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# '68' MICRO JOURNAL


**VOLUME II ISSUE 2 • Devoted to the 68XX User • February 1980**


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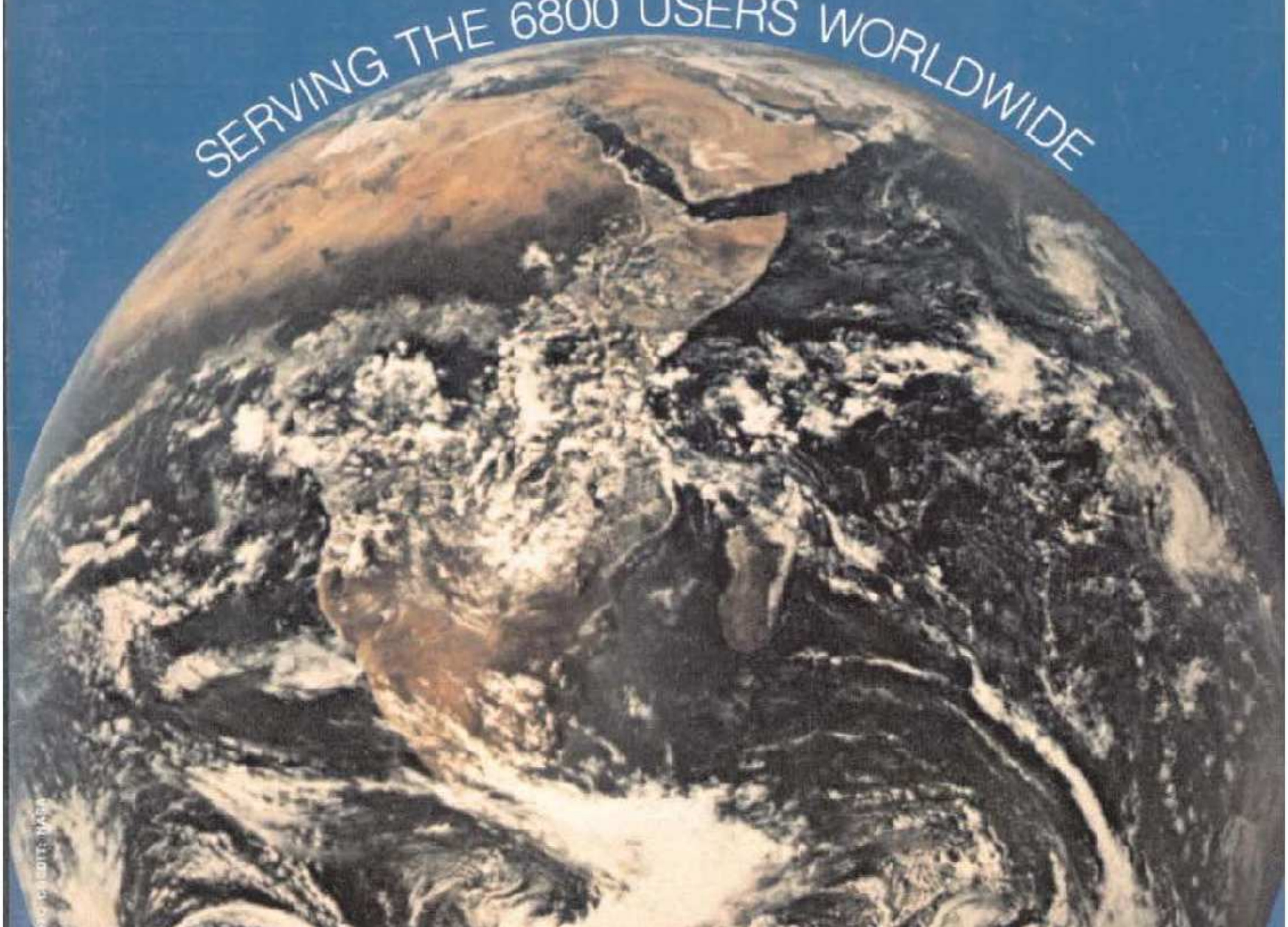

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(Letters to the Editor for Publication) All 'letters to the Editor' should be substantiated by facts. Opinions should be indicated as such. All letters must be signed. We are interested in receiving letters that will benefit or alert our readers. Praise as well as gripes is always good subject matter. Your name may be withheld upon request. If you have had a good experience with a 6800 vendor please put it in a letter. If the experience was bad put that in a letter also. Remember, if you tell us who they are then it is only fair that your name 'not' be withheld. This means that all letters published, of a critical nature, cannot have a name withheld. We will attempt to publish 'verbatim' letters that are composed using 'good taste.' We reserve the right to define (for '68' Micro) what constitutes 'good taste.'

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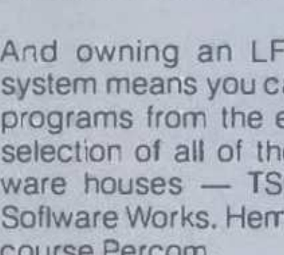
Available in versions for mini FLEX†, FLEX 2.0† and Smoke Signal Broadcasting Company's DOS, SOFTRAN™ copies soft-sectored minidiskettes track-for-track onto hard-sectored minidiskettes. If the source disk includes a FLEX† or 'Smoke' DOS, SOFTRAN™ is used to modify the operating system to function with the Percom LFD-400™.



SOFTRAN™ is supplied on a minidiskette along with utilities for only $24.95. A users manual is included. You must indicate whether SOFTRAN™ is to be used for mini FLEX†, FLEX 2.0† or Smoke's DOS.

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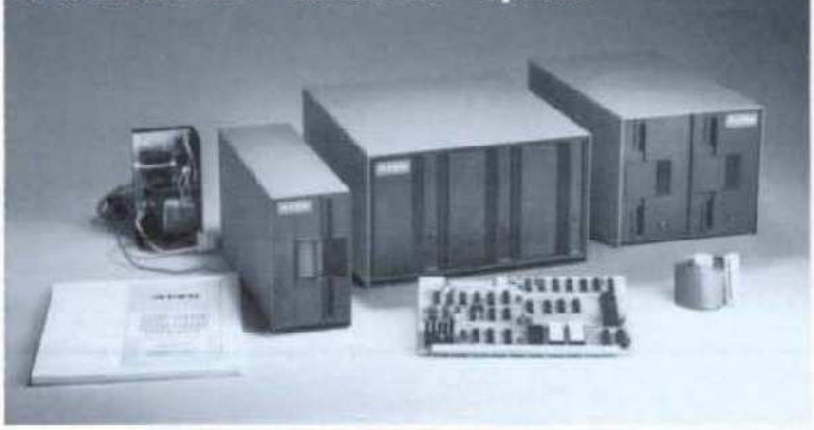


Each LFD mini-disk storage system includes:

- drives with integral power supplies in an enamel-finished enclosure
- a controller/interface with ROM operating system plus extra ROM capacity
- an interconnecting cable
- a comprehensive 80-page users manual

## Low-Cost Mini-Disk Storage in the Size You Want.

Percom LFD mini-disk drive systems are supplied complete and ready to plug in the moment they arrive. You don't even have to buy extra memory. Moreover, software support ranges from assembly language program development aids to high-speed disk operating systems and business application programs.

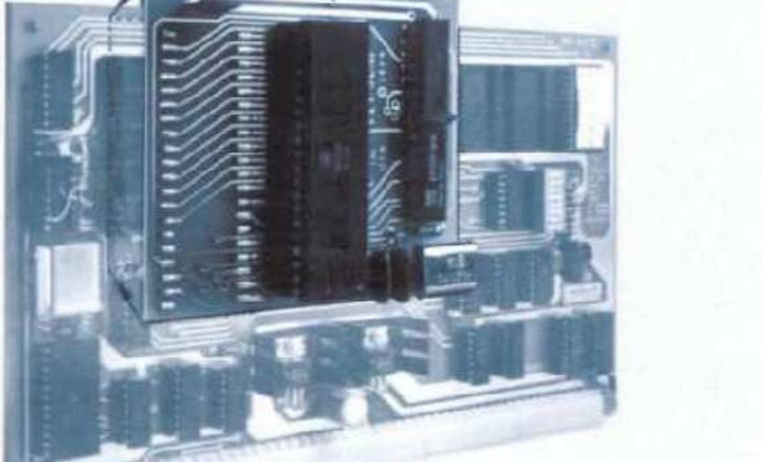
The LFD-400™ and -400EX™ systems and the LFD-800™ and -800EX™ systems are available in 1-, 2- and 3-drive configurations. The -400, -400EX drives store 102K bytes of formatted data on 40-track disks, and data may be stored on either surface of a disk. The -800, -800EX drives store 200K bytes of formatted data on 77-track disks.

The LFD-1000™ systems (not pictured) have dual-drive units which store 800K bytes on-line. The LFD-1000™ controller accommodates two drive systems so that a user may have as much as 1.6M bytes on-line.

**Mini-disk storage system prices:**

| MODEL | 1-DRIVE SYSTEM | 2-DRIVE SYSTEM | 3-DRIVE SYSTEM |
|---|---|---|---|
| For the SS-50 Bus: | | | |
| LFD-400™ | $ 599.95 | $ 999.95 | $1399.95 |
| LFD-800™ | 895.95 | 1549.95 | 2195.95 |
| For the EXORciser* Bus: | | | |
| LFD-400EX™ | $ 649.95 | $1049.95 | $1449.95 |
| LFD-800EX™ | 945.95 | 1599.95 | 2245.95 |
| LFD-1000™ | (dual) $2495.00 | (quad) $4950.00 | — |

*EXORciser* Bus LFD-400EX,™ -800EX™ Systems*



### *Upgrade to 6809 Computing Power. Only $69.95*

Although designed with the SWTP 6800 owner in mind, this upgrade adapter may also be used with most other 6800 and 6802 MPUs. The adapter is supplied assembled and tested, and includes the 6809 IC, a crystal, other essential components and user instructions. Restore your original system by merely unplugging the adapter and a wire-jumpered DIP header, and re-inserting the original components. Also available for your upgraded system is PSYMON™ (Percom SYstem MONitor), the operating system for the Percom 6809 single-board computer. PSYMON™ on 2716 ROM costs only $69.95. On diskette (source and object files), only $29.95.

### Data Terminal & Two-Cassette Interface — the CIS-30+

- Interface to data terminal and two cassette recorders with a unit only 1/10 the size of SWTP's AC-30.
- Select 30, 60 or 120 bytes per second cassette interfacing; 300, 600 or 1200 baud data terminal interfacing.
- Optional mod kits make CIS-30+ work with any microcomputer. (For MITS 680b, ask for Tech Memo TM-CIS-30+-09.)
- KC Standard/Bi-Phase-M (double frequency) cassette data encoding. Dependable self-clocking operation.
- Ordinary functions may be accomplished with 6800 Mikbug* monitor.

Prices: Kit, $79.95. Assembled, $99.95. Prices include a comprehensive instruction manual. Also available: Test Cassette, Remote Control Kit (for program control of recorders), IC Socket Kit, MITS 680b mod documentation and Universal Adapter Kit (converts CIS-30+ for use with any computer).

# of 6800 Microcomputing.

## 6800/6809 SOFTWARE

### System Software

6800 Symbolic Assembler — Specify assembly options at time of assembly with this symbolic assembler. Source listing on diskette ........ $29.95

Super BASIC — a 12K extended random access disk BASIC for the 6800 and 6809. Supports 44 commands and 31 functions. Interprets programs written in both SWTP 8K BASIC (versions 2.0, 2.2 & 2.3) and Super BASIC. Features: 9-digit BCD arithmetic, Print Using and Linput commands, and much more. Price ........ $49.95

TOUCHUP™ — Modifies TSC's Text Editor and Text Processor for Percom mini-disk drive operation. Supplied on diskette complete with source listing ........ $17.95

### Operating Systems

INDEX™ — This easy-to-use disk-operating and file management system for 6800 microcomputers is fast. I/O devices are serviced by interrupt request. INDEX™ accesses peripherals the same as disk files — new devices may be added without changing the operating system. Other features: unlimited number of DOS commands may be added • over 60 system entry points • display only those files at or above user-specified fileactivity level • versions available for SWTP MF-68, Smoke's BFD-68 and Motorola's EXORciser*. Price ........ $99.95

MINIDOS-PLUSX™ — An extension of the original MINIDOS™ for LFD-400™ mini-disk systems. MINIDOS-PLUSX™ manipulates files by six-character names. Supports up to 31 files. Resident commands include Initialize, Save, Allocate, Load, Files (directory list), Rename and Delete. Supplied on 2708 ROM with a minidisk file that includes transient utilities such as Copy, Backup, Create, Pack and Print Directory. Price ........ $34.95

PSYMON™ — Percom SYstem MONitor for the Percom single-board/SS-50-bus-compatible 6809 computer accommodates user's application programs with any mix of peripherals **without** modifying programs. PSYMON™ also features character echoing to devices other than the communicating device, sophisticated register and memory dump routines and more. Price (on 2716 ROM) ........ $69.95

WINDEX™ — Described in detail elsewhere on this page.

### Business Programs

General Ledger — For 6800/6809 computers using Percom LFD mini-disk storage systems. Requires little or no knowledge of bookkeeping because the operator is prompted with non-technical questions during data entry. General Ledger updates account balances immediately — in real time, and will print financial statements immediately after journal entries. User selects and assigns own account numbers; tailors financial statements to firm's particular needs. Provides audit trail. Runs under Percom Super BASIC. Requires 24K bytes of RAM. Supplied on minidiskette with a comprehensive users manual. Price ........ $199.95

FINDER™ — This general purpose data base manager is written in Percom Super BASIC. Works with 6800/6809 computers using Percom LFD-400™ mini-disk drive storage systems. FINDER™ allows user to define and access records using his own terminology — customize file structures to specific need. Basic commands are New, Change, Delete, Find and Pack. Add up to three user-defined commands. FINDER plus Super BASIC require 24K bytes of RAM. Supplied on minidiskette with a users manual. Price ........ $99.95

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| Relocting Disassmblr/Segmented Text Gen | $40.95 |
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| Support Relocator Program | $25.95 |
| Relocating Assembler/Linking Loader | $55.95 |
| SmithBUG** (2716 EPROM) | $70.00 |

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| | |
|---|---|
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| STRUBAL+‡ compiler | $124.97 |
| EDIT68 text editor | $ 19.97 |
| MACRO-Relocating Assembler | $ 39.97 |
| Linkage Editor (LNKEDT68) | $ 24.97 |
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## This programmable VIDEO DISPLAY CONTROLLER

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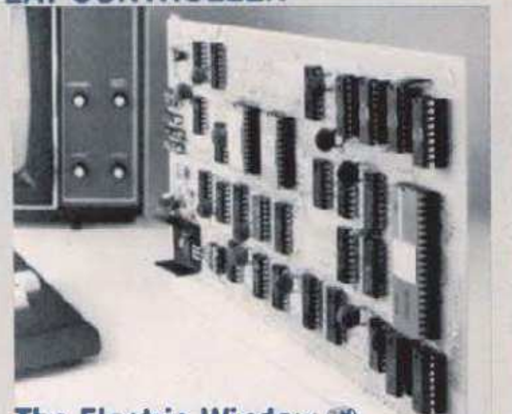

## The Electric Window.™ Worth Looking Into. $249.95

- **Programmable CRT controller chip** that provides extraordinary versatility in software control of horizontal and vertical formatting, cursor positioning, scrolling and Start/Reset functions.
- A standard ASCII 128-unit ROM character generator which generates easy-to-read **7 x 12 dot-matrix characters with lower case descenders**. Plus ...
- Provision for an **optional ROM** that may **be programmed for special symbols or characters**.
- Resides **entirely in 2K on-board RAM** mapped into main memory.
- An optional **software driver program** called WINDEX™ that complements the fast, hardware-implemented functional capability of the controller. WINDEX™ will auto-link to PSYMON™, the monitor for the Percom SBC/9™ single board computer. The ROM version of WINDEX™ costs $39.95. The minidiskette version (with source and object files) sells for $29.95.
- **Up to 24 80-character lines** — programmable.
- Program control of **display highlighting**.
- Program **interlaced or non-interlaced** scan.
- Use either **standard video monitor or modified tv**.

## Now Available! the SBC/9™ MPU/Control Computer

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See full page ad elsewhere in this magazine for all of the SBC/9™ features.

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All of the features needed for rapid, straightforward circuit prototyping. Use 14-, 16-, 24- and 40-pin DIP sockets
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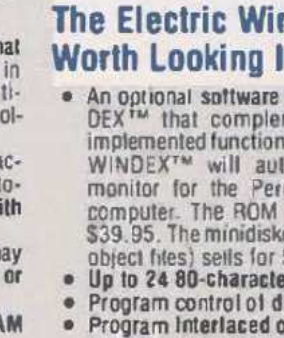

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# 68 MICRO JOURNAL SOFTWARE CONTEST

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THIRD - 3 year extension 68 Micro Journal™

4th-10th 1 year extension 68 Micro Journal™

The software must be applications, utilities or serious software, of original design, to operate with the following CATEGORIES:

| | |
|---|---|
| TSC FLEX | 6800 Disk System MiniFlex |
| TSC FLEX | 6800 Disk System FLEX Ver. 2.0 5" |
| TSC FLEX | 6800 Disk System Ver. 1.0 8" |
| TSC FLEX | 6809 Disk System Ver. 09 5" or 8" |
| SSB | Dos Version 5 |
| SSB | Dos Version 4 or earlier |
| SSB | TSC FLEX Version |
| PERCOM | INDEX |
| PERCOM | MiniDos+ |
| HEMENWAY | CP/68 Disk System |
| MSI | Disk Operating Systems |
| SOFTWARE DYNAMICS SDOS | |
| JPC | TC-3 Cassette System |
| ANY | KC Standard Tape System |
| BASIC | Any 6800 Version |
| BASIC | Any 6809 Version |

There are sixteen (16) categories, as indicated above. In addition we have other prizes donated by various vendors of 6800/09 products. As of the 15th of November 1979 over $13,000.00 in prizes has been pledged.

GIMIX - Mainframe, value $829.00. ** A GRAND PRIZE **

SOUTHWEST TECHNICAL PRODUCTS CORP (SWTPC) Computer 69/8, value $595.00. ** A GRAND PRIZE **

DIGITAL RESEARCH: COMPUTERS, 16K static memory board kit, value $295.00.

JPC PRODUCTS, TC-3 kit w/CFM-3 package; AD-16 kit; CK7 kit, total value $190.00.

STAR-KITS, Set checkbook balancing software : MiniFLEX™ or PERCOM Super BASIC on disk, value $40.00.

MICROWARE Systems Corp, Package 1 each: ABASIC Compiler, ABASIC Source Gen., ABASIC Interpreter, LISP Interpreter; also 6 each RT/68 ROM OS and 6 each 6800 Chess programs. Total value $1,005.00.

