TALKING ELECTRONICS®

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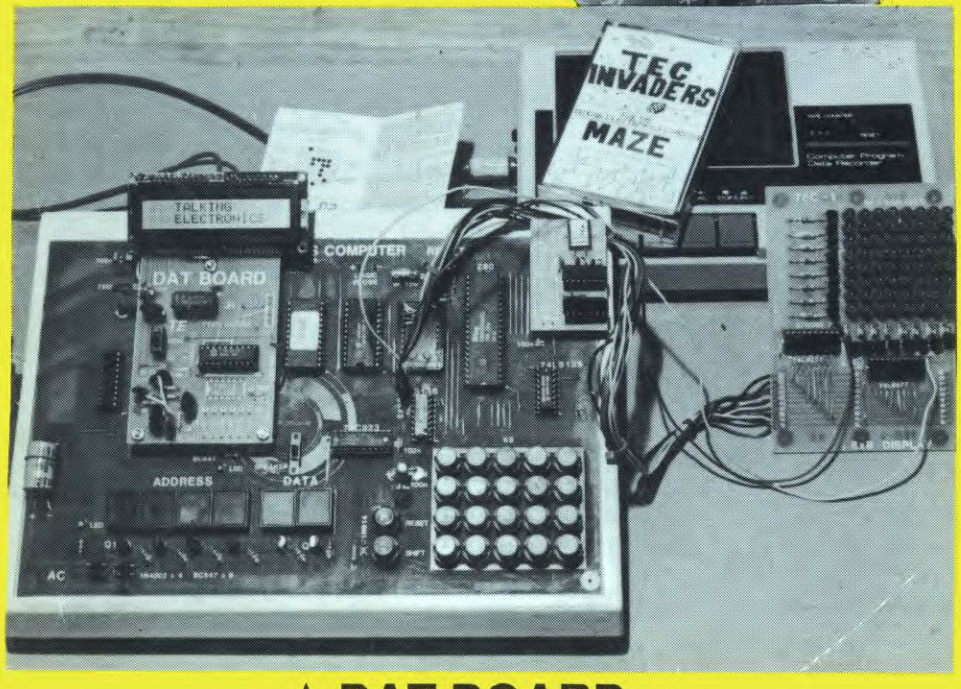
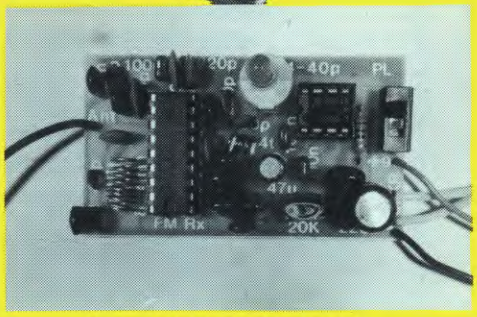
$3.00
$4.60NZ

Issue No 15

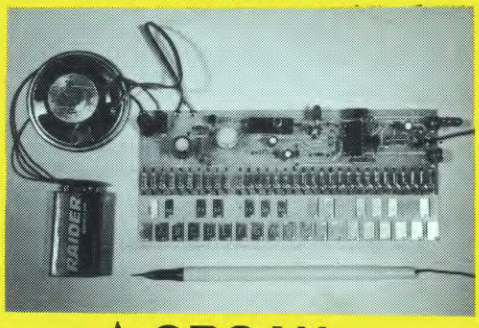
☆CAR ALARM
☆ULTIMA
(A 1km TRANSMITTER)
☆SPEECH MODULE



☆ DAT BOARD



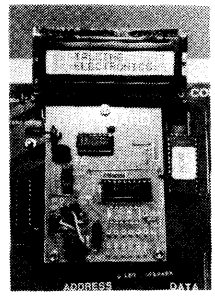
☆ FM RADIO



☆ ORGAN

KITS IN THIS ISSUE

All the projects in this issue are available in kit form. Each kit comes with a professionally-finished PC board with all parts identified on the overlay and pre-tinned copper tracks.
Don't forget to add the price of the PC board to the kit to get the total price. See the centre pages of this issue for the full range of TE kits including an order form and postage charges.



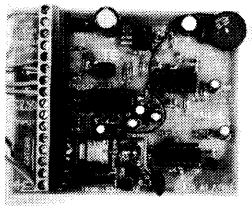
DAT BOARD

The DAT BOARD extends the TEC's capabilities by providing a tape interface, a Liquid Crystal Display Module and single stepper. The DAT BOARD works in conjunction with Jim's new MONitor: JMON.

Parts: $ 11.80
PC board: $ 4.55
Complete: 16.35
LCD: $ 39.00

CAR ALARM

An essential addition to your car. Has all the features you need including ignition killer, all for under $100!



Parts: $ 57.70
PC board: $ 5.95
Complete: $ 63.65

Ignition killer:
Parts: $8.00
PC board: $ 2.80
Complete: $ 10.80

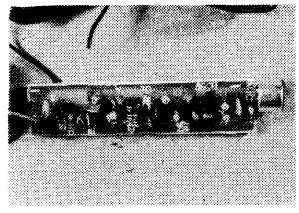
Complete: $74.75
(less back-up battery)

Battery: $ 19.00

JIM'S PACKAGE

Learn the inside workings of JMON with this package. Contains a complete disassembly of JMON with comments.

$16.00



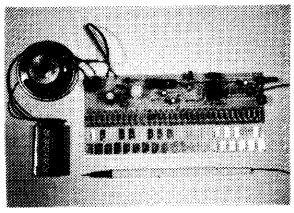
ULTIMA

Our 1km FM bug. Using a 6v supply, you can be assured of reaching 1km with this handy little transmitter. You will need the LED Power Meter to peak the output.

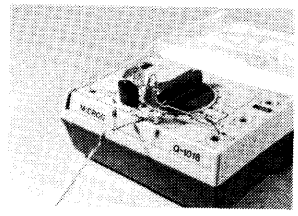
Parts: $ 10.00
PC board: $ 2.50
Complete: $ 12.50

ORGAN

A simple 32 note monophonic organ using a stylus to produce the notes. Has vibrato and effects and makes an ideal gift.

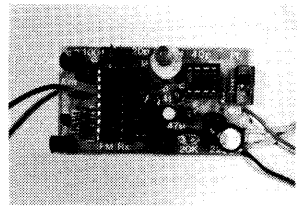


Parts: $ 14.50
PC board: $ 4.25
Complete: $ 18.75



LED POWER METER

Required to peak the ULTIMA for maximum range. **$ 1.10**



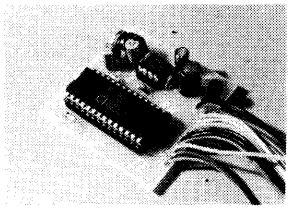
FM RADIO

This is a two-chip FM receiver using the popular TDA 7000 FM chip. It's very easy to build and requires no alignment.

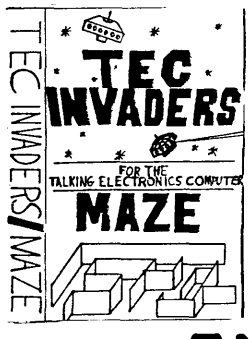
Parts: $ 19.15
PC board: $ 2.80
Complete: $ 21.95

SPEECH

A very simple project that adds speech to your TEC computer. Can be programmed to say any word at all or you can use the library of words included in the project.



Parts: $ 24.25
PC board: $ 3.00
Complete: $ 27.25



TEC INVADERS AND MAZE

The first tape software for the TEC. Written by Cameron Sheppard, these 2 games will keep you amused for weeks. Instructions are included. Both games use the 8x8 on ports 5 and 6.

$ 6.50

EPROM BURNER UP-GRADE

Fix a few bugs and extend the versatility of the issue 13 EPROM programmer with this kit. A "MUST" if you are to burn the unused half of the JMON ROM. **$ 2.30**

TALKING ELECTRONICS Pty Ltd
35 Rosewarne Ave., Cheltenham, 3192.
(03) 584 2386

MasterCard VISA bankcard

Post & Pack $2.50 per kit.
Max. P&P $8.00

15058920k

TALKING ELECTRONICS

Vol.1 No: 15.

Editorial

It's great to get another issue of TE out. If you think the delay between issues is intentional you're wrong. It's much more complex than that.

The instant we get an issue out the orders start to flow and it takes about three months before they taper off enough for us to get back to the drawing board for the next issue.

Since the last issue we have doubled in size and now have 6 staff and 2 part-time helpers. Even so, we can't get the issues out any quicker as each project takes a long time to prepare, when you take as much care as we do.

Most of the delay is not our doing at all.

It comes from the run-arounds from suppliers and the like. Take the trouble we have had with designing a new microprocessor project. It is practically impossible to find a suitable CPU thats cheap and surpasses the Z-80. We have come to so many dead ends that we have given up on the idea for the moment.

Even with the range of common parts as used in TE kits, we experience shortages of components for nearly every kit and it's a constant hassle waiting for things to come in.

Never-the-less we have been hard at it, producing ideas for beginners, add-ons for the TEC and projects for the more advanced experimenter.

The DAT board is our latest add-on for the TEC and includes a software package that advances the TEC's capability quite considerably.

Also included is a speech project using the SP 0256 AL2 allophone chip. Although I find it difficult to understand some of the words it produces, this chip is the cheapest and best on the market at the moment. With this project we can finally say we have a talking project to substantiate our name "Talking Electronics."

Our cover project is a car alarm that offers all the features you have ever wanted, and at a price that beats anything else on the market.

For the beginner we have a couple of starter projects that will introduce the magic of electronics.

All in all we hope to cater for everyone and I hope you have noticed our new format and different type-style.

This is the first issue from our desk-top publishing set-up. After spending nearly $20,000 and experiencing 2 hard-disk crashes with the loss of weeks of work, we can say we are on the way to producing page-finished copy for the magazine. We will tell you more about our system next time as we have a whole story to relate! It's a bit like the photocopy saga all over again.

See the centre pages of this issue for a current list of kits and books we have released. The notebook series is especially important as notebook number 5 has a BEC (Basic Electronics Certificate) set of questions to show you the content of a course that gets you started in electronics via Australia-wide TAFE colleges. If you have ever wanted to know where to start, this is it. The BEC is the first step to take.

Our shop at Moorabbin has just opened to coincide with the release of this issue. If you are passing by that way, call in and see Ross, he will be only too glad to show you the enormous range of Public Domain software and all the other things he has on the shelves.

Don't forget our kits (we have over 100 different models) and I hope to see you sending for something in the near future.

For now,

Colin Mitchell.

PUBLISHERS NOTE:

Talking Electronics is designed by Colin Mitchell at 35 Rosewarne Avenue, Cheltenham, Victoria 3192, Australia. Articles suitable for publication should be sent to this address. Ring us first on (03) 584 2386. All material is copyright however photocopies are allowed when building a model and for those issues no longer available.

*Maximum recommended retail price only

CONTENTS

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Technical: Jim Robertson
CAD Artwork: Paul Loiacono
Enquiries: 10 minute queries
584 2386 8am - 6pm.

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PC-Blue 499 PC-Write ver 3.01 (vol 1 of 3)
PC-Blue 498 DiskWiz v1.3 disk manager
PC-Blue 497 HP LaserJet Support
PC-Blue 496 Medlin Account Shareware Programs
PC-Blue 495 Clip Art Decals
PC-Blue 494 Clip Art Fancy Letters [2 of 2]
PC-Blue 493 Clip Art Fancy Letters [1 of 2]
PC-Blue 492 Telix v3.1 comm software [2 of 2]
PC-Blue 491 Telix v3.1 comm software [1 of 2]
PC-Blue 490 ZIPDELIM 32,200+ comma delimited
PC-Blue 489 RBBS-PC ver 17.1A [vol 4 of 4]
PC-Blue 488 RBBS-PC ver 17.1A [vol 3 of 4]
PC-Blue 487 RBBS-PC ver 17.1A [vol 2 of 4]
PC-Blue 486 RBBS-PC ver 17.1A [vol 1 of 4]
PC-Blue 485 PFROI v2.3m portfolio management
PC-Blue 484 PC-EXPERT stock market analysis
PC-Blue 483 Payroll USA v2.0 [1989] disk 2 of 2
PC-Blue 482 Payroll USA v2.0 [1989] disk 1 of 2
PC-Blue 481 Free Press
PC-Blue 480 KwikStat v1.2a -statistic package
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PC-Blue 478 CTask v0.1 Multitasking Kernel for C
PC-Blue 477 Finance Man II v1.2 -general ledger
PC-Blue 476 Basic Maillist System
PC-Blue 475 Vernon D. Buerg List Utility
PC-Blue 474 The Window BOSS Revision 6.01.88
PC-Blue 473 The Window BOSS Revision 06.01.88
PC-Blue 472 Winner's Choice
PC-Blue 471 Phil Katz PKware Utility version 1.1
PC-Blue 470 College Football Pool v2.0
PC-Blue 469 Bradford version 2.04
PC-Blue 468 Professional PC Accounting System
PC-Blue 467 Robert Stout Toolkit v2.04D [2 of 2]
PC-Blue 466 Robert Stout Toolkit v2.04D [1 of 2]
PC-Blue 465 Ask-It version 0.15
PC-Blue 464 ModLib
PC-Blue 463 Lotto Fever version 2.0
PC-Blue 462 Mass Appeal v3.0
PC-Blue 461 See Volume 460
PC-Blue 460 ProComm Plus TestDrive version 1.1
PC-Blue 459 In-Control "12 Pack" Options
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PC-Blue 456 Church Contribution System v2.02
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PC-Blue 454 PC-Key-Draw version 3.33
PC-Blue 453 Brown Bag Series [3 of 3]
PC-Blue 452 Brown Bag Series [2 of 3]
PC-Blue 451 Brown Bag Series [1 of 3]
PC-Blue 450 Nimble v1.40 database management
PC-Blue 449 A86/D86 Assembler/Debugger v3.14
PC-Blue 448 RBBS-PC v16.1a [4 of 4 /doc
PC-Blue 447 RBBS-PC v16.1a[3 of 4 /source]
PC-Blue 446 RBBS-PC v16.1a [2 of 4 /.EXE ASM]
PC-Blue 445 RBBS-PC v16.1a [1 of 4 /utilities]
PC-Blue 444 Canon LBP laser drivers (disk 2 of 2)
PC-Blue443 Canon LBP laser drivers (disk 1 of 2)
PC-Blue 442 4PRNT v2.20 HP LJ print utility
PC-Blue 441 INVESTOMAT securities analysis
PC-Blue 440 The HOLY BIBLE - K James (5 of 6)
PC-Blue 439 The HOLY BIBLE - K James (5 of 6)
PC-Blue 438 The HOLY BIBLE - K James (4 of 6)
PC-Blue 437 The HOLY BIBLE - K James (3 of 6)
PC-Blue 436 The HOLY BIBLE - K James (2 of 6)
PC-Blue 435 The HOLY BIBLE - K James (1 of 6)
PC-Blue 434 X Window System version 11
PC-Blue 433 ProComm Plus Test Drive
PC-Blue 432 DMail version 3.2
PC-Blue 431 DROEGE - Dsgn Robot for Origination
PC-Blue 430 Turbo C Utilities
PC-Blue 429 PC-File + version 2.0 [2 of 2]
PC-Blue 428 PC-File + version 2.0 [1 of 2]
PC-Blue 427 PC 370 version 3.2
PC-Blue 426 MrBill version 3.26 [2 of 2]
PC-Blue 425 MrBill version 3.26 [1 of 2]
PC-Blue 424 COordinate GeOmetry [COGO] v1.22
PC-Blue 423 PC-CALC + documentation
PC-Blue 422 PC-CALC + electronic spreadsheet
PC-Blue 421 PC-CALC + electronic spreadsheet
PC-Blue 420 Cambridge Handicappers version 3.0
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PC-Blue 418 Checking Account Man System v2.12
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PC-Blue 416 CopyFit version 1.0
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PC-Blue 412 Modula-2 Tutorial version 1.00
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PC-Blue 410 Profile Professional Filing version 1.0
PC-Blue 409 A Robot Control "C" Library (2 of 2)
PC-Blue 408 A Robot Control "C" Library (1 of 2)
PC-Blue 407 Wildcat BBS version 1.03 SW (2 of 2)
PC-Blue 406 Wildcat BBS version 1.03 SW (1 of 2)
PC-Blue 405 FastBucks ver 3.18 Home Finanace
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PC-Blue 403 Income Tax Preparation Programs
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PC-Blue 401 PC-SSP Scientific Subroutine Pkage
PC-Blue 400 Batch Menu Maker, v4 & File Finder
PC-Blue 399 On-Line Reference v1 - Softek, Blackbeard Pgmr's Editor, v7.34
PC-Blue 398 CheckMate-GL v1 G/L -T.Bougan HP LaserJet Fonts -MS Word
PC-Blue 397 Prof MasterKey v2.1a DOS util
PC-Blue 396 Envelope HPLJ v5.02 template-H
2 TMSN3060 60Pt Times Roman
PC-Blue 395 PC Text v2c text analyzer toolbox
PC-Blue 394 CheckMate v1.05 Checkbook mgmt
-T.Bougan Galaxy v2.2c WP
PC-Blue 393 Communications: MiniHost by Mankin
QuickTalk v2.1-D.Rand
PC-Blue 392 CD ROM Utilities EDIT1302 v1.38
PC-Blue 391 HP LaserJet Fonts - Ventura Pub
PC-Blue 390 HP LaserJet+ Fonts - Ventura Pub
PC-Blue 389 MicroTEK Utils -Computer Consultants Mail Right v2.5
PC-Blue 388 Application Talker Screen Print
BarLine Graph v1.3 - H
PC-Blue 387 FastMenu v1.2 & PC-Accounting
PC-Blue 386 386MUL checks 386 MPU LIMS 4.0 -Intel AboveBoard
PC-Blue 385 GT Power Communications v13 #3
PC-Blue 384 GT Power Communications v13 #2
PC-Blue 383 GT Power Communications v13 #1
PC-Blue 382 MYSTAT -Interactive Statistics
PC-Blue 381 C Spot Run -B Pritchett
PC-Blue 380 SMALL-X EXpert system shell-R Kaplan HDP -A/R -B.Holman
PC-Blue 379 Book201 & MultiFile v1.5 & Artificial
PC-Blue 378 PC-Util v1.1 misc utils -ABACUS Computer Svc
PC-Blue 377 Qmodem v3.1 - Forbin Project[vol 2]
PC-Blue 376 Qmodem v3.1 - Forbin Project[vol 1]
PC-Blue 375 Boyan D3 Communications Pgm - J Boyan Gemfiles Clip Art -
PC-Blue 374 Grocery Store Coupon Organizer
PC-Blue 373 Wampum version 3.1b [disk 2 of 2]
PC-Blue 372 Wampum version 3.1b [disk 1 of 2]
PC-Blue 371 BarCode graphics generator
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PC-Blue 361 Aseasy v 3.0 Spreadsheet
PC-Blue 360 Cl v 1.10 - CPU and Wait State Info
PC-Blue 359 PC-Accounting - AP GR GL system
PC-Blue 358 Backgammon version 2.00
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PC-Blue 356 HP Laserjet II Utilities / Fonts (2 of 2)
PC-Blue 355 HP Laserjet II Utilities / Fonts (1 of 2)
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PC-Blue 350 PD PROLOG version 1.95D - B Morein
PC-Blue 349 PD LISP - D Morein
PC-Blue 348 Cellular Automata Abstract Mathematical Art-Byte Dec 86
PC-Blue 347 RBBS-PC v15.1b [3 of 3] - CPCUG
PC-Blue 346 RBBS-PC v15.1b [2 of 3] - CPCUG
PC-Blue 345 RBBS-PC v15.1b [1 of 3] - CPCUG
PC-Blue 344 PCHECK3 Personal Check Acct Mgmt
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PC-Blue 342 SURFMODL v1.2 [1 of 2]-.Van Camp
PC-Blue 341 PC-ACCOUNT v2.05 - personal acct
PC-Blue 340 MOVIEBASE movie classif database -
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PC-Blue 316 Buttonware Collection 005 - J Button
PC-Blue 315 Buttonware Collection 004 - J Button
PC-Blue 314 Buttonware Collection 003 - J Button
PC-Blue 313 Buttonware Collection 002 - J Button
PC-Blue 312 Buttonware Collection 001 - J Button
PC-Blue 311 QMODEM v3 - Comm 002 - Forbin
PC-Blue 310 QMODEM v3 - Communications 001
PC-Blue 309 MSDOS Utils - Handy DOS - J.Dart Freemacs Emacs Editor -
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PC-Blue 302 PseudoSAM Cross Assemblers 001
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PC-Blue 299 RBBS-PC v15.1A 001 remote bulletin
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PC-Blue 296 001 : HomeBase v2 Desktop Organizer
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All disks $6.00 each including Post & Pack. Some pages 35+ for more titles. We stock the full range.

TE's

CAR ALARM

PROTECT YOUR CAR FROM THEFT WITH THIS FULL-FEATURED ALARM

Car Alarm parts: $57.70
PC board: $5.95
Ignition Killer parts: $8.00
PC board: $2.80
Total: $74.45
12v 1.2AHr battery: $19.00

Police records show that, in 1988, 780 cars were stolen per 100,000 population. That's 117,000 cars per year for a population of 15 million. Or approximately 1 car every 4.5 minutes!

Most cars are usually stripped and sold as spare parts to wreckers or taken by joy riders, for an evening of what they call fun, or broken into just for the contents.

Insurance companies have increased their premiums accordingly and some offer a small discount if your car is fitted with a car alarm. That's what inspired us to design an alarm for the magazine.

A lot of thought has been put into the design and all the common features have been included, including a few of my own.

Here they are:

*Runs off a 12v car battery.

*Has battery backup. (Kept charged when the engine is running)

*Will flash a signal lamp as soon as the ignition is switched off, regardless of whether the alarm is swithed on or not.

*As soon as the ignition is switched off, a beep will be produced for approximately 5 seconds (to remind you to turn the alarm on).

*A 10 second exit delay is provided to allow you to leave the vehicle and lock all doors. (The delay can be removed, as explained in the article)

*The indicators will flash twice after the 10 second exit delay to indicate the alarm is activated and ready.

*Two delayed inputs on-board (active low, ie must be taken to ground or low) to trigger the alarm.

*The alarm is activated approximately 5 seconds after an input has been taken low to give plenty of time for it to be turned OFF by the operator.

*The siren will sound for approximately 2 minutes and shut down ready for another break-in attempt.

*Indicators flash in conjunction with the siren to give a visual indication that the vehicle has been broken into.

*An ignition killer cuts off the ignition as soon as the alarm is turned on.

HOW THE CIRCUIT WORKS

The best way to describe how the circuit works is from the power supply section and battery charger.

The battery charger and power supply is fairly straight foward. The car battery voltage is approximately 12v. This passes through a 1N5404 power diode to the input of a 5 volt regulator. The ground pin of the regulator has two resistors to increase the output voltage to about 9 volts and supplies the rest of the circuit. The key switch connects power to sections of the circuit to activate the alarm.

When the engine is started, the voltage across the car battery increses to about 14 volts. This is due to the battery charging. When the voltage rises to 14 volts, there will be sufficient voltage drop across the 1N5404 diode to keep the backup battery charged.

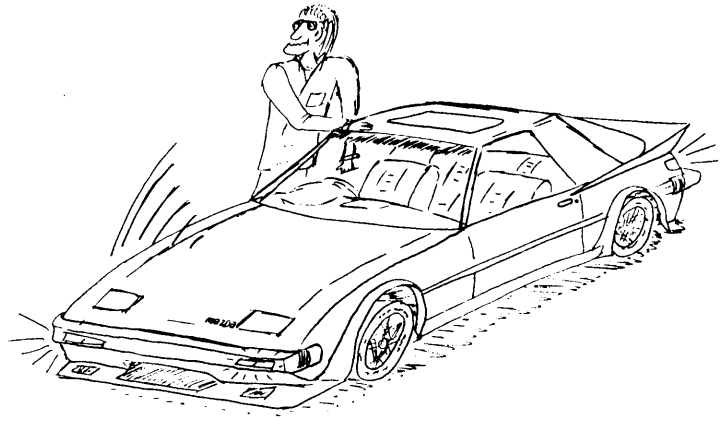
As soon as the ignition is switched off, the voltage on the 47k on the ignition line is removed, thus enabling pin 13 of IC1 and allowing the gate to operate as a low frequency oscillator with an even mark-space ratio. Output pin 12 drives the base of a BC338 transistor via a 1k resistor which in turn switches a dash lamp on and off. The lamp will flash at about one flash per second regardless of whether the alarm is switched on or not.

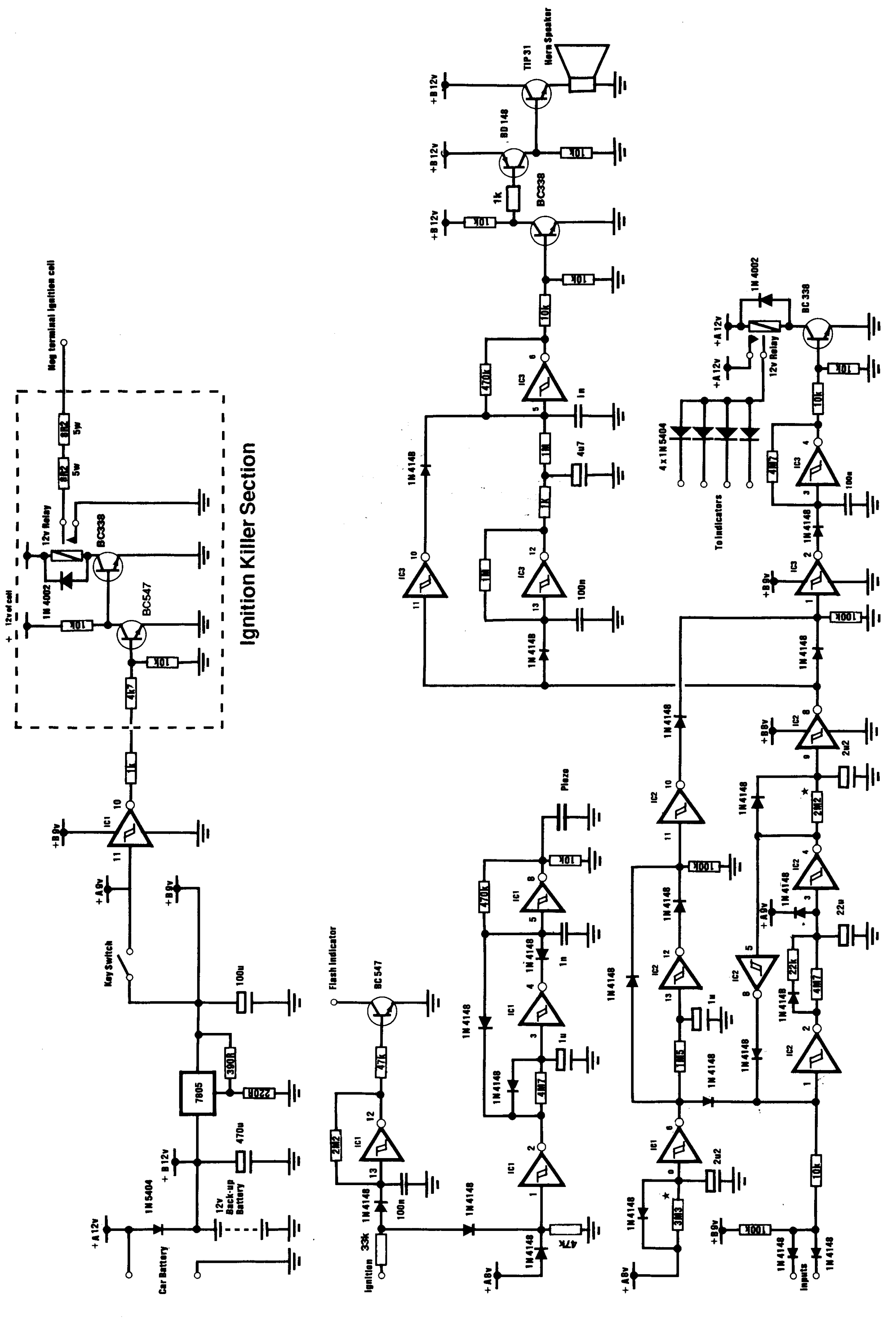
Pin 1 of IC1 will also go low when the ignition is switched off, causing pin 2 to go high. This in turn enables pin 5 of IC1, allowing the gate to operate as another oscillator to directly drive a piezo.

While the tone is being generated, a 1uF electro is slowly charging from pin 2 of IC1 via a 4M7 resistor, increasing the voltage on pin 3 of IC1. After about 5 to 8 seconds the voltage reaches 66% of the supply voltage (approximately 6 volts). Output pin 4 will go low, causing pin 5 of IC1 to go low, disabling the oscillator and the tone will stop. This part of the circuit is used to remind you to turn the alarm on before you leave the vehicle.

When the alarm is turned on, the 2.2uF electro on pin 9 of IC1 is slowly charged via a 3M3 resistor, and increases the voltage on pin 9. When the voltage reaches 66% supply, pin 8 will go low. This part of the circuit is the exit delay and the process takes about 20 seconds.

When pin 8 of IC1 goes low, pin 11 of IC2 is forced low via a 100k resistor. Thus the output pin 10 goes high





CAR ALARM CIRCUIT

enabling the indicator flash circuit, causing all four of the car's indicators to flash. The 1uF on pin 13 of IC2 is slowly discharging, thus decreasing the voltage on pin 13. When the voltage on pin 13 drops to 33%, the output pin 12 will go high, taking pin 11 high, causing the output pin 10 to go low. This disables the indicator flash circuit. This process will flash the indicators twice, indicating the alarm is activated and ready.

Pin 1 of IC2 is also enabled when pin 8 of IC1 goes low and is ready to detect when either or both alarm inputs are pulled low. When this happens, pin 1 of IC2 will go low and the output pin 2 will go high, quickly charging the 22uF electro on pin 3 of IC2. When the voltage on pin 3 rises to 66%, the output pin 4 will go low, taking pin 5 low with it. This causes pin 6 to go high and holds pin 1 high to prevent the circuit from being retriggered. Pin 2 will go low, allowing the 22uF electro to slowly discharge through pin 2 via the 4M7 resistor.

While pin 4 of IC2 is low, the 2.2uF on pin 9 of IC2 is slowly discharging through pin 4, via the 2M2 resistor and when the voltage drops to 33%, the output pin 8 will go high. This part of the circuit is the entry delay and the process takes about 10 seconds. When the 10 seconds are up, both the siren circuit and the indicator flash circuit are enabled.

When pins 8 or 10 of IC2 are high, pin 1 of IC3 will go high and the output pin 2 will go low, enabling pin 3 of IC3, and the gate will operate as a low frequency oscillator with even mark-space ratio. The output pin 4 drives the base of a BC338 transistor, via a 10k resistor, to switch a relay and turn the car indicators on and off (via four 1N5404 power diodes).

The siren circuit is also activated when pin 8 of IC2 goes high. Pin 11 of IC3 goes high causing the output pin 10 to go low. This enables pin 5 of IC3 and the gate works as an oscillator to generate a tone. Pin 13 is also enabled and the gate works as a low frequency oscillator of about 2Hz (2 pulses per second). The purpose of the 1k resistor, the 4.7uF electro and the 1M resistor, is to alter the output frequency of pin 6, as the output pin 12 rises and falls to give a WAH WAH tone rather than a pulsed-tone effect.

Pin 6 is then fed into the input of a simple three transistor amplifier via a 10k resistor. The collector of the first transistor, a BC547, is taken to the base of the second, a BD140. The collector of the BD140 drives the base of the third transistor, a TIP31. This is an emitter follower and the emitter drives an 8 ohm horn speaker to give a very loud output.

The ignition killer is a seperate board controlled by the main board. When the alarm is switched on, pin 11 of IC1 goes high, causing the output pin 10 to go low. This is then passed to the ignition killer board.

The ignition killer consists of three main parts; two transistors and a relay. The positive of the board goes to the positive terminal of the ignition coil. When pin 10 of IC1 is low, the first transistor in the ignition killer (a BC547) is turned off, allowing the current flowing through its 10k collector resistor to flow through the base of the second transistor (a BC338) switching the trasistor on. If the ignition is started, the 12v 10A relay will close, connecting two series 8R2 resistors from the negative terminal of the ignition coil to ground, making it impossible to start the car.

CONSTRUCTION

Construction is straight foward. The board may look difficult to build but is really quite simple.

The first thing to do is to inspect the P.C. board for any holes not drilled or shorts due to poor etching. Some holes may be covered by solder, but this can be removed by applying a hot soldering iron to the land to melt the solder.

PARTS LIST

CAR ALARM - MAIN BOARD

1 - 220R All resistors on the
1 - 390R main board are 1/4 Watt
4 - 1k
8 - 10k
1 - 22k
1 - 33k
1 - 47k
3 - 100k
2 - 470k
2 - 1M
1 - 1M5
2 - 2M2
1 - 3M3
3 - 4M7

2 - 1n Greencap
3 - 100n Greencap
2 - 1u 25v Electrolytic
2 - 2u2 25v Electrolytic
1 - 4u7 25v Electrolytic
1 - 22u 25v Electrolytic
1 - 100u 25v Electrolytic
1 - 470u 25v Electrolytic

21 - 1N4148 Signal Diodes
1 - 1N4002 1A Power Diodes
5 - 1N5404 3A Power Diodes
3 - BC338 Transistor
1 - BD140 Transistor
1 - TIP31 Transistor
1 - 7805 Regulator
3 - 74C14 or 40106 IC's

3 - 14 Pin IC sockets
1 - FBR611D012 12v 10A SPDT Relay
1 - 16 way screw terminal strip or 2 x 8 way
1 - Small Piezo
1 - Key Switch
1 - 12v Dash Lamp
1 - 8R 10 Watt Horn Speaker
1 - Nut and Bolt for regulator
8 - 2m heavy duty hook up wire (2 Red, 2 Black, 2 Brown and 2 Blue)
3 - 2m medium duty hook up wire (3 different colours)
4 - 1m medium duty hook up wire (different colours)

1 - 1m of light duty hook up wire (any colour)
20cm Tinned Copper Wire for links and tests

CAR ALARM P.C. BOARD

IGNITION KILLER SECTION

2 - 8R2 5 Watt
2 - 10k 1/4 Watt
1 - 47k 1/4 Watt

1 - 1N4002
1 - BC547
1 - BC338

1 - FBR611D012 12v 10A SPDT Relay

IGNITION KILLER P.C. BOARD

Lay out the components of the kit on a clean spot on the bench and compare each with the list above. In some cases we may have substituted a part due to the difficulty in obtaining it or as a modification to the circuit.

This is a digital circuit and a wide tolerance can be accepted for most of the parts. If a part is substituted, a note will be included in the kit.

The easiest way to construct the kit is to start with all the components that lie flat on the board. Starting with the 3 links, you will need three lengths of tinned copper wire approximately 2cm long. It will be easier to do these one at a time. Bend the wire like a staple and fit each end through a hole. Solder one end and with a pair of long nose pliers, gently grab and pull the unsoldered end until the link is lying flat on the board. Don't pull too hard or the wire will break. Once the link is flat, solder the other end. Repeat for the other two links.

Next those resistors that lay flat on the board. These can be soldered either way round, but make sure you put the correct resistor in each place. If you are unsure of the resistor colour code, flick through some of your notes or books for the information. There is a complete colour code on the back cover of issue No. 1 of our magazine.

Next those 1N4148 signal diodes that lay flat on the board. These look like little glass beads with a black or coloured band near one end. This is the cathode end and should be placed over the bar or line on the overlay. This is important or the circuit will not function properly.

The IC sockets are next. Looking from the top of an IC socket, you will notice an indent at one end. If you turn the socket so that the indent is to your left, pin one will be directly below. The three IC sockets should be placed on the board so that the indent is over the dot on the overlay.

Solder any two opposite pins of each IC socket. While holding the board in your left hand (if you are left handed, hold the board in your right hand) with the components facing your palm. Gently push the IC sockets while reheating the comer pins to ensure they are sitting flat on the board. You can now solder the rest of the pins.

Now the upright resistors and signal diodes. Take extra care not to put the diodes around the wrong way. Remember the cathode is represented by a band at one end.

Next the power diodes can be soldered in place. There are six of these. One 1N4002 and five 1N5404's. They should also be placed on the board the right way around, taking note of the cathode.

The capacitors and electrolytics go in next. The electros should be placed on the board so that the positive lead goes down the hole marked with a PLUS "+" sign. The greencaps can be placed on the board either way around.

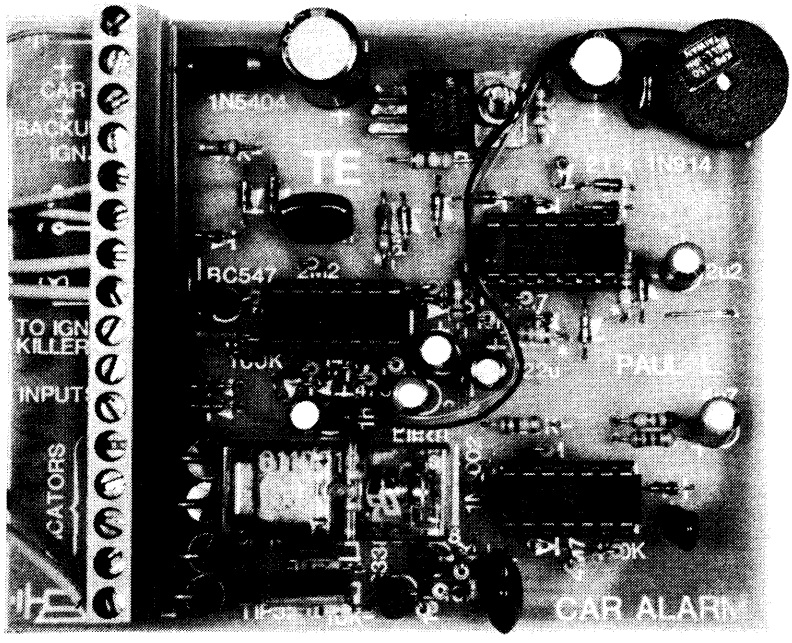
Next the transistors and voltage regulator. These are soldered in, taking note of the orientation. The small signal transistors are placed as per the overlay. The power transistors are placed so that the emitter of each goes down the hole labelled "e". The overlay for each power transistor shows one side thicker than the other. This represents the back (the metal part).

The 7805 voltage regulator is placed on the board face up and must be bolted down first then soldered. If it is soldered first, the pins may be pushed through the board when the bolt is being tightened. This may cause the lands to lift off and the whole thing may become messy.

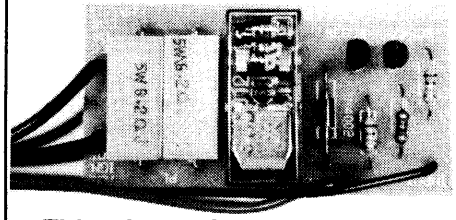
The 16-way screw terminal, relay and piezo are the last items to be added. The terminal strip is soldered with the openings facing out. There is not much you can get wrong with the relay as it only fits one way on the board. The piezo can be soldered either way around and the case can be glued or "blu tacked" to the top right corner to keep it from moving around.

The three 74C14 ICs are inserted into their sockets with pin one towards the left of the board. Construction of the main board is now complete.

You should have no trouble in building the ignition killer board by yourself. The only odd parts are the two 8R2 5 watt resistors. These are placed either way around, with the identification facing up for easy recognition.



The overview of the CAR ALARM board clearly shows where the major components are placed. Note the orientation of the IC's, regulator and the power transistors.



This photo shows the ignition killer board, ready for installation.

TESTING THE ALARM

Before installing the alarm, we suggest you test it first to avoid the inconvenience of pulling everything out if it doesn't work.

Cut 16 lengths of tinned copper wire, each 2cm long and insert them into the screw terminals. Using jumper leads, connect "IGN." to "+ CAR".

If you have a 12v globe, connect it between one of the "indicator" outputs and "ground". A LED and 1k resistor could be used if a 12v globe is not available. Connect the horn speaker between the "horn speaker symbol" (terminal 16) and ground. Connect the dash lamp to the terminals with the "lamp symbol" (terminals 7 and 8) and the key switch to the terminals with the "switch" symbol (terminals 5 and 6). Turn the key anticlockwise to ensure the switch is in the OFF position.

Connect the ignition killer board input to the main alarm board; the positive to "+ CAR" and the negative to "ground".

Now connect a 12v battery, capable of delivering a constant current of 1 AMP comfortably, or a power supply, between "+ CAR" and ground, making sure the positive of the supply goes to "+ CAR" and negative to "ground".

While power is connected, remove the jumper lead between "IGN." and "+ CAR". A tone will be heard and the dash lamp will flash. The tone will be heard for about 5 seconds.

Turn the key clockwise to the "on" position. As soon as this is done the relay on the ignition killer board will close and after about 10 seconds, the indicators will flash twice to indicate the alarm is ready to detect a low signal on the inputs.

With a jumper lead, connect one end to ground and touch any of the inputs with the other for about 2 seconds. There is a delay to stop glitches and spikes in the power from triggering the alarm. This delay can be changed. 5 seconds after the alarm is triggered, the siren will sound and the indicators will flash. This will continue for about 2 minutes and then stop, ready for another trigger.

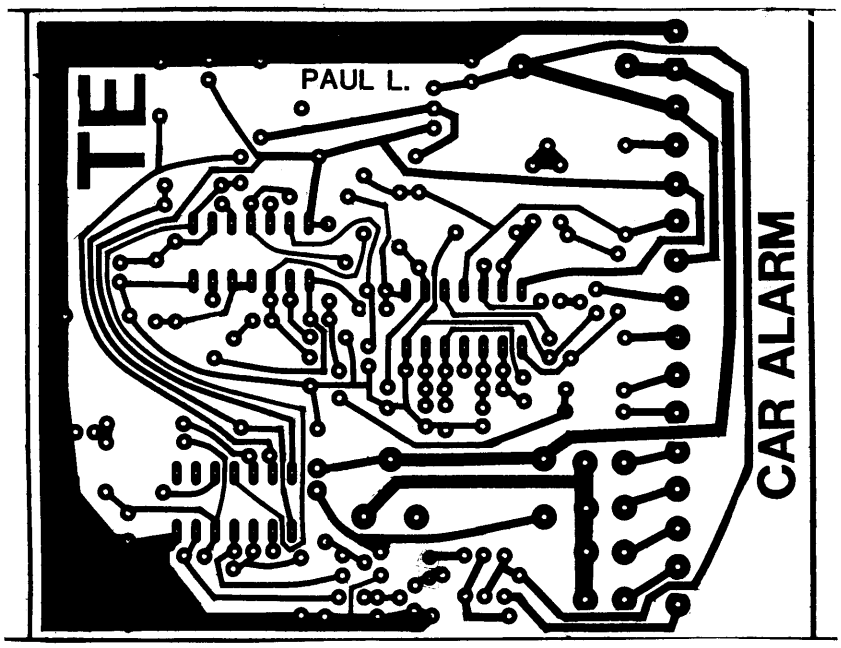
If you had no luck with this section, go to the IF IT DOESN'T WORK section.

If all went well you can change the delays to suit your needs. The 3M3 on pin 9 of IC1 is the exit delay and is increased to increase the delay or reduced to reduce the delay. The 22k on pin 3 of IC2 is the sensor delay and the 2M2 on pin 9 of IC2 is the entry delay. These two are also adjusted in the same way as for the exit delay to increase or reduce the delays. All these resistors are marked with an asterisk on the overlay.

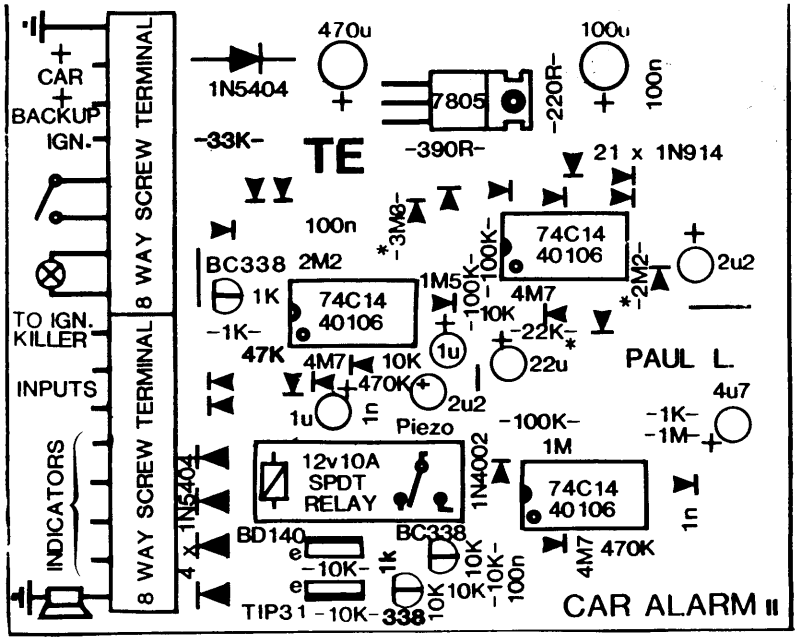
Now you can install the alarm in your vehicle. Due to the fact that all cars are different, we will leave the installation entirely to you. We will list where each terminal goes and how to install the ignition killer. A simple diagram below will show you how to wire the alarm.

Starting from the top:-

1 - To any ground connection on the vehicle.



CAR ALARM ARTWORK



CAR ALARM ARTWORK

2 - "+ CAR" - Directly to the positive of the vehicle (preferably to the fuse box).

3 - "+ BACKUP" - To the positive of the backup battery.

4 - "IGN." - To any point in the fuse box that goes high only when the ignition switch is on.

5 and 6 - To the alarm key switch.

7 and 8 - To the dash lamp

9 - To the ignition killer input.

10 and 11 - To the door switches or any other alarm sensor.

12, 13, 14 and 15 - to each of the four car indicators.

16 - To the horn speaker. The other end of the speaker goes to ground.

The ignition killer is mounted in a small jiffy box and is placed in the engine compartment close to the ignition coil. Connect the negative terminal to ground and the positive to the positive terminal of the ignition coil. The input of the unit goes to the main alarm board and the left-over wire, labelled "NEG. IGN. COIL", is screwed to the negative terminal of the ignition coil.

Now the alarm is ready to be tested, BY A REAL CAR THIEF.

IF IT DOESN'T WORK

First remove any power from the board and check thoroughly for any shorts, solder bridges, or cracks that may go through a track. Then check that all the parts are on the board, in their correct position and round the right way. If everything looks to be in order re-apply the power and check the voltages on the board. You should have 12v - 14v coming into the board and the output of the regulator should be about 9v.

If the dashlamp doesn't flash or does not illuminate at all when the ignition switch is off, short between collector and emitter of the BC338 transistor. The lamp should illuminate.

With a multimeter or logic probe measure pin 12 of IC1. Take pin 13 low. Pin 12 should go high, turning the transistor on and illuminating the lamp. If pin 12 goes high and the lamp still does not come on, replace the transistor. Take pin 13 high. Pin 12 should go low, turning the transistor off. If pin 12 does not go low, the gate is faulty.

If no beep is heard from the piezo, check to see that pin 2 of IC1 is high. If so, take pin 3 low and check if pin 6 is oscillating. If so, the piezo is faulty. If not, while pin 3 is still low, pin 4 should be high. If you take pin 5 high. Pin 6 should go low and vice versa.

If the beep does not go off, the 1uF on pin 3 is not charging due to a very leaky electro or the 4M7 is open. If the beep is only off when the alarm or ignition is on, the fault will be the diode between pins 2 and 5 is open.

If there is no exit delay, the diode on pin 9 of IC1 could be shorted or the 2.2uF electro dry or open and have very high resistance.

If the alarm does not activate, check pin 8 of IC1. A high on pin 9 will make pin 8 go low and vice versa. Check pin 6 of IC2. Take pin 3 of IC2 low, pin 4 should go high and pin 6 should go low. Take pin 3 high, pin 4 should go low and pin 6 should go high.

Next check pin 2 of IC2. Assuming there are no inputs connected and the alarm is switched on, short across the 22uF on pin 3 to discharge the electro. Pin 2 should be low. Take pin 1 low, pin 2 should go high and pin 4 should go low shortly after. Next check pin 8 of IC2. Taking pin 9 low will make pin 8 go high and vice versa. If there is no entry delay, the diode between pins 4 and 9 could be shorted or 2.2uF not connecting properly.

If the indicators do not flash twice, 10 seconds after the alarm has been switched on, take pin 13 of IC2 low. Pin 12 should go high and vice versa. Take pin 13 high and take pin 11 low, pin 10 should go high and taking pin 11 high will make pin 10 low. If the diode between pins 12 and 11 is open, the indicators will always flash when the alarm is switched on and if the diode between pin 8 of IC1 and pin 11 of IC2 is open the indicators will always flash when the alarm is switched off.

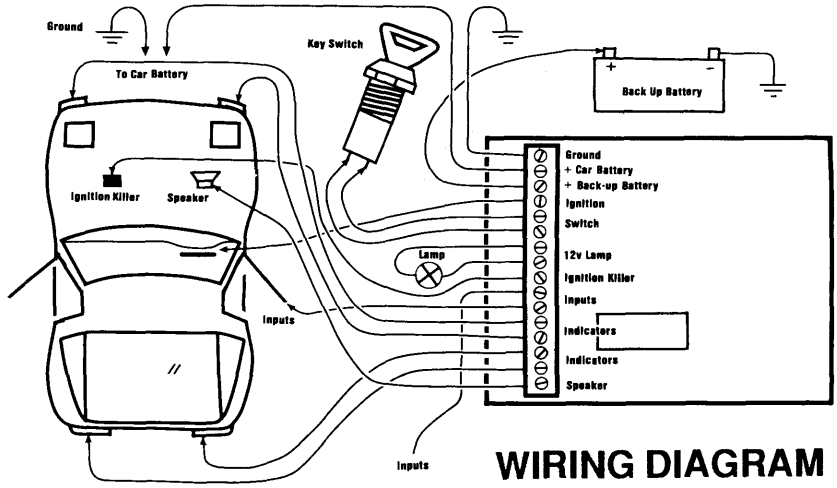
If the indicators do not flash at all, check that the diode between pin 10 of IC2 and pin 1 of IC3 is not open. Switch off the alarm and take pin 1 of IC3 low, pin 2 should go high and vice versa. While pin 1 is low pin 4 should be high, turning on the transistor which turns on the relay. If the relay is not activated and pin 4 is high, short between the collector and emitter of the transistor. If the relay still does not pull in, the transistor is faulty and should be replaced. If the diode between pins 2 and 3 is open, the indicators will never stop flashing.

If the siren doesn't work properly, switch the alarm off and take pin 9 of IC2 low. Pin 8 will go high enabling the first oscillator, at the same time taking pin 10 of IC3 low which should enable the final oscillator. If the diode between pins 10 and 5 of IC3 is open, a tone will be heard continuously from the horn speaker.

