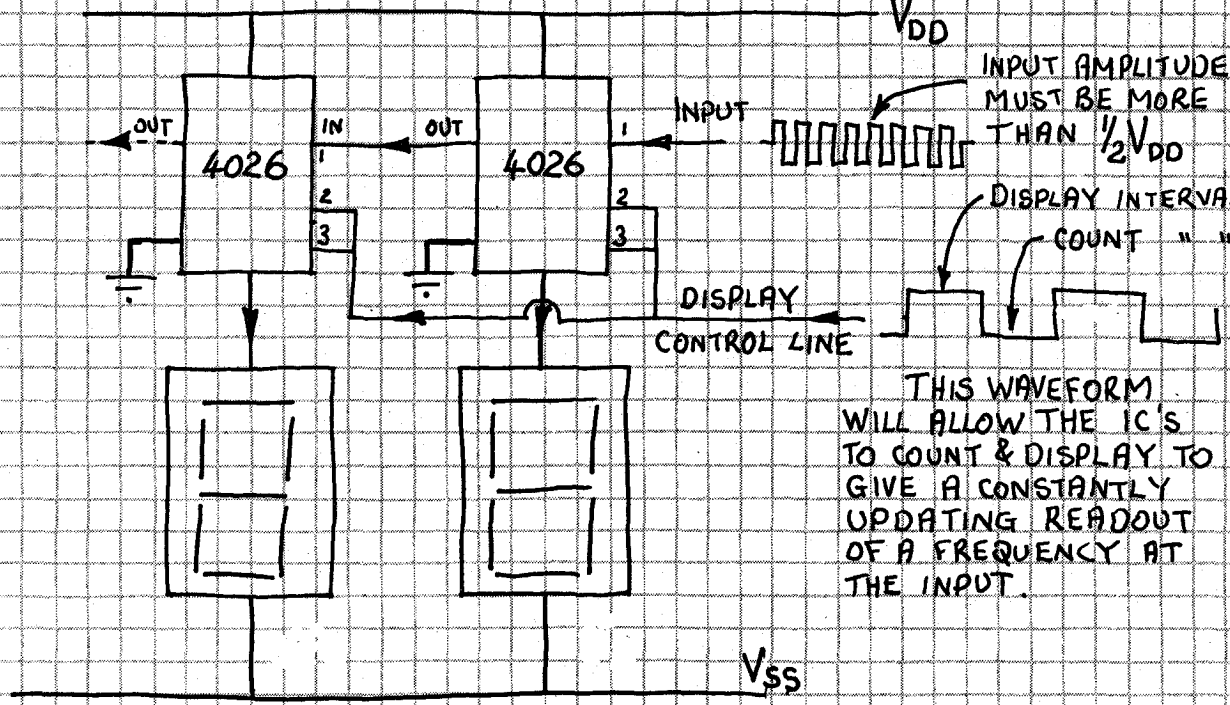


WHEN THE CLOCK INHIBIT PIN 2 IS HIGH IT WILL PREVENT THE IC COUNTING ANY INPUT PULSES A LOW ON PIN 2 WILL ALLOW THE IC TO COUNT.

A LOW ON THE DISPLAY ENABLE PIN 3 WILL SHUT OFF THE DISPLAY IT DOES THIS BY PRODUCING A LOGIC LOW ON ALL OUTPUTS A HIGH ON PIN 3 WILL PRODUCE A BRIGHT DISPLAY

37

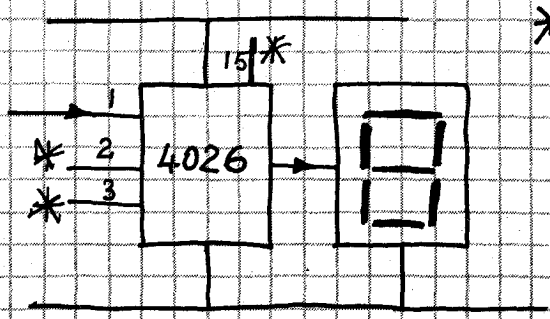
PINS 2&3 ON THE 4026 CAN BE WIRED TOGETHER TO PROVIDE A SIMPLE COUNT-AND-DISPLAY EFFECT. IT WORKS LIKE THIS: PINS 2&3 ARE WIRED TOGETHER AND KEPT LOW. THE IC WILL COUNT INTERNALLY & THE DISPLAY WILL BE CUT OFF. IF THE PAIR IS NOW TAKEN HIGH THE COUNT WILL FREEZE AND THE DISPLAY WILL SHOW THE TOTAL NUMER OF PULSES. THE 4026 IC & DISPLAY CAN BE JOINED TO ANOTHER 4026 IC & DISPLAY TO COUNT UP TO 99 OR EXTENDED EVEN FURTHER. THIS IS CALLED CASCADING.



THIS WAVEFORM WILL ALLOW THE IC'S TO COUNT & DISPLAY TO GIVE A CONSTANTLY UPDATING READOUT OF A FREQUENCY AT THE INPUT.

CASCADING 2-4026's

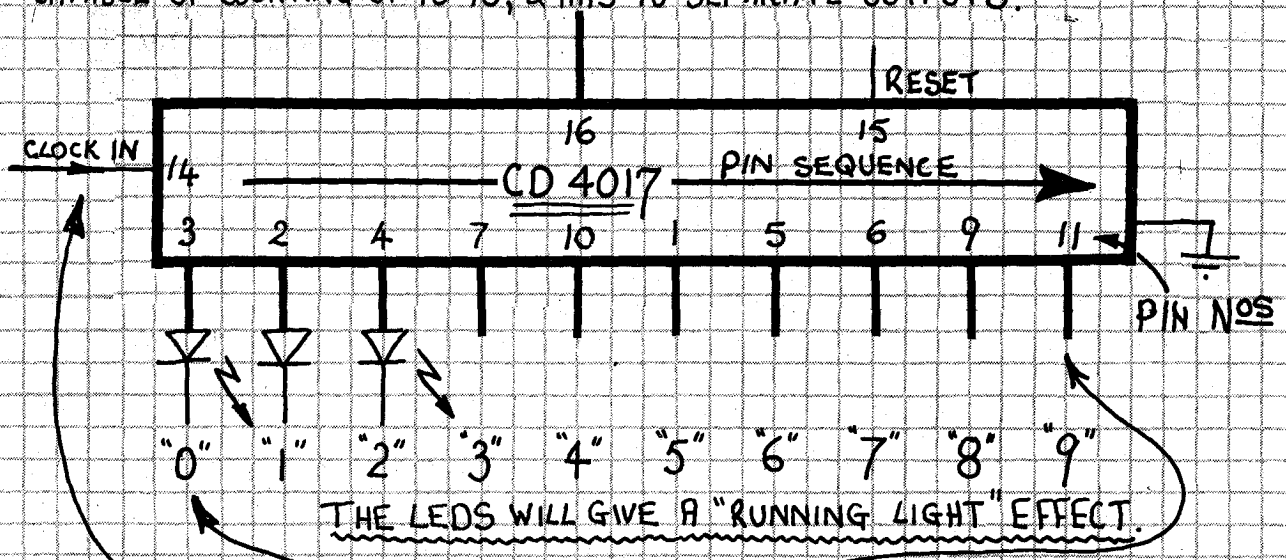
BY TAKING PINS 2&3 ALTERNATELY HIGH & LOW AT 5Hz THE CIRCUIT ABOVE IS CAPABLE OF COUNTING FREQUENCIES UP TO 1,000 COUNTS PER SECOND. THE INPUT IS SHOWN AT THE RIGHT HAND SIDE AND THE COUNT PROGRESSES TO THE LEFT TO CREATE A "FORWARD READING" DISPLAY.
A 2 UNIT DISPLAY OPERATING IN THIS ARRANGEMENT WILL DISPLAY "TENS" AND "HUNDREDS" AS THE COUNTERS COUNT THE INCOMMING CYCLES FOR 100mS (1/10Sec) AND DISPLAY FOR 100mS. THUS THE DISPLAY IS UPDATED EVERY 200mS AND APPEARS AS A BLINKING DISPLAY AT THE RATE OF 5 TIMES PER SECOND.



* PINS 2,3 & 15 MUST NOT BE LEFT "OPEN" OR "FLOATING". THE HIGH IMPEDANCE OF THESE THREE INPUTS WILL PICK UP STRAY SPIKES & NOISES AND CAUSE THE COUNTER TO "HUNT" AND CHANGE STATES. A 100K OR 1M RESISTOR TO LOW OR HIGH IS NECESSARY ON PINS 2&15. THE DISPLAY WILL NOT ILLUMINATE SINCE PIN 3 IS NOT CONNECTED HIGH.

38 THE DECADE COUNTER

ONE OF THE MOST VERSATILE COUNTERS IS THE CD 4017. IT IS CAPABLE OF COUNTING UP TO 10, & HAS 10 SEPARATE OUTPUTS.



THE LEDS WILL GIVE A "RUNNING LIGHT" EFFECT.

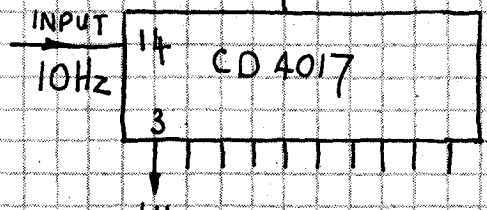
THE COUNTER ADVANCES ONE COUNT ON THE POSITIVE-GOING CLOCK SIGNAL

THIS IS THE FIRST OUTPUT AND IS LABELLED "0" AS YOU WILL SEE LATER WHEN THE IC IS USED AS A COUNTER

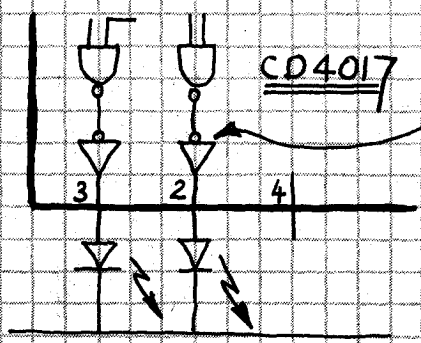
THE 10 OUTPUTS ARE NORMALLY LOW AND GO HIGH IN SEQUENCE

ONE LED WILL LIGHT AT A TIME

IF A FREQUENCY OF 10Hz IS APPLIED TO THE INPUT PIN, IT IS EQUALLY DIVIDED BETWEEN THE 10 OUTPUTS. THUS THE FIRST OUTPUT (OR ANY OTHER OUTPUT) WILL TURN ON AND OFF ONCE PER SECOND. THIS SHOWS THE CHIP HAS DIVIDED THE FREQUENCY BY 10. WE CALL A CD4017 A DECADE COUNTER/DIVIDER



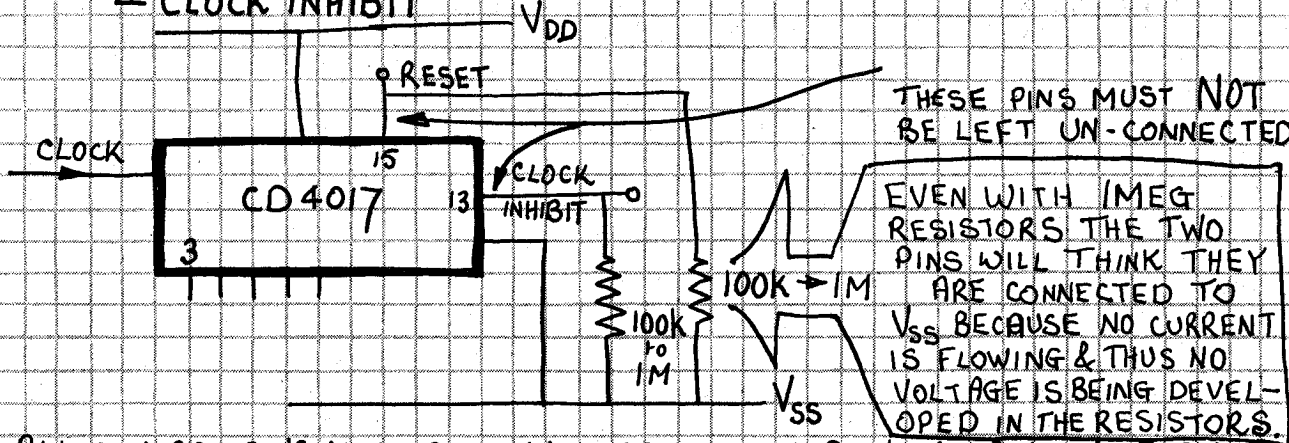
A CD4017 CAN BE USED AS A DIVIDER



EACH OUTPUT OF A 4017 HAS A BUFFER CAPABLE OF DRIVING A LED. THE CIRCLE ON ITS INPUT INDICATES IT RECEIVES A LOW DURING QUIESCENT CONDITIONS AND CHANGES TO THIS LOW STATE ON THE FALLING EDGE OF THE WAVEFORM. SINCE THIS GATE IS INSIDE THE IC ITS OPERATION DOES NOT CONCERN US. AND THIS FALLING WAVEFORM IS ALSO INTERNAL