SMOKE SIGNAL BROADCASTING, two $500.00 gift certificates for any SSB product. Categories eligible SSB DOS Ver. 4 or earlier and Ver. 5 or later; total value $1,000.00.

LUCIDATA, 5 each PASCAL Ver. 2, 1 to each FLEX™ category. Total value $750.00.

COMPUTERWARE, 2 each $200.00 gift certificates for any Computerware software product. 1 gift certificate for best of SSB disk BASIC and 1 gift certificate for best of Computerware's Random BASIC. Total value, $400.00.

SSI, Schreier Software Index, choice of $100.00 of SSI software.

SOFTWARE DYNAMICS, 6800 BASIC Compiler, value $350.00.

The MICRO WORKS, choice of any one item, value up to $179.95.

HEMENWAY ASSOCIATES, INC., Books, 3 each CP/68, 3 each XA6809 Macro Cross Assembler, 3 each STRUBAL+ Compiler, total value $329.55.

CER-COMP Microcomputers, MiniDisk+ Disk system (EPROM) and software on disk. Total value $89.00.

TECHNICAL SYSTEMS CONSULTANTS (TSC), $250.00 choice of any TSC software, for best of FLEX™ entries.

HHH Enterprises and Springbok Digitronics, SPIRIT (disk SSB) and a copy of STD-1, these will be awarded for 'best of SSB DOS. Value $110.00.

ED SMITH'S SOFTWARE WORKS, RRMAC Recursive Macroassembler and Linking Loader, $150.00, for best recursive macro program.

PERCOM, Assorted hardware and software, items to be listed next month

Final decision shall be delegated to a panel of judges selected by the staff of 68 Micro Journal™. All judges decisions are final and each person submitting, shall by his or her submitting material for evaluation, acknowledge that they agree to abide by any and all rules of this contest, as published within the pages of 68 Micro Journal™

Programs and material submitted shall be judged on the basis of good and workable software. By this we mean, it should do something useful and be needed by the average 6800/09 user in the particular category. Size is of little importance, the most important consideration will be how useful it is.

All material submitted shall remain the property of the original owner (who should be the author). Each submission shall contain a paragraph that states the material submitted is of original design and the property of the person in whose name it is submitted.

It shall be understood that regardless of who wins or does not win a prize, all material submitted shall be authorized and eligible, to be published by 68 Micro Journal™. Material published, which was not a winning entry, shall gain the author an extension to his or her subscription. Anyone may enter and it is not a requirement that the person submitting material be a subscriber to 68 Micro Journal™. Prizes will be awarded on the quality of the material submitted and being or not being a subscriber, will have no bearing.

Full details may be secured from previous issues of 68 Micro Journal™.

## AN I N D E X
## to the
## "68" MICRO JOURNAL
Compiled by Jim Schreier

### Preface

Few Microcomputer publications can match the variety of the 1979 issues of the "68" MICRO JOURNAL. The 200 plus entries of this Index will be proof enough. My 6800 interest was created a few years ago when when it was discovered the 6800 systems were the only ones to make sense. And they worked. And worked. In almost three years my SWTPC 6800 went down once. It blew a fuse. So you see, the "68" MICRO JOURNAL has a good act to follow: It makes sense and provides excellent information.

The thousands of MICRO JOURNAL readers probably keep back issues under protective custody. And, based on the assumption that the average reader's ability to find a specific article, news release, product announcement, review or letter is no better than mine, an Index is a must. Some microcomputer magazines are made to look nice, some aim at the hippie market (yet!); but the MICRO JOURNAL is, like a three course meal, made to be enjoyed and digested.

This Index covers everything but ads. Some of the page layouts in early issues are not clear, however any Index errors are my responsibility. The Index was prepared using the TSC FLEX2 Text Editor, Text Processor and Sort/Merge Package. Five fields were established after examining the various type source entries. Since the sources contain two type of entries the fields had to have certain common elements for proper layout. Normally the "no entry" character ("-") would be edited out prior to the final Text Processor pass. In order for MICRO JOURNAL users unfamiliar with Text Processing to observe these items, "no entry" characters have been retained. The FLEX2 DOS TTYSET WD command was set at 42.

It is my hope that the labor represented in this Index may be of current and future value to that special group of people, the "68" MICRO JOURNAL readers.

6800 Memory Clear article By Brian Abernathy July 1979 p 39

6800 PASCAL news release By - August 1979 p 28

6800 Patches to GIMIXBUG v 2.0 & 2.3 etc. letter By Richard Don September 1979 p 17

6800 Software TSC Cassette BASIC patch to Disk Save & Load (assembled listing) By Mickey E. Ferguson August 1979 p 14

6800 Software Print Using for CCS BASIC v 4.0 (assembled listing without comments) By Jeff Brownstein August 1979 p 30

6800 Software Program to test addition (assembled listing-symbol table) By Jack Bryant February 1979 p 11

6800 Software Conversion (2) programs FLEXtm to BDF (assembled listings-symbol table) By Dale L. Puckett February 1979 p 15

6800 Software Tiny BASIC music generation (1 assembled listing; 4 BASIC routines) By Noel J. Thompson February 1979 p 22-26

6800 Software Patches to G2 Standard BASIC allowing storage on PERCOM disk (assembled listing) By Chuck Adams July 1979 p 31

6800 Software Print Spooling for SSB (assembled listings with comments) By Dan Johnson July 1979 p 33

6800 Software Integer Arithmetic Package v 3.0 (assembled listing with comments and symbol table) By Jack Bryant July 1979 p 8

6800 Software Improved Boot for SWTPC Mini Disk System (assembled listing with symbol table) By Allen Clark & Al Tejera July 79 p 17

6800 Software LOCATE (Update) assembled listing with comments and symbol table (FLEXtm utility) By Dennis Womack June 1979 p 13

6800 Software Time Prompts for FLEXtm (assembled listing with some comments) By R. Dembinski June 1979 p 30

6800 Software BASIC Renumbering for SWTPC 8K BASIC (assembled listing with comments and symbol table) By Mickey Ferguson June 79 p 20

6800 Software Integer Arithmetic Package v 1.0 (assembled listing with symbol table) By Jack Bryant March/April 1979 p 6

6800 Software Integer Arithmetic Package v 2.0 By Jack Bryant May 1979 p 12

6800 Software BASIC (MSI BASIC) String Editor (assembled routine without comments) By E. M. Pass November/December 1979 p 10

6800 Software SWTPC CT-82 configuration routine (assembled listing) By Anthony Niesz November/December 1979 p 26

## Micro-time 6800 Review

The Micro-time 6800 is a stand alone real-time clock and calendar. This means that no system overhead or interrupts are required for time keeping as in some other system clocks. The clock is timed by a quartz oscillator with a trimmer capacitor for fine tuning. This allows operation without need for timing from the sixty Hertz power source and steering diodes are provided to allow operation from separate dc power sources or for battery backup to keep the clock running during power blinks.

The clock board plugs into a standard 30 pin I/O port and has a connector on top where manual time and date set switches may be attached.

The software provided with the board is in three sections. The first section when called as a subroutine, updates the time and date in a scratch area in ram. The second routine prints the time and date on the I/O device in the form : "12/17/79 10:35:22 PM EST". The last routine is used to set the clock and calendar.

The clock board is offered just as a bare board with connectors and documentation or factory assembled and tested. The assembled unit is available in either a switch setable version or software setable. The version which was sent for evaluation was the software setable version and seems to be well worth the few extra bucks that it costs.

The software was provided with a commented source listing, which was fortunate since I had to reassemble for my 09 system. Incidentally, when reassembled for the 09, the code was about 101 longer; however, when optimized for the 09, the needed code required approximately 151 fewer bytes than the 6800 version.

The documentation supplied is complete and explains operation adequately. The quality of the board and components used is good and the advantage of not having to worry about loosing the time every time the reset button is pressed, as happens with the clock I have been using, makes this device a worthwhile addition to any 68XX system. Other accessories include an A/C adapter for powering the clock while the computer is turned off and a Kansas City cassette with the previously described software. The Micro-time 6800 is available from :

THE DATA MART
914 E. WAVERLY DRIVE
ARLINGTON HEIGHTS, IL 60004

A 68 Micro Journal™ lab rating of: AAA

Rating Scale:
AAA - Excellent
AA - Good
A - Fair (could be better but works)
P - Poor (may not always work properly)
X - Not recommended for children
(or anything else!)

-----

## PERCOM PROTOTYPING BOARDS REVIEW

Percom Data Company has recently announced two new 68XX prototyping circuit cards. One card fits the standard SS-50 bus and has enough room to accomodate up to 70 14-pin DIP sockets or less 16,24, or 40-pin sockets. The top of the board has pads for insertion of a 34-pin and a 50-pin ribbon cable connector. One side of the board provides an area for miscellaneous circuitry or test points. DC power for the board is fed from the 8-volt bulk supply and goes to circiut pads for a 5-volt regulator. From the regulator a plus supply buss feeds between alternate rows of pads so that it is close to all circuits. A ground buss passes between opposite alternate rows also in close proximity to all circuits.

The second board is a SS-30 bus board. It has room for up to 34 14-pin DIP sockets or less larger sockets.The top edge provides pads for one 12-pin Molex connector and a 34-pin ribbon cable connector. A small area is also provided at the top for other miscellaneous circuits,indicators, or test points. The SS-30 board also has pads for a 5-volt regulator and positive supply and ground busses close to all socket locations. Both boards are single sided, solder plated, and up to Percoms usual high quality.

One thing that I watch closely on 68XX boards is how well the mother board molex connectors fit. There is nothing that bothers me more than boards that fit onto the mother board at a 30-degree angle. The Percom boards passed this test well. The quality of the boards is excellent and allow for optimun placement of IC's and components. The only complaint that I have is the fact that there is no identification of any of the mother board signals on the board. This would have made use of the boards somewhat easier. The boards are available from:

PERCOM DATA COMPANY, INC.
211 N. KIRBY
GARLAND, Texas 75042

A 68 Micro Journal™ lab rating of: AAA

Rating Scale:
AAA - Excellent
AA - Good
A - Fair (could be better but works)
P - Poor (may not always work properly
X - Not recommended for children
(or anything else!)

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## J.B.I. CT1024-64 High Speed Conversion

If you are like a lot of the rest of us 68XX users, you still use one of the SWTPC earlier terminals. The SWTPC CT-1024 and CT64 were two of the most popular video display units for 68XX users. They were low in cost and worked reasonably well. The keys were sometimes balky or at other times self striking. This was annoying but not fatal to the operation. The screen when refreshed looked like a midwest blizzard and occasionally the cursor developed a mind of it's own, wandering here and there at will. One of the most annoying drawbacks was the slow write speed of either. Three hundred baud was the normal and twelve hundred baud was the upper limit, and still is until you install the J.B.I. conversion kit. Despite these and other occasional quirks; the CT-1024 and CT-64 were and still are in use by thousands of micro users worldwide today.

The J.B.I. conversion kit eliminates many of the major drawbacks of the CT series of video displays. It can be adapted to those units that have been field-updated with 64 character mod (CT-1024) and other popular changes. It uses a DMA method of screen memory, essentially causing the terminal memory to become computer memory. By this scheme the screen can be written to at near computer speed. Screen writes can range from one character per second to 4,000 characters per second (40K baud). All of the memory management (terminal) is still accomplished by the terminal and leaves the CPU unburdened for these chores. BASIC can 'POKE' directly any character position (limited grapics) and 'PEEK' any character position.

Terminal memory can be relocated to any 1K block in computer memory range that is available. This requires a software change of three standard Mikbug™ routines. These are the ones used in screen write, e.g. $E1D1 OUTEEE, $E1AC INEEE and $E07E PDATA. Patches are furnished for practically all popular software.

The board has been run on 2 meg machines and requires no delay. Included with the kit is a scource listing of all changes or patches. The supplied software is RDMable. The converted terminal allows software control over scrolling or paging. One foil cut on the terminal eliminates the 'snow' problem when using the conversion kit. Baud rates are controlled from the keyboard or from software. It honors the tape 'SAVE and LOAD' thru BASIC at 300 baud. Exisiting software reqires only a change of the three routine references to run in the converted mode.

COMPUTER MODS

If you are still using the MP-C I/O board in slot 1 you will be required to lift one IC pin on the board, this eliminates 'echo' to the terminal. No changes are required to the computer if you are using a serial 'MP-S' I/O board.

MODS FOR CT-64

One trace cut and two IC pin cuts (or lift out if you are using sockets) also one wire jumper added.

MODS FOR CT-1024

One IC pin lift or cut and two grounds extended. One or possibly two wire extensions.

The conversion comes with two boards connected by two ribbon cables. The boards are factory built and require only memory chip installing if you use your own. One board fits on the computer S50 bus and the other replaces the memory board in the terminal. The kit comes with or without out memory IC's. This way you can use your old 2102 memory chips (if they are in sockets) or can be ordered with all new memory chips (2 Mhz). The prices advertised are $169.00 with you supplying the memory chips. If you order with new memory chips the price is $179.00. We recommend that you order with new chips as most all older chips are slow and end up looking like worms are eating portions of some characters, interesting but annoying!

One note of caution if you are going to update a CT-1024 you need to let them know if it has been modified for 64 characters per line or is original.

The documentation seems very complete and should be useable by anyone who originall constructed his terminal. It comes with 12 pages of instructions, diagrams, board layouts, software patches and assembled source code.

Additional information can be secured from:

JOHNSON MICRO COMPUTER
2607 E Charleston
Las Vegas, Nevada 89104
1-702-384-3354

A 68 Micro Journal™ lab rating of: AAA

Rating Scale:
AAA - Excellent
AA - Good
A - Fair (could be better but works)

P - Poor (may not always work properly)
X - Not recommended for children
(or anything else!)

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## CORESIDENT JBUG AND MINIBUG II MONITOR ROM FOR MEK6800S2 MICROPROCESSING SYSTEM

K. Russell Peterman Staff Scientist
Radian Corp. 8500 Shoal Creek, Austin, TX 78766

The Motorola MEK6800D2 microprocessor system features a hexadecimal keypad for data/address entry and a 7-segment LED array for data/address display. The system also utilizes one ACIA as a Kansas City Standard audio cassette interface. The JBUG ROM monitor supplied with the system will support the functions outlined in Table I, including audio cassette read/write capabilities. However, during applications program development it is much more productive to use an external crossassembler such as M68SAM (Ref.1) for building object files. When the crossassembler is resident in a larger computer or development system, this almost always implies an RS-232 serial interface standard for data communications between the data terminal and the resident crossassembler. Thus, for prototyping purposes, it would be ideal in a system such as the MEK6800D2 to provide coresiding ROM monitors to format I/O data for either the hex keypad/audio cassett (JBUG) or an RS-232 serial data communications port (MINIBUG II) (Ref.2) as shown in Fig. 1. Although Motorola has released an excellent applications note (Ref.3) outlining the modifications required to allow coresiding ROM monitors in the MEK680002, their scheme is somewhat complex, so that it can provide program control of which ROM monitor is addressed. However, in many applications the monitor need simply be selected manually using a front panel control switch. In this manner applications program development could proceed from a source file in the development system machine to an ASCII coded object file on a digital cassette tape. The object file may then be transferred from cassette tape, via RS-232 serial interface, to the RAM resident in the MEK6800D2 system using the MINIBUG II monitor. The ROM control may then be switched to JBUG to allow complete system control of the MEK6800D2 from front panel keypads.

To implement this scheme, only one control signal need be switched between the two ROMs as shown in Fig. 2. The signal designated as $\overline{ROM}$ is output to the selected ROM by the JBUG/MBUG switch, shown in the figure. The upper portion of the switch also parallels the Tx clock and the Rx clock of the ACIA (U23), as shown in Fig. 1, when the MBUG ROM monitor is selected. Adequate space is provided on the MEK6800D2 board to add the second MC6830 ROM as shown in Fig. 1 as well as the RS-232 driver-receiver shown in Fig. 2. Note also that in order to ensure that no data are lost during monitor switching the MC6800 microprocessing unit should be held in the reset condition while the JBUG/MBUG switch is changed. The MEK6800D2 system provides baud rate logic for standard rates up to 9600 baud which may be selected at the output taps of counter U17 The JBUG ROM is normally supplied with the MEK6800D2 system; however the MINIBUG II ROM may be specified separately by asking for an MEX68MIN II preprogrammmed MC6830 read only memory.

### REFERENCES

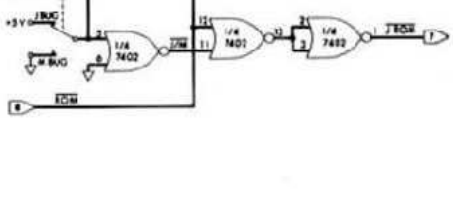
1. M68SAM is the property of Motorola SPD, Inc. Copyright 1974 to 1978 by Motorola, Inc.

2. Motorola Semiconductor Products, Inc., Applications Note AN-771, "MEK6800D2 Microcomputer Kit System Expansion Techniques", Motorola Semiconductor Products, Inc., Phoenix, Arizona, 1977.

3. Motorola Semiconductor Products, Inc., "Evaluation Module II User's Guide", Motorola Semiconductor Products, Inc., Phoenix, Arizona, 1976.

TABLE I

| Monitor Function | JBUG | MINIBUG II |
|---|---|---|
| Display Registers | R | R |
| Load From Tape | L | L |
| Dump to Tape | P | P |
| Memory Examine/Change | M | M |
| Execute from Entered Address | G | G |
| Set Terminal Baud Rate | - | S |
| Test Memory | - | W |
| Punch Binary Tape | - | Y |
| Load Binary Tape | - | Z |
| Abort Program Execution | E | - |
| Trace (Single Step) | N | - |
| Set Breakpoint | V | - |
| Reset Breakpoint | V | - |
| Continue Execute from Breakpoint | E,G | - |
| Delete All Breakpoints | V | - |



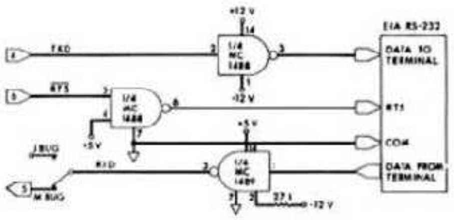


FIGURE 2
M6800 D II
DUAL MONITOR LOGIC
CIRCUIT DIAGRAM

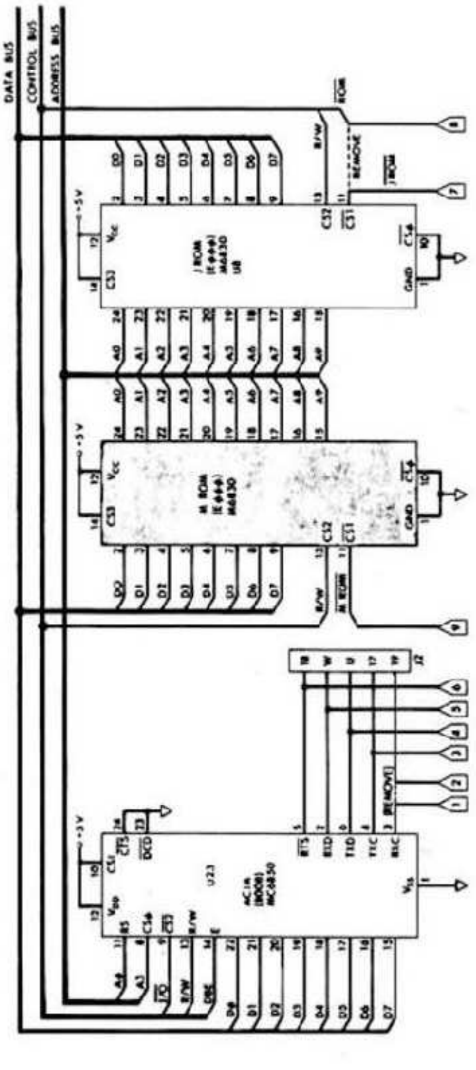


FIGURE 1
M6800 D II
DUAL MONITOR/I/O LOGIC
CIRCUIT DIAGRAM

## ***** CLASSIFIED ADVERTISING *****



## USING THE 6801/6803 AND 6809 IN THE MP-A2 BOARD

Dr. J L Pentecost
3605 Clubwood Trail
Marietta, GA 30067

Both the 6801 (or 6803) and the 6809 MPU chips can be used with the SWTP MP-A2 board with simple adapters. This article describes this approach to use both the 6801/6803 and6809, in adapters, with TSC software.