If there is never any sound, the fault will be in the amplifier section. Connect a multimeter to measure the voltage on the collector of the BC338 transistor. The meter should read about 12v. Connect a 10k resistor between +12v and the base of the BC338. The meter should now read approximately 0v.

When the reading on the collector of the BC338 is 12v, the collector of the BD140 should be approximately 0v and the emitter of the TIP31 should be 0v. When the reading on the collector of the BC338 is 0v, the collector of the BD140 should be 11.5v and the emitter of the TIP31 should be approximately 11v. If this is not the case, replace the suspect transistor.

If the ignition killer stage doesn't work, connect the meter to measure pin 10 of IC1. Switch the alarm on,



WIRING DIAGRAM

pin 10 should go low. Switch the alarm off and pin 10 should go high. If this is the case then the fault is in the ignition killer board.

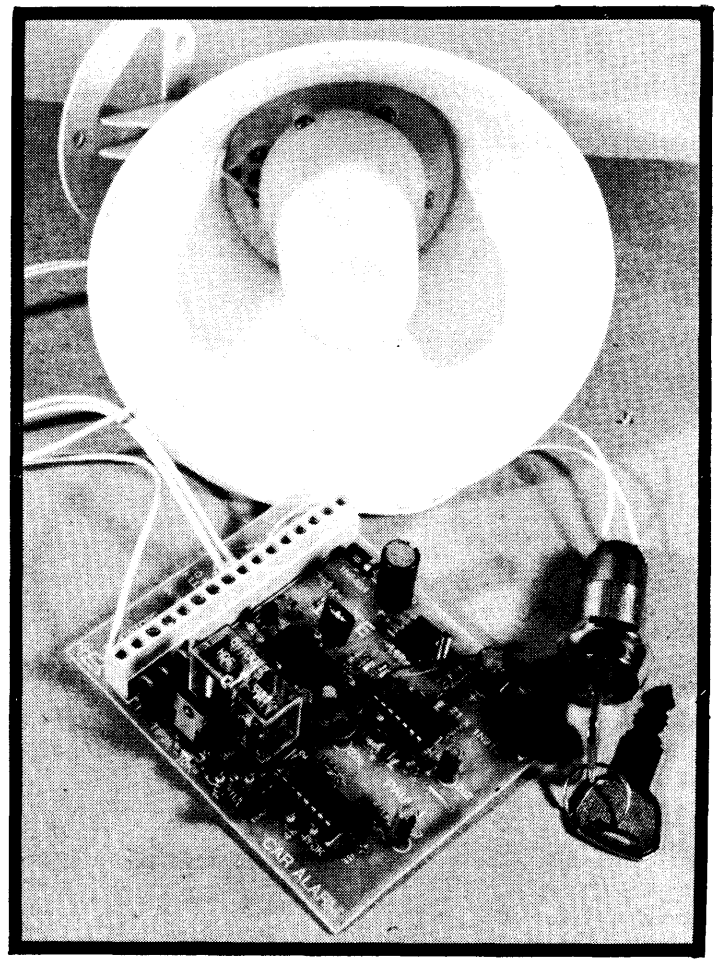
Switch the alarm on and short between the collector and emitter of the BC338 transistor. The relay should switch on. When the alarm is on, there should be 12v on the collector of the BC547 that drives the base of the BC338 to turn on the relay. When the alarm is off, there is 0v on the collector of the BC547 and nothing to drive the base of the BC338 and therefore the relay is de-activated. If this is not the case, replace the suspect transistor.

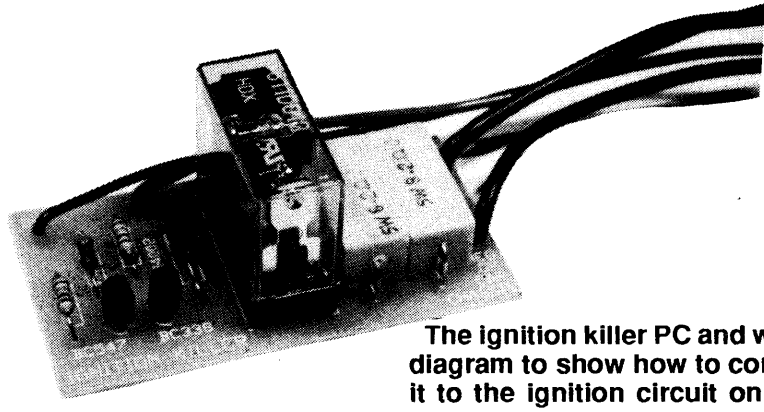
If you still have trouble repairing the alarm, we offer a backup service for repairing OUR KITS for a special price of $9.00 plus parts and postage.

If the parts are bought seperately through us and other retailers, the cost for repair by us will be $14.00 plus parts and postage.

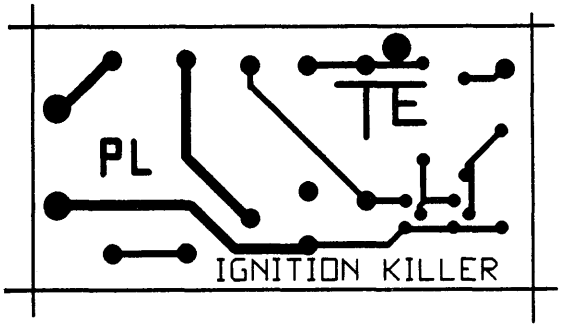
There will be add-on projects for the CAR ALARM in future issues. These will include:

* UHF REMOTE SWITCH
* ULTRASONIC MOVEMENT DETECTOR
* BATTERY BACKED UP SIREN

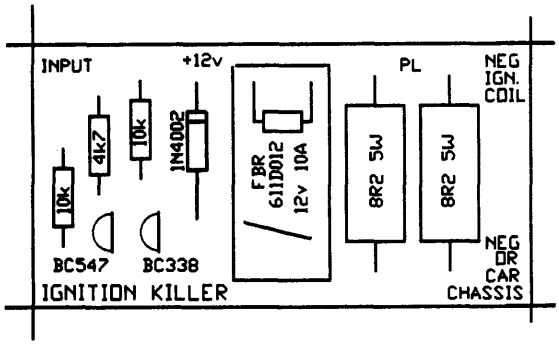


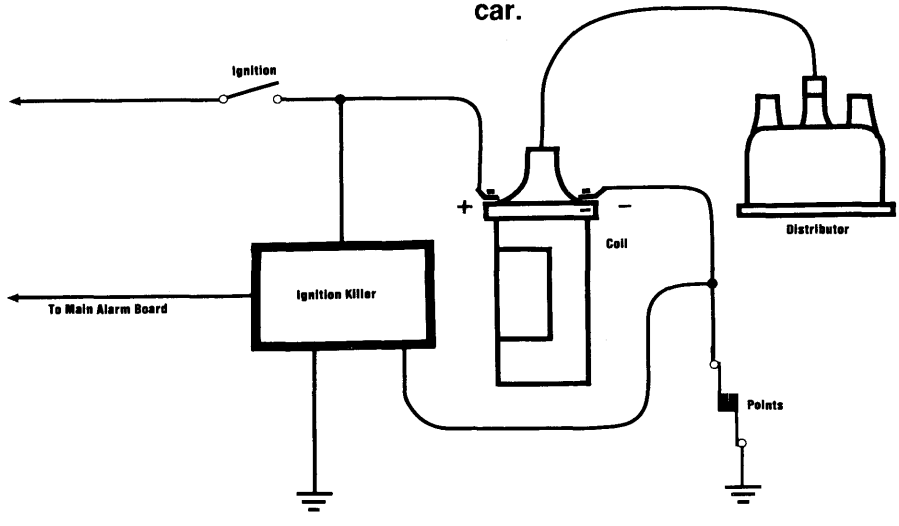


The ignition killer PC and wiring diagram to show how to connect it to the ignition circuit on your car.



IGNITION KILLER ARTWORK





ALL RESISTORS 5c EA

MINI TRIM POTS 50c

CAPACITORS

CERAMICS

5p6	.15
10p	.15
18p	.15
27p	.15
47p	.15
56p	.15
100p	.15
220p	.15
330p	.15
1n	.15
22n	.15
33n	.15

GREENCAPS

1n	.25
2n2	.25
3n3	.25
3n9	.25
4n7	.25
6n8	.25
10n	.25
22n	.25
33n	.25
39n	.25
47n	.28
100n greencap	.30
100n monoblock	.35
220n monoblock	.55
Air Trimmer 5-40p	.70

ELECTROLYTICS

1u	63v	27c
2u2	16v	27c
3u3	16v	27c
4u7	16v	27c
10u	16v	27c
22u	16v	27c
47u	16v	30c
100u	16v	45c
220u	25v	60c
220u	63v	75c
470u	25v	70c
100u	25v	85c
1000u	63v	1.70
2200u	25v	2.00

IC's TTL

7400	.80
74LS04	.75
74LS11	.75
7420	.90
74LS73	.70
74LS74	1.00
7476	1.10
74LS123	1.30
74LS138	1.50
74LS273	2.25
74LS367	1.25
74LS373	2.25

CMOS

4001	70c
4011	70c
4013	90c
4015	1.45
4017	1.50
4020	1.80
4024	1.30
4026	2.60
4040	1.80
4046	2.10
4047	2.10
4049	2.00
4051	1.90
4060	2.60
4069	80c
4071	75c
4510	2.10
4511	2.10
4514	5.60
4518	1.90
40085 or 74c85	3.95
74c14 or 40106	1.75
74c922	9.95
74c923	10.95
74c926	13.90

MICRO IC's:

8255	7.50
2114	5.00
6116(58725)	7.95
2732	8.95
SPO 256AL2 Speech IC	15.00
Z-80A	6.50
JMON	16.00
TEC MONitor ROM	15.00
Microcomp-1 MON	15.00
PRINT-3	12.50
Dedicated MICRO	12.00

LINEAR

LM 380	2.80
LM 383 or TDA 2002	5.95
LM 386	1.95
741	.90
555	.60
TDA 7000	4.95

VOLTAGE REGULATORS

7805	1.20
7905	1.90
7812	1.20
7815	1.20
7915	1.90
7824	1.20

IC SOCKETS

8 pin	30c
14 pin	40c
16 pin	45c
18 pin	45c
20 pin	50c
24 pin	65c
28 pin	75c
40 pin	95c

Surface Mount Resistor packs. 60 Resistors. 2 off each value 10R to 1M $12.00

Surface mount Capacitor packs.64 Capacitors (8 values) 10p to 22n $18.00

HEADERS, WIRE WRAP

16 pin DIP header	2.25
24 pin DIP header	3.95
24 pin wire wrap	3.95
40 pin wire wrap	4.95

SEMI's

1N 4148	.10
1N 4002	.15
1N 5404	.30
IFR Z40 (BUZ 11)	5.00
BC 547	.25
BC 557	.25
BC 338	.30
BD 139	.80
BD 140	.80
2N 3563	.90
2N 3055	1.50
TIP 31	1.00
TIP 32	1.00

OPTO DEVICES

3mm RED LED	.18
3mm GREEN LED	.30
3mm ORANGE LED	.30
3mm YELLOW LED	.30
5mm RED LED	.20
5mm GREEN LED	.30
5mm ORANGE LED	.30
5mm YELLOW LED	.30
MEL 12 Photo transistor	1.20
TIL 313 Com cathode	2.50
FND 560	2.90
16 Char by 2 line LCD	39.00

MISC COMPONENTS

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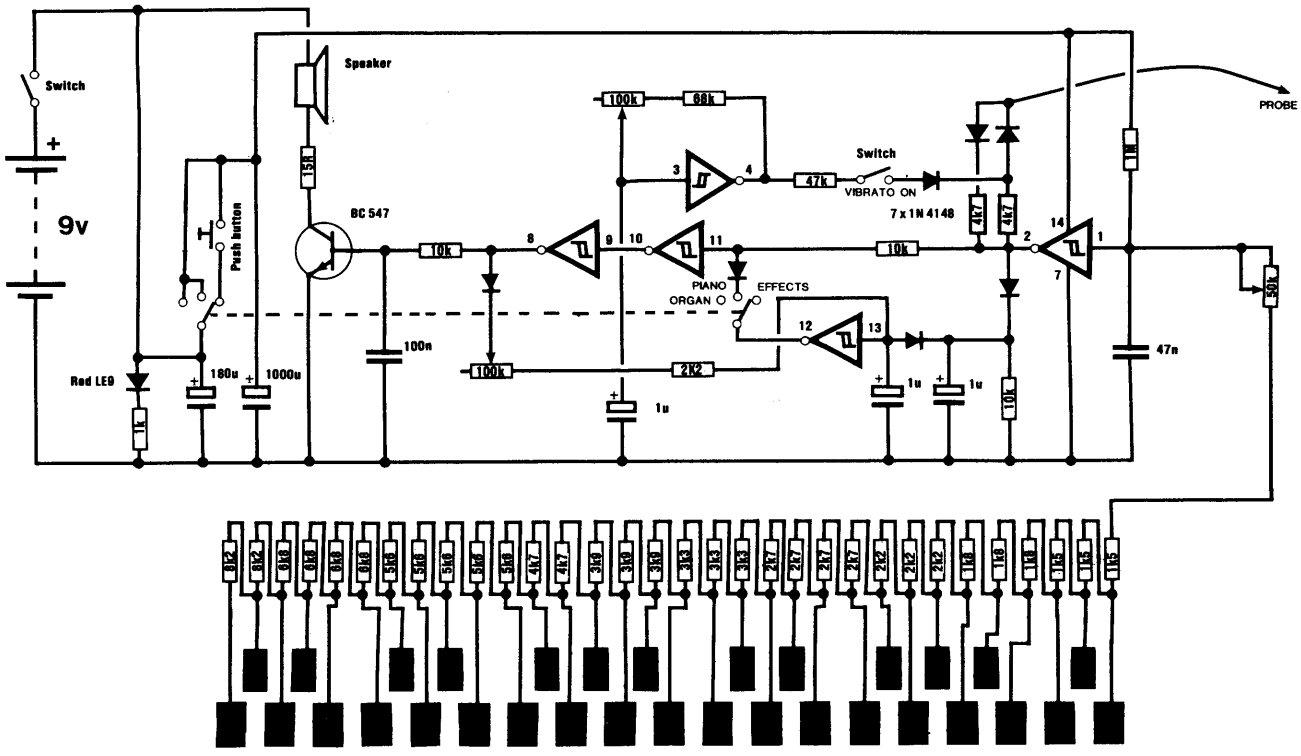


ORGAN CIRCUIT

This is a great little toy for musical tinkering. It offers more than two octaves of notes and a variety of effects that will keep a player amused for hours.

You can put it together in a couple of hours and have lots of fun yourself.

My interest in a simple organ began some 20 years ago when Rolf Harris popularized a "Stylophone" organ. It used a stylus to play the notes and had a range of about two octaves and included vibrato.

I remember buying one of these toys and failed miserably to produce anything more than a few bars of the simplest tune.

However the concept never left me and over the years a number of similar stylus organs have been produced, both in magazines and on the market.

Many of the magazine circuits were grossly over-designed and too costly to build. None used a single chip like ours nor did they have the features we have built into our design.

Ours is a "skeleton" design and needs no case as all the components fit on the track-side of the board so that the keys can be accessed without having to turn the board over.

I am surprised no other designs have used this approach as it makes the best use of the board and allows it to sit on a surface without the need

PARTS LIST

1 - 15R
1 - 1k
3 - 1k5
3 - 1k8
4 - 2k2
4 - 2k7
3 - 3k3
3 - 3k9
4 - 4k7
5 - 5k6
4 - 6k8
2 - 8k2
3 - 10k
1 - 47k
1 - 68k
1 - 1M

1 - 50k mini trim pot
2 - 100k mini trim pots

1 - 47n
1 - 100n
3 - 1uF electrolytics PC mount
1 - 100uF 16v PC mount electro
1 - 1000uF 16v PC mount electro

7 - 1N 4148 signal diodes
1 - 5mm red LED
2 - 5mm red LEDs for trim pots
1 - BC 547 transistor
1 - 40106 Hex Schmitt trigger IC (effects section does not work as well with 74c14 IC)
2 - SPDT slide switches
1 - DP 3T slide switch
1 - PC mount push switch
1 - 9v battery
1 - 9v battery snap
1 - 14 pin IC socket
1 - 8R speaker
1 - 50cm hook-up flex
1 - paper clip for probe

1 - ORGAN PC BOARD

(pen barrel for probe not supplied)

for rubber feet etc.

With modern technology, an organ such as ours could be designed to fit into a birthday card, with touch sensitive keys and a single chip under a blob of epoxy. But unfortunately none of this technology is available to us in Australia and we have to be content with chips, resistors and a stylus.

As it stands, the Organ would make a great gift for a youngster and could even be adapted to go into a baby's play pen (without the stylus) to give various tones when large objects were touched.

We will leave this sort of adaption to you and show you how the basic model can be put together.

The use of a hex Schmitt trigger gives plenty of scope for effects and we have created 3 modes of play: Standard or Organ, Piano and Effects. The effects mode produces a gliding tone that will last quite a few notes and produce a lot of fun.

But the organ is not limited solely to playing around. By setting middle C accurately via a frequency counter or from someone with perfect pitch, you can play simple tunes that will sound quite authentic.

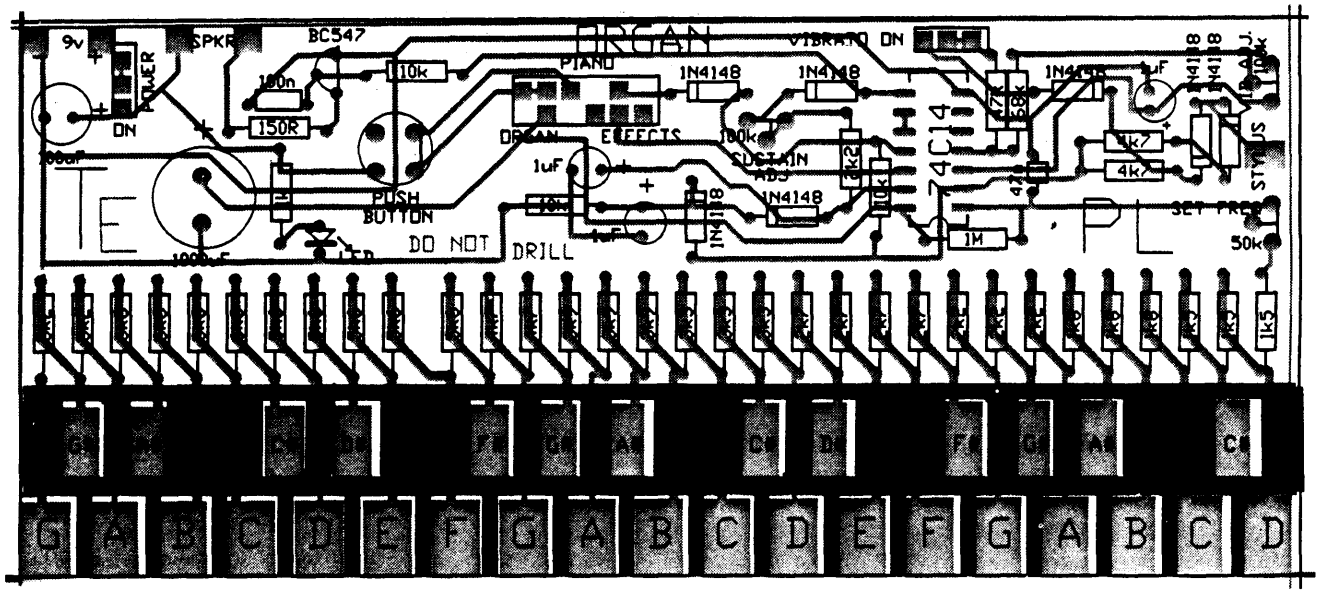
The set of resistors that have been chosen for the train gives an amazingly accurate scale and all the work of setting each of the frequencies has been done for you.

HOW THE CIRCUIT WORKS

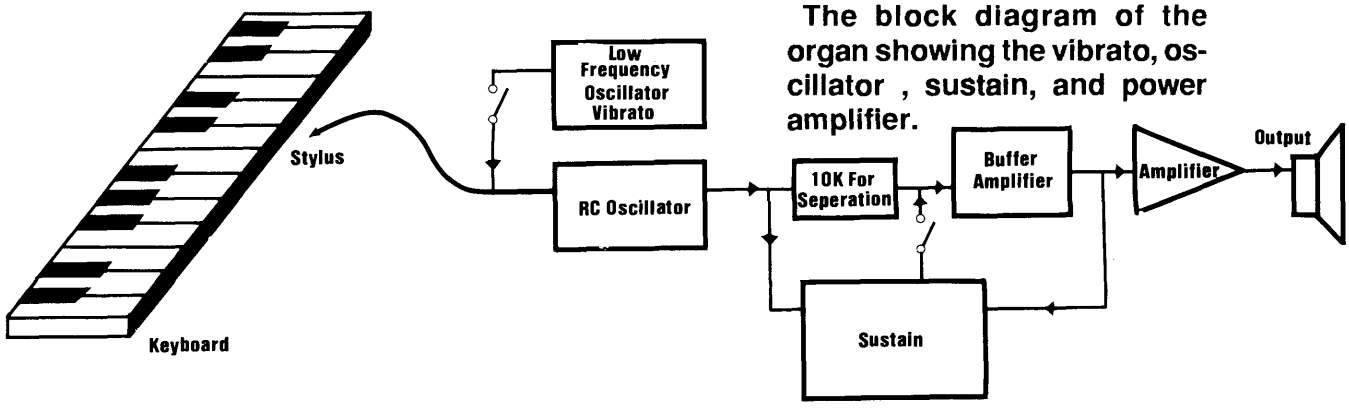
The organ has been designed around a voltage controlled oscillator made up of the Schmitt trigger between pins 1&2. The 47n, combined with the train of resistors connected to the keys, makes up the RC network and the stylus completes the path to the output of the chip.

The frequency of the oscillator depends on which key is touched by the stylus and these keys are laid out similar to that of a piano to help with understanding the keyboard.

Middle C is the fourth white note from the left and for those that are not familiar with a keyboard, middle C is the first note you look for when



The overlay acts as a resist to allow the keys to be accessed by the stylus. This makes a very effective keyboard.



The block diagram of the organ showing the vibrato, oscillator , sustain, and power amplifier.

presented with an unfamiliar keyboard.

Above the white notes are the black notes and you will notice we have labeled them with the sharp equivalent. This is due to the hatch symbol being available on the typewriter. As a point of interest, all the black notes have a flat equivalent such that A sharp is the same note as B flat. This will help you read music in B flat etc.

The output of the oscillator passes through two Schmitt buffer stages to a buffer transistor. The transistor drives an 8R speaker via a 15R current limiting resistor to give a pleasant sound for individual practicing.

When the vibrato section is fed into the oscillator via the vibrato switch, a 3Hz free-running oscillator is combined with the organ tone to produce a very pleasing effect.

The speed of the vibrato can be set via the 100k vibrato speed pot near the edge of the board.

When the selector switch is in the mid position, the "piano" effect is selected and this has the effect of chopping the note into a short burst, similar to a piano.

The length of the burst is controlled by the gate between pins 13 and 12. When it is switched into operation, the input line is initially low.

When a note is played, the input delay circuit, made up of the 10k resistor and 1uF electrolytic is charged via the diode on pin 2. This causes the cathode of the diode on pin 13 to go high and effectively puts its shorting effect, out of operation.

The 1uF on the input (pin 13) can now charge via the diode on pin 8 and the 100k "sustain adj" control.

When the 1uF charges to 2/3 supply voltage, the output of the gate goes low, decking pin 11, and inhibits the tone.

The third position of the selector switch is "effects".

In this mode the chip gets its supply from a 1000uF electrolytic and as the voltage falls an amazing thing happens....The frequency of the tone increases. You can take advantage of this by playing a few notes and see what happens. The push button will restore the charge in the electrolytic for further playing.

BEFORE YOU START

This project uses a special PC board in which the keys are laid out on the copper side of the board. So that the organ can be placed on a table, the components are also fitted to the copper side and this means no holes are needed.

This form of mounting creates a very effective project. You can see all the components as well as the track-work, at the same time.

It's great for a demonstration project, and when you are playing with the organ, you will be reminded of how it goes together.

Let us not kid you. Soldering the parts on the copper side of the board is more difficult than normal construction and you have to be very good at soldering to get a good finish.

But most important you will need a very fine tipped soldering iron to get under the IC socket and switches.

If you don't have a very fine tip, don't start, you will only mess up the board and damage the lands.

The temperature of the iron should not be too hot otherwise it will melt the glue that holds the copper tracks to the board. Yes, the copper tracks are stuck to the board with glue!

Since there are no holes in the board to provide added strength, it is important that none of the lands fall off.

The circuit may be simple and inviting but construction is at an intermediate level. If you are a beginner, you should ask for assistance - we can only tell you how to do it, we can't show you how.

CONSTRUCTION

With this project, the order in which you fit the parts is important.

Start with the 3 switches, the IC socket and the push button. Make sure the switches stand upright when soldering to the first land as they cannot be straightened by bending as this will rip the land off the board.

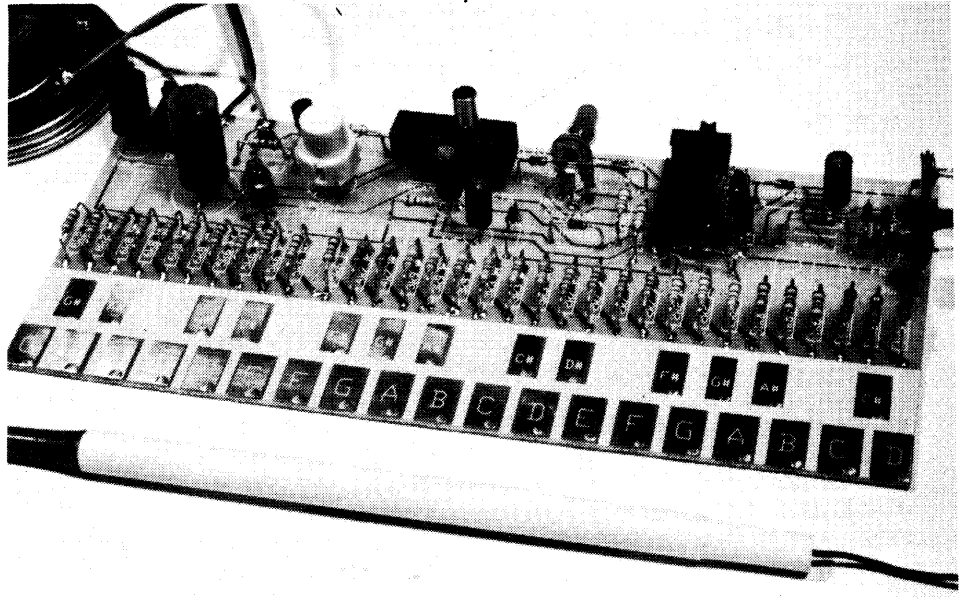
The notch (or cut out) for the IC is identified on the board and this indicates pin 1 is near the keys. Set the pins of the IC socket on the lands and "tack" two opposite corners. Make sure the socket is square with the side of the board and carefully solder each land so that the pins connect firmly.

The next components are the electrolytics and capacitors. Cut the leads so that they are 3mm long and tin them - this means adding a small dob of solder to each lead and land so that the actual soldering process requires little or no extra solder. You merely heat up the joint with the iron and the connection is made. This reduces soldering time and prevents the lands coming off.

Next fit the 3 mini trim pots. When these are in place, the sustain and vibrato pots have 5mm red LEDs soldered to the wipers so that the controls can be turned with the fingers.

When soldering the leads to the wiper, make sure solder does not run onto the fixed section otherwise the control will be frozen.

Next fit the "Power ON" LED and signal diodes. These diodes will give



you the first taste of the difficulty in soldering a component with short leads.

You may need a pair of long nose pliers to prevent burning your fingers and also to get components into awkward places.

The same care applies to the BC 547 transistor. Cut the leads slightly shorter and bend them to match the pads on the board. Tin the leads and the pads and use a pair of pliers to hold the transistor in place while the leads are being soldered.

You are now about half way, with only the resistors and a little wiring remaining.

Lay the resistors on the bench in the same positions as on the PC board so that you cannot make a mistake with the values.

Cut all the leads short and bend each to 90° so that they are all ready. Start at one end of the board and fit each as you come to it.

It does not matter which way around they are placed however if the tolerance band is kept to one end, it is easier to read the values when troubleshooting.

The stylus is made from an old pen barrel and the probe is a nail or paper clip fitted into the end. It connects to the PC board via a 40cm length of hook-up wire and to prevent the lead breaking off, it is tucked under the body of the nearest diode, to act as an anchor.

Connect the speaker via short lengths of hook-up flex and solder the battery snap in position.

The organ is now ready for setting the frequency.

SETTING THE FREQUENCY

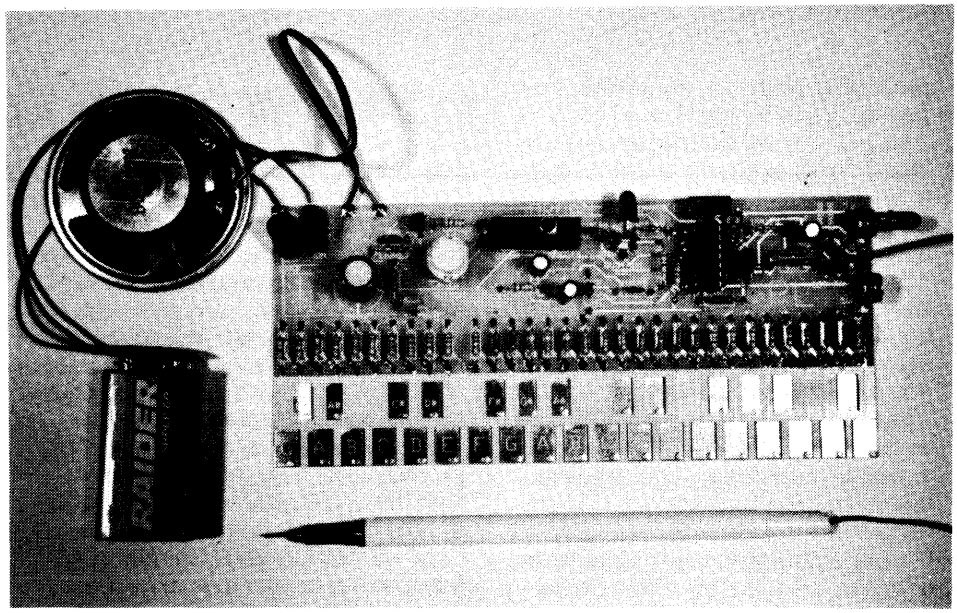
The organ is set by adjusting the frequency of middle C to 261.6Hz by holding the stylus on the fourth white key from the left and adjusting the frequency via the "set frequency" trim pot.

You can use a frequency counter or by comparing one of the notes of the organ with another musical instrument, you can listen for any "beating" between the notes. It is amazing how close you can get via this method.

That's all there is to it.

IF IT DOESN'T WORK

The layout of the circuit diagram closely follows the components on the board and this will assist fault finding.



Our organ ready for playing. The stylus (or probe) has been made from a ball-point pen barrel with a nail fitted into the nib end. The legend (or overlay) covers the tracks of the keyboard so that you can use the stylus to get a gliding effect across the keyboard.

If a tone is not produced from the speaker when the stylus touches the keys, the first thing to check is the position of the large slide switch.

It must be switched to organ or piano and NOT to the effects mode. Next check the "Power ON" LED, connections to the speaker, the battery voltage and the voltage on pin 14 of the IC.

If one of the diodes near the stylus comes adrift, the output will cease. You can check this by taking a jumper lead from either 4k7 resistor and any of the keys.

If there is still no output, short between pin 2 of the 74c14 and any of the keys.

For the next tests you will need a multimeter or logic probe. Connect the multimeter between pin 2 and negative and take pin 1 HIGH. Pin 2 should go LOW and vise versa.

If you do not get this result, there may be a short or bridge on the board, or the chip may be faulty.

If this gate works, move to pin 10 and measure the output. Take pin 11 HIGH and pin 10 should go LOW. Taking pin 11 LOW should make pin 10 go HIGH.

Connect the multimeter to pin 8 and take pin 11 HIGH. Pin 8 should go HIGH. Take pin 11 LOW and pin 8 should go LOW. If not, check the board for shorts.

The next stage to check is the transistor. You will need a 10k resistor for this test. Connect the multimeter (set to volts scale) so that the positive lead is taken to the +9v and the negative is on the collector of the BC 547. There should be no reading on the meter. Connect the 10k resistor between positive and base of the transistor. The needle should indicate a voltage. If not, check to see that no shorts exist and the transistor is soldered correctly.

Next the sustain stage. This only comes into operation when the 3-way switch is in the mid (piano) position. If this does not work properly, check pins 13 and 12 for inversion.

If the tone is only heard once when the stylus touches one of the keys, the fault is due to the 1uF capacitors not discharging fully and this could be due to either the 10k resistor being open or the signal diode being faulty.

If the tone does not turn off, the fault is the diode on pin 11 being open or the capacitors in the sustain section not charging. Test the diode on pin 8 for correct operation.

If the vibrato stage does not work, check the tracks on the board, the gate between pins 3 and 4 and the vibrato switch.

This is the first board off our CAD program and we are very pleased with its appearance.

If you are careful with assembly, you too will be pleased with the results and I am sure you will find someone who would love the Organ as a present.

TEC TALK

This page is for TEC owners. Through this, we can conduct a forum on the uses and future of the TEC. As we cannot reply to every letter sent in, we will attempt to answer letters of common interest through this page.

When writing in, put your letter on a seperate page if you are ordering kits etc. This helps us file things in some sort of reasonable order.

SENDING IN PROGRAMS VIA TAPE

We are looking forward to readers sending programs to us. There aren't any in this issue due mainly to the shortage of space. Hopefully, issue 16 will contain several pages or more.

A big factor in deciding weather or not we publish a "reader send-in" is the way the program is sent to us.

If you do have something to send, here is what we want you to do.

Provide us with a copy of the program Save it on tape with a crystal speed of half 3.58MHz. Put your name and address on the tape so we can send it back, if requested.

We also need documentation on the program. Write what it does and where it runs in memory and include any notes you may have generated. The first thing we will do is disassemble it and load it into our IBM clone. Here we can format it for publishing.

For the sake of our disassembler, please, if you can, put tables at the end of the program code and write down where the tables are located. This way we can use our HEX dump routine and tack the tables on at the end of the code.

JMON UP-GRADES

JMON has been designed to be upgraded without losing software compatibility.

Some likely changes are the removal of the low speed tape save (unless there is a storm of protest). This will decrease the software overhead in the tone routine and even-up the period measurement. The result will be an increase in the tolerance of different TEC frequencies and different tape speeds. This should make it possible to freely interchange half 3.58MHz and half 4.MHz tape software as well as allowing poorer quality tape players to be used.

The single stepper, which has no effect on the MONitor at all, may be shifted to a more specialized ROM to increase the stepper's abilities.

The keyboard and LCD RST's will not be changed, so any routine you write using these will run on future up-grades. The same cannot be said if you directly call into JMON. So don't do it!

ISSUE 15 CONTENT

Missing from the TEC section are two usual features. The reader send-ins and tutorial section.

The reason for this is mainly due to lack of room. Already the TEC section is the largest ever and the material left over will be a good start for issue 16.

A different direction is planned for issue 16. The basic lay-out will be two MAJOR add-ons and the rest of the article will be filled with programs (mine and yours, so send them in). There are a couple of reader send-ins that we intend to publish, so if you have sent something in already, we haven't just tossed it in the bin!

JIM's PACKAGE

This package is centered around JMON. The main feature is a complete line-by-line disassembly of the JMON ROM. I hope that, with careful study, you will be able to look at any instruction and understand its role.

My programming style is very optimized. Generally my programs are short and to the point. This does make them a little difficult to read but at the same time by studying and learning my ideas, your own programming abilities will be improved.

If the role of every instruction escapes you, you will still learn important concepts and a better way to do some things.

I wish I had a Jim's package when I was just starting out!

The package will be 20 pages long as this is the limit of our collating photocopier. If there is enough room, some other notes and programs will be included.

It is a pity that such a listing was not available for the earlier MONitors.

Because Jim's package contains every byte in JMON, you can actually burn your own JMON ROM.

Keep in mind that this means typing in 2k worth of program and one mistake will ruin the whole MONitor.

If you feel up to it then go to it. We don't mind you doing this ONCE for YOUR OWN USE.

This offer does not apply to schools or commercial buyers.

If you don't wish to try to type out JMON, I present you with this offer:

Purchase and pay for JMON and Jim's package together, and save $3.50.

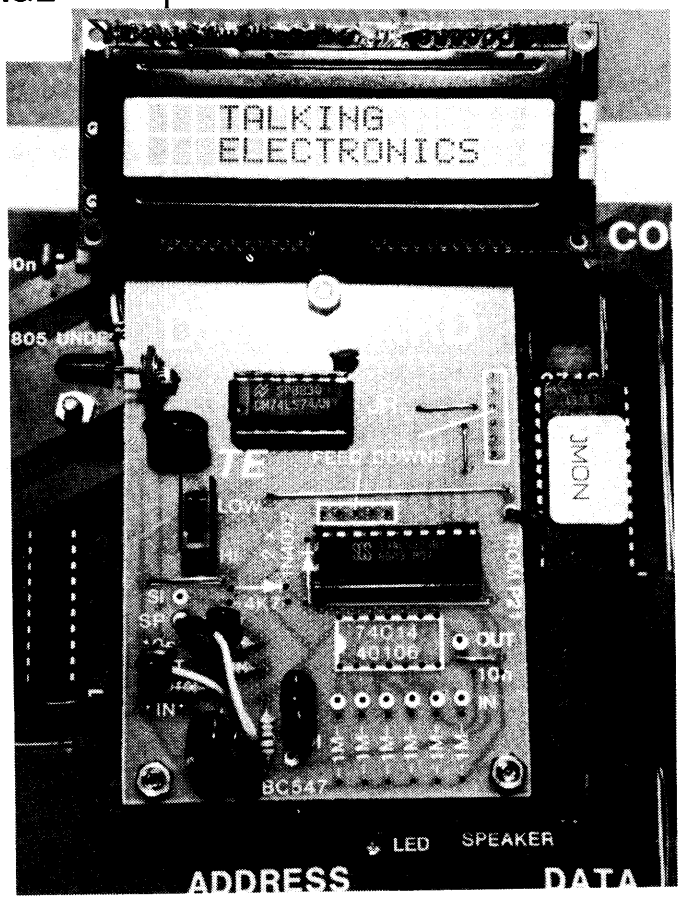
This means the total price for both is $27.50 instead of $31

ISSUE 16 and the TEC

Most of issue 16's TEC pages have been allocated and about half of these are already finished.

If you have some thing for us, don't waste time if you want the chance to see it in print.

- Jim



Completed DAT board displaying "TALKING ELECTRONICS." See the DAT board article starting on P. 47, and LCD article on P.52. Read the whole TEC article before starting anything!

INTRODUCTION

A discussion on Talking Electronics latest monitor for the TEC computer

Article and monitor by Jim Robertson

JMON is a big step ahead for the TEC.

Some of the contents of JMON are: a highly improved Monitor Program, a versatile Tape Storage Program, software for driving a liquid crystal display, a Menu Driver for utilities, a Perimeter Handler, User Reset Patch, Single Stepper and Break Pointer with register display software, and simplified access to utilities and user routines.

JMON also uses indirect look-up tables stored in RAM. This idea leaves the door open for many possibilities.

All the above and more is contained in 2k bytes.

The following is a description of the major blocks in the ROM.

THE MONITOR PROGRAM

To support new features added to the TEC, a new interactive monitor program has been written. The new monitor is, by itself, a considerable upgrade over previous monitors and when combined with other software in the monitor ROM, gives great features for the TEC user.

Major improvements have been made in the MONitor software, to allow quicker entry and editing of code. This has been achieved by adding such features as auto key repeat and auto increment. If you add the LCD, its larger display and cursor control software open up a second level of improvement.

THE TAPE SOFTWARE

The TAPE SAVE facility is versatile and reliable.

Some of the functions include: 300 and 600 baud tape SAVE, auto execution, LOAD selected file, LOAD next file, LOAD at optional address, TEST tape to memory block and TEST tape check sum. Both tests may be combined with other options.

The tape software uses the universal MENU driver and perimeter handler. These routines allow easy selection of cassette functions (e.g. Load, Save, etc.) and easy passing of variables to the tape software.

The tape software contains check-sum error detection that allows the user to know if the load has failed. A check-sum compare is performed after every page (256 bytes) and also after the leader is loaded. This means the user does not need to wait until the end of a load or test for error detection.

Each full page to be loaded, tested or saved, is displayed on the TEC LED display. Up to 16 pages are displayed.

Upon completion of a tape operation, the MENU is re-entered with an appropriate display showing:-END -S (END SAVE); PASS CS (CHECK SUM); PASS Tb (TEST BLOCK); PASS Ld (LOAD); FAIL CS (CHECK SUM); FAIL Tb (TEST BLOCK); FAIL Ld (LOAD).

The one exception is when an auto execute is performed after a successful load.

The tape software will display each file as it is found and also echo the tape signal.

LIQUID CRYSTAL SOFTWARE

This software is called from the monitor program. It is possible to deselect this software to allow the liquid crystal display to perform a user-defined purpose while the monitor is being used.

The Liquid Crystal Display is being accessed as a primary output device to the user during the execution of the monitor. Eight data bytes are displayed at a time and a space between each for the prompt (it appears as a "greater than" sign). Four digits in the top left hand corner show the address of the first byte.

In the bottom left hand corner is a current mode indicator and this lets you know which particular mode JMON is in. E.g. Data mode, Address mode etc.

The prompt points to the next location to have data entered, or if at the end of the 8 bytes being displayed, the prompt parks at the top left corner indicating a screen change will occur on the next data key press. This allows revision before proceeding.

It is possible to use the monitor with only the LCD unit, the only drawback being the actual current value of the address pointer is not displayed (the value shown in the address portion of the LED display). However this is only minor.

MENU DRIVER

This is a universal routine used to select various utilities routine from JMON. It is already used by the tape software and the utilities ROM. It may also be easily used by the TEC user.

The Menu Driver displays names of functions in the TEC LED display. The number of different names is variable and may be user defined. It is possible to step forward and backward through these names.

A 3-byte jump table with an entry for each name provides the address of the required routine. A jump is performed upon "GO."

To have a look, call up the cassette software by pressing SHIFT and ZERO together. If you have not fitted a shift key, the cassette software can be addressed by pressing the address key, then the plus key, then zero.

To move forward through the MENU, press "+". To move backward, press "-". Notice the automatic FIRST-TO-LAST, LAST-TO-FIRST wrap around.

Pressing "GO" will take you into the perimeter handler.

PERIMETER HANDLER

Like the Menu Driver, this is a universal program and may be easily used by the user.

This routine allows variables to be passed to routines in an easy manner. The variables are typically the start and end address of a block of memory that is to be operated on, such as a load, shift, copy, etc.

A 2-character name for each 2-byte variable is displayed in the data display while the actual variable is entered and displayed in the address display.

The number of variables may be from 1 to 255 and is user definable.

The data display is also user definable.

It is possible to step forwards and back through the perimeter handler in the same fashion as the MENU driver.

When a "GO" command is received, control is passed to the required routine

via a 2-byte address stored at 0888 by the calling routine.

The SINGLE STEPPER and BREAK POINT handler.

A single stepper program can be important when de-bugging a program. It effectively "runs" the program one step at a time and lets you know the contents of various registers at any point in the program.

If you have ever produced a program that doesn't "run", you will appreciate the importance of a single stepper. Many times, the program doesn't run because of an incorrect jump value or an instruction not behaving as the programmer thinks.

The single stepper runs through the program one instruction at a time and you can halt it when ever you wish. By looking at the contents of the registers, you can work out exactly what is happening at each stage of the program.

The single stepper operates by accessing a flip flop connected to the Maskable Interrupt line of the Z-80. It can be operated in the manual mode, in which a single instruction is executed after each press of the "GO" key. In the auto mode, 2 instructions are executed per second.

BREAK POINTS

Break points work with groups of instructions. They allow register examination in the same way as a single stepper. The advantage of break points is that there is no time wasted stepping slowly through a program. This is particularly important as some programs contain delay loops and they may take weeks to execute at 2Hz!

Break points are one of the most effective ways to debug a program!

STARTING WITH JMON

JMON is straight forward to use. Some new habits must be learnt, however they are all quite easy.

JMON has 4 modes of operation. They are:

DATA MODE, ADDRESS MODE, SHIFT MODE and FUNCTION MODE.

The data address and shift modes are not new but have been, in part, changed in their operation. The function mode is new to the TEC and I am sure you will find it useful. Below is a description of each mode.

THE DATA MODE

The data mode is used to enter, examine and edit, hex code into RAM memory. It is identified by one or two dots in the data display and the word "DATA" in the bottom left hand corner of the LCD display. It is similar to the data mode on all previous MONitors.

The data mode has a sub-mode called AUTO INCREMENT. This is a default setting, meaning that it is set to auto increment on reset. The user may turn off the auto increment sub-mode if desired.

When in the auto increment mode, the current address pointer in the address display is automatically pre-incremented on each third data key press.

A SINGLE DOT in the RIGHTMOST LED display indicates the current address will be incremented BEFORE the next nibble received from the keyboard is stored.

This allows the user to review the byte just entered. If an incorrect nibble is entered, the internal nibble counter MUST BE RESET by pressing the ADDRESS KEY TWICE. Then two nibbles may be entered at that location. This is a slight annoyance at first, but it is a small price to pay for such a powerful feature as auto increment!

After two nibbles have been entered, the prompt on the LCD is IMMEDIATELY updated and points to the next memory location, or in the case of the last byte on the LCD, the prompt PARKS AT THE TOP LEFT CORNER signifying an entire screen update UPON THE NEXT DATA KEY PRESS.

This allows the user to revise the entered code before continuing.

You must be in the data mode to perform a program execution with the "GO" key. (Actually, you can be in the SHIFT mode also.)

Because of the auto key repeat, and "auto increment", it is possible to fill memory locations with a value by holding down a data key. This may be useful to fill short spaces with FF's or zero's.

Because the LCD prompt is advanced immediately after the second nibble being entered while the LED display is advanced on the third nibble received, the "+" key will advance only the LED display while the "-" key will shift the LCD prompt back two spaces, if either are pressed immediately after the second nibble is entered. This may seem strange but is the result of a clever design which allows for revision of entered code on either display before proceeding.

ADDRESS MODE

This is identified by 4 dots appearing in the address display of the LED display and "ADDR" in the LCD bottom corner.

The address key is used to toggle in and out of this mode.

TEC INVADERS AND MAZE

These two games come on a 10 minute tape with instructions and a detailed diagram of the "invaders" screen showing the various characters.

The instructions are basic but sufficient. One VERY IMPORTANT omission is the 8x8 is connected to PORTS 5 and 6 for both games.

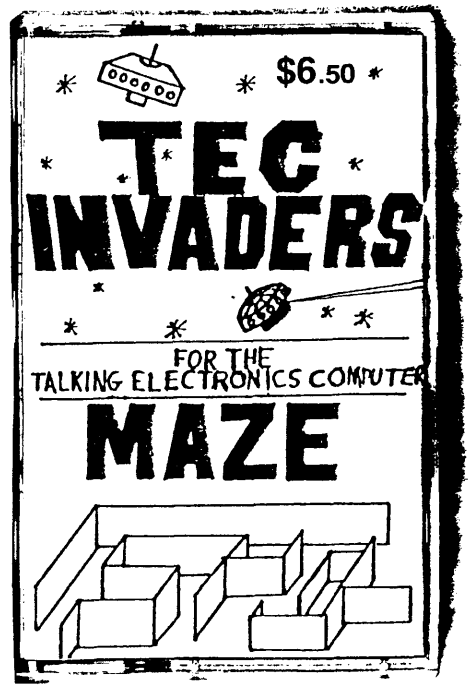
Both games are very entertaining but invaders suffers a little by the limitations of the 8x8.

However it does impose a challenge and you can constantly improve on your score.

Maze dose not suffer one bit by the limits of the 8x8. In fact the 8x8 is perfect for the Maze. The scrolling effect has to be seen to be appreciated.

Maze is a game to keep you occupied for hours.

See Camerons tape #1 on P. 39.



The address mode will be entered by an address key press from either the data or function mode. An address key pressed while in the address mode will result in a return to the data mode.

While in the address mode, data keys are used to enter an address while the control keys (+, -, GO) are used to enter the function mode. No auto zeroing has been included, therefore 4 keystrokes are required to enter any address.

SHIFT MODE

This mode allows easy manual use of the cursor. The shift works by holding down the shift key and at the same time, pressing a data key.

The monitor must be in the data mode and only data keys work with the shift.

Sixteen functions are available but only ten have been used in this monitor.

The shifts are:

Shift-zero: Cassette MENU is displayed.

Shift-one: Cursor back one byte.

Shift-two: Start single stepper at current address.

Shift-four: Cursor forward 4 bytes.

Shift-five: Break from shift lock (see function mode).

Shift-six: Cursor back 4 bytes.

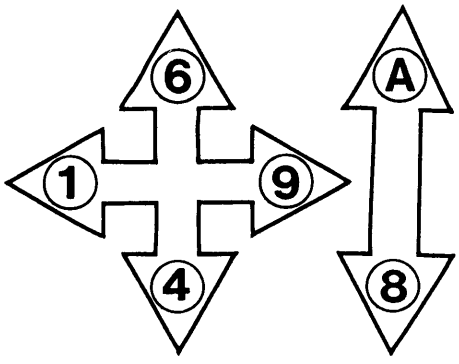
Shift-seven: Enter register examination routine.

Shift-eight: Cursor forward 8 bytes.

Shift-nine: Cursor forward 1 byte.

Shift-A: Cursor back 8 bytes.

Note that 1, 4, 6 and 9 form a cross and 8 and A form an arrow and each is positioned to correspond to their cursor movement.



Keys 1, 4, 6 and 9 move the cursor LEFT, RIGHT, UP AND down on the LCD.
Key "A" shifts the screen back to display the previous eight bytes.
Key "8" shifts the screen forward eight bytes.

When editing a program, the shift enables fast movement through the memory. Data entry is achieved by releasing the shift key.

The shift mode is not identified explicitly on either display.

THE FUNCTION MODE

This has been provided to enable a quick way to call commonly used routines. Only three keystrokes are required invoke up to 48 different routines.

The function mode is broken up into 3 sections.

They are: Function select-1, Function select-2 and Function select-3.

Each is identified by a single dot in the address display: right-most for function 1, second right for function 2 and third right for function 3. On the LCD display, the functions are identified by: Fs - 1, Fs - 2, or Fs - 3 in the bottom left corner.

