LCD PORTABLE COMPUTER

SPECIFICATION JAN 1984

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CONTENTS

LIST OF FIGURES

1.Ø Introduction

This document describes the features and specifications of two battery operated lap size portable computers, one is fitted with a 4Ø x 8 Liquid Crystal Display the other with an 8Ø x 16 display. Both use a 65CØ2 microprocessor running at 1 MHz. A Wordprocessor, Spreadheet, Time Manager and Terminal emulation software are supplied as standard, other standard features are listed below.

1. 128K ROM containing
   a).Kernal
   b).BASIC (CBM version 2 plus extensions)
   c).Applications software as described above.

2. 16K of RAM expandable to 16K internally.

3. 4Ø x 8 or 8Ø x 16 display (the 4Ø x 8 is easily expanded to 8Ø x 16)

4. 72 Key ASCII keyboard with 8 function keys.

5. CBM serial bus for use with existing Commodore peripherals.

6. Two RS232C ports one linked to an internal modem.

7. Telephone auto-dial and line interface.

8. High Speed spiral disk interface.

9. Connector for barcode reader or joystick.

1Ø. Expansion facilities through cartridge port.

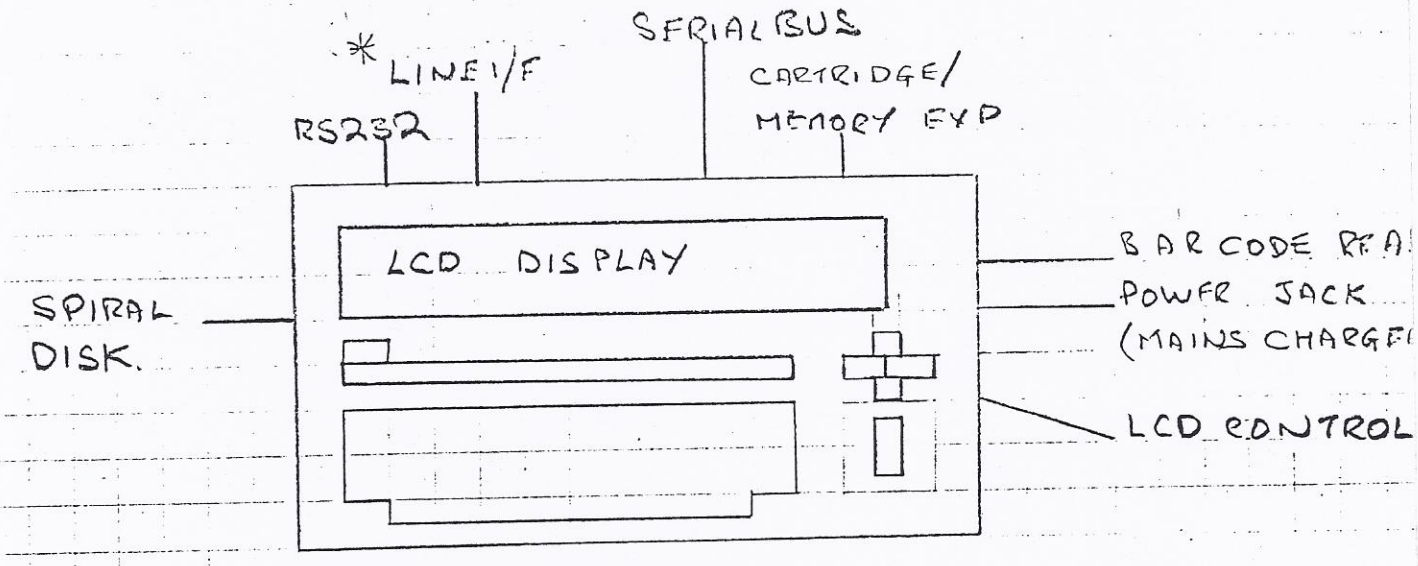

FIG 1.0

* THE LINE JACK WILL BE DIFFERENT FOR EACH COUNTRY.

2.0 General Specifications

CPU	:	Rockwell 65C02 (8 bit CMOS).
Clock Speed	:	1MHz
Address Space	:	1MB total ROM and RAM 4K I/O SPACE 128K ROM standard 32K RAM (battery powered CMOS) standard
Display	:	40 x 8 or 80 x 16 LCD
Keyboard	:	72 Key ASCII 8 function Keys 4 cursor Keys
Sound	:	Simple internal sound generator
Interfaces	:	CBM Serial RS232c Modem line I/F Spiral Disk Cartridge adaptor Barcode/Joystick
Storage	:	RAM File system (standard) spiral drive (optional) serial disk (1541)

2.1 System Architecture

This section describes the memory
s interfaces in greater detail.