First examination of the 6801/6803 specifications reveals a faster processor with equivalent 6800 instructions, plus some added instructions (Table I). Tests show that the 6801/03 runs typically 17.51 faster than the 6800 at the same clock frequency. The only disadvantage of the 6801/03 is the inability to use the first 20 Hex addresses in memory. These addresses have the special purpose registers and ports and are not available for memory use on the direct page. The pin-out of the 6801 and 6803 is not equivalent to the 6800 and an adapter is required. A circuit of an effective adapter is shown in Figure 1. With this adapter, and a jumper header substituted for the 6875 (as for the 6809, 68MJ6P6) on the MP-A2 board, the 6801 or 6803 runs most programs without any modification of the monitor or software. The only notable exception is disk versions of SWTPC BASIC (and possibly other versions). The TSC Editor, Assembler, BASIC, etc., operate properly.

Some additional advantages of the 6801/6803 include the availability of a programmable timer and a direct page ACIA port, the availability of 16 bit arithmetic shift instructions, PSHX, PULX and 8 bit multiply. The only disadvantages are the loss of 20 Hex bytes of memory on the direct page, and the inability to use DMA readily. Since most software for the 6800 also runs on the 6801/03 little difficulty should be experienced with this modification.

### THE 6809

The 6809 may be used with the SWTPC MP-A2 board with simple adapters like the PERCOM. Some difficulty was experienced with this adapter on my system since a PIA port would not operate properly. The solution was found in pulling VMA high with a 1K resistor rather than by using E

AND Q. The 6809 in a simple adapter requires a new monitor. The easy approach is to modify the SWTPC S-BUG monitor for the standard 8000 Hex I/O normally used with the MP-A2 board. This is simpler than modifying the MP-A2 board to allow the E0XX addresses to be put on the main buss. These addresses are only used with the on-board EPROM or monitor. The contents of the monitor addresses in Table II should be changed from E0 to 80 to modify the ACIA location for the control port (only a MPS card!) and the 5 addresses for the mini- disk boot. This can be done by reading the standard S-BUG monitor into the EPROM programmer routine, modifying the addresses in memory, and programming a 2716 with the new code.

To modify TSC software to run on this system, it is only necessary to change the E0XX addresses in NEWDISK.CMD and FLEX.SYS. Once these addresses are changed, a new disk is formatted, these two programs copied onto the new disk and the modified FLEX.SYS LINKed, the new disk will boot and operate properly with the utilities. These changes may not be simple to make with only a 6809 disk and a single system. Here are two approaches.

First, if FLEX 2 is available (FLEX at 7000 will not work) it can be brought up and with memory from A000 to DFFF, GET,FLEX.SYS from the 6809 disk to place FLEX.SYS into memory. Change all E0 addresses (Table III) to 80 and SAVE,FLEX.NEW,C700,DF4D,CA00 on the 6809 disk. NEWDISK.CMD can be modified and saved similarly (see Table IV). This still does not allow the disk to boot even when linked, however, because the track 00 boot sector still contains E0 addresses. Only disks formatted with the modified NEWDISK command will boot with 8000 I/O.

If battery back-up for C000-DFFF is available to maintain FLEX 9 in memory, the system can be shut down, converted to a 6809 system and reset. Upon jumping to CD00 or CA00, FLEX 9 works properly. From here, NEWDISK a blank disk with the modified utility, copy FLEX.NEW to it and LINK,FLEX.NEW on the new disk.

This new disk will now boot properly and the system is up. The next approach can be used if FLEX 2 is not available and will work if no battery back-up is available for the RAM memory.

1. Boot the 6809 disk using the modified S-BUG and memory at C000-DFFF, reset, one sector will have loaded at C000.

2. Change all E0 addresses in this sector (Table V).

3. Set X to C000, jump to C000. This will cause the disk to load FLEX.SYS, but hang up, so reset again. Change all E0XX addresses (Table III) and jump to CD00.FLEX 9 will be operating.

4. SAVE,FLEX.NEW,C700,DF4D,CA00. Modify and save NEWDISK as above.

5. Format a new disk with the modified utility, copy FLEX.NEW and NEWDISK to this disk and LINK. The new disk will boot and all utilities will work properly.

Advantages:

1. No buss modifications or motherboard changes.

2. Low cost modifications allow use of both 6800 and 6809

3. All TSC software for 6809 can be used.

4. Up to 40K of memory is accomodated exactly as with the SWTPC board.

5. With the MOVE9 utility (by James Hughes), MINI-FLEX files are easily transferred to FLEX 9 disks.

Disadvantages:

1. Only 32K of useful memory is available vs 48K for I/O at E0XX.

2. Some initial software modification is required.

For those with Thomas Instrumentation video boards, a version of JOEBUG monitor (68MJ2) for the 6809 is also available to operate the video board, printer, keyboard and terminal ports simultaneously. FLEX 9 I/O must be modified for the video drivers however. It was noted in performing this modification that the jump table (D3E7-D3FC) is not normally used for CHAR in and CHAR out routines at 0370 and D3BB respectively and that jumps (7E XXXX) must be placed at D37D, INCH; D388, OUTCH; and D39C, STATUS to accomplish this modification.

TABLE I. NEW INSTRUCTIONS IN THE 6801/6803

| | |
|---|---|
| ABX | B+X -> X |
| ADDD | M, (M+1) + D -> D |
| ASLD | C <- D <- 0 |
| LDD | M, (M+1) -> D |
| LSRD | 0 -> D -> C |
| MUL | A x 8 -> 0 |

| | |
|---|---|
| PSHX | X -> Stack |
| PULX | Stack -> X |
| STD | D -> M, (M+1) |
| SUBD | D - M, (M-1) -> D |

TABLE II. S-BUG MONITOR I/O ADDRESSES

| | | |
|---|---|---|
| F825 (ACIA) | FBC8 | FBDD |
| FBB1 | FBCD | FBEB |
| FBB4 | FBD6 | FBF0 |

TABLE III. FLEX 9 FLEX.SYS I/O ADDRESSES

| | | |
|---|---|---|
| D3E1(Timer) | DE79 | DEB9 |
| D3E3(ACIA) | DE88 | DECB |
| D3E5(ACIA) | DE8B | DEE6 |
| DE40 | DE90 | DEFC |
| DE48 | DE98 | DF23 |
| DE58 | DEB1 | DF28 |
| DE71 | | DF32 |

SAVE,FLEX.NEW,C700,DF4D,CA00

TABLE IV. FLEX 9 NEWDISK.CMD I/O ADDRESSES

| | | |
|---|---|---|
| C479 | C4BE | C626 |
| C47F | C5ED | C627 |
| C48E | C5F6 | C633 |
| C499 | C603 | C63F |
| C49E | C618 | C65E |
| C4A4 | C624 | |

SAVE,NEWDISK8.CMD,C100,C6A7,CA00

TABLE V. I/O ADDRESSES IN BOOT SECTOR

| | | |
|---|---|---|
| C015 | C04C | C067 |
| C01E | C04F | C086 |
| C02B | C054 | |
| C040 | C05B | |

——————————>>>

REFERENCE 'BOOKEEPING' NEXT COLUMN

NOTE: Due to the volume of data in the BASIC programs we will furnish copies of the entire disk programs (.BIN and .BAS) for $6.50 (miniFLEX® format) including postage and handling. The BASIC programs will be run next month in source format.

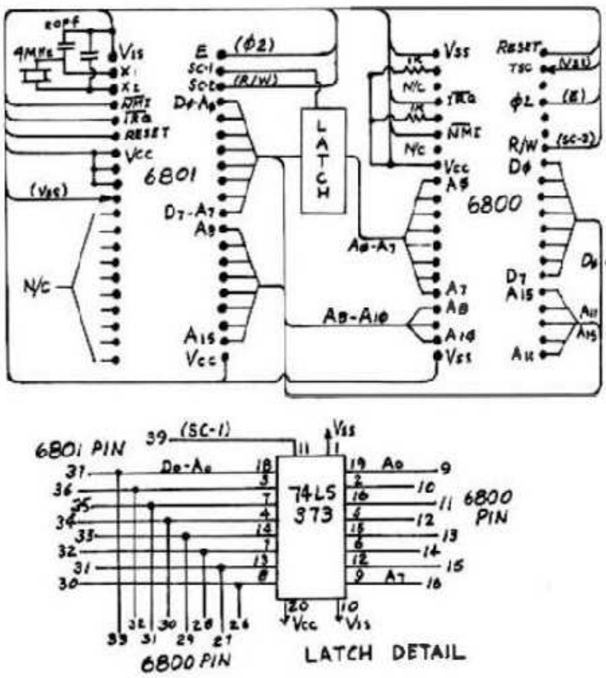



FIGURE 1 ADAPTER FOR USING 6801/03

BOOKEEPING (Disk & Tape)
MiniFLEX

William R. Stock
1125 Lois Dr
Cincinnati, OH 45237

Totally ignoring the fact that my father kept adequate financial records with nothing more than a check register and 39¢ worth of index cards, I have convinced all concerned that my SWTPC 6800 is useful because it keeps my books. Assuming you have similar problems, this bookkeeping system may be for you.

It is written in SWTPC BASIC 3.0, intended to be used with the Southwest minidisks under miniFLEX 1.0. If you have another system you may have to modify the programs a little.

HOUSEHOLD NEEDS

The primary purpose of a household bookkeeping system is to keep a record of all income and expenses; the former for your friend and mine, the IRS, and the latter for you. However, if we're going to do this on a computer we may as well go ahead and list our assets and liabilities (debts). This gives a General ledger, and a much more comprehensive picture of our financial status.

To this base I have added a rudimentary Accounts Payable, to assist in projecting cash requirements.

Notice that this system is designed for households. Businesses will still have to look elsewhere.

DESIGN PHILOSOPHY

In any monetary record keeping system, accuracy is of paramount importance. As a result, this system uses a double entry ledger. A double entry system can get unwieldy, however, if you have to keep track of assets, liabilities, debits and credits, and how they interact. This leads to the second design consideration: simplicity.

be used if it is too complicated to operate. Consequently, this system was designed so that once it is booted up, all instructions are displayed on the CRT. The only debit/credit decisions you have to make are on the first entry of each transaction, and they are further simplified, as we shall show. Moreover, the programs call each other from disk, eliminating the need to remember what comes next.

## SYSTEM REQUIREMENTS

This system was designed to run on (my) SWTPC 6800 with 20K RAM, a SWTPC 1024 terminal, SWTPC mini-floppies running TSC's miniFLEX 1.0 and BASIC 3.0 (the additional 4K required for miniFLEX is not included in the 20K), and the SWTPC AC-30 cassette interface + SWTBUG for tape backup of the data files.

The only programs unique to the SWTPC system are those dealing with the cassette. These programs are written in assembler, and interface with miniFLEX 1.0.

## PROGRAM DESCRIPTIONS

POSTING: Transactions are entered into the books by the posting routine. The APIN program validates the transactions, makes the debit/credit decisions, and writes the transactions to the TRAN file. If any entries affect Accounts Payable, they are also written to the PTRAN file.

If any transactions were written to the PTRAN file, they are now sorted and the APMASTER is updated. If there are any rejected entries, they are displayed and the program aborted.

The Journal APPend program is called next, and it simply appends the transactions to those already present in the Journal. This was done in BASIC to keep things simple.

Next, the TRAN file is sorted, and the GLMASTER is updated. At the same time, the sorted TRAN file is merged with GLHISTory, to produce an updated file of G/L transactions. Rejected entries are displayed on the CRT.

JOURNAL PRINT: Occasionally you will want to look at some transactions. This program lists them as they were input, within either a date or a sequence number range.

TRIAL BALANCE: This program lists the asset and liability accounts, with or without a listing of the transactions on file. It reads, but does not display, the income and expense accounts to arrive at the surplus, which is needed to make the debits equal the credits. These two figures will always match (unless you have posted to an account not on file.)

PROFIT & LOSS: You are sometimes interested in either how you made so much money, or where it all went. This program tells you. It reads the income and expense accounts, displays them, and by a clever algorithm (subtraction), gives you the amount of either profit or loss.

CASH REQUIRED: This is the only function of Accounts Payable at this time. The program tells you how much you need to meet the bills that will come due between the date of last update and the date you enter.

END OF PERIOD: Although the diskettes will probably hold a year's transactions, the update time can get rather long, so this program allows you to scratch the JOURNAL and the GLHISTory, with the option of saving the data on tape. Should you need to refer back to the saved data, the RECOVERY program will put the data back to disk, from which you can run the usual trial balance and journal print.

END OF YEAR: To set up your books for a new year, this program performs the end of period function, then zeros out the income and expense accounts and updates the net worth.

MAINTENANCE: You will have occasion to add and delete accounts. This routine performs the task. It also allows you to change an account name, and, on the accounts payable file, change the date and amount due.

BUDGET: Since everybody talks about budgets, I have included a budget program. It will tell you how much you've budgeted for each expense account so far this year, how much you've actually spent, and what percentage you've spent.

## PART II: OPERATION

Once you have created all the disks, bringing up the system is a snap. Power up your computer, put the SYSTEM disk in drive #0, and enter D (SWTBUG). The computer will eventually respond with:

READY
#

to which you respond: CHAIN 0.START.

This routine gets today's date and saves it for all subsequent processing. You now select a job from the CRT menu.

1 - TRANSACTION POST. There are two rules to remember when posting transactions. First, ALL ACCOUNTS MUST BE ON FILE. Second, THE FIRST ENTRY DETERMINES DEBIT/CREDIT FOR THE ENTIRE TRANSACTION. We will now look at each of these in detail.

Since a typical household chart of accounts will contain between 75 and 100 entries, it is not feasible to verify account numbers on the input run. (It is possible, but response time suffers terribly.) Consequently, it is imperative that you make sure each account number is correct. If a transaction contains items on file and items not on file, then some accounts get updated and some don't (because they're not there!), leading to an out of balance condition. (In which case you start over.)

My approach to the second rule might drive professional bookkeepers crazy, but it makes things simple. The computer knows, because you told it, which accounts are income, asset, liability, etc. It also knows, because the programs tell it, that increases to income are debits, and so forth. Furthermore, it can figure out, based on the first entry, the debit/credit status of each item. Consequently, to make things as simple as possible, I have adopted this rule: IF IT ADDS TO THE ACCOUNT BALANCE, ENTER IT POSITIVE. Consider the following transaction:

```
ACCT  AMOUNT  COMMENT
? 111 298.8 10/20

? 711 40.94
? 712 16.92
? 713 2.12
? 714 5.52
? 583 1.6
? 322 20
? 324 211.7
```

You will notice that the first entry is positive. It adds to 'Dad's income'. The computer knows that 111 is an income account, and makes a positive entry a debit. It also knows that accounts 711 through 583 (in the example) are expenses, and makes these entries credits. 322 and 324 are assets, and these will be debits. The important fact is that YOU don't have to worry about anything but the FIRST ENTRY. The rest is taken care of for you.

Less obvious, but equally important, the second through last entries add up to the amount of the first entry. This is the basis of the double entry system. You cannot post a transaction unless this condition is met, which means you cannot get out of balance (unless you post to an account that doesn't exist, as we've already mentioned.)

When you have made the last entry of a transaction, the 'in balance' condition triggers a neat, columnar display of the transaction. The program asks if everything is ok. At this point you should double check the account numbers, and then answer yes or no.

If you have entered the last line of a transaction and the program doesn't list it out, then the transaction obviously is not in balance. Figure out why, press return, and re-enter it.

When you are finished posting all your transactions, press return without entering anything. The program asks if you are REALLY finished. Answer yes (or no, if you're not!).

There is one last remark about the input program. If you look at the example, you will notice that it looks sloppy. This is not because I am a poor typist, but because I am lazy. It is far easier to hit the space bar than the comma, so the entire line is one INPUT A$ command. The program picks A$ apart, retrieving the account number, amount, and comment (if any). While this makes input easy, it does place one restriction on you: the fields must be separated by one, and only one, space.

2 - JOURNAL PRINT. The operator input to thee program is minimal. It asks if you want the entire journal printed. If you answer 'no', it asks if you want the range based on date or sequence number. Depending on your answer, it asks for the beginning and ending dates or sequence numbers.

3 - TRIAL BALANCE. Trial balance asks only one question: do you want detail to print. A 'yes' will display every transaction to every account that is on file. A 'no' will cause only the account number, description, and balance to print.

4 - END OF PERIOD. The only question is whether or not you want to save the data to tape. Answer yes or no.

5 - END OF YEAR. The same question for end of period is asked here.

6 - PROFIT & LOSS. There is no input to P&L. It runs all by itself.

7 - CASH REQUIRED. The cash required program must know the cutoff date you are interested in. It will add up the amounts due from the date of last update to the date you enter. Additionally, it asks whether or not you want it to display a list of which accounts and amounts are due.

The routine is limited by the fact that the amounts are added only once. Consequently, the date range should not encompass two payment periods.

8 - MAINTENANCE. Before we start talking about the input, let me remind you that all accounts must be accessed in ascending account number sequence. After you have all additions, deletions, and changes in sequence, you may start.

Enter the account number. If this is an old account you can 'return' through the description and it will stay the same. If it is a new account, enter the description. If it is an A/P account, enter the date due and amount due.

To delete an account, enter 'DELETE' for description. An account must have a zero balance to be deleted. Balances cannot be changed by maintenance.