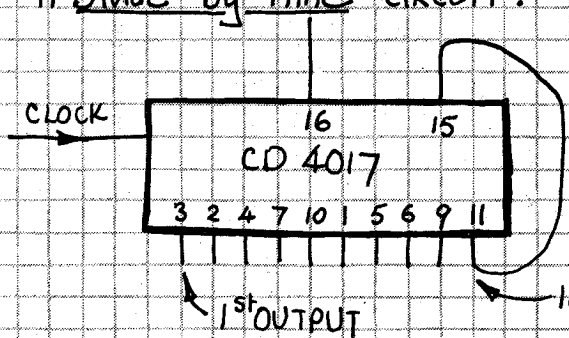
39

THE COUNTER HAS 2 OTHER IMPORTANT PINS:
— RESET
— CLOCK INHIBIT



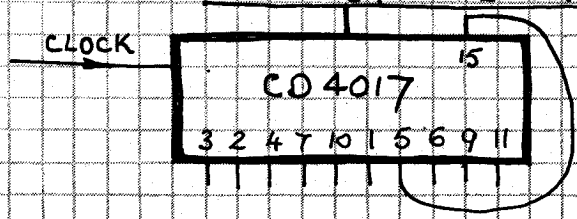
ALL CONTROL PINS MUST BE CONNECTED TO EITHER HIGH OR LOW. THEY CANNOT BE LEFT FLOATING. THIS APPLIES TO THE RESET & CLOCK INHIBIT PINS.
WHEN THE RESET IS CONNECTED LOW AS SHOWN, THE IC WILL COUNT THE FULL 10 OUTPUTS.
WHEN A VOLTAGE ABOVE $\frac{2}{3}V_{DD}$ (About 6v) OR A PULSE OF SHORT DURATION IS APPLIED TO THE RESET PIN IT WILL RESET THE IC TO THE FIRST OUTPUT (PIN NUMBER 3) IF A HIGH IS MAINTAINED, THE COUNTER WILL REMAIN AT PIN 3.
WHEN THE CLOCK INHIBIT PIN IS CONNECTED LOW, AS SHOWN, THE IC WILL COUNT THE FULL 10 OUTPUTS
WHEN THE CLOCK INHIBIT PIN IS CONNECTED HIGH THE COUNTER WILL "FREEZE" ON THE OUTPUT IN OPERATION.
THE 100K OR 1M RESISTORS KEEP SPIKES FROM ENTERING THE CONTROL PINS WHILE AT THE SAME TIME GIVES THE PIN A HIGH IMPEDANCE PATH TO ANY CONTROL VOLTAGES.

A CD4017 WILL DIVIDE BY 9 or 8 or 7 or 6 or 5 or 4 or 3 or 2.
A Divide-by-nine CIRCUIT:



THE 10TH OUTPUT IS CONNECTED TO THE RESET PIN. THIS WILL MAKE THE COUNTER COUNT TO 9 THEN RESET.

DIVIDE-BY-NINE CIRCUIT



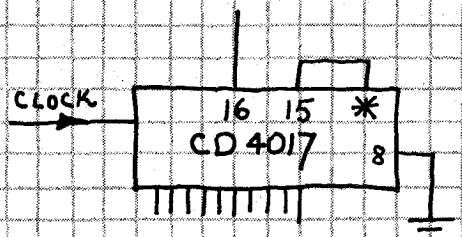
THE 7TH OUTPUT IS CONNECTED TO THE RESET PIN. THIS WILL MAKE THE COUNTER COUNT TO 6 THEN RESET.

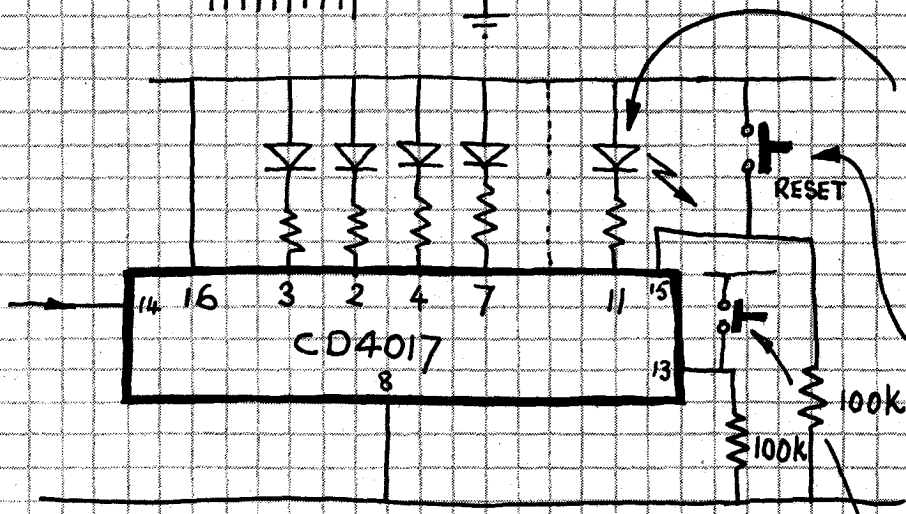
DIVIDE-BY-SIX CIRCUIT

40

"DIVIDE-BY-N"

* A DIVIDE-BY-N CIRCUIT FOR THE CD4017 REQUIRES THE n+1 OUTPUT TO BE CONNECTED TO THE RESET PIN. THIS CIRCUIT IS HANDY FOR ODD DIVISIONS OR FOR A CIRCUIT REQUIRING EASY ALTERATION. FOR STANDARD DIVISIONS, A NUMBER OF CHEAPER AND BETTER ICs ARE AVAILABLE.





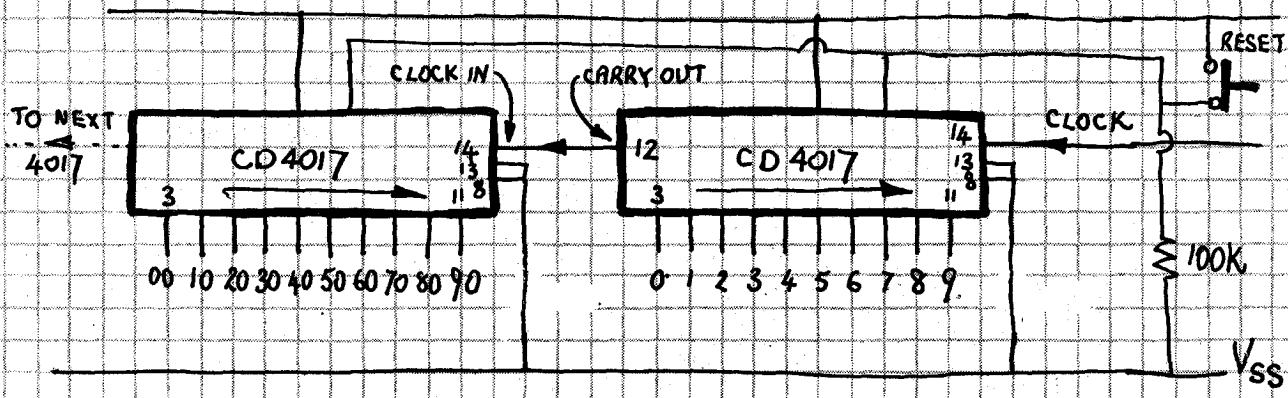
BY TAKING THE ROW OF 10 LEDS "HIGH" WE OBTAIN A ROW OF ILLUMINATED LEDS WITH ONE LED GOING OFF AT A TIME TO GIVE A RUNNING "HOLE" EFFECT.

BY TAKING THE RESET PIN LOW VIA A 100K RESISTOR A SIMPLE PUSH-TO-MAKE SWITCH CAN BE USED TO RESET

A RUNNING "HOLE" EFFECT

"FREEZE" BUTTON.

CASCADING THE 4017 COUNTER:



TWO (OR MORE) 4017 COUNTERS CAN BE CASCADED TO PRODUCE A COUNTER. IDEALLY IT CAN BE A PRE-SET COUNTER IN WHICH THE OUTPUTS ARE DIODE GATED TO A SIGNALLING DEVICE SUCH AS A LAMP OR BELL. THE CIRCUIT IS ARRANGED TO PRODUCE A FORWARD READING DISPLAY AND ANY NUMBER OF CHIPS CAN BE ADDED TO INCREASE THE RANGE. THE CARRY-OUT PIN IS CONNECTED TO THE CLOCK PIN OF THE NEXT COUNTER. THE RESET AND CLOCK INHIBIT PINS MUST BE TAKEN TO EARTH POTENTIAL (V_{SS}). THE ADVANTAGE OF INCLUDING THE 100K RESISTORS ALLOWS A SIMPLE PUSH-TO-MAKE SWITCH TO BE INCLUDED IN THE CIRCUIT FOR "RESET" OR "FREEZE".

TV Servicing Part III

Ramblings from our disheartened serviceman.....

Everything happens in cycles. Some weeks you are snowed under with work, then a complete lull comes to give you time to think "why on earth am I in this crazy job?" Who else offers instant in-home service for an enormous range of equipment designs and then has to account for the last dollar? The only consolation comes when a whole string of sets require nothing more than a handful of cheap components to get them back to almost brand new. This was the week that was. It started on Monday with a fairly new Philips set showing a dark picture. Now you all know how I have boosted Philips designs to the hilt. And how I haven't yet had to replace a tube in a Philips set ..... well this could be the turning point. After checking the voltages to the accelerating anodes on the tube and the drive voltages I came to the conclusion that an internal leak was affecting the brightness level. I hauled out my trusty B&K Picture Tube Rejuvenator and looked up the Swe-Check picture-tube adaptor list. This is the most valuable list to be compiled. It lists all the known picture tubes in Australian sets and the adaptor required to give them a "hit". Since it was one of the newer in-line tubes, I needed a rarely-used adaptor No 115. Sure enough, as with all tubes tested, the tube showed an almost perfect reading. For all my experience, I have not yet had a sensible reading on a tester, showing the actual condition of the tube.

"Be patient, you're dealing with Murphy's Law!"

Quite often an almost unwatchable tube will record three guns to be better than 50% emission while a couple of quite good picture tubes gave an almost undetectable reading. Just purely reading the static emission levels is not good enough. A number of other factors affect the resulting brightness. Although the actual phosphor screen gives very little trouble, the accelerating voltage and the video current available from the video amplifiers has considerable effect on the overall brightness.

Back to our case. The tube tested alright and since everything had been checked for voltage levels, it had to be the tube. When I set the instrument to rejunevate, the three guns showed a considerable tendency to short between electrodes when a slightly higher voltage was impressed. The clever feature of the B&K tester is in the safety rejuvenating system. When the rejuv button is pressed, the filament is extinguished. This prevents the cathode from heating up to red hot as this would burn all the thorium-type material off the cathode and reduce the tube to scrap. One at a time the particles between the elements were burnt away. After the majority of these particles were disintegrated, I removed the adaptor and replaced the picture tube board. On turning on the set the picture was absolutely perfect. The brightness control could be placed at half level, the colour control was reduced and the focus had come back into the picture. It was quite pleasing. This was one of the first times I had used that particular adaptor and

"Some days every thing goes wrong!"

so the result was quite gratifying. Two other jobs that day were also similarly encouraging. The first of these was a General 43cm set. I have sold hundreds of these sets and have only needed to service about 15 out of three hundred in the past four years. That is an incredible record. And when you think of it, all the sets suffer from only three faults.....Most of their faults begin with intermittent symptoms and sure enough, by the time I got to the house, the sets were behaving normally. The complaint with the set was a picture jumping up from the bottom and narrowing in height. After waiting for about 15 minutes for this to occur, I finally tried the old trick of hitting the top of the set.

The picture immediately collapsed to a narrow line. Another simple job. The soldering on the vertical module pins had become dry. Even though the soldering connections are extra robust the heating and contracting of the module finally breaks the joint. A slight knock will heal the connection for a while but finally it becomes so annoying that the customer calls in the technician. If it is allowed to persist in the collapsed state for too long, the dropper resistor to the push-pull amplifier will burn out. Fortunately, in this case, this load resistor was still intact and so the job required nothing more than a little re-soldering. The third job worth mentioning on the Monday involved a Pye colour set with lack of width. If you have ever seen inside a Pye set, it consists of two swing-out mother boards which have a feeble copy of the Philips design. After a few years in operation, the large signal board (carrying the horizontal output section) begins to show signs of wear. Many of the parts get too hot and begin to discolour the board and this in turn removes the printed overlay showing resistor and capacitor numbers, so that they become un-readable. Along with the overheating, some of the pins are carrying quite heavy currents, especially to the vertical and horizontal sections of the yoke. Over the years dry

joints begin to appear between the pins and PC board which can introduce a small resistance into the circuit. The other common fault occurs on the incoming supply pin. It eventually burns out completely resulting in no picture and no sound. The former fault was the complaint with the Pye set. Again I charged a small fee for the simple repair. By the time Thursday came, you guessed it, all the three sets had resulted in callbacks. The Philips picture tube fault had lasted just three days after which the picture had become too dull to watch, the General set had developed another fault, and the Pye set had collapsed to a white line. To some customers, it takes quite a bit of convincing that you haven't planted a time delay fault in their set or fitted faulty components. Many often refuse outright to pay any more for repairs and it would very soon become an awkward stalemate if you stood your ground. The Philips set was an obvious challenge and required full explanation as to the nature of the fault. When you see a fault like this as one in a thousand, you think how unlucky for it to occur to those who can least afford it. I always seem to find the most expensive fault happens to the nicest customers. The tube needed a second attempt at removing the built-up carbon deposits and I had to explain factually that the tube may or may not last the week. It was unfortunate but a premature failure like this is not the end of the set. The remaining portion of the set was still perfect and a new tube will keep the set going for another 5 years or more. This is the only way to approach the customer in the home. How could you possibly tell them that the cost of a new tube was not economics? How can you say "throw away a four year old set and buy a new one?" It's only when you go back to the work shop and find out the real costs of a new tube has gone up $50

"Replacing the tube is just not economics"

due to the new sales tax and the waiting time for a replacement is at least two weeks that you think "well maybe you are being squeezed out of business." Some technicians may invest in a re-gun tube but from my experience, they cause more trouble and headaches than they are worth. From the outset they are not perfect. They rarely purity fully and they have a very bad tendency to go soft within a year or two. Most of the re-guns I have come across are back at the unwatchable state within 18 months.