Fs-1, Fs-2 and Fs-3 are entered FROM THE ADDRESS MODE by pressing the "+" key for Fs-1, the "-" key for Fs-2, the "GO" key for Fs-3.

It is possible to swap between sections without coming out of the current function mode by pressing the required function select key. After entering the required section, A DATA KEY IS THEN USED TO SELECT ONE OF SIXTEEN ROUTINES.

The address of these routines are stored in a look-up table.

SECTION-1 - the SHIFT-LOCK FEATURE.

Section-1 is selected FROM THE ADDRESS MODE by pushing the "+" key. The keys 0, 1, 2, 4, 5, 6, 7, 8, 9 and A then have the functions as listed in the shift mode. (Key 5 has the function of returning to the data mode.)

Cursor control routines return back to section-1 to enable continuous cursor movement (shift-lock).

The look-up table for the jump addresses for section-1 is at 07E0.

SECTION-2

Section-2 is selected from the address mode by pushing the "-" key. This is unused by any existing software and is available to the user.

HERE'S HOW TO USE IT:

Using the section-2 is very easy. All that is required is to enter the address(es) of the required routines in a table. The table begins at 08C0. The first two bytes at 08C0 correspond to the zero key in section 2. While the second two (08C2) correspond to key one etc.

Here is a short program as an example:

08C0: 00 09 04 09 08 09

(These are the addresses of the routines).

0900: 3E EB 18 06 3E 28 18 02

0908: 3E CD D3 02 3E 01 D3 01

0910: 76 C9

Now push ADdress, "-", "0" and the routine at 0900 will be CALLED from the MONitor. Reset the TEC and try ADdress, "-", "1" and ADdress, "-", 2.

Because these routines are CALLED from the MONitor, you may use a return (RET, C9 or RET NZ etc.) instruction to re-enter the MONitor in the same state as you left it. e.g. in the function select-2 mode.

SECTION-3

This has been reserved for the utilities ROM at 3800. The table for Section-3 is at 3820.

USING THE SINGLE STEPPER

Getting the single stepper to work is simple enough, however there is some skill required to understand its limitations and knowing how to avoid them.

To start with, you need a program that you require to be SINGLE STEPPED.

This program may be anywhere in memory except in the lowest 2k (the MON ROM).

This is because the MON select line is used as part of the timing. You may call into the MON ROM but only the first instruction will single step, and when returning out of the ROM, the next instruction will also not be stepped. (However they will be executed at normal speed.)

Programs that use the TEC's keyboard require careful attention as you cannot step them in the normal way. This is because there is no way to distinguishing between key-presses for the single stepper and those for the subject program.

This reduces the usefulness of the single stepper a little however thoughtful software design enables a fair degree of flexibility and this problem may be side-stepped.

The key use of the single stepper is as a de-bugging aid. When you are writing programs. effective use of the single stepper usually requires that while writing your programs, you allow for the use of the single stepper by leaving room to place one byte instructions that turn ON and OFF the single stepper.

Programs using the keyboard may be stepped by turning OFF the stepper. This allows areas requiring use of the keyboard to run in real time while other areas may be single stepped. This applies only to programs that use the keyboard routines provided inside JMON.

The only disadvantage here is that after completing your program you may have NOPs left.(from where you blanked over the single stepper control bytes).

The keyboard controls for the single stepper are as follows:

To start single stepping from the current address, this is what to do: From the data mode, press shift-2. This will start the single stepper. The first instruction will be performed and the address will be displayed as "PC" (Program Counter) on the single stepper. To examine the registers, press "+". The left two nibbles correspond to the high order byte and in the case of register pairs, the left-hand register. You may go backwards also by pressing "-". The registers displayed are : PC, AF, BC, DE, HL, IX, IY, AF', BC', DE', HL' and SP, in this order.

To step the next instruction, press GO. You can also step continuously at about 2Hz by pressing any data key.

When in the auto step mode, you can stop at any time and examine the registers by pressing "+" or "-", or bring it back to the manual mode by pressing GO.

The address key resets back to the MONitor unconditionally. The control bytes for the single stepper are as follows:

To stop single stepping in a program: F3 (disable interrupt).

To restart in a program: EF (restart 28). This causes a restart to 0028 where a routine passes the start address (which is actually the return address of the restart 28 instruction) to the single stepper. It also enables the interrupts and then returns to the next instruction which is then single stepped.

This SINGLE STEPPER is only a first model. Hopefully, when more room is available, some improvements can be added. One improvement on the "cards," is allowing it to be interfaced with a utilities ROM. This ROM will extend the display capabilities, allow editing while stepping and to disassemble on the LCD each instruction as it is stepped. If you have any ideas or requirements, write in and tell us.

BREAK POINTS

Break points are locations in a program where execution is stopped and the registers are examined in the same fashion as the single stepper. The advantages over single stepping include real time execution and less or no control bytes in a program. They also usually allow much quicker fault finding.

As a trade-off move, only a simple (but effective!) form of break-point is available with JMON. This allows for more MONitor functions and also eliminates the need for extra hardware.

More complex methods automatically remove the break-point control byte and re-insert the correct op-code and allows re-entry to the program.

USING JMON BREAK-POINTS

Break points are achieved by using a restart 38 instruction. The op-code for this is FF and all that is required is for it to be placed where ever you require your break point.

Before running your program, make sure the TEC is reset to 0900. This is necessary to clear the auto-repeat on the stepper/break-point register display. (This is explained in the LCD section).

Simply run your program as normal. When the break point is reached, the register display routine is entered. The value of the program counter display WILL NOT BE VALID on the first occurring break unless you provided the address of the break point at 0858. This minor flaw was unavoidable without considerable additional software which would have "eaten" memory like there's no tomorrow!

If you allowed for break commands in your program, you may then have multiple breaks and step to the next break with the GO key.

However if you placed a break command over an existing instruction then no further breaks will be valid and you should never try multiple breaks in this case AS YOU MAY CRASH THE MEMORY.

In the above case, make a note of the contents of the registers and return to the monitor via the address key and then examine memory locations, if required. (You may enter the register examination routine via shift-7). Further breaks should be done by removing the existing break and placing it where required and re-executing the program from the start.

Some other good ideas are to load the stack away from the MONitor's RAM area. (08F0 is good but make certain that 08FF does not contain AA - as this prevents the MONitor rebooting its variables on reset and your stack may have accidentally crashed these variables.) Also, if you are using the LED display scan routine in the MONitor ROM, shift your display buffer to 08F0 by putting this address into 082C/2D. Now you can examine your stack and display values after returning to the MONitor.

There is a conditional way to cause breaks. To do this requires a conditional jump relative with FF as the displacement. If the condition is met, the jump is made and jumps back onto the displacement which then becomes the next op-code! Remember this as it is a very useful idea. You cannot continue on with multiple breaks after a break caused by this method.

Break points are a quick way to debug a program. It is very important that you familiarize yourself with them. They have been the single most important programming aid used when writing most of JMON and the utilities ROM.

SUMMARY:

Clear the auto-repeat via the reset.

: Use FF to cause a break

: PC not valid on first break.

: For multiple breaks, provide spaces for the break control byte.

: Shift stack and display buffer (optional)

: Use FF as displacement for conditional breaks.

Finally, make sure you write down when, where and why, each time you insert a break-point.

ACKNOWLEDGMENT

Thanks to MR. C PISTRIN of Traralgon VIC. His SINGLE STEPPER program for the MON-1B inspired me to include one in JMON and provided me with a circuit for the hardware section.

See page 47 for the circuit

THE TAPE SYSTEM

This discussion covers all the areas needed to use the tape save and its various options.

TEC CONSIDERATIONS

The tape software works on any type of TEC, the only consideration is the various different clock speeds.

The following description generally applies to TEC's with a crystal oscillator that is fitted with a colour burst (3.58MHz) crystal and divide-by-two stage.

If you are still using a 4049 based oscillator, the tape system will work ok, but it will be very important to note the TEC clock speed when saving as the TEC must be set to the same speed when re-loading. Another problem can be the drift in frequency over a temperature range and the different oscillator frequencies between TEC's.

When saving a tape, the best idea is to wind the clock up to full speed, and then turn back the speed control pot one quarter of a turn. This will allow you compensate for speed drift if ever required.

The tape also works very reliably with a 4MHz crystal and divide by two stage, however a tape written using a 3.58MHz oscillator cannot be loaded by a TEC that uses a 4MHz oscillator, and vice versa.

If you are sending programs into TE on tape, they must be recorded with the 3.58MHz crystal. (divided by two).

The tape system has been extensively tested and found to be very reliable under a wide range of conditions. We don't expect you to have any trouble in getting it to work reliably for yourself.

LET'S BEGIN

To start with, you need a JMON monitor ROM as the tape software is inside this ROM.

Secondly, you will need a cassette recorder with both "mic" and "ear" sockets. Any audio cassette player of reasonable quality should be ok, provided it has the two sockets mentioned above.

We have tested more than six types, and found them to be quite suitable.

Thirdly, you will need to have constructed the cassette interface on the LCD interface board and have made up the two connecting cables, with 3.5mm plugs on each end. Finally you will need a new C60 or C90 cassette of the better quality types, such as TDK or Sony. We found the cheap tapes from the junk shops or supermarkets to be unreliable. (Some of them didn't work AT ALL, so don't take the chance).

Now connect the "mic" on the tape recorder to the "tape out" from the TEC and "ear" socket to the "tape-in" on the TEC. (It's a good idea to mark the cables between the recorder and the TEC to prevent incorrectly connecting the leads).

Insert a tape and we are ready to learn how to operate the system.

HOW TO OPERATE THE TAPE SYSTEM.

We will start by saving a few bytes at 0900. Enter at 0900 the following: 01 02 03 04 05 06 07 08 09 0A.

OK. Now connect up the tape recorder as described above and call up the tape software by pushing shift and zero at the same time or Address, "+","0" consecutively.

The TEC display will now show "SAVE-H" and this is the heading for SAVE at HIGH SPEED. Now select this by hitting "GO"

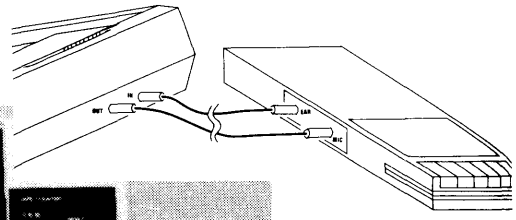
The display will now have a random two-byte value in the address display and "-F" in the data display. The "-F" in the data display is for the file number, while the address number is just junk from the RAM. You can enter a file number by pressing the data keys. Enter anything you want. The numbers you enter will shift across in the same fashion as when entering an address on the MONitor. Then when you have entered a file number, press the "+" key. The data display will now show "-S". This is where you enter the start of the block you wish to output. Enter 0900, and then press "+". The data displays now show "-E." This is where you enter the address of the last byte of the block to be saved.

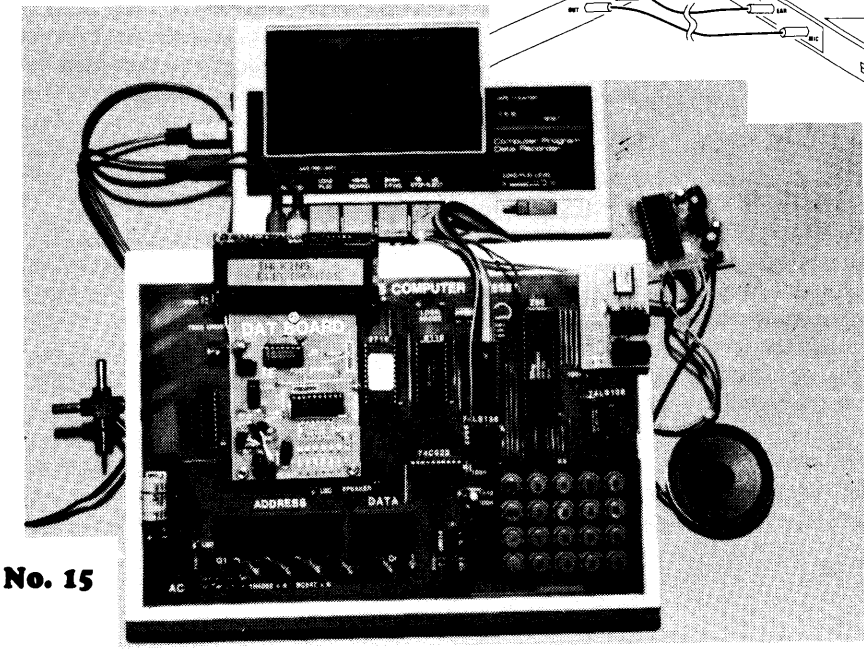
Enter 090A and press "+". The next data display is "-G". This is the OPTIONAL AUTO-GO address, this is always set to FFFF by the software as this is its NON-ACTIVE state, i.e. NO AUTO-GO upon a re-load. ANY other value entered here will result in an automatic execution upon a SUCCESSFUL LOAD AT THE ADDRESS ENTERED HERE.

We don't require auto execution, so leave this at FFFF.

Now press play and record on the tape recorder and wait for the clear plastic leader to pass if at the start of a tape. Incidentally, it is not a good idea to remove this leader as has been advised in another magazine, as it protects the tape from stretching and possibly breaking, when rewound.

When the tape is right, press GO. The display will blank and a continuous tone will be heard from the speaker. After a few seconds the file information will be outputted and then a period of high frequency tone. This "middle sync" tone is to cover the time that the filename is displayed when re-loading.





After the high tone, the code will be outputted and also a digit will appear on the TEC LED display. This is the number of COMPLETE pages to be saved. In this case it will be zero.

A point to raise here is that if you ever accidentally enter a start address that is HIGHER than the end address, when GO is pressed, the software will detect this and display "Err-In". In this case, Push "+" or "-" to go back to the perimeter handler where you can correct the error.

When the code has been saved, a short end tone will be heard and then the menu will re-appear with "-END-S", meaning end of save.

Once the code has been saved, rewind the tape.

To re-load the tape press the "+" key and you will see "SAVE-L" on the display, then "TEST-BL", "TEST-CS", then you will come to "LOAD-T" (for load tape). Note that there is no "TEST-H" or "TEST-L" for low and high speeds as the test and load routine will load either speed automatically.

Press GO. The data display shows "-F" for file number. This will be as you left it when you saved. When loading or testing from tape, the file number here determines which file will be subject to the selected operation. If you enter FFFF here, the next file found will be used, regardless of its file number.

For now, we will leave it as it is.

Next push "+". The data display will show "-S", meaning Start address. This is always set to FFFF by the software. The start address allows you to optionally load a file or test a file at an address different to the one on the tape, (which is the address from which it was saved). To demonstrate its operation and to make it a more convincing trial, we will enter 0A00. The file will now be loaded at 0A00. If you press the "+" key again, you will be back at the file name. (This last point demonstrates the programmable number of "windows" feature of the perimeter handler. It was set up for 2 "windows" by a short routine entered from the Menu driver before passing control to the Perimeter handler, remember that there was 4 "windows" when you saved the file).

Now press GO.

The display will blank. Now start the tape playing. The sound from the tape will be echoed on the TEC speaker. Soon the leader will be heard and it should sound as crisp as when it was saved. If not, experiment with the volume. The interface allows for a wide variation of volumes but 3/4 volume is a good place to start.

After the leader has passed, the file name is loaded and should appear on the display. If it was not correctly loaded, "FAIL-Ld" will appear. In this case experiment with the volume and retry. After a few seconds the file name disappears and the number of complete pages to load are displayed on the middle digit. The code is now being loaded.

The code is loaded very quickly and hopefully a "PASS-Ld" will appear. If not, re-try with a different volume setting. After you have successfully loaded, hit reset and ADdress 0A00 and 01, 02 etc. will be found.

If you are unable to get a successful load after many attempts, then skip ahead to the trouble shooting section.

Now we have a successful load, we will experiment with the TEST BLOCK function.

Change a byte in the 0A00 block. Now call up the tape software (Shift-0, or ADdress, "+" ,0), select "TEST-BL", and LEAVE FFFF at the optional start. ("-S") Then rewind the tape and play it back like you did when loading.

At the end of the test, the display comes back with "PASS-TB". Now do this again, but this time enter 0A00 at the optional start and FFFF for the file. This will demonstrate the load/test next file feature.

Because 0A00 has been entered in the optional start "window", the test will be between tape and the code at 0A00.

Rewind the tape and press "GO" on the TEC, then play the tape.

Because a byte has been changed, the test this time will fail and the display will show "FAIL-TB."

Use the test-block feature whenever you wish to compare a tape file with a memory block or test that a save operation was successful.

If ever revising software on a tape of which you do not have a copy in memory, use the test checksum (TEST-CS) to ensure that the file is good. By use of the "LOAD NEXT FILE" feature (FFFF in the file number window) you can go through a tape completely, checking each file.

THE "AUTO-GO"

To use the Auto-GO feature, you must enter the required GO address WHEN YOU SAVE THE FILE. The go address is entered under the "-G" data display.

Experiment with the following:

0900: 21 10 09 11 00 08 01 06

0908: 00 ED B0 CD 36 08 18 FB

0910: 6F EA C6 EB E3 EB.

Save this as described above, but this time enter 0900 under the "-S" heading, 0921 under "-E", and 0900 under "-G".

Now re-load it and if the load is successful, the program will start automatically and an appropriate display message will appear.

USING THE TAPE SYSTEM.

The primary use for your tape save system is as a mass storage device for your files.

Files may be saved and loaded as described previously, the important addition here is good paper-work habits. It is very important to keep a log of your files or you will quickly forget what you have, where it is located, and you will end up writing over your files!

Your log system must include identifying each cassette and the side of the tape, the files on the cassette in the correct order, how many of each file, the date and any notes on the file. If your recorder has a tape counter facility, it makes good practice to record the readings from this, so that files may be quickly found anywhere on the tape.

Also a great aid is to log approximately the location of each file e.g. half-way, 30 seconds from rewind from end etc.

Apply the above idea to the start of vacant area on the tape also.

Another very good way to use the tape system is as a "RUNNING LOG", where a whole side of a cassette is used to save a developing program, stage-by-stage. If you crash your program, you can re-load it back from tape. A good idea here is to use the high byte of the file number as the program identification and the low byte as the progressive count or version number on the tape.

When you have a final version, then save that on a permanent cassette. The "RUNNING LOG" cassette can then be used over and over.

Once again, paper work is very important. Make sure you document any differences between successive files. This may help later in de-bugging. Also, always include the date and time as this will give a chronological order to your work.

If you are wondering how many times you should save a file, and at what speed, the answer really depends on the reliability of your system.

The major factors in reliability are your tape player and cassette quality and how well you constructed your interface. If any of these are borderline, the system may work but you may have a higher than normal failure rate. Our tests show reliability at better than 98% on saves of 2K blocks. Different cassettes and players were used over many months and rarely did a fault creep in.

You can test your system out by saving the monitor 10 times on each speed and then perform a BLOCK TEST. You should get at the very least, 17 out of 20 passes. If not, some trouble-shooting may be required. If you get 19 or 20 you could probably get away with high speed saves and not have to worry about checking them on your running log. For permanent storage, a good system is a high speed save, then two low speed saves and check each afterwards.

The low speed save should be more reliable than the high speed save as the low speed save will tolerate the occasional hiccup. However, this extra reliability does not cover all possible causes of failure, e.g. problems related to frequency or bandwidth restrictions of your tape player as the period is not changed only the ratio of pulses.

Finally, a file that is absolutely necessary to be retrieved from tape must be stored on two tapes. This provides a double back-up facility against accidental erasure or damage.

"OH NO!" IT DOESN'T WORK.

If your tape system fails to work correctly, then check the interface board or better still, have a friend check it.

Eliminate any problem and re-try.

If problems still exist, test the cassette player with a normal pre-taped audio tape. The music should sound normal and not flutter. If it flutters, the tape player is due for a service or replacement, or if battery operated, the batteries may be flat.

Various sections may be eliminated by listening to the tape signal. If the signal saved on the tape sounds ok when played back on the player, but is not heard on the TEC, check the input section of the interface board and also the "E" output of the player with a pair of Walkman-type headphones.

It is possible that the volume output is not high enough to be amplified on the interface board.

This is very unlikely though on ordinary tape players but we found this to be the case with our VZ-200 data cassette player.

If no signal is getting to the TEC and everything else seems to be ok, test the input buffer by setting the tape software to load and taking the input high and low with a jumper lead.

The LED on the speaker should echo the inverse of the input. If not, shift the jumper to the collector lead of the input transistor and repeat the process.

If the speaker LED now toggles, the input transistor is faulty.

If not, investigate the latch chip. Make sure all the pins are well soldered and the feed-throughs are connecting properly.

If the tape signal is heard, in the TEC speaker, but the file number is not recognised, loaded correctly, or the tape fails to load the data blocks consistently, try a better quality cassette tape. If problems persist, try a different player as the signal may be distorted or not have enough amplitude.

If you still can't get it to go, a repair service is available for $9.00 plus $2.50 postage.

RUNNING OLD PROGRAMS WITH JMON

Most old programs will run with JMON without to much alteration.

For most, they will only need to be relocated from 0800 to 0900 and that's all. Those that use old MON-1 routines such as the running letter program or the tune player can't, of course, run with JMON.

Of those which use the keyboard, most can be easily altered but some require a complete overhaul.

These ones listed below cannot run on JMON, or require more extensive changes that those presented here:

SPIROID ALIENS, HALILOVIC'S PIANO, BIG BEN CHIMES, WINNERS CALL, YOU'RE DEAD FUNERAL DIRGE, TOCCATA, THE STRIPPER, ADDING AUTO REPEAT, AUTO RETURN AND STOP, AUTO MOVEMENT AND HALT, THE ROMMED PRINTER SOFTWARE and SPACE INVADERS SHOOTING.

Those not mentioned should run ok if re-located to 0900 and the mods listed below are done, if required. These mods apply only to routines which use the keyboard.

TEC KEYBOARD THEORY

Basically the keyboard usage of earlier routines is broken up into two types: Those which halt and wait for a input via the interrupt, and those which intialize the input buffer (the interrupt vector register or I register) and read it "on the fly."

The first type may again be broken into two groups. Those which explicitly read the value from the input buffer, with a LD A,I instruction (ED 57), and those which assume the input to be inside the Accumulator after the interrupt has occurred. (Remember the earlier MON-1 series did not save the accumulator during the NMI routine but instead returned with the input key value inside the accumulator. A disastrous state of affairs)!!

JMON

The specially-provided routines in JMON will work for all the above types, the only difference being the way you alter the program in question. Here's how to alter the routines:

To up-date any type which uses a HALT instruction (76H) as part of the keyboard input section, change the HALT instruction (76H) to a RST 08 (CF).

The RST 08 routine SIMULATES the halt instruction by first looping until NO key is pressed then looping until a key IS pressed.

After a key press is received the input value is masked to remove unwanted bits and stored in the input buffer, (the interrupt vector register), in identical fashion to the old interrupt routine.

Now if the halt instruction is immediately followed by a LOAD A,I (ED 57), you may leave it as it is or remove it as it is not required any more as the input value is returned in A.

If a program doesn't have a HALT instruction but uses the keyboard, then look for the LOAD A,I instruction (ED 57). Change this to a RST 20 (E7) and place a NOP over the unused byte. Notice that this IS NOT the same RST instruction as above.

Be careful not to mistake the LOAD A,I (ED 57) with a LOAD I,A (ED 47) otherwise you program may get upset and go on strike.

Programs which have neither a HALT or LD A,I instruction cannot be altered by any of the above methods because they enter a continuous loop and require the interrupt to force an input value into the accumulator. A classic example of this is the "space invaders shooting" on page 14, issue 14. This above loop is located at 0821. (while you're looking at this, grab a pen and change the byte at 0812 from 02 to 01, at least it will run correctly with MON-1)! All the above types are among those listed as not being suitable for modification via these methods.

FINALLY

If you find a program which doesn't work (we haven't tried them all) or something else interesting, please write and let us know.

USING THE KEYBOARD IN YOUR PROGRAMS

The new keyboard set-up is no more difficult to use now than before. In actual fact it is easier and requires less bytes than before thanks to the use of the RST instructions.

Four RST's are provided to handle the keyboard in different ways. The first RST we shall look at is RST 08 (CFH). This RST is a "loop until a NEW key press is detected" routine. If you refer to the section on running old programs, you will see that this RST is used to simulate/replace the HALT instruction. (You know how to use it Already!)

An important feature of this RST is that it ignores any current key PRESSED, that is if a key is being pressed when this RST is performed, it will not be recognized. This mimics the NMI which only recognized a key press once. (This is why the auto-repeat feature could not be done with the keyboard hooked up to the NMI).

When this RST detects a valid key press, it inputs the value from the key encoder and masks the unwanted bits and stores the input in the interrupt vector register (as did the MON-1 series). The input value is also returned in the accumulator. The shift key can not be read from this (or any other MONitor keyboard routine) as the shift input bit (bit 5) is masked off.

Here is an example of its use:

```
0900  CF      RST 08
0901  FE 12   CP 12
0903  20 04   JR NZ,0909
0905  3E EA   LD A,EA
0907  18 06   JR 090F
0909  FE 01   CP 01
090B  20 F3   JR NZ,0900
090D  3E 28   LD A,28
090F  D3 02   OUT (02),A
0911  3E 01   LD A,01
0913  D3 01   OUT (01),A
0915  18 E9   JR 0900
```

The first thing you should notice when you enter and run the above, is that the "go" key is not detected when the routine is first started, even though it is being pressed. This is because the first part of the RST loops until the key being pressed is released. The RST then loops until a new key press is detected. When the RST returns, the input value is both in the interrupt vector register and the accumulator. The rest of the routine tests for either a 01 or "GO" key and outputs to the display.

Use this RST when ever you want the TEC to go "dead" and wait for a key press.

The second RST is RST 10 (D7). This is similar to the first RST but has one very important difference. The difference is that this RST DOES NOT wait for a key being pressed to be released before returning. While this is not as likely to be used as much as the first RST, it does have some good uses. Any program which requires some action to take place while there is a key pressed, but do nothing when there is not, may make good use of this RST. Some possible uses include random number generation on the time the key is held down; count while a key is pressed; turn on a relay while a key is pressed etc. As you can see, this RST simulates momentary action switches.

This RST exits with the input stored in the same fashion as the above RST.

The third RST is RST 18 (DF). This is a LED scan loop and keyboard reader. The scan routine will scan the 6 TEC LED displays once with the display codes addressed by the address at 082A. (0800 is stored here by JMON. You can leave it as it is, just store what ever you want at 0800 before using this RST). After the scanning routine is done, the keyboard routine is called. The keyboard routine is actually called from RST 20. What happens is this. After the scan has been called from the RST 18, the program continues on at 0020, which is the start address for RST 20. So the RST 18 is the same as RST 20 EXCEPT THAT RST 18 CALLS FASTSCAN. Therefor the description below applies to BOTH RST 18 AND RST 20.

This keyboard routine is very intelligent and is able to detect several different conditions.

One important feature is that it "remembers" if it has already detected the one key press and it ignores it if it has. This provides us with a "ONE AND ONLY ONE" key recognition for each key press. Each key press is "recognized" on the first detection.

The key is checked for a "FIRST KEY PRESS" by the use of a flag byte. When the routine is entered AND NO KEY IS PRESSED, this flag byte is CLEARED. When a key is detected, the flag byte is checked. If zero, the key is accepted as a "FIRST KEY PRESS." The flag byte is then set to stop further "validating" of the same key press. The input value is then masked and returned in the Accumulator (only).

If the flag byte IS NOT CLEAR, then the key is not recognized as "valid."

Careful consideration was giving to the interaction of the MONitor and user routines so that the "GO" command from the MONitor WILL NOT BE TREATED AS THE FIRST KEY PRESS of a user routine. (This was achieved by using the same flag byte for both JMON and any user routine).

HOW TO INTERPRET THIS RST

If a key is recognized as a "FIRST KEY PRESS" then the ZERO FLAG will be set to its active state (a logic 1) and the MASKED KEY INPUT will be returned in the accumulator.

If the key is NOT valid then the ZERO FLAG will be clear AND the accumulator WILL HAVE ALL ITS BITS SET (FF).

(FOR ADVANCED PROGRAMMERS)

In addition to the zero flag being conditionally set, the RST 20 (E7) also sets the carry conditionally, according to the following conditions:

If there is a key pressed then the carry will be SET REGARDLESS of whether it is a "first key pressed" or NOT. If NO key is pressed then the carry is cleared.

This allows you to interpret the keyboard the way you want, while still giving you the convenience of using the RST to do some of the work.

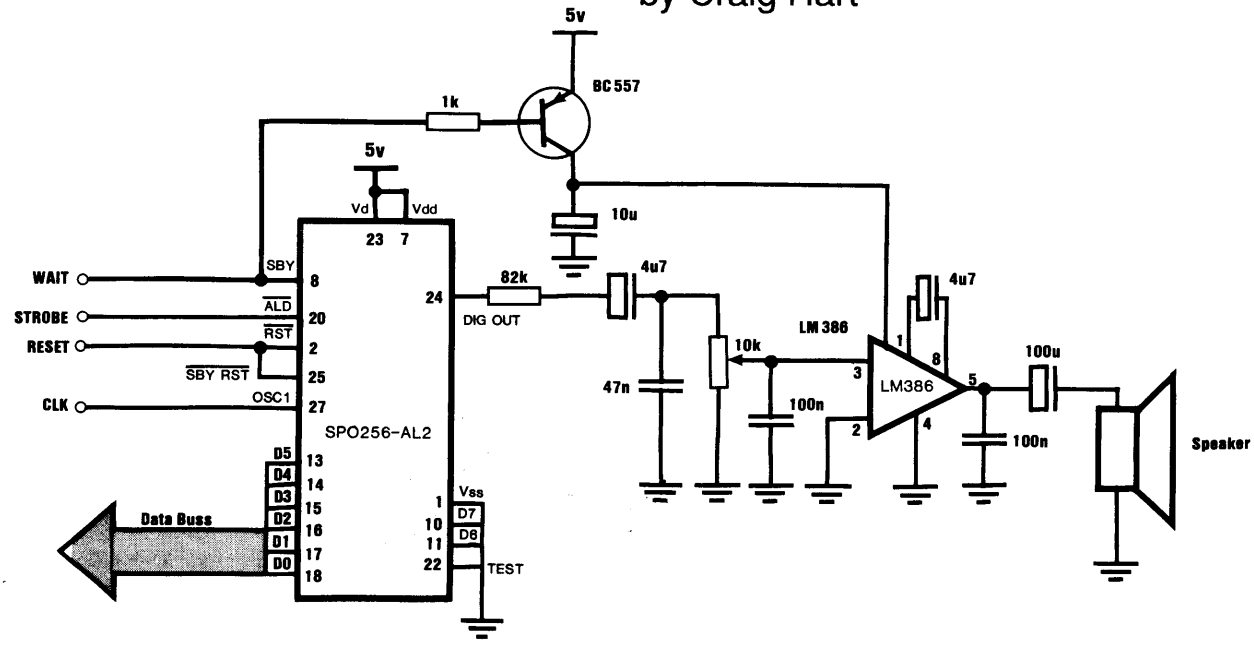
Jim's section cont P 47.

Speech Module

Parts $24.25
PC board $3.00
Total $27.25

Add speech to your TEC!

by Craig Hart



SPEECH MODULE CIRCUIT

Since the dawn of time, Colin has been fascinated by electronic speech synthesis, so it was with immense joy that we discovered the SPO256A-AL2 speech chip. This chip is a universal speech unit that can be made to speak almost any English word. The price was cheap and the interface was minimal, it was just too good to pass up! So I took took up the project and this is the result.

The module is interfaced to the TEC, and the TEC controls what is said. The only requirement is that you have a crystal oscillator, as the module requires a 3.58MHz clock signal from the unit. Demonstration programs have been included for testing and simple word sequencing, and these programs will show how the unit is accessed.

This is the ideal companion project to go with the I/O board, and a robot created out of the two projects will cause a real stir if it speaks a comment in response to what it is sensing in its environment.

The module is connected via an 8 way ribbon cable and 4 flying leads. The ribbon cable picks up D0-D5, and the 5v supply. The other 4 leads connect to STROBE 05, WAIT, RESET, and CLK. Note that only the lower six bits of the data bus are used by the speech chip. The reasons for this will be explained later.

OPERATION

The operation of the unit is straight forward, but it is important to understand its operation so that you can use it once you have built it. The SPO256A-AL2 is made to speak by sending it a series of ALLOPHONES. An allophone is the smallest individual sound that the unit can speak. Words and sentences are formed by outputting a series of allophones, one after the other.

Each allophone is assigned a number and this number is loaded into the chip via the TEC data bus, then the ALD line is pulled low (by strobe line 05).

The SPO now commences to speak the allophone and indicates so by pulling the WAIT line low, halting the TEC until the module is ready for more data. The BC557 is turned on hard by this and the LM386 amplifier is switched on.

Sound is clocked out of the unit at a rate determined by the CLOCK line. For normal speech this is 3.58MHz. Sound is filtered by an R-C network, to make the sound more "human like" and amplified by the LM386.

PARTS LIST

All resistors 1/4W 5%
1 - 1k Brown Black Red
1 - 82k Grey Red Orange

1 - 10k trimpot.

1 - 47n greencap.
2 - 100n monoblock.
2 - 4u7 electrolytic.
1 - 10u electrolytic.
1 - 100u electrolytic.

1 - BC557 transistor.
1 - LM386 amplifier IC.
1 - SPO256A-AL2 Speech IC.
1 - 8 pin IC socket.
1 - 28 pin IC socket.

1 - 8 ohm speaker.
4 - PC pins.
4 - PC pin connectors.
1 - 20 cm length 14 way ribbon cable.
1 - 24 pin DIP header.
1 - 10 cm length 2mm heatshrink tubing.

1 - 'SPEECH MODULE' PC board.

When speech output ceases, the wait line goes HIGH, and the TEC is able to continue processing. In doing so, the BC557 is switched off and thus the LM386's power supply is switched off. The reason for doing this is due to the high input impedance of the chip; it is prone to picking up stray noise. The most common noise source is the scanning of the LED displays! This results in an uncomfortable buzz when the unit is not speaking and by switching the power to the amplifier this has been eliminated.

THE ALLOPHONE SET

The SPO has little intelligence about what you want it to speak. You cannot simply feed it a word, and have it say the correct pronunciation in every case. (Although other chips do have this capability) Instead you, the programmer, must translate each word into the appropriate allophone(s) for that word. There are 64 individual allophones, and each sounds different. In these 64 allophones, there are 5 pauses of various lengths, corresponding to word and sentence breaks.

By consulting the Allophone reference table you can look up what you think the right sequence is then play around with different pronunciations of the same basic letter, until you reach the best sounding word. It can be a tedious process, but many common words have been pre calculated and a list appears at the end of the article, along with the table of individual allophones.

Take a sample word : ALARM. Sound out the word slowly, letter by letter. Now look for a matching sound in the list. Write down your guess and progress through the word. Where you have two or more choices, pick the allophone of the appropriate length. For alarm, I chose AA LL AR MM, or 18 2D 3B 10. Add a pause to the end and the terminating byte 04 FF. Plug the data into the test program at 0910 and run it.

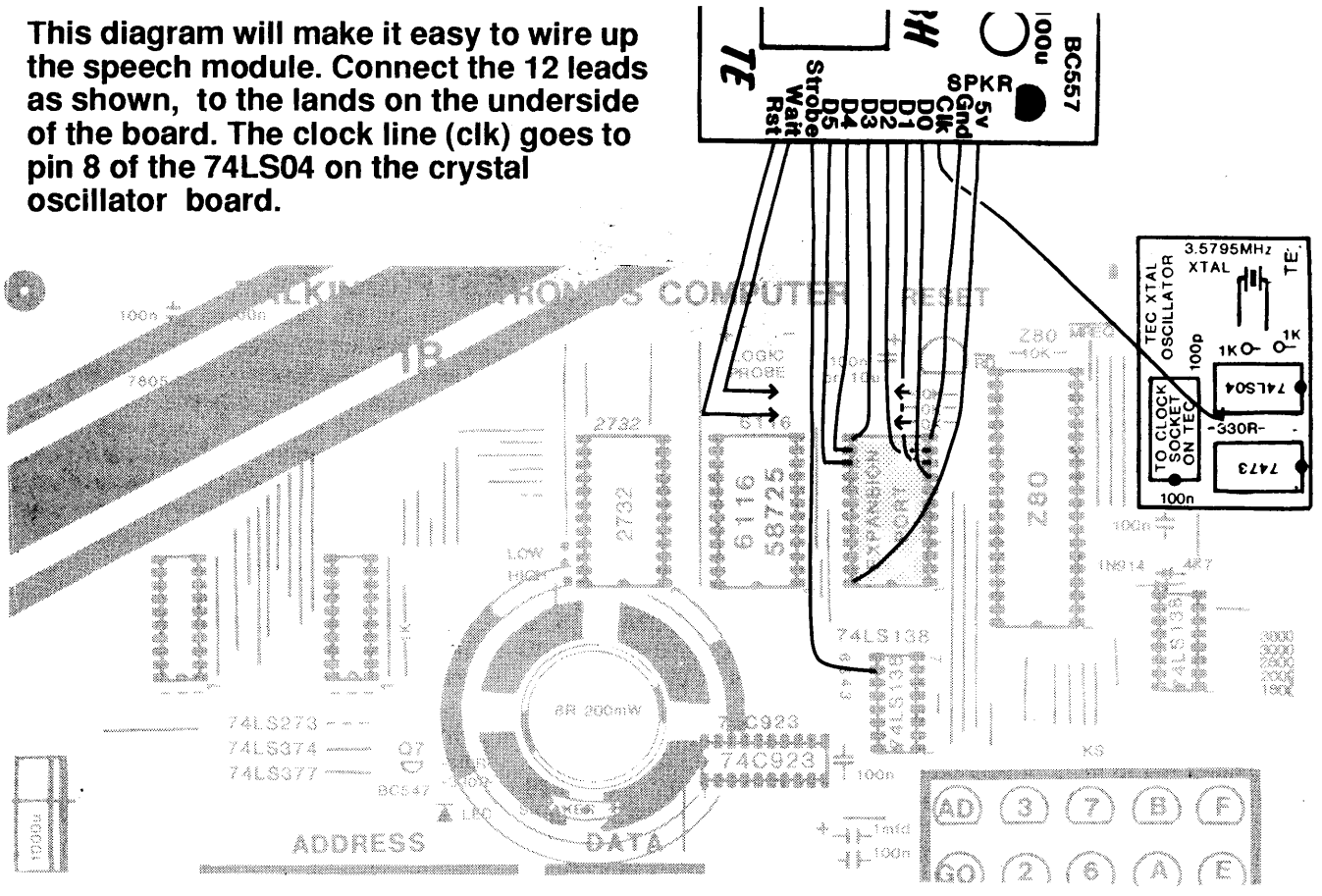
It sounds a little cut-off in the first 'a', so try a longer 'A' i.e. AX (0F) and try again. Enter 0F at 0910 and run the program again. Sounds better now doesn't it!

By following this method, you should be able to come up with any word within a short space of time. Remember, the secret is to sound each letter and syllable out and then search for the best allophone of the group. The sample word provided gives you a context in which the allophone is used. This is useful when deciding between TT1 and TT2 etc.

We also discovered that it was much easier to produce an understandable word if you used the slang way of saying it. The speech module always produces the same type of sound for any given allophone, so if you stick to spelling only, then the words always come out very strange. If you use slang then you will find that the resulting word is much easier to understand.

A perfect example of this came up when we first started work on the project. We bought our first sample chip from Tandy. It came with a list of words and full specification data. When the project was working, we started trying some given examples, and although the examples were recognizable, they were not very clear. Then Ross said to try the slang pronunciation. Voila! perfect. The words which were before just average became clearer and much more recognizable.

This diagram will make it easy to wire up the speech module. Connect the 12 leads as shown, to the lands on the underside of the board. The clock line (clk) goes to pin 8 of the 74LS04 on the crystal oscillator board.



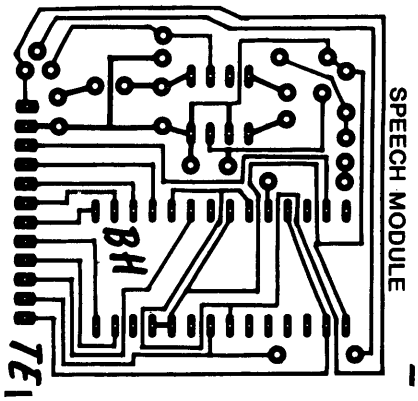
PAUSES AND REPEATING ALLOPHONES

The five pauses are worthy of a separate mention. You must always pause after a word, to make the SPO stop talking. Use a PA1 or a PA2. Use PA3 or PA4 between sentances. Refer to the following table for when to use PA1, PA2, and PA3 DURING words.

PA1 Before BB, DD, GG and JH.

PA2 Before some BB, DD, GG and JH.

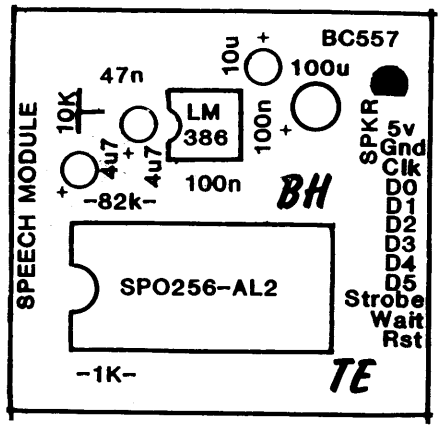
PA3 before PP, TT, KK, and CH.



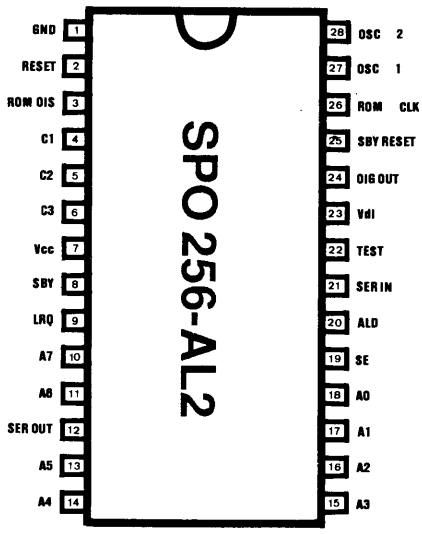
Begin by inserting the resistors. Solder them in and cut their leads short. Next insert the Capacitors, observing polarity with the Electrolytics.

Insert and solder the trimpot, then finally the transistor. Turn the trimpot fully towards the SPO - this is full volume and should be set here until testing is complete.

Check to see that you have a BC557 and insert it according to the 'D' on the overlay. Lastly insert the two IC sockets and plug the chips in, being careful to orientate pin one with the mark on the PC and avoid touching the pins of the SPO256A.



The speech board is very simple. Don't forget you will need the crystal oscillator project to get the 3.58MHz clock line.



The pin out of the SPO-256-Al2 allophone chip.

Strip 6 wires from the ribbon cable, then connect the remaining 8 between the data lines and the DIP header. Connect power with the last two strands. Follow the diagram and you can't go wrong. Separate 4 of the remaining wires into individual lengths and solder into the 4 remaining holes on the module.

Attach a matrix pin connector to the other end of each wire for connection to the TEC. Heatshrink each connector with the tubing supplied. A note on heatshrinking: Don't skip this section because you think it's a waste of time or too hard to do. Heatshrinking the connectors strengthens them and the wire is

A repeating allophone is one which can be spoken twice and flow along. i.e. EY EY produces 'AY pause AY', while FF FF produces one long 'Ffff'. Only 10 of these 64 allophones are repeatable like this. They are: IH EH AE UH AO AX AA FF TH & SS. Use these allophones in preferance to long timed syllables like SH in SHirt, WE in tWEnty, or SH in leaSH.

CONSTRUCTION

Although a simple project, care should be taken to ensure that a good job is done, so do not rush. Lay all the parts out in front of you on a piece of paper or cardboard (Not the High - Low shagpile of the living room!) and check to see that you have been supplied with everything.

TEST PROGRAM

```
0900 21 10 09  LD HL,0910      HL = Points to start of table.
0903 7E        LD A,(HL)       Get next Allophone.
0904 FE FF     CP FF           End of table ?
0906 28 05     JR Z,090D       Yes, HALT.
0908 D3 05     OUT (05),A      Speak allophone.
090A 23        INC HL          Next allophone.
090B 18 F6     JR,0903         Say next ...
090D 76        HALT            EOT, stop until key pressed.
090E 18 F0     JR,0900         Key pressed, say again.

0910 0D 17 17 02 2A 0C 2C 04   Your allophones are entered
0918 04 2A 0F 10 00 31 16 0D   from 0910 onwards.
0920 33 04 04 FF               this says 'TALKING COMPUTER'

0910 1B 07 2D 35 00 36 07 2F   Here is another greeting
0918 04 06 00 1A 10 00 12 13   message.
0920 00 0D 13 03 13 03 37 13
0928 03 08 18 10 09 31 16 11   The TEC introduces itself
0930 33 04 04 04 38 20 00 30   here!
0938 0C 1D 37 09 13 32 04 FF
```

much less likely to break off. If you always melt the wire when shrinking over a candle, then try using the BARREL not the tip of your soldering iron. This gives you a better controlled heat source and a neat job can be done on those small connections.

The last two lengths of wire connect to the speaker. Wire these up and the board is complete. Now for connection to the TEC. You will need to have your crystal oscillator inserted. If you do not currently own a crystal oscillator, you must purchase one with a 3.58MHz crystal. If you have a different frequency crystal fitted, it must be around 3.2 - 4.0MHz otherwise the sound will be too high or low pitched. A 2MHz or 8MHz crystal will not suffice.

Insert a PC pin in port 5 pad, a second pin in the board for the WAIT line, and a third pin in the board for the RESET line. Most users will already have done so, but if not, see the wiring diagram for the three pin locations.

The other pin you will have to connect as best you can. To tap the 3.5MHz signal, DO NOT connect to pin 6 of the Z80. This is because the crystal's frequency is divided by two before reaching the TEC board. Instead, solder a PC pin onto pin 8 of the 74LS04 on the crystal oscillator PC. This is the 3.5MHz clock output.

TESTING

Plug everything together and power up. If your TEC locks up or the unit makes strange sounds, remove power and go to the section on troubleshooting. Your TEC should start up as normal, with the unit deadly quiet. Enter the TEST PROGRAM and you should be greeted with a message. Listen carefully and let your hearing adjust to the metallic pitch. If all you can hear is junk, check your program, then if still no go, proceed to the troubleshooting section.

If the test program produces recognisable output, try the other examples and then try making up a few words of your own. You will soon find that you can say just about any word, once you get the right allophones.

There can be hours of fun even getting it to correctly pronounce your name. 'Paul' is easy enough, but what about 'Vouzopolous'?? or even common words like 'construction' and 'calculator'?? With such a versatile unit, the sky's the limit.

ALLOPHONE REFERENCE TABLE

NUMBER	ALLOPHONE	DURATION	SAMPLE
00	PA1	10 ms	PAUSE
01	PA2	30 ms	PAUSE
02	PA3	50 ms	PAUSE
03	PA4	100 ms	PAUSE
04	PA5	200 ms	PAUSE
05	OY	420 ms	Boy
06	AY	260 ms	Sky
07	EH*	70 ms	End
08	KK3	120 ms	Comb
09	PP	210 ms	Pow
0A	JH	140 ms	Dodge
0B	NN1	140 ms	Thin
0C	IH*	70 ms	Sit
0D	TT2	140 ms	To
0E	RR1	170 ms	Rural
0F	AX*	70 ms	Succeed
10	MM	180 ms	Milk
11	TT1	100 ms	Part
12	DH1	290 ms	They
13	IY	250 ms	See
14	EY	280 ms	Beige
15	DD1	70 ms	Could
16	UW1	100 ms	To
17	AO*	100 ms	Aught
18	AA*	100 ms	Hot
19	YY2	180 ms	Yes
1A	AE	120 ms	Hat
1B	HH1	130 ms	He
1C	BB1	80 ms	Business
1D	TH*	180 ms	Thin
1E	UH*	100 ms	Book
1F	UW2	260 ms	Food
20	AW	370 ms	Out
21	DD2	160 ms	Do
22	GG3	140 ms	Wig
23	VV	190 ms	Vest
24	GG1	80 ms	Got
25	SH	160 ms	Ship
26	ZH	190 ms	Azure
27	RR2	120 ms	Brain
28	FF*	150 ms	Food
29	KK2	190 ms	Sky
2A	KK1	160 ms	Can't
2B	ZZ	210 ms	Zoo
2C	NG	220 ms	Anchor
2D	LL	110 ms	Lake
2E	WW	180 ms	Wool
2F	XR	360 ms	Repair
30	WH	200 ms	Whig
31	YY1	130 ms	Yes
32	CH	190 ms	Church
33	ER1	160 ms	Fir
34	ER2	300 ms	Fir
35	OW	240 ms	Beau
36	DH2	240 ms	They
37	SS*	90 ms	Vest
38	NN2	190 ms	No
39	HH2	180 ms	Hoe
3A	OR	330 ms	Store
3B	AR	290 ms	Alarm
3C	YR	350 ms	Clear
3D	GG2	40 ms	Guest
3E	EL	190 ms	Saddle
3F	BB2	50 ms	Business

* = Repeating Allophone.