To exit maintenance, hit 'return' without entering an account number.

10 - BUDGET. Printing a budget has no input and is no fun. Building a budget, however, is as close to a game as we will get with this pedestrian system.

First, let me warn you that the budget build program was designed to work off the previous year's actual expenses. As a result, it won't work until there is at least something in the general ledger balances.

The program starts out by asking you to select a budget period. Since we all pay as we go, we tend to think in weekly, monthly, etc., terms. And since our computer can multiply and divide, we will let it annualize our input.

Next, the program needs to know our best guess at our annual income. Guess too high and you'll be within budget, but show a loss. Guess too low and you'll have a rough time budgeting. I usually guess high, go over budget, and make New Year's resolutions.

The program now reads the general ledger expense accounts, computes what percentage of the total expense was spent on each account, computes what should be spent, and you're off to the races!

The repetitive display consists of the account name, the amount you have previously input, and the suggested amount. You now enter.

The item-by-item input is very flexible. It is so flexible, in fact, that it is simple to use and impossible to explain. Here are the possibilities:

(amount)(return): the amount entered replaces the previous amount. It is for the period chosen at the beginning of the program.

(amount),F (return): the amount entered replaces the previous amount as in the above example, and the account is then removed from further consideration (frozen).

(return): everything for this account remains the same.

F (return): Everything for this account remains the same and it is removed from consideration.

(amount),(period) (return): the amount entered is multiplied by the period entered, and the product divided by the initial period to arrive at the amount to be displayed. This is handy for things like insurance premiums.

(acct #),T (return): this places the entered account back into the matrix (thaws it). The disadvantage is that you have

When you have journeyed through all your expenses, the program will display how much you are over your income. It will then re-compute suggestions for all non-frozen accounts, and you play it again, Sam.

When you have finally figured out how to live within your income, the final budget will print, and you will be asked if you want to revise it. If you say 'no', the general ledger is updated with the new budget. (OBVIOUSLY you run the budget build before the end-of-year program!!)

In closing, let me point out that you can't freeze nothing (zero amount). You can, however, freeze a penny, which will have minimal impact on the results.

## PART III: CONVERSION

Building all the disks required is the most difficult aspect of the whole operation. Not only is everything unfamiliar, but you are dealing with a great volume of data, all of which must be entered correctly. Take heart; you have to do it only once.

Since miniFLEX file organization precludes a destructive update (rewrite), father/son is the only technique available. This means the masterfile must be in ascending account number sequence.

Since the programs assume the lowest account numbers are income accounts, followed by receivables, assets, expenses, payables and net worth, your chart better follow this scheme. The available numbers are 1 through 99999999. Since the 1024 screen is 32 characters wide, I used 3 digit numbers.

With these restrictions in mind, we are ready to get started.

First, NEWDISK a box of diskettes. You will need at least seven, and ten is better. (One SYSTEM, and two or three each GENERAL LEDGER, JOURNAL, and ACCOUNTS PAYABLE.)

Next, write labels for each diskette, so when things start to move you know what's what.

Place your miniFLEX disk in #0. This is the disk you got when you bought your computer. Place the newly NEWDISKed disk marked SYSTEM in #1. Enter:

```
COPY,0,1,.CMD,.OV,.LOW,.SYS
LINK,1.DOS
```

Then build your STARTUP file. The instructions came with your SWTPC disk system, and you're interested mostly in TTYSET. The STARTUP file, or the file it calls to, must end with EXEC,0.BOOKSUG. This loads the end-of-period/end-of-year binary program, the BASIC interpreter, and a housekeeping binary program when the system is booted up.

Now remove the SYSTEM disk from #1 and replace it with the BASE disk (which has all the programs on it).

Enter:

```
COPY,0.EXEC.CMD
COPY,0.COPY.CMD
```

Take your miniFLEX disk out of #0 and store it away. Take the BASE disk out of #1 and place it in #0. Place your newly made SYSTEM disk back in #1 and enter:

```
EXEC,0.BOOKS.ICL
```

The system takes over from this point, and puts the system programs on the system disk. It then requests you to put a JOURNAL, GENERAL LEDGER (G/L), and ACCOUNTS PAYABLE (A/P) disk on #1. Do what it says, and then enter Y. NOTE: The programs at this point aren't sophisticated. They wait to fetch a character, ANY CHARACTER, from the keyboard, (to give you time to change disks), and then they take off again. So change disks BEFORE hitting anything!

Since you will need at least two of each data disk, your first answer to the 'another set' question should be 'Y', (no 'return'; just Y). After you have made as many sets as you need (or can afford), enter N. The system will respond with the familiar +++.

At this point, all the disks have their minimum contents. You will now need your own particular data to flesh out the skeletons. After reading the rest of the instructions, get some paper and write down your chart of accounts and their balances. Don't waste your time trying to calculate your net worth. The computer will do that for you.

Power up your computer and put the SYSTEM disk in #0. Enter 'D'. When the system responds READY #, enter: CHAIN 0.INSTALL.

The first file you will build is the parameter file. We need the highest possible account numbers for each of the six categories: income, receivables, assets, expenses, payables, and net worth. (See the sample chart for an example.)

The next file will be the accounts payables. Before putting an A/P disk in the drive, get a label and write today's date on it. Stick it on the disk. The last thing you want is to get the disks mixed up.

The information requested for A/P is:

ACCT #
DESCRIPTION
BALANCE
AYMENT
DATE DUE.

The first three are self-explanatory. The payment entry is used by the cash required program, and should be the amount you expect to pay on the date due. If the payment field is zero, the program assumes the entire balance is due (not so cool in the case of the mortgage). The date due can be either an MMDD format (325 = March 25th) or a DD format (10 = 10th of every month). If the date due is zero, then the program assumes you don't have to pay this one until you want to, and it ignores the account.

The last two entries (payment and date due) can be null entered (return), in which case they default to zero.

When all the accounts payable have been entered, you exit the routine by pressing 'return' without an account number.

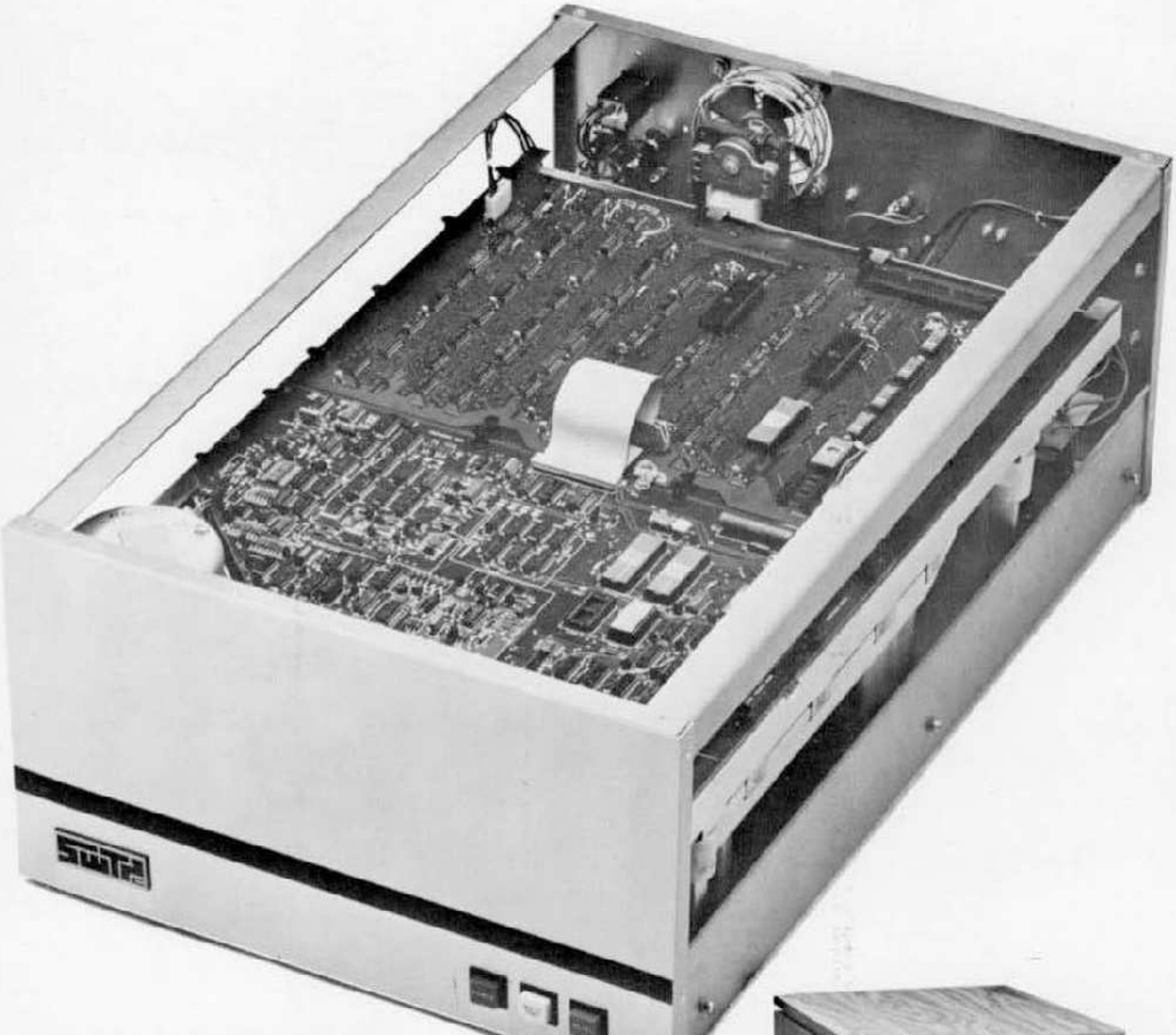
Did you get the data on the A/P disk? Good. Now put one on a General ledger disk. The G/L files are identical to the A/P files, except there aren't any payments or dates due.

When you are finished with the general ledger entries, you exit the routine the same as accounts payable. Since the A/P file is already built, there is no reason to enter the data twice. The program will build the A/P section of the G/L, compute the net worth, and call in the START program. Enter today's date and you're finished.

PLEASE, PLEASE, PLEASE, keep track of which disks are current. The small Avery labels are inexpensive, and worth their weight in gold. I have seen a couple sites update from an old disk to their current disk, creating a collossal mess. Some never recover.

BOOKS.S C

```
                  NAM   BOOKS
                  OPT   O,S,NOP,NOG
         START    EQU   $2442      SWTPC BASIC 3.0 END
         PDATA    EQU   $E07E      SWTBUG
         INEEE    EQU   $E1AC      SWTBUG
         FLXFCB   EQU   $7809      FLEX 1.0 FCB POINTER
         PBEG     EQU   $A044      SWTBUG
         PEND     EQU   $A004      SWTBUG
         PCHON    EQU   $E34D      SWTBUG
         PUNCH    EQU   $E37E      SWTBUG
         PCHOFF   EQU   $E353      SWTBUG
         DELAY    EQU   $E2C2      SWTBUG
         FMS      EQU   $7806      FLEX 1.0 FMS ENTRY
         BUF      EQU   $7884      FLEX 1.0 DISC BUFFR
         USER     EQU   $5D        BASIC 3.0 USER(X)
         BASIC    EQU   $100       BASIC 3.0 COLD ENTRY
         BASPGM   EQU   $14E       BASIC 3.0 START OF PGMS
         DOSENT   EQU   $32A       BASIC 3.0 JUMP TO DOS
         FLXWRM   EQU   $7103      FLEX 1.0 WARM START
         FLXCLD   EQU   $7100      FLEX 1.0 COLD START
         R   N    EQU   $E334      SWTBUG
         JNCH     EQU   $E078      SWTBUG
         CKSM     EQU   $A00F      SWTBUG
         BYTE     EQU   $8055      SWTBUG
         BYTECT   EQU   $A047      SWTBUG
         BADDR    EQU   $E047      SWTBUG
         OUTCH    EQU   $E075      SWTBUG
         RDOFF    EQU   $E347      SWTBUG
                  ORG   START
2442              JMP   BOOT       CNTL STNG ENTRY
2445              JMP   ZOJNL      JOURNAL PUNCH
2448              JMP   ZOGL       GL PUNCH
244B              JMP   ZIJNL      JOURNAL READ
244E              JMP   ZIHST      HIST READ
2451              IMP   ZIGL       GL READ
         ZOJNL    LDX   #MSG01     INITIAL M SSAGES
                  JSR   PDATA
                  LDX   #MSG03
                  BRA   OMES1
         ZOGL     LDX   #MSG01
                  JSR   PDATA
                  LDX   #MSG02
         OMES1    JSR   PDATA
                  LDX   #MSG04
                  JSR   PDATA
                  LDX   #MSG07
                  JSR   PDATA
         OMES2    LDX   #MSG08
                  JSR   PDATA
                  JSR   INEEE
                  CMPA  #$D
                  BNE   OMES2
                  LDAA  FLXFCB+1   GET ADDRESS OF FILE
                  LDAB  FLXFCB
                  SUBA  #$1C
                  SBCB  #0
                  STAA  FCB+1
                  STAB  FCB
                  LDX   #BUF
                  STX   CURPOS
                  STX   PBEG
                  LDAB  #11        GET LABEL READY FOR  UNCH
                  LDX   FCB
         OLABEL   LDAA  4,X
                  INX
                  STX   TEMP
                  LDX   CURPOS
                  STAA  0,X
                  INX
                  STX   CU POS
                  LDX   TEMP
```





```
710                DECB
720                BNE    OLABEL
730                LDX    CURPOS
740                DEX
750                STX    PEND
760                JSR    PCHON       PUNCH LABEL
770                JSR    DELAY
780                JSR    DELAY
790                JSR    DELAY
800                JSR    PUNCH
810                LDX    #$9         TO EXIT READ ON RECOV
820                JSR    PDATA
830                JSR    PCHOFF
840                LDX    FCB         PREPARE FILE TO READ
850                LDAA   #5
860                STAA   0,X         REWIND
870                JSR    FMS
880       PREC1    LDX    #BUF
890                STX    CURPOS
900       PCHR1    LDX    FCB         READ FILE
910                JSR    FMS
920                TST    1,X
930                BNE    OERR        READ ERROR OR EOF
940                LDX    CURPOS
950                STAA   0,X
960                INX
970                STX    CURPOS
980                CPX    #BUF+125    END OF BUF?
990                BNE    PCHR1
1000      PCHR2    LDX    #BUF        PREPARE TO PUNCH DATA
1010               STX    PBEG
1020               LDX    CURPOS
1030               DEX
1040               STX    PEND
1050               JSR    PCHON       PUNCH
1060               JSR    DELAY
1070               JSR    DELAY
1080               JSR    DELAY
1090               JSR    PUNCH
1100               LDX    #$9         TO EXIT READ ON RECOV
1110               JSR    PDATA
1120               JSR    PCHOFF
1130               LDX    FCB
1140               TST    1,X         LAST BLOCK?
1150               BEQ    PREC1       GET NEXT RECORD
1160               BRA    ONOERR      MUST BE EOF
1170      OERR     LDAB   1,X         ERR OR EOF
1180               CMPB   #8
1190               BEQ    PCHR2       PUNCH PARTIAL SECTOR
1200      ONOERR   LDX    FCB
1210               LDAA   1,X
1220               LDX    USER

1240               CLRB
1250               TSTA
1260               BEQ    OUSER4      NO ERRORS
1270               CMPA   #8
1280               BNE    OUSER2      NOT EOF
1290               CLRA               EOF WILL BE "0" to BASIC
1300      OUSER2   ADDA   #0          CHANGE HEX TO BCD
1310               DAA
1320               BITA   #$F0        FORMAT & STORE IN USER(X)
1330               BEQ    OUSER4
1340               TAB
1350               LSRA
1360               LSRA
1370               LSRA
1380               LSRA
1390               ASLB
1400               ASLB
1410               ASLB
1420               ASLB

1440      OUSER4   CLR    6,X         EXPONENT
1450               STAA   0,X         SIGN + 1st DIGIT
1460               BEQ    OUSER5
1470               INC    6,X         EXPONENT
1480      OUSER5   STAB   1,X         2ND DIGIT
1490               BEQ    OUSER6
1500               INC    6,X         EXPONENT
1510      OUSER6   INX
1520               LDAB   #4          CLEAR REST OF USER(X)
1530      OUSER1   CLR    1,X
1540               INX
1550               DECB
1560               BNE    OUSER1
1570               LDX    #BUF
1580               LDAA   #4          EOT FOR LAST TAPE RECORD
1590               STAA   0,X
1600               STAA   1,X
1610               STX    PBEG        PUNCH EOT
1620               INX
1630               STX    PEND
1640               JSR    PCHON
1650               JSR    DELAY
1660               JSR    DELAY
1670               JSR    DELAY
1680               JSR    PUNCH
1690               LDX    #$9
1700               JSR    PDATA
1710               JSR    PCHOFF
1720               RTS
1730      ZUNL     LDX    #MSG01      INITIAL MESSAGES
1740               JSR    PDATA
1750               LDX    #MSG03
1760               BRA    IMES1
1770      ZIHST    LDX    #MSG01
1780               JSR    PDATA
1790               LDX    #MSG02
1800      IMES1    JSR    PDATA
1810               LDX    #MSG04
1820               JSR    PDATA
1830               LDX    #MSG06
1840               JSR    PDATA
1850      IMES2    LDX    #MSG08
1860               JSR    PDATA
1870               JSR    INEEE
1880               CMPA   #$D
1890               BNE    IMES2
1900      ZIGL     LDAA   FLXFCB+1    ENTRY FOR NO MESSAG
1910               LDAB   FLXFCB      GET ADDRESS OF FIL
1920               SUBA   #$1C
1930               SBCB   #0
1940               STAA   FCB+1
1950               STAB   FCB
1960               JSR    LOAD        1ST RECORD OF TAPE
1970               LDX    FCB
1980               STX    TEMP
1990               LDX    #BUF
2000               STX    CURPOS
2010               LDAB   #11         VERIFY LABEL
2020      LAB1     LDX    TEMP
2030               LDAA   4,X
2040               INX
2050               STX    TEMP
2060               LDX    CURPOS
2070               CMPA   0,X
2080               BNE    BADLAB      WRONG TAPE
2090               INX
2100               STX    CURPOS
2110               DECB
2120               BNE    LAB1
2130               LDX    FCB         LAB L OK
2140               LDAA   #4
2150               STAA   $22,X       RESET DATA INDEX
     2160 - 2220 deleted
2230      IREC     LDX    #BUF        FILL BUFFER FOR END DETECT
2240               LDAA   #$FF
2250               LDAB   #124
2260      IFILL    STAA   0,X
2270               INX
2280               DECB
2290               BNE    IFILL
2300               JSR    LOAD        READ TA E RECORD
2310               LDX    #BUF
2320      ICHR     LDAA   0,X
2330               CMPA   #$FF         ND OF BLOCK
2340               BEQ    IREC
2350               CMPA   #4          END OF FILE
2360               BEQ    IDONE
2370               INX
2380               STX    CURPOS
2390               LDX    FCB
2400               JSR    FMS         WRITE CHARACTER
2410               LDAA   1,X
2420               BNE    IERR        WRITE ERROR: ABORT
2430               LDX    CURPOS
2440               CPX    #BUF+125
2450               BNE    ICHR        GET NEXT CH R
2460               BRA    IREC        GET NEXT RECORD
2470      BADLAB   LDAA   #8          8 = BAD LABEL
2480               BRA    ICLO1
2490      IERR     LDX    FCB
2500               LDAA   1,X
2510               BRA    ICLO1
2520      IDONE    CLRA
2530      ICLO1    LDX    USER        SET UP USER(X)

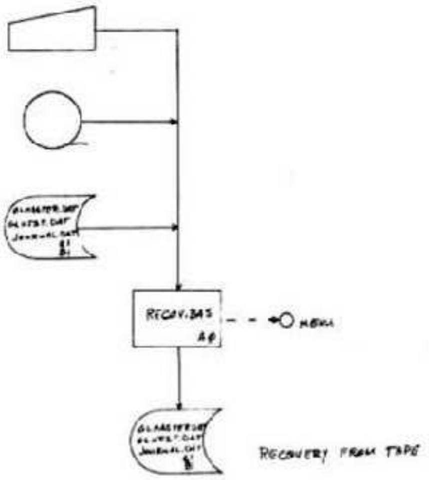
2550               CLRB

2580               ADDA   #0          HEX TO BCD
2590               DAA
2600               BITA   #$F0
2610               BEQ    ICLO3
2620               TAB
2630               LSRA
2640               LSRA
2650               LSRA
2660               LSRA
2670               AS B
2680               ASLB
2690               ASLB
2700               ASLB

2720      ICLO3    CLR    6,X         EXPONENT
2730               STAA   0,X         SIGN + 1ST DIGIT
2740               BEQ    ICLO4
2750               INC    6,X         EXPONENT
2760      ICLO4    STAB   1,X         2ND & 3RD DIGITS
2770               BEQ    ICLO5
2780               INC    6,X         EXPONENT
2790      ICLO5    INX
2800               LDAB   #4          CLEAR REST OF USER(X)
2810      TCLO1    CLR    1,X
2820               INX
2830               DECB
2840               BNE    TCLO1
2850               RTS
```

```
        MSG01  FDB   $1016,0,0
               FCC   /THE /
               FCB   4
        MSG02  FCC   /GENERAL LEDGER/
               FCB   4
        MSG03  FCC   /JOURNAL/
               FCB   4
        MSG04  FDB   $D0A
               FCC   /IS READY FOR TAPE./
               FCB   $D,$A,$A
               FCC   /SET BAUD AT 300 FOR K. C. STD./
               FDB   $D0A
               FCC   /TAPE./
               FCB   $D,$A,$A
               FCC   /PUT TAPE IN RECORDER AND/
               FDB   $D0A
               FCC   /PREPARE TO /
               FCB   4
        MSG05  FCC   /READ./
               FCB   4
        MSG07  FCC   /RECORD./
               FCB   4
        MSG08  FCB   $D,$A,$A
               FCC   /RETURN WHEN READY.       ? /
               FCB   4
        S9     FCC   /S9/
               FCB   4
        TEMP   RMB   2
        CURPOS RMB   2
        FCB    RMB   2
        LOAD   JSR   RDON      SWTBUG READ MODIFIED
        LOAD3  JSR   INCH      AS SUBROUTINE
               CMPA  #'S
               BNE   LOAD3
               JSR   INCH
               CMPA  #'9
               BEQ   LOAD21
               CMPA  #'1
               BNE   LOAD3
               CLR   CKSM
               JSR   BYTE
               SUBA  #2
               STAA  BYTECT
               JSR   BADDR
        LOAD11 JSR   BYTE
               DEC   BYTECT
               BEQ   LOAD15
               STAA  0,X
               CMPA  0,X
               BNE   LOAD19
               INX
               BRA   LOAD11
        LOAD15 INC   CKSM
               BEQ   LOAD3
        LOAD19 LDAA  #'?
               JSR   OUTCH
        LOAD21 JSR   RDOFF
               RTS
        DOS    LDX   #FLXWRM   FIRST FLEX ENTR  MUST
               STX   DOSENT    BE COLD
               JMP   FLXCLD
        BOOT   LDX   #DOS      INITIALIZE BASIC
               STX   DOSENT
               LDX   #BOOT
               STX   BASPGM
               JMP   BASIC
2780    DONE   FDB   *         FIND END OF PGM FROM
               END             SYMBOL TABLE
```