2.1.1 Memory mapping

The 65C02 only has a 64K address space to obtain a 1MB address space memory has to be switched, this is achieved by dividing the 64 address space into 6 areas as described in FIG 2.0. Each area has a register associated with it that contains an offset into the 1MB address range the value of this register is added to the top 4 bits of the address to form a full 20 bit address. The lower 12 bits are not passed through the mapping device. All system addresses are achieved using this method. I/O selects are also provided.

e.g the Kernal has an associated 7 bit register allowing upto 128 8K images

The I/O area however does not have a register and has only 1 image.

	Address Range	Size	Usage
1	$ffff-$e000	8K	Kernal/Operating System
2	$d000-$dfff	4K	I/O
3	$c000-$cfff	4K	Ram file window
4	$a000-$bfff	8K	BASIC or Applications Software
5	$8000-$9fff	8K	BASIC or Applications Software
6	$0000-$7fff	32K	Users Workspace.
		64K	

2.1.2 Display Controller

The Display is controlled by a Mitsibushi 50740 8 bit single chip micro-computer which has 32 i/O lines, 3K of on board ROM and 96 bytes of on board RAM. 10 I/O lines are used to communicate with the 65C02, 16 are used to address the display. 576 bytes of ROM are required for the ASCII character dot patterns (96 chars 6 bytes each), leaving 2496 bytes of ROM to achieve, scrolling (Horizontally and Vertically), Cursor blink, Position Calculation, Insert, delete functions. Graphics mode and Read/Set point functions. The 50740 enters a sleep mode when a job is finished to reduce power consumption.

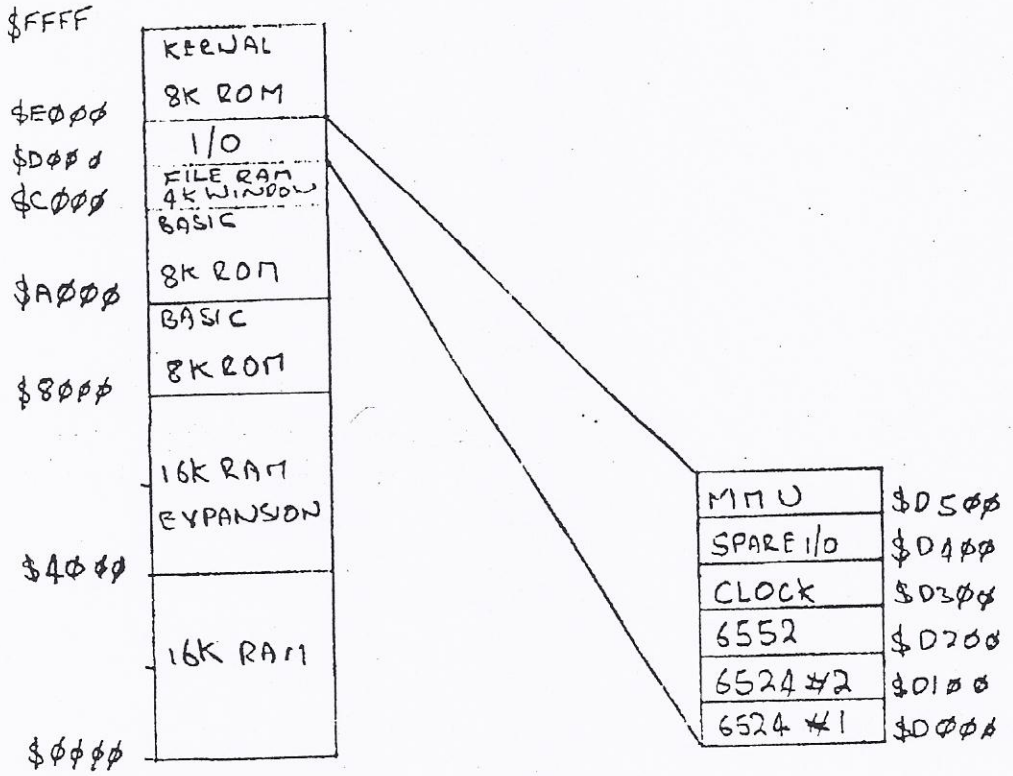
$FFFF
KERNAL
8K ROM
$E000
I/O
$D000
FILE RAM
4K WINDOW
$C000
BASIC
8K ROM
$A000
BASIC
8K ROM
$8000
16K RAM
EXPANSION
$4000
16K RAM
$0000
MMU
$D500
SPARE I/O
$D400
CLOCK
$D300
6552
$D200
6524 #2
$D100
6524 #1
$D000