BASIC DICTIONARY

```
0          2B 3C 35
1          30 0F 0B
2          0D 1F
3          36 27 13
4          28 17 17 27
5          28 06 23
6          37 0C 29 37
7          37 37 07 07 23 0C 0B
8          14 11
9          38 06 0B
10         0D 07 07 0B
11         13 2D 07 23 34 0B
12         0D 2E 07 3E 01 23
13         1D 33 0D 13 0B
14         28 17 27 0D 13 0B
15         28 0C 28 0D 13 0B
16         37 0C 29 37 0D 13 0B
17         37 37 07 07 23 0C 0B
           0D 13 0B
18         14 11 0D 13 0B
19         38 06 0B 0D 13 0B

A          14
Alarm      0F 2D 3B 10
Alex       1A 2D 07 29 37
Alexandra  1A 2D 07 29 37 1A 0B
           15 27 0F
All        17 17 2D
Am         1A 10
Amateur    1A 10 1A 11 31 33
An         1A 0B
And        1A 0B 15
April      14 01 09 0E 0C 2D
Are        3B
At         1A 0D
August     17 1E 22 0F 37 11

B          3F 13
Baby       01 3F 14 01 3F 13
Bathe      3F 14 36
Bather     3F 14 36 33
Be         3F 13
Becky      3F 07 29 13
Bee        3F 13
Beer       3F 3C
Beth       01 3F 07 1D
Birthday   01 3F 33 1D 01 21 07
           14
Bite       01 3F 06 03 11
Blank      01 3F 2D 1A 0B 02 29
Bob        01 3F 18 18 01 3F
Bread      1C 27 07 07 00 15
```

Brett	01 3F 27 07 03 11
Brother	01 3F 27 0F 1D 33
Buy	3F 18 06
By	3F 18 06
Byte	01 3F 06 03 11
Bytes	01 3F 06 03 11 2B
C	37 37 13
Calendar	2A 1A 1A 2D 07 0B 01 21 33
Calling	08 17 3E 2D 0C 2C
Cat	2A 1A 02 0D
Check	32 07 07 02 29
Checked	32 07 07 02 29 0D
Checker	32 07 07 02 2A 33
Checkers	32 07 07 02 2A 33 2B
Checking	32 07 07 02 2A 0C 2C
Checks	32 07 07 02 2A 37
Clock	2A 2D 18 18 02 29
Close	2A 2D 35 37 37
Clown	2A 2D 20 0B
Collide	08 0F 2D 06 36
Computer	2A 0F 10 09 31 16 11 33
Cookie	08 1E 2A 13
Correct	2A 34 07 07 01 29 01 11
Corrected	2A 34 07 07 01 29 01 0D 0C 01 15
Correcting	2A 34 07 07 01 29 01 0D 0C 2C
Correct	2A 34 07 07 01 29 01 11 37
Crane	08 27 14 0B
Crown	2A 27 20 0B
D	21 13
Data	21 18 18 01 11 33
Date	21 14 02 0D
Daughter	21 17 0D 33
Day	01 21 14
December	15 13 00 37 07 30 1C 33
Dennis	21 07 0B 0C 37
Disk	21 0C 37 37 29
Divided	21 0C 23 06 01 21 0C 01 15
Do	03 21 16 1F
Drive	21 27 06 36
Drives	21 27 06 36 2B
E	13
East	13 37 11
Eight	14 11
Eighteen	14 11 0D 13 0B
Eighty	14 0D 11 13
Eleven	13 2D 07 23 34 0B
Emergency	13 10 33 0A 07 0B 37 13
Engagement	07 07 00 0B 24 14 01 0A 10 07 07 0B 01 02 0D
Engages	07 07 00 0B 24 14 01 0A 0C 2B
Engaging	07 07 00 0B 24 14 01 0A 0C 2C
Enrage	07 0B 0E 14 01 0A
Enraged	07 0B 0E 14 01 0A 01 15
Enrages	07 0B 0E 14 01 0A 0C 2B
Enraging	07 0B 0E 14 01 0A 0C 2C
Error	07 07 27 00 33
Extent	07 2A 37 0D 07 07 0B 0D
Exterminate	07 29 37 0D 33 10 0C 00 14 0D
F	07 07 28 28
Father	28 3B 12 33
February	28 07 1C 00 19 1F 34 13
Fifteen	28 0C 28 0D 13 2B
Fifty	28 0C 28 0D 13
Fir	28 34
Five	28 06 23
Fool	28 1E 1E 2D
Force	28 3A 37 37
Four	28 17 17 27
Fourteen	28 17 27 0D 13 0B
Forty	28 17 27 0D 13
Freeze	28 28 0E 13 2B
Freezers	28 28 0E 13 2B 33 2B
Friday	28 27 06 01 21 14
From	28 27 18 10
Frozen	28 28 0E 35 2B 07 0B
G	0A 13
Glenn	01 22 2D 07 2C
H	14 01 02 32
Happy	39 1A 09 13
Has	1B 1B 1A 2B
Have	1B 1B 1A 23
Hello	1B 07 2D 35
Hertz	39 39 34 11 2B
How	39 20
Hundred	39 0F 0F 0B 01 21 27 0C 0C 00 15
I	06
Idiot	0C 01 21 0C 0C 0C 0F 11
In	0C 0B
Input	0C 0B 00 09 1E 11
Is	0C 2B
It	0C 03 11
J	0A 07 14
January	0A 1A 0B 1F 31 34 13
John	0A 18 0B
Julie	0A 31 3E 13
July	0A 1F 2D 06
June	2A 1F 0B
K	2A 07 14
Karen	2A 1A 27 00 07 0B
Kilo	2A 0C 2D 35
Know	38 35
Kristy	08 27 0C 37 11 13
L	07 07 3E
Live	2D 13 23
M	07 07 10
March	10 3B 32
Mark	10 3B 29
May	10 14
Memory	10 07 10 18 27 13
MHz	10 07 24 0F 39 39 34 11 2B
Minute	10 0C 0B 0C 02 0D
Minutes	10 0C 0B 0C 02 0D 2B
Modem	10 35 01 21 07 10
Monday	10 0F 0F 0B 01 21 14
Month	10 0F 0B 1D 1D
Mother	10 0F 36 33
My	10 06
N	07 07 0B
Name	38 14 10
Naughty	38 17 17 02 11 13
Nine	38 06 0B
Nineteen	38 06 0B 0D 13 0B
Ninety	38 06 0B 0D 13
No	38 35
November	38 35 00 23 07 10 1C 33
O	35
October	18 29 00 11 35 1C 33
Of	18 23
On	18 0B
One	30 0F 0B
Or	3A
Our	20 33
P	09 13
Past	09 3B 37 0D
Penelope	01 02 09 07 0B 07 2D 35 09 13
Penny	01 02 09 07 0B 13
Point	09 05 0B 11
Q	2A 31 1F
R	3B
RAM	27 01 1A 1A 10
Rebecca	0E 33 3F 07 02 08 3B
Ross	0E 18 37 37
S	07 07 37 37
Saturday	37 37 1A 02 0D 33 21 14
September	37 07 09 11 07 10 1C 33
Seven	37 37 07 07 23 0C 0B
Seventeen	37 37 07 07 23 0C 0B 0D 13 0B
Seventy	37 37 07 07 23 0C 0B

	0D 13
Sister	37 37 0C 37 0D 33
Six	37 0C 29 37
Sixteen	37 0C 29 37 0D 13 0B
Sixty	37 0C 29 37 0D 13
Son	37 0F 0B
Sound	37 20 0B 15
South	37 37 20 1D
Space	37 09 14 37
Speech	37 09 13 32
Statement	37 01 11 14 01 11 10 07 0B 11
Sunday	37 37 0F 0F 0B 02 21 14
T	0D 13
Talker	0D 17 17 01 29 33
Talking	0D 17 17 02 2A 0C 2C
Television	0D 07 2D 0C 23 0C 37 0C 18 0B
Ten	0D 07 07 0B
Test	0D 07 37 01 11
Testing	0D 07 37 01 11 0C 2C
The	12 13
There	36 07 2F
Thirteen	1D 33 0D 13 0B
Thirty	1D 33 0D 13
This	12 0C 37
Thousand	1D 20 2B 1A 0B 15
Three	36 27 13
Thursday	1D 34 2B 01 21 1A 14
Tim	0D 1C 10
Time	0D 06 10
To	0D 1F
Today	0D 1F 21 14
Tuesday	0D 31 2B 01 21 14
Twelve	0D 2E 07 3E 01 23
Twenty	0D 2E 07 0B 0D 13
Two	0D 1F
U	31 1F
V	23 13
Vision	23 0C 26 0C 0C 18 0B
W	21 0F 01 3F 3E 1F
Want	2E 18 0B 02 11
Wednesday	2E 07 07 0B 2B 01 21 14
What	30 18 02 11
Who	39 1E 1F
With	30 0C 1D
X	07 07 02 29 37 37
Y	2E 06
Year	19 3C
Yes	19 07 37 37
You	19 1F
Your	19 3A
Z	2B 07 02 15
Zero	26 13 27 35

IF IT DOESN'T WORK

If your speech unit does not work, DON'T PANIC. Firstly, check your wiring. Most errors are in wiring, causing the TEC to lock up. Look for obvious faults like shorts, dry joints, components of wrong value or orientation. Check that your chips are inserted correctly - pin one of each chip faces AWAY from the off-board wires.

If you bought your parts from all over the place, make sure you get a SPO256A-AL2 device. Other suffix numbers are not acceptable.

Check that the trimpot is turned all the way towards the SPO256A - full volume. You can temporarily short between the collector and the emitter of the BC557, to turn the amplifier on fully. This should produce a lot of hiss, and touching pin 3 of the LM386 should produce a buzzing sound.

Check that you have +5v on each chip, and that the SPO's reset pin (pins 2 and 25) are normally HIGH, and that they follow the reset pin of the Z80 (pin 26).

If all you get is garbage then you probably have the data lines wired around the wrong way. Check against the wiring diagram, and have a friend check it as well. Look for pins bent up under the SPO and not connecting with the IC socket. Check the program through and make sure that you are sending it the correct data.

If you are totally lost, give us a call. Sometimes we can solve a problem straight away, and most times within a few minutes. If all else fails, we offer a repair service. Costs are:

Basic repair $ 7.00
SPO256A replacement $15.00
Postage $ 3.00

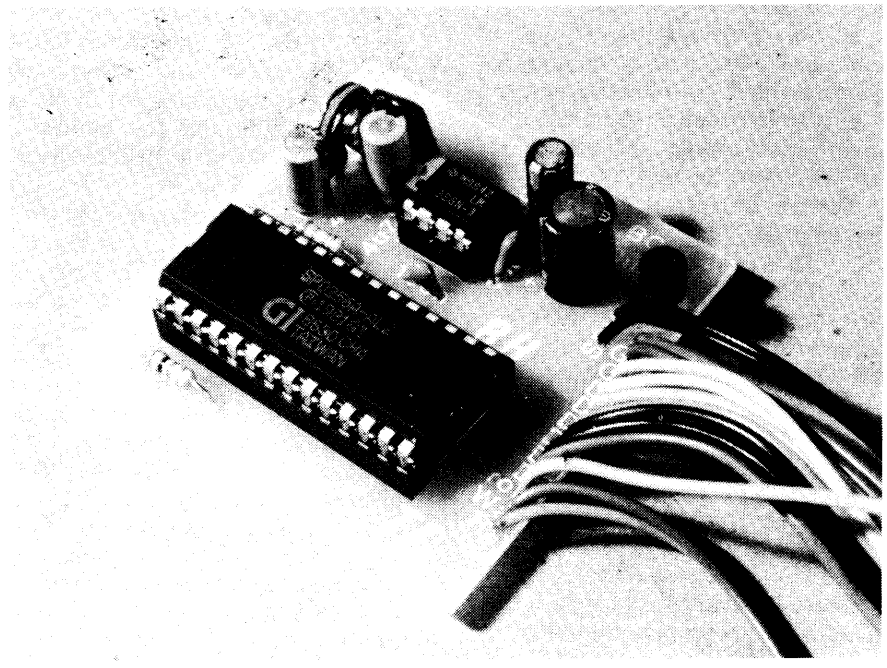
If your SPO256A-AL2 is damaged, you will be charged extra due to its high replacement cost.

MODIFICATIONS

If you don't intend to fit a crystal oscillator to your TEC, you can put a crystal on the speech board. Simply fit the crystal across pins 27 and 28 of the SPO256A. Then fit a 27p between pin 27 and ground, and a 27p between pin 28 and ground. This enables the SPO's internal oscillator. We did not include this on the basic board because we wanted to keep the price as low as possible, in order to counter balance the cost of the SPO256A. We reasoned that most people will change over to JMON, therefore purchasing a crystal oscillator anyway.

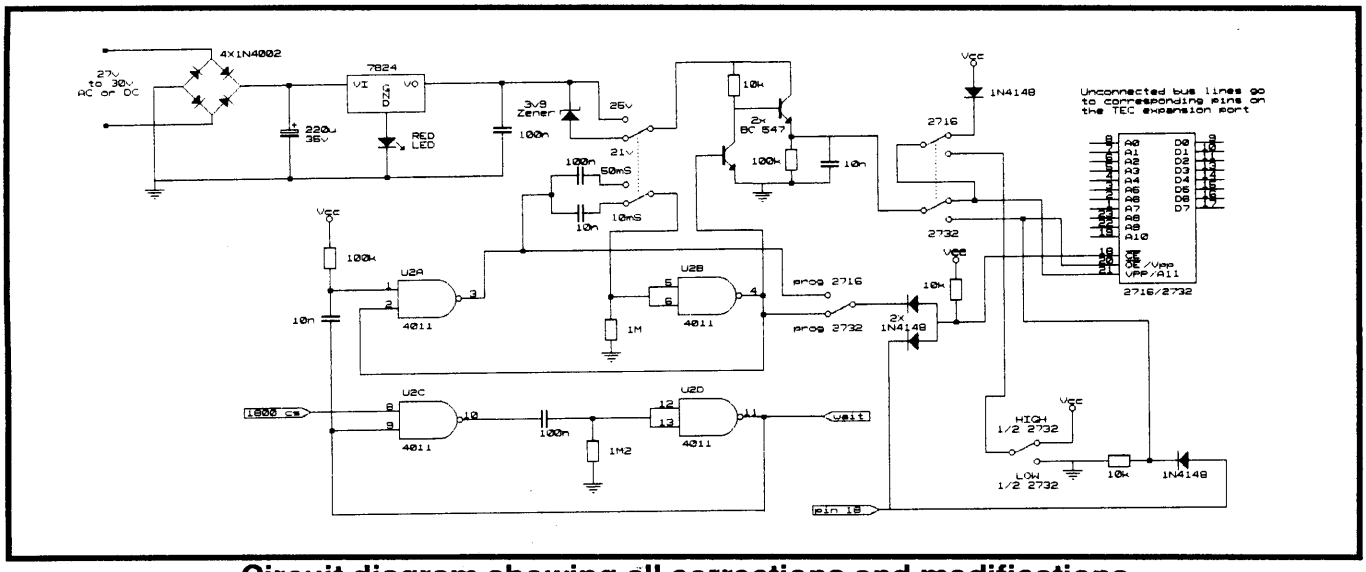
If you find that you are using long silent periods between words, you may find that you can hear an annoying click from the speaker as the LM386 gets switched. This is because the 10u capacitor is too low in value. Increase this capacitor to 22u or 47u and the problem should go away.

If you need to make the output louder, change the 4u7 between pins 1 and 8 of the LM386 to 10u. This increases the gain of the LM386 to 200.



EPROM PROGRAMMER REVISITED

Parts $2.30



Circuit diagram showing all corrections and modifications

CIRCUIT DIAGRAM CORRECTION

A mistake has been made with the circuit diagram on page 20 in issue 13.

The 100k resistor between pins 8 and 1 of the 4011 does not exist on the board and pin 8 is actually directly connected to the ROM SELECT LINE. It is not coupled through the 10n capacitor (via the 100k mentioned above) as shown.

CIRCUIT UP-GRADES

If your EPROM programmer is working ok and you're completely satisfied with its performance, perhaps it is best left alone. There are two modifications though, that are HIGHLY RECOMMENDED:

The first is the 100k resistor on the left-hand side of the EPROM socket (next to a diode) SHOULD BE REDUCED to 10k. This will allow for far more reliable readings (if yours doesn't read at all or very poorly, then this will almost certainly fix it).

The second is a 10n greencap is connected across the 100k resistor next to the EPROM socket on the right-hand side of the board (when looking at it from the top).

This 10n greencap is to prevent spikes from damaging the EPROM.

There are some other very handy mods to make. This next one will make it possible to read from 2732 (4k EPROMs) without having to slide the switch across. The BIG advantage of this is that it is possible for the software to read from the 2732 just after you have programmed each location. The software can then diagnose a failure and re-try or abort quickly. The software routine is provided below which will do this for either a 2716 or 2732.

Three additional parts are required for this mod. They are two 1N 4148 diodes and a 10k resistor.

The first diode is soldered between the DIP-HEADER and the EPROM socket. The cathode (the end with the band on it) is soldered to pin 18 of the DIP-HEADER and the anode is soldered to pin 18 of the EPROM socket. Next, the track running between pin 18 of the EPROM socket and the middle of (program 2716 read 2732)/program 2732 switch is cut. The anode of the second diode is soldered to the pin 18 side of the cut and the cathode is soldered onto the middle terminal of the switch. One end of the 10k resistor is soldered to the anode side of the second diode (the end connected to pin 18). The other end of the resistor is soldered to ground.

Once you have fitted this modification, it may be tested by fitting a 4k ROM into the socket and addressing 1000. You should be able to read the contents regardless of the position of the read/program 2732 switch. The high/low switch is still used to select which half of the EPROM you wish to read and the read/program switch is used to select the type of EPROM you wish to program.

The next mod is a little more involved but is an important one if you wish to re-program some of the EPROMs supplied by TE.

The programming requirements of some types of more modern (but now obsolete) EPROMs are not compatible with the current set-up of the EPROM programmer. This mod allows the EPROM programmer to be used with a wider variety of EPROMs. The mod does this by switching the programming voltage from 25v to 21v and reduces the programming pulse from 50mS to 10mS.

The parts required for this mod are: one DPDT switch, one 10n greencap,. one 100n greencap, a 3v9 zener diode

cont. P 45 . . . . .

PARTS LIST

(For all mods)

2 - 10k

1 - 10n greencap
1 - 100n greencap

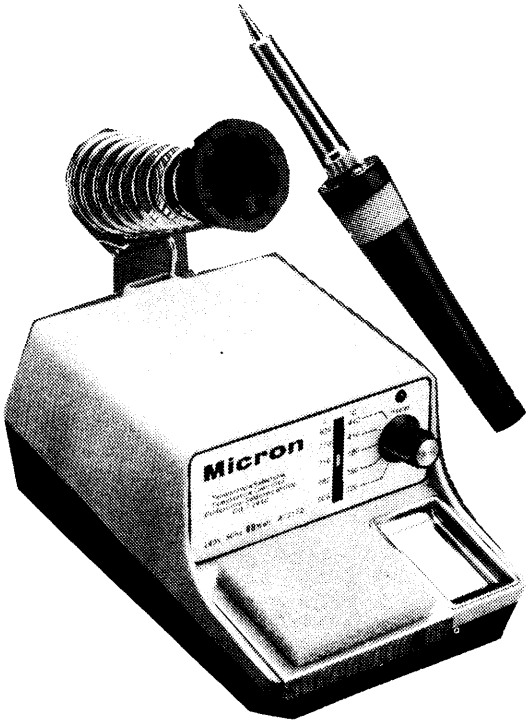
2 - 1N4148 diodes
1 - 3v9 Zener diode

1 - DPDT switch
1 - 10cm tinned copper wire
1 - 10cm hook-up wire

OPENING SPECIALS!

MICRON T2440
Electronic Temperature-Controlled Temperature-Selectable Soldering Station

The MICRON T 2440 soldering station, offers the ultimate in controlled temperature hand soldering. 320°C, 350°C, 380°C, 410°C (608°F, 662°F, 716°F, 770°F and 824°F) fixed temperatures are selectable by rotating the detained rotary switch freely without changing heater or tip.



Comes with free roll of solder

$99.00

P&P $7.00

200g roll of solder $5.50

THE EXECUTER CHAIN

DON'T GET MAD! GET EVEN.

Effective sound effects in key ring package

DEATH RAY
MACHINE GUN
GRENADE BOMB
STUN
RIFLE GUN

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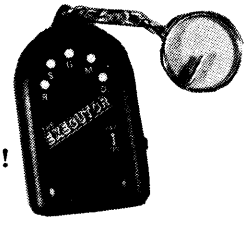
Great for stress relief!
Unless you are the victim!



TE OPENS SHOP!

After 4 years of procrastination, Colin Mitchell has finally opened a Talking Electronics shop.

This will allow our many customers to come and see the full range of TE kits, components and books etc. The Magazine will still be produced at Rosewarne Ave and sales will continue at both addresses but a display area was long over due.

The shop isn't a huge emporium in the main street but a small, low rent affair, in a side street. It's next to the Moorabbin station, right at a bus terminal and a large car park is directly opposite.

There isn't a similar electronics shop for miles and it will be a boon for everyone to be able to buy components at the right price.

The shop also stocks a comprehensive range of Altronics kits, test gear and devices as well as the full range of bugs and SECURITY DEVICES as outlined in the 3 bugging books.

The advantage of the shop is you can ask questions and not get a blank look or wild guess. The full range of TE magazines can be seen as well as the 6 lesson Digital Electronics Course ($25 per lesson, $30 for lesson 6) as seen on the back cover of TE magazines.

There is also a work bench where you can use a soldering iron to fix up a project or be shown how to solder. We offer a friendly atmosphere where you can sit and think. The only thing we ask is not to get in the way of the paying customers!

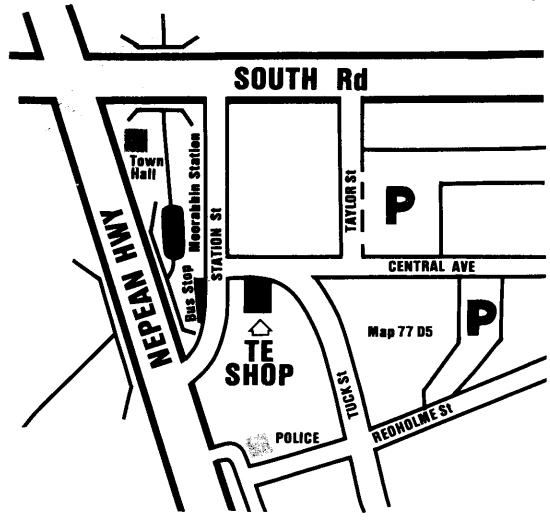
All the items shown in this 4 page "lift out" are also available via mail order.

Don't forget, we also stock a comprehensive range of Altronics items as shown in their catalogue.

You can phone your orders or mail them to the shop address.

We hope you can see us soon,

Ross

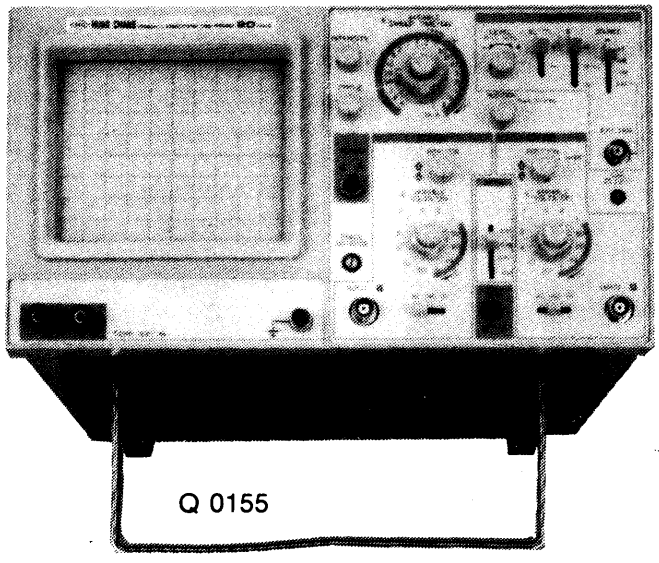


TALKING ELECTRONICS SHOP

2 Central Ave, (off Station St,)
Moorabbin, Vic. 3189
Tel: (03) 532 0236
Mon-Fri: 8.30 - 6.30 Sat: to 4.30

Sensational Labtech

Dual Trace 20MHz Cro With Component Tester



Q 0155

DESCRIPTION:

This model is a dual-trace 20 MHz Oscilloscope using a high brightness CRT. The vertical amplifiers have high sensitivity of 5mV/Div and a frequency characteristic response with smooth roll off exceeding 20MHz. The highest triggering sweep speed is 0.2 usec/Div. For component tests, a special circuit is designed, with which a single component or components in or out of actual circuit board can be easily tested, requiring no power to drive the circuit. The display shows fault of component value, characteristics of component, and half-dead components under dynamic test.

FEATURES:

• Component Tester • Wide bandwidth and high sensitivity • Very low power consumption • High sensitivity X-Y mode • Z axis (intensity modulation) • Front panel electrical trace Rotator • Regulated power supply circuit for Accuracy.

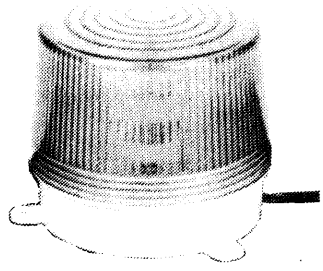
Comes with two sets of probes and posted FREE ! anywhere in Australia.

Unbeatable Value! **$679.00**

Strobe Signal Lamps

Uses Xenon Strobe tube for High energy strobe flash output at a rate approx. 1 per second.

Fantastic light energy output for the DC power used. DC input 12V 320mA.



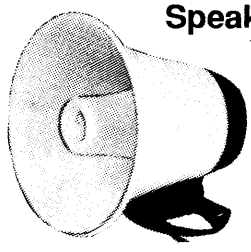
Dimensions 97 diam. 90H
Two Colours Available

S 5455 Blue **$27.50**
10 Up **$26.00**

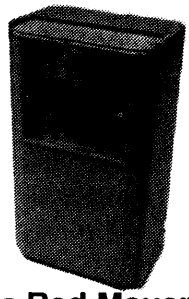
S 5450 Red **$27.50**
10 Up **$26.00**

Weatherproof Horn Speakers

10 Watt



C 2015 **$15.95**
10 Up **$14.80**



Infra Red Movement Detector

Pulse Count Type

Our 1989 Model IRD now includes pulse count circuitry with a specific time delay between pulse sensing. Three pulses of IR radiation are required to trigger the detector Providing the detectors are sensibly positoned i.e. away from direct sunlight, log fires etc. false triggering, the bain of early design IRS's is completely eliminated.

FEATURES:

- Lens simply 'snaps' to either **wide angle** (range 40 ft) for normal use or **Narrow angle** (and 80ft plus) for corridor applications.
- Snazzy integral mounting bracket allows corner 90° mounting as well as normal surface mount.
- 12V DC Powered
- Built-in test lamp.
- Relay output SPST 30V 1a max.
- 9-18V DC

S 5301 **$79.00**

12v TEST PROBE

$2.50

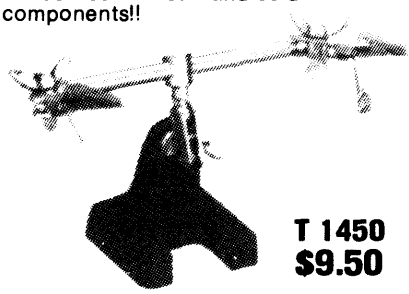
Probe Sets

1:1 or 10:1 Attenuation

Q 0175 **$49.95**

PCB Stand With Alligator Clips

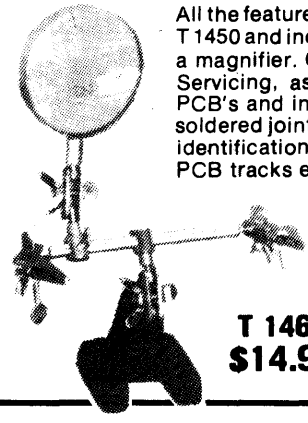
Screw this handy little jig to your work bench and presto! you now have both hands free to insert and solder components!!



T 1450
$9.50

PCB Stand With Magnifier

All the features of the T 1450 and including a magnifier. Great for Servicing, assembling PCB's and inspecting soldered joints, component identification, cracks in PCB tracks etc.



T 1460
$14.95

TALKING ELECTRONICS PUBLIC DOMAIN

2 Central Avenue, Moorabbin, 3189. Victoria. Tel: (03) 532 0236
Fax: (03) 583 1854

PUBLIC DOMAIN SOFTWARE

Welcome to TE's Public Domain Software.
As you are no doubt aware, the range of programs in Public Domain has increased in leaps and bounds and is now possibly the largest collection of software available.
One of the misconceptions with this software is: "Because it's free, it must be junk."
Surprisingly the opposite is true. Many of the program rival the copyright material as they have been generated by dedicated computer buffs who have used the costly packages in their workplace and become aware of the limitations.
In their quest to produce a more user friendly program, they have generated a superior product. For one of a number of reasons they have opted for the benevolent approach of letting other computer users copy the program and use it for the cost of copying a disk.
Many of the Public Domain programs are supported by a manual or set of notes that explain the program fully and allow you to make the most of its operation.
For the cost of $10 to $30 or so, you can purchase the notes from the author and reap the full benefit.

Some authors also send an updated disk and the package is well worth it. This part of the deal is entirely between you and the author of the program. The end result is a very neat arrangement whereby you can get top quality software without the enormous middle-man mark-up.
This arrangement is so successful that some programmers concentrate full time on producing Public Domain titles and get their return by selling the support-ware.
To start our library of disks we have picked out about 100 of the most recent PC SIG titles and listed them in this newsletter. We have over 2,000 titles and a full catalogue will be available shortly for $5.00 plus $2.00 post.
Because of the enormous range of titles, we cannot personally try each program or send for the update package from the author.
For this reason we will be asking you to give us feedback as to the cost and quality of the support you get from the author.
This is the first time in Australia that such a large selection has been made available at such low cost and you will be able to enjoy programs that you once only dreamed about.
You are invited to send in a review of any programs that you find particularly good and in return we will give you a credit or allow a swap for another title on our list.
Please send your reviews on disk so that we can import them directly into Ventura for our next newsletter.
There is no joining fee to our library and no tricks or traps about the price of each disk. They are $5.00 per disk and you can buy one or any number, plus $1.00 pack and post per disk.
With the order you will receive our next newsletter and latest range of titles. We are adding new titles all the time and if you want our latest listings, send $20.00 for 12 months subscription. You will get monthly updates as well as promotional disks showing you the content of the latest programs.
In the meantime we have produced a short-form catalogue listing the entire range. If you would like a copy, send a large self-addressed envelope and we will send you the pages.
Our numbering system is the same as PC SIG and PC BLUE and none of the names or descriptions have been altered to confuse the buyer.
Don't forget, we have the entire range of titles, so you can't go past our one-stop shop.

The following is a selection of about 100 titles and a brief summary of each:

Disk No 1076 MANDELBROT & JULIA SET GENERATOR EGA/VGA PC-SIG v 1

Take advantage of your EGA or VGA monitor by generating detailed and colorful mathematical patterns with MANDELBROT. When loaded, it automatically detects whether you have an EGA or VGA monitor so each pattern is properly displayed on your screen. These patterns are based upon a recently developed part of mathematics called "fractal geometry," which creates images in which a small part of the image has the same pattern as the whole part of the image. With this program, you can generate an unlimited amount of new images, change the colors of the images, and save the images to a disk file. The images or patterns that are saved on disk can be displayed on the screen at a later time. MANDELBROT is a comprehensive program that takes some time to generate a new image, but once saved to disk the image can be displayed on the screen more quickly. It lets you create "Mandelbrot set" images and "Julia set" images. The Julia images are similar to the Mandelbrot images, but require different numerical values to be inputted to generate the image. It has on-line help that displays suggested numerical values for both Mandelbrot and Julia images. Sample images are already included on this disk, and the documentation has suggested readings for more information on Mandelbrot and Julia set images.

Disk No 1078 PC-CALIB version 1.03 PC-SIG Version 1

Chemists, researchers, and users of analytical instruments will find PC-CALIB a multifaceted aid to the sometimes tedious task of instrument calibration or verification. PC-CALIB's curves can have up to 8 points with 3 replicates each, and can be measured in any of 12 different standard units. They can be curve-fitted using linear, log-linear, linear-log, or log-log equations (log base 10) and either a first- or second-order polynomial least- squares fit. Experimental values or controls can be entered and checked against a generated curve. Data can either be viewed onscreen, printed, or formatted as ASCII files for import into other software. Documentation for this menu-driven program is 45+ well-written pages, and telephone support is available.

Disk No 1079 4PRINT version 2.20 PC-SIG Version 1

If you're a professional programmer or just a home hacker who's "gone laser," 4PRINT is a simple-to-use, paper-conserving laser printer utility that can ease program code documentation. 4 PRINT lets the HP LaserJet, LaserJet+, Laser Jet II, and compatible print title lines plus four 66- line, 80-column pages of ASCII text on one double-sided, 8-1/2" X 11" sheet of paper.

Disk No 1084 Freeword version 1.0 PC-SIG version 1

If you don't want the cost and sophistication of full-featured wordprocessors like MS Word, Wordperfect, or WORDSTAR, then FREEWORD (FW) is a good bet! It supplies virtually any wordprocessing capability most users will ever need and does so at reasonable cost. In addition to all the normal wordprocessing features, FW also includes a built-in spell checker and an on- disk tutorial with three lessons. The program is menu-driven and very intuitive in structure. On-line help is available from the main menu. FREEWORD's documentation is indexed and ample in both content and quantity.

Disk No 1087 DRIVECHK version 4.3 & ALIGN version 2.9 PC-SIG V 1

This package should occupy a prominent place on the reference shelves of any computer repairman! Just about everything you'd ever want or need to know about disk drive diagnosis and adjustment is included in DRIVECHK & ALIGN. The diagnostics provided are quite simple to learn and operate. However, be warned that both special tools and some level of hands-on technical experience in the repair field are necessary to use all the power built into the repair end of this package!

Disk No 1090 BATTLE GROUND and ARIONX: SEEKER OF GANS PC-SIG version 1

BATTLE GROUND is a two-player World War II field combat game simulator. Each player is the general of either the U.S. or German army. At the beginning of the game, the players select the battlefield on which to compete. You have five different battlefields to choose from. Each side has 16 privates with various weapons, two medics, one sergeant, and a major.

Disk No 1092 MONODRAW & SCNDSIGN version 2.01 PC-SIG version 1

One of the tedious parts of programming in Turbo Pascal is designing the screens for inputting data. However, SCNDSIGN lets you do this with very little effort. You can create your screen on the monitor exactly as you want it to appear in your program. As you design your screen, you can visually see what it is going MONODRAW gives yopu a Herules graphics 740x348 pixel graphics drawing program.

Disk No 1094 & 1095 System for Business & the Workplace (SBW) PC-SIG V1.1

SYSTEM for BUSINESS & the WORKPLACE (SBW) is a multifaceted integrated system that meets many common business needs. The system has five different functions and a separate module for each: customer information system, human resource (personnel) management, accounting, inventory, and production system.

Disk No 1096 KB0ZP SUPER CONTEST LOG version C.4 PC-SIG version 1.1

KB0ZP SUPER CONTEST LOG is a contest-logging program for amateur radio operators who want to record each contact made on the radio. You can enter the person's call sign plus two other pieces of information of your own choice. The main screen displays total number of contacts, a chart showing the frequency band and the mode of each contact, the date, the time, the elapsed time in between contacts, the name of the contest, and your call sign.

Disk 1098 SCHEDULE MAGIC PC-SIG version 1

SCHEDULE MAGIC is a universal vehicle scheduling software system for automatically calculating and optimizing daily vehicle schedules for a number of industrial scheduling applications. The purpose of schedule optimization is to find vehicle routes to minimize the number of vehicles needed and reduce the total fleet miles of the schedule – thus directly improving profitability. Until now, the formidable mathematics of optimization needed mainframe computers for vehicle scheduling. This program is a new method -- so powerful that the same calculations can now be made easily on any IBM Personal Computer.

Disk No 1099 FORM MASTER version 1.0 PC-SIG Version 1

Questionnaires? Surveys? Order Blanks? If you routinely generate and use such standard forms, FORM MASTER is a versatile, powerful, and inexpensive shareware tool for their creation, modification, completion, and printing.

This disk is a hotchpotch of utilities - DISK SIGN, CIPHER, AUTONUM, and MASTERDOS.

Disk No 1102 THE E88 TEXT EDITOR ver 4.22 & NAMES ver 1.0 PC- SIG Version 1

The E88 TEXT EDITOR (E88) is a powerful, fully-functional 8088- based text and programming editor completely written in Assembler language. It is both compact and extremely fast. Rather than using complicated keyboard commands such as those commonly-used in other editors or wordprocessors, E88 primarily uses single- keystroke commands. These make E88 more natural, logical, and easy-to-learn.

Disk No 1106 FLEXICAL version 4.1 PC-SIG version 1.2

FLEXICAL lists your business or social engagements, with an always up-to-date calendar that uses space efficiently, yet contains complete explanations of where to go, what to do, and when you plan to do it. The runner's diary tells you how far and how fast you have run in any period with detailed run reports whenever you want them. The FLEXICAL calendars are remarkably flexible engagement and event calendars for personal and business use. You always have a calendar on your desk or wall, available to go with you when you travel. The calendars don't devote space to days with no planned events, but they expand to hold as many events as you choose in any period with as many details as you wish.

Disk No 1109 CELL SYSTEMS version 1.0 PC-SIG version 1.1

CELL SYSTEMS creates beautiful patterns which also have mathematical significance. The patterns simulate the growth processes of simple biological entities. The disk has a library of patterns already installed, with room for many more. This program lets you create new growth patterns of your own, save them, re-run them, and edit them. Your new cell can die, flourish, create a mess, or make a beautiful pattern that can be stored on disk. You can also view the parameters for the sample cells on this disk, and edit them if you want a slightly different pattern. The patterns can be created on either a medium- or high-resolution monitor and can be printed. An installation program configures the program to fit your printer needs.

Disk No 1110 MINDREADER version 2.00 PC-SIG version 1.0

If you're the kind of person who types letters or reports containing the same phrases or paragraphs repeatedly, and want to save yourself needless keystrokes, MINDREADER by Brown Bag Software is for you. MINDREADER is a curious mix of word processor, spelling checker, address book and Artificial Intelligence. As you type, MINDREADER scans the words you are writing and brings up a menu listing words which might fit next in the sentence.

Disk No 1111 A86 ASSEMBLER PACKAGE version 3.04 PC-SIG v 1

A86 is an excellent assembler that actually performs better than Microsoft's MASM 4.00. It is a lot easier to use than MASM. It also assembles your programs a lot faster than MASM. It allows you to leave out all segmentation directives, if you wish. The debugger is great. It has a floating point display window for use with the 8087 or 80287 that will knock your socks off.

Disk No 1115, 1116, 1117 C-A-S-E ACCOUNTING PROGRAM DISK PC-SIG version 1.1

System Requirements: 640K RAM, two floppies or a hard drive.

C-A-S-E ACCOUNTING offers functions that should meet the requirements of most businesses and surpass the requirements of many small businesses. The Main Menu of the program includes Cash Sales and Sales Journal, Credit Sales and Invoices, Accounts Payable, General Journal, Payroll, Capital Equipment, Closing Books for Period or Year, and Setting Up the Accounting System. Menus lead you through tasks in a clear yet detailed manner. For instance, if you choose option A, Cash Sales, you get the Cash Sales & Journal Menu with the options "Enter Cash Sale," "Display Sales Journal," "Print Sales Journal," or "Return to Main Menu." "Enter Cash Sale" allows you to record the following: Sales number, Sales Date, Customer, Sale Amount, Post and Pack Amount, Profit Line, Case Number, Tax Status, Expected Sales Tax, and Sales Tax Paid. Other functions are equally detailed, and some of the information requested may not be known to persons with little or no accounting background but the documentation on this program is extensive. This is a good accounting program with every feature the small business will need. Once the program is started, it is straightforward and professionally detailed.

Disk No 1118 SCREEN-DO version 1.0 PC-SIG version 1

SCREEN-DO enables you to design and create screens that can be used by BASIC programs. Each screen that is saved to the disk is 3848 bytes long and can be accessed through the BLOAD command in BASIC. SCREEN-DO simplifies the process of editing screens through a number of commands. There are cursor, line, and paragraph functions that allow the user to easily delete, insert, move, and copy certain sections of the screen. Another function displays the ASCII characters numbered 126 to 254 and lets the user display them on the screen. One option allows the cursor to be moved across the screen to trace a certain character selected by the user. SCREEN-DO has on-line help that makes it easy to learn, in addition to simplifying the designing of screens for use with BASIC programs.

Disk No 1119 FLUSHOT+ version 1.4, HDSENTRY and MORE PC-SIG version 1

System requirements: A hard disk.

Many computer users are now worried about how they can protect themselves from the viruses and Trojan horses that are out there . . . just waiting to attack an unsuspecting system. Well, we've put together a disk which is filled with programs that will help in that fight. One of the programs included will allow you to write protect your hard disk before you try any new software, thus keeping viruses off your hard disk. A second program, HDSENTRY, sets itself up in memory and monitors all commands sent to the hard drive of your system. If the command is potentially harmful in any way, such as if it tries to write to the drive or erase a file, HDSentry will intercept the command and prompt you for continuation.

Disk No 1120, 1121, 1122 BLACK MAGIC PC-SIG v 1

System requirements: Graphics card and hard disk.

By now, you have probably heard about hypertext. If you want to know more about it and use it, BLACK MAGIC is your best bet. Ordinary word processors structure information in a specific sequential manner. Database management systems use another. Spreadsheets use still another method of structuring information. Hypertext systems such as BLACK MAGIC enable you to expand information by linking keywords and blocks of information to one another. For example, suppose you are typing a document and need to define a concept or word where the definition would distract the reader from the main text. You first mark a keyword that will point to the definition somewhere else. An area of the screen opens and you type the definition or explanation. This is a simple illustration of hypertext. BLACK MAGIC is an elementary hypertext system based on a word processor. However, do not expect it to take the place of major commercial word processors such as WordStar, Word or WordPerfect. BLACK MAGIC's printing capabilities are limited, although the package supports Epson printers and the Hewlett-Packard LaserJet Series II. You will need all three disks to use BLACK MAGIC.

Disk No 1123 RAMTEST version 3.0 PC-SIG version 1

RAMTEST is a utility that tests your random access memory (RAM). It tells you which chips are faulty and need to be replaced. You can use the top line menus to indicate how reports are to be made, the types of chips you have, where to send error messages, parity, and how many times you want the test repeated. RAMTEST tests RAM for all IBM Personal Computers and clones, including those with expanded memory (beyond 640K), provided you have the Expanded Memory Manager in your CONFIG.SYS file, and an AT with extended memory. If you need a utility to test your RAM, this program is easy to use.

Disk No 1124 PC-KEY-DRAW Tutorial Disk v 3.51 (Disk 4 of 4) PC-SIG version 3.6

This is the fourth disk in the four disk set of PC-KEY-DRAW. You will also need disks #344, #345, and #1032 in addition to this disk to run the program. Please see a full description of this program under disk #1032.

Disk No 1126 CHECKBOOKS and BUDGETS PLUS v 3.2 (Disk 1/2) PC- SIG version 2

This disk has a full-featured checkbook database, check printing and budgeting program which lets you keep track of your personal checking and savings accounts with ease. CHECKBOOKS & BUDGETS PLUS lets you automatically set aside a portion of your income into each different category in your budget. The budgeting section of the program is completely flexible letting you move budgetde funds from account to account at will. Features include: an easy-to-use, windowed, menu-driven, checkbook and budgeting system, full multi-colored displays with pop-up windows for easy readability, optional printing of industry-standard checks, built-in help menu system, instant hot key listings at any time from anywhere in the program, data-input editing and error checking, up to 180 accounts (120 for expenses; 60 for income), and up to 192,000 check-register entries (limited by disk space available). It uses keyed index files for rapid data storage and retrieval and provides multiple format listings to screen, printer, files or print spooler.

Disk No 1127 TERRA*TIME and WORLD CITY DISTANCE COMPUTER PC-SIG v 1

TERRA*TIME tracks and displays the local time in as many as 44 cities all around the globe. Unlike other programs of this type, TERRA*TIME considers not only time zone effects, but also daylight savings time at each city. Information comes up on a full-screen color non-graphics display. Windows and menu-driven commands are used for program modifications. WCD, The WORLD CITY DISTANCE COMPUTER, is designed to provide distance and travel time information between over 400 different world cities, including most major US cities. The program is windowed and menu- driven, and basically self-explanatory.

Disk No 1130 PICTURETHIS (tm) version 1.0 PC-SIG version 1

System requiements: 384K RAM, CGA Card, postscript printer.

PICTURETHIS makes professional-looking drawings on your post- script and compatible laser printers and imagesetters. With PICTURETHIS, you can quickly and easily prepare resolution independent drawing files for printing on PostScript-compatible laser printers and imagesetters, either freehand or by tracing "template" screens captured with a companion program, CAPTURETHIS.

Disk No 1133 WORLD GENERATOR version 1.2 PC-SIG version 1

WORLD GENERATOR is a solar system generation utility for science fiction & role-playing games. It produces solar systems in which each player takes on the persona of a human or alien of the far future, in a universe controlled by a referee. WORLD GENERATOR is similar to Dungeons and Dragons with spaceships. You can quickly generate, store, and edit designs for individual planets and entire solar systems. WORLD GENERATOR will also produce maps of planets. WORLD GENERATOR is menu-driven and provides on-line help displays as well as a tutorial and a rolling demonstration to help you get started. Each sector of the universe can contain up to 100 solar systems and each solar system is allocated a star and up to 17 planets, asteroid belts, dust clouds, or secondary stars.

Disk No 1136, 1137 SEARCHLIGHT BBS v 1.28 PC-SIG v 1

System Requirements: 256K RAM, Hayes compatible modem.

Looking for a bulletin board system that's both powerful and easy-to-use, then take a look a SEARCHLIGHT BBS. Unlike other bulletin board systems, SEARCHLIGHT BBS is designed to be user friendly with both you (the system operator) and those who call in to your system through other modems. SEARCHLIGHT BBS has an easy to understand menu command system, so that users who call in to your system do not need any documentation or help from you to use the bulletin board system. If any aid is needed, the program has on on-line help system. Moreover, SEARCHLIGHT BBS has some significant features, such as optional ANSI graphics and color selections for the screen, customized menus, public message boards, private mail, a full screen text editor (compatible with WORDSTAR commands), and a file transfer system with both XMODEM and YMODEM transfer protocols. SEARCHLIGHT BBS has password protection and 255 levels of security, allowing you to control access to your system. Like other bulletin boards, SEARCHLIGHT BBS can be left unattended while other callers leave messages to you and others, and transfer files to and from your bulletin board. Disk No 1140 INTERNATIONAL GAME COLLECTION PC-SIG version 1

This disk consits of 3 games, PC PONTOON, PRINCE and BALL CATCHER.

Disk No 1141 MENU-MATIC version 4.0 PC-SIG version 1

MENU-MATIC is a hard disk menuing program that lets you access various programs on a hard disk

ORDER FORMS AND PRICE LIST

MAGAZINES AND BOOKS:

This is a full list of the magazines and books produced by TE. The subscription delivers each publication as soon as it is printed. We aim for 4 releases per year but we cannot offer a print schedule as they come out as soon as we get the pages ready.

( ) Next 4 publications with PC boards	$17.00
( ) 6 issue subscription without PC's	14.00
( ) Project book #1 Mini Frequency Counter	3.95
( ) Project book #2 Logic Designer	3.95
( ) Project book #3 Dual Tracking Supply	3.95
( ) Project book #4 3-Digit Voltmeter	3.95
( ) Project book #5 Logic Designer Mk II	3.95
Note: Project books #4 and #5 yet to be published	
( ) Electronics Stage-1 (photocopy)	9.00
( ) Electronics Stage-2 (yet to be published)	3.30
( ) Digital Electronics Revealed	2.90
( ) Electronics Notebook 1 (photocopy)	5.00
( ) Electronics Notebook 2	2.60
( ) Electronics Notebook 3	2.80
( ) Electronics Notebook 4	3.10
( ) Electronics Notebook 5	3.25
( ) Electronics Notebook 6 (yet to be published)	3.35
( ) Electronics For Model Railways	3.30
( ) TE Cover Projects	4.00
( ) CMOS Data Book	3.00
( ) Starting In TTL	3.50
( ) FM Bugs	2.95
( ) More FM Bugs!	3.25
( ) Bugging And Its Prevention	3.35
( ) Security Devices	3.40
( ) Magazine Binder: to hold 12 issues	6.50

BACK ISSUES:

( ) Issue #1	$2.00
( ) Issue #2	2.00
( ) Issue #3	2.00
( ) Issue #4 (photocopy)	5.00
( ) Issue #5 (photocopy)	5.00
( ) Issue #6 incl Hangman PC	4.00
( ) Issue #7 incl VU Meter PC	4.00
( ) Issue #8 incl Clock PC	4.00
( ) Issue #9 incl Lotto PC	4.00
( ) Issue #10 (photocopy)	5.00
( ) Issue #11 incl FM Bug and Pwr supply PC	4.10
( ) Issue #12 incl Headlight Reminder PC	4.10
( ) Issue #13 incl Logic Pulser PC	4.10
( ) Issue #14 incl Continuity Tester PC	4.10
( ) Issue #15 incl Car Alarm PC	4.50

POSTAGE:

Subscription rates include postage. Postage on books and magazines: $2.00 for first item, 60¢ for each additional item up to a maximum of $8.00 For Airmail: add $2.00. Postage on magazine binder: $2.50. You can add magazines to your kit order and pay the one lot of postage. As you are no doubt aware, postage is expensive and since magazines are heavy (yes, paper is quite heavy. After all it is wood!) they generally cost more to post than we charge.

ORDER FORM:

TALKING ELECTRONICS Pty Ltd., (03) 584 2386
35 Rosewarne Ave., Cheltenham, Vic. 3192
FAX: (03) 583 1854

Name: . . . . . .

Address: . . . . . .

. . . . . .Post code: . . . . .

Description of kits etc:	$	
Kits for issue 15:		
Car Alarm Kit: $57.70		
Car Alarm PC board: $5.95		
Ignition killer kit & PC: $10.80		
12v back-up battery: $19.00 ($4.50 post)		
DAT board & PC: $55.35 (includes LCD)		
FM Radio & PC: $21.95		
LED Power Meter: $1.10		
Organ & PC: $18.75		
Speech & PC: $27.25		
Ultima & PC: $12.50		
3m 1mm solder: $1.00		
5m very fine solder: $1.00		
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Mastercard	**TOTAL $:**	
Visa		

Send Credit card Number/Money Order/Stamps for orders under $10.00/Cheques for orders over $10.00 or CASH. Minimum order $5.00

Credit Card No:

REPAIR SERVICE

All our kits are guaranteed to work and if you have any trouble getting them to go, you can ring and ask for assistance. If all fails, they should be sent in for checking and/or alignment. This only applies to kits and boards bought from us.
Cost of repair is based on complexity of the project.

Repair cost:

All kits from FM BUGS book:	$7.00
All kits from MORE FM BUGS (except VOX Mk I)	$7.00
VOX Mk I	$9.00
Voyager	9.00
Water Alarm	7.00
Hikers Alarm	9.00
Rip Off	7.00
Listener	9.00
Phone Bug Sniffer	18.00
VOX Mk II	7.00
Car Alarm:	20.00
DAT Board	9.00
FM Radio	9.00
Organ	7.00
Speech	7.00
Ultima	9.00

Add $3.00 pack and post.
Any damaged parts are an extra. Complete "right-offs" will be returned. Before you send anything in, get someone to check it over and clean up the soldering. Most of our time is spent re-soldering the board and this is quite often the only fault!
This Repair Service costs us more than we charge. It is a back-up service for all our projects to prove we care.