And that is false economy.

I am still waiting on the customers call to let me know how the set is going. One interesting fact about picture tubes is worth mentioning here. If this Philips' customer was to leave the set on 24 hours a day and never turn it off, the picture tube would remain perfect. It's not the use of the set which poisons the cathodes, it is the non-use. I have proven this fact with a previous set which suffered from a similar complaint. I connected the filament of the picture tube to a 6 volt mains transformer which was directly coupled to the power point. This meant the filament of the tube remained alight 24 hours a day and gave them the advantage of an instant picture. The result was that the tube lasted for months and months while the customer began to save up for a replacement tube. This is not always the case, but nine times out of ten the ageing of the tube takes place when the set is not being watched. This accounts for the anomoly as to why sets which are used by children for long periods of time suffer from the least number of faults. Now about the General set. After fixing the height problem, the customer called back a day later to say the brightness was disappearing every few minutes and even with the brightness turned up fully, the only parts of the picture which were discernable were the reds and blues. They seemed to infer something about the fact that this did not happen till I took the back off the set and did some soldering the day before. As it turned out, the luminance delay line was intermittent. (It is a long blue rectangular box containing a specially wound coil of fine wire). The fault with these lines is due to the potting mixture encapsulating the wires. The rate of expansion between the copper wire and the potting compound is different and this causes the wire to fracture inside the unit. Fortunately they are not expensive and once you have fixed this type of fault before, it is a routine replacement. Fortunately the customer was understanding and was prepared to pay a little extra for the component. In these circumstances I generally charge only for the parts and show them the components I have removed. This generally turns out to be a lot less than even the cost of a service call from one of the larger firms, but then this is the service expected from a small firm.

Lastly let's look at the Pye set with collapsed vertical. The picture did not collapse completely but tended to drop more from the top of the screen than from the bottom. A small amount of crimping occurs with this fault and the suspect components are invariably the output transistors. Originally the output transistors were 2N4232 or AY8171 but as these are no longer available, the substitutes are 2SC1104 or 2SC1025.

It is always a wise move to replace both transistors in the one operation, as this fault will overload both devices. As a matter of interest, the lower transistor on the heatsink drives the upper portion of the picture and the upper transistor operates the lower half of the screen. This is just one of the layout design faults I try to avoid when designing a project as it causes inconvenience and confusion for others who might have to perform troubleshooting. Consideration to these small points makes the difference between a good design and a failure.

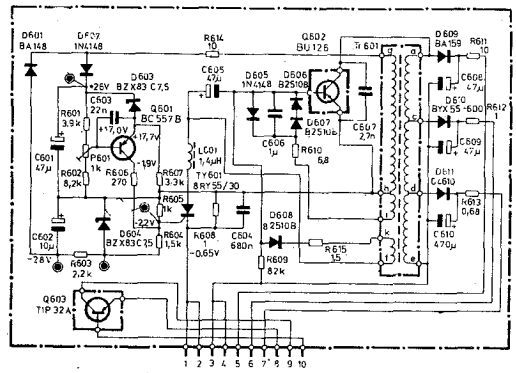
These facits are self-levelling. They actually work themselves out over a period of time. Look at the number of TV makes which are with us today and compare this with about 40 different manufacturers competing on the market just five years ago. When the next generation of designs comes on the market. you will see yet another fall-off in makes, as the more progressive manufacturers keep abrest with the times and the struggling suppliers fail to adopt the more advanced technology into their sets.

This weeks examples are just a microscan of the ever increasing problems with colour sets. Even though the failure rate is considerably less than for black and white sets, the faults seem to come in pairs. Quite often you just complete one fault and another will develop. It's just the luck of the game but it tends to eat into the meagre profits and tries our resources to the limit.

THE SWITCH MODE POWER SUPPLY

In part III of TV SERVICING I outlined the circuit for a switch mode power supply. I mentioned the two methods of approach to repairing these units. For the initial servicing, an overhaul is the best approach. Most of the electrolytics will have dried out over the years and will prove to be a source of intermittent troubles. The original diodes are also very troublesome and a number of dry joints are generated in the circuitry. Once all these are removed, the power supply is very reliable.

The Luxor Power Supply Module provides an ideal reference for discussing SMPS faults. They provide



Luxor Switch Mode Power Supply circuit

considerable service for field technicians due to the high break-down rate. The power supply itself is well designed; it is the choice of components which prove to be the downfall. Once these components are replaced, the supply operates very satisfactorily. We will assume you have overhauled the power supply as suggested in the last section. And for one reason or another the power supply still does not operate satisfactorily. Here is a list of features to locate the possible source of trouble.

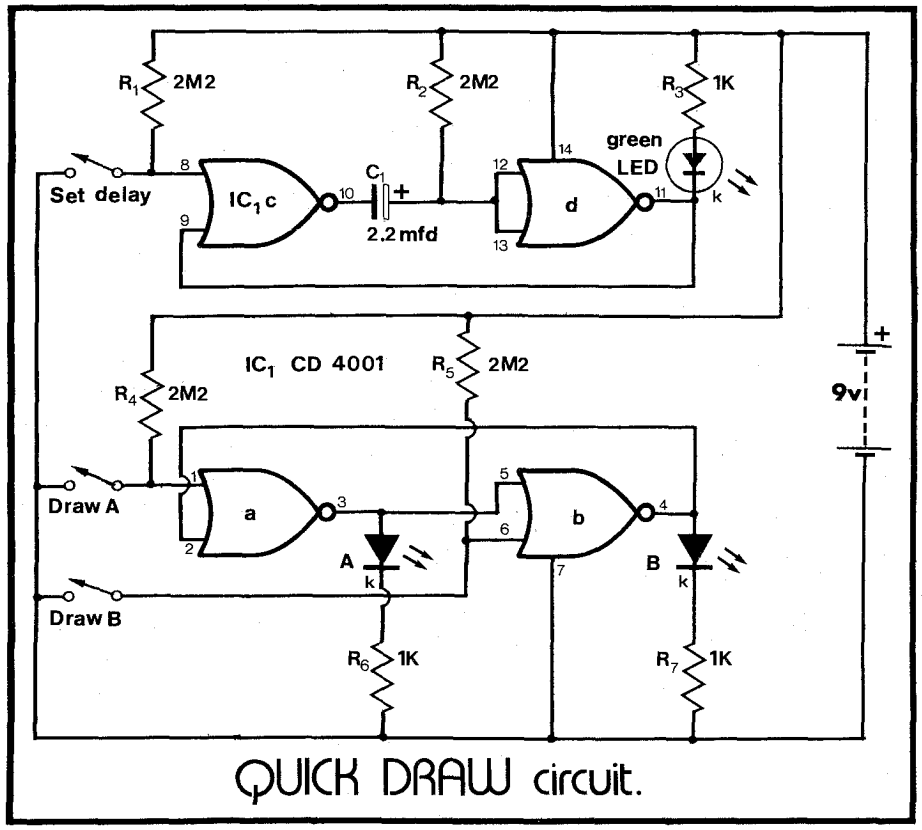
SMPS FAULTS

FAULT	CURE
BU 126 chopper keeps blowing	- dry joints all over PC board - hairline cracks near high wattage components - loose transformer connections - charred PC board - 2700pf tuning capacitor open circuit - 1k trim pot intermittent
Damaged BRY 55 thyristor	- Always due to faulty chopper transistor caused by one of the above
Short circuit 47/350v electrolytic	- check one of the above causing high output voltage
Power supply whistles	- replace D 606 and D 607 in the base circuit of the BU 126 with MR 812 or BYX 55/600v high speed diodes
Low output (about 150v)	- replace two 47/63v electrolytics and 10mfd 63v electrolytic
Sides of raster bending and moving and this slowly moves down the screen	- replace 470mfd 350v electrolytic on the Mother Board outside the module.
Slight noise from power supply	- replace 1mfd 250v capacitor on Mother Board near 1 amp fuse
Dot pattern on low channels	- Replace 47mfd 350v electrolytic
Power supply does not always start up	- Replace 47mfd 250v electrolytic.

Quick Draw

A simple circuit showing the versatility of a quad NOR gate

Project cost: $3.50



QUICK DRAW circuit.

This is a game for two players. It's rather like an up-to-date version of HIGH NOON. The object of the game is to fire your 'gun' before your opponent. In this version we have substituted the gun for a switch and in place of the bullet we use a LED.

This project will give you an indication of your reaction time matched against your partner. Your "draw time" is calculated from the time a green LED lights up, to the time your red LED is lit. Suppose you take switch A. This will connect and control LED A. The aim is to press switch A before your partner presses switch B. If you succeed in doing this, you automatically lock off his circuit and only LED A will light up. For both players to have an equal chance at "drawing", the green LED comes on after a delay of a few seconds. Either player can press the SET DELAY to begin the timing as both will have to wait a few seconds for the green LED to light up...this way it gives both a fair chance.

PARTS LIST

R1 resistor 2M2 ¼watt
R2 " 2M2 "
R3 " 1k "
R4 " 2M2 "
R5 " 2M2 "
R6 " 1K "
R7 " 1k "

C1 electrolytic 2.2mfd 10v

LEDs A&B 5mm red LEDs
Green LED 3mm

IC1 CD 4001

9v battery clip
9v battery
springy brass strip
"Quick Draw" PC Board

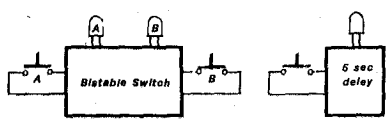
HOW THE CIRCUIT WORKS

The circuit consists of two separate sections. Gates "a" and "b" form a bistable switch while gates "c" and "d" form a TIME DELAY circuit. Beginning at the lower part of the circuit, LEDs A and B are connected to two NOR gates. These are interconnected so that only one output can be HIGH at any one time. For either output to be HIGH, its two input gates must be LOW. This can only occur when one switch is pressed AND the other LED is not lit. This circuit is not a LATCH. The LEDs are only lit while the switch is pressed. This means that we do not need a reset to turn off the red LEDs.

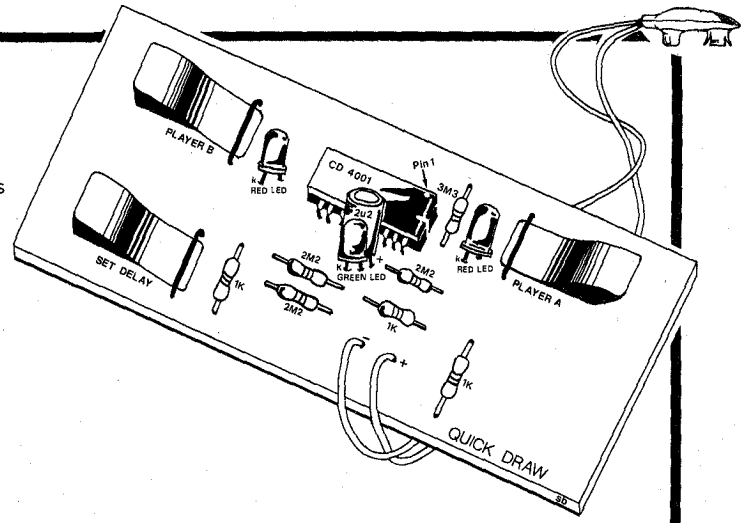
The other half of the integrated circuit is used for the delay. We can analyse the upper circuit or building block as follows: When the power is applied, one input of the first gate is HIGH via R_1 and its output will be LOW. Capacitor C_1 will gradually charge up via R_2 and after a few seconds will supply a HIGH to both inputs of the second NOR gate so that its output becomes LOW and the green LED lights up. The circuit will remain in this state ready for play. When the SET DELAY switch is pressed, the output of the first NOR gate will go HIGH and C_1 will discharge via the input protection diodes of the second gate. The output of the second NOR gate does not alter at this stage. When the SET DELAY switch is released, the discharged capacitor C_1 is brought to deck and this produces a LOW on pins 12 and 13. The second NOR gate responds to this and turns off the green LED. Capacitor C_1 gradually charges via R_2 until the threshold voltage of about 5v-6v is reached to change the state of the second NOR gate and light the green LED again. This is a signal to press your switch and lock in a result on LED A...before your opponent fires LED B.

CONSTRUCTION

Construction is made easy on a small Printed Circuit Board. For economy we have used fabricated switches mounted directly on the board. The switches are made from thin springy brass .005" thick and cut to fit over the pattern marked on the underside of the board. If you wish to house the project in a zippy box, you can connect hook-up wire from the PC board to the switches mounted on the lid of the box. When a project is neatly laid out such as this one, I prefer to see the components. If it is a mess, I hide it away in a box!