FIG 2.0

2.1.3 Display Interface

Data is written/read to/from the display controller using a Rockwell 65C24 PIAT the I/F consists of 8 bi-directional data lines and two control lines (not command/data and not busy/data ready) see FIG 2.1

2.1.4 Keyboard Interface

The keyboard is scanned as a 10 x 8 matrix using a Rockwell 65C24 PIAT (details FIG 2.1)

2.1.5 CBM Serial bus

A CBM Serial bus is made from 6 I/O lines on a 65C24 (details FIG 2.2)

2.1.6 Audio Output

An Audio tone generator is provided by the CB2 line of a 65C24 (details FIG 2.1)

2.1.7 MODEM Facilities

One of the ports of a Rockwell 65C52 Dual ACIA is used to drive a single chip modem (300 baud full duplex,Originate/Answer) two versions of this modem are required BELL 103 for the USA and CCITT V23 for UK/Europe. Pulse dialing is achieved using the CB2 line of a 65C24 (details FIG 2.1).

2.1.8 RS232C port

Half of the 65C52 not used to drive the MODEM provides an RS232c port for connection to alternative modems and printers

2.1.9 Real Time Clock

A Real time Clock I.C provides time/date/day of week/month/year/ information.

2.1.10 Spiral Disk

A High speed port is provided for interfacing to the Spiral disk, the port provides 16 address lines, 8 data lines system clock and control lines IRQ and 2 I/O lines, This allows for 3 controller options as follows.
1. The disk controller stops the CPU and pushes data into the system RAM.
2. The disk controller runs on phase #1 of the system clock and passes data and control messages into system RAM.
3. An 6524 or similar can be used to provide an I/O port.

	6524 #1 at $D000		6524 #2 at $D100	
LINE	FUNCTION	DIRECTION	FUNCTION	DIRECTION
PA0	COL 0 - KEYBOARD	OUT	DISPLAY DATA BIT 0	IN/OUT
PA1	COL 1 - KEYBOARD	OUT	DISPLAY DATA BIT 1	IN OUT
PA2	COL 2 - KEYBOARD	OUT	DISPLAY DATA BIT 2	IN/OUT
PA3	COL 3 - KEYBOARD	OUT	DISPLAY DATA BIT 3	IN/OUT
PA4	COL 4 - KEYBOARD	OUT	DISPLAY DATA BIT 4	IN/OUT
PA5	COL 5 - KEYBOARD	OUT	DISPLAY DATA BIT 5	IN/OUT
PA6	COL 6 - KEYBOARD	OUT	DISPLAY DATA BIT 6	IN/OUT
PA7	COL 7 - KEYBOARD	OUT	DISPLAY DATA BIT 7	IN/OUT
CA1	POWER OFF CONTROL	IN	NOT BUSY - DISPLAY	IN
CA2	SRQ - SERIAL BUS	IN	NOT CMD - DISPLAY	OUT
PB0	COL 8 - KEYBOARD	OUT	ROW 0 - KEYBOARD	IN
PB1	COL 9 - KEYBOARD	OUT	ROW 1 - KEYBOARD	IN
PB2	DATA IN - SERIAL	IN	ROW 2 - KEYBOARD	IN
PB3	DATA OUT - SERIAL	OUT	ROW 3 - KEYBOARD	IN
PB4	CLOCK IN - SERIAL	IN	ROW 4 - KEYBOARD	IN
PB5	CLOCK OUT - SERIAL	OUT	ROW 5 - KEYBOARD	IN
PB6	ATN OUT - SERIAL	OUT	ROW 6 - KEYBOARD	IN
PB7	POWER DISABLE	OUT	ROW 7 - KEYBOARD	IN
CB1	NOT USED		NOT USED	OUT
CB2	DIAL PULSE	OUT	AUDIO	OUT

FIG 2.1

3.0 Technical Specification

This Section provides greater details for those topics discussed in previous sections.