ORDERING INSTRUCTIONS:
You can phone your order, quote your credit card number and the goods will be sent the same day. We also send orders COD. (COD costs $6.00 extra). Allow 3-7 days for delivery. Add $3.00 if you want next day delivery (Priority post). For orders under $10.00, please send stamps (39c, 41c, 70c, or $1.00) or cash.
A $2.40 cheque costs $1.00 to process through a bank and $12.00 if it doesn't go through!!!!
All enquiries: Please send a large stamped addressed envelope.
New Zealand readers should send a stamped addressed envelope for a price list to our NZ agent:
Trevor Cooper,
33 York St.,
Timaru,
New Zealand. Phone: 83 787

PACK AND POST CHARGES:
Small kits: $2.50 per kit (parts and PC)
Large kits: (e.g. computer) $4.00
Heavy kits: (e.g. TEC Power Supply) $6.50
For those ordering **PC boards only:** 90c for first board, each additional board: 35c.
Maximum pack and post: $8.00
Additional services: (in addition to the $8.00 above)
Airmail: $2.00 extra.
For orders over $50.00, add $1.05 for Certified Post.
Or for orders over $100.00, add $2.00 for Insured Post.

TALKING ELECTRONICS Pty Ltd

35 Rosewarne Ave., Cheltenham, Vic. 3192. Tel: (03) 584 2386

Send this page or the Order Form on P. 38. You can also phone your order and quote your credit card number.

All orders sent out the same day.

PLEASE NOTE:

Our kits do not come with instructions. The instructions are the articles in the magazines. If you require any of the back copies of the magazine or a particular article, send $2.00 per article. You will get a photocopy or a cutting. We do not have any other notes other than the article (and any mod sheets that come with the kit).

Here is a complete list of kits and a summary of what they do:

( ) Amoeba 8.00
( ) " " PC Board 1.40
See More FM Bugs! A 400m room bug with tank circuit output. A very good performer.

( ) The ANT 7.35
( ) " " PC Board 1.15
See FM Bug book 1. A stable 200m room bug that fits into a Tic Tac box.

( ) Beetle Mk I 6.20
( ) " " PC Board 1.15
See FM Bugs! Connects a guitar to an FM receiver via the air waves.

( ) Beetle Mk II 12.15
( ) " " PC Board 1.30
See More FM Bugs! An upgraded guitar transmitter with adjustable input sensitivity.

( ) BIG EAR see FM Bug 6.95
( ) " " PC Board 2.45
See issue 11 P.71 & FM Bug book. A sensitive FM bug that can be used with a parabolic dish.

( ) Black Jack 10.50
( ) " " PC Board 3.45
See issue 11 P.56. An electronic version of the card game - counts to 21 but not over.

( ) Bread Board WB - 2N 16.75
( ) BUG TUNER see peaker .....
These components are used to peak the FM bugs and are connected to a multimeter to indicate the output.

( ) CAMERON'S TAPE #1 ..... 6.50
TEC Invaders and Maze on a 10 minute digital tape for the TEC computer.

( ) Capacitance Meter 5.75
( ) " " PC Board 2.85
See issue 6 P54 and issue 7 P63. An add-on for the mini frequency counter. Measures from 100p to 10u.

( ) CAR ALARM 57.70
( ) " " PC Board 5.95
( ) IGNITION KILLER 8.00
( ) " " PC Board 2.80
( ) Back-up 12v battery 19.00
A high performance car alarm for under $100.

( ) Clock 27.05
( ) " " PC Board 4.55
See issue 8 P 5 and Cover Projects. A digital readout of the time using the mains 50Hz as a reference.

( ) Clock Large Display 7.50
( ) Combination Lock 7.50
( ) " " PC board 2.85
See issue 5 P.33 A simple lock project using a CD 4017 to unlock a relay.

( ) Continuity Tester 8.55
( ) " " PC Board 2.40
See issue 14 P 5. Measures continuity to locate cracks in the trackwork and short circuits. Does not give false reading across a diode.

( ) Co-ordinator 6.60
( ) " " PC Board 2.85
See issue 14 P 47. A game of skill to get a LED to light up by pressing a button at the right time.

( ) Counter Module 24.85
( ) " " PC board 5.25
See issue 2 P 4. A 4 digit counter using a single chip. (74C926)

( ) Seven Segment Display 9.60
( ) " " PC board 6.25
See issue 2 P 12. A large display using LEDs to create 2.5cm numbers.

( ) The Cricket 5.60
( ) " " PC board 2.10
See FM Bugs! A tone transmitter used for 'Hunt the transmitter.'

( ) Crystal Oscillator 11.40
( ) " " PC Board 2.40
See issue 14 P 21. Add-on for the TEC computer to run the computer at ½ crystal freq.

( ) Cube Puzzle 18.80
( ) " " PC board 5.95
See issue 8 P 28. Three faces of a Rubik's cube containing 9 LEDs each. Skill required to fill the 3 faces.

( ) Designer Board (mother) 4.75
( ) Designer Board#1 ..... 5.55
( ) Designer Board #2 ..... 5.55
( ) Designer Board #3 ..... 5.55
( ) Matrix Board 24x25 ..... 2.85
( ) Matrix Board 15x40 ..... 2.45
( ) Matrix Board 24x50 ..... 5.25
( ) 3 Boards 24x25 ..... 8.00
( ) 1 board of each 9.60
( ) Type 200 + 640 board 5.95
( ) 5 Type 200 + 640 ..... 23.90
( ) Fibre Glass 200 + 640 ..... 7.20
( ) Kit of 6 (1 of each) 25.50
( ) Digi Chaser 21.55
( ) " " PC Board 3.60
See issue 8 P69 & issue 9 P67. Programs a sequence into memory and recalls the pattern.

( ) Diode Tester 2.10
( ) " " PC board 2.45
See issue 6 P 58. Tests diodes and determines the cathode end.

( ) DAT BOARD 50.80
( ) " " PC Board 4.55
DAT Board without LCD display (for those who want only the tape save and single stepper facilities): $11.80 plus $4.55 for the PC.

( ) DISH BUG 15.05
( ) " " PC Board 2.50
See More FM BUGS! A Non-transmitting super sensitive microphone connected to a parabolic dish.

( ) Door chime ..... deleted
( ) Dual Power Supply (kens) .. 11.05
( ) " " PC board 5.25
See issue 11 P 5. A low-current dual supply for +5v, -5v and +15v, -15v.

( ) Dual Tracking Supply 18.40
( ) " " PC board 4.55
See Project book 3. A dual supply for 5v to 15v in which the positive and negative values are equal.

( ) Earwig 6.85
( ) " " PC Board 1.70
An FM bug in a match-box. See Electronics Australia Feb. 88 Same as GNAT Bug.

( ) Egg Timer 8.60
( ) " " PC board 2.85
See issue 6 P 34. Times up to 4 minutes for eggs etc.

( ) Eprom Burner 19.00
( ) ZIF Socket (cheap type) 8.75
( ) " " PC Board 4.85
See issue 13 P 20. Add-on for the TEC computer to burn 2716 and 2732 EPROMS.

( ) EPROM BURNER Upgrade 2.30
See issue 15.

( ) 8x8 Display 23.25
( ) " " PC board 8.30
See issue 11 P 22. Add-on for the TEC computer. A matrix of 64 LEDs can be programmed to produce many effects.

( ) 8-watt Amplifier 10.00
( ) " " PC board 3.45
See issue 9 P 13. An 8-watt amplifier using a LM 383 or TDA 2002 chip. Very easy to assemble.

( ) Experimenter Board 1-8 .. 16.90
( ) " " PC board 2.85
See issues 1-16, 2-20, 3-28, 5-60. A series of experiments built on a 3-IC's PC board where the parts are re-used.

( ) Experimenter Deck 1-10 .. 18.35
( ) " " PC board 5.95
See issues 1-31, 2-46, 3-55, 4-63. Parts are successively added to a PC Board to produce 10 different projects.

( ) FM Bug 6.95
( ) " " PC board 2.45
See issue 11 P 71 & FM BUG book. P 41. Our first FM Bug project. Easy to build and transmits about 200 metres.

( ) FM RADIO 19.15
( ) " " PC Board 2.80
See issue 15. A miniature FM Radio project.

( ) Gnat 6.95
( ) " " PC Board 1.50
See FM Bugs! An FM bug that fits in a match-box.

( ) Guitar Amplifier 14.20
( ) " " PC Board 3.95
( ) Guitar Amp extras 30.50
See issue 14 P 27. An 8 watt amplifier with pre-amp and Fuzz for practice sessions.

( ) Hangman 12.75
( ) " " PC board 4.55
See issue 6 P 5. An electronic game of Hang The Butcher. Covers a number of building blocks. A good electronics kit for learning.

( ) Headlight Reminder 13.30
( ) " " PC board 4.55
See issue 12 P 5. A car project to remind you to turn off your headlights. Includes a flashing LED to deter thieves.

( ) Hikers Alarm (Car Tracker) .. 14.50
( ) " " PC Board 2.50
See Bugging. Suitable for taking on camping, hiking, skiing, etc in case of emergency. Transmits audio with background beeps.

( ) IC Pocket Radio ..... deleted
( ) IN/OUT Module 41.15
( ) " " PC Board 5.75
See issue 14 P 23. Add-on for the TEC computer. Has 8 input lines and 16 output lines

( ) Jiffy Box UB3 plastic lid ... 2.95
( ) Jiffy Box UB5 & plastic lid 2.25
( ) JIM'S PACKAGE 15.00
A technical reference to support JMON, with additional programs and documentation.

( ) JMON 16.00
Advanced MONitor (with tape save and LCD routines etc.) for TEC computer.

( ) KITT Scanner 7.70
( ) " " PC Board 2.45
See issue 13 P 27. Seven LEDs are scanned by a clever reversing circuit to give the effect as in the KITT car.

( ) LED Dice MkII 8.00
( ) " " PC board 4.55
See issue 5 P 72. The face of a dice is represented by LEDs. Can be used for all types of board games.

( ) LED POWER METER 1.10
Required for Ultima bug.

( ) LED Zeppelin 8.00
( ) " " PC board 2.85
See issue 1 P 11. A game of skill to get all 6 LEDs illuminated by pressing a switch at the right instant.

( ) Light the LED ..... deleted
( ) LISTENER 20.70
( ) " " PC Board 5.50
See Bugging. Lets you listen for illegal use of your phone.

( ) Logic Designer 24.85
( ) " " PC board 4.55
See Cover Projects. A CMOS designer for designing CMOS circuits. Has a power supply, 7 segment display and driver, binary counter, one-shot and 10Hz oscillator. Comes with a set of experiments. As used by NSW correspondence schools.

( ) Logic Probe 14.20
( ) " " PC board 3.90
See issue 10 P 5. Invaluable for testing logic circuits such as computers or any of our projects. Has HIGH-PULSE-LOW LEDs to show the state of the line and a mini piezo to let you hear the state of the line.

( ) Logic Pulser 16.25
( ) " " PC Board 2.85
See issue 13 P 5. Produces pulses for injecting into logic circuits to determne if they are functioning correctly.
( ) Lotto Selector 18.30
( ) " " PC board 4.55
See issue 9 P 4 & Cover Projects P 75. Counts to 99 but can be converted to count to 45, for selecting your lucky numbers.
( ) **Microcomp-1** parts 60.60
( ) " " PC Board 11.70
See Issue 13 P 59 and issue 14 P 59. A very simple dedicated Z-80 micro computer to show you how a programs runs.
( ) Microcomp-1 complete..... **72.35**
( ) Microcomp-1 case..... 17.30
( ) 300mA DC plug Pack..... 17.30
( ) Mini Frequency Counter . . 21.55
( ) " " PC board 4.55
See Cover Projects P 5. A simple 3-digit frequency counter for measuring frequencies from 100Hz to 5MHz.
( ) Cascade red LEDs..... 13.55
( ) Mini Mixer..... 3.05
( ) " " PC board..... 2.35
See issue 6 P 64. Mixes up to 6 inputs to one output.
( ) **MONitor 1B/2 for TEC 15.00**
Two MONitors in the one chip for TEC.
( ) Music Colour 10.75
( ) " " PC board 2.85
See issue 7 P 72. A set of 14 LEDs flash in time with music and sounds.
( ) Noise-A-Tron..... 4.55
( ) " " PC board 2.75
See issue 4 P 28. A set of noises similar to space effects.
( ) Non-Volatile RAM 27.15
( ) " " PC Board 5.00
See issue 13 P 17. Add-on for the TEC computer. 2k memory holds information for up to 1 year.
( ) **ORGAN**..... **14.50**
( ) " " **PC Board** **4.25**
See issue 15. A stylus organ with a 2½ octave range.
( ) Peaking circuit ..... 75¢
Needed to peak the FM bugs such as the Hikers Alarm and Water Bug.
( ) PEN BUG..... 8.20
( ) " " PC Board 2.50
See More FM Bugs! A bug that fits into a marker pen and transmits about 20 metres.
( ) Phaser GUN 7.05
( ) " " PC board 2.85
See issue 7 P 64. Phaser gun sounds.
( ) PHONE BUG SNIFFER.... 36.90
( ) " " **PC Board** **5.50**
See Bugging. Detects 3 types of BUGS on the line.
( ) Phone Tape - 01 ..... 10.50
( ) " " PC Board 4.50
See More FM Bugs! Fits across your phone lines and activates a tape recorder whenever the phone is off the hook.
( ) Pill Timer..... 8.05
( ) " " PC board 2.85
See issue 7 P 65. A long duration timer suitable for when taking pills etc.
( ) Power Supply 1 amp..... 6.15
( ) " " PC board 2.85
See issue 3 P 4. A regulated power supply. 5v to 15v at about 1 amp (700mA).
( ) Pre-amp (stereo)..... 13.55
( ) " " PC Board 4.75
See issue 7 P17. See Simplicity Amplifier project for more details.
( ) Printer Interface..... 34.45
( ) " " PC board 5.25
See issue 12 P 30. Add-on for the TEC computer. Make sure you have a 4 pen printer/plotter before ordering the kit. Enquire about Print 2 and Print 3 updates (free) for MON 2 & JMON.
( ) Programmable Counter.... 11.40
( ) " " PC board 5.00
See issue 6 P 71. A 4-digit counter with auto reset and audible alarm, for counting etc.
( ) Auto Reset Section..... 10.00
( ) " " PC board 3.45
( ) Complete kit..... 29.05

( ) Quick Draw..... 2.75
( ) " " PC board 2.85
See issue 5 P 58. Game for two players to see who has the fastest reaction.
( ) RAM Stack - per 2k 8.50
See issue 12 P 28. Add-on for TEC. 2k of RAM for expansion.
( ) Relay Driver Board..... 27.00
( ) " " PC board 12.50
Add-on for TEC computer. Outputs to 8 relays for robotics etc. (4 relays in kit).
( ) RIP OFF..... 17.90
( ) " " PC Board 4.50
See Bugging. Times the duration of your phone calls and puts a beep on the line.
( ) RouLED 9.00
( ) " " PC board 5.00
See issue 10 P 13. A set of 10 LEDs in a circle to give simulated rotation.
( ) Simplicity Amp 1 channel . .6.50
( ) " " PC board 3.35
See issue 5 P 11. A 4-watt amplifier in a chip. Two can be combined with pre-amp section to create a stereo amplifier.
( ) Pre-amp Section 13.55
( ) " " PC board 4.75
( ) **SPEECH**..... **24.25**
( ) " " **PC Board** **3.00**
Make your TEC talk.
( ) Square Wave Oscillator..... 3.60
( ) " " PC board 2.85
See issue 3 P 26. Outputs a square wave at 5 different frequencies for test purposes.
( ) Stereo Mini Mixer (4ch)... 27.15
( ) " " PC board 4.70
See issue 9 P 17. Mixes 4 or 6 channels into two outputs.
( ) 2 Channel add-on..... 7.50
( ) Stereo Amp. (uses 2 simplicity amp modules and pre-amp section. complete 38.00
( ) Stereo VU Meter..... 14.85
( ) " " PC board 4.55
See issue 7 P 4. A LED readout for balance of 2 channels etc.
( ) Super BUG..... deleted
( ) TEC-1B parts..... 104.60
( ) " " PC Board 28.05
( ) TEC-1B complete..... 132.70
( ) TEC CASE..... 29.80
( ) TEC 500mA plug pack 18.80
See issues 10, 11, 12, 13, 14. A simple Z-80 based computer using machine code programming to show how a computer operates. An ideal computer project.
( ) TEC Power Supply 19.25
( ) " " PC Board 7.60
( ) TEC Power Supply complete kit incl 1 transformer, all parts, PC board & large case: 61.30
See issue 13 P 23. A power supply for the TEC computer. Has 5v, 12v and 30v outputs.
( ) Telemite Mk I..... 8.55
( ) " " PC board 1.15
See FM Bug book 1. A phone pick-up coil is used to tape phone calls.
( ) TELEMITE Mk II..... 5.95
( ) " " PC Board 1.50
See More FM Bugs! This model is attached to the phone lines for very good pick-up of audio.
( ) Throttle Mk II 3.45
( ) " " PC board 2.45
See issue 6 P 60. A simple throttle for train control.
( ) Touch Puzzle..... 5.75
( ) " " PC board 2.85
See issue 12 P 72. A simple puzzle to test your skill at turning on a LED.
( ) Train Signals..... 9.35
( ) " " PC board 3.55
See issue 9 P 33. A simple train signal simulation with boom crossing indicators.

( ) Tremolo..... 2.75
( ) " " PC board 2.45
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simply by selecting a menu choice. The main menu lets you designate up to 16 different options. In addition, five linked choices can be added to each menu choice, allowing a total of 80 possible options. For example, one menu choice could be WORDPROCESSORS. This choice would then let you select from up to five different word- processing programs.

Disk No 1143 PC-QUIZZER version 2.1 PC-SIG version 1

System Requirements: A CGA card.

PC-QUIZZER is an educational program for instruction in almost any subject including foreign languages, history, science, math, vocabulary, trivia, and word definitions. PC-QUIZZER is an excellent educational tool and a must for anyone involved with learning or teaching, as it lets you create your own computer lesson. Quiz files can be created using any standard ASCII text editor or wordprocessor. Graphic images for use with this program can be created with any graphics or painting package or by a BASIC program.

Disk No 1145 GRAB PLUS version 4.5 PC-SIG version 1

GRAB PLUS is a memory-resident utility that will "grab" an address that was typed up with a wordprocessor and immediately print it. While using your wordprocessor, you can call up the GRAB PLUS menu by pressing a selected "hot key." A box will then appear which is used for "grabbing" the address to be printed. It does not matter what the size of the address is because you can adjust the size of the box. You can edit the address before printing or even type in a whole new address. GRAB PLUS will also print a default return address on the envelope if you desire. Once the address is printed, GRAB PLUS will disappear back into memory returning you to normal computer operation. Disk No 1146 LOGIN version 1.10 PC-SIG version 1

System Requirements: A hard drive.

LOGIN will restrict access to the computer by requiring each user to enter in an authorized user name and password. A menu with up to 45 choices is then displayed from which each person can execute programs and DOS commands. LOGIN will even allow users to temporarily exit the program to DOS, where other functions can be done. If nothing is done by the user after a certain amount of time, LOGIN will automatically log off the user and blank the computer screen. Disk No 1147 FAST INVOICE WRITER and FAST STATEMENT WRITER PC-SIG version 1

FAST INVOICE WRITER and FAST STATEMENT WRITER creates invoices and statements for the small businessman in a quick and orderly fashion. FAST INVOICE WRITER is just what the small businessman ordered, it turns out a numbered, professional looking invoice in about 60 seconds and prints as many copies as you want. Then it prints your mailing labels and inserts for 10-inch window envelopes. It also prints your firms name, address and phone number on the invoice in big letters and handles all sorts of taxes and shipping charges. A winner for everyone from landlords to health professionals.

Disk No 1150 SIMPLY LABELS version 2.01 PC-SIG version 1

System Requirements: A printer.

SIMPLY LABELS is a unique label program that lets you design your own labels, any size you want. Each label format you create can have its own standard background text, which can include graphics characters. In this way you can create labels with blank lines or boxes for data entry. You can also specify the length of the label and the number of lines each label contains. Each line of the label you create can have a different kind of typeface, such as normal print, condensed print, elite print, etc. You can create mailing labels, tape labels, VCR labels, filing labels, or any kind of label for whatever purpose you need. Several predefined label formats are included in the program, and you can design up to 25 different label formats. SIMPLY LABELS prints the labels to the printer, a disk file, or the screen.

Disk No 1151 ROAM PC-SIG version 1

ROAM is a DOS shell, an easy-to-use interface that insulates the user from the complexities of DOS. It makes it easier to enter commands and manage files. ROAM helps organize and control a hard disk and makes it possible for the user to customize its organization to fit individual user needs.

Disk No 1159 CONSTRUCTION ESTIMATOR & More PC-SIG v 1.2

For the home handyman and amateur builder who likes to tackle major projects, CONSTRUCTION ESTIMATOR provides a menu-driven aid for estimating building project costs. Estimation calculations are provided for concrete footings, stem walls, and floor slabs; block and wood walls; ceiling and floor joists; roof and floor sheeting; sheetrock; and roof cut and stack. Disk No 1162 REMINDERS version 1.07 PC-SIG v 1

Completely menu-driven, REMINDERS is a perpetual calendar, coupled with a tickler file for reminding you of important activities and dates. All date reminders are organized on a month and day of date basis: enter a date for a birthday, anniversary, or accounting deadline once, and that date reminder will then be shown on the correct day of the month, year after year. Ten codes are used to group reminders under specific headings such as holiday, birthday, meeting, deadline, etc. REMINDERS can be displayed or listed to the printer by date, code, date range, code and date range, or in summary form, and calendar format, for any one month.

Disk No 1163 3GRAPH version 2.01 PC-SIG v 1

System Requirements: 512K RAM, Hercuiles graphics, or EGA with 128K ram. Epson or compatible dot-matrix printer. Math coprocessor optional.

You can literally add an extra dimension to your graphics plotting with 3GRAPH. This abbreviated shareware version of 3GRAPH allows plotting of up to 10 data points in a three- dimensional representation through use of a spreadsheet- structured interface. 3GRAPH is straightforward in operation, and the accompanying documentation is adequate and understandable. You can import files from your ASCII editor or LOTUS 1-2-3 version 2.1. Serious users will undoubtedly prefer the commercial version for its expanded 625 data point plotting capabilities. Special note: the program will work on a CGA system, but only to view the graphics on the screen, not print them.

Disk No 1165 PC-DASHBOARD ver 1.02 PC-SIG v 1

System Requirements: A hard disk.

PC-DASHBOARD is a program menu system to make the operation of programs on a hard disk much easier and quicker. The program consists of a main menu and a virtually unlimited number of submenus, and each menu can have up to 24 choices. From the menus you can perform DOS commands, execute your favorite programs, go to other submenus, or shell to a specific directory.

Disk No 1166 POETRY GENERATOR v 1.0 PC-SIG v 1

System Requirements: A hard disk.

POETRY GENERATOR produces original poetry effortlessly: thousands of phrases, words, and several formats can be combine by random selection to form thousands of different poems. After the poem has been created, you may save it by pressing the Shift and PrtSc keys.

Disk No 1168, 1169 BILLPOWER PLUS PC-SIG v 1.1

System Reqirements: 512K RAM and a hard disk.

BILLPOWER is an extremely powerful time-keeping, billing, and bookkeeping system designed specifically for small firms. It's designed to help attorneys, accountants, and other professionals keep precise records and bill regularly. BILLPOWER will track time worked on professional matters and calculate the amount owed by each client. It will also keep up with receipts and disbursements, and it will maintain such accounts, allowing you to carry out simple bookkeeping functions. Perhaps most importantly, it will automatically compile service, disbursement, and receipt transactions for each client into monthly bills. Billpower also needs disk #1169 to run.

Disk No 1170 Sagewords (A Wordprocessor) PC-SIG v 1.1

A general purpose wordprocessor.

Disk No 1171 THE COMPUTER BAKER PC-SIG v 1.1

THE COMPUTER BAKER is a computer recipe book containing 99 recipes for homemade–made from scratch–baked goods that are very quick and easy to prepare. THE COMPUTER BAKER is completely menu driven and provides the ability to select recipes from six categories, Snacks (Brownies and Pastries), Fudge and Candy, Muffins and Bisquits, Cookies, Cakes and Frostings, and Pies.

Disk No 1174 FOURSOME GENERATOR PC-SIG v 1

FOURSOME GENERATOR is a program which will automatically calculate foursomes (teams of four) for golf tournaments based upon their handicaps. This program allows you to keep a running roster of members eligible to play, and up to 500 people can be entered on each list. Separate lists may be saved to disk. You can edit and update the names and handicap numbers at any time, and the program lets you define the range for the handicap numbers. Once the names are entered, the program can sort the list alphabetically. From a list of names you can mark the names of those people who are going to play in a foursomes tournament. The program then will quickly generate foursomes so that all teams will have an equal or almost equal handicap total. This program will allow you to produce a printout of the entire player listing or a printout of the calculated foursomes.

Disk No 1175 WORTHY OPPONENT v 1.4 PC-SIG v 1.2

System Requirements: A modem.

WORTHY OPPONENT is competitive, challenging, and entertaining game package that actually allows to play games over your modem with other opponents. What makes WORTHY OPPONENT unique are the sophisticated communications capabilities. Game competition occurs with an opponent miles away. You can still taunt and jeer at your opponent with every move.

Disk No 1176 DABUTIL, EZDO, CAPP, & EASYDOS PC-SIG v 1.1

This disk contains four general utilities for disk maintenance, file encryption, a C or PASCAL source code formatter that formats your source code text for easy reading, and a simple DOS menu.

Disk No 1177 COMPUTER SOLITAIRE PC-SIG v 1

System Requirements: CGA Card.

The government should put COMPUTER SOLITAIRE on its list of addictive substances. The three games offer the compulsive obsessive card dealer all the variety and challenge you can handle. SPIDER is a tricky deal, the nearest thing to a solitaire strategy and skill game. Played with two decks, it's easy to learn but hard to master. You'll recognize KLONDIKE, today's most popular solitaire game. But you'll be taunted by three skill levels and a unique scoring system. CANFIELD, a voice from Saratoga's past, will haunt you. Originally, you bought a deck for $50 and got $5 for every card played in the field.

Disk No 1178 Title: BOOKMINDER v 1.10 PC-SIG v 1.1

BOOK MINDER is a book-cataloging system designed for both personal and business use. It can be used with books, magazines, newspapers, or almost any other published material. BOOK MINDER allows you to catalog a library and then locate a book or article in a magazine, by any one of up to 21 characteristics. Entries can be made for individual articles. This allows you to list the individually unique information contained in each article. Disk No 1181 BASIC ENGLISH and POETEASE v 1.1 SIG v1.1

Roses are red, violets are blue, POETEASE will rhyme most anything for you. Likewise, BASIC ENGLISH tells you how many words in your poem or prose are on the magic list of 850 words scholars agree are simple and most understandable by most people. Disk No 1182 VIBRATING, RORTATING AND COOLING. v 2 PC-SIG v1

System Requirements: CGA, EGA, or VGA graphics, delpending on program.

View and manipulate surfaces created by a mathematical function through three and four dimensional space by pressing a key on your PC. Graph x and/or y calculus functions and stand in awe at your new insight as you test the limits of your EGA. Ogle at wave and stable state movements like heat flow. Then, you will be venturing into the world of VIBRATING, ROTATING AND COOLING. Disk No 1183 MTOOL and CONVERT PC-SIG v 1

System Requirements: A 640x200 (CGA) graphics card to plot the functions.

MTOOL is an easy-to-use mathematic function interpreter that will analyze functions of a single

variable defined by the user. This program can evaluate a function for a range of points or for a single point of the independant variable. It can also evaluate the derivative of the function for any value of the independent variable. This program can also find solutions for the function over a range of values for the independant variable. MTOOL can plot the function using a 640x200 resolution screen. CONVERT is a unit-conversion utility that accepts arguments from the command line and shows a list of equivalent quantities of different units.

Disk No 1184 ON-SIDE PC-SIG v 1.1

System Requirements: IBM or EPSON/Compatible dot matrix printer.

ON-SIDE prints reports down the page (on their side), instead of across, in a variety of character font styles. It is useful for a presentation which looks perfect on the screen, but when you attempt to print it, it's too wide to fit on the paper. If a report overlaps onto two or three pages, the perforations can be left connected so a really wide report folds up nicely for filing. ON-SIDE is perfect for use with a spreadsheet, word processor or any other program that can write its printed output to a diskette.

Disk No 1188 POINT & SHOOT BACKUP/RESTORE v 1.0 PC-SIG v 1

System Requirements: A hard disk.

Finally a program that makes backing up your hard disk so simple you'll wonder why you didn't buy POINT & SHOOT BACKUP/RESTORE sooner. POINT & SHOOT BACKUP/RESTORE is a companion program for the POINT & SHOOT HARD DISK MANAGER (disk #930) but can also be used as a stand-alone product. POINT & SHOOT BACKUP/RESTORE is designed to provide fast, easy backups of your hard disk data to floppy disks. User involvement is minimized in the backup and/or restore process. If you own a hard disk, point & shoot backup/restore is a necessity.

Disk No 1190 WYNDSHELL v 1.0 PC-SIG v 1.0

WYNDSHELL is an friendly and complete disk manager for users who fear the DOS prompt world. In addition to superior disk management, this menu-driven program can call programs or user created macro commands (in lieu of batch files) with one keystroke, or mouse click, superseding the need to ever use the standard DOS prompt. The WYNDDOS section of the WYNDSHELL program graphically displays disk and directory information. Using pull-down menus you can execute all DOS file (copy, delete, etc.) and directory (cd, md, etc.) commands. There are commands to move files, re-sort the directory listing, print disk info, and more.

Disk No 1191 POKER SQUARES PC-SIG v 1

POKER SQUARES is a computerized card game for one to ten players in which each player tries to obtain the best poker hands possible. The program also allows you to save up to fifteen games on disk for later use.

Disk No 1192 PC-DISK LABEL v 2.0 PC-SIG v 1.1

System Requirements: IBM compatible or Okidata model 82, 83,92, or 93 printers.

PC-DISK LABEL prints out diskette labels for 5-1/4" diskettes and saves them for later reference or reprinting. PC-DISK LABEL (PCDL) is a simple program that can help organize a computer user's diskette collection and, at the very least, make every diskette label legible to the untrained eye. On each label PCDL can print 4 lines of 22 characters and a 5th line of 74 characters in "compressed mode."

Disk No 1194 MEGAGOPOLY v 1.00 PC-SIG v 1

MEGAGOPOLY is a game of high finance. The scenario: you have just inherited $100,000, The object: make millions more with MEGAGOPOLY in twenty years. MEGAGOPOLY presents you the opportunity to create unlimited wealth by offering different investments. Depending upon how wisely or not you invest your money, you watch it grow or shrink. Types of investments include stocks, bonds, oil, real estate, and even betting.

Disk No 1195 PC Shift v 1.01 PC-SIG v 1.1

System requirements: A printer to print the reports.

PC-SHIFT is a program that will help organize your employee shift schedule. PC-SHIFT allows you to divide the jobs by location or category and then lets you describe each job required for each area. The job descriptions consist of the beginning date, the location or department, the job title or description, the minimum and maximum qualification level, and the minimum and maximum security level.

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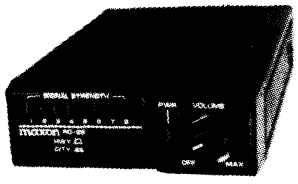

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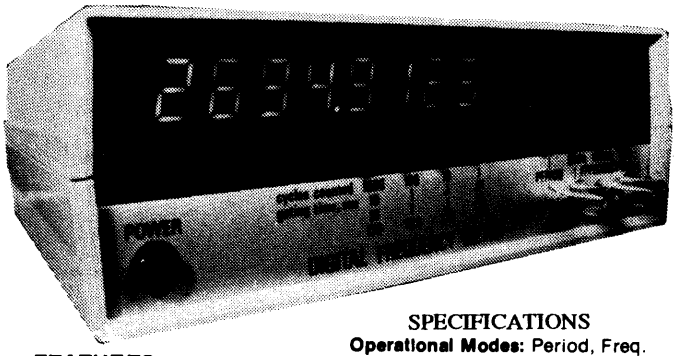

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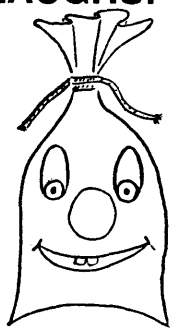

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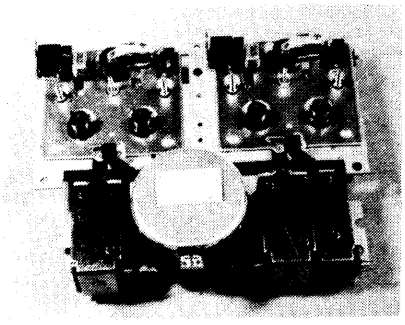

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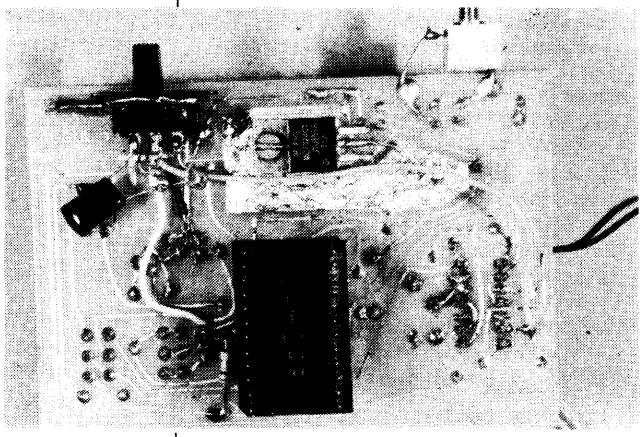
. . . . .from P. 32.

and some hook-up wire. To start, mount the switch on the bottom of the PCB by drilling two holes and wrapping tinned copper wire around the switch (see photo). Next cut the track between the output of the 24v regulator and the transistor switching block. The bottom middle terminal of the switch is connected to the transistor side of the cut. Connect the bottom right-hand side terminal to the regulator output and also solder the cathode end of the zener to this junction. The anode end of the zener is soldered to the bottom left-hand side of the switch. The zener, which is connected between the regulator and the high voltage switching section, drops the programming voltage by about 4v.

This completes the voltage switching section. Below is the programming pulse length mod.

The photograph on the right shows how the parts on our prototype are mounted. The description of the parts placement in the text, corresponds to this photo.



Remove the 100n greencap on the extreme left-hand side of the board (top view). Solder one end of the new 100n to the top right-hand side of the switch. Take the 10n cap and solder one side of this to the top left-hand side of the switch. The other ends of the caps are soldered together and a jumper is also soldered onto this junction. The jumper is then soldered to pin 3 of the 4011. Another jumper is soldered between pin 6 of the 4011 and the top middle terminal of the switch.

When the switch is in the right-hand position (top view), the EPROM programmer is set up for the modern 21v/10mS EPROMs.

One of these types of EPROM is being supplied by TE. It can be identified by the following markings:

TMS
2732A-25JL
LHE XXXX (DATE CODE)

To increase the reliability of the programmer, another mod is suggested. Follow the track from the ROM select line to where it joins the 10n cap. Cut both the tracks that join to the cap at this junction. Then run a link from the ROM select input pad to pin 8 of the 4011. Now run a jumper from the wait pin to the now isolated end of the greencap.

This mod slightly delays the programming pulse to the EPROM by triggering it from the wait line, not the input ROM select line.

The software for burning EPROMs provided in issue 13 is only very basic. There is one VERY IMPORTANT ADDITION to make to the issue 13 software. After you have loaded BC, DE and HL, as described in issue 13, add the following:

XOR A (AF)
LD I,A (ED 47)
JUMP 0700 (C3 00 07)

These instructions stop the noise on the expansion port which is a result of several TEC design oversights.

The following software is designed to be burnt into either a MON-1 or MON-2 EPROM at 0700.

The software is JUMP TO with the "from address" in HL, the "to address" in DE and the number of bytes in BC.

Before it attempts to burn into the EPROM, it checks that the area to be programmed contains only FF's. If not, the routine displays an "F", for FULL in the data display and halts. You may continue on and burn the EPROM by hitting "GO". Each location is checked after it is burnt and if not correct, it is reprogrammed several more times before being aborted. The routine then displays "E" for ERROR.

You must do the "read 2732" mod to program 2732 EPROMS.

An added feature to this software is that it flashes the address being programmed on the TEC display.

EPROM BURNING SOFTWARE

```
0700  AF          XOR A
0701  ED 47       LD I,A
0703  CD 90 07    CALL 0790
0706  7E          LD A,(HL)
0707  12          LD (DE),A
0708  D5          PUSH DE
0709  D9          EXX
070A  D1          POP DE
070B  CB 9A       RES 3,D
070D  D5          PUSH DE
070E  01 F0 0F    LD BC,0FF0
0711  C5          PUSH BC
0712  CD 5A 07    CALL 075A
0715  7B          LD A,E
0716  CD 5A 07    CALL 075A
0719  7A          LD A,D
071A  CD 5A 07    CALL 075A
071D  C1          POP BC
071E  01 10 00    LD BC,0010
0721  C5          PUSH BC
0722  CD 6E 07    CALL 076E
0725  C1          POP BC
0726  0B          DEC BC
0727  78          LD A,B
0728  B1          OR C
0729  20 F6       JR NZ,0721
072B  D1          POP DE
072C  1A          LD A,(DE)
072D  D9          EXX
072E  BE          CP (HL)
072F  20 08       JR NZ,0739
0731  23          INC HL
0732  13          INC DE
0733  0B          DEC BC
0734  78          LD A,B
0735  B1          OR C
0736  20 CE       JR NZ,0706
0738  C7          RST 00
0739  C5          PUSH BC
073A  01 05 00    LD BC,0005
073D  CB DA       SET 3,D
073F  7E          LD A,(HL)
0740  12          LD (DE),A
0741  10 FE       DJNZ,0741
0743  CB 9A       RES 3,D
0745  1A          LD A,(DE)
0746  BE          CP (HL)
0707  20 03       JR NZ,074C
0749  C1          POP BC
074A  18 E5       JR 0731
074C  0D          DEC C
074D  20 EE       JR NZ,073D
074F  C1          POP BC
0750  3E C7       LD A,C7
0752  D3 02       OUT (02),A
0754  3E 01       LD A,01
0756  D3 01       OUT (01),A
0758  76          HALT
0759  C7          RST 00
075A  F5          PUSH AF
075B  CD 63 07    CALL 0763
075E  F1          POP AF
075F  0F          RRCA
```

```
0760  0F          RRCA
0761  0F          RRCA
0762  0F          RRCA
0763  E6 0F       AND 0F
0765  21 B0 07    LD HL,07B0
0768  85          ADD A,L
0769  6F          LD L,A
076A  7E          LD A,(HL)
076B  02          LD (BC),A
076C  03          INC BC
076D  C9          RET
076E  21 F0 0F    LD HL,0FF0
0771  06 06       LD B,06
0773  0E 01       LD C,01
0775  7E          LD A,(HL)
0776  D3 02       OUT (02),A
0778  79          LD A,C
0779  D3 01       OUT (01),A
077B  0E 40       LD C,40
077D  0D          DEC C
077E  20 FD       JR NZ,077D
0780  07          RLCA
0781  4F          LD C,A
0782  AF          XOR A
0783  D3 01       OUT (01),A
0785  23          INC HL
0786  10 ED       DJNZ,0775
0788  C9          RET
0789  FF          RST 38
078A  FF          RST 38
078B  FF          RST 38
078C  FF          RST 38
078D  FF          RST 38
078E  FF          RST 38
078F  FF          RST 38
0790  D5          PUSH DE
0791  C5          PUSH BC
0792  CB 9A       RES 3,D
0794  1A          LD A,(DE)
0795  FE FF       CP FF
0797  20 09       JR NZ,07A2
0799  13          INC DE
079A  0B          DEC BC
079B  78          LD A,B
079C  B1          OR C
079D  20 F5       JR NZ,0794
079F  C1          POP BC
07A0  D1          POP DE
07A1  C9          RET
07A2  3E 47       LD A,47
07A4  D3 02       OUT (02),A
07A6  3E 01       LD A,01
07A8  D3 01       OUT (01),A
07AA  76          HALT
07AB  18 F2       JR 079F
```

```
07B0 EB 28 CD AD 2E A7 E7 29
     EF 2F 6F E6 C3 EC C7 47
```

PRINT-2 AND PRINT-3 SOFTWARE

With the changes to the keyboard handler routines in both MON-2 and JMON, an up-dated printer ROM has been produced.

The new software is burnt into the same ROM at higher locations. When MON-2 was released, an up-dated ROM called print-2 was included in the printer interface kits. This gave you the same routines with an altered keyboard section. It was also a little more fancy as it showed the start address on the LED display as you typed it in. Unfortunately, Print-2 did not include a "dump string at 0900" routine to replace the dump from 0800 which is now unusable as MON-2 uses 0800 for its variable storage.

With the advent of JMON, the same arrangement has been used. The JMON printer routines are located higher again, so in the one ROM you have the printer software for all three MONitors. The list routine for JMON is an improvement on both earlier software packages, as JMON's routine uses the perimeter handler to allow you to enter both a START and END address. Print-3 includes a "dump from 0900" routine which can be used with MON-2.

The ROM with the JMON routines in it is called PRINT-3 and is supplied with the printer interface as standard.

JMON's hex dump routine is at 1A20, the typing routine at 1AA0 and the "dump string at 0900" routine is at 1AC0.

Below is a dump of PRINT-3. Burn the additional section(s) in PRINT-1/2 ROM.

The graphic demonstration routines in PRINT-1 will work with all MONitors.

```
1800 3E 0D D3 06 3E 0A D3 06
     76 ED 57 17 17 17 17 57
1810 CD 5D 18 76 ED 57 82 57
     CD 61 18 76 ED 57 17 17
1820 17 17 5F CD 5D 18 76 ED
     57 83 5F CD 61 18 C3 49
1830 18 3E 0D D3 06 3E 0A D3
     06 7A CD 5D 18 7A CD 61
1840 18 7B CD 5D 18 7B CD 61
     18 06 08 3E 20 D3 06 1A
1850 CD 5D 18 1A CD 61 18 13
     10 F1 C3 31 18 1F 1F 1F
1860 1F 21 6C 18 E6 0F 85 6F
     7E D3 06 C9 30 31 32 33
1870 34 35 36 37 38 39 41 42
     43 44 45 46 FF FF FF FF
1880 21 00 08 7E FE FF 20 05
     3E 11 D3 06 C7 D3 06 23
1890 18 F1 FF FF FF FF FF FF
     FF FF FF FF FF FF FF FF
18A0 21 C3 18 7E FE FF 28 05
     D3 06 23 18 F6 06 0A 21
18B0 CF 18 7E FE FF 28 05 D3
     06 23 18 F6 10 F1 3E 11
18C0 D3 06 C7 0D 0A 0A 0A 0A
     0A 0A 12 43 30 0D FF 49
18D0 2C 44 33 32 30 2C 30 0D
     4D 31 32 30 2C 30 0D 44
18E0 38 30 2C 2D 31 36 30 0D
     4D 32 32 30 2C 2D 38 30
18F0 0D 44 31 36 30 2C 2D 38
     30 2C 31 34 30 2C 2D 31
1900 36 30 2C 32 30 30 2C 2D
     31 36 30 0D 4D 31 35 30
1910 2C 2D 31 32 30 0D 44 32
     30 30 2C 2D 31 32 30 0D
1920 4D 33 32 30 2C 2D 38 30
     0D 44 32 36 30 2C 2D 38
1930 30 2C 32 34 30 2C 2D 31
     36 30 2C 33 30 30 2C 2D
1940 31 36 30 0D 4D 33 36 30
     2C 2D 31 32 30 0D 44 34
1950 30 30 2C 2D 31 32 30 0D
     4D 34 36 30 2C 2D 38 30
1960 0D 44 34 34 30 2C 2D 31
     36 30 0D 4D 32 2C 2D 32
1970 0D 43 33 0D FF FF FF FF
     FF FF FF FF FF FF FF FF
1980 76 ED 57 E6 0F 17 17 17
     17 57 76 ED 57 E6 0F 82
1990 D3 06 18 EC FF FF FF FF
     FF FF FF FF FF FF FF FF
```

The next block is the PRINT-2 additions:

```
19A0 76 3A E0 08 E6 0F 17 17
     17 17 57 76 3A E0 08 E6
19B0 0F 82 D3 06 18 EA FF FF
     FF FF FF FF FF FF FF FF
19C0 3E 0D D3 06 3E 0A D3 06
     3E 29 21 D8 08 06 06 77
19D0 23 10 FC CD 00 1A 32 D8
     08 CD 00 1A 32 D9 08 CD
19E0 00 1A 32 DA 08 CD 00 1A
     32 DB 08 CD D8 01 CD 89
19F0 02 50 59 C3 31 18 FF FF
     FF FF FF FF FF FF FF FF
1A00 3E FF 32 E0 08 CD A0 02
     3A E0 08 FE FF 28 F6 E6
1A10 0F C6 FF CD 70 01 D6 01
     C9 FF FF FF FF FF FF FF
```

Below is PRINT-3 additions:

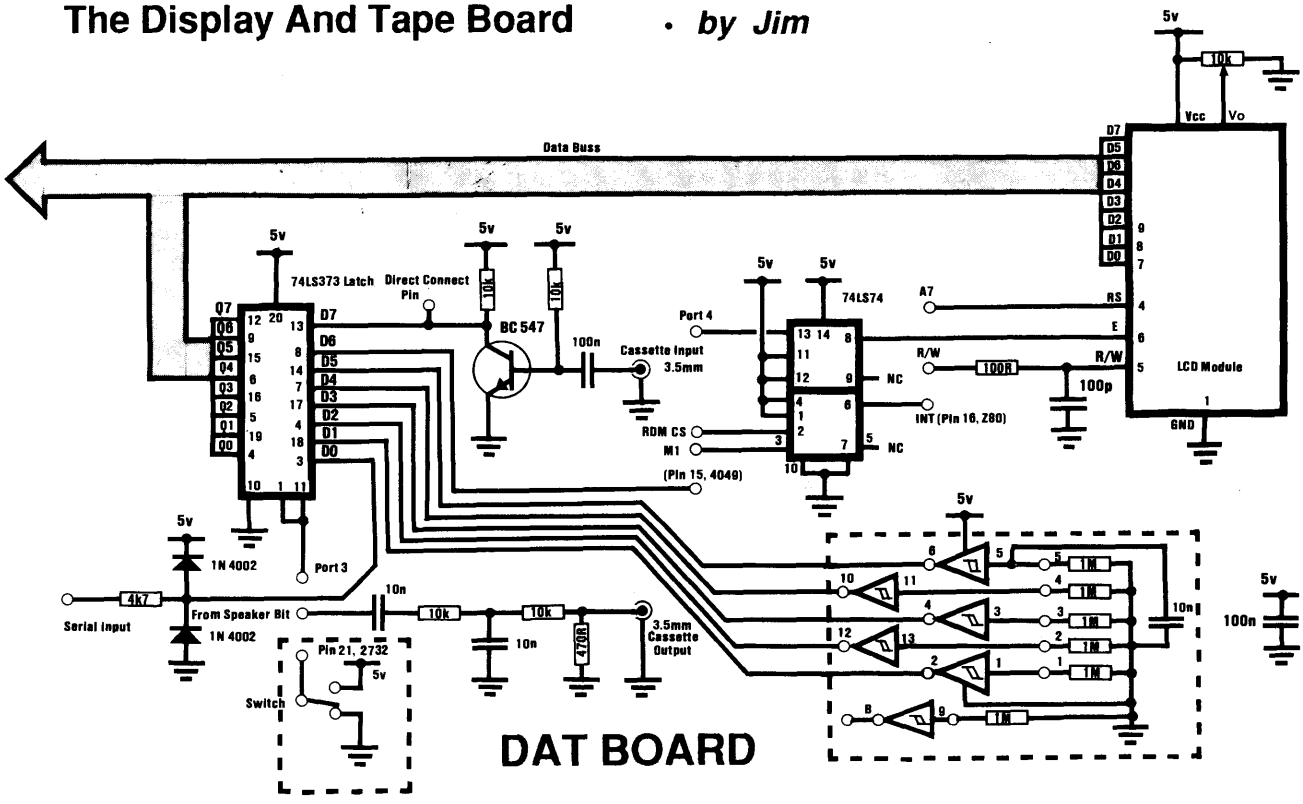
```
1A20 21 34 1A 11 80 08 01 0A
     00 ED B0 21 00 00 22 9C
1A30 08 C3 44 00 00 00 3E 1A
     99 08 00 01 50 1A 04 A7
1A40 04 C7 04 EB FF FF FF FF
     FF FF FF FF FF FF FF FF
1A50 3E 0D D3 06 2A 98 08 7C
     CD 82 1A 7D CD 82 1A 06
1A60 08 C5 3E 20 D3 06 7E CD
     82 1A 23 C1 10 F3 3E 0D
1A70 D3 06 3E 0A D3 06 ED 5B
     9A 08 E5 B7 ED 52 E1 38
1A80 D6 C9 F5 0F FF 0F 0F CD
     8B 1A F1 E6 0F C6 90 27
1A90 CE 40 27 D3 06 C9 FF FF
     FF FF FF FF FF FF FF FF
1AA0 CF E6 0F 07 07 07 07 57
     CF E6 0F 82 D3 06 18 F0
1AB0 D3 06 18 EC FF FF FF FF
     FF FF FF FF FF FF FF FF
1AC0 21 00 09 7E FE FF 20 05
     3E 11 D3 06 C7 D3 06 23
1AD0 18 F1 FF FF FF FF FF FF
     FF FF FF FF FF FF FF FF
```

TE

THE DAT BOARD

Parts $50.80
PC board $4.55
Total $55.35
Parts without LCD: $11.80

The Display And Tape Board · *by Jim*



This board will change the way you program for ever. The DAT BOARD is perhaps the most vital addition to the TEC ever. Not just a part time "add on," but rather a permanent addition to your TEC.
Once you start using it, we think you'll agree.
The name "DAT" is an acronym for Display And Tape. While others brawl over "their" DAT, (have you seen one?), we have quietly slipped in the back door with our version.

The DAT BOARD provides these functions:
* 16x2 LCD display.
* Cassette tape I/O interface.
* Single stepper module.
* 5 Buffered and latched input bits.
* 1 Inverter for general use.
* Diode clipped input line. (For RS232 input)
* MON select switch.

PORT 3

Port 3 addresses an input latch. Below is a break-down of the bits on port 3.

BIT#
0 - Serial in
1 - input 1
2 - input 4
3 - input 2
4 - input 5
5 - input 3

The above are the inputs from the 74C14.

6 - key pressed signal.
7 - Tape input.

CONNECTION

Up until now, TEC add-on's have been connected via the expansion port. We wished to avoid this as there are too many devices cluttering up this area already. The search was on for a better place to put our new board. We decided upon the blank area left of the eprom, because it is common to all TEC's and has up until now not been used by anything else.

But there's nothing to connect to there! I hear you say. Well not quite, Simply solder a cut-up I.C. socket onto the links and you have an (almost) instant data buss socket. The DAT BOARD has a set of feed downs that push into the sockets and serve the dual purposes of connection and fixation.