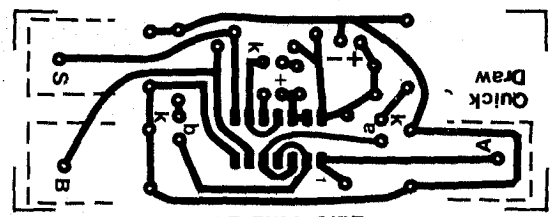
THE 2 QUICK DRAW BUILDING BLOCKS



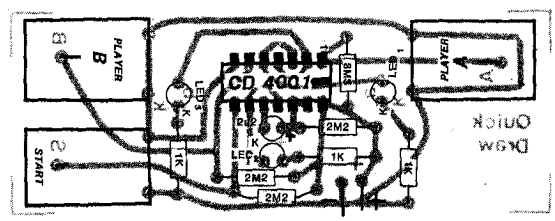
The circuit has a couple of other features which I won't mention. I will let you find these out for yourself. When you construct the PC board, touch the underside of the circuit with your fingers and see what effect it has on the LEDs. In fact you might even come up with the unusual characteristic which we discovered by chance. Since the two parts of the circuit are completely separate, you can use either the delay or the bistable switch for another project.

MAKING THE SWITCHES

The three switches are made from springy brass strip .005" thick. It is cut to 8mm wide. Each switch is 25mm long. The point contact on the board is made from an unused resistor lead. Solder it in position and bend it over the top of the board. Make up 3 staples of wire to fit over the brass strip and into the holes on the PC board. Solder each to the PC wiring and then to the brass strip to make a firm anchor. Bend the strip upwards and check the contact. "Switch bounce" will not affect this project so don't worry about very clean contacts.



NOT FULL SIZE



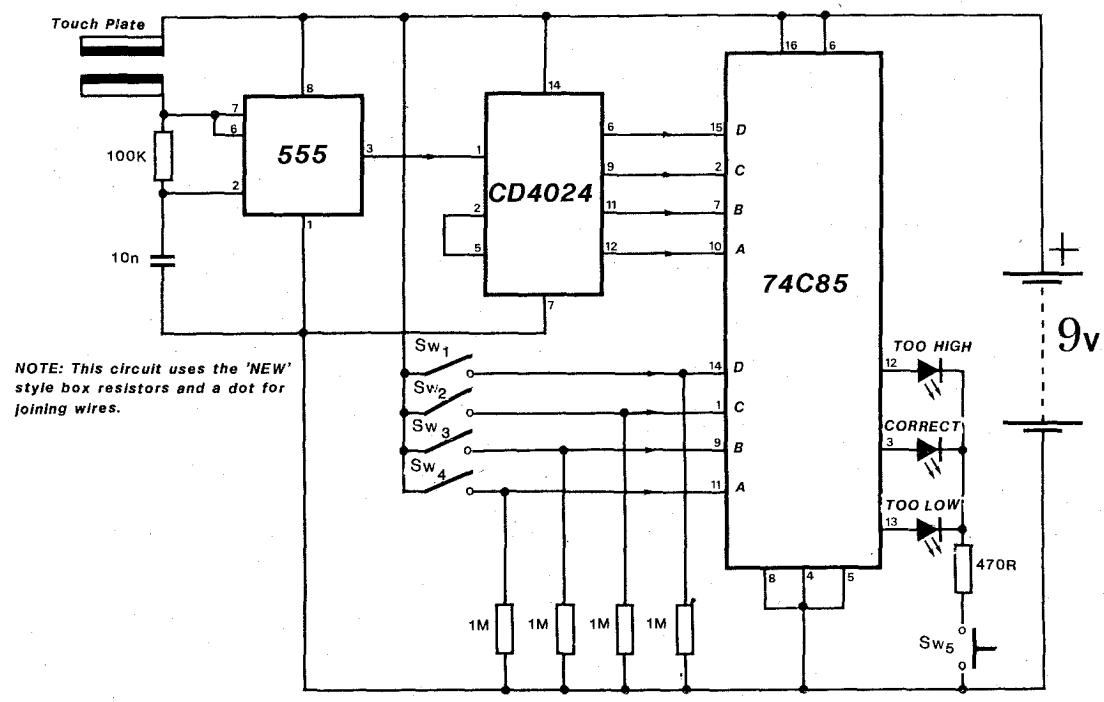
.....Continuing the series

EXPERIMENTER BOARD

BINARY HIGH-LOW GAME

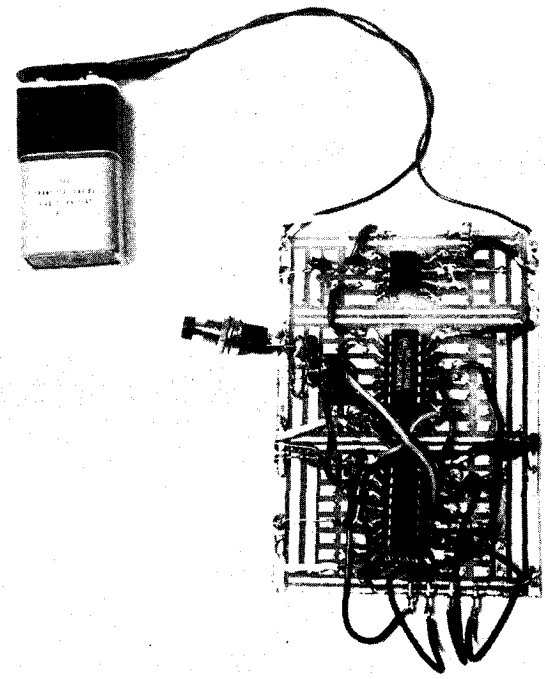
Project 8

By P. Fyffe 3126



PROJECT COST $2

AFTER BUILDING PROJECT 7



Our BINARY HIGH-LOW GAME is a simple game and is intended as an introduction to comparitors.

A comparitor such as the 74C85 compares two four-bit words and determines if one is greater than, equal to or less than the other. Since a four-bit word can be expressed in 16 different ways, this IC is capable of accepting 16 different possibilities and comparing this information with a second four-bit word to display an answer.

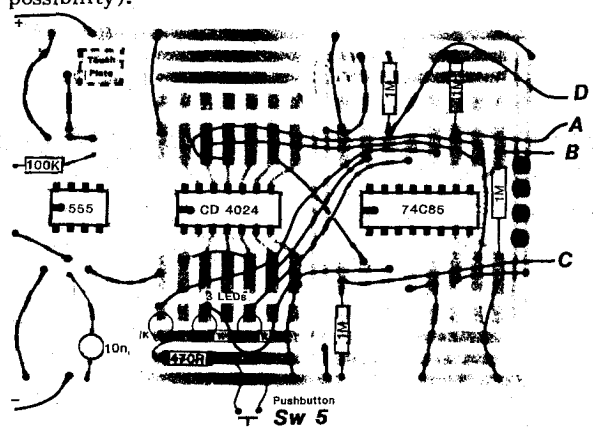
The idea of the game is to guess "what number the Binary Counter thought of". By using the flying leads and the molex pins, this number is entered into the second half of the comparitor chip. The circuit will then tell you if your guess is high, low or exact. The unknown number entering the first half of the chip is generated by the CD 4024 Binary Counter IC in which its first four outputs are connected to the first half of the comparitor. Four binary bits are called a four-bit word or NIBBLE.

A second nibble is generated by the flying leads and Molex pins. If the lead is left flying, a logic Low ("0") is present on the input pin of the comparitor. When the lead is connected to a Molex pin, the IC records a HIGH ("1").

In issue 3 we presented a BINARY COUNTER on the Experimenter Board. This was slightly modified in issue 4 for the SHOOT GAME in which we moved the LEDs to the centre section so that the gating transistor circuit could be assembled in the last segment.
For this BINARY HIGH-LOW GAME we need only remove the gating transistor section and the board is ready for the 74C85 magnitude comparitor.
These projects must be assembled in sequence if you intend to really understand digital circuitry. Merely by looking through and studying a circuit will not make you fully ofay with its mode of operation. Lots points crop up while you are handling the parts and these can never be fully expressed in a constructional article. Very often the most informative part of the project is hunting through the completed layout trying to find the incorrect connection or dry joint. If you are really intent on learning . . . construct EACH STAGE.
The 74C85 is a four-bit magnitude comparitor which will perform comparison of two four-bit words and determines whether they are "greater than" or "equal to" or "less than" each other. The IC provides a HIGH on one of the three outputs as an indication of this information. The CMOS version in our project is NOT a pin-for-pin equivalent of the 74LS85 TTL comparitor or the low power 74L85 or the 74LS85. If you are only able to obtain these versions, you will need to use different pin connections and operate the circuit from 5v by using a 6v supply and placing a diode in the positive rail. The current limiting resistor for the LEDs will need to be reduced to 270R or 330R for the lower voltage.

HOW THE CIRCUIT WORKS

When you place your finger on the touch pads on the top right hand corner of the board, the resistance of your finger allows a very small current to flow and supply a voltage to the pins 7, 2 and 6 of the 555 oscillator. Even with resistances as high as 100k, the IC will begin to clock. The speed of this clocking is not important as we are only interested in the fact that it is loading a number into the comparitor via the 4024 IC.
The binary counting IC CD 4024 is wired with pin 5 connected directly to the rest pin 2. This means the IC will reset on the 15th count and this will be the highest number available. This will give us a possible choice of 16 numbers which can be entered into the comparitor. (Assuming we include zero as a possibility).



PARTS LIST

R1	resistor	100k	¼ watt
R2	"	1M	"
R3	"	1M	"
R4	"	1M	"
R5	"	1M	"
R6	"	470R	"
C1	capacitor	10n	100v
IC1	timer IC	NE 555	
IC2	binary counter	CD 4024	
IC3	magnitude comparitor	74C85	

LED1 to LED 3 3 or 5mm LEDs

Push-to-make switch
4 Molex pins
Hook-up wire
battery snap
9v battery

"EXPERIMENTER BOARD 3IC's"

Lets look at how the comparitor works. Suppose the counter were to stop on 1000. In binary terms this would correspond to D being HIGH, C being LOW and A being LOW. The first "1" on the left hand side corresponds to the D output and is the most significant digit.
If we load our guess into the machine by connecting leads D, C and B and push switch Sw_5 we will get an answer of too HIGH. If you remove lead B the reading will still be too HIGH. But on removing lead C the centre LED will light up to show the correct value. It is now your requirement to invent a method for selecting the correct combination "within 4 attempts."

CONSTRUCTION

This project is an extension of the binary counter project. The third section of the board accommodates the magnitude comparitor, 3 LEDs and the set of switches. Follow the lay-out diagram and you should have no trouble completing the circuit. The 7 LEDs from the binary counter project can be left on the board if you wish. Out-put 5, the fifth LED, will need to be taken back to pin 2 so that only the first four outputs are clocked. This means the other 3 LEDs will not illuminate and can be taken off the board and used as the HIGH, CORRECT AND LOW LEDs.
If you have a selection of coloured 3mm LEDs, you can use red orange and green for the outputs to make the game a little brighter. Even two red LEDs and a green LED will give you instant recognition of the result.

GETTING IT GOING

The first two IC's will be ready and operating as they formed the previous project. The comparitor IC will be our main concern. There is one important point worth remembering about the four flying leads. They produce a HIGH when connected to the Molex pins. Cut out the overlay and paste it onto the chip to show the outputs D, C, B and A.

WIN A MULTIMETER!
(or equivalent in components)

Conducted by TALKING ELECTRONICS
35 Rosewarne ave
Cheltenham 3192

Donated by

ROD IRVING ELECTRONICS

Send us a good idea or clever circuit design and win a MULTIMETER...

Here are the simple rules:

1. Maximum of 2 IC's and 4 transistors.
2. Maximum cost: $15.
3. It must work.

The circuit should preferably be something you have constructed yourself. All entries will receive a free packet of transistors and a set of resistors to defray your postage and/or photocopying costs. We reserve the right to adapt any circuit and publish it in TALKING ELECTRONICS.

The entry form opposite is only a sample idea. You can enlarge the sheet or choose your own layout. Any complete projects sent into us as an entry will be replaced with new components or returned to you after judging. This will obviously count towards your score. Judging will incorporate neatness, design, originality and suitability. You must use freely available parts.

Entries close 31st December 1981.