3.1 Memory Management

The memory management scheme must allow for a very large range of memory sizes, the amount of RAM can vary from as little as 16K to nearly 1M. Fig 3.1 shows how the memory management scheme operates with both large and small size memory

In the basic system work space RAM is shared with File RAM, the work area has a 32K window while the file system is in 4K segments. As a 6502 system requires pages 0 - 3 for system operation it may be desirable if the first 1K of RAM remains fixed registers R6 & R7 allow the user to turn off the mapping to the bottom 1K. The workspace area grows upward from hex $0400 while the file area grows down from the top of physical memory in 4K segments.

The Applications programmer can use this mapping technique to arrive at the memory map most appropriate to the application.

The MMD contains 7 registers as follows

R1	.A19.A18.A17.A16.A15.A14.A13.000.	WINDOW AT $E000-$FFFF
---------	I/O SPACE ---------	
R2	.A19.A18.A17.A16.A15.A14.A13.A12.	WINDOW AT $C000-$CFFF
R3	.A19.A18.A17.A16.A15.A14.A13.000.	WINDOW AT $A000-$BFFF
R4	.A19.A18.A17.A16.A15.A14.A13.000.	WINDOW AT $8000-$9FFF
R5	.A19.A18.A17.A16.A15.000.000.000.	WINDOW AT $0000-$7FFF
R6	.XXX.XXX.XXX.XXX.XXX.XXX.XXX.XXX.	BOTTOM 1K ENABLE
R7	.XXX.XXX.XXX.XXX.XXX.XXX.XXX.XXX.	BOTTOM 1K DISABLE

ALL REGISTERS ARE WRITE ONLY.
XXX = DON'T CARE, OOO = NOT USED, ANN = ADDRESS BIT

A diagram showing greater detail and pin count information is shown in FIG 3.0

3.2 Keyboard

The Keyboard is an ASCII keyboard with 8 function keys but without a numeric keypad the keyboard should allow for emulation of terminals such as VT52/100 etc.
An ON/OFF switch is provided on the keyboard because the machine incorporates a battery saving time-out sequence that turns the display off the on/off switch is therefore made readily available for convenience. The keyboard is shown in FIG 3.2