PARTS LIST

1 - 100R
1 - 470R
4 - 10k
1 - 10k mini trimpot

1 - 100p ceramic
2 - 10n greencaps
3 - 100n greencaps

1 - BC 547
1 - 74LS373
1 - 74LS74

1 - 5mm LED (for trimpot handle)
2 - 3.5mm sockets
1 - 20 pin IC socket
2 - 14 pin sockets (one to cut-up)
1 - 20cm 12 way ribbon cable
1 - 50cm figure-8 shielded cable
1 - 1.2 metres hook-up wire
4 - 3.5mm mono plugs
1 - 100cm tinned copper wire
1 - Female matrix connector
3 - 32mm x 2.5mm bolts
9 - 2.5mm nuts
1 - 16 character x 2 line LCD*
1 - DAT PC Board
*Don't Forget: The LCD display can be bought separately.

The feed downs are simply lengths of stiff wire soldered to the underside of the P.C. that extend about 1 to 1.5 cm down to push into the I.C. sockets.
The fixing of the DAT BOARD is also aided by three "stand offs," in the form of three bolts with nuts to tighten against the board. These may extend through the TEC board if you want as there is no track work underneath.

CONSTRUCTING THE DAT BOARD

Originally, the kit of parts for the DAT BOARD was going to be supplied in two sections. We have changed our minds since, but have decided to present these construction notes unchanged. The first thing to do, is to fit ALL the links, regardless of what section you are constructing.
If you have already built the TAPE and keyboard section and/or are now constructing the LCD/SINGLE STEPPER interfaces then skip ahead to the respective notes. Once you have built the LCD section skip back to the notes on inserting the feed downs, stand-offs and control buss leads.

THE TAPE AND LATCH SECTION

Most the components for the TAPE SECTION are fitted on the bottom left corner of the board. The exceptions being a 100n greencap, that goes on the middle left of the board, the latch chip and its socket. Fit these in the order you prefer and then solder a short piece of tinned copper wire in the hole marked "SP."
This is where the female matrix connector will slide on. If you are wondering why we recommend a piece of tinned wire instead of a male matrix pin, the reason is that the force needed to push a female over a male matrix pin is far to great to be healthy for the TEC or DAT PCBs. (The keyboard is destructive enough). The tinned wire can be tinned again to give just the right fitting diameter, if required.
After fitting all the components, cut the length of hook-up wire into 4 equal sections. Strip and tin each end of all the lengths. Solder two pieces to the ground strip next to the tape in and tape out pads on the DAT BOARD. The other ends of these wires solder to the top tags of the 3.5mm sockets.
Solder the two remaining wires to the tape in and tape out pads. The other ends are soldered to the DIAGONALLY OPPOSITE tags on the 3.5mm sockets. Keep track of which socket the wires are joined to, and mark them accordingly.
Drill two holes large enough for the 3.5mm sockets in the back or side of the RETEX case and fit the sockets in place.
Strip the ends of the shielded cable and twist the shield into one strand. Remove the covers of the 3.5mm plugs and slide them onto the figure 8 cables, so they are back to back. Solder the shields to the larger tags on the plugs. The middle conductor is soldered to the smaller tags. Do this for each of the four ends.
Solder a 5cm piece of hook-up wire on the 1K resistor which connects the output latch to the speaker transistor. The wire is soldered on the LATCH SIDE of the resistor. The other end of the wire is soldered to the female matrix connector. This matrix connector slides over the pin marked SP on the DAT BOARD.
Now you are ready to insert the feed downs.

INSERTING THE FEED DOWNS

The feed down are made of stiff tinned wire of about 2cm length. The easiest way to solder these is to solder a continuous length in each hole, and then trim it down afterwards. Do this for all the feed downs and try to get them straight as possible.
The feed downs plug in to a cut-up IC socket soldered across the links near the EPROM. The socket is soldered where the links form a straight line as they disappear into the TEC PCB. (See diagram). If you want, you may make the feed downs longer, remove the links, and permanently solder the DAT BOARD in place. Of course, you will need to put jumpers beneath the board to replace the missing links. This arrangement will provide a far more reliable circuit connection. Make sure you have finished the board COMPLETELY before you do this, as you will not be able to solder underneath the board afterwards.

CONNECTION OF THE CONTROL LINES

There are 10 control lines that are soldered to the bottom of the TEC board. A 20 cm 12 way ribbon cable is used to make all the connections. The ribbon cable is soldered to a row of pads on the DAT BOARD about 2.5cm below the top edge. The ribbon cable is soldered to the BOTTOM SIDE of the DAT BOARD and then drops down between the TEC board and the RETEX case (if you have one).
All the connections to the DAT BOARD are printed on the solder side of the board while the connections to the TEC are made as per the wiring diagram.
The two 3.5 mm sockets for the tape in/out are mounted in either the back or side of the RETEX CASE. If you do not have a case, then the sockets can be connected with short pieces of wire and left "floating." We do not recommend that you drill holes in either the TEC or DAT boards for the sockets. This is to save the expensive TEC board from the excessive force involved in plugging and unplugging the leads. The best idea is to hold the sockets when inserting the leads.

THE STAND-OFFs

In addition to the feed downs, three bolts act as stand-offs. The head of these bolts sits on the TEC board or, if you wish, you may drill into the board and feed the bolts up through the board. If you have the original TEC-1 board with the 8212 latch chips, the top bolt will not be able to be feed through the board as there is track work associated with the (now aborted) on-board tape interface and battery backed RAM.
If you have drilled the holes, then feed the bolts up from the bottom of the TEC and lock each in place with a nut. A second nut is screwed down to about 1cm off the TEC board on each bolt. This sets the height of the DAT BOARD. The DAT BOARD is then placed over the two bolts and a third nut is tightened onto the DAT BOARD.
If you to not wish to drill into your TEC, which is quite understandable, then place a nut on each bolt and wind it down to about 1cm from the head. Poke the bolts through the the hole in the DAT BOARD and tighten down the second nut.
Next, insert the board and note how high it is off the TEC. Ideally it should be 1.5 to 2cm off the board. Trim the feed downs until you are happy with the height. Adjust the stand-offs until they all sit neatly on the TEC board. Finally, a blob of blu-tack can be used to secure the top stand-off on to the board. This will help keep the DAT BOARD square on the TEC.

TESTING THE LATCH/TAPE INTERFACE

The latch is easily tested by running up JMON. If the keyboard works then the latch is obviously working. You can test each bit of the latch by taking the remaining inputs to ground. These pins are connected to pins 2,4,6,8 and 12 on the 74C14 socket and also pin 3 of the latch chip itself. Make sure that you don't have the 74C14 fitted as this may damage the chip.
The following program will echo the latch on the LED display:

0900 3E 3F D3 02 DB 03 E6 3F
0908 D3 01 C3 00 09

To test the tape, refer to the pages on using the tape system that show how to use and trouble shoot the tape interface.

THE SINGLE STEPPER/LCD INTERFACES

If you are constructing this section before the tape/latch section, you will need to make a modification to the TEC. The mod is to add a 4k7 resistor between pin 15 of the 4049 and pin 10 of the Z80. The purpose of this mod is to route the DATA AVAILABLE SIGNAL to the DATA BUSS. Without this, JMON is unable to read the keyboard. (This mod is described numerous times throughout this issue). The LCD interface consists of just four components. They are a D flip flop, a 100p cap, a 100R resistor and a 10k trimpot. The D flip flop, (that was spare) is configured to act as an INVERTER!! This design saved us from having to use another chip.
The single stepper interface simply uses one half of a dual D flip flop!

CONSTRUCTION NOTES

These 2 interfaces are simple to construct. Just take care with the orientation of the 74LS74 chip. If you have a spare LED on hand then you can solder it onto the trimpot to use as a knob (one is provided in the kit).

FITTING THE LCD

Place the LCD FACE DOWN on the work bench and feed a 5cm length of tinned copper wire into each hole on the LCD. Solder the wires in place and then, starting at one end, trim the wires to form a ramp. This helps you to insert the 14 wires one-at-a-time into the DAT BOARD. The DAT BOARD edge connector is placed at the top of the DAT BOARD and the LCD overhangs the board like a verandah.
Insert the LCD into the DAT BOARD as best you can. A second person with a pair of tweezers could help tremendously in getting each wire down its hole.
After you have fitted the wires into their holes, position the LCD to the height you want. This should be about 1cm to 1.5cm, and carefully solder it in place.

TESTING THE LCD

After you have finished construction and wired the DAT BOARD to the TEC as shown in the wiring diagram, you're ready to go. Fit the board in place and turn the 10k trimpot clockwise when looking at it from the left. Turn it as far as it goes, then turn it back just slightly. This sets the contrast level and if it is not approximately at the position described above, nothing will appear on the LCD.
If you have JMON then fit it into the EPROM socket and power up the TEC. All things being equal, the display will show the following:

0900>xx xx xx xx
Data xx xx xx xx

If not, the most likely cause is that one of the data lines is not getting to the display. The easiest way to check this is to type in the following:

0900 3E 55 D3 04 C7

AFTER you have entered this, connect a jumper between port 4 and the wait line of the Z80. When you have done this, hit go.
The TEC should go "dead." Now, with a logic probe, test the edge connector of the LCD. Starting from the right, the logic levels should be: H, L, H, L, H, L, H AND L.
If not, then check all the connections and retry until right. If the connections are right, but there is nothing on the display, check the voltage on pin three of the LCD. This voltage should be in the range of 0.5v to 1v. Adjust the trimpot until you measure this voltage.
Still no luck? Turn off the TEC, hold reset down and turn the TEC back on while still holding down the reset. The top row of the LCD should be dark and the bottom line should be light. If not then there maybe no power getting to the LCD, the contrast voltage may be incorrect (but you have already checked this), or the display has been damaged, they are all tested before they leave TE).
If the top line is dark when power is applied but the display does not respond when reset is released, then put your logic probe on pin 6 of the LCD. Hold down the "+" key and watch the logic probe. Pin three should pulse HIGH each time the TEC beeps. If not then check that you have the wire going to port 4 in the correct place. Check the track work around the 74LS74 chip and the chip itself.
If pin 6 seems ok, then check that the 100p cap is fitted as this is VERY IMPORTANT. Pin 5, the r/w line, should always be pulsing. Check this with the logic probe.
The only other line left to test is the register select (RS). This line is address 7, and the easiest way to check this is with a continuity tester. If the LCD clears when power is applied, but nothing appears on the LCD, then it is odds-on that the cause is address 7 not being wired correctly.

TE REPAIR SERVICE

Still can't get it going? Check it all through again, keep in mind that the most likely cause is a mistake in your wiring. As a VERY last resort (after ringing us) send it in and we'll see what we can do.
Our repair fee is $9.00, plus $2.50 for post and handling. This includes replacement of all parts except the LCD (that was tested before leaving us). Before you send it in, remove the control buss wires (the ribbon cable) from the DAT BOARD. Pack it up securely and send it down. If you want the tape section tested leave the 3.5mm sockets connected.

TESTING THE SINGLE STEPPER

This is easy. With JMON fitted, enter this at 0900:

0900: 00 00 00 00 00 C3 00 09

Now, press shift 2. The single stepper will show 0900 PC. Press any data key and the single stepper will cycle automatically. The occasional clicking you (may) hear is a result of the interaction of the interrupt response cycle and the decoding of the 74LS138 decoder chip.
If the single stepper doesn't work, then check your wiring as it is doubtful that the 74LS74 chip is faulty.

WHAT THE LCD INTERFACE DOES

The LCD is designed to directly interface to microprocessors. Unfortunately there are two main types of microprocessor buss timing and the LCD is designed for the wrong type (as far as we are concerned). In order to get the LCD to interface to the Z80, a little bit of juggling with the timing is needed.
The first problem is the the LCD requires an active HIGH Enable signal. This has been achieved by inverting the PORT 4 I/O select line. This inverting is done by the spare D flip flop on the DAT BOARD. By looking at the TRUTH TABLE for the 74LS74, I found that it was possible to configure it as an inverter if I used the CLR pin as the DATA input!
To cut a long story short, the idea worked. Eureka!
The next problem is the LCD requires R/W to be stable on the falling edge of the E signal. If you look at the Z80 timing, you will see that the R/W line and the IORQ change state simultaneously. By the time that IORQ has gated port 4 and the port 4 signal has been inverted, the R/W line will actually change (slightly) before the E line on the LCD!
To overcome this problem, a simple RC network has been placed on the R/W line. This RC delay holds the R/W line stable while the E line goes low. The time we are talking about here is just a fraction of a microsecond, but that is all it takes for the chips in the LCD to accept or reject the in-coming signals.
Another problem is that the LCD requires 2 ports to communicate with the Z80. It also wants to decode the second port itself. This is a common requirement of many peripheral devices, and the solution provided here is also useful for all these.
To give the LCD its second port, and let it decode it for itself, address line 7 has been presented to the LCD. This means that the second port is decoded (by the LCD) on port 84.

DISPLAY CONTRAST

The LCD requires an external voltage to set the contrast level.
The contrast of LCDs varies with temperature and viewing angle. To allow for this, the LCD has an external contrast control. The contrast is controlled by adjusting the voltage on this pin. This is the function of the 10k trimpot, that is wired as a voltage divider.

OPTIONS

Several optional extras can be added to the DAT BOARD. Below is a description of each:

MON SELECT SWITCH

When you add the DAT BOARD, there may not be enough room between the board and the EPROM to fit your MON select switch. If this is the case, provision has been made to fit the switch to the DAT BOARD. Simply install the dotted link and move your switch to the dotted switch position on the DAT BOARD. Run a wire between the pin marked 'ROM P21' and pin 21 of the EPROM.

SERIAL INPUT

The SERIAL INPUT (SI)
This input is for a serial signal, or a RS232 level signal from a printer or RS232 device. This input clips the signal, which can be +/-15V to +/-25V, to safe logic levels.
This signal winds up as D0 on the 74LS373.

THE 74C14

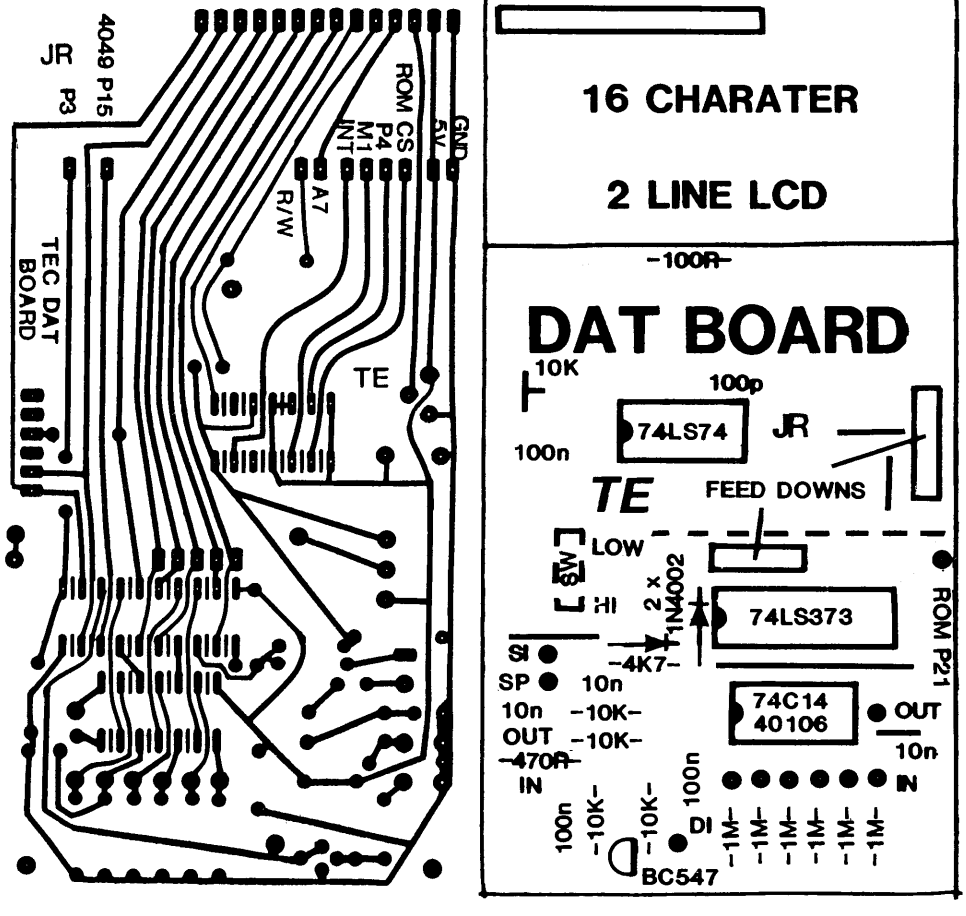
This has been added to increase the versatility of the DAT BOARD. Some possibilities for it include a touch sensitive qwerty key pad, an external time reference, a thermistor controlled oscillator for temperature measurement or just buffered inputs. Nothing permanent has been planned for it, it is mainly for experimentation. We are open to your ideas!

THE DIRECT CONNECT PIN

This is located between the transistor and the 6 x 1M resistors. The purpose of this pin is to allow direct connection between two TECs. One TEC can down load to another through the tape software or a serial communication program. (I have a 9600 Baud routine that also talks to IBM's and compatibles).

THE UNUSED INVERTER

The input for the unused inverter is the right most matrix pin on the bottom right-hand side of the DAT BOARD. The output is the matrix pin directly above it.

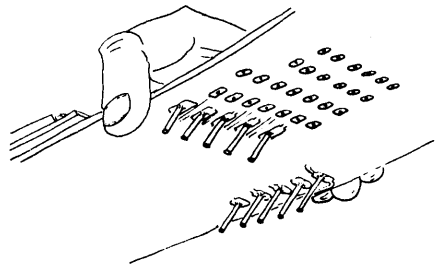


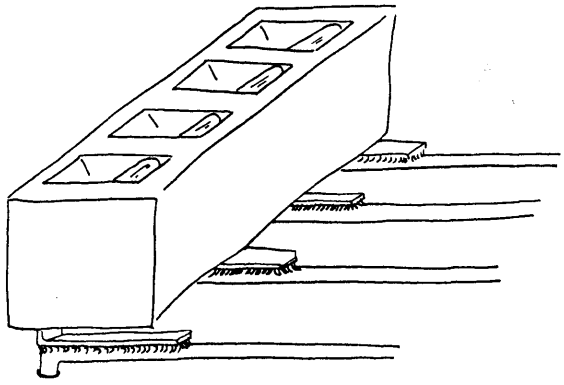
HOW THE TAPE CIRCUIT WORKS

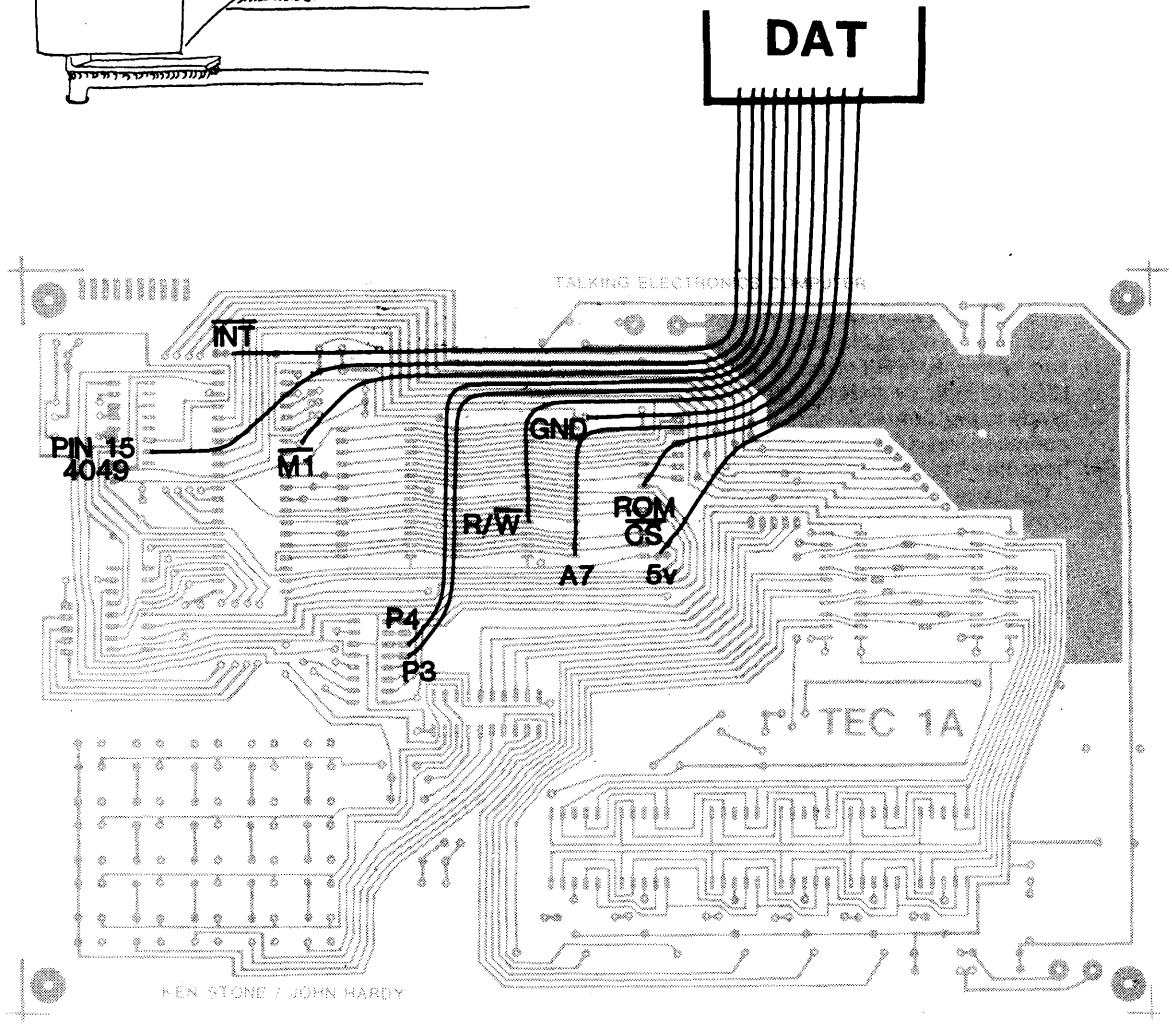
There's not much to describe about the tape circuit as all the hard work is done by software. The output section consists basically of an AC coupled LOW PASS filter with some attenuation on the end to prevent the digital level voltage from over driving the cassette players input.
The input section is just a simple AC coupled common emitter transistor amplifier with the base heavily biased on. The bias on the transistor is important as this ensures that the software is able to read a steady logic 0 when no (AC) input is present.

HOW THE SINGLE STEPPER INTERFACE WORKS

The single stepper INTERFACE works by interrupting the Z80 after each instruction. The interrupts are generated from a D flip flop on the DAT BOARD. Each time the Z80 fetches the first byte of an instruction a special signal called M1 is generated. This M1 is used to clock the ROM CS line into the D flip flop. The Q-bar output of the flip flop is connected to the INTerrupt pin. This means that an interrupt will be requested on every instruction fetch unless the instruction was fetched from the MONitor ROM.
It is important to prevent interrupts while executing in the MONitor ROM. If we don't, then an interrupt will occur just after it is re-enabled, at the end of the stepper routine. Immediately following the EI (enable interrupt), is a RETurn. If an interrupt occurs on this RETurn, then the stepper routine is re-invoked and each time this RETurn is reached, the program loops back to the stepper routine forever!! (If it wasn't for this problem we would not require any external hardware at all).







TOP RIGHT

Bottom side of the DAT board with the feed-downs fitted.

TOP LEFT

Diagram showing how the cut-up IC socket is mounted on the links.

LEFT

Wiring diagram showing where the "flying leads" from the underside of the DAT board are connected to the TEC.
Note that the diagram DOES NOT show the wires leaving the DAT board in the correct order, only the correct places on the TEC board. Use the labels on the underside of the DAT board for the correct DAT wiring positions.

THE LIQUID CRYSTAL DISPLAY

by Jim.

INSIDE THE DISPLAY

The display has three internal registers though which all communication is done. These are the registers:

THE DATA REGISTER

The data register is a read or write register to which all DISPLAY DATA (in ASCII format) and BIT MAPPED PROGRAMMABLE CHARACTERS are sent. This DATA register acts as a TEMPORARY BUFFER between the internal DISPLAY RAM or CHARACTER GENERATOR RAM (both described below) and the host computer (our TEC).

Characters may also be read from this register.

Internal operations transfer data between this register and the internal RAM (or between RAM and this register). This register is located on port 84H.

THE INSTRUCTION (or CONTROL) REGISTER

The instruction register receives all instruction bytes. ALL bytes sent to this register will be interpreted as CONTROL by the LCD. This is a WRITE ONLY register and is decoded on port 04.

THE ADDRESS COUNTER/BUSY FLAG

Bit 7 of this register is used as the busy flag. After EVERY operation it goes HIGH to indicate that the display is not ready to perform ANY type of additional operation yet. As soon as the display becomes "on line" again, it will go LOW.

The lower 7 bits are the current address of the internal cursor. All read or write operations occur between the data register and the address held in this register.

This register is READ ONLY. (The ADDRESS COUNTER is set or altered by instructions sent to the INSTRUCTION REGISTER and then transferred into THE ADDRESS REGISTER by an INTERNAL operation). This register is located on port 04 with the control register. Internal decoding gates the R/W line to select between each register.

As well as the registers, the display contains both RAM and ROM. Below is a description of the internal memory inside the LCD.

THE DISPLAY RAM

All the display information sent to the DATA REGISTER is transferred into the DISPLAY RAM by an internal operation. This RAM can hold 80 bytes of display information. While the LCD may only display 32 characters at a time, the extra bytes allow for the display to be shifted or can serve as general purpose storage RAM. An unusual feature of the display RAM is that the address from the last location on the top line (27H) to the address on the bottom line (40H) IS NOT CONSECUTIVE.

THE CHARACTER GENERATOR ROM

This ROM contains 192 different 5x7 dot matrix characters. These include full upper and lower case Alphabet characters, numbers, maths symbols, Greek and Japanese characters.

All of the most used characters are here. Any type of character we need that is not there, can be made up on the CHARACTER GENERATOR RAM.

THE CHARACTER GENERATOR RAM

The CHARACTER GENERATOR RAM allows us to define up to 8 different characters of our choice. The format of each is a 5x8 dot matrix with the cursor making up the 8th row. Any or all can be displayed together on different parts of the LCD and also may appear in several places at once. We can use this to make games characters.

GETTING SOMETHING ON THE LCD

Using the LCD is easy because it contains its own "intelligent" chips which do all the hard work for us. From JMON, putting anything on the LCD is VERY easy because the LCD has been set-up by JMON.

JMON sets the LCD to shift the cursor right after each entry. You cannot see the cursor as it has been turned off by the software in JMON.

To aid with the experiments below, put FF at 0821 (the LCD will stop changing after the first F) and AA at 08FF. These disable the LCD from the MONitor (the FF at 0821) and stop the MONitor rebooting its variables on a reset (the AA at 08FF). The MONitor will reset to 0A00 to remind you that the variables have not be re- booted on reset. (Unless a key was held down while reset was pushed, in which case you must again put FF at 0821 and AA at 08FF).

Ok, lets start by putting the letter L on the screen.

Firstly we must clear the screen and send the cursor home. This may be done by one instruction - 01. We output this to the control register on port 04. Before we can output to the LCD we must wait until it is ready. Because this is required to be done frequently, the RST 30 instruction has been used to do this for us. The RST 30 reads the LCD busy flag and loops until it goes LOW.

Ok lets type this in:

```
0A00  F7      RST 30
0A01  3E 01   LD A,01
0A03  D3 04   OUT (04),A
0A05  76      HALT

Reset, Go
```

The display will go blank and the (invisible) cursor will return to home (top left-hand corner). The 01 instruction sets all the display RAM locations to 20H (space). The 01 instruction doesn't affect any previous mode setting or display options (discussed below).

Now enter this with the RST over the HALT at 0A05:

```
0A05  F7      RST 30
0A06  3E 4C   LD A,4C "(L)"
0A08  D3 84   OUT (84),A
0A0A  76      HALT

Reset, Go
```

The letter L appears in the top left corner.

Ok, now as before, put this in with the RST over the HALT:

```
0A0A  F7      RST 30
0A0B  3E 43   LD A,43 "(C)"
0A0D  D3 84   OUT (84),A
0A0F  F7      RST 30
0A10  3E 44   LD A,44 "(D)"
0A12  D3 84   OUT (84),A
0A14  76      HALT

Reset, Go
```

The above section outputs two more bytes to the DATA REGISTER.

Until now we have just been using a simple method to output data. This has shown us the basic way to talk to the LCD. Now that we have come this far and learned the basics, we'll advance to something more useful.

The code below will output a word onto the bottom line of the LCD. The display DATA will be held in a table at 0B00.

```
0A14  F7        RST 30
0A15  3E C0     LD A,C0
0A17  D3 04     OUT (04),A
0A19  01 84 06  LD BC,0684
0A1C  21 00 0B  LD HL,0B00
0A1F  F7        RST 30
0A20  ED A3     OUTI
0A22  20 FB     JRNZ 0A1F
0A24  76        HALT

0B00 4D 41 53 54 45 52
```

To set the cursor to the bottom line we output 80 to the instruction register (bit 7 sets the cursor address entry) + 40 (which is the actual address of bottom left display) = C0.

The OUTI instruction is new to our repertoire. It's operation is to output the byte addressed by HL to the port addressed by C. HL is then incremented and B is decremented. If B becomes ZERO the ZERO FLAG is set and the operation is complete. This instruction can output up to 256 bytes at a time.

Because we need to check the busy flag we loop back to the RST 30 until all the bytes have been done. If we didn't need to check the busy flag we could have used the OTIR instruction which automatically repeats itself until B=0.

All the above is done with the cursor switched off. For the next section we want to have the cursor on. To switch on the cursor output 0E to the instruction register on port 04.

```
0A00  F7        RST 30
0A01  3E 0E     LD A,0E
0A03  D3 04     OUT (04),A
0A05  76        HALT
0A06  C7        RST 00
```

Now let's see what does what on the display.

Using the above routine, output the bytes below one at a time, to port 04 and HALT between each. (leave what's on the display there).

Check the function of each on the table of controls.

```
18 1C 1C 1C 02 14
14 10 0C 0F 08 0C
```

Good luck!!

SETTING THE ENTRY MODE

The display may be configured to perform several different functions UPON EACH DATA BYTE ENTRY. They are:

1 INCREMENT CURSOR ADDRESS after storing inputted data byte (06H). This is our normal mode.

2 DECREMENT CURSOR ADDRESS after storing input (04).

3 SHIFT THE DISPLAY RIGHT after entry (05).

4 SHIFT THE DISPLAY LEFT after entry (07).

Each mode is selected by outputting the byte shown to port 04.

Once the entry mode is set it IS ONLY CHANGED BY ANOTHER ENTRY MODE SET COMMAND. None of the other control bytes will alter the entry mode.

The shift on entry feature (05,07) has been found to be difficult to use and even appears to contain design bugs.

You may experiment with it but we won't be using it in these notes.

The CURSOR DECREMENT may come in handy sometimes but it's more likely to be useful to processors which move blocks of data around in a more limited way to the Z80.

RUNNING WORDS ON THE LCD

Running words along the LCD is also simple because the LCD'S intelligent chips do most the work for us again. Our job is to enter the words we want to scroll (up to 16 characters per line for this routine) and send shift commands each time we want a shift.

The routine below is entered in 3 sections. Each section is a logical progression and increases the programs abilities. You can look at the instructions in each section and compare it to what the section does. This way you can learn how to put blocks together to use the display any way you want. Before entering the code below put FF at 0821 and AA at 08FF as described before.

Enter this and INCLUDE the NOPS and the table at 0B00 then run it:

```
0A00  3E 01     LD A,01
0A02  D3 04     OUT (04),A
0A04  F7        RST 30
0A05  3E 06     LD A,06
0A07  D3 04     OUT (04),A
0A09  F7        RST 30
0A0A  3E 0C     LD A,0C
0A0C  D3 04     OUT (04),A
0A0E  F7        RST 30
0A0F  00        NOP
0A10  00        NOP
0A11  00        NOP
0A12  00        NOP
0A13  00        NOP
0A14  01 84 10  LD BC,1084
0A17  21 00 0B  LD HL,0B00
0A1A  F7        RST 30
0A1C  ED A3     OUTI
0A1D  20 FB     JRNZ 0A1A
0A1F  F7        RST 30
0A20  3E C0     LD A,C0
0A22  D3 04     OUT (04),A
0A24  F7        RST 30
0A25  21 30 0B  LD HL,0B30
0A28  06 10     LD B,10
0A2A  F7        RST 30
0A2B  ED A3     OUTI
0A2D  20 FB     JRNZ 0A2A
0A2F  76        HALT

0B00: 54 41 4C 4B 49 4E 47 20
0B08: 20 20 20 20 20 20 20 20
      (TALKING)
0B30: 45 4C 45 43 54 52 4F 4E
0B38: 49 43 53 20 20 20 20 20
      (ELECTRONICS)
```

This will put "TALKING" on the top line and "ELECTRONICS" on the bottom line of the LCD and stop. Study the above section and see if you can work out the role of each instruction.

Now we'll add the shift section. Enter this with the first "NOP" over the last "HALT" and run it:

```
0A2F  00        NOP
0A30  00        NOP
0A31  3E 18     LD A,18
0A33  D3 04     OUT (04),A
0A35  01 00 60  LD BC,6000
0A38  0B        DEC BC
0A39  78        LD A,B
0A3A  B1        OR C
0A3B  20 FB     JRNZ 0A38
0A3D  18 F2     JR 0A31
```

The above code loads the shift instruction (18H) into the accumulator and outputs it to the control register on port 04.

As you can see it shifts the display, but this method is not very good if we want to shift only a few characters as we must wait for them to be shifted through the entire display RAM before they re-appear. To overcome this we can count the number of shifts and reset the display with a 02 command, as soon as all the letters have been shifted outside the display. The 02 instruction resets the display from shift WITHOUT CHANGING the contents of the DISPLAY RAM, CHARACTER GENERATOR RAM, or the CONTROL MODE. Because we would like the words to shift across the entire display and re-appear as soon as they have all gone, we must load the words just outside the screen to the right. The following additions make the words start shifting into the display from right-to-left.

Ok, Now enter the following, AT THE ADDRESSES SHOWN:

```
0A0F  3E 90     LD A,90
0A11  D3 04     OUT (04),A
0A13  F7        RST 30
----------------------
0A22  3E D0     LD A,D0
```

The above instructions set the DISPLAY RAM ADDRESSES to the RAM locations just right of the screen. The address of the top line is 90 and the address of the bottom line is D0. (Actually

these are the addresses + 80H, the SET ADDRESS instruction).

```
0A2F  16 1B        LD D, 1B
```

(The D register is our shift counter).

```
0A3D  00           NOP
0A3E  00           NOP
0A3F  15           DEC D
0A40  20 EF        JRNZ 0A31
0A42  3E 02        LD A,02
0A44  D3 04        OUT (04),A
0A46  F7           RST 30
0A47  18 E6        JR 0A2F
```

The last group makes up the shift counter and resets the display when the counter reaches Zero. When the 02 command is received by the LCD the display is returned to its NORMAL position. This means that the inputted data is returned to WHERE IT WAS ENTERED (just right of the screen). Now, when the next shift command is received, the letters start to shift left back on to the screen.

QUESTION:
Why don't we need to wait for the BUSY flag to go low after the shift instruction?

If you wish to change the number of characters to be shifted, you may do so by putting your new characters at 0B00 for the top line +and at 0B30 for the bottom line. Unused locations should have 20 (space) inserted until 16 locations are filled. (From 0B00 to 0B10 and from 0B30 to 0B40). The value of the loop counter loaded into D at 0A2F should also be changed. The value of the loop counter is best set to 10H + the number of letters occurring in the longest line.

e.g. For the the example above:
ELECTRONICS = 11 (0BH) Letters.

So add 0BH + 10H = 1BH.
So 1BH is loaded into D at 0A2F.
To understand the above formula better, try 1C and 1A and see the result.

FINAL NOTES

The slow response of the LCD detracts from the effectiveness of the shifting a little but by experimenting with the delay at 0A35 you should be able to get a good compromise between speed and display clarity.

The above shifting method is just one of dozens of ways we could have used. A more complex program could shift information across and out one end and load new information in the other to create a running information display.

Use the blocks in this program and the others to make up your own display routines. If you come up with something interesting, write in. We would love to see what you've come up with.

DESIGNING YOUR OWN CHARACTERS

You can have up to eight different characters stored in a character-generator RAM. Each character is displayed on the screen when it is addressed in the display RAM. The addresses are between 0-7. The user-defined characters are made up of an 8x8 matrix (only 5 columns are displayed, the cursor makes up the 8th row.)

To set up a character, 8 bytes are outputted to the character- generator RAM. The first byte makes up the top row (only the 5 lower bits are displayed). The second byte makes up the second row etc.

Before sending the 8x8 character (actually a 5x8 character), the entry mode must be set (if not already) to address-increment with no display shift (06) and a set character RAM address operation must be done.

The control byte for this is 40 + the address of the first byte of each character-matrix. E.g: 40, 48, 50 for characters 1, 2, 3 etc.

Once a character is set up, it is displayed by placing its address in the DISPLAY DATA RAM. Before doing this the DISPLAY RAM must be selected via 80 + address.

OK, let's put our own character on the LCD.

```
0A00  F7           RST 30
0A01  3E 01        LD A,01
0A03  D3 04        OUT (04),A
0A05  F7           RST 30
0A06  3E 40        LD A,40
0A08  D3 04        OUT (04),A
0A0A  01 84 08     LD BC,0884
0A0D  21 00 0B     LD HL,0B00
0A10  F7           RST 30
0A11  ED A3        OUTI
0A13  20 FB        JRNZ 0A10
0A15  F7           RST 30
0A16  3E 80        LD A,80
0A18  D3 04        OUT (04),A
0A1A  F7           RST 30
0A1B  3E 00        LD A,00
0A1D  D3 84        OUT (84),A
0A1F  76           HALT

0B00:

11, 0A, 04, 11, 0A, 04, 11, 0A
```

Experiment with the values in the table and see how it all goes together. By increasing the value loaded into B, to 10(hex) (at 0A0C) a second character may be programmed at the same time. The table for the second character will start at 0B08. This will be displayed when a 01 is written into the DATA DISPLAY REGISTER. Experiment and see if you can get 8 characters appearing in several places at once on the display.

MYSTERY EFFECT

The routine below produces a very interesting effect. It uses the PROGRAMMABLE CHARACTER GENERATOR to produce 8 different characters some of which are displayed several times. We won't tell you the effect, we'll let you type it in and see for yourself. You won't be disappointed!

The program consolidates much of what we have learned about "driving" the LCD. If you experiment further and add a shift to it then it will be a complete revision of what we have covered in these pages.

Now that you know how to use the LCD, start writing some programs that use it. If you come up with something interesting don't hesitate to send it in to TE. We would be very interested in some simple animation or an adventure game or anything that others would be interested in seeing. Go to it!

```
0A00  F7           RST 30
0A01  3E 01        LD A,01
0A03  D3 04        OUT (04),A
0A05  F7           RST 30
0A07  3E 06        LD A,06
0A08  D3 04        OUT 04
0A0A  21 00 0B     LD HL,0B00
0A0D  01 84 10     LD BC,1084
0A10  F7           RST 30
0A11  ED A3        OUTI
0A13  20 FB        JRNZ 0A10
0A15  F7           RST 30
0A16  3E 40        LD A,40
0A18  D3 04        OUT (04),A
0A1A  21 20 0B     LD HL,0B20
0A1D  06 40        LD B,40
0A1F  F7           RST 30
0A20  ED A3        OUTI
0A22  20 FB        JRNZ 0A1F
0A24  F7           RST 30
0A25  3E C0        LD A,C0
0A27  D3 04        OUT (04),A
0A29  21 10 0B     LD HL,0B10
0A2C  06 10        LD B,10
0A3E  F7           RST 30
0A3F  ED A3        OUTI
0A31  20 FB        JRNZ 0A3E
0A33  76           HALT

0B00: 20 4D 49 52 52 4F 52 20
0B08: 49 4D 41 47 45 21 20 20
0B10: 20 00 01 02 02 03 02 20
0B18: 01 00 04 05 06 07 20 20
0B20: 00 11 11 11 15 15 1B 11
0B28: 00 0E 04 04 04 04 04 0E
0B30: 00 11 12 14 1E 11 11 1E
0B38: 00 0E 11 11 11 11 11 0E
0B40: 00 11 11 1F 11 11 11 0E
0B48: 00 0F 11 11 17 10 11 0E
0B50: 00 1F 10 10 1E 10 10 1F
0B58: 00 04 00 00 04 04 04 04
```

CONCLUSION

This concludes this issues instalment on the LCD.

Study the previous notes carefully and get to know the LCD fully. There is enough information here for you to write routines using the LCD and we would like to see some ideas sent to us for issue 16.

The LCD will be supported further in issue 16 and if all goes well, we will have a cheap, full alpha-numeric keyboard with supporting software. I am working towards the stage were you can anotate your routines and send the text and the routine in on tape. We can then load them into our desk top publisher.

Don't forget if you have any good ideas or questions about the TEC, send them in to "TEC TALK."

Below is the table of LCD control bytes. Use these in conjunction with the previous notes

Instruction	Code										Function	Execution time
	RS	R/W	DB_7	DB_6	DB_5	DB_4	DB_3	DB_2	DB_1	DB_0		
(1) Display clear	0	0	0	0	0	0	0	0	0	1	Clears all display and returns cursor to home position (address 0)	1.64 ms
(2) Cursor Home	0	0	0	0	0	0	0	0	1	*	Returns cursor to home position. Shifted display returns to home position and DD RAM contents do not change.	1.64 ms
(3) Entry Mode Set	0	0	0	0	0	0	0	1	I/D	S	Sets direction of cursor movement and whether display will be shifted when data is written or read	40 µs
(4) Display ON / OFF control	0	0	0	0	0	0	1	D	C	B	Turns ON/OFF total display (D) and cursor (C), and makes cursor position column start blinking (B)	40 µs
(5) Cursor/Display Shift	0	0	0	0	0	1	S/C	R/L	*	*	Moves cursor and shifts display without changing DD RAM contents	40 µs
(6) Function Set	0	0	0	0	1	DL	1	*	*	*	Sets interface data length (DL)	40 µs
(7) CG RAM Address Set	0	0	0	1	A_{CG}						Sets CG RAM address to start transmitting or receiving CG RAM data	40 µs
(8) DD RAM Address Set	0	0	1	A_{DD}							Sets DD RAM address to start transmitting or receiving DD RAM data	40 µs
(9) BF/Address Read	0	1	BF	AC							Reads BF indicating module in internal operation and AC contents (used for both CG RAM and DD RAM)	0 µs
(10) Data Write to CG RAM or DD RAM	1	0	Write Data								Writes data into DD RAM or CG RAM	40 µs
(11) Data Read from CG RAM or DD RAM	1	1	Read Data								Reads data from DD RAM or CG RAM	40 µs

* : Invalid bit
A_{CG} : CG RAM address
A_{DD} : DD RAM address

I/D = 1 : Increment
I/D = 0 : Decrement

S = 1 : Display shift
S = 0 : No display shift

D = 1 : Display ON
D = 0 : Display OFF

C = 1 : Cursor ON
C = 0 : Cursor OFF

B = 1 : Blink ON
B = 0 : Blink OFF

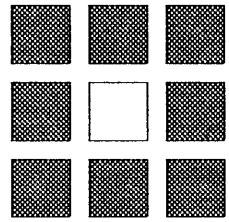
S/C = 1 : Display shift
S/C = 0 : Cursor movement

R/L = 1 : Right shift
R/L = 0 : Left shift

DL = 1 : 8 bits
DL = 0 : 4 bits

BF = 1 : Internal operation in progress
BF = 0 : Instruction can be accepted

MAGIC SQUARE



by Jim Robertson

This is a fun game for the 8x8 that will have you amused and frustrated for hours.
The object is to light up the outside square of the 8x8. The game is made up of three 2x2 boxes of LEDs with a space between each. This makes full use of the 8x8 to display a playing field that is actually 3x3.
Nine keys are used to play the game and each key corresponds to a group of LEDs on the display.

TO SET UP

This game, like JMON, requires EITHER a 4k7 resistor between the NM1 (pin 17 of the Z-80) and D6 (Pin 10 of the Z-80) OR the LCD expansion board with the input chip fitted on port 3.
The 8x8 is fitted to ports 5 and 6 with the port select strobe of the left-hand latch going to port 6.
This is very important! (once you master the game, try swapping them over, this will invert the playing field and gives you a mirror image to work with).
The 8x8 is placed with the LEDs above the latch chips.
It is important to fit the 8x8 before typing in the code or at least hold down the reset if you have already entered the code, by using your third hand.
MAGIC SQUARE has been written to run with the TEC crystal oscillator however it will work with the 4049 oscillator but the tones will be lower pitched.

TO PLAY

Type in the code and save it if you have a tape system. Now address 0C00 and press GO. The code is placed at 0C00 to allow Simon and Magic Square to be saved, loaded and played together (however they do not require each other). (Unfortunately Simon has been held over to issue 16 because of the shortage of space in this issue).
After starting the game, a random pattern appears. By pressing the game keys, the playing field will change. Each key has a particular effect that remains constant throughout the game. The effects of each key is for you to work out!
The keys used for the game are: 4, 5, 6, 8, 9, A, C, D and E.
As you can see, these make up a 3x3 box pattern on the keyboard.
Go to it! The object of the game is to light up the outside border with the centre OFF.
A fair point to add is that it is always possible to do this regardless of the starting pattern - believe it or not!
When (if!) you finally succeed, your effort will be greeted enthusiastically on the 8x8. The game may be re-started by hitting the GO key.

HOW THE SOFTWARE WORKS

Three random numbers are generated from the time it takes to release the GO key and also from the refresh register.
The three lowest bits of these three bytes are used to form a 3x3 matrix. The top 5 bits are ignored.
All processing, pattern changing and testing is done on this 3x3 matrix. After processing, this matrix is converted to its equivalent 8x8 display and then scanned. A loop is used to scan the 8x8 and read the keyboard until a key is detected.
When any key is detected for the first time, a flag byte remembers this and the program will ignore any subsequent pushes.
This allows each key to be processed just once. When no key is pressed, the flag is cleared to allow the next key to be processed.
When a key is pressed and allowed as a "FIRST KEY" press, it is checked for a corresponding table entry. If no corresponding value is found, the key is ignored. This is how the unwanted keys are masked.
After a key has been validated a table entry 9 bytes higher is accessed. This entry is a byte that will be exclusive-ORed with the first byte of the 3x3 matrix.
A second byte 9 bytes higher again contains the low order byte of the address of the 3x3 matrix entry. The first byte is now EX-ORed with the matrix byte and the result stored as the new updated matrix byte. This is how the patterns are changed.
The above process is repeated for the second and third matrix bytes. The exact same process described above is used. The entry for the second byte is 9 bytes higher than the first and the address 9 higher again.
The same convention is used for the third entry. This convention allows a loop to be used for all three matrix bytes. This loop is located at 0C49.
After the above process, the 3x3 is checked for the required box pattern. If correct, the pattern is converted to its 8x8 format and flashed with accompanying tones.
If the pattern is not complete, the program loops back to the main playing loop.
A routine at 0CAB converts the 3x3 to 8x8 display format. This routine is called after all the required processing has been performed on the 3x3 matrix. This routine is a loop that gets each 3x3 matrix byte, calls another routine to convert each matrix bit to two 8x8 bits and spacing, then stores the result twice and adds a blank line.
The last blank line is ignored by the scan routine and the result is an 8x8 format.
At 0CC4 a loop converts one bit to two and adds spacing. This is done by shifting the matrix bit into the carry and if the carry is clear, the two 8x8 bits are left clear and shifted twice for the 2x2 box bits and once for the space between.
If the carry is set, the 2x2 box bits are set by rotating the SET CARRY into the 8x8 byte and also setting bit 7 before rotating. This will then set the carry after the first rotation, ready for the second rotation. The third rotation clears the space bit. After this is done three times, the 8x8 byte is rotated back to remove the last unwanted space before returning.

THE TONE ROUTINE

The tone routine is located at 0CD8. The duration of the tone period is in D while the cycle count is in E. The "KEY PRESS" beep uses this value loaded into DE while other tones such as the restart tone load DE before calling the tone routine.

SCAN ROUTINE

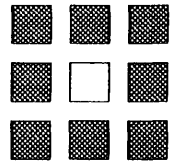
The scan 0CE7 is a straight-forward multiplex routine except that it scans backwards. This allows the 8x8 to be right-way-around while keeping the rest of the program straight forward (otherwise the 8x8 buffer would need to be loaded backwards).

"Magic Square" contains a number of very valuable "building blocks" that can be used in your own programs. It can stand studying for many hours to see how the various operations have been achieved. The fully documented program is presented on the next two pages and you should add your own notes alongside Jim's to help you understand what is happening at each step.

Colin Mitchell.