Win a Multimeter contest.
Conducted by TALKING ELECTRONICS,
35 Rosewarne ave Cheltenham Victoria, 3192

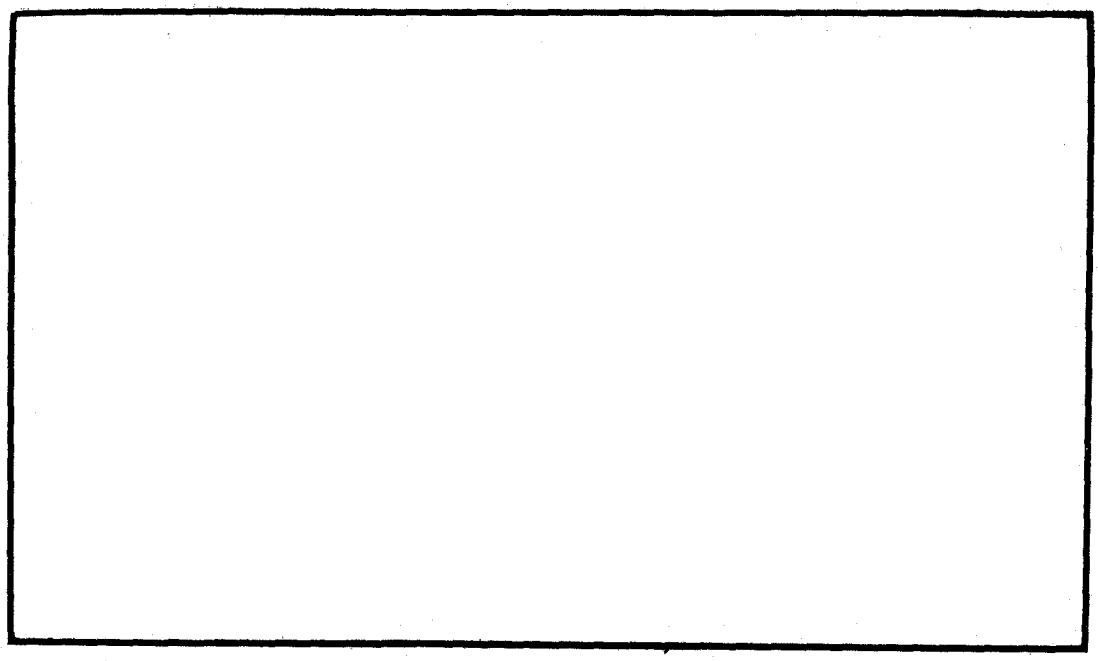
Name:_____

Address:_____ **Post code:**_____

Name of PROJECT:_____

Label to be attached to any models etc

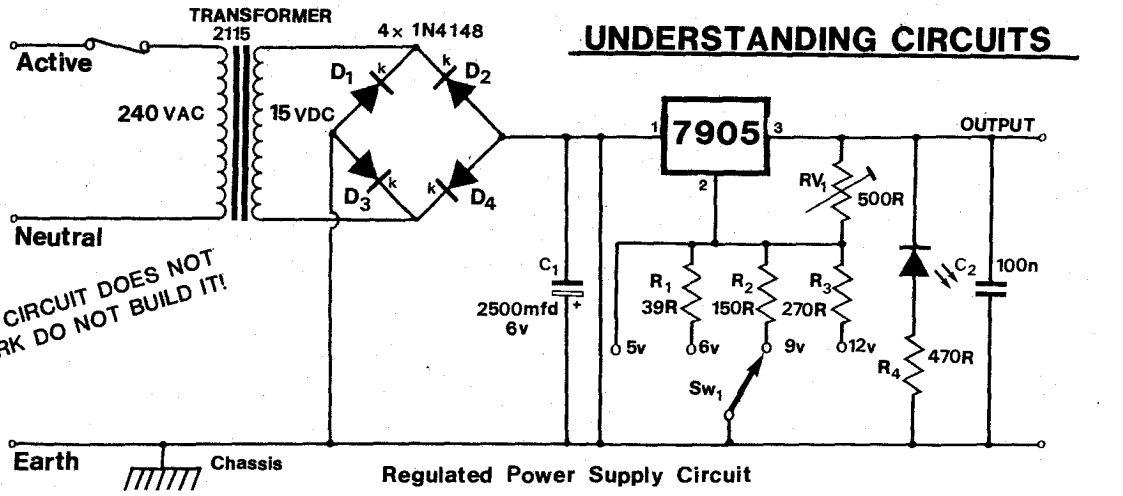
_____ by _____



TEST YOURSELF..

All too often we take it for granted that a circuit will operate. Possibly because we have faith in the designer or maybe because we don't know how the circuit operates. Try your skill at picking the faults in these circuits and determine the working values in the other two circuits.....

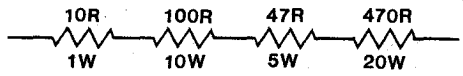
1 THIS POWER SUPPLY CIRCUIT CONTAINS AT LEAST 10 FAULTS CAN YOU LOCATE THEM?



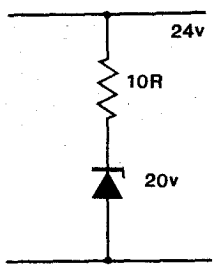
Regulated Power Supply Circuit

UNDERSTANDING CIRCUITS

2 Which resistor will burn out first when the combination is connected to a high voltage.

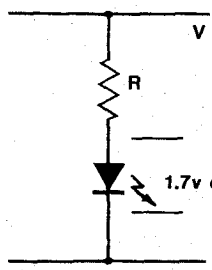


3



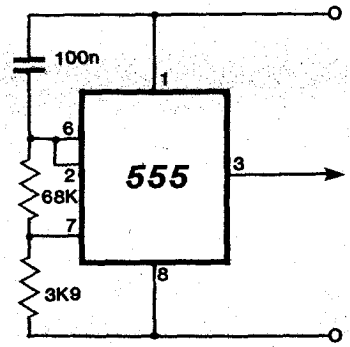
A 20v zener diode is connected to a 24v line via a 10 ohm resistor. What is the current in the zener diode?

4

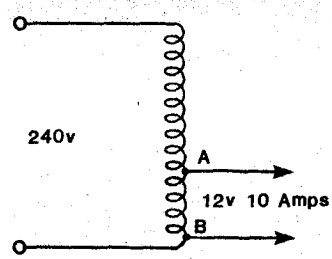


A light emitting diode is connected to a high voltage rail via a dropping resistor. Calculate the value of the resistor when the voltage is: (a)10v (b)15v (c)20v. The LED requires 10mA.

5 can you list the faults in this circuit?



6 An auto transformer is tapped at 12v and is required to deliver 10 amps to a load. What is the approximate current in winding 'a'?



Answers

1
1. Fuse - no rating
2. Diodes D_2D_4 around the wrong way
3. 4 x EM 401 not IN 4148
4. 2500mfd up-side-down
5. 7905 is a negative regulator
6. Regulator numbering should be 132
7. LED reversed biased
8. 15VAC not DC
9. 6v electrolytic should be 25v
10. Short-circuit wire near electrolytic.

2 The 470 ohm resistor has the lowest wattage rating for the current flow.

3 The voltage across the resistor is 24-20v
=4v. From ohms law I=E/R =4/10amp
=.4amp

4 Supply voltage 10v.
Voltage across the resistor = 10 - 1.7
= 8.3v I=E/R
.01=8.3/R
R = 830 ohms

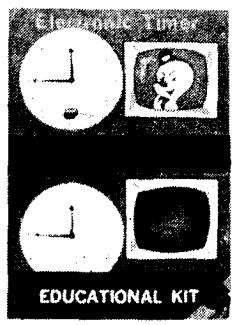
Supply voltage 15v:
Voltage across the resistor = 15 - 1.7
= 13.3v I=E/R
.01=13.3/R
R= 1.33K

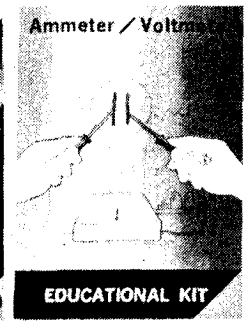
Supply voltage 20v
Voltage across the resistor = 20 - 1.7v
= 18.3v I=E/R
.01=18.3/R
R = 1.83K
Obviously you will use the nearest preferred value for the dropper resistor.

5 We cannot find anything incorrect with the circuit excepting that it is up-side-down!

6 The auto transformer can be treated as a normal double-wound transformer for this situation. The output wattage is 12x10 watts (actually volt-amps) so that the input must be 120 watts, assuming the transformer is 100% efficient. This gives us an input current of 240/120 = .5 amps.

ELECTRONIC KITS!





$4 50 each!

plus 60¢ P&P

any 4 kits for $16 00

plus $2 00 P&P

- **EASY TO BUILD**
- **CONTAINS ALL PARTS** + ROLL OF FINE SOLDER
- ***16* DIFFERENT KITS TO CHOOSE FROM!**

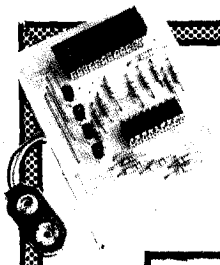
SINGING BIRD
RADIO
ELECTRONIC ORGAN
TOUCH SWITCH
MOSQUITO REPELLER
ELECTRONIC TIMER
SLEEPING BELL
SOUND SWITCH
PHOTO ELECTRIC SWITCH
WATER PURITY TESTER
POLICE CAR SIREN
MORSE CODE
FLASHER
DECISION MAKER
ELECTRONIC SIREN
ELECTRIC FAN NOT ELECTRONIC

EXPERIMENTER PARTS CO.*

2 Ethel St.,
Moorabbin 3189

see page 64 for order form

MAIL ORDER ONLY



COUNTER MODULE

Part II

Adding these sensors to the COUNTER MODULE:

HALL EFFECT SOUND

TYPICAL APPLICATIONS

Linear and Rotary motion detection
Position or Movement detection
Current sensing
Limit switch
Switch Matrix
Industrial machinery
Vending Machines
Medical and Scientific equipment.

RATINGS:

Supply voltage Vcc 7v
Output voltage 30v
Output current 20ma
Magnetic flux density....unlimited

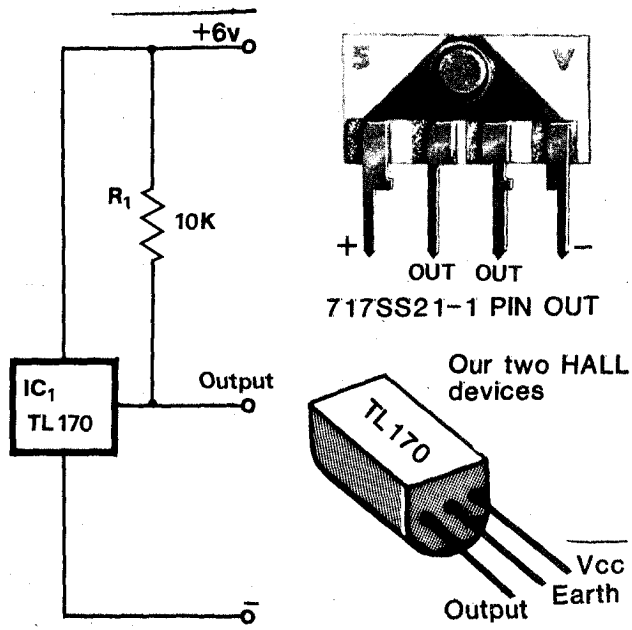
WHAT IS "HALL EFFECT"

For over 100 years, scientists have known about the effect of passing a conductor through a magnetic field. This is how our electricity is generated. It applies to our enormous generators right down to the dynamo on our bicycle. However when the magnet stops rotating, or the conductor stops moving, the electricity ceases. It was not until recently that scientists found that when a current carrying conductor was placed in a magnetic field, this field would modify the current flowing even though the conductor was not moving. This voltage developed was extremely minute and is known as the HALL EFFECT. It varies for different materials and the microscopic voltage must be amplified and passed to a trigger so that it can be used in a switching circuit. This action is now available in a package the size of a standard transistor. The block diagram fig. 1. shows the functions within the HALL device. The tables list the most important parameters and typical applications.

Since a HALL EFFECT DEVICE produces only a switching action, you may be tempted to say "Why not use a reed switch?". If you knew the limitations of a reed switch, you would realize the value of this new device. A reed switch has a very limited life. Even with a life expectancy of 1 to 10 million operations, this becomes fairly short if we use it for detecting shaft rotations or large-scale counting. In addition, a reed switch has a fairly slow speed of operation and produces a lot of switch bounce which would need to be removed before it could be used in digital circuits. The HALL device has a Schmitt trigger built into the package to produce a very clean on/off signal. It also has a guaranteed life expectancy of 12 billion operations and can operate at speeds in excess of 100,000 pulses per second. With these figures there is no comparison. A reed switch is purely suited for detecting the opening of a window or door in a burglar alarm system.

We have selected two types of HALL switches. We found them to be almost identical in sensitivity and suitability. The "transistor looking" HALL switch is a TL 170C and costs about $1.70. The other looks like a thick film construction and cost a little more at about $2.35. Both are available from Stewart Electronics, 44 Stafford St., Huntingdale, 3166. (Their origin of manufacture would account for the difference in price.)

Both switches are very easy to connect to the counter module. The TL 170 requires a 10k resistor as shown in figure 2 to supply the output transistor with rail voltage. We are using only low voltage in our circuit and the maximum Vcc of 7v will not be exceeded. If you intend to use a higher voltage, it will be necessary to add a zener reference and filtering. The voltage on the output transistor is limited to 30 volts and is capable of supplying 20ma. You will see that the output transistor is quite separate from the HALL sensing circuit and this is the reason for the two different voltage levels.

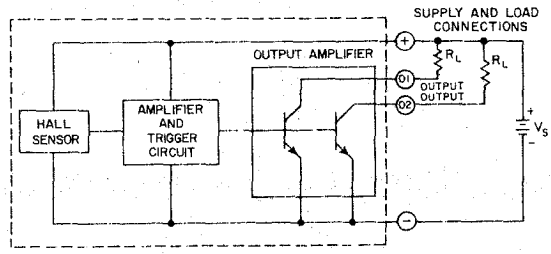


To trigger the HALL device, almost any magnet will be suitable. Try robbing one from a magnetic badge of a small motor. Set up the following experiment and see how the HALL device responds to magnetism.