NOTE: Object file = BOOKS.BIN,2442,277F,2442




RECOVERY FROM TAPE

SAMPLE CHART OF ACCOUNTS

| | |
|---|---|
| 111 | Dad's income |
| 121 | Mom's income |
| 131 | XYZ capital gains |
| 132 | ABQ capital gains |
| 141 | golden savings interest |
| 142 | rog savings interest |
| 151 | XYZ dividends |
| 152 | ABQ dividends |
| 200 - 299 | accts receivable (bal) |
| 311 | XYZ stock |
| 312 | ABQ stock |
| 321 | golden savings |
| 322 | rog savings |
| 323 | wife's savings (double ba) |
| 324 | checking |
| 331 | house |
| 332 | cars |
| 333 | furniture &c. |
| 334 | appliances |
| 335 | other (computer) |
| 412 | interest on house note |
| 413 | house insurance |
| 414 | house taxes |
| 421 | gas & elect |
| 422 | water |
| 423 | phone |
| 424 | elect maint |
| 425 | plumbing maint |
| 426 | heating maint |
| 427 | general repairs |
| 429 | other |

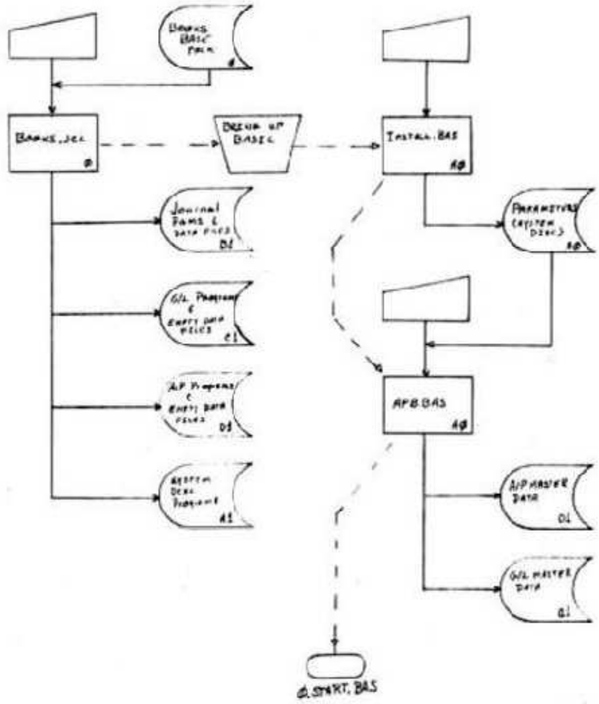
| | |
|---|---|
| 431 | furnishings under $100 |
| 432 | furnishings over $100 |
| 491 | books, magazines... |
| 511 | Dad's allowance |
| 512 | Mom's allowance |
| 520 | food |
| 530 | babysitters |
| 540 | tuition |
| 550 | medical |
| 560 | personal insurance |
| 571 | Dad's clothing |
| 572 | Mom's clothing |
| 573 | kid #1 clothing |
| 574 | kid #2 clothing |
| 575 | kid #3 clothing |
| 581 | Christmas gifts |
| 582 | other gifts |
| 583 | united appeal &c. |
| 584 | Cr card interest $$$ |
| 585 | church donations |
| 586 | Merrill Lynch donations |
| 589 | misc. misc. |
| 611 | Dad's gas and oil |
| 612 | maintenance |
| 613 | insurance |
| 614 | company reimbursed |
| 621 | wife's gas & oil |
| 622 | wife's car maint |
| 623 | wife car ins |
| 711 | dad fed withhold |
| 712 | dad fica |
| 713 | dad state donations |
| 721 | wife fed withhold |
| 722 | wife fica |
| 723 | wife state tax |

SAMPLE CHART OF ACCOUNTS (cont)

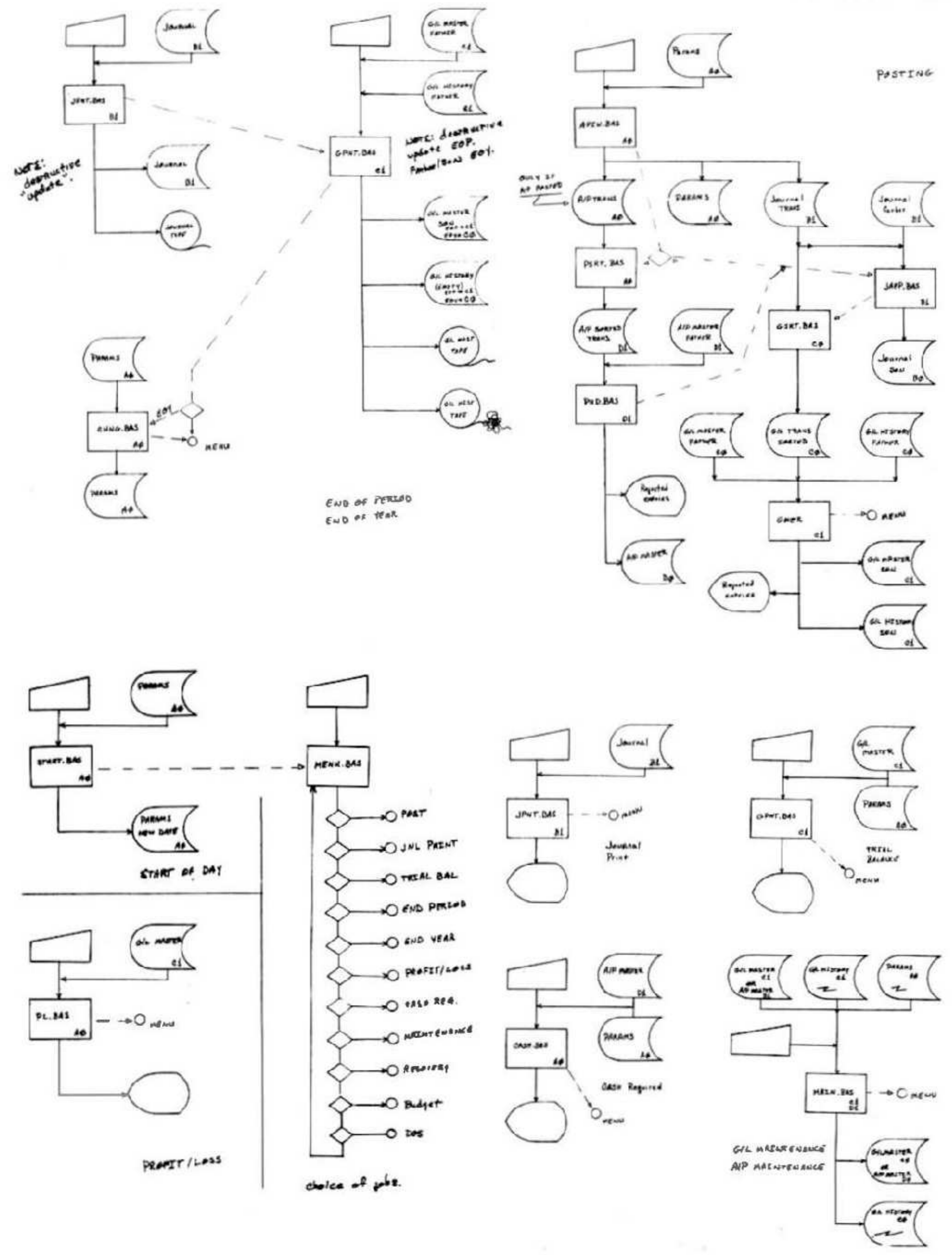
| | |
|---|---|
| 811 | DEF insurance |
| 812 | credit card #1 |
| 813 | mortgage |
| 814 | dept store #1 |
| 815 | dept store #2 |
| 816 | credit card #2 |
| 817 | credit card #3 |
| ... | |
| 900 | Net Worth |

Sample entries for parameter build, using the above chart:

| | |
|---|---|
| INCOME | 199 |
| RECEIVABLES | 299 |
| ASSETS | 399 |
| EXPENSES | 799 |
| PAYABLES | 899 |
| NET WORTH | 900 |




CONVERSION


POSTING
APEN.BAS
PSRT.BAS
PUD.BAS
JAPP.BAS
GSRT.BAS
GMER
END OF PERIOD
END OF YEAR
START.BAS
MENU.BAS
POST
JNL PRINT
TRIAL BAL
END PERIOD
END YEAR
PROFIT/LOSS
MAINTENANCE
Budget
DOS
START OF DAY
PL.BAS
PROFIT/LOSS
choice of jobs.
JPNT.BAS
Journal Print
GPNT.BAS
TRIAL BALANCE
CASH Required
MAIN.BAS
G/L MAINTENANCE
A/P MAINTENANCE

# A SOFTWARE DATA ENCRYPTON STANDARD IMPLEMENTATION FOR THE 6800

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The security of digital communications is becoming of great importance as the use of distributed systems becomes commonplace. Several systems for encrypting sensitive data have recently appeared in the literature, and some controversy has arisen over the relative security of these systems. The purpose of this article is to describe a 6800 software implementation of one of these systems, the National Bureau of Standards Data Encryption Standard (DES). This particular standard was developed by NBS in response to the requirement for a single certifiable standard to be used for all federal government unclassified data stored and transmitted by computer.

The contract to develop the standard was issued to IBM in 1974. During the development phase of the program, the National Security Agency was consulted regarding certain aspects of the standard, one of which was the key length. This fact led to speculation that perhaps the NSA had "tampered" with the encryption algorithm, creating a weakness which only they could exploit. The NBS Data Encryption standard was adopted on November 23, 1976, with an effective date of July 15, 1977. After this date, all federal agencies were required to comply with the standard. On April 13, 1978, the United States Senate Select Committee on Intelligence issued a report which, among other things, concluded that NSA did not tamper with the design of the DES algorithm in any way. And so, the DES exists today as the single method by which encryption of nonclassified data within all federal agencies is accomplished.

The Data Encryption Standard is thoroughly described in Federal Information Processing Standards (FIPS) Publication 46, U.S. Department of Commerce, National Bureau of Standards, issued on January 15, 1979. It is described as "an algorithm to be implemented in electronic hardware devices" and not by software. The 6800 user who can utilize the Motorola Exorcisor bus configuration can purchase a data security module which will encrypt a 64-bit block of data in less than 200 microseconds, and which has been certified by the NBS. The cost is around $500. Those computer users with a requirement for data encryption not involving any federal agency, or those merely wishing to experiment with data encryption, can use a software implementation of the algorithm. Such software implementations offer the same immunity to cryptanalysis as the hardware versions, in that the best machines available for the next few years would take some 200 years to break the code.

Since the DES algorithm is fully explained in FIPS Publication 46, only the rudiments will be discussed here. The algorithm utilizes a 64 bit input block, a 64 bit outblock block, and a 64 bit key of which 56 bits are actually used as the key, with the remaining eight bits baing reserved for parity checks on the key itself. The 64 bit input block is first passed through an initial permutation (IP) which shuffles the input bits in accordance with a specified permutation table. The resulting 64 bit permuted input is then split into two 32 bit blocks, L and R, such that the permuted input block is LR. The L and R blocks are then passed through 16 iterations of a calculation described below in terms of a cipher function f. Successive functions $L_m$ and $R_m$ are determined by the recursive equations

$$L_m = R_{m-1}$$
$$R_m = L_{m-1} \oplus f(R_{m-1}, K_m)$$

Where initial values $L_0$ and $R_0$ are those resulting from initial division of the permuted input block, and where $\oplus$ represents the bit-by-bit exlusive OR operation. The subkey $K_m$ is a block of 48 bits chosen from the 64 bit key in accordance with the expression

$$K_m = KS\ (M, KEY)$$

where KEY is the 64 bit input key, KS is a function called the key schedule, and $K_m$ is determined by the bits in 48 distinct bit positions within KEY, as specificed by the key schedule. The KS function consists of putting the 64 bit key through a specified permutation and bit selection process (PC-1), resulting in two 28 bit blocks termed $C_0$ and $D_0$. These blocks are then left shifted in accordance with a specified schedule to generate $C_m$ and $D_m$ for each of the sixteen iterations. The block $C_m D_m$ is then passed through a second permutation and bit selection process (PC-2) to produce $K_m$, a 48 bit block used as the subkey for iteration M.

Finally, the cipher function $f(R_{m-1}, K_m)$ is determined by first forming a 48 bit function $E(R_{m-1})$ from the 32 bit $R_{m-1}$ block by means of a specified bit selection table, exclusive OR-ing this block with the 48 bit subkey KM, and then passing each six bit block of the result through a specified selection function, $S_1, S_2, \ldots, S_8$. These so called "S-boxes" generate eight four bit blocks, one from each of the six bit blocks, which combine to form a 32 bit result. This result then undergoes a final permutation P to produce the 32 bit cipher function $f(R_{m-1}, K_m)$. The 32 bit $R_m$ is then determined from f and $L_{m-1}$ as described above.

When $L_{16}$ and $R_{16}$ are finally determined, the 64 bit block $L_{16}R_{16}$ is passed through the inverse of the initial permutation ($IP^{-1}$) to yield the 64 bit output ciphertext. To decrypt a ciphertext encoded by the DES algorithm, it is necessary only to process the encrypted block through the same algorithm, only now the subkeys $K_n$ are generated in reverse order.

The algorithm itself is fairly complex but the procedures, including the permutations, bit selections, shift schedules, and the S-boxes themselves, are public knowledge and are fully described in FIPS Publication 46. The only thing which needs to be kept secret is the key. The reasons behind the particular selection of these various functions by NBS is not obvious to those unfamiliar with cryptographic techniques, but it must be assumed that the selections and procedures were chosen to enhance the security of the algorithm against cryptanalysis. In fact, it is the design of the S-boxes themselves, which has never been explained by IBM, NBS, or NSA, which has led to the speculation of tampering.

The particular software version of the DES described below was written for a SWTP 6800 microcomputer using the FLEX operating system, and requires approximately 1100 bytes of memory. The permutation routine PERM is used most often and with various inputs, outputs, and permutation tables. A parameter table is used to indicate to the permutation routine the number of bits in the output byte, the number of output bytes, the location of input and output blocks, and the desired permutation table. All permutation tables are stored in the format mmmmbbbb as described in the program listing. The mask number mmmm gives the location of the source bit within the source byte. The bbbb gives the location within the input of the byte which contains the desired bit. The desired bit is masked out and shifted into a holding byte which, when full, is stored in the output block.