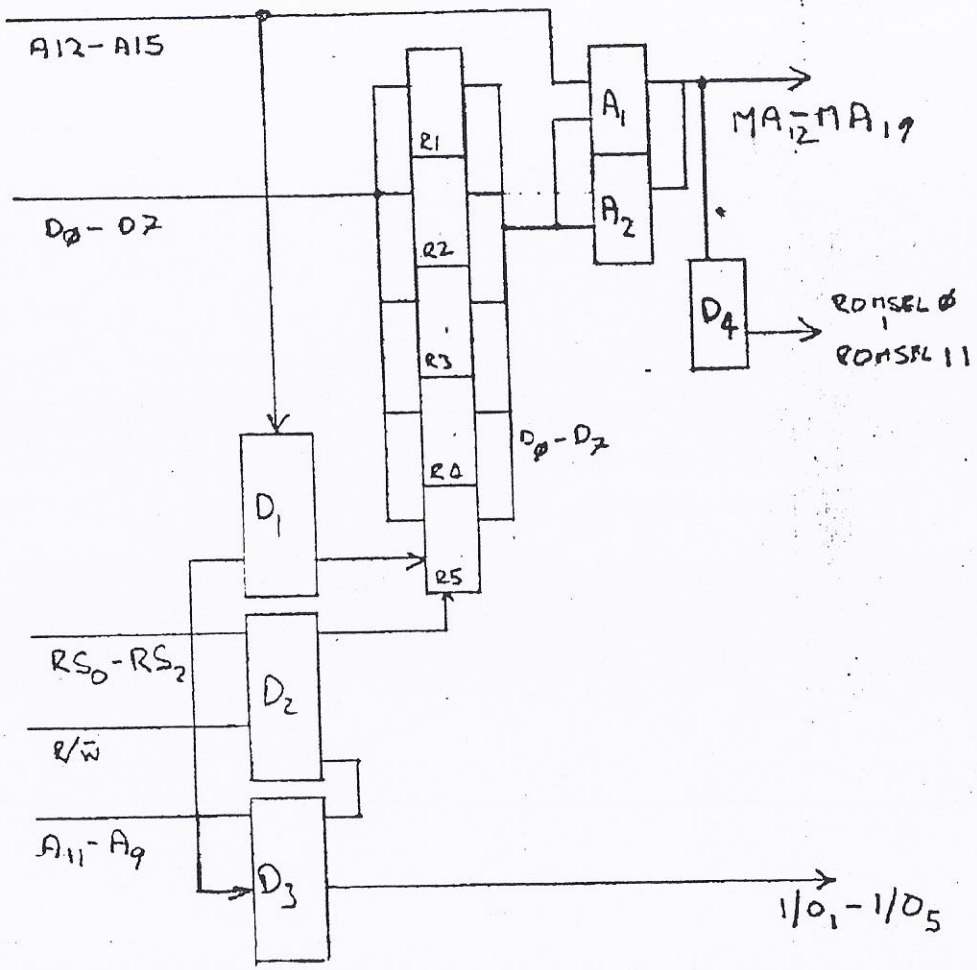

FIG 3.0

PINS		
$A_9 - A_{15}$	-7	in
$D_0 - D_7$	-8	in
ROMSEL0-11	-12	out
$RS_0 - RS_2$	-3	in
$IO_1 - IO_5$	-5	out
$MA_{12} - MA_{19}$	-8	out
+5v/GND	-2	in
R/W	-1	in
	48	

DEVICES	
$A_1 - A_2$ -	ADDERS
$D_1 - D_4$ -	DECODERS
$R_1 - R_5$ -	REGISTERS

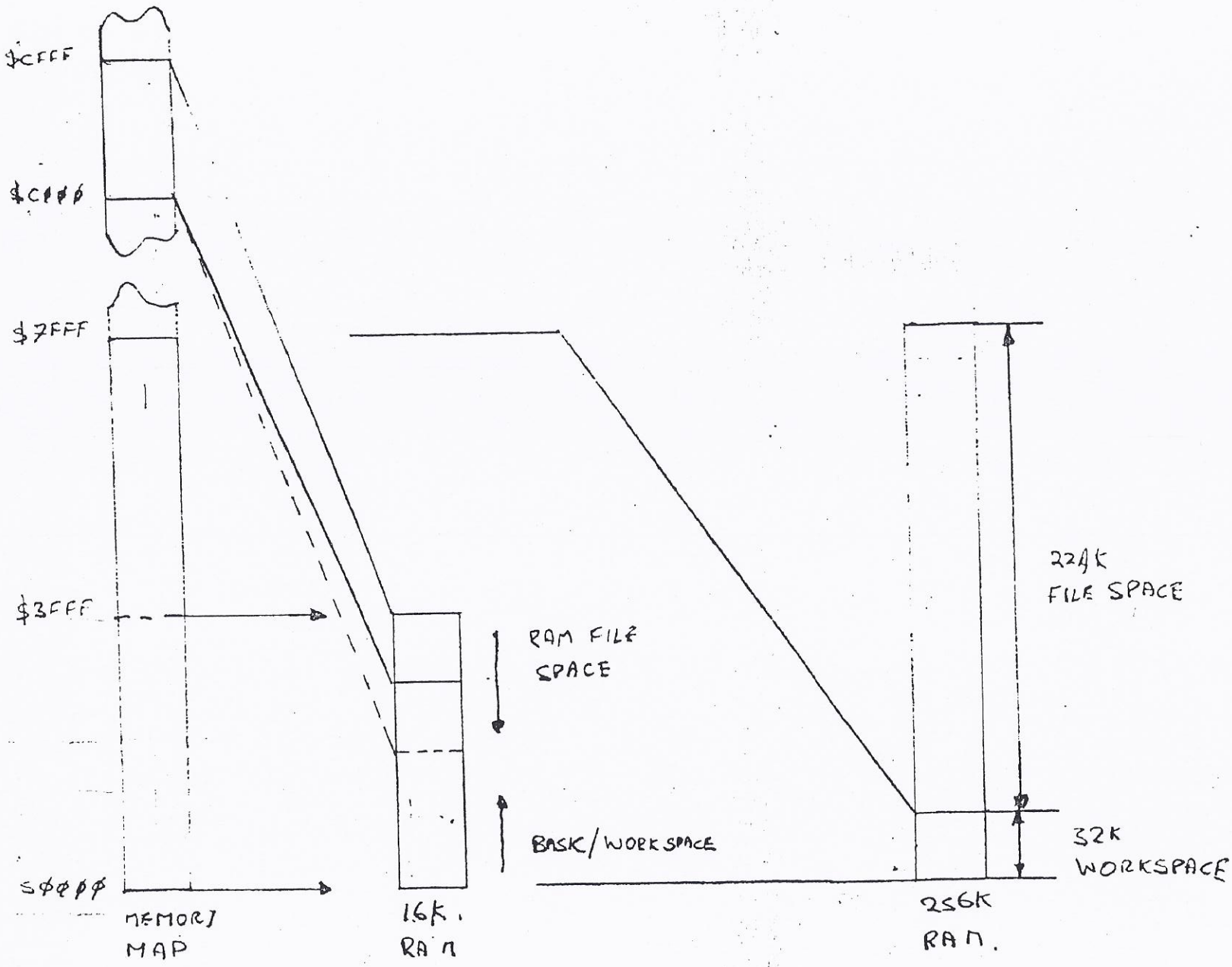
$CFFF
$C000
$7FFF
$3FFF
$0000
MEMORY MAP
16K. RAM
RAM FILE SPACE
BASK/WORKSPACE
224K FILE SPACE
32K WORKSPACE
256K RAM.