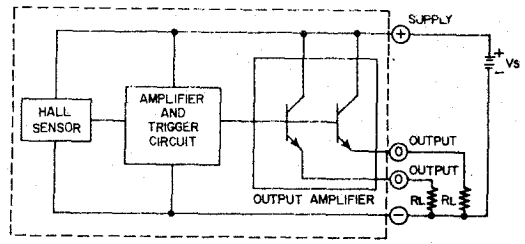
DETECTING ROTATION

The HALL EFFECT sensor is ideal for detecting shaft rotations. It can be set up fairly quickly with a magnet attached securely onto the shaft and the sensor placed alongside. The sensor should be mounted in a diecast box as shown in the diagram with the three leads clearly marked. Cut out an opening in the lid of the box about 2cm x 4cm and cover it with clear perspex or plastic from a blow-moulded bottle. We found the HALL device was only capable of detecting movement in one direction. This means that the magnetic tab will not be picked up when the shaft is rotating in the opposite direction. This can be awkward if you are sensing the tail shaft of a car or truck. To overcome this, place one tab in the NS direction longitudinally along the shaft and another tab in the opposite direction at the 180° mark. As the two tabs come around, the sensor will respond to only one tab. On reversing the truck, the other tab will record a pulse. The speed of rotation will only be limited to the centripetal force exerted on the magnet. The sensor is capable or detecting 100,000 revolutions per second. That's even faster than a high-speed dentists drill.

CURRENT SINKING CIRCUIT

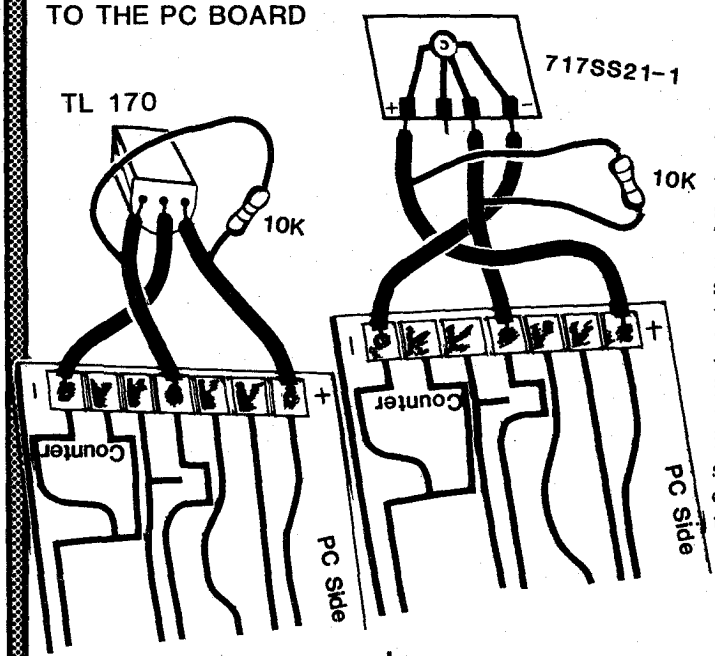


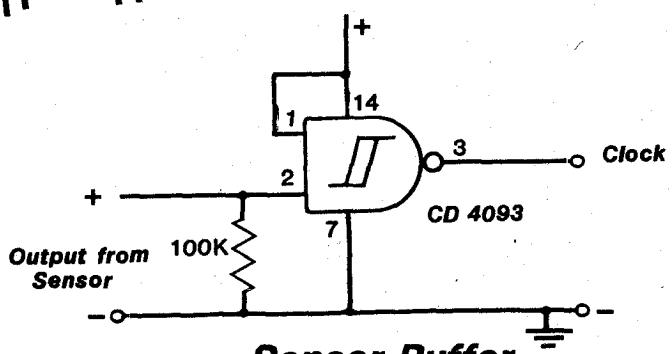
CURRENT SOURCING CIRCUIT



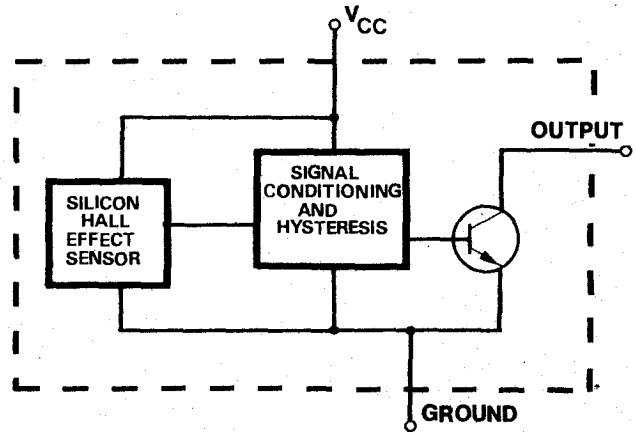
With either HALL device, mount it on a piece of Veroboard to prevent the leads from breaking, as the unit is handled. Fit the 10k dropper resistor and connect the three leads to the Counter Module PC board as shown. The sensitive face of the HALL device is shown upwards. Slide a magnet across the front of the sensor. Note the counter adds one unit count. Now move the magnet away from the sensor a very small distance and bring it back again. Notice the counter does not add a count this time. The magnet must be taken further away from the sensor and brought back again to register a count. This feature prevents the sensor from false triggering or "bouncing" as the magnet is moved past the sensor. If this feature was not included, a point would be reached by the magnet which would pulse the sensor an excessive number of times, even without the magnet moving. In magnetic terms this is called hysteresis and is electronically analagous to the Schmitt trigger. In fact a Schmitt trigger is incorporated in the sensor to give us this stable situation and completely remove any bouncing. An output transistor is integrated onto the silicon chip to enable the HALL device to supply about 20ma.

CONNECTING THE SENSORS TO THE PC BOARD





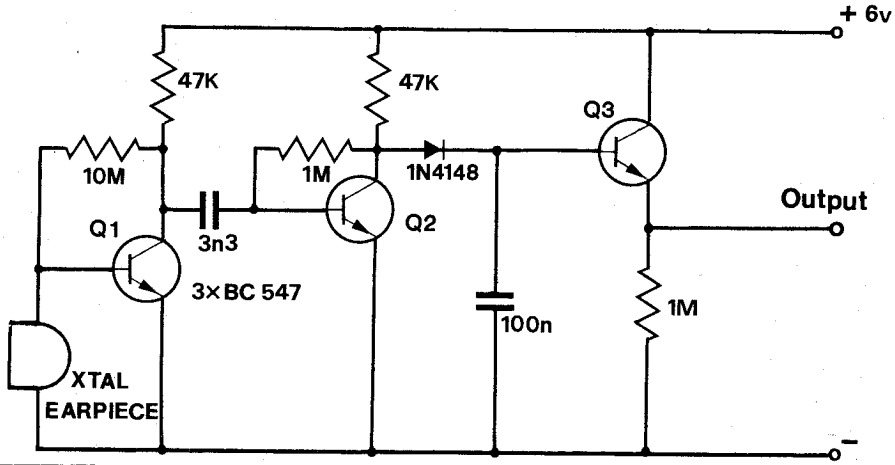
Sensor Buffer



HALL EFFECT SWITCH TL 170

SOUND

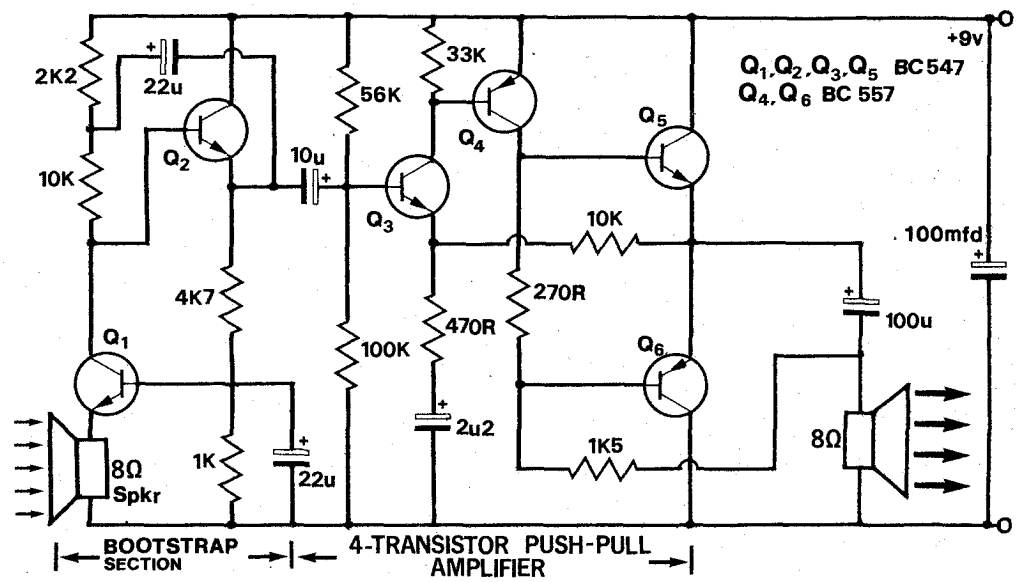
The sound detector circuit uses a crystal earpiece to pick up audible sounds and convert them into a reference voltage for Q3. The signal appearing at the base of Q1 is amplified and passed to Q2 via the 3n3 capacitor. Both Q1 and Q2 are self-biasing stages requiring only one resistor to give a slight turn-on voltage. Q2 will respond to the signal passing through the 3n3 and this will appear at the collector in an amplified form. The 1N 4148 diode rectifies this voltage and charges the 100n capacitor. This voltage is transferred to the 1M resistor via Q3 which acts as an impedance matching device to separate the capacitor from the load. This rising voltage will then trigger the Schmitt trigger which is made from one gate of a CD 4093 and will pulse the counter one count. The circuit is fairly sensitive and will respond to a whistle or clapping of the hands as one count. A natural time delay is provided by the discharging of the 100n capacitor so that the circuit cannot be pulsed any faster than about 5 cycles per second. The output from this circuit must be passed to a Schmitt trigger to clock the Counter Module. It does not have a fast rise-time and cannot be connected directly.



THE TRANSISTOR PAGE

& 4-Transistor Amplifier

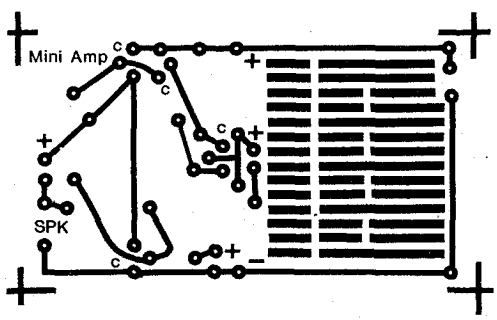
SUPER BUG

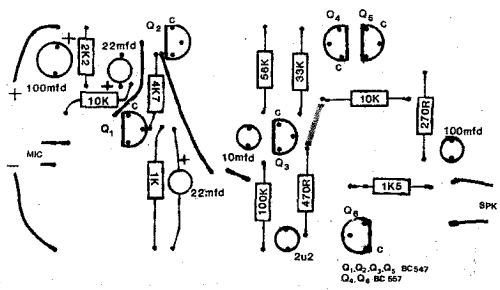


This is a dual purpose project. It combines a printed circuit board layout with a matrix-type front end. This will give a wide range of possibilities for experimenting. The SUPER BUG circuit is only one of the many input arrangements suitable for matching an input device to an amplifier, As you may know, an amplifier must be designed around the capabilities and impedance of the pick-up. And these vary considerably from one device to another. One of the lowest output devices in both voltage and impedance, is a loudspeaker and normally it is quite unsuitable as a microphone. This is due to the difficulty in matching its 3 ohm impedance to the input of a transistor amplifier. We have overcome this with the bootstrap section made up of transistor Q1 and Q2. Not only does it match the low impedance of the speaker to the amplifier but it provides a voltage gain of about 500 times. This turns a worthless speaker into a magnificant microphone. And it really works well. To prove it we received an interesting letter from Paul Pallaghy who improved the performance of the SUPER BUG considerably when he placed a 100mfd electrolytic across the battery. As he writes "I accidently discovered that if a capacitor is placed across the 9v battery, the amplification of the circuit is increased considerably. Using an 8 inch speaker, there was so much feedback that I needed to place the speaker on 4 metre leads". There is a simple explanation for this. The electrolytic reduces the internal impedance of the battery by storing energy during the low current demands and delivering it when required. This enables the amplfier to increase its output as it raises the effective voltage to the pre-amplifier stage.

This project can be treated as two separate units.

Stage one is to consider the 4-transistor amplifier as a handy test amplifier and stage two is to use the whole project as a sensitive listening device. This choice will depend on your requirements. It will be presented as a whole and you can select which arrangement you require.





A bench amplifier is a very handy piece of equipment for testing small signal devices. Three simple uses which come to mind are: testing a faulty transistor radio, a piezo crystal in a tone arm or a crystal microphone. It can also be used to amplify a crystal set or a single transistor radio. In fact, any output device with less than 500mV output will need amplification before it can be expected to drive a loudspeaker. All the above input devices are of fairly high impedance, but suppose you had a very low impedance device. This would include a moving coil microphone or a tape-recorder head. These devices would not only require greater gain but also some form of special impedance matching between the unit and the first transistor to ensure the full sensitivity is obtained.

You may even wish to experiment with designing your own front end for a very low impedance sensor or produce a set of tone controls to fit between the output of a pre-amplifier and the 4 transistor amplifier. For these situations, this project is the answer. It provides just the right facilities for experimenting. The 4 transisitor amplifier is mounted on portion of the printed circuit board and the remainder is left for your own choice of circuitry. The "front end" layout is arranged in the form of "breadboarding" with the familiar matrix of strips. This layout has been chosen to save you making any cuts in the tracks. With normal matrix strips, it is fairly difficult to think ahead as to where the cuts should be located and this situation has been avoided. If you wish to alter the circuit, it is a simple matter of removing the components and refitting new ones. Actually, at the low cost of this whole project, it would not be beyond consideration to invest in two printed circuit boards and two sets of components. With this transformerless output stage, the cost of the parts is very little. With two units, one would function as a low impedance amplifier while the other would test high impedance devices.