Routine SHIFT generates the shifting operation necessary for generation of the subkeys. Since each subkey corresponds to a specific iteration of L and R, it is used only once in the encryption of a given 64 bit input block. This makes it possible for the subkeys to be generated as they are needed, rather than having them stored in memory. This requires a shift routine which will handle both left and right shifting of 28 bit blocks of data.

The routine which requires the most memory and table searching is PERMS, which performs the S-box mapping. Since each element of an S-box can fit into a half byte, a compacted table is used so that two elements are contained in a single byte. To access an S-box entry, the row and column numbers are specified. The column number is then divided by two and added to the row number, which in turn is adjusted to the left half byte of the table pointer. This provides the table offset, which is added to the table address to get the byte containing the desired half-byte. The particular half-byte of interest is then determined, together with the specification of the half of the output byte into which it is to be stored.

The routine which actually performs the iterative procedures of the DES algorithm is ITER. It calls the various subroutines, and directs the logic flow for both encryption and decryption. It follows the iterative procedures described above for generating $L_m$, $R_m$, and $K_m$ for each of the 16 iterative steps.

The main routine converts the DES program into a FLEX utility responding to the entry DES from a FLEX prompt. It responds with a user prompt for the DES parameters, and calls ITER to initiate the encryption or decryption. The DES parameters are:

(1) MODE (00 = encrypt, 01 = decrypt)
(2) KEY (16 hexadecimal digits)
(3) INPUT (16 hexadecimal digits)

After the input data is entered, the system responds with the output of 16 hexadecimal digits. A sample encryption followed by a decryption is shown following the program listing.

It will be noted that the main routine utilizes certain FLEX and MIKBUT (DISKBUG in this case) routines. These are not necessary unless something like the main routine is used to interface the program with FLEX. Also, the FLEX routine ADDBX is used by two of the subroutines. This merely adds the B accumulator to the index register, and could be replaced by a user provided subroutine. It is used to provide a variable offset to the index register, permitting easier table access.

## REFERENCES


FIPS Publication 46, "Data Encryption Standard," U.S. Department of Commerce, Bureau of Standards, January 15, 1977.

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                           NAM     DES
                  ****************************************************
                  *       STANDARD DATA ENCRYPTION ALGORITHM         *
                  ****************************************************
                  *         AUTHOR: Sam J. La Cour Jr.               *
                  ****************************************************
0000                       ORG     $0000
0000 20 61                 BRA     ENT
0002 01           WH       FCB     1
0003 7E 03 19     ENT      JMP     MAIN
0006 45           CODMSG   FCC     /ENTER A 0E FOR ENCRYPT, D1 FOR DECRYPT /
0028 04                    FCB     $04
002E 49           KEYMSG   FCC     /INPUT KEY (8 BYTES)/
0041 04                    FCB     $04
0042 45           INPMSG   FCC     /ENTER DATA TO BE ENCODED (8 BYTES)/
0064 04                    FCB     $04
0065              STLOC    RMB     2
0067              MRESDT   RMB     1
0068              NPERM    RMB     1
0069              AINPUT   RMB     2
006B              ARESAD   RMB     2
006D              TABADR   RMB     2
006F              NBIT     RMB     1
0070              ED       RMB     1
0071              TMASK    RMB     1
0072              L        RMB     4
0076              R        RMB     4
007A              K        RMB     8
0082              K1       RMB     4
0086              INPUT    RMB     8
008E              C        RMB     4
0092              D        RMB     4
0096              SD16     RMB     1
0097 3F           SHIFT    FCB     $3F,$7E
0099 00 7A        KADR     FDB     K
009B 00 82        K1ADR    FDB     K1
009D 01 D9        SADR     FDB     S
009F              KEY      RMB     8
00A7              APARM    RMB     2
00A9 08           PARMS    FCB     $08,$08
00AB 00 86                 FDB     INPUT,L,INITAB
00B1 08                    FCB     $08,$04
00B3 00 9F                 FDB     KEY,C,PCH1A
00B9 08                    FCB     $08,$04
00BB 00 9F                 FDB     KEY,D,PCH1B
00C1 06           KPARM    FCB     $06,$08
00C3 00 8E                 FDB     C,K,PCH2
00C9 06                    FCB     $06,$08
00CB 00 76                 FDB     R,INPUT,E
00D1 08                    FCB     $08,$04
00D3 00 82                 FDB     K1,INPUT,P
00D9 08                    FCB     $08,$08
00DB 00 72                 FDB     L,INPUT,INVTAB
00E1 27           INITAB   FCB     $27,$26,$25,$24,$23,$22,$21,$20
00E9 47                    FCB     $47,$46,$45,$44,$43,$42,$41,$40
00F1 67                    FCB     $67,$66,$65,$64,$63,$62,$61,$60
00F9 87                    FCB     $87,$86,$85,$84,$83,$82,$81,$80
0101 17                    FCB     $17,$16,$15,$14,$13,$12,$11,$10
0109 37                    FCB     $37,$36,$35,$34,$33,$32,$31,$30
0111 57                    FCB     $57,$56,$55,$54,$53,$52,$51,$50
0119 77                    FCB     $77,$76,$75,$74,$73,$72,$71,$70
0121 17           PCH1A    FCB     $17,$16,$15,$14,$13,$12,$11
0128 10                    FCB     $10,$27,$26,$25,$24,$23,$22
012F 21                    FCB     $21,$20,$37,$36,$35,$34,$33
0136 32                    FCB     $32,$31,$30,$47,$46,$45,$44
013D 77           PCH1B    FCB     $77,$76,$75,$74,$73,$72,$71
0144 70                    FCB     $70,$67,$66,$65,$64,$63,$62
014B 61                    FCB     $61,$60,$57,$56,$55,$54,$53
0152 52                    FCB     $52,$51,$50,$43,$42,$41,$40
0159 64           PCH2     FCB     $61,$12,$31,$82,$10,$50
015F 36                    FCB     $36,$43,$71,$60,$52,$21
0165 72                    FCB     $72,$32,$41,$60,$23,$80
016B 81                    FCB     $81,$70,$33,$42,$51,$20
0171 55                    FCB     $55,$86,$34,$15,$36,$37
0177 24                    FCB     $24,$45,$76,$16,$34,$46
017D 85                    FCB     $85,$56,$33,$47,$64,$17
0183 26                    FCB     $26,$65,$44,$84,$14,$44
0189 83           E        FCB     $83,$10,$20,$30,$40,$50
018F 40                    FCB     $40,$50,$60,$70,$80,$11
0195 80                    FCB     $80,$11,$21,$31,$41,$51
019B 41                    FCB     $41,$51,$61,$71,$81,$12
01A1 81                    FCB     $81,$12,$22,$32,$42,$52
01A7 42                    FCB     $42,$52,$62,$72,$82,$13
01AD 82                    FCB     $82,$13,$23,$33,$43,$53
01B3 43                    FCB     $43,$53,$63,$73,$83,$10
01B9 81           P        FCB     $81,$70,$42,$52
01BD 53                    FCB     $53,$41,$43,$12
01C1 10                    FCB     $14,$71,$72,$23
01C5 50                    FCB     $50,$22,$73,$21
01C9 20                    FCB     $20,$80,$82,$61
01CD 83                    FCB     $83,$33,$30,$11
01D1 32                    FCB     $32,$51,$63,$60
01D5 62                    FCB     $62,$31,$40,$13
01D9 E4           S        FCB     $E4,$D1,$2F,$B8,$3A,$6C,$59,$07
01E1 0F                    FCB     $0F,$74,$E2,$D1,$A6,$CB,$95,$38
01E9 41                    FCB     $41,$E8,$D6,$2B,$FC,$97,$3A,$50
01F1 FC                    FCB     $FC,$82,$49,$17,$5B,$3E,$A0,$6D
01F9 F1                    FCB     $F1,$8E,$6B,$34,$97,$2D,$C0,$5A
0201 3D                    FCB     $3D,$47,$F2,$8E,$C0,$1A,$69,$B5
0209 0E                    FCB     $0E,$7B,$A4,$D1,$58,$C6,$93,$2F
0211 D8                    FCB     $D8,$A1,$3F,$42,$B6,$7C,$05,$E9
0219 A0                    FCB     $A0,$9E,$63,$F5,$1B,$C7,$B4,$28
0221 D7                    FCB     $D7,$09,$34,$6A,$28,$5E,$CB,$F1
0229 D6                    FCB     $D6,$49,$8F,$30,$B1,$2C,$5A,$E7
0231 1A                    FCB     $1A,$D0,$69,$87,$4F,$E3,$B5,$2C
0239 7D                    FCB     $7D,$E3,$06,$9A,$12,$85,$BC,$4F
0241 D8                    FCB     $D8,$B5,$6F,$03,$47,$2C,$1A,$E9
0249 A6                    FCB     $A6,$90,$CB,$7D,$F1,$3E,$52,$84
0251 3F                    FCB     $3F,$06,$A1,$D8,$94,$5B,$C7,$2E
0259 2C                    FCB     $2C,$41,$7A,$B6,$85,$3F,$D0,$E9
0261 EB                    FCB     $EB,$2C,$47,$D1,$50,$FA,$39,$86
0269 42                    FCB     $42,$1B,$AD,$78,$F9,$C5,$63,$0E
0271 B8                    FCB     $B8,$C7,$1E,$29,$6F,$09,$A4,$53
0279 C1                    FCB     $C1,$AF,$92,$68,$0D,$34,$E7,$5B
0281 AF                    FCB     $AF,$42,$7C,$95,$61,$DE,$0B,$38
0289 9E                    FCB     $9E,$F5,$28,$C3,$70,$4A,$1D,$B6
0291 43                    FCB     $43,$2C,$95,$FA,$BE,$17,$60,$8D
0299 4B                    FCB     $4B,$2E,$F0,$8D,$3C,$97,$5A,$61
02A1 D0                    FCB     $D0,$B7,$49,$1A,$E3,$5C,$2F,$86
02A9 14                    FCB     $14,$B8,$C3,$7E,$AF,$60,$05,$92
02B1 6B                    FCB     $6B,$D8,$14,$A7,$95,$0F,$E2,$3C
02B9 B2                    FCB     $B2,$84,$6F,$D1,$A9,$3E,$50,$C7
02C1 1F                    FCB     $1F,$B8,$A3,$74,$C5,$6B,$0E,$92
02C9 7B                    FCB     $7B,$41,$9C,$E2,$06,$AD,$F3,$58
02D1 21                    FCB     $21,$E7,$4A,$8D,$FC,$90,$35,$6B
02D9 84           INVTAB   FCB     $84,$80,$85,$81,$86,$82,$87,$83
02E1 74                    FCB     $74,$70,$75,$71,$76,$72,$77,$73
02E9 64                    FCB     $64,$60,$65,$61,$66,$62,$67,$63
02F1 54                    FCB     $54,$50,$55,$51,$56,$52,$57,$53
02F9 44                    FCB     $44,$40,$45,$41,$46,$42,$47,$43
0301 34                    FCB     $34,$30,$35,$31,$36,$32,$37,$33
0309 24                    FCB     $24,$20,$25,$21,$26,$22,$27,$23
0311 14                    FCB     $14,$10,$15,$11,$16,$12,$17,$13
E1AC              INEEE    EQU     $E1AC
E1D1              OUTEEE   EQU     $E1D1
E0BF              OUT2H    EQU     $E0BF
E0C8              OUT4HS   EQU     $E0C8
E047              BADDR    EQU     $E047
E055              BYTE     EQU     $E055
E07E              PDATA1   EQU     $E07E
E0CA              OUT2HS   EQU     $E0CA
E0CC              OUTS     EQU     $E0CC
AD03              WARMS    EQU     $AD03
AD1E              PSTRNG   EQU     $AD1E
AD2D              GETFIL   EQU     $AD2D
AD33              SETEXT   EQU     $AD33
AD36              ADDBX    EQU     $AD36
AD3F              RPTERR   EQU     $AD3F
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AD13            BETCHR  EQU     $AD15
AD24            PCRLF   EQU     $AD24
AD18            PUTCHR  EQU     $AD18
                ****************************************************
                * MAIN ROUTINE:                                    *
                *                                                  *
                *  FUNCTION: Prompts user  for DES parameters and  *
                *            invokes ITER to do the encryption     *
                *            or decryption. The DES parameters     *
                *            consist of:                           *
                *              (1) MODE (00=Encrypt,01=Decrypt)    *
                *              (2) KEY  (8 hex bytes).             *
                *              (3) INPUT DATA (8 hex bytes).       *
                *                                                  *
                *  EXTERNAL ROUTINES:                              *
                *                                                  *
                *     FLEX: PCRLF, WARMS                           *
                *     DISKBUG: BYTE, PDATA1, OUT2HS                *
                *                                                  *
                ****************************************************
0319 BD AD 24   MAIN    JSR     PCRLF
031C CE 00 D6           LDX     #MODMSG
031F BD E0 7E           JSR     PDATA1
0322 BD AD 24           JSR     PCRLF
0325 BD E0 55           JSR     BYTE
0328 97 76              STA A   SDIR
032A BD AD 24           JSR     PCRLF
032D CE 00 2E           LDX     #KEYMSG
0330 BD E0 7E           JSR     PDATA1
0333 BD AD 24           JSR     PCRLF
0336 C6 08              LDA B   #08
0338 CE 00 9F           LDX     #KET
033B 37         INKET   PSH B
033C BD E0 55           JSR     BYTE
033F A7 00              STA A   0,X
0341 08                 INX
0342 33                 PUL B
0343 5A                 DEC B
0344 2E F5              BGT     INKEY
0346 BD AD 24           JSR     PCRLF
0349 CE 00 42           LDX     #INPMSG
034C BD E0 7E           JSR     PDATA1
034F BD AD 24           JSR     PCRLF
0352 C6 08              LDA B   #08
0354 CE 00 B6           LDX     #INPUT
0357 37         INPLB   PSH B
0358 BD E0 55           JSR     BYTE
035B A7 00              STA A   0,X
035D 08                 INX
035E 33                 PUL B
035F 5A                 DEC B
0360 2E F5              BGT     INPLN
0362 BD AD 24           JSR     PCRLF
0365 BD 03 B3           JSR     ITER
0368 C6 08              LDA B   #08
036A CE 00 B6           LDX     #INPUT
036D BD E0 CA   PX      JSR     OUT2HS
0370 5A                 DEC B
0371 2E FA              BGT     PX
0373 7E AD 03           JMP     WARMS
                ****************************************************
                * SUBROUTINE SHIFT:                                *
                *                                                  *
                *  FUNCTION: Rotates 28 bits pointed to by X       *
                *            either left or right depending on     *
                *            the value in "SDIR" (00 for left,     *
                *            01 for right). The result is stored   *
                *            in the source field.                  *
                *                                                  *
                *  EXTERNAL ROUTINES: NONE                         *
                *                                                  *
                ****************************************************
0376 36         SHIFT   PSH A           Save accumulators A and B.
0377 37                 PSH B
0378 36                 PSH A           Clear out right side of last
0379 A6 03              LDA A   3,X     of C or D.
037B 84 F0              AND A   #$F0
037D A7 03              STA A   3,X
037F 32                 PUL A
0380 81 01              CMP A   #$01    Encrypt or decrypt?
0382 27 15              BEQ     RSHIFT  Decrypt -- right rotate.
0384 68 03      LSHIFT  ASL     3,X     Encrypt -- left rotate.
0386 A6 03              LDA A   3,X
0388 69 02              ROL     2,X
038A 69 01              ROL     1,X
038C 69 00              ROL     0,X
038E 89 0F              ADC A   #$0F    Force carry into bit 4 of last
0390 84 F0              AND A   #$F0    byte and reset bits 3 - 0.
0392 A7 03              STA A   3,X
0394 5A                 DEC B           More than one shift?
0395 2E ED              BGT     LSHIFT  Yes -- do it again.
0397 20 17              BRA     OUTSHF  Exit.
0399 64 00      RSHIFT  LSR     0,X     Decrypt -- right rotate.
039B 66 01              ROR     1,X
039D 66 02              ROR     2,X
039F 66 03              ROR     3,X
03A1 A6 03              LDA A   3,X
03A3 48                 ASL A           Force previous bit 4 of last byte
03A4 48                 ASL A           to position 1 so it can be placed
03A5 48                 ASL A           in bit 1 of the first byte which
03A6 48                 ASL A           has been cleared by the LSR 0,X.
03A7 84 80              AND A   #$80    Get this bit.
03A9 AA 00              ORA A   0,X     OR it into byte 1.
03AB A7 00              STA A   0,X     Restore byte 1.
03AD 5A                 DEC B           More than one shift?
03AE 2E E9              BGT     RSHIFT  Yes -- do it again.
03BC 33         OUTSHF  PUL B           Restore accumulators A and B.
03B1 32                 PUL A
03B2 39                 RTS
                ****************************************************
                * SUBROUTINE ITER:                                 *
                *                                                  *
                *  FUNCTION: Actually the main DES routine, ITER   *
                *            calls all other DES routines and      *
                *            directs logic flow for either         *
                *            encryption or decryption.             *
                *                                                  *
                * EXTERNAL ROUTINES: NONE                          *
                *                                                  *
                ****************************************************
03B3 CE 00 A7   ITER    LDX     #PARAM  Initialize parameter pointer to
03B6 DF 65              STX     STLOC   first group of parameters.
03B8 CE 3F 7E           LDX     #$3F7E  Initialize shift schedule indicator.
03BB DF 97              STX     SNUM
03BD BD 04 6F           JSR     PERM    Perform initial permutation.
03C0 BD 04 4F           JSR     PERM    Perform permuted choice 1a.
03C3 BD 04 4F           JSR     PERM    Perform permuted choice 1b.
03C6 86 10              LDA A   #16     Initialize iteration counter.
03C8 36         ITERA   PSH A           Save current iteration counter.
03C9 CE 00 C1           LDX     #KPARM  Force parameter pointer to start
03CC DF 65              STX     STLOC   of parameters used in iterations.
03CE 96 76              LDA A   SDIR    Set encrypt, decrypt mode.
03D0 26 1D              BNE     DECR    If 1 then decrypt mode.
03D2 78 00 98           ASL     SNUM+1  Rotate next shift schedule bit into
03D5 79 00 97           ROL     SNUM    carry then add the carry to 1,
03D8 C6 01              LDA B   #01     giving the number of shifts.
03DA C9 00              ADC B   #00
03DC CE 00 8E           LDX     #C      Prepare to shift C to the left.
03DF BD 03 76           JSR     SHIFT   Shift C left.
03E2 CE 00 92           LDX     #D      Prepare to shift D to the left.
03E5 BD 03 76           JSR     SHIFT   Shift D left.
03E8 BD 04 4F           JSR     PERM    Perform permuted choice 2.
03EB 20 1A              BRA     GOON    Continue.
03ED BD 04 4F   DECR    JSR     PERM    Perform permuted choice 2 first.
03F0 96 98              LDA A   SDIR    Set encrypt, decrypt code.
03F2 76 00 97           LSR     SNUM    Rotate next shift schedule bit into
03F4 76 00 98           ROR     SNUM+1  carry ( from right for decryption ).
03F7 C6 01              LDA B   #01     Now add the carry to 1 giving the
03F9 C9 00              ADC B   #00     number of shifts.
03FB CE 00 8E           LDX     #C      Prepare to shift C to the right.
03FE BD 03 76           JSR     SHIFT   Shift C to the right.
0401 CE 00 92           LDX     #D      Prepare to shift D to the right.
0404 BD 03 76           JSR     SHIFT   Shift D to the right.
0407 BD 04 4F   GOON    JSR     PERM    Perform E permutation on R.
0409 CE 00 7A           LDX     #K      Prepare to XOR subkey K with
040C C6 08              LDA B   #08     result of E permutation, result in K.
040E 36         XOT1    PSH A
040F A6 00              LDA A   0,X     Get a byte of K.
0411 A8 0C              EOR A   12,X    EOR it with a byte of "INPUT".
0413 A7 00              STA A   0,X     Store it back in K.
0415 08                 INX
0416 32                 PUL A
0417 5A                 DEC B
0418 2E F4              BGT     XOT1
041A BD 04 B1           JSR     PERMS   Perform S1 - S8 selection mapping.
041D BD 04 4F           JSR     PERM    Perform P permutation giving f(R,K1).
041F CE 00 72           LDX     #L      Prepare to swap and EOR L and R.
0422 86 04              LDA A   #04     Four bytes in each.
0424 36         XOT2    PSH A
0425 A6 00              LDA A   0,X     Get a byte of L.
0427 A8 14              EOR A   20,X    EOR L with f(R,K) ( in "INPUT" ).
0429 E6 04              LDA B   4,X     Get a byte of R.
042B A7 04              STA A   4,X     Put new L where R was.
042D E7 00              STA B   0,X     Put R where L was.
042F 08                 INX
0430 32                 PUL A
0431 4A                 DEC A
0432 2E F0              BGT     XOT2
0434 32                 PUL A           Pull iteration counter off stack.
0435 4A                 DEC A           Decrement it.
0436 2E 90              BGT     ITERA   Keep going.
0438 CE 00 72           LDX     #L      Prepare to perform final swap.
043B 86 04              LDA A   #04
043D 36         SW1     PSH A
043E A6 00              LDA A   0,X     Get a byte of L.
0440 E6 04              LDA B   4,X     Get a byte of R.
0442 E7 00              STA B   0,X     Put R in L.
0444 A7 04              STA A   4,X     Put L in R.
0446 08                 INX
0447 32                 PUL A
0448 4A                 DEC A
0449 2E F2              BGT     SW1
044B BD 04 4F           JSR     PERM    Perform inverse initial permutation
044E 39                 RTS             Finished.
                ****************************************************
                * SUBROUTINE PERM:                                 *
                *                                                  *
                *  FUNCTION: Performs bit mapping from input       *
                *            to output using a mapping table.      *
                *            Input,output and table are specified  *
                *            in a parameter table which is         *
                *            traversed serially each time          *
                *            PERM is called. The mapping table     *
                *            entries are in the form aaaabbbb      *
                *            where aaaa is a mask number which     *
                *            gives the location of the source      *
                *            bit within the source byte.           *
                *            The bits are numbered from 1 TO 8.    *
                *            bbbb gives the location within the    *
                *            input of the byte which contains      *
                *            the desired bit. These bytes are      *
                *            numbered from 0 TO 7.                 *
                *            The parameter list also gives the     *
                *            number of bytes and the byte length   *
                *            of the output.                        *
                *                                                  *
                *  EXTERNAL ROUTINES:                              *
                *     FLEX: ADDBX                                  *
                *                                                  *
                ****************************************************
044F 86 4?      PERM    LDA A   #$08    Number of parameter bytes to be moved
0451 CE 00 47           LDX     #BRESBT Address of parameter storage area.
0454 DF A7              STX     APARM
0456 DE 65      P1      LDX     STLOC   Current parameter pointer.
0458 E6 00              LDA B   0,X     Get a parameter byte.
045A 08                 INX             Move parameter pointer along.
045B DF 65              STX     STLOC   Save it.
045D DE A7              LDX     APARM   Address of recieving field.
045F E7 00              STA B   0,X     Move parameter to current parameter list.
0461 08                 INX             Save this pointer along also.
0462 DF A7              STX     APARM
0464 4A                 DEC A
0465 26 EF              BNE     P1      Do until all parameters moved.
0467 DE 63              LDX     TABADR  Get table pointer from parameter list.
0469 D6 67      PLOOP   LDA B   BRESBT  Number of bits per permuted byte.
046B D7 6F              STA B   NBIT    Save it.
046D 7F 00 70           CLR     RB      Clear work byte.
0470 E6 00      GETB    LDA B   0,X     Get byte from table.
0472 17                 TBA             Put a copy in B.
```