FIG 3.1

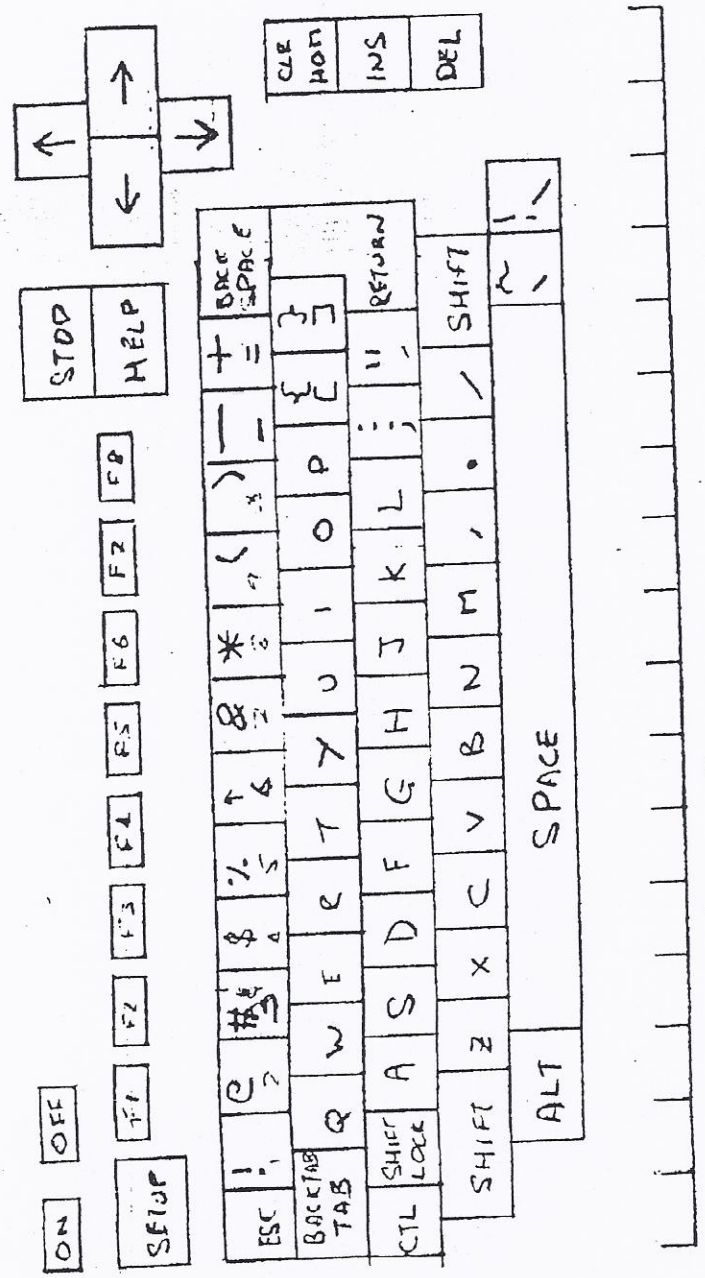
5.6"
12.75"
ON
OFF
SETUP
F1
F2
F3
F4
F5
F6
F7
F8
STOP
HELP
CLR HOME
INS
DEL
ESC
BACK TAB
CTL
SHIFT LOCK
SHIFT
ALT
SPACE
BACK SPACE
RETURN
SHIFT

FIG 3-2

3.3 Display Controller

The Display Controller uses a Mitsibushi 50740 micro-computer as described in 2.1.2. This device can be put in a sleep mode to reduce power consumption by the instruction 'STP' an IRQ will restart the CPU as follows.