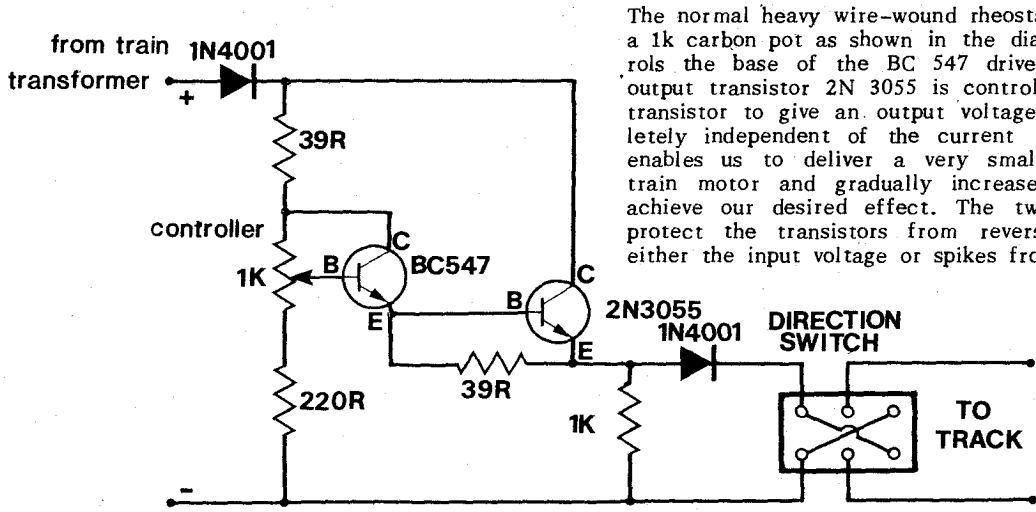
The layout diagram on the previous page shows the arrangement for the bootstrap section and the parts location for the 4 transistor amplifier. Obviously the location for the amplifier parts is fixed but the pre-amplifier or bootstrap section can be altered to suit your own conditions.

These projects on the TRANSISTOR PAGE are generally intended as a guide and not a fully described project. As such we leave it to your own ability to do a lot of the circuit arrangement. Just as we have had to experiment with making up the pre-amp stage, we would like you to see if any of the components can be omitted from the front end without having any effect on the gain. You cannot come to any harm by placing large electrolytics across each component or halving the value of any resistor.
This will help your understanding more than two dozen pages of notes. I only remember by actually performing the task myself. If you read about it, you may forget it. But if you DO it, the knowledge remains with your for ever.

□

K Stone 3192

Train Throttle

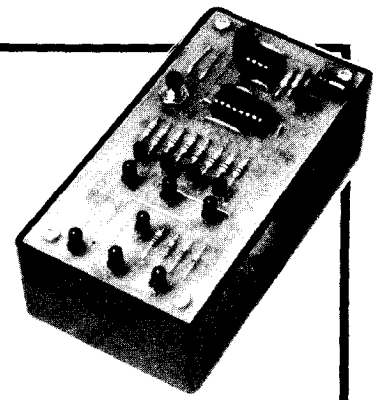


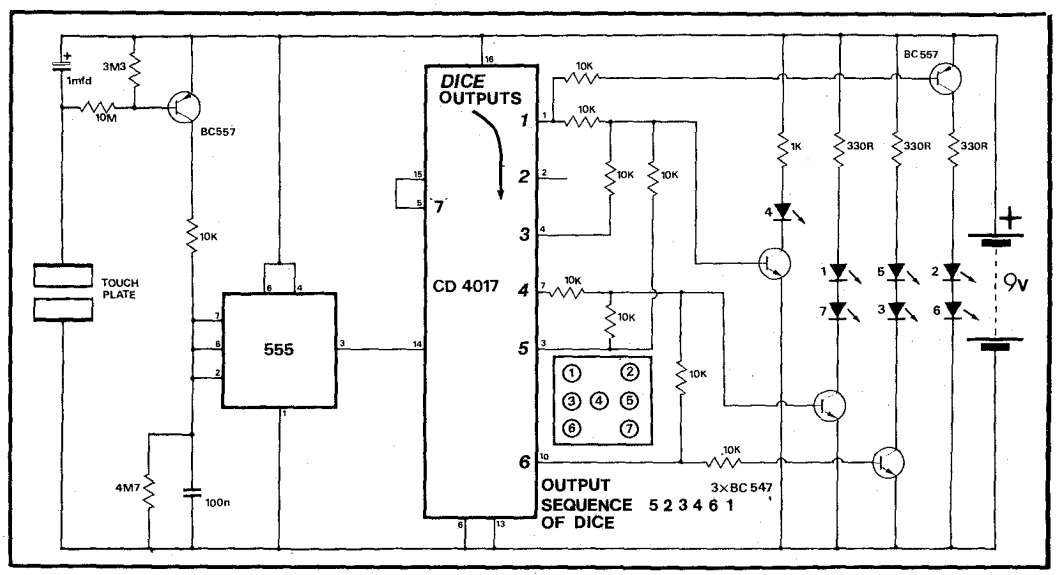
This throttle is for model train enthusiasts. By adding this circuit to your speed control box you will be able to simulate a train slowly starting from rest. Especially a fully laden gooods train. In real life these trains may take a number of kilometres to gain full speed and this effect is desirable in a model situation where the maximum effect is desired. The normal heavy wire-wound rheostat is replaced by a 1k carbon pot as shown in the diagram. This controls the base of the BC 547 driver transistor. The output transistor 2N 3055 is controlled by the driver transistor to give an output voltage which is completely independent of the current requirement. This enables us to deliver a very small voltage to the train motor and gradually increase the voltage to achieve our desired effect. The two diodes are to protect the transistors from reverse polarity from either the input voltage or spikes from the rails.

□

LED DICE *WITH SLOW DOWN*

A REALISTIC DICE WITH "TUMBLING" ACTION



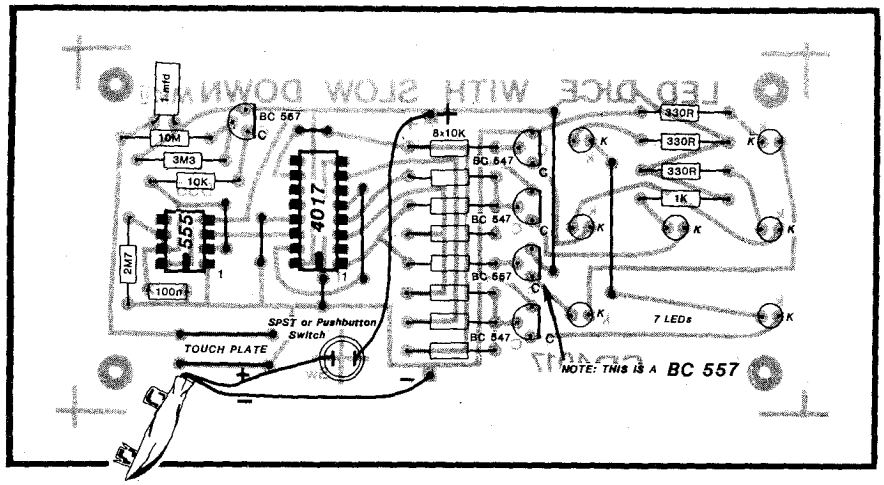


This project combines the advantages of our other two dice projects. If you have built either one or both of the other models you will be very pleased with this improved version. It uses a realistic readout via seven LEDs and has a "slow down" feature. The LEDs are positioned on the printed circuit board in the same positions as the dots on a dice. The effect of the flashing of these LEDs similates the rolling of a real dice in as much as the flashing slows down like a tumbling dice. Consequently what else could we call the project but LED DICE WITH SLOW DOWN. It fits neatly on top of a medium size zippy box with the printed circuit board mounted directly on top in place of the alumium lid. It's another one of "neat little projects" which you will be pleased to show around. A small pre-printed panel can be placed under the LEDs before soldering them onto the board to add realism to the project. Since the LEDs have a low level of illumination, they may be lost in bright sunlight but in a normally lit room they will be most effective. All the parts for this project are readily available and should cost about $7. The only extra parts you will need will be a zippy box and a 9volt battery.

The way in which the circuit works is very ingenious. When you touch the TOUCH PLATE WIRES, the LEDs start flashing in a similar manner to a dice rolling over and over. This gradually slows down to rest on a number which is displayed exactly like the dots on a dice. This "illuminated dice" effect has fascinated me ever since I saw it on an animated display near a busy city junction. It showed a pair of brightly lit dice tumbling over and over and finally coming to rest on a randomly selected number. An apt caption below the neon sign read "DON'T GAMBLE, USE SHELL" Unfortunately the sign was pulled down to make way for road widening and I don't think it has appeared elsewhere. In those days, whenever I passed, I had a personal bet as to which number would come up next. I don't think I ever won, even though the chances were just 36:1. With the passage of 20 years, the mechanics and electronics of this display can be reduced to a couple of IC's and a handful of parts. I hesitate to think how many switches and relays were used in the original design.

As we have mentioned before, the operation of the circuit is quite ingenious. We have programmed the first six outputs of a DECADE COUNTER to light various combinations of LEDs. These LEDs are arranged at one end of the PC board to form the dot layout of a normal dice. One extra LED is placed in the centre to create "one" and "five" patterns. Instead of sequencing each output to correspond to one, two, three etc on a dice, we have jumbled up the sequence to simulate the rolling of a real dice.

The first unusual feature you will notice with this circuit lies in output pin 2. It seems to go nowhere. Only after examining the make-up of the numbers 1, 2,3,4,5,6 will you notice that the LEDs representing



the number 2 are also used for 3,4,5,6. The only time when they are extinguished is for the number 1. We have used this knowledge to reduce the number of components. The next important feature involves the buffer transistors. They are necessary to drive the LEDs adequately to obtain maximum brightness. We found it impractical to drive the LEDs directly from the output of the CD 4017, especially when a number of LEDs were to be illuminated.

The 10k resistors have a dual function. They are used partially as gating and partially for current limiting to the base of the transistors.

Take for instance, pin 1 of the CD 4017. When it is HIGH, it will turn off the upper BC 557 via the top 10k resistor and will allow sufficient current to flow to achieve this. Also connected to pin 1 are three other 10k resistors and we must work out the resulting voltage which will appear on the output of this combination if say 8v is present on pin 1. By simply calculating the value of these resistors in series/parallel we find the voltage is about one-third of pin 1 voltage or about 2.6 volts. This is adequate to turn on the transistor driving the single LED number 4. (In actual practice you will find the voltage will have dropped to the full turn-on voltage of about .6 to .7v.) When output pin 2 goes HIGH, the only LEDs to be illuminated will be 2 and 6. This represents the number 2 on the dice.

The rest of the circuit is fairly straight-forward. It comprises two building blocks from the previous project. We have found these to operate most successfully.

Testing The Unit

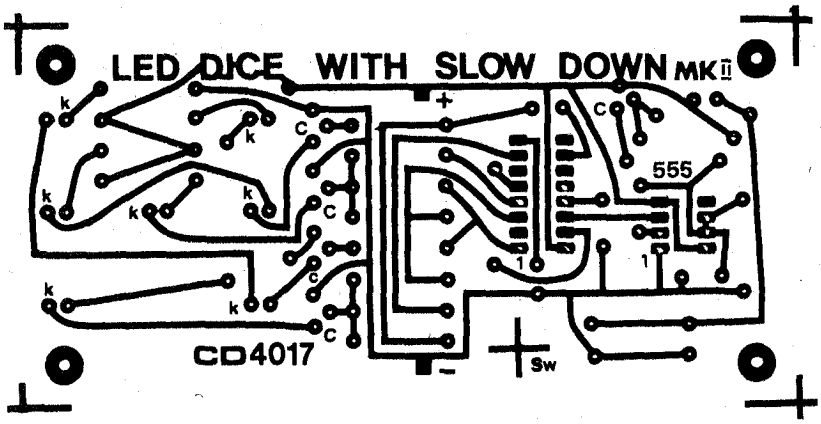
Connect the battery and you should see a number of LEDs light up. Place your finger on the TOUCH PLATE and all the LEDs will appear to be lit. They will gradually slow down to a flicker and finally come to rest. This is the normal action of the project but sometimes things don't work out quite so simply.

There are 3 possible areas of faults.
1. The slow down section,
2. The oscillator section,
3. The counter and readout section.

Without any test equipment it is only possible to test these three sections by starting at the display end and working back to the slow-down stage.