```
0472 84 F0          AND A  #$F0     Extract mask for source byte.
0474 44             LSR A           Right justify mask number.
0475 44             LSR A
0476 44             LSR A
0477 44             LSR A
0478 DE 6F          LDX    AINPUT   Get input address from parameters.
047A C4 0F          AND B  #$0F     Extract source byte number.
047C BD AD 36       JSR    ADDBX
047F E6 00          LDA B  0,X      Get source byte.
0481 7F 00 71       CLR    TMASK    Prepare mask area.
0484 0D             SEC             Set carry to be rotated into mask.
0485 76 00 71 SLOOP ROR    TMASK    Location of mask bit is in A.
0488 4A             DEC A
0489 2E FA          BGT    SLOOP    Continue shifting mask bit in.
048B D4 71          AND B  TMASK    Use mask to get bit from source byte.
048D C9 FF          ADC B  #$FF     Any one bit will be forced into the carry.
048F 79 00 70       ROL    R0       Move the carry into R0.
0492 DE 6D          LDX    TABADR   Move pointer to next table entry.
0494 08             INX
0495 DF 6D          STX    TABADR
0497 7A 00 6F       DEC    NBIT     Decrement bit counter.
049A 2E 33          BGT    SHFIN    Continue until finished with current byte.
049C D6 70          LDA B  R0       Get completed work byte.
049E DE 6B          LDX    ARESUD   Get result address.
04A0 E7 00          STA B  0,X      Store work byte.
04A2 08             INX             Point to next result byte.
04A3 DF 6B          STX    ARESUD
04A5 7F 00 70       CLR    R0       Clear out work byte for next iteration.
04A8 DE 6D          LDX    TABADR   Get current table location.
04AA 7A 00 6D       DEC    NPIBM    Decrement byte counter.
04AD 2E B9          BGT    PLOOP    Continue till finished.
04AF 39             RTS             Return to sender.
                    ****************************************************
                    * SUBROUTINE PERMS:                                *
                    *                                                  *
                    *  FUNCTION: Performs S mapping from K to K1       *
                    *            using S tables which are compacted    *
                    *            so that odd-even elements are in      *
                    *            the same byte.                        *
                    *                                                  *
                    * EXTERNAL ROUTINES:                               *
                    *     FLEX: ADDBX                                  *
                    *                                                  *
                    ****************************************************
04B0 C6 08    PERMS  LDA B  #08     Initialize select S iteration counter.
04B2 37       PERMS1 PSH B
04B3 DE 99           LDX    KADR    Get current address of K.
04B5 E6 00           LDA B  0,X     Get a byte of K.
04B7 17              TBA            Put a copy in A.
04B8 C4 1E           AND B  #$1E    Mask bits 4 - 7 to get column no.
04BA 54              LSR B          Right justify column number.
04BB D7 70           STA B  R0      Save column number for now.
04BD 54              LSR B          Integer divide col. no. by 2.
04BE 84 21           AND A  #$21    Get row number.
04C0 8B 0F           ADD A  #$0F    Force bit 1 next to bit 3.
04C2 84 F0           AND A  #$F0    Clear right part of byte.
04C4 44              LSR A          Integer divide row number by 2.
04C5 DE 9D           LDX    TADR    Get beginning address of current S table.
04C7 1B              ABA            Form byte number within table.
04C8 16              TAB
04C9 BD AD 36        JSR    ADDBX
04CC E6 00           LDA B  0,X     Get table entry.
04CE 76 00 70        ROR    R0      Rotate original col. no. to see if the
04D1 24 07           BCC    GETL    value is on the left or right side.
04D3 7F 00 71        CLR    TMASK   Clear flag byte.
04D6 C4 0F           AND B  #$0F    Get the right value from the table entry.
04D8 20 06           BRA    PSIDE   So see which side to put it in.
04DA C4 F0    GETL   AND B  #$F0    Get the left value from the table entry.
04DC 86 01           LDA A  #01     Set left side flag.
04DE 97 71           STA A  TMASK   Save it.
04E0 32       PSIDE  PUL A          Get copy of iteration counter.
04E1 36              PSH A          Restore it to stack.
04E2 46              ROR A          Rotate rightmost bit into carry.
04E3 24 13           BCC    STL     If 0 then even numbered iteration.
04E5 96 71           LDA A  TMASK   Add number - if the entry is already
04E7 27 04           BEQ    KSHFR   on the right side then no shift needed.
04E9 54              LSR B
04EA 54              LSR B
04EB 54              LSR B
04EC 54              LSR B
04ED DE 93    KSHFR  LDX    K1ADR   Get current byte address.
04EF EA 00           ORA B  0,X     Place right side of byte in.
04F1 E7 00           STA B  0,X
04F3 08              INX            Since the byte is now completed,
04F4 DF 93           STX    K1ADR   increment the result byte pointer.
04F6 20 0C           BRA    STO
04F8 96 71    STL    LDA A  TMASK   Get flag.
04FA 26 04           BNE    KSHFL   If flag is 0 then need to left
04FC 58              ASL B          justify the table entry to fit
04FD 58              ASL B          the output.
04FE 58              ASL B
04FF 58              ASL B
0500 DE 93    KSHFL  LDI    K1ADR   Get current result byte address.
0502 E7 00           STA B  0,X     Left side -- just store it.
0504 DE 99    STO    LDX    KADR    Increment source data addr pointer.
0506 08              INX
0507 DF 99           STX    KADR
0509 DE 9D           LDX    TADR    Increment table pointer to next table.
050B C6 20           LDA B  #32
050D BD AD 36        JSR    ADDBX
0510 DF 9D           STX    TADR
0512 33              PUL B          Get iteration counter.
0513 5A              DEC B
0514 2E 9C           BGT    PERMS1  Keep going.
0516 CE 00 7A        LDX    #K
0519 DF 99           STX    KADR    Reset source data pointer.
051B CE 00 82        LDX    #K1
051E DF 93           STX    K1ADR   Reset result data pointer.
0520 CE 00 ??        LDX    #S1
0523 DF 9D           STX    TADR    Reset table pointer.
0525 39              RTS
                     END

NO ERROR(S) DETECTED
```

```
SYMBOL TABLE:

ADDBX   AD36  AINPUT  006F  APARS   00A7  ARESUD  006B  BADDR   E047
BYTE    E033  C       008E  D       0092  DECR    03ED  E       0184
EXT     0003  GETCHR  AD15  GETFIL  AD2D  GETL    04DA  GOBM    0407
INECE   E1AC  INKEY   0338  INPLN   0357  INPMSG  0042  INPUT   0086
INTTAB  00E1  INVTAB  0209  ITER    0383  ITER1   03C8  K       007A
K1      0082  K1ADR   0093  KADR    0099  KEY     009F  KEYMSG  002E
KPARM   00C1  L       0072  LSHIFT  0384  MAIN    0319  MOMSG   0006
NST1    040E  NST2    0424  NBIT    006F  NPIBM   006D  NRESET  0067
NSHFL   0501  NSHFR   04EE  OUT2HS  E00F  OUT2HS  E0CA  OUTHHG  E0C8
OUTEEE  E1D1  OUTS    E0CC  OUTBUF  03B0  P       0189  PDO     0199
P1      0456  PARMS   00A9  PCR1A   0121  PCR1B   0130  PCRLF   AD24
PDATA1  E07E  PERM    044F  PERMS   04B1  PERMS1  0483  PLOOP   0449
PSIDE   04E1  PSTRNG  AD1E  PUTCHR  AD18  PX      036D  R       0076
R0      0070  RPTERR  AD3F  RSHIFT  0399  S       01D9  SADR    009D
SBER    0096  SETEXT  AD33  SHFIN   0470  SHIFT   0376  SLOOP   0486
SMUR    0097  STL     04F9  STLOC   0045  STO     0503  SUL     0431
TABADR  006D  TMASK   0071  VN      0002  WARMS   AD03
```