MAGIC SQUARE PROGRAM

```
        0C00  11 00 00  LD DE,0000    Random number generated
        0C03  13        INC DE        by the duration it takes the player to release the key at the start of the
        0C04  DB 03     IN A,(03)     program.
        0C06  CB 77     BIT 6,A
        0C08  28 F9     JR Z,0C03
        0C0A  ED 5F     LD A,R        The value of the refresh register is loaded into the accumulator.
        0C0C  82        ADD A,D       D register is added to the accumulator and stored as the first value.
        0C0D  32 40 0D  LD (0D40),A   E register is added (with carry) and stored as the second value.
        0C10  8B        ADC A,E       Registers are added to the accumulator and shifted to produce the
        0C11  32 41 0D  LD (0D41),A   third random number. This is also stored.
        0C14  82        ADD A,D
        0C15  83        ADD A,E
        0C16  07        RLCA
        0C17  32 42 0D  LD (0D42),A
MAIN    0C1A  CD AB 0C  CALL 0CAB     Call 3x3 to 8x8 conversion routine.
PLAYING 0C1D  CD E7 0C  CALL 0CE7     Call scan.
LOOP    0C20  DB 03     IN A,(03)     Test for key press.
        0C22  CB 77     BIT 6,A       If bit 6 on port 7 HIGH then no key is pressed.
KEY     0C24  28 06     JR Z,0C2C     Jump if key pressed otherwise clear "key pressed" flag and loop until
PRESSED 0C26  AF        XOR A         key pressed. Otherwise clear.
        0C27  32 43 0D  LD (0D43),A   "key pressed" flag.
        0C2A  18 F1     JR 0C1D       Loop until key pressed.
        0C2C  3A 43 0D  LD A,(0D43)   Test "first key press" flag.
        0C2F  B7        OR A
        0C30  20 EB     JR NZ,0C1D    Jump if key already pressed, otherwise set key pressed flag
        0C32  3E FF     LD A,FF
        0C34  32 43 0D  LD (0D43),A
        0C37  21 00 0D  LD HL,0D00    HL = base of valid key table.
        0C3A  01 09 00  LD BC,0009    BC = number of valid key entries
        0C3D  DB 00     IN A,(00)     Get input value from encoder chip
        0C3F  E6 1F     AND 1F        mask unwanted bits
        0C41  ED B1     CPIR          block compare with increment.
        0C43  20 D8     JR NZ,0C1D    NZ means no right entry. After all values tested, ignore key.
KEY     0C45  CD D8 0C  CALL 0CD8     Key valid. Call key pressed beep.
VALID   0C48  2B        DEC HL        Decrement HL as CPIR increments it before testing the zero flag.
        0C49  11 09 00  LD DE,0009    DE = table index.
        0C4C  06 03     LD B,(03)     Set B for 3 loops. One for each matrix byte.
        0C4E  19        ADD HL,DE     Get value to EX-OR with matrix.
        0C4F  7E        LD A,(HL)     Save in A.
        0C50  19        ADD HL,DE     Calculate address of low byte of matrix byte and put in HL.
        0C51  E5        PUSH HL       Save for later.
        0C52  6E        LD L,(HL)     Set HL to matrix byte address.
        0C53  AE        XOR (HL)      Toggle bits and store
        0C54  77        LD (HL),A     as updated matrix byte
        0C55  E1        POP HL        Recover HL
        0C56  10 F6     DJNZ,0C4E     Loop for 3 bytes.
        0C58  21 40 0D  LD HL,0D40    Check for box pattern. (HL) = first matrix byte.
        0C5B  7E        LD A,(HL)
        0C5C  E6 07     AND 07        Remove unwanted bits
        0C5E  FE 07     CP 07         and test for 7 (111)
        0C60  20 B8     JR NZ,0C1A    Jump to main playing loop if not 7, otherwise
        0C62  23        INC HL        Test second matrix byte.
        0C63  7E        LD A,(HL)
        0C64  E6 07     AND 07
        0C66  FE 05     CP 05         Test for 5, (101)
        0C68  20 B0     JR NZ,0C1A    Jump if not, otherwise
        0C6A  23        INC HL        do third matrix
        0C6B  7E        LD A,(HL)     byte which should
        0C6C  E6 07     AND 07        be equal
        0C6E  FE 07     CP 07         to 7 (111)
        0C70  20 A8     JR NZ,0C1A    Jump if not box pattern.
PATTERN 0C72  CD AB 0C  CALL 0CAB     Pattern right so call 3x3 to
DONE!   0C75  11 30 00  LD DE,0030    8x8. Load DE with win tone
        0C78  CD DB 0C  CALL 0CDB     and call tone routine.
        0C7B  06 03     LD B,03       Set B for 3 flashes.
        0C7D  C5        PUSH BC       and save count
        0C7E  16 10     LD D,10       D = scan counter
        0C80  CD E7 0C  CALL 0CE7     Call scan.
        0C83  15        DEC D         Loop until D = 0
        0C84  20 FA     JR NZ,0C80
        0C86  AF        XOR A         Clear display.
        0C87  D3 06     OUT (06),A
        0C89  CD D8 0C  CALL 0CD8     Call beep.
        0C8C  01 00 15  LD BC,1500    Load BC with off time
        0C8F  0B        DEC BC        and delay.
```



```
          0C90  78        LD A,B
          0C91  B1        OR C
          0C92  20 FB     JR NZ,0C8F
          0C94  C1        POP BC          Recover flash loop counter
          0C95  10 E6     DJNZ 0C7D       and loop for 3 flashes.
          0C97  CD E7 0C  CALL 0CE7       Call scan.
          0C9A  DB 00     IN A,(00)       and loop continuously
          0C9C  E6 1F     AND 1F          looking for the GO key
          0C9E  FE 12     CP 12           to be pressed.
          0CA0  20 F5     JR NZ,0C97      Jump if GO not pushed.
          0CA2  11 80 00  LD DE,0080      Load DE with restart tone
          0CA5  CD DB 0C  CALL 0CD8       Call tone.
          0CA8  C3 00 0C  JP 0C00         Restart game.
3x3       0CAB  06 03     LD B,03         B = loop counter set for 3 conversions.
to        0CAD  21 40 0D  LD HL,0D40      HL = address of 3x3 matrix.
8x8       0CB0  11 50 0D  LD DE,0D50      DE = 8x8 buffer.
MATRIX    0CB3  C5        PUSH BC         Save loop counter.
TO        0CB4  7E        LD A,(HL)       Get matrix byte.
DISPLAY   0CB5  CD C4 0C  CALL 0CC4       Call 1 to 3 bit conversion.
FORMAT    0CB8  12        LD (DE),A       Save first display
          0CB9  13        INC DE
          0CBA  12        LD (DE),A       byte twice
          0CBB  13        INC DE          and then
          0CBC  AF        XOR A           add
          0CBD  12        LD (DE),A       a blank line
          0CBE  13        INC DE          increment to next display buffer.
          0CBF  23        INC HL          Increment HL to next matrix byte.
          0CC0  C1        POP BC          Recover loop counter.
          0CC1  10 F0     DJNZ 0CB3       Repeat for 3 bytes.
          0CC3  C9        RET             done.
1 TO 3 BIT 0CC4 01 00 03  LD BC,0300      B = 3 loops. C is cleared ready to receiver display byte.
CONVER-   0CC7  0F        RRCA            Rotate matrix byte to set or clear carry.
SION      0CC8  30 02     JR NC,0CCC      Jump NC to shift C 3 places
          0CCA  CB F9     SET 7,C         else set bits 1 and 2 of C with SET CARRY and
          0CCC  CB 11     RL C            bit 7
          0CCE  CB 11     RL C            rotate C left
          0CD0  CB 11     RL C            Last rotation inserts space
          0CD2  10 F3     DJNZ 0CC7       do for 3 loops
          0CD4  CB 19     RR C            remove last space
          0CD6  79        LD A,C          place result in A.
          0CD7  C9        RET             done.
BEEP      0CD8  11 50 50  LD DE,5050      D= period  E = loop counter
          0CDB  AF        XOR A           Clear A.
TONE      0CDC  D3 01     OUT (01),A      Sound out to speaker.
          0CDE  42        LD B,D          Delay for tone
          0CDF  10 FE     DJNZ 0CDF       period.
          0CE1  EE 80     XOR 80          Toggle bit 7,A (speaker bit)
          0CE3  1D        DEC E           Decrement loop counter.
          0CE4  20 F6     JR NZ,0CDC      Loop until zero.
          0CE6  C9        RET             Done.
SCAN      0CE7  21 57 0D  LD HL,0D57      HL = end of 8x8 buffer.
          0CEA  06 80     LD B,80         B = scan bit output byte.
          0CEC  7E        LD A,(HL)       Output first display
          0CED  D3 05     OUT (05),A      byte to port 5
          0CEF  78        LD A,B          then output scan bit
          0CF0  D3 06     OUT (06),A      to port 6.
          0CF2  06 40     LD B,40         short multiplex
          0CF4  10 FE     DJNZ 0CF4       display delay
          0CF6  2B        DEC HL          Decrement HL to next display byte
          0CF7  47        LD B,A          replace scan bit in B.
          0CF8  AF        XOR A           clear accumulator and
          0CF9  D3 06     OUT (06),A      output to port 6.
          0CFB  CB 08     RRC B           Shift scan bit loop until scan bit
          0CFD  30 ED     JR NC,0CEC      falls into carry
          0CFF  C9        RET             then return.
```

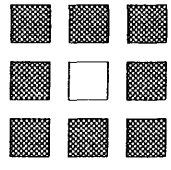
TABLES:

```
0D00: 04 05 06 08 09 0A 0C 0D 0E 06 04 00 07 02 00 03

0D10: 01 00 40 40 40 40 40 40 40 40 40 40 06 04 02 07

0D20: 02 01 03 01 41 41 41 41 41 41 41 41 41 00 04 06

0D30: 00 02 07 00 01 03 42 42 42 42 42 42 42 42 42 42
```



A sneak preview of our next bugging book:

SECURITY DEVICES

Hot on the heels of issue 15 will be the next in the series of bugging books: SECURITY DEVICES.

Although its final content has not yet been decided, I can let you know about some of the projects. One of them is a 1km bug called the ULTIMA. Because it is so good, I have decided to include the article in this issue.

The Ultima represents the next stage in our series on FM bugs and has the impressive range of 1km.

As with all our performance ratings, it is very conservative and has been determined under adverse conditions, exactly as would be found in normal conditions, through buildings and across undulating terrain. We don't believe in "over the water" exaggerated claims as touted by the imported devices.

We actually achieved better than 2km in our tests (considerably better) but we down-play everything so that you can come up with similar (or better) figures. Our test vehicle was a van with a gutter antenna and the added height of the roof is a decided advantage over a car or pedestrian with portable radio.

Although the circuit is very similar to its predecessors, the Ant and Amoeba, it has taken a lot of experimentation to get the added performance. It's not just a matter of adding an extra 3v and rushing the circuit together. Current consumption has to be taken into account and the prevention of harmonics has to be considered.

A number of readers have sent in designs for operation on 3v and 6v and when the circuits were constructed, the output transistor almost started to get warm! We measured the current at 40 - 50mA! This is brute-force designing and is against our policy. Our design takes about 7-10mA and the added output power (over the Amoeba) has been achieved by the improvement in efficiency due to the 6v supply.

The Ultima produces the maximum allowed power for a simple RF design. The circuit has been designed for 6v and must not be over-driven by a higher voltage.

Anything over 6v will over-excite the output stage and produce considerable harmonics and TV interference.

Some TV's are particularly susceptible to interference and will produce a herringbone pattern on any one or more of the channels. Other times, talking lines can be seen when speech is being transmitted by the bug. Just because one set is not producing any symptoms does not mean a nearby set is not being affected. It depends heavily on the rejection capabilities of the tuner and IF strip.

Our main aim with this project is to demonstrate the efficiency of FM transmission and provide a basic design for you to experiment with. By altering the component values slightly and adjusting the size and spacing of the coils, you may be able to get improved performance. We will certainly be interested in any improvements you get.

The concept of Community Radio has been explored by one of our readers and he has used the Amoeba to communicate to hundreds of nearby residents and students his own age. It has proved to be extremely popular and he has created a lot of interest.

Another reader has used the Amoeba to transmit within the confines of his school, during lunch time, and his request was for a slightly more powerful device to prevent drop-out in some of the more-distant rooms.

The Ultima is sure to solve the problem. We found its range to be 2-3 times that of the Amoeba and this equates to a power increase of some 4-8 times. These figures are quite arbitrary as the ERP (effective radiated power) is in the order of only a few milliwatts and it has not actually been measured on a calibrated instrument as yet.

So much for the cover project.

Some of the other projects in the book are just as interesting. Take the Field Strength Meter. It's a very simple add-on for a multimeter, to detect the output power of a bug, without physically connecting to the transmitter. We tried every field strength meter circuit ever produced and none of them worked. But our does.

It will prove to be a very important piece of test equipment for testing and peaking RF circuits.

Since it does not connect to the circuit under test, it doesn't introduce a loading factor or upset the frequency. This will allow you to get much higher peaking values and consequently better range.

Unfortunately you will have to wait for the book to come out, to see this circuit so keep on the look-out.

Also included will be a very small beeper, suitable for gliders or any other situation where size is important.

It uses a simple discrete circuit and is powered by 3 button cells. Provided you can create an effective antenna, you will be able to achieve a transmission range of up to 1km.

Other projects are based on non-transmitting devices and there are a number of articles and stories that have been accumulated during the production of the book.

We get into a lot of hassles with suppliers. Some would think it is our fault but the fact is Australia is getting more and more inefficient. When we order simple components, we get told stories about the reason for a delay in supply that are so bizarre that they create a legend of their own.

Like waiting 6 weeks for a packet of FET's and then be told they would be another 2 months!

But the biggest run-around we got from the supplier of single chip micros. Supposedly technical staff gave us lots of false information and tried to steer us up a country lane! These things, and more are related in our stories, with names suppressed to prevent us being sued again!

As with all our releases, they are filled with reading material and eventually sell out. If you are quick, you can always buy them at a newsagents or write to TE for a copy of Security Devices ($3.40 + $2.50 post). Or better still, get a 6 issue subscription for $15.00 and receive each issue as soon as it is printed.

We cannot possibly keep to a printing schedule and a 6 issue sub will extend more than a year. That's why we can't offer an annual rate.

To answer some of your questions before you think of them: Yes, we have more security devices on the drawing board . Those that come to mind include an RF motion detector and a phone dialer. We are working on things all the time. As soon as a range of projects is complete, we bring out a book.

If you have any design ideas, let us know. Many of our projects start from a few unrelated ideas and all of a sudden, a new project is born. I'll finish now as I know you are dying to get on with the Ultima. Don't forget to buy a kit if you want the project to work first go!

Learn DIGITAL ELECTRONICS with:

THE AUSTRALIAN DIGITAL ELECTRONICS SCHOOL

★★

The Australian Digital Electronics School course has been very popular from its inception and many of the students who have completed the course have asked for additional lessons.

We are pleased to say a new lesson has now been included.

It is a TTL lesson based on the book **STARTING IN TTL** and includes the Trainer Deck, text book, answer sheets for the questions in the text and a separate test that is sent in to the school for correction. This is lesson number 6 in the course and can be purchased separately for $30.00 incl postage.

As we have mentioned previously, the price of the course has been set to rise for some time and it is now $120.00 for the first 5 lessons or $25.00 per lesson. Lesson 6 is $30.00 incl postage, making the six lesson course $150.00 incl postage.

This course is still far cheaper and the most informative course available on the market and hundreds of successful students can attest to this.

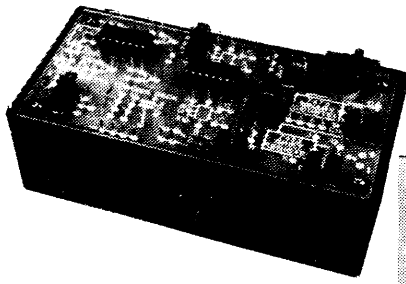
The course starts with a preliminary parts identification and soldering ability test. From there you will be guided through 3 interesting projects of which two are sent into the school for marking. These will be returned and remain your property.

A test accompanies each lesson and these are also sent to the school to be corrected by your instructor.

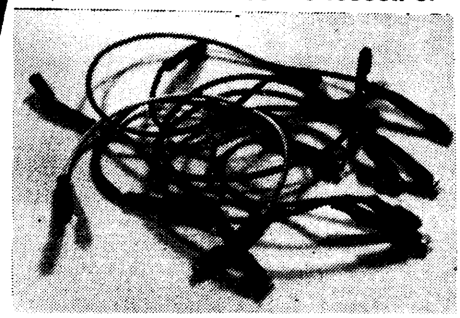
Individual attention will be given to each student and you progress at your own rate. This is the most important aspect of the course. You can repeat any section until it is fully understood and you can ask for any additional help relevant to the topic.

Don't delay. This may be the turning point for you. You may think you know electronics, but until it is put to the test and you receive an assessment, you may have some incorrect concepts.

Ring Talking Electronics on (03) 584 2386 for any information.



The TTL Trainer Deck is lesson 6.



20 jumpers for use on the DECK.

THE AUSTRALIAN DIGITAL ELECTRONICS SCHOOL, Box 334, Moorabbin, Victoria, 3189.

ENROLMENT FORM:
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Photocopy this page or apply on a plain sheet of paper. You will be sent a PRELIMINARY TEST sheet by return mail.

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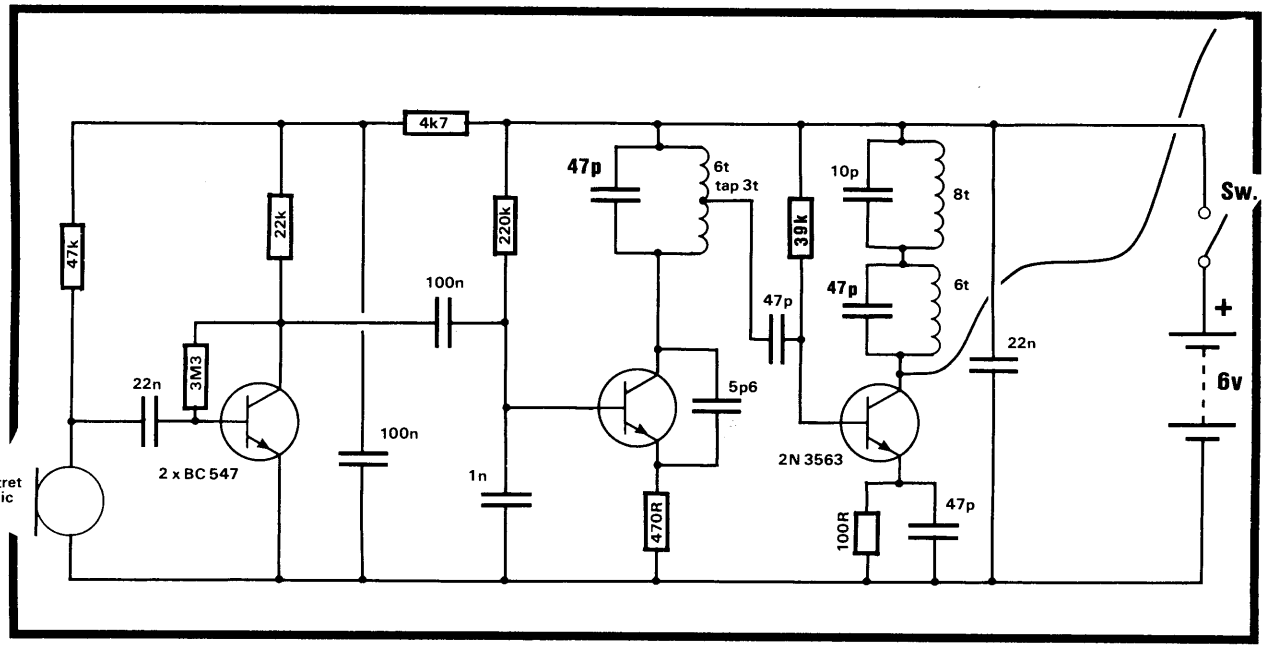
ULTIMA

Our 1km FM transmitter

Parts $10.00
PC board $2.50
Total $12.50
Don't forget the LED Power Meter kit: $1.10



ULTIMA CIRCUIT

Encouraged by the popularity of all our previous bugs, we have designed another FM transmitter, this time with a range of 1km.

The efficiency of this design is slightly higher than the Amoeba as the power consumption is about double and yet the Effective Radiated Power (ERP) is about 4 times.

This is borne out by the fact that the range is about twice as far - it requires 4 times the power to double the range.

In this project we will cover some of the design features that make the circuit so efficient. Basically it is the higher voltage. The way it works is this:

This design has a minimum threshold of about 1v so that a circuit powered by a 1.5v battery has very little potential for producing any output. At 3v it can reach about 400 metres and at 6v it can reach about 1km. You will recall the increased range of the Voyager was purely due to the 9v supply and this time the 6v supply, as well as the tuned output, will assist in producing the output power.

With any transmitting device, the primary requirement is range. To achieve this, an effective antenna system must be used and although a dipole or loaded antenna provide a slight antenna gain, the usual purpose for which this project is intended, makes a special antenna impractical.

The main use for the the Ultima is as an emergency beacon or signaling device and in such a situation, the user may only have the branch of a tree to throw the antenna over.

For this reason, and to keep the transmitter compact, a length of hook-up wire about 1.6metre long is provided.

You could say it's another version of our Hiker's alarm, this time without the beep, and is small enough to be carried by anyone on a hiking expedition or skiing holiday.

If a number of adventurers got together and produced a few units, they could install them on and around the area they frequent and provide a network of communication links in case of an emergency.

PARTS LIST

1 - 100R (all resistors 1/4 watt)
1 - 470R
1 - 4k7
1 - 22k
1 - 39k
1 - 47k
1 - 220k
1 - 3M3

1 - 5p6
1 - 10p
4 - 47p
1 - 1n
2 - 22n
2 - 100n monoblocks

2 - BC 547 transistors
1 - 2N 3563 RF transistor
1 - 6 turn tinned copper wire coil
1 - 6 turn enameled wire coil
1 - 8 turn enameled wire coil
1 - electret microphone insert
4 - AAA or AA cells
1 - mini slide switch SPDT
1 - length hook-up wire for antenna (1.6m long)

1 - "ULTIMA" PC BOARD

(You can specify AA cells or AAA cells)

It would only take one or two instances where a transmitter of this type proves to be a life saver and its worth will be incalculable.

The advantage of transmitting on the FM band should be obvious as most cars are now fitted with an FM receiver and they can be used to pick up the transmission without the need for any special receiving equipment.

If a frequency were set aside at the lower end of the FM band for such a purpose, a safety channel could be set up at all outdoor activity centres. The transmissions would not interfere with any commercial operations as few if any FM stations operate in remote areas.

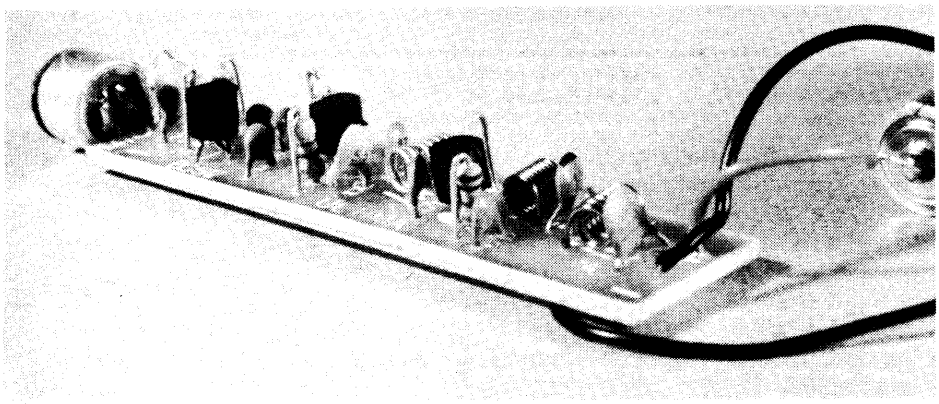
Maybe something like this will be introduced in the near future. It's a "catch 22" situation where you would have to start by cutting through a lot of red tape to get something like this accepted nationally.

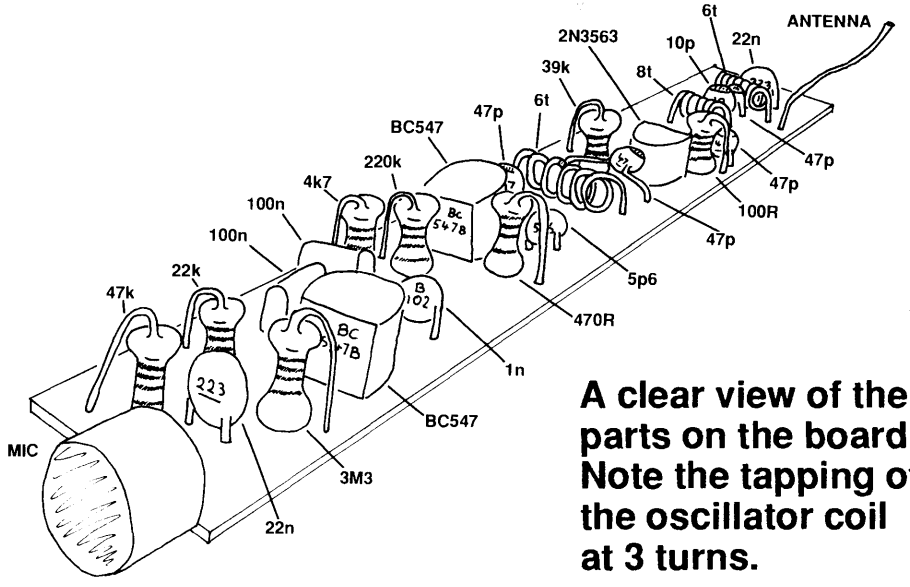
The Ultima project is built on a PC board 1.5cm x 7cm and can be fitted into a variety of cases. The most appropriate will depend on the intended use and if you want the project to be as small as possible, it can be heatshrunk and made virtually watertight.

FM transmission is highly efficient and a few milliwatts can get you a long way. The clarity of FM, its lack of background noise and immunity to electrical interference makes it ideal for faithfully monitoring all types of sounds.

The impressive range of the Ultima makes it ideal as a surveillance device, for monitoring remote sheds and buildings, where the slightest disturbance will be picked up and relayed to the monitoring point.

The Ultima is not intended as a hand-held microphone as firstly the microphone sensitivity is too high and the circuit is not "tight" enough to prevent the effect of stray capacitance of your body causing the frequency to drift. See our hand-held transmitter, the ANT, for this.





A clear view of the parts on the board. Note the tapping of the oscillator coil at 3 turns.

HOW THE CIRCUIT WORKS

The main purpose of a transmitter is to get the greatest distance with the least current consumption.

To this end, the Ultima is the ultimate in design. It contains 3 novel features that have possibly never before been incorporated in the one design.

The front end is a simple common emitter stage with a gain of about 70-100, and decoupled from the battery via a 4k7 and 100n capacitor. These two components prevent motor-boating (instability) at low frequency.

There's another little known fact to be aware of, when designing the front end of a high gain amplifier such as this.

Since the electret microphone is an active device (it contains a FET), the gain of the FET must not be allowed to be too high, otherwise the front end will break into oscillation (sometimes called front-end squeal).

The gain is kept low by making the load resistor high and that's why we have chosen 47k.

Coupling the audio to the RF oscillator is a 100n capacitor and this value is needed to pass the low audio frequencies.

The first of our "unusual" features is the 220k turn-on resistor on the base of the oscillator transistor.

After a great deal of experimenting we found a very high value base resistor was sufficient to turn the transistor ON and produce a high amplitude waveform.

The oscillator circuit has been designed to oscillate at about 88MHz.

The tuning capacitor in the oscillator is 47p and when the frequency is set, it remains set. The Ultima is not a tunable bug and you should select a clear spot on the dial when setting the bug up, so that you don't interfere with any radio stations.

Apart from being illegal to transmit over a commercial station, you would have almost no chance of achieving any range if you were to do so.

The output of the oscillator is taken from the third turn of the oscillator coil and this is common practice in transmitter circuits - it has been done with the Amoeba and has proven to be very successful.

Quite often the tapping of a coil is very critical and half a turn either side of the optimum value will reduce the performance considerably.

The idea of tapping a coil is to produce an auto transformer. This has nothing to do with cars (auto's) but means a two-winding transformer is produced by using only a single winding.

We all know what a transformer does and one of its features is to change a high voltage, low current packet of energy into a low voltage, high current package.

In a limited way, that's what the tapping on the oscillator coil does. It produces a very efficient matching between the oscillator section and the output stage.

The aim of the tapping is to pick off as much signal as possible without overloading the oscillator.

In technical terms we need a considerable amount of current to drive the output stage as its gain is quite low (possibly about 5-20), depending on the quality of the transistor and the frequency of operation.

At 100MHz, the reactance of the 47pF in the base of the output transistor will be only about 30 ohms and that's why a small value such as this can be used.

The output stage has a number of features worth mentioning.

Firstly the emitter capacitor and resistor network may appear to be unnecessary as the stage is not a full bridge design. These components reduce the peak current and increase the input impedance of the output stage as seen by the oscillator stage. This improves and guarantees "start-up" of the circuit.

To get the greatest range out of the Ultima, the output stage must be peaked and this is an essential part of the tuning and aligning. The tuned circuit in the output stage consists of a 6 turn coil and 47pF capacitor. The 8 turn coil is effectively an RFC (Radio Frequency Choke) to improve the matching of the output circuit to the antenna. The 10p capacitor across the RFC is designed to reduce harmonics and prevent interference on TV sets in the vicinity.

As output power is increased (such as from the Gnat design, to this), the effect of harmonics becomes a real problem.

Shielding the project will have little effect as they are already appearing on the antenna and it's too late to suppress them once they get this far.

As we have said, one of the important stages in the construction is to peak the output. For this, a simple POWER METER is required and its construction is also covered. The circuit attaches to a standard multimeter and uses the meter to give an indication of the signal strength. It also has a Light Emitting Diode that illuminates to give an indication of the relative power being emitted.

The illumination of the LED will give you a valuable indication when peaking the circuit and will show how critical the values are at high frequency.

An on/off switch allows the project to be turned off when not required and the current consumption of our prototype was measured at 8mA, allowing a set of AA cells to last for about 150 hours.

The 2N 3563 transistor in the output has been chosen as it gives the best performance at the least cost.

Surprisingly, a BC 547 will operate quite satisfactorily as an oscillator at 100MHz but provides very little gain at this frequency.

It only requires a gain greater than unity to function as an oscillator but in the output, a 2N 3563 provides a gain of between 5-20 and delivers the output we need.

No matter what other tricks you add to the output stage, you will not achieve better performance - for the same current.

The suggested maximum current for a 2N 3563 is 10-12-15mA (depending on the specification sheet you use), and only by decreasing the value of the bias resistor, does the output rise by a noticeable amount.

As you experiment with the circuit and peak it, you will see the changes in output power on the meter and/or the LED. But if the range is increased at the expense of more current, you haven't improved the efficiency.

Our prototype produced 2v across the LED/resistor combination and the chip inside the LED could be seen to glow quite noticeably.

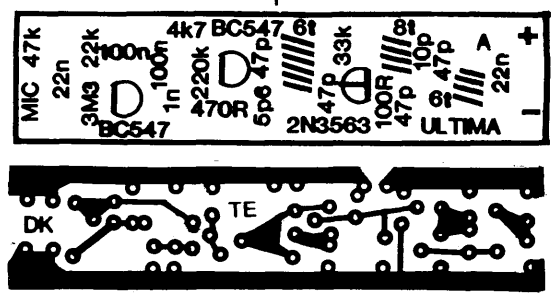
Not a great deal of weight can be put on this as a lot of RF energy is floating around the meter and will get into the movement to create a false reading.

But if you can see the LED glowing you know that energy MUST be present and that's why we have called it a LED POWER METER.

ASSEMBLY

A complete kit of components, including pre-wound coils and roll-tinned PC board is available from us and we hope you will buy more than one kit! Many readers buy two or more kits for their friends and some keep coming back for more! We have sold over 10,000 ANT bug kits already! The artwork for the PC board is also given so that you can make your own, if you are set up to do so.

The economics of making your own board is dubious.



PC artwork for the Ultima. The switch is soldered directly to the AAA cell. The positive and negative leads connect to the board via short lengths of hook-up wire.

By the time you buy the blank board, cover it with ultra-violet sensitive material and spend an hour or so etching and drilling, you could have bought a professionally made board from us for less.

Before arriving at the final design, we built at least 12 experimental versions, all with parts hanging off the board, in a birds-nest array.

Without exaggeration, it has taken hundreds of hours of experimenting and at least 100 trips "around the block" to see how effective each modification has been.

Sometimes an improvement via the power meter did not co-relate to an improvement in range. You must always make a "field test" - it's the only proof.

Although the circuit is not critical as such, a lot of work has gone into the selection of each component and the layout of the board.

If you want your model to perform as good as ours, it is important to use the exact same components and the same layout. That's why I suggest you buy a kit.

If you are a seasoned hobbyist, and know what you are doing, you will know the type of components to use. But if you are unsure or missing one or two of the critical parts, don't take the chance, buy a kit.

Kits have proven the most popular way of making a project.

The ratio of "kits" to junk-box assembly is greater than 50:1, in our experience of over 100,000 kits. Kits are generally no more expensive than buying the parts individually and quite often some of the special components are not readily available, like the wire for the coils, the RF transistor and high quality electret microphones.

I am not going to go through the finer points of placing the parts on the board as we expect you will have made some of our other designs already.

The coil winding details are below for those who wish to wind their own. You can use slightly different gauge wire but the coil diameter and spacing is critical.

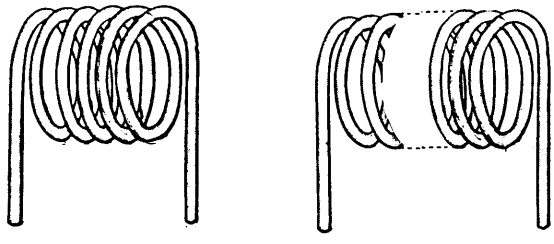
All the parts for the Ultima fit onto the board almost exactly as they appear in the circuit diagram. This makes the circuit very easy to follow and is one of the factors to good layout.

Two of the coils are enamel coated and the enamel must be scraped off or burnt off before fitting them to the board. It is not satisfactory to expect the enameling to burn off at the time when the coil is being soldered in place.

All the components should be pressed firmly up to the board before soldering. This also applies to the transistors. They should be pushed down to the same height as the resistors as can be seen in the photograph.

There are three points that may be new to many constructors. The first is the soldering of the 47pF to the top of the 3rd turn of the oscillator coil (the tinned copper wire coil).

The turns are counted from the "earthy" end and earthy end means the end that is not alive or oscillating.



COIL WINDING DETAILS:

1 - 6 turn tinned copper coil (.6mm wire) wound on a 3mm diam screwdriver.
1 - 6 turn enameled wire coil (.5mm wire) wound on a 3mm diam screwdriver.
1 - 8 turn enameled wire coil (.5mm wire) wound on a 3mm diam screwdriver.

The turns are counted at the top of each loop. Six loops at the top indicates a six turn coil etc.

The end connected to the positive rail is not "alive" and although it not earth as far as DC is concerned, the rail is "dead" as far as the signal is concerned - the active end is the collector end.

When making the connection, make sure the solder does not bridge across two turns as this will create a shorted turn and the transmitter will either not work at all or operate on a much higher frequency - we have had both occur, although I would prefer to state that the shorted turn will prevent the circuit from operating at all.

You should also take care that bending the leads of the 47pF does not damage the capacitor or create an open circuit. They are fairly delicate.

Finally, removing the enamel of the coils, must be mentioned.

The acid fumes that are produced when burning the enamel are so strong that they will attack the plating on the tip of your soldering iron.

I have already gone through a number of tips and put it down to this procedure as the pitting has developed after removing the enamel from a number of coils. Normally a tip will last for months but after a few "removals," the tip succumbs to a "crater." Soon after, the tip falls off.

You should remove the enamel with a blade, sandpaper or file and the ends must be cleaned and tinned before fitting the coil.

All the rest of the construction is straight-forward. The PC board contains a legend and the accompanying photos will show where everything goes.

The next stage is tuning and peaking but before this can be carried out, you will need to make up the LED POWER METER.

LED POWER METER

To get the best performance out of this transmitter, an RF power meter is used to maximize the output.

Since the output is very low, a conventional RF power meter cannot be used. We need an RF milliwatt meter.

The circuit described in this section is very simple and uses a standard multimeter to show the reading.

Across the input is a LED and resistor and the degree of brightness of the LED, together with the voltage reading on the meter, gives an indication of the energy level.

A digital multimeter may be used but the presence of RF may produce a false reading.

Likewise, the radiated energy may upset some analogue meters and you may get full scale deflection on the 15v range as well as the 250v range! But the LED won't lie. It will accurately indicate the RF and you can see the change in brightness as you adjust the coils in the output stage.

LED POWER METER

PARTS LIST:

1 - 470R
1 - 100p ceramic
1 - 100n greencap

2 - 1N 4148 signal diodes
1 - 5mm red LED
1 - 5cm hook-up wire
2 - paper clips

NO PC board required

Build the circuit for the LED Power Meter exactly as shown in the photo and make sure the input lead is exactly 5cm long. If you keep to the same layout as shown, your readings will closely coincide with ours.

When dealing with RF, lead length is very important and if the input lead is longer, the meter will produce a lower reading.

The type of multimeter will also affect the reading and this is why we cannot give a quantitative value for the output.

We don't have any means of providing a "standard" as we don't have any bench-mark or reference point.

As soon as you build the power meter you will be able to test the transmitter.

Connect the input lead to the antenna point (don't fit the antenna lead yet) and switch on. Switch the multimeter to the 2v (or 2.5v or 5v) range.

Keep the transmitter away from the meter to prevent the movement being influenced by the RF and you should get a reading of about 2v.

The LED will glow quite noticeably and you can see the output on the LED before the circuit is peaked.

Next you have to tune the transmitter to a clear spot on the dial. For this part of the operation you will need a transistor radio, or more preferably, a radio with a tuning indicator.

Keep the radio at least 2-3 metres away and tune to a clear spot.

The lead of the power meter is used to radiate the signal and you will get a range of 10 metres or so.

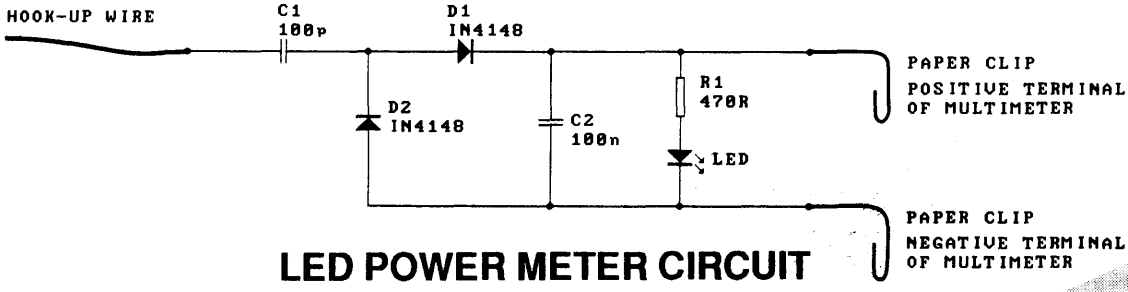
Turn the transmitter ON and adjust the turns of the tinned copper wire coil to get a feedback whistle from the radio.

There may be a number of spots where a signal is detected and it is important to pick the fundamental.

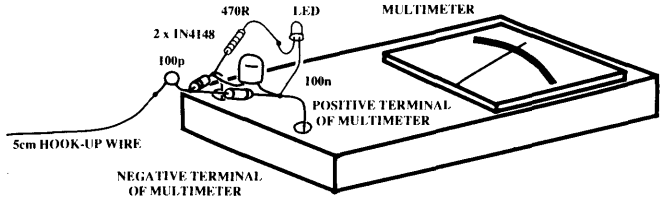
The weaker side-tones have no range and this is where a tuning indicator comes in. It will quickly indicate the fundamental frequency.

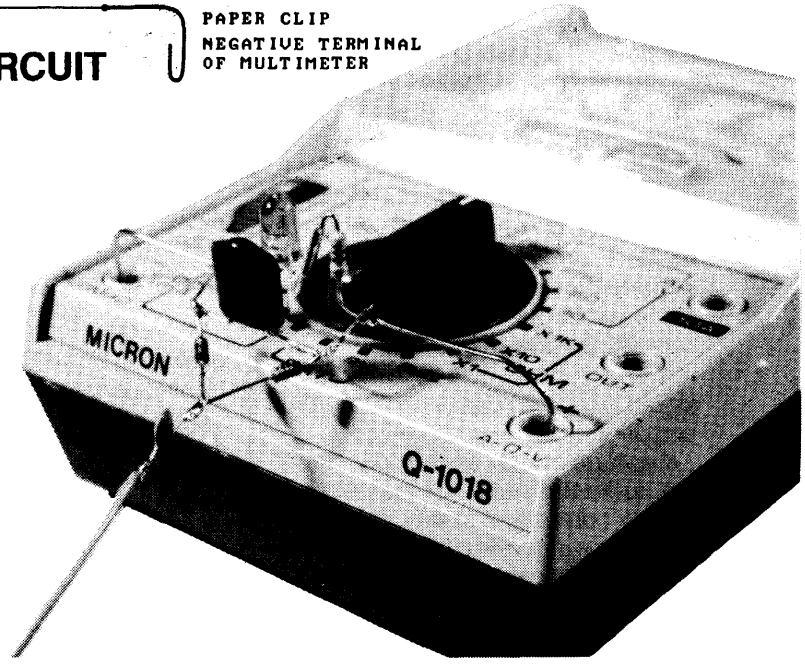
Move the radio away to confirm that the fundamental is being detected.

Once the frequency of transmission has been set, the peaking of the tuned circuit (in the output stage) must be undertaken. This is done by squashing or stretching the turns of



LED POWER METER CIRCUIT





LED POWER METER

These diagrams give a clear view of the LED POWER METER connected to an ordinary multimeter. The parts are soldered to two paper clips and connected to the input terminals of the meter. Set the meter to low DC volts scale. Make sure the input lead is 5cm long to get the same readings as discussed in the article.

the 6 turn coil and as you do this, you will be able to see the effect on the LED POWER METER.

In this way the output stage can be optimized and you can be sure the maximum output has been gained.

MODS

If you want to detune the transmitter to below 88MHz or run it at the top end of the band, you will have to change the oscillator section as well as the output section as they both determine the frequency.

To detune the transmitter to say 85-87MHz, you will need to add one turn to both the oscillator coil and the tank coil, making them 7 turns.

To operate at 108MHz, you will need to change both the 47p's in the oscillator stage and tank circuit to 39p and follow the peaking procedure as described above.

IF IT DOESN'T WORK

Before you get involved in any technical problems, have someone check the construction for dry joints, parts placement, shorts, and the like. Nine times out of ten it's something simple.

Next check the current. It should be 8-10mA and any value outside this range will indicate a fault is present. Also check the voltage across the power rails and the voltage across the front end (about 5v).

Next you must determine if the fault is in the audio section or the RF section.

If the carrier is being produced you will get a blank spot on the dial and the power LED will light up.

In this case the fault lies in the front end and can be due to the microphone being around the wrong way, the audio transistor being faulty, the 100n capacitor not passing the signal or one of a number of faults.

Firstly check the voltage across the electret microphone. If it is between .7v and 2v, the mic is drawing current and if you want to see the output signal, you will need a CRO or mini amplifier.

A voltage of 2-3v on the collector of the audio transistor will indicate it is biased correctly and any value outside this range may mean the transistor is faulty or has a gain above or below that expected.

In a self-biasing stage such as this, the gain of the transistor sets the collector voltage and maximum amplification is achieved when the collector is sitting at mid rail.

Two other components affecting the audio are the 22n and 100n capacitors.

They may be damaged due to soldering and the only way to check them is by bridging another capacitor across each or using a mini amplifier to detect the audio.

If you have access to a CRO, you can observe the signal at each point in the circuit and almost no fault will escape you.

Replacing all the components in the front end is a last resort but may be necessary if simple tests do not reveal the fault.

On the other hand, if no carrier is produced, the oscillator or output stages will be at fault.

Firstly check the oscillator stage by removing the 47p capacitor from the oscillator coil and connecting the input lead of the LED POWER METER to the collector of the BC 547.

The meter should deflect slightly but the LED will not come on as it requires at least 1.7v to be present before the LED will start to illuminate.

The LED and resistor do not have to be removed as they do not impose any load on the circuit until the voltage rises to above 1.7v.

If the meter does not deflect, the fault will lie in the oscillator stage. The first component to change is the transistor, then the 5p6 feedback capacitor.

Make sure the 220k turn-on resistor is providing a voltage to the base of the oscillator transistor. It will be difficult to measure this voltage accurately as the stage is producing RF and will upset the meter reading.

Make sure the 470R has a voltage across it and this will indicate the transistor is turned-on.

If the 47p capacitor has shorted, or if two turns of the coil are touching, the circuit will not oscillate. If these tests fail to locate the fault, you should assemble another kit and come back to this one later.

NO deflection of the LED POWER METER can only mean one thing. The output stage is not operating.

Firstly test the output transistor and make sure the voltages are correct. Don't forget the 47p that taps onto the 3rd turn of the oscillator coil. Replace it if you think it has been damaged during soldering.

The enamel on the coils must be removed before soldering as it does not conduct electricity at all.

Make sure the 39k provides a turn-on voltage and you can try shorting across the 100R if you think this resistor is open.

A low RF output can be due to an open 22n capacitor across the battery, the coils in the collector being spread too far apart or a faulty RF transistor.

The only other possible explanation is damage to some of the components during soldering.

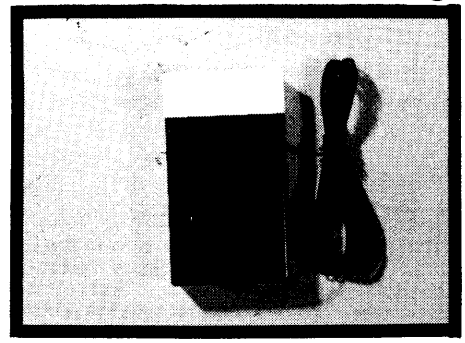
For the cost of another kit, the quickest and easiest way is to start again. You will take more care with the next construction and hopefully things will work out successfully.

MOUNTING IN A BOX

The project can be mounted in a jiffy box that is large enough to take the PC board and a battery holder. This will give it protection from the weather etc if used in an outdoor situation.

If you want the project to be as small as possible, the PC board can be heatshrunk but you must be careful that the heatshrinking does not move the coils and change their frequency. Do not use a voltage higher than 6v as the circuit is not designed for it and harmonics will be produced that will interfere with TV reception.

I hope you find this project as interesting as we did. The range is most impressive and it is incredible that such a low output will reach 1km.



SHOP TALK

I hope you have noticed the typesetting in this issue. It's been done on a laser printer.

For those not up with this modern marvel, a laser printer is simply a photocopier with a point source of light (the laser) that scans across a light-sensitive drum to set up the charges. After that, the printer works in the normal way to a photocopier and out comes the page of printing.

In our case the printer is a 300 dot model and produces a quality that is suitable for directly pasting up for the magazine. The advantage of a laser printer is flexibility.

Staff members can prepare articles at home, on their own IBM compatible computers and bring them to work for page making on our hard-disk system, using Ventura Publisher.

Although all publishing packages have a number of limitations and take a long time to learn to drive, we have found Ventura to be the most suitable for our requirements.

Computer preparation has certainly been a quantum leap for us. It was at first difficult for us to see the benefits of outlaying a lot of funds for a magazine that comes out so infrequently. But with the promotion and dedication of Jim, Paul and Craig, the benefits were soon realised.

The second advantage of computer setting is the interchange of articles. We can write an article for our magazine and send it to another publication where they will set in their format without any additional work.

This also introduces the possibility of readers sending in articles for the magazine. All you need is an IBM or IBM compatible and a good word processing package like wordstar.

Articles need to be produced in unformatted form, and we will use Ventura to transform it into a finished format and output it to the laser printer.

Our PC boards are also being prepared on a computer using a Protel package and we have successfully produced the Organ board and Ignition Killer PC.

The completed files are sent to our PC board manufacturer on floppy disk where it is automatically plotted onto film.

The file is also converted into a drilling guide for a high-speed NC drill and within half and hour a drilled board is ready.

The photo plotter produces the trackwork negative and component print and using these a single prototype can be produced via a photographic process.

The board is pre-coated with a laminate and when exposed to light through the negative mentioned above, the unexposed laminate can be washed off. From there it goes through the normal etching and tinning process and finally the component print is screen printed onto the top side.

Prototyping time has been reduced to 4 hours for a single sided board and 8 hours for a double-sided plated-through hole board.

We have liaisons with several PC board suppliers and if you want to produce a board for the magazine we can assist you with artwork design packages.

The only problem we are having is with drawing circuit diagrams. Paul is having trouble creating his own library using ORCAD and if anyone can help, please let us know.

As you may already be aware, we have opened up a Talking Electronics shop at 2 Central Ave, Moorabbin, to display all our products and provide a customer service that could not be provided in the cramped quarters at Rosewarne Ave.

Already, after only 2 weeks of opening and without any advertising, we are getting a number of customers who say they have heard about the shop. The word is spreading quickly and after this magazine hits the newsstands, things will really start to move.

Without blowing our trumpet, everyone knows we provide a service and range of kits that cannot be beaten.

After all, we have survived for 5 years, and increased sales each year, without ever spending a cent on advertising.

With the added space of the shop we will be able to increase our range of goods and include CB's, Radar Detectors, 240v inverters and antennas etc.

We also intend to directly import a number of lines and offer them at amazingly low prices.

Some devices are marked up 100% by the importers before we get them and its impossible to sell them at a resonable price.

The SAB 0600 is a typical example. It's a 3-note doorbell chip. It costs over $6 each when bought by the hundred and the equivalent from Hong Kong is 50c!

The same applies to panel meters, switches and so many hardware lines.

We have a member of staff going to HK in a month to start the importing business. I hope it works out.

The secret of our survival has always been the wide variety of lines. No one particular line has kept us solvent but a little dribble from 100's of different kits has kept us bouyant. We're making headway but only slowly.

With this, you are possibly surprised to see issue 15. Without constant pressure from Jim, the articles for this issue would still be sitting in the filing cabinet.

The conversion to computer type-setting was both very expensive and much more involved than we envisaged.

But with the setting-up done, we will be able to bring out the issues with increased regularity.

In this issue, Jim has shown the TEC is far from a limited design and via his 30 page article is showing how the TEC can be expanded.

If you have not yet bought the TEC computer, now is the time to buy a kit. Start with the notes in issue 10 and work through the experiments to issue 14. Then you can add the DAT board and Speech Board and see how versatile the computer is.

Many new products such as "beer ticket" vending machines, speech in lifts, speech for the disabled and alarm systems, are still using Z-80 processors. If you want to get into product design, the TEC is one of the best ways to do it. Try it, you won't be disappointed.

Jim is waiting to see the response to the TEC article. As long as readers are showing interest in the TEC, Jim is happy to stick around and share his knowledge with us.

Some of the planned articles for this issue have had to be held over due to the lack of space. While we would have liked to bring them to you, it is just not economical for us to add the extra pages. To add the extra pages, we would have to include advertising to cover the additional cost. This would mean we have less pages for our articles. A no-win situation!

Looking on the bright side, we have already several completed articles ready for issue 16.

NZ Readers

We have a very reliable representative in New Zealand. Write to: Trevor Cooper, 33 York St., Timaru, New Zealand. Phone: 83787. He stocks all our kits, books and fully constructed security devices.

We also have a number of shops in Aust. that buy large quantities of kits. See if your local electronics store is one of them.

Don't forget, our very survival relies on the support we get from readers with the purchase of kits etc. See our redesigned order form in the centre pages for the kits in this issue. Pull-out the lift-out section for the "Shop" and you will find the complete litst of kits, including the "Earwig" (an Electronics Australia article) and Jim's package.