Parts List

R1	resistor	10M	¼ watt
R2	"	3M3	"
R3	"	4M7	"
R5	"	10k	"
R6	"	10k	"
R7	"	10k	"
R8	"	10k	"
R9	"	10k	"
R10	"	10k	"
R11	"	10k	"
R12	"	10k	"
R13	"	1k	"
R14	"	330R	"
R15	"	330R	"
R16	"	330R	
C1	capacitor	100n	100v
C2	electrolytic	1mfd	16v
Q1	transistor	BC 557	
Q2	"	BC 547	
Q3	"	BC 547	
Q4	"	BC 547	
Q5	"	BC 557	
IC1	timer	NE 555	
IC2	decade counter	CD 4017	
LED 1 - 7	5mm red LEDs		
battery snap		switch	
9v battery			
"LED DICE WITH SLOW DOWN" PC BOARD			



The printed circuit board has been designed to fit exactly on top of a UB 3 Zippy or Jiffy box. The corner holes take self-tapping screws which fit into the moulded pillars.
All that will be contained inside the box is a 9v battery.
Before soldering any components, make sure the board fits neatly over the Zippy box opening. Trim the sides of the board with a fine file or sandpaper, to give it a neat fit. Open out the four corner holes to take self tappers.
Begin construction by mounting the resistors, capacitors and transistors. Note: a BC 557 fits between the set of BC 547 transistors. You will also need to take care when inserting the LEDs. All the cathodes of the LEDs face towards one direction excepting one. LED 2 is positioned around the other way. Every thing else is fairly straight-forward. The layout of the board is fairly open and the parts are neatly laid out. The TOUCH PLATE consists of two parallel wires fitted over the top of the board like two staples. The on/off switch can either be a press-on switch or a single pole single throw switch. If a push button is used, you can use it to clock the CD 4017 display and this will show a random number without having to wait for the slow-down.
The integrated circuits are now fitted. You can use sockets or mount them directly on the board. Finish assembly with a battery snap and add a 9v battery.

Mounting The Parts

If the LEDs do not begin to flash when you touch the TOUCH PLATE, you will need to isolate the fault by removing pin 3 of the oscillator from the input clock of the CD 4017 and manually clock the IC with a 10k resistor connected to positive. This should make the LEDs change from one state to another.
Next re-connect the output of the 555 and bridge Q_1 with a 10k resistor. This will make the 555 clock the counter fairly quickly. If this does not happen , check the 555 and the capacitor. To test the slow-down circuit, short out the two TOUCH PLATES with a wire link to produce a very fast changing display. If this has no effect, check the BC 557 and its surrounding components.

If one or more LEDs do not light up, check their orientation or swap them over with some of the other LEDs. With this method you will gradually "home-in" on the fault.

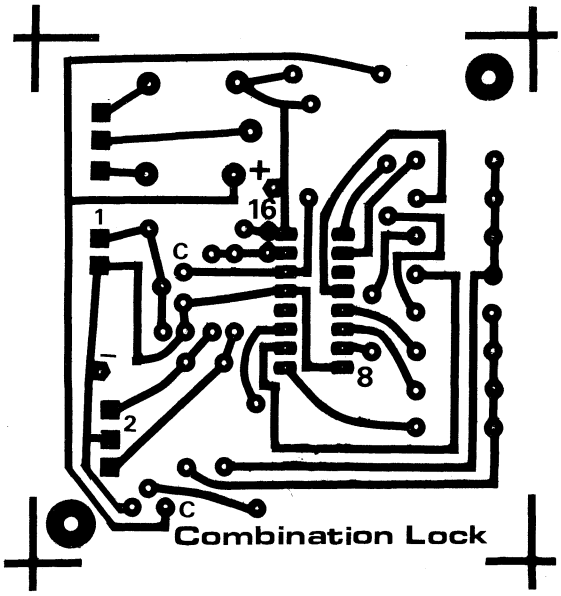
Drag out your old MONOPOLY game. This LED DICE will add new enthusiasm to playing the game. It may even bring you better luck than a couple of dice.

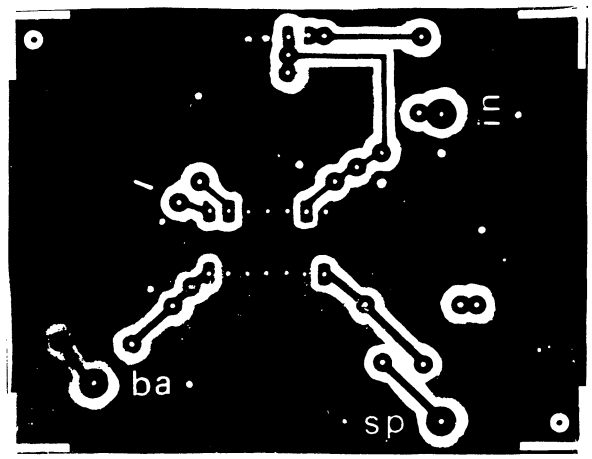
Quiz:

by Craig Jones

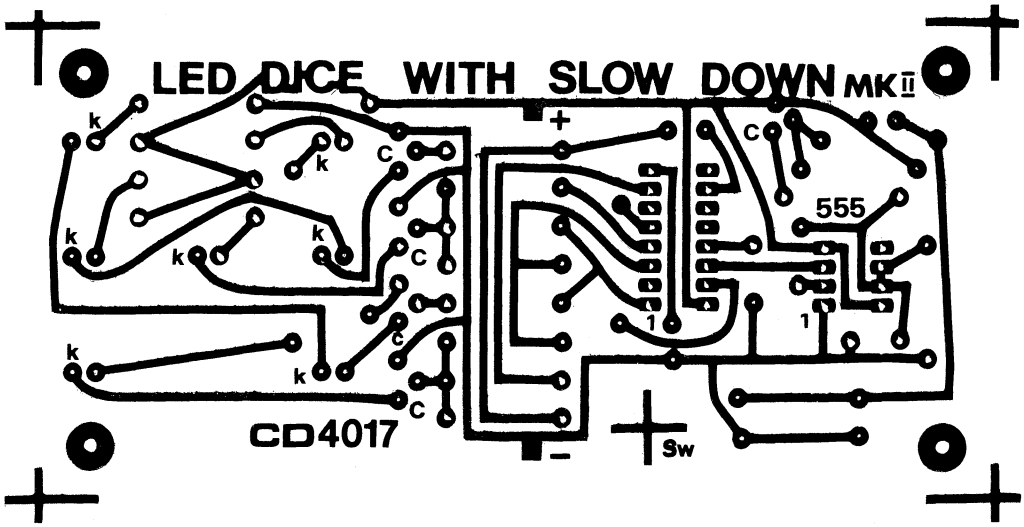
1. What does BCD stand for?
2. Which segments of a 7 segment display would be illuminated for the number 4.
3. Draw the circuit for a simple bistable switch using a CD 4001.
4. Which way do electrons flow through a diode?
5. What is a 74C85?
6. What is 4-bit word?
7. How many ways can a 4-bit word be expressed?
8. What is 4511?
9. What is a pi filter?
10. How many mfd/amp do we use when designing power supplies?
11. Which is more efficient: half-wave rectification or full wave rectification?
12. What is the voltage drop across a silicon diode?
13. Don't get fooled by this one . . . using only a multimeter, how do you detect the difference between a 74C85 and a CD 4024, if the numbers are rubbed off?
14. Why are voltage dividers inefficient?
15. Describe the operation of a full wave bridge rectifier.

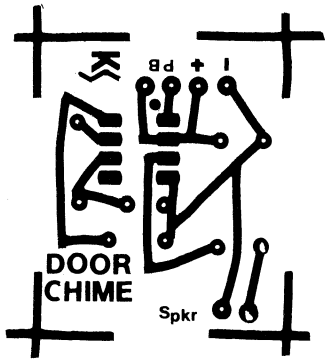
Printed Circuit Board Artwork

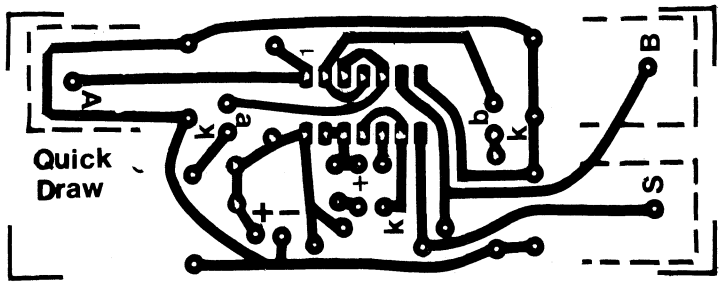


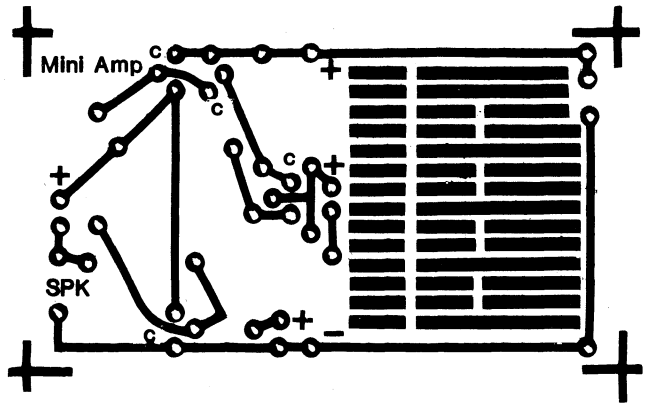


ALL FULL SIZE



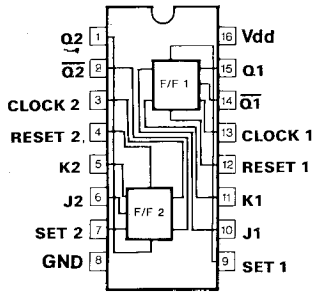






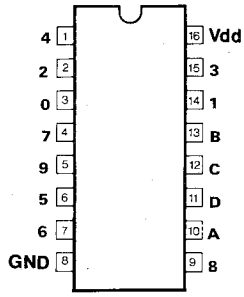
DATA

CD4027B



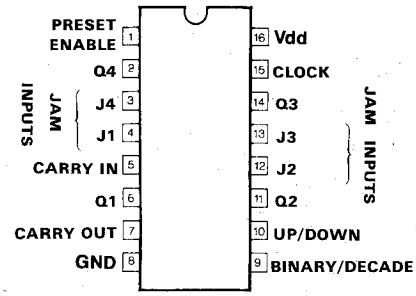
DUAL J-K MASTER/SLAVE FLIP FLOP WITH SET AND RESET

CD4028B



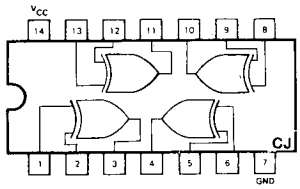
BCD TO DECIMAL DECODER

CD4029B



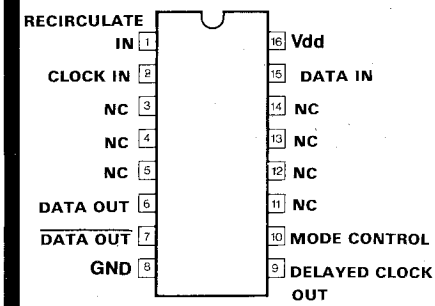
PRESETTABLE BINARY/DECADE COUNTER

CD4030B



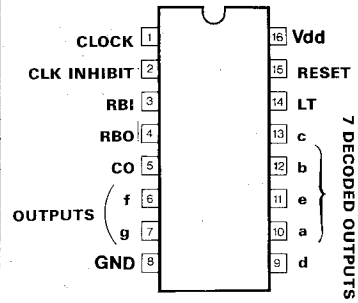
QUAD EXCLUSIVE - OR GATE

CD4031B



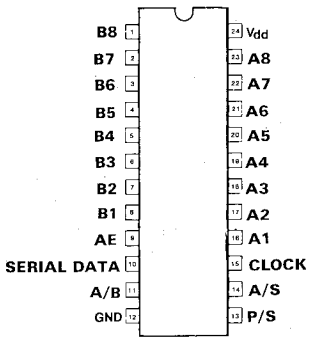
64-STAGE STATIC SHIFT REGISTER

CD4033B



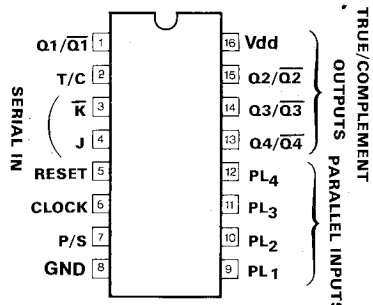
DECADE COUNTER DIVIDER

CD4034B



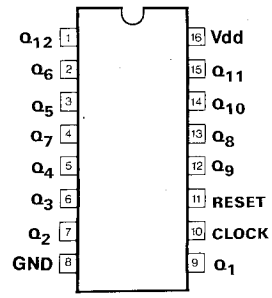
8-STATE TRI-STATE BIDIRECTIONAL PARALLEL/ SERIAL INPUT/OUTPUT BUS REGISTER

CD4035B



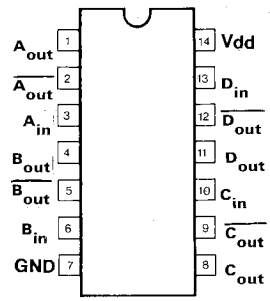
4-BIT PARALLEL-IN/PARALLEL-OUT SHIFT REGISTER

CD4040B



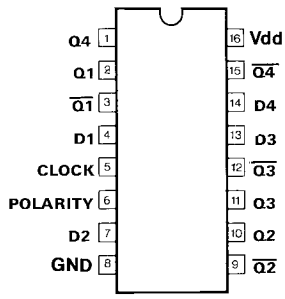
12-STAGE RIPPLE CARRY BINARY COUNTER

CD4041CN



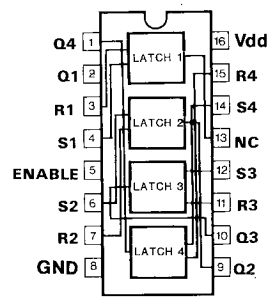
QUAD TRUE/COMPLEMENT BUFFER

CD4042B



QUAD CLOCKED D LATCH

CD4043CN



QUAD TRI-STATE NOR R/S LATCHES

CPW