```
+++DES
ENTER A 00 FOR ENCRYPT, 01 FOR DECRYPT
00
INPUT KEY (8 BYTES)
0101010101010101
ENTER DATA TO BE ENCODED (8 BYTES)
95F8A5E5DD31D900
80 00 00 00 00 00 00 00
+++DES
ENTER A 00 FOR ENCRYPT, 01 FOR DECRYPT
01
INPUT KEY (8 BYTES)
0101010101010101
ENTER DATA TO BE ENCODED (8 BYTES)
8000000000000000
95 F8 A5 E5 DD 31 D9 00
+++
```

# Letters—New Products—Etc.

*Alford and Associates*
*P.O. Box 6743    Richmond, Virginia 23230*
*phone 804 355 5016*

28 November 1979

NEW PRODUCT ANNOUNCEMENT FOR THE M6800 / SS-50 USER

Alford and associates is pleased to announce the availability of their new SCREDITOR Screen Editing System for operation with Smoke Signal Broadcasting DOS version 5.1X.

The SCREDITOR provides the most flexible and convenient combination of capabilities available in any editing utility today. Dual mode operation is provided, allowing the editing of SOURCE files whose lines must be exactly defined as well as TEXT-typed material, where the need to constantly watch for margin overrun makes line-editors clumsy. In 'TEXT-MODE', part-words are AUTOMATICALLY SHIFTED to the next line, making margin-watching unnecessary. In 'SOURCE-MODE', the SCREDITOR sets a fixed right margin.

The SCREDITOR provides FOURTEEN major edit commands, giving it all the power of the best of line-editors. In addition, in the screen editing mode, TWENTY-TWO screen operators (cursor operations, insertions, deletions, movements, case-changes, etc...) provide a level of control over the edit process that is not matched by any other system in the industry to our knowledge. With editing being done ON-SCREEN, the operator controls the edit process, eliminating costly errors common to line-editors.

The SCREDITOR is designed to operate with either 16 x 64 or the now-available 24 x 80 character memory-mapped displays for the SS-50 buss. Necessary modifications to support a particular memory-mapped display board are minimal, if any.

The manual provided with the software provides a tutorial section to familiarize the operator with the unique features of the SCREDITOR. Complete information to allow the user to modify the package for individual tastes and system considerations is provided. Keyboard definition, system I/O, etc..., are user alterable to meet special requirements.

When compared to other screen-editing software available to the users of microcomputers, the SCREDITOR, priced at $99.95, is one of the best buys available to the M6800 user today. The SCREDITOR may be ordered by phone or mail, and payment may be made by VISA, MASTERCHARGE or by personal check. Check payments will delay the normal three-day shipment by about two weeks on the average. Dealer and OEM inquiries are invited.

A version for the 6809 will be available in the first quarter of 1980.

11/26/79

Mr. Don Williams
'68' Micro Journal
3018 Hamill Road
Hixson, TN 37343

Dear Mr. Williams:

You did not print the truth table of AND,NAND,OR,NOR,Ex.OR in the article, "Logic Gate Tester", in Nov./Dec. 1979 issue on page 33.

Enclosed please find the truth table for your correction.

Sincerely,

S. J. Houng
E. 36 Salmon Street
Spokane, WA 99218

| Test Pattern | AND | NAND | OR | NOR | Ex.OR |
|---|---|---|---|---|---|
| 0 0 | 0 | 1 | 0 | 1 | 0 |
| 0 1 | 0 | 1 | 1 | 0 | 1 |
| 1 0 | 0 | 1 | 1 | 0 | 1 |
| 1 1 | 1 | 0 | 1 | 0 | 0 |
| Hex. Value | 1 | E | 7 | 8 | 6 |
| Displayed Character | [illegible] | [illegible] | [illegible] | [illegible] | [illegible] |

| Test Pattern | Hex. Value | Displayed Character |
|---|---|---|
| 0 1 0 1 | | |
| Inverter: 1 0 1 0 | A | [illegible] |
| Buffer: 0 1 0 1 | 5 | [illegible] |

| Clock | D-Input | D-Type Flip-Flop Q | D-Type Flip-Flop Q̄ | J-K Flip-Flop J=K=1 Q | J-K Flip-Flop J=K=1 Q̄ |
|---|---|---|---|---|---|
| 0 | 0 | 1 | 0 | 0 | 1 |
| 1 | 0 | 0 | 1 | 0 | 1 |
| 0 | 1 | 0 | 1 | 1 | 0 |
| 1 | 1 | 1 | 0 | 1 | 0 |
| Hex. Value | | 9 | 6 | 3 | C |
| Displayed Character | | [illegible] | [illegible] | [illegible] | [illegible] |

November 27, 1979

'68 Micro Journal
3018 Hamill Road
Hixson, Tennessee 37343

Dear Mr. Williams:

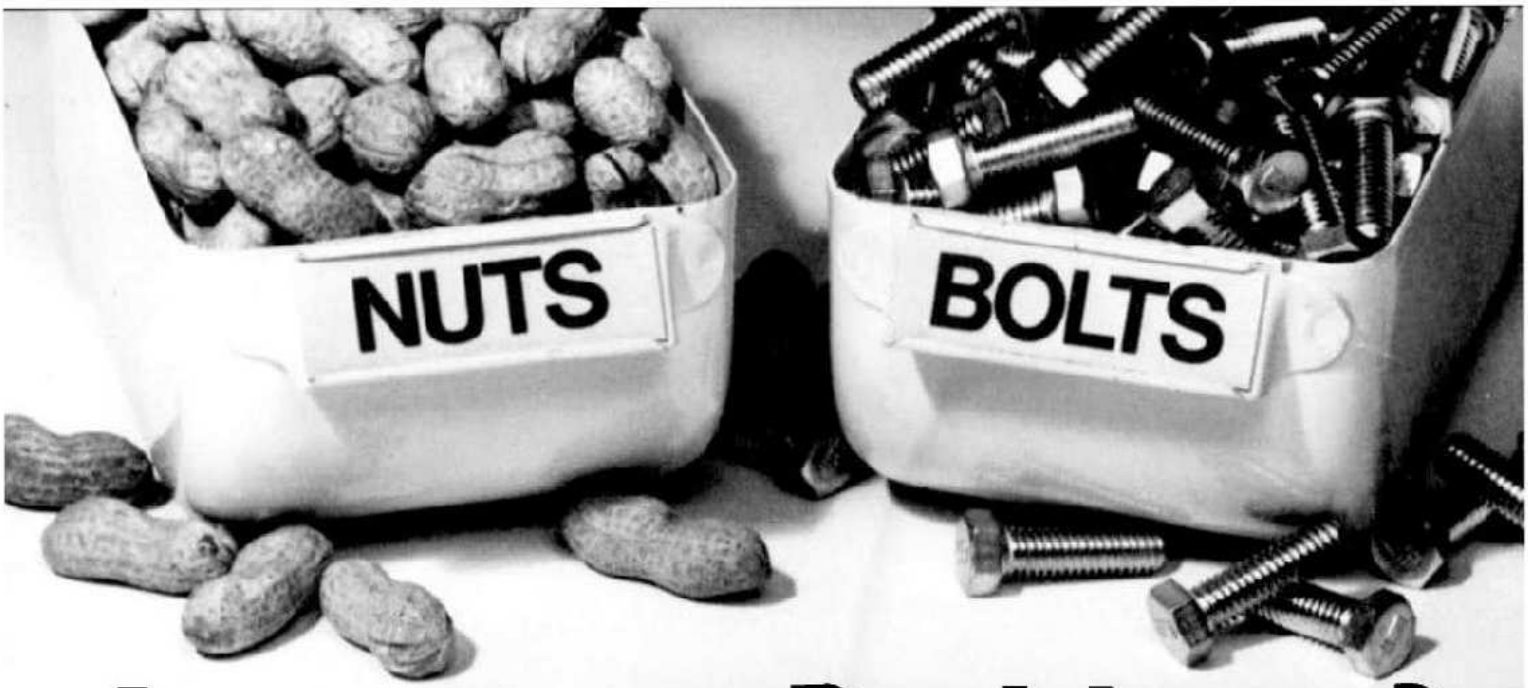
While loading and debugging the Christmas File Program submitted by Mr. Paul Phelps in the Nov/Dec issue of '68 Micro Journal, I discovered a small error in the listing. On line 2200: FOR I = 1 to Y + 1 should be FOR I = 1 to Y. After I made this correction the program ran perfectly.

I would also like to take this opportunity to plug what I think is one of the best Floppy Disk Systems available for SS50 buss computers, and this, of course, is Percom's LFD-400" Floppy Disk System. It comes from Percom with "Mindos-Plus X" Percom's named file DOS in ROM.

Sincerely,

D. B. Taylor
Route # 4 - Box 196
Seneca, S.C.

DBT/PC




# Inventory Problems?

Are you having trouble keeping the right nuts and bolts in stock? Since even a simple mistake can cost you time and money, a good inventory system should do more than just count parts. It should tell you exactly what you need, when you need it, where to get it, and how much it will cost.

The MSI Inventory System Seven enables you to maintain a versatile data base for controlling inventory. It lists part number, description, quantity on hand, vendor, cost, selling price, optional pricing, usage levels for previous month, present month, and year-to-date, and much more.

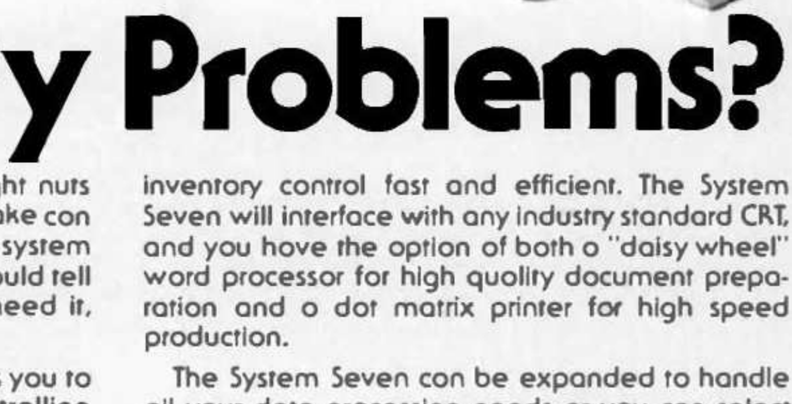
When quantity on hand items reach minimum levels, the System Seven compiles an automatic reorder list. This list can be generated by specific vendor as well as a complete listing of all materials to be ordered.

In addition to the item listing, the Inventory System Seven "bill of materials" provides you with a complete inventory of items used in the manufacture of subassemblies and complete products. It also contains other cost items such as labor costs, total raw materials costs, and miscellaneous costs.

The MSI Inventory System Seven is built around the versatile MSI 6800A Computer with 56K of RAM. An integral dual mini-floppy memory gives you an additional 630K of memory and makes inventory control fast and efficient. The System Seven will interface with any industry standard CRT, and you have the option of both a "daisy wheel" word processor for high quality document preparation and a dot matrix printer for high speed production.

The System Seven can be expanded to handle all your data processing needs or you can select one of nine other MSI systems now available for business, industrial, scientific, educational, and personal applications.

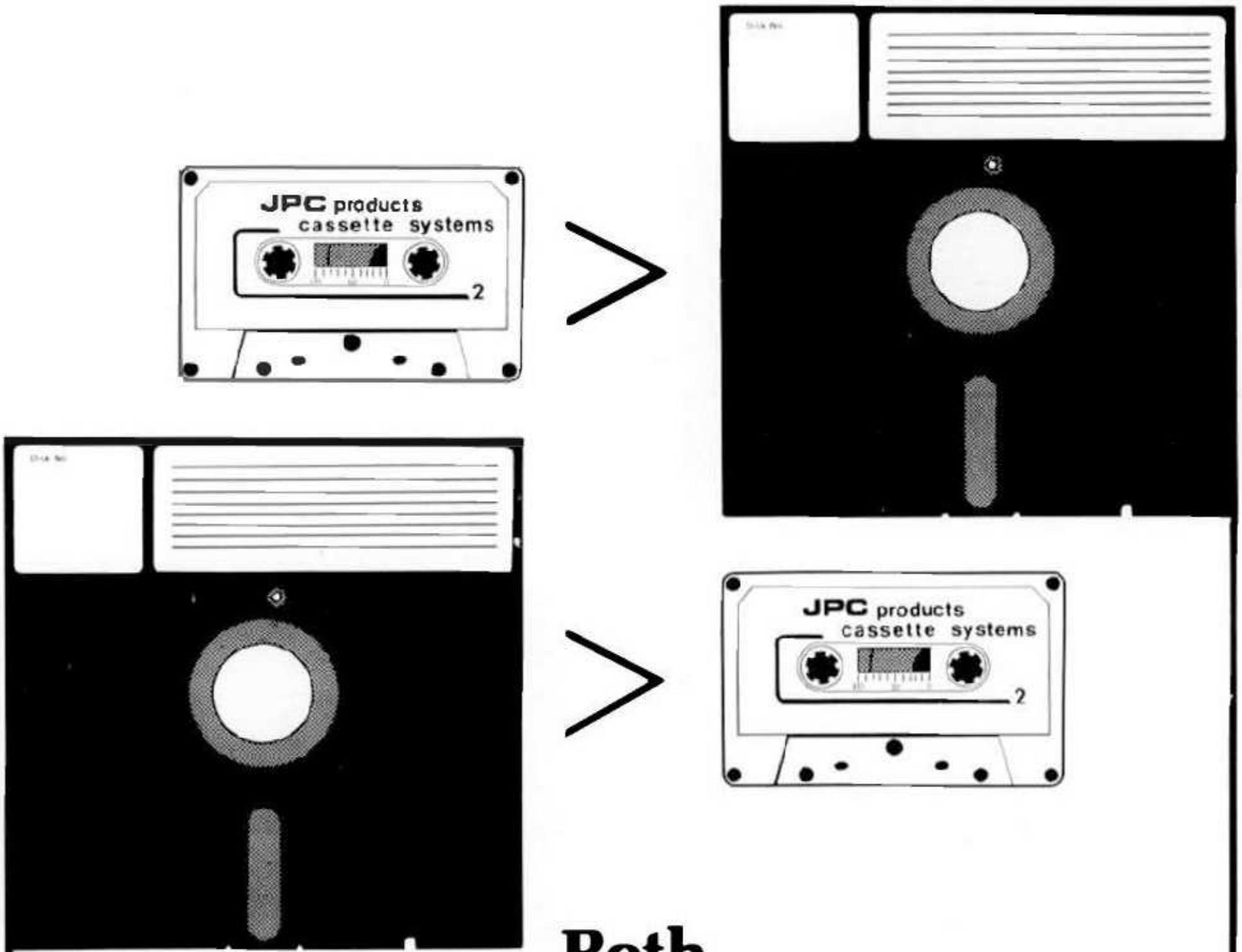
If you need more than just a nuts and bolts inventory system, we have more information about how the Inventory System Seven can solve your problems economically.



**MSI Inventory System Seven**

MSI **Midwest Scientific**

220 W. Cedar, Olathe, Kansas 66061, (913) 764-3273
TWX 910 749 6403 (MSI OLAT), TELEX 42525 (MSI A OLAT)

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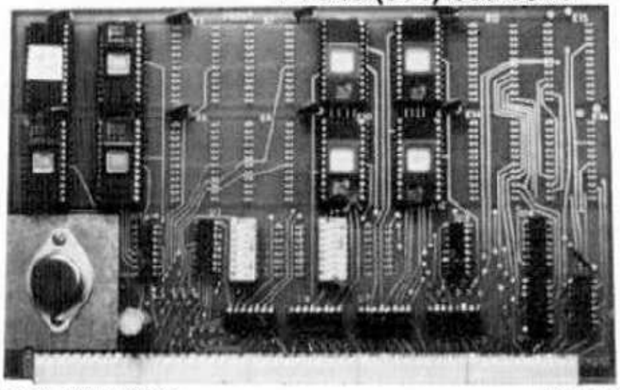

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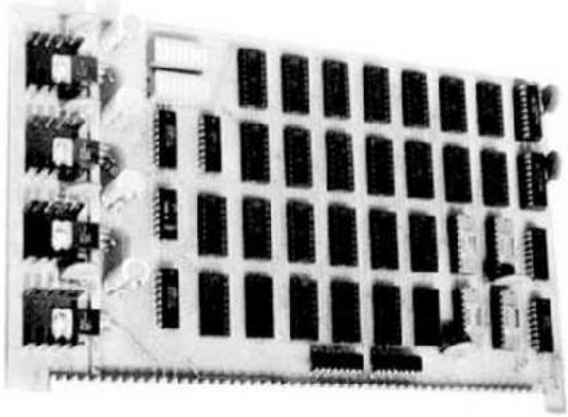

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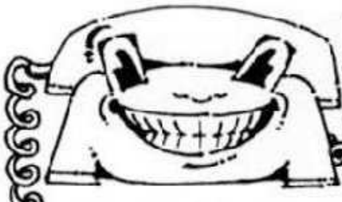

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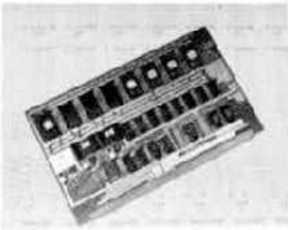
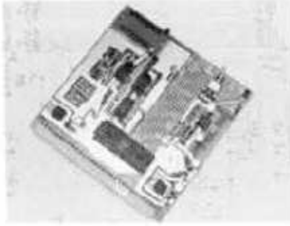
*(Note: Above Basics have random disc files and were designed for Smoke disk; available on cassette for additional $5.00)*

See Gimix Ad on page 3

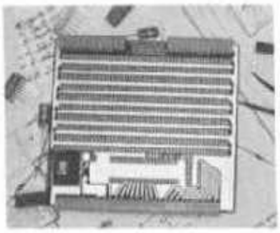
DS-68 DIGISECTOR



PSB-08 PROM SYSTEM BOARD



B-08 EPROM PROGRAMMER



UIO UNIVERSAL I/O BOARD

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**DS-68 DIGISECTOR** is a random access video digitizer featuring 256 × 256 picture element scan and 64 levels of grey scale, with conversion times as low as 3 microseconds per pixel. It accepts either interlaced (NTSC) or non-interlaced (industrial) video input. Use it for computer portraiture, moving target indicators, precision security systems, fast to slow scan conversion. . . with clever software, the Digisector can read just about anything. Truly a professional tool at a price you can afford. $169.95

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**B-08 2708 EPROM PROGRAMMER** is a compact unit that fits in the 6800's I/O slot. A safety switch and LED indicator provide control over the high programming voltage generated on board. An industrial quality Textool socket and extended board height allow effortless PROM insertion and retrieval. Fully commented source listings of U2708 is included in the Owner's Manual. $99.95

**U2708** utility for testing, burning, verifying and copying 2708s in EPROM. $29.95

**M6809 EMULATOR** is a machine language program that will emulate all of the functions of the Motorola 6809 third generation microprocessor. Developed for use on any 6800 system, the program allows software development and debugging. The 3K byte program is complete with a 6809 mini-monitor and single-step trace routines. Fully commented source listing included. Specify Smoke Signal Broadcasting or FLEX™ disk, or KCS cassette. $49.95

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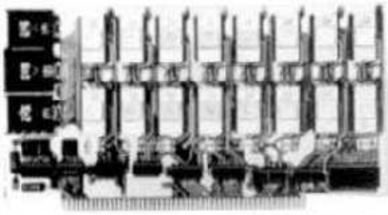

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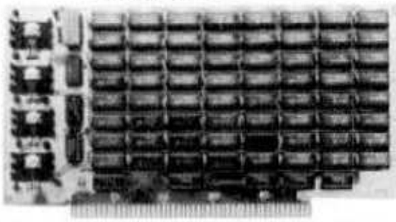

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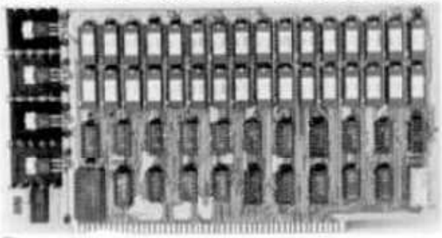

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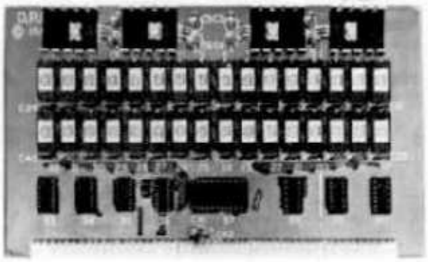

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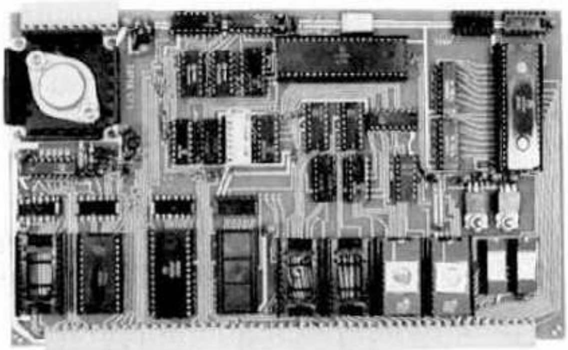

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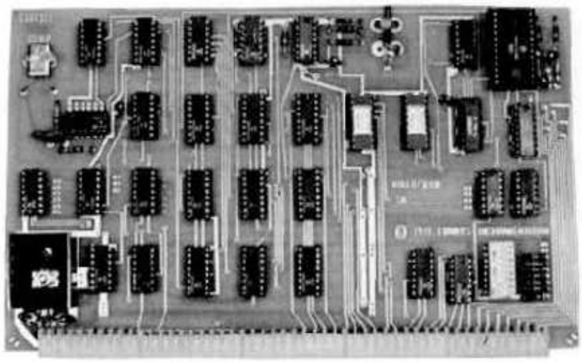

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NOTE: DOS 69 is supported on Smoke Signal Broadcasting's Chieftain systems with Smoke Signal Broadcasting's 6809 CPU board; and on SWTPC systems with Smoke Signal's BFD or LFD disc system and SWTPC 6809 CPU board (I/O moved to $E000 in accordance with SWTPC instructions). Support for other hardware configurations including consultation on operation with other CPU boards cannot be provided.

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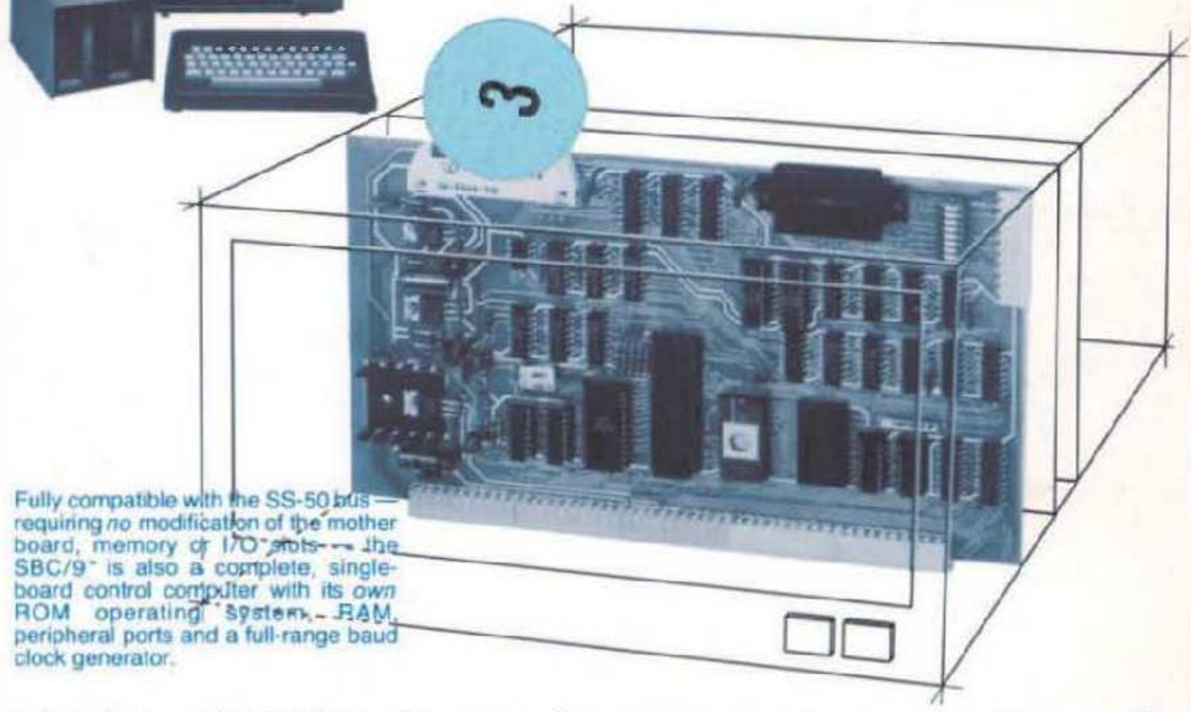

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