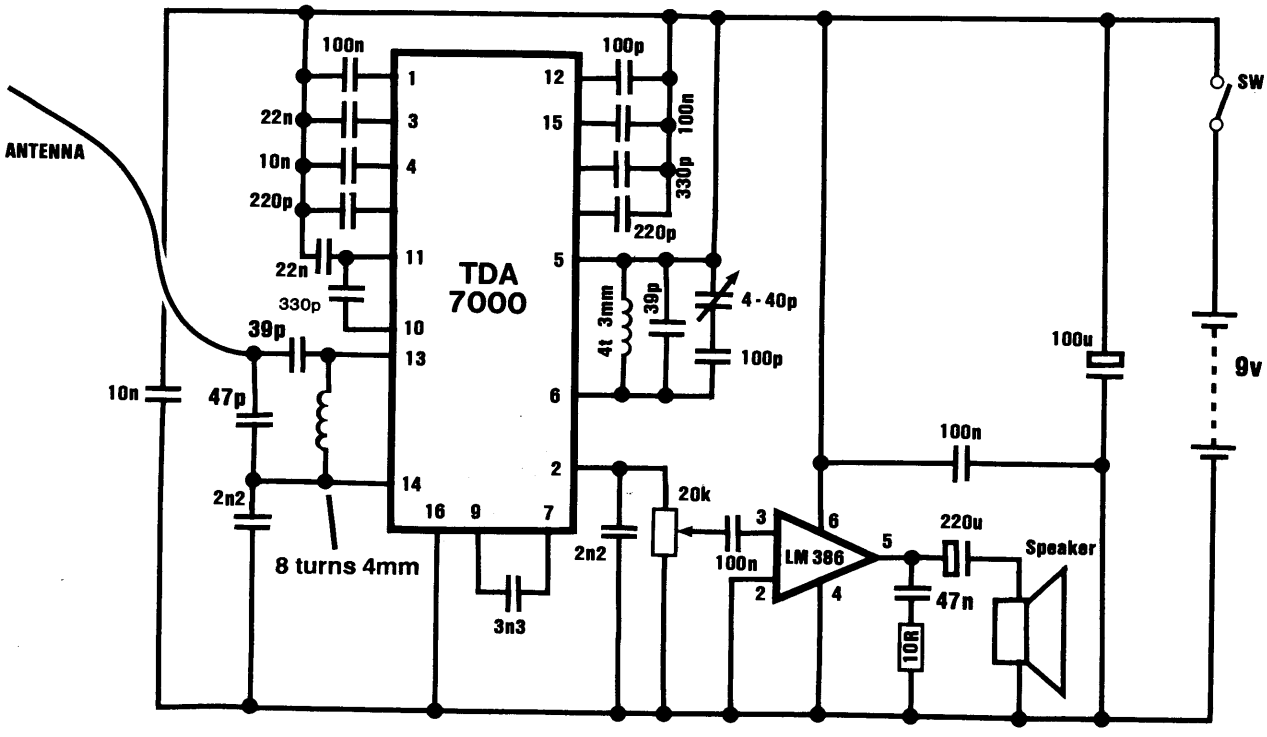
That's it for now, keep up the reading and building!

- Colin.

FM RADIO

A radio you can build into a cigarette pack

Parts $19.15
PC board $2.80
Total $21.95



FM RADIO CIRCUIT

This FM Radio has been designed to complement our range of FM transmitters. With an FM bug and an FM radio, you can produce an FM link.

The receiver described in this article uses two chips and is small enough to fit into a case about the size of a pack of cigarettes.

Use can use either an earphone or small speaker as the output device and create a one-way link for a baby monitor etc. This will allow you to be in constant contact with a baby or sick child.

There are many uses for an FM link and I am sure this will satisfy your needs.

We have had many requests for such a link, from those who have built up one of our bugs and here's our fully-tested design.

We made a number of simpler FM radios but they did not work satisfactorily. We started with a synchrodyne design but found it too difficult to tune in the stations. Then we tried another design similar to reactance in AM reception but found the whole arrangement too fiddly and susceptible to drift when being handled.

When a dedicated chip such as the TDA 7000 came on the market, we had to try it.

The results were most impressive. Using only a short antenna we could pick up all the local stations.

As with all radio designs, the most difficult component to obtain is the tuning gang. We would have liked the proper thing but since no one manufactures FM radios in Australia, we have had to settle for second best.

It's an air trimmer with an added knob in the form of a 5mm LED to tune the range 88 - 108MHz.

The advantage of making your own radio is the band can be broadened to 75 - 115MHz so that a private band can be created on either side of the commercial range. This is the area I suggest you choose as any transmission must not infringe on the commercial band.

PARTS LIST

1 - 10R 1/4 watt
1 - 20k trimpot
2 - 39p ceramic
1 - 47p ceramic
2 - 100p ceramic
2 - 220p ceramic
2 - 330p ceramic
2 - 2n2 greencap
2 - 3n3 greencap
2 - 10n greencap
1 - 22n greencap
1 - 47n greencap
1 - 100n greencap
3 - 100n monoblock
1 - 100u 16v electrolytic
1 - 220u 16v electrolytic
1 - 5 - 40p Philips trimcap
1 - 5mm LED for trimcap knob
1 - LM 386 Low Power Amp
1 - TDA 7000 FM Radio IC
1 - 8 pin IC socket
1 - 18 pin IC socket
1 - 4 turn 3mm coil
1 - 8 turn 4mm coil
1 - SPDT slide switch
1 - 8R speaker
1 - 9v battery snap
1.5m hookup wire for antenna

FM RECEIVER P.C. BOARD

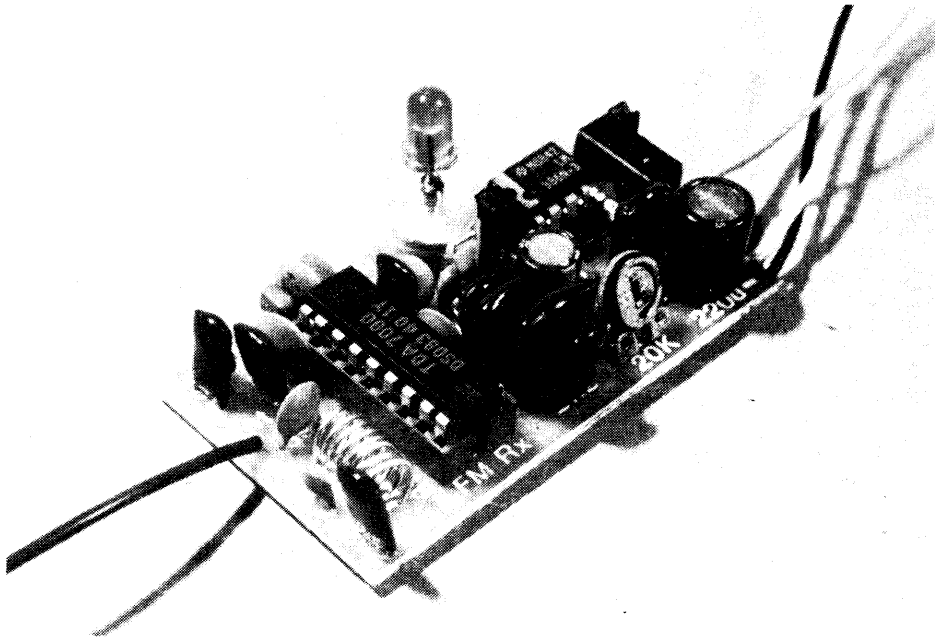
At the low end of the band there are courier companies and at the high end, airport traffic. No matter where you settle, you must not sit on top or near any other operator as this will not only limit your range but your transmission will be picked up by others. After all, who wants to hear a baby crying over the radio!

This circuit offers an introduction into FM reception and you will be able to determine the critical nature of many of the components.

This project should not be made on your own layout as the critical nature of the tuned circuits will prevent the radio from operating. At least that's what we found.

Essentially the tuning capacitor and 4 turn coil must be kept close to each other and the chip for the tuned circuit to operate and you are advised to use our layout to be sure the circuit will work first go.

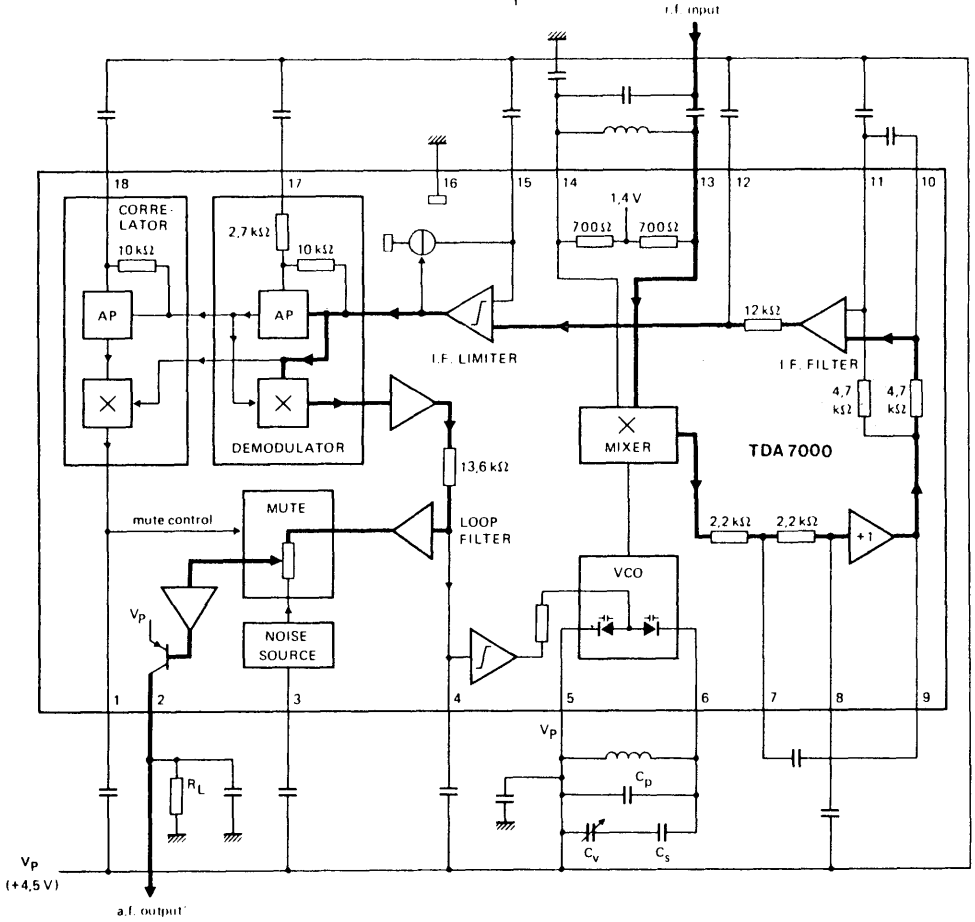
Once you have it working successfully, the oscillator coil can be adjusted to shift the band up or down. More about this later.



Note the 5mm LED soldered to the shaft of the air trimmer to act as a knob.

With this project, as with many of our designs, we have not suggested a case to house it in. Although there are many plastic boxes around, we have not settled on one particular type as the availability of chocolate boxes etc will vary from state to state.

We are always on the lookout for suitable boxes and sometimes the perfect answer pops up by chance. Both the Tic Tac box for the Amoeba and Livil box for the Ultima came as a passing suggestion from a customer. Maybe there's something along the same lines for the FM radio?



Block diagram of the TDA 7000 chip. The signal path through the chip is shown in heavy lines. The capacitors around the chip correspond to those in our circuit.

CONSTRUCTION

Place the contents of the kit on a clean part of the bench and check that everything has been supplied. If there are any notes in the kit they will explain any changes that have been made since the release of the magazine.

Inspect the board for any shorts or cracks (we have changed PC board manufacturers and our latest batch of boards are absolutely perfect. Not a single hole has been forgotten and no holes are filled with solder.)

The first component to be fitted is the 10R resistor. It is the only resistor in the kit and goes near the on-off switch.

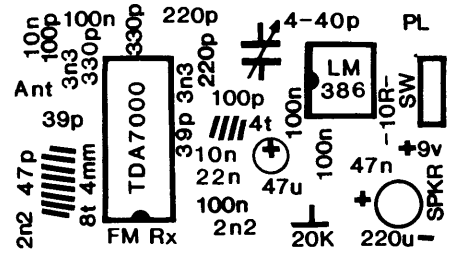
The 8 pin and 18 pin IC sockets are fitted to the board so that the notch covers the half circuit on the overlay. This is important so the the chips can be fitted correctly at the end of assembly.

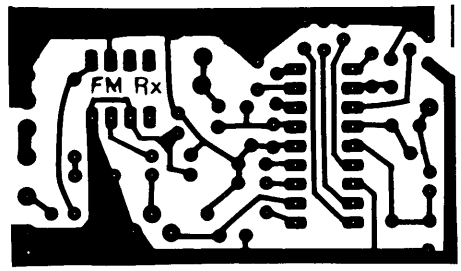
The capacitor and 2 electrolytics are next. If you have trouble working out their value, refer to some helpful hints on the back cover of the first issue of Talking Electronics.

The electrolytics are polarised and should be placed on the board so that the positive lead goes down the hole marked with a "+" symbol.
The 20k mini trim pot and the trim cap fit on the board one way only. When soldering these in place, do not leave the soldering iron on the joint too long or the plastic parts will melt. An insulating handle is made for the trim cap by soldering the 5mm LED to the shaft. Cut the leads of the LED short and tin both LED and shaft. Bring the two together and solder very quickly.
If you have bought the kit from us, you will find the coils have already been wound. If not, the next steps will be important. Wind 4 turns of enamelled wire clockwise around a 3mm Philips screwdriver. Heat the ends of the coil with the soldering iron to remove the enamel and tin the ends. This will make it easier to solder it to the board.
Wind 8 turns of tinned copper wire clockwise around a 4mm Philips-head screwdriver and solder both coils to the board in the positions identified on the layout.
The antenna, switch, battery snap and speaker and the next items to be added. The speaker is fitted via two 10cm lengths of hook-up flex and the antenna is 100cm of hook-up flex. Paint one end of the slide switch with red nail polish to identify the "on" position.
Fit the two chips into their sockets and give the board one final look-over. If all is in order, connect a 9v battery and turn the trim cap to pick up a station.
To move the whole band higher, squeeze the turns of the 4 turn coil together. To move the band down, separate the turns slightly.

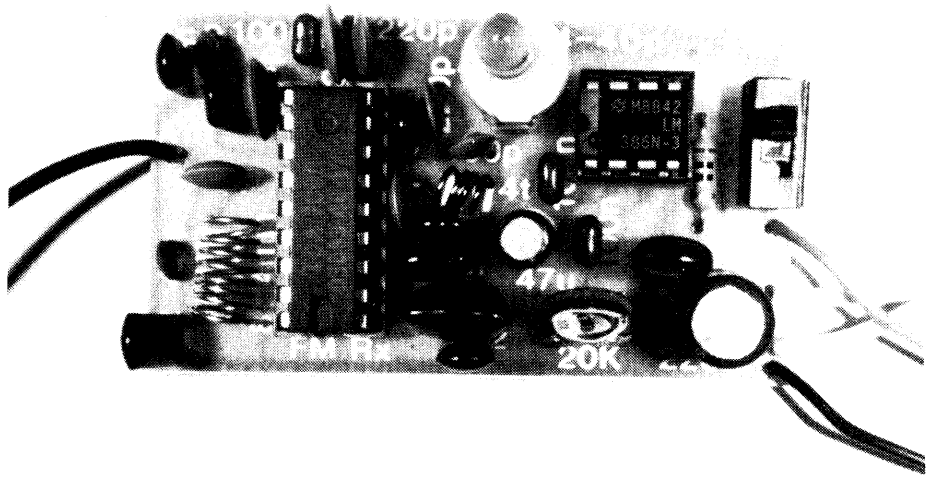
IF IT DOESN'T WORK

If the radio doesn't work, you will have to decide which section is at fault. There are basically two sections. The FM stage and the audio stage.
Turn the volume control to mid position and touch the centre leg with a screwdriver. You should hear a click or hum in the speaker. If nothing is heard, the audio section is at fault.
Measure the voltage across the chip (pins 6 & 4) and the current taken by the circuit (approx 50mA).
If these readings are correct, you should make sure the speaker is wired correctly and the output electrolytic is soldered in place.
The voltage on the output pin of the chip should be half rail voltage (4.5v).
If this does not solve the problem, the only other possibilities are the IC socket being faulty or the chip being damaged.
Make sure you do not connect the battery around the wrong way as the chips will be damaged instantly.
If a click is heard in the speaker, but no audio comes from the radio chip, check all the capacitors for correct value. These are the main external components for the chip as they are difficult to fabricate on the silicon substrate. If you pull the leads on a ceramic, or take too long when soldering, the connections inside the capacitor can come adrift. The only solution is to replace the capacitor.
Make sure the turns of the 8 turn coil are not touching each other.
Measure the voltage across the chip (9v) and see that the chip has been inserted into the socket with all pins making contact.
There is really little else you can do without test equipment. The only trouble we had with our first prototype was the tuned circuit containing the 4 turn coil. The capacitor must be close to the coil and chip for it to work and it is important to use the coil as supplied in the kit to be sure the circuit works.
We will leave housing the radio to you. The antenna can be cut shorter if the radio stations are strong.
Try the radio with the Ultima and see if you get the same range as a commercial receiver. Let us know how you go.

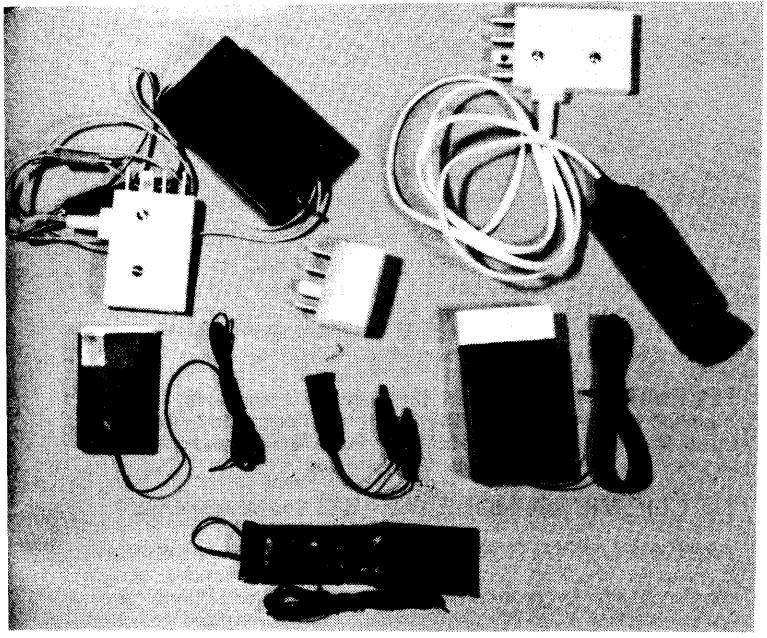




Full-size artwork for those who produce their own boards. Remember, the layout is critical. Especially the tank circuit made up of the 4 turn coil and capacitor.



Plan view of the completed FM receiver showing the placement of all the parts on the board. Make sure the chips are inserted correctly as shown in the photo, with pin 1 of each chip covering the dot on the overlay



The following is a complete list of security devices from Talking Electronics. All items are professional quality and guaranteed to perform as stated.
If you are not certain about your requirements, please phone for a discussion.
Don't let the low prices put you off. They are half the price of anything else on the market because they have been designed by us and made on our premises. There is no import duty or high mark-up. We make what we sell.

Here is our product range:

AMOEBA AM - 01 $50 ($3.00 pack and post). A super sensitive FM bug capable of transmitting 300 - 400 metres in a built-up area (possibly 1km in open country) and is fixed at a frequency between 88 and 90MHz. It can pick up sounds better than your ear and you can hear the ticking of clocks, birds and other faint sounds. It fits into a box the size of a Tic Tac box and is powered by two AAA cells. It will transmit 200 hours and has a tank circuit output (and RFC) to get the maximum range. The batteries are soldered in place and the unit must be returned to us for battery replacement (cost: $6.00) after 200 hours use.

BEETLE MKII also called **AIR LINK AL - 01** $39.50 ($3.00 pack and post). This is an improvement over the Beetle MK I and has better range. It fits onto the guitar strap and transmits to an FM receiver. It has input sensitivity control and requires a patch cord from the guitar to the input of the unit.

BRIEF CASE BUG BC - 01 $115 ($10.00 pack and post). This is a quality made brief case (Combination lock type) that has been fitted with a super-sensitive bug, capable of transmitting about 100 metres. The case can be 'left behind' and the resulting conversation detected in a nearby room or car.

BUG DETECTOR 2000 BD - 2000 $150 ($5.00 pack and post). Detects transmitting bugs in a room, car, office or telephone. The unit works on the wide-band principal of RF detection. It is switched on & the antenna extended. With a sweeping motion the antenna is probed into all parts of the room. The unit will give a feedback whistle when a bug is detected. The volume control is turned down and a meter on the detector indicates the relative strength of the bug. In this way you can 'home in' on its exact location.
For phone use: Wind the telephone cord about 4 times around the antenna and place the mouthpiece of the phone against the speaker in the bug detector. A feedback whistle will indicate an RF bug on the line. (The bug will be within 20 metres). Be sure to test every phone on the line in this way, as some bugs are designed to operate on one specific extension only.

CAR TRACKING TRANSMITTER CT - 02 $65 ($5.00 pack and post). This unit fits to the underside of a car with double sided foam tape and transmits a beep up to 400 metres. Use a directional antenna or standard FM radio to pick up the signal. The unit has very low battery consumption and will last up to three months of continual use.

DISH BUG DB - 01 $85 ($6.00 pack and post). Also known as a parabolic microphone, this is a non-transmitting bug that detects low intensity sounds and amplifies them to a pair of headphones. Listening range is up to 50 metres on a calm day.

DOUBLE ADAPTER BUG DA - 01 $105 ($3.00 pack and post). This is a transmitting bug, exactly like the SCORPION except that it is very easy to install. It can be installed in less than 30 seconds while pretending to make a phone call, by removing the phone plug from the wall, inserting the double adapter and then refitting the plug into the top of the adapter. The bug transmits down the phone line when the phone is in operation and its range depends on the effectiveness of the line as an antenna. 100 metres is the average range to be expected.

HIKERS ALARM HA - 01 $50 ($3.00 pack and post). This device is intended for bush walkers but can also be used as a car tracking transmitter. A beep tone is emitted and an electret microphone picks up noises and conversation in the background at the same time. Battery life is about 50 hours and then it must be returned for battery changeover. ($6.00 battery change incl post).

INFINITY BUG SIMPLE IBR - 00 $100 ($3.00 pack and post). This is the simplest version of our popular infinity bug. This model is small enough to place in the base of the phone and works like this: After making a call the other party hangs up. Instead of you hanging up, whistle down the line and the bug will 'open up' and you will be able to hear whatever is being said at the other end. Note: This model requires someone at the other end to answer every time you wish to use this bug. Size: 2cm x 3cm x 6cm. Also, all infinity devices must be connected to the phone line within the room you wish to listen to. You cannot place it on your own line then dial someone else. The bug must be in the other person's house. Several people tried to use the bug incorrectly, then rang us and complained that it did not work!

INFINITY BUG RING VERSION IBR - 01 $195 ($5.00 pack and post). This unit is connected to the phone lines and has a super-sensitive microphone and a complex circuit for detecting a coded phone ring. It an be installed in your home, office or factory and is ideal for checking on the presence of staff or burglars or keeping tabs on the children.
It works like this: The unit is connected to the number to be monitored as per the instruction sheet accompanying it and a special note must be made of the time intervals required to activate the device.
When you ring the monitored number you must let the phone ring for only one or two rings. At the receiving end, this will sound like a faulty line and anyone near it will soon forget. You must then hang up and wait an exact number of seconds (as supplied on the instruction sheet), before redialling the bug again. This time, when the phone starts to ring, the bug switches on and the bell does not sound at all.
Again you must wait until you hear a click on the line. Once you hear the click, you must whistle down the line and this will open up the bug and let you hear whatever is happening in the room being monitored. The sounds are clearer than if you were in the room and if someone picks up the phone, the bug automatically hangs up. The bug times out after 5 minutes and can be immediately re-activated to keep the line open. You can hang up at any time. The bug works on both decadic and DTMF (rotary dial and tone phone systems)
The bug also works in another mode: After making a normal phone call to the bug, the person at the other end will hang up. But you mustn't hang up. Instead you must whistle down the line and this will open up the bug and you will again be able to hear what goes on after the call has terminated.

INFINITY BUG NO RING VERSION INBR - 01 $330 ($5.00 pack and post). Same operation as the ring version, except that whilst you are accessing the bug, the phone bell does not ring at all. You can access the bug without anyone at the other end knowing. This unit has been upgraded and now cancels the ringing on both mechanical and electronic telephones.

LISTENER LI - 01 $75 ($3.00 pack and post). The listener enables you to listen in on illegal use of your phone. It will defeat infinity bugs and can be used as an amplifying device for those who are hard of hearing. It also monitors the extension phone to prevent the embarrassment of picking up the main phone when the extension is busy.

MINISTER'S MIC WM - 631 $45 ($3.00 pack and post). Ideal for ministers, Auctioneers, Stage work Etc. This unit is worn on the belt and has a small tie clip microphone which is attached on the wearers lapel or tie. It is tunable and stable. With a transmitting range of about 30 - 50 metres this is the ideal pocket bug!

PEN BUG PB - 01 $50 ($3.00 pack and post). A bug contained in a key finder. Can be left on an office desk and will transmit about 10

metres. Ideal for use in restaurants etc. where only a small range is required.

PHONE BUG PH - 01 $85 ($3.00 pack and post). A bug that is disguised as an electronic component. Fits inside the phone and requires soldering in place. Works the same as the SCORPION, except that the casual observer would think that it is just another part in the phone.

PHONE BUG SNIFFER PBS - 01 $145 ($5.00 pack and post). The Phone Bug Sniffer will detect 3 different types of 'taps' on the line including 'EXTENSION PHONE','INFINITY BUG', and 'SERIES LINE BUG' Our new improved model now successfully detects series bugs and does away with the 'imaginary bug' that was used during calibration. The unit requires fitting and INTERNAL ADJUSTMENT before it will operate on a given phone line, and will not detect bugs that are installed already, only if another bug is added after the unit is installed. (See also Bug Detector 2000 for RF bugs on the line).

PHONE TAPE PT - 00T $35 ($3.00 pack and post). This consists of a Tee piece and microphone lead. It is designed for manual operation. The Tee piece plugs into the phone line and the lead plugs into the MIC input of a tape recorder.

PHONE TAPE PT - 01 $70 ($3.00 pack and post). Comes with 2 alligator clips to be connected to the phone line (called parallel connection) so that when the handset is picked up, the tape starts. The 2.5mm plug fits into the remote socket and the 3.5mm plug fits into the MIC socket. The circuit is powered by one AA cell and this will last many months. For the Phone Tape to work, the recorder must have jacks labeled 'REM' and 'MIC'

PHONE TAPE PT - 01T $80 ($3.00 pack and post). Identical to PT - 01 except the input lead has a Tee piece for connecting to the phone line and the phone is plugged into the other end. This unit is easy to install by anyone in a matter of moments.

PHONE TAPE PT - 02 $65 ($3.00 pack and post). This is a miniature version of PT - 01 and requires NO BATTERY. Can be used with any tape recorder having 6v or 9v supply or mains operation. For 3v microcassettes, you must use PT - 01. Note: PT - 02 does not pick up dial pulses.

PHONE TAPE PT - 05 $85 ($5.00 pack and post). This unit is similar to PT - 01 except that it has a timing circuit to limit recording time to the first 5 minutes of a call. (This can be switched off.) This allows you to get up to 12 calls on a C-120 cassette.

PHONE TAPE PT - 05T $95 ($5.00 pack and post). Same as PT - 05 but with Tee piece for quick connection to the phone line.

RF OPERATED TAPE RECORDER RFT - 01 $180 ($10.00 pack and post). This tape recorder is designed for use with the SCORPION or VOX bugs. It turns on when it picks up RF transmission and begins to record the signals received. The advantage of this is that it can be left unattended and you can catch every event that occurs without wasting hours of tape. It will record up to 1 hour of speech and can be placed 200 - 400 metres away, in a convenient location. Comes complete with two C-90 cassettes.

RF OPERATED TAPE RECORDER RFT - 01S $220 ($10.00 pack and post). This unit is the same as the RFT - 01 except that it has a special slow down feature whereby you can increase the recording time to over two hours per side of a C 120 tape.

RIP OFF RP - 01 $65 ($3.00 pack and post). This unit provides a fixed time limit for STD calls etc. It puts a beep on the line every 3 or 6 minutes to inform you of the duration of the call. Will also prevent calls going overtime (by hanging up before the time expires) and unauthorised use of the phone. Please specify 3 minute or 6 minute timing intervals when ordering.

SCORPION SC - 01 $90 ($3.00 pack and post). This bug is designed to transmit telephone conversations up to 200 metres. It uses the phone line for power and antenna, therefore there are no obvious wires. The transmitting range will vary depending on your telephone installation. If the lines are above ground they will be better than if they are under ground. The only way to find out is to buy one and try it. It can be returned for a SPIDER if required. It is fitted in series with one phone wire and comes with full fitting instructions.

SCORPION SC - 02 $100 ($3 pack and post) Same as SC - 01 except it is fitted with a 4 pin US plug for electronic phones.

SPIDER SP - 01 $85 ($3.00 pack and post). Identical to the SCORPION, except that it has an antenna for better transmitting range if you have a poor phone line.

STD/ISD BAR ADAPTER BAR - 01 $45 ($3.00 pack and post). This device is mounted in a double adapter and prevents the caller dialing STD or ISD phone numbers. The adapter plugs into a standard socket and the phone plugs into the adapter. A hidden switch allows calls to be made or prevented.

TELEMITE MK II TM - 01 $48 ($3.00 pack and post). This is an improved version of the TELEMITE MK I and connects to the phone line instead of using a pick-up coil. It uses 2 AAA cells and operates at all times. Battery replacements: See Amoeba.

TIE CLIP MICROPHONE WM - 631 See Minister's mic.

TAPE RECORDER TR - 01 $65 ($6.00 pack and post). This is a specially modified tape recorder with zero standby current consumption for long battery life. Designed for use with Phone Tapes, the unit features AC or DC operation and uses normal sized cassettes. Size 5cm high x 14cm wide x 27cm long.

ULTIMA UL - 01 $65 ($3.00 pack and post). This is our most powerful bug yet. Capable of transmitting 1KM in a built up area (Several kilometres in open country) it is the most suitable unit for long distance transmission. Operation is the same as the Amoeba and the only difference is a slightly larger size. This unit is the size of a pack of 30's cigarettes and it uses 4 AAA cells. Battery replacement: $8.00 posted to you after 100 hours use.

VOX BUG VOX - 01 $75 ($3.00 pack and post). This is a voice operated bug that only transmits when it picks up sounds in a room. The battery life is about 3 times longer than normal because it is only transmitting when sounds are present. It has a very sensitive microphone and a trigger level control so you can set at what noise level the bug will activate.

VOX MK II VOX - 02 $35 ($3.00 pack and post). Same as the Vox Bug except that instead of transmitting, it switches a tape recorder on and off. Note: this unit does not improve the pick up of the tape recorder, it only switches it on and off.

VOYAGER VO - 01 $55 ($3.00 pack and post). A very small bug that fits on top of a 9v battery and transmits up to 800 metres.

WALL BUG WB - 01 $50 ($3.00 pack and post). This is an AMOEBA with a vibration detector input instead of a microphone. It is designed to be stuck on a window with Blu Tack and will listen right through the glass. Also called a SPIKE MIC or CONCRETE BUG by the professionals it will also listen through walls and doors. It is attached to the wall with double sided foam tape and the antenna is held down with Blu Tack.

WATER BUG WA - 01 $65 ($3.00 pack and post). Provides a homing beep and consumes very little current. When two probes come into contact with water, the bug transmits a continuous tone. Can provide three levels of indication via LOW - MEDIUM - HIGH tones to assist in tank or dam filling and can be used in irrigation fields or for bilge water in boats etc. Battery life is several months.

WIRELESS MICROPHONE WM - 01 $28 ($3.00 pack and post). A hand held mic for singers etc. Transmits up to 100 metres and is tunable to any position on the FM band.

All units are fully assembled and tested. They are sold on the understanding that they be used for your own personal safety and surveillance. On no account do we sell these devices for the purposes of intentional bugging of another person or persons.
All devices are guaranteed and we can modify certain units for specific applications.

Ring, write or call and see them demonstrated.

Talking Electronics,
35 Rosewarne Ave.,
Cheltenham, Vic. 3192
Tel: (03) 584 2386

TALKING ELECTRONICS Pty Ltd

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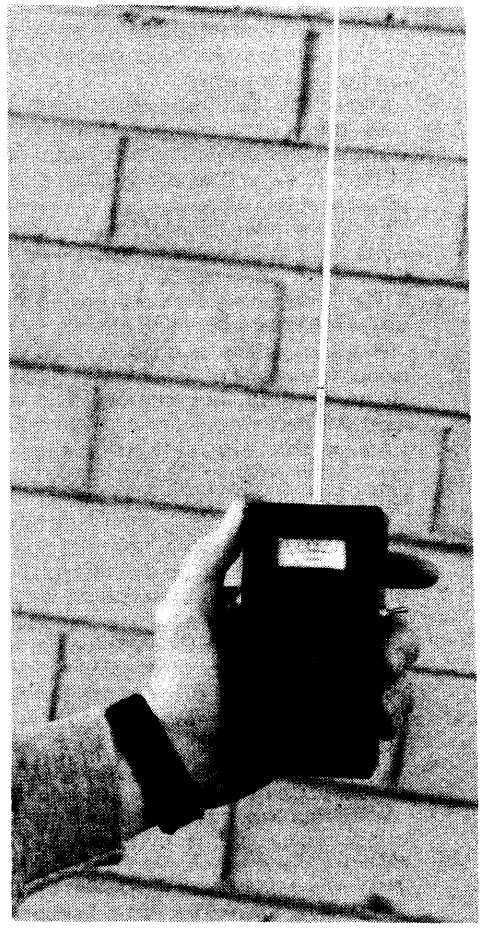
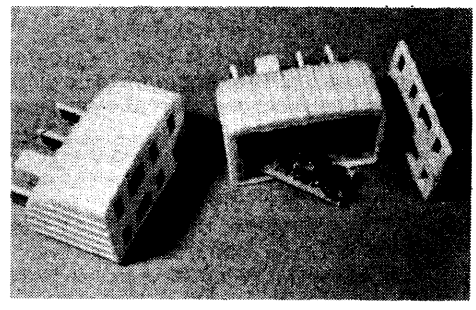
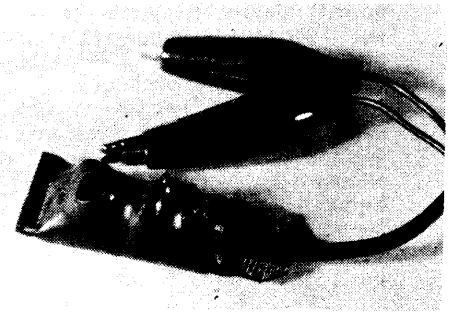
Coming soon! A bug detector with memory!
BD - 3000 $250.

SECURITY DEVICES PRICE LIST

Cat. No:	Description:	Price:
AB-01	Airball bug. A micro sized FM Bug in a "Magic mushroom".	45
AF-01	AM/FM Pocket radio. 12-719	40
AF-02	AM/FM Portable radio. 12-717	70
AL-01	Air link. (Guitar transmitter)	39
AM-01	Amoeba 400m Room transmitter	50
BAR-01	STD/ISD adaptor bar. Prevents outgoing STD calls.	45
BC-01	Room bug in a brief case. (Case supplied).	115
BD-2000	Bug Detector that finds transmitting bugs. 20-200 MHz	150
C-120	120 minute 'long play' cassette tape.	5
CT-01	Car tracker version 1 beep and audio, range 200m	55
CT-02	Car tracker version 2 beep only, range 400m	65
DA-01	'Double Adapter bug' A scorpion in a Double Adapter.	105
DB-01	'Dish bug' sensitive listening device non-transmitting.	85
HA-01	'Hiker's alarm' beeps & transmits voice of hiker in trouble	50
IBR-00	Infinity bug simple. Listen after other party hangs up	100
IBR-01	Infinity bug, coded auto answer. Ring version.	195
IBNR-01	Infinity bug, coded auto answer, mechanical phones no ring.	280
IBNR-02	Infinity bug, coded auto answer, electronic phones no ring.	330
KC-01	Key chain bug. (Looks like a 'key finder' beeper.)	50
LI-01	Listener. Phone amplifier for the hearing impaired	75
PB-01	Bug inside a key chain.	50
PBS-01	Phone bug sniffer. Detects bugs on your telephone line.	145
PH-01	Phone bug disguised as a capacitor. Requires soldering.	85
PT-00	Phone tape for sound only, no motor on/off switch.	35
PT-01	Standard phone tape with motor control	70
PT-01T	Standard phone tape with motor control, Tee piece.	80
PT-02	Phone tape with motor control, no battery required.	65
PT-02T	Phone tape with motor control, no battery, Tee piece.	75
PT-05	Phone tape, records 1st 5 minutes of call only	85
PT-05T	Phone tape, records 1st 5 minutes of call only, Tee piece.	95
PR-01	RQ-2104 National tape deck, A.C. powered.	70
PR-02	'International' A.C. & D.C. tape deck for phone tapes etc.	65
RO-01	M-1115 VOX tape deck, with remote socket	150
RO-02	Micro 18 micro cassette recorder.	110
RFT-01	RF Operated tape recorder.	180
RFT-01S	RF Operated tape recorder with motor speed control.	220
RP-01	'Rip Off' phone timer, 3 or 6 minute intervals	65
SC-01	Scorpion phone transmitter	90
SC-02	SC-01, with 4 pin U.S. plug for electronic phones.	100
SP-01	SC-01, with antenna for better range in poor areas.	85
TM-01	Constant phone transmitter (10 days life).	48
UL-01	Ultima 1Km room transmitter	65
VOX-01	Transmitting VOX bug.	75
VOX-01B	Transmitting VOX in-a-box, with telescopic antenna.	95
VOX-02	VOX MkII VOX unit for tape decks.	35
VO-01	Voyager 800m room Transmitter using a 9v battery	55
WA-01	Water bug. Three tone water detector - transmitter.	65
WB-01	Wall bug. 400m Transmitter that listens through glass etc.	50
PR-01	'Pro 2' stage mic for singers & performers.	28
WM-631	"Ministers mic" Lapel microphone. Transmits 50 metres	45







DRIGS

How many times have you flipped through a magazine in the vain hope of finding an interesting article? As you thumb through the pages, the hopes are dashed and finally you come to the last page.

There you find an article of untold wit and interest to make the purchase of the magazine worthwhile.

I hope this isn't the present case but now that you have reached the end I want to summarise all that's happened in the TE world and bring together the projects in this issue.

Firstly we have the CAR ALARM. It has a range of features to rival anything on the market and can be built for under $100. If you have a car worth saving, this alarm will keep your mind at rest.

The TEC article is quite large in this issue as a result of Jim's tireless effort. Some readers, not interested in the TEC, will think it goes on for too long. But one of the biggest criticisms of worthwhile projects in other magazines is the lack of back-up and support.

Generally the project extends over an issue or so and is never heard of again. All those who build it up are left high and dry with little understanding of its full potential.

Not so with the TEC. We have gone a full circle looking for other microprocessors, to rival the Z-80. But after spending thousands of dollars and hundreds of hours we have come to the conclusion that the Z-80 is the best (overall) and cheapest on the market.

With this we have no hesitation in bringing you pages of assistance in designing and developing programs in Z-80 code and it is our firm belief the the Z-80 will be around for years to come.

The two new projects for the TEC are the DAT board and Speech board.

The DAT board is a boon for programmers as it allows programs to be written and analysed one step at a time via a single stepper program.

The DAT board interfaces the TEC to a tape recorder to allow the storage of programs in a very convenient form.

The software to drive the DAT board and the tape interface is contained in Jim's new MONitor ROM called JMON.

JMON is the result of 9 months continuous refinement and hundreds of different versions have been created over that time. The end result is certainly a very good MONitor package.

Because JMON is a considerable advancement over MON 2, if you are building the computer from scratch you should start with MON 1B/2 and go through the experiments contained in issues 10, 11, 12, 13, and 14.

One essential add-on for the TEC is the NON VOLATILE RAM (issue 13) and if you would like to create a matrix of 64 pixels, the 8x8 is a must.

After these you can build the DAT BOARD and appreciate its wide range of capabilities.

In the TEC article we have supplied a game program called MAGIC SQUARE.

It can be typed in and played on the 8x8 display. MAGIC SQUARE is fully documented and it is hoped that you will appreciate how the routine works as much as you enjoy the game.

MAGIC SQUARE will have you baffled for hours. Once you work out how to get the square out, see it you can work out how the program works!

Once you have typed it in, it can then be saved on tape and recalled later.

If the TEC computer has grabbed you, a documentary package is available from Jim for $15.00 plus $2.50 postage. In this you get a full line-by-line explanation of how all the JMON routines work. As Jim put it, he hopes that you can understand the purpose of every instruction. Also if you purchase this package, you help Jim offset his costs on developing JMON and the DAT BOARD etc.

Drigs is the dregs!

There are also some other notes on programming in the package and will prove to be more beneficial than buying a $25 book on the Z-80 by a "bandwagon" publishing Co.

If you have really been bitten by the bug, you can buy a program tape with two TEC games, written by Cameron Sheppard. The first program is called MAZE and is played on the 8x8. It consists of a 27x30 playing field and the aim is to get out. This will keep you occupied for weeks!

The other game is "TEC invaders" and it's a bit like Space Invaders on a smaller scale.

These programs came as a result of co-operation between Jim and Cameron. It all started when Cameron came into TE some years ago with his TEC INVADERS. At the time the program was far to long to be published and the best efforts of Cameron and myself were unable to shorten it. One day Jim found the program and thought it would be a good program to put onto tape. Jim rang Cameron and they formed an agreement together.

Jim provided Cameron with a tape system and Cameron did some work required to add the finishing touch.

The rest is history!

To go over the TEC projects once again: DAT BOARD and PCB is $55.35 or $16.35 if you want just the tape and single stepper facilities without the LCD. Speech is $27.25, JMON is $16.00. Jim's package is $15.00, Cameron's tape is $6.50, Jim's EPROM programmer up-date is $2.30. These are all essential if you want to get into programming.

Next we have a beginners project (although the soldering requires a fair degree of skill). It's an Organ along the lines of a stylus organ and is great fun to play. It looks most impressive when built up and is ideal as a gift for the budding Beethoven.

A miniature FM radio has been a constant request from readers who have constructed one of our FM bugs. It's small enough to be hidden and allows you to create your own FM link.

And finally we have the FM bug that everyone's been waiting for. Our 1km bug, the ULTIMA. It's a sneak preview of out next bugging book "Security Devices." Once the word got out that it had been developed, we started selling kits! Now it's available for everyone and provided you are careful, you can experiment and achieve ranges of 1km and more.

The articles for Security Devices are nearly ready for final page-making and they should be going to the printer very soon.

Apart from the 1km bug and FM radio, we have included 6 other security-related projects to add to our range.

Many of these are not available on the market while others cost hundreds, if not thousands of dollars. (Take for instance the Pen bug. It sells for over $3,000 on the commercial market!)

You can save a fortune by building things yourself and at the same time, learn how its all done.

Look out for this book, as well as future issues of the magazine at your local newsagents or send for a subscription and be assured you don't miss a copy.

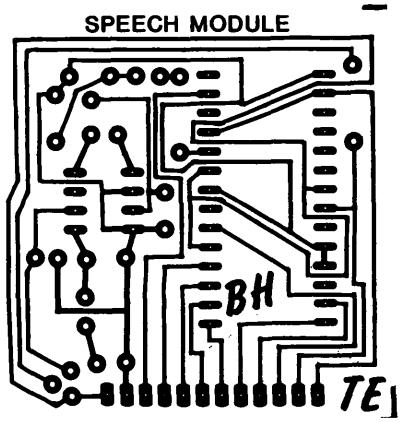
ISSUE 16

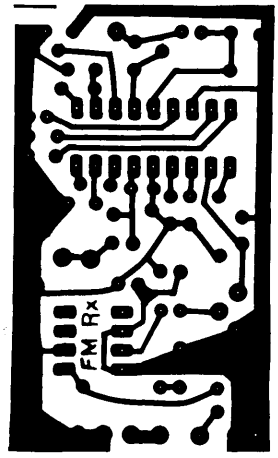
We hope to see both issue 16 and 17 out in '89. Issue 16 should not be too far off as we have have numerous articles left over from this one.

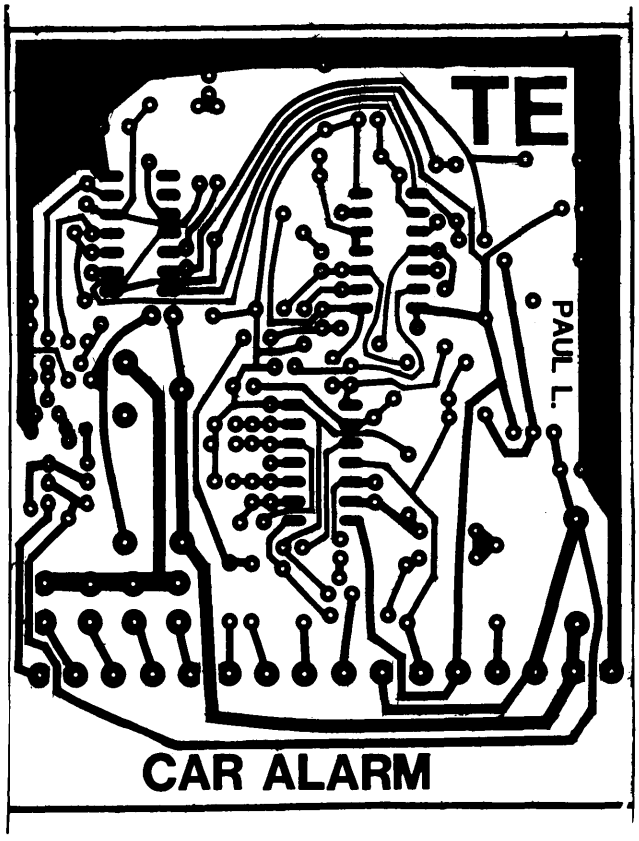
Jim is designing an expansion board for the TEC. The board was to be presented in this issue but it became clear that there just wasn't the room. Jim's board increases the memory by 20k. 8k of this is a battery backed RAM. There is an on-board "intelligent" EPROM programmer that when not being used to read and program EPROMS, can be used as 20 general input/output lines.

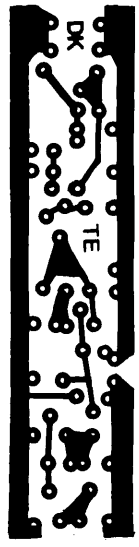
So we come to the end of another packed issue. So full that we didn't have any room for the adverts. Ah! Such is life. A magazine without advertising.

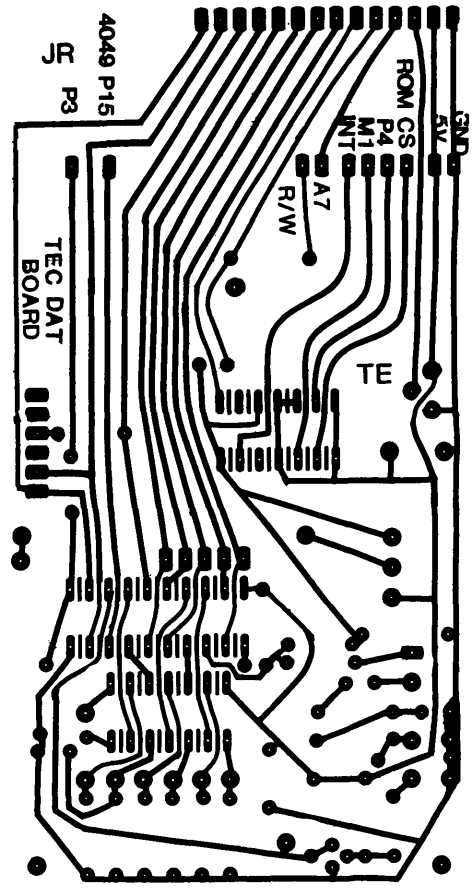
PC ARTWORK FOR THIS ISSUE

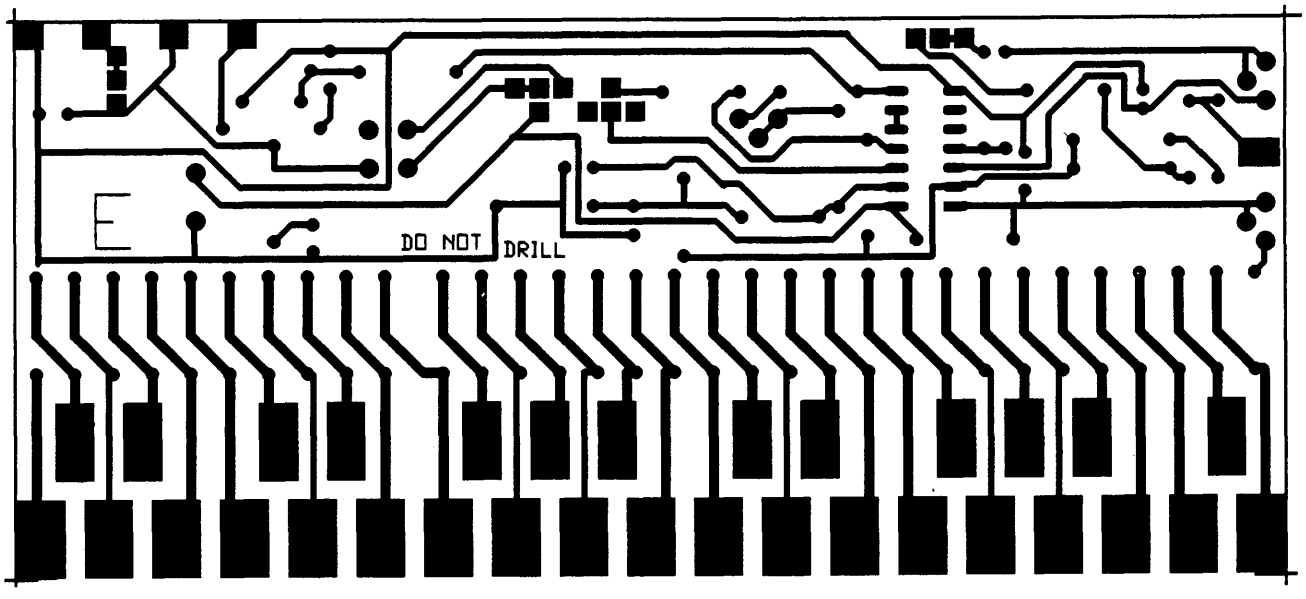












ASCII DISPLAY TABLE FOR LCD

Upper bit 4 bit / Lower bit 4 bit	0000	0010	0011	0100	0101	0110	0111	1010	1011	1100	1101	1110	1111
××××0000	CG RAM (1)												
××××0001	(2)												
××××0010	(3)												
××××0011	(4)												
××××0100	(5)												
××××0101	(6)												
××××0110	(7)												
××××0111	(8)												
××××1000	(1)												
××××1001	(2)												
××××1010	(3)												
××××1011	(4)												
××××1100	(5)												
××××1101	(6)												
××××1110	(7)												
××××1111	(8)												