EXAMPLE

```
LOOP FCHOP     ;fetch command
     EXCMD     ;execute
     STP       ;stop
     BRA LOOP  ;fetch command

IRQ  RTI       ;do nothing
```

The NOT COMMAND line from the CPU should generate an interrupt.

The display controller should also be able to turn off the Display.

The display controller recognises a special command as having bit 7 set after receiving an interrupt (not command going low) if bit 7 is clear then the byte is assumed to be a valid ASCII char and the relevant character is displayed, not busy is held low until the char is displayed

Special commands.

$80 - Move cursor to location x,y specified in the two bytes following.
$88 - set cursor mode - bit 0 - on/off - bit 1 - blink/no blink - bit 2 - underline/solid
$90 - Clear screen.
$a0 - Scroll / bit0 vert/hor / bit1 up & down / bit2 left & right.
$b0 - shift left - shift all chars from the cursor position to end of line left one place deleting the current position
$b8 - shift right - shift all chars from the cursor position to end of line right one place leaving a space at the current position
$c0 - shift up - shift all lines from the current line to the end of screen up by one line overwriting the current line.
$c8 - shift down - shift all lines from the current line to the end of screen down by one line.
$d0 - set reverse mode - bit 0 - on/off
$e0 - graphic mode - bit 0 on/off
$f0 - set point - x,y in 3 bytes following
$f8 - read point - x,y in 3 bytes following

3.4 Modem

A copy of standards for telecommunication in each country to which the modem is to be supplied will be required, as, for example, British Telecom in the UK require high specification line transformers and protection against induced high voltages appearing on the public line.
PRESTEL uses a 1200/75 BAUD link, this modem cannot therefore be used on this system. There are however other information sources available Telecom Gold, Bulletin boards etc. that use 300 baud, this modem is therefore still useful in the UK.

3.5 RS232C

The RS232C port should be provided with its own 256 byte receive buffer, software should also support the following . . .
1. XON/XOFF soft handshake.
2. programmable delay after carriage return.

3.6 Real Time Clock

A real time clock will provide calendar/time information for the diary/time management software and is an essential part of the machine. All clock information should also be accessible from BASIC. The OKI MSM5832 provides these facilities and requires a 32.768 KHz clock.

3.7 Spiral Disk

It is assumed that the spiral drive behaves like a high speed tape drive with the advantage that the head can be moved back to the beginning of a data BLOCK. The unit is therefore intended as a RAM FILE backup system and not as a primary storage media.

4.Ø RAM File System

The primary data storage medium for this system is a RAM file system, the system will however, also operate with floppy disk and spiral disk. The File system is accessed through a 4K window this window is divided into 256 byte blocks. The filing system uses 256 byte blocks to reduce fragmentation and hence wasted memory. (on the BASIC system there is only 16K !). This operating system must therefore keep a deleted block chain or similar and the block in files must also be chained. Random access techniques should be left to the applications programmer.

4.1 User Interface

During the power up sequence the kernal should look for applications software in ROM and update a 'SOFTWARE MENU' the software in RAM should also appear in this menu, this menu is the first display a user would see along with a 'CBM' message and the DAY/DATE etc.

EXAMPLE

```
   Ø        1Ø        2Ø        3Ø        4Ø
Ø CBM OS V1.Ø xxxxK bytes  Wed Ø4 JAN  1984
1 ----------------------------------------
2 BASIC    WORDPRO   SPREAD SH TIME MANAGE
3 COMMS    MY PROG   TEST      data
4
5
6
7                                   * PAGE *
```

EXECUTABLE files are in capitals, data files in lower case. A program is chosen by moving the cursor onto the desired option, the '* PAGE *' function displays the next page if there is one.

4.2 Applications software.

A separate specification for the applications software is required so that the 'USER interface' is common to all application packages ie key functions, display and file formats are consistent. It is important that data can be used by all programs with the minimum of difficulty.

4.2.1 BASIC

The version of BASIC used is 2.x ie BASIC V2 with the following enhancements.

1. Faster garbage collect

2. Structured functions (if... then ...else,repeat until etc)
3. RAM file instructions.
4. Display instructions

The RAM file instructions should include ERASE "name" to delete a file, COPY "name",dn,"name",dn to copy a file (in background) from RAM file to printer or disk. Display instructions should include SIZE col,row to set the size of the editing screen SET x,y & RESET x,y to turn a pixel on and off also TEST x,y to test for a pixel on or off. Other useful facilities should be included such as PRINT USING and Programmers AID instructions.

4.2.2 Word processor

The word processor should be less than 16K of code offering facilities like those found in 'Easysript'. Mailmerge facilities are not important but calculation facilities would be useful (for doing quotes etc). It is also important that word processor files can be sent/received in terminal mode.

4.2.3 Spread Sheet

The Spread Sheet should offer better facilities than those found in Visi-calc, better number formatting and allow a field to both input and output information i.e. the field in which a result appears can also be included in the calculation. There should also be a Calculator mode so that a user can achieve quick calculations in a familiar calculator looking environment. The Word processor should be able to pick up columns or rows of figures. The program should be under 16K.

4.2.4 Time Manager

The Time manager should provide all the facilities found in the TIME MANAGER INTERNATIONAL system. ie Diary / calendar / Daily planner / notebook etc. This should fit into 8K.

4.2.5 Terminal Emulation

The Terminal Emulator will provide VT100 (80 COL only) and TTY terminal interfaces. A configurable terminal package similar to 'COMPASS' should also be included. Fig 4.1 shows the character code functions for VT100 emulation.

4.2.6 Simple File Manager

A simple file manager similar to the 'MANAGER' should be included for handling name address and Telephone numbers etc and should be less than 16K.

Total ROM USAGE

16K KERNAL
16K BASIC
16K Word processor.
16K Spread Sheet.
 8K Time manager
 8K Terminal Emulation.
16K File management.

96K ROM

This is well within the 128K ROM space provided within the system.

5.Ø Power Supply.

Power for the RAM is provided by a re-chargable battery mounted on the PCB. Operating power is supplied from 4 x aa size alkaline cells (6V) as used in many domestic appliances. Power is switched electronically, this enables the power to be turned off by a timer or by the 'OFF' key. During the power on sequence the CPU can determine how the power was turned off and can return the user to his/her previous task or to the start up menu. FIG 5.1 is a diagram of the proposed system.

6.Ø Case Considerations

The shape of the case for this product has greater effect on how easy to use this computer is, for example if the screen is nearly flat as found on competitors models the user has to stoop over the display to avoid seeing reflections in the glass. This is most apparent when using the machine at a desk, it is uncomfortable to sit back and work with the machine. The control used to adjust the viewing angle does help but is insufficient.

The size of the unit should be such that the unit can be placed in a brief case easily

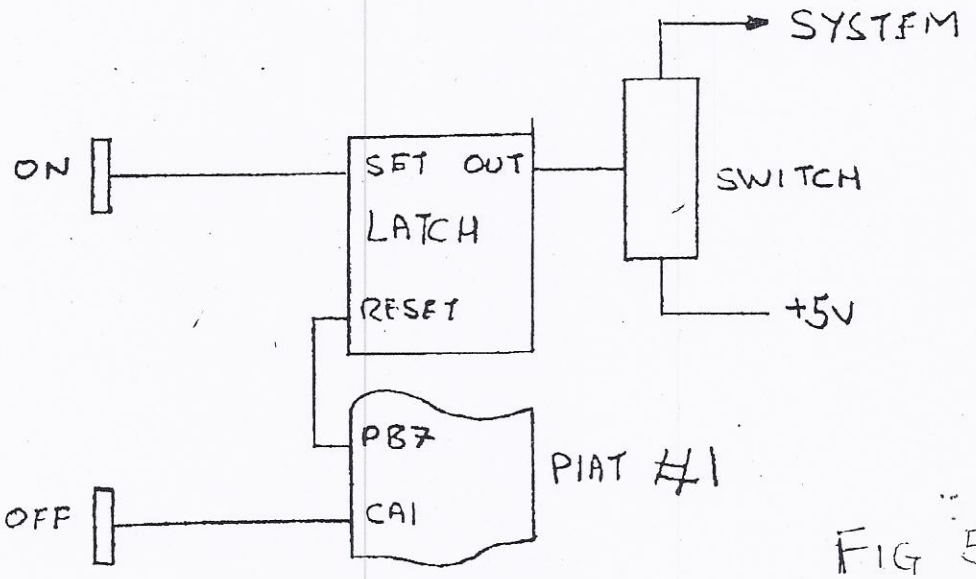

FIG 5.Ø