AMATEUR COMPUTER CLUB NEWSLETTER

VOL. 5 ISS. 6 FEB. 1978

J-2 VDU PART A

BRIEF NOTES

Working through the system; G17 is the Master Clock running at approx. 2MHz, which will be the approx. video bandwidth required for a display device. CT trims MCK to allow for later phase-locking to 50Hz frame rate, or to correct for changes of the space link on G1. Position 1 gives 2 spaces between characters, position 2 gives 1 space, and no-link gives 3 spaces. Decoded carry G2 to following stages allows RAM/ROM settling during the inter character spaces. G5,G6 latch disables the following line counters for one character frame (33rd.) during line flyback.

FF1 & X2 count 32 characters / line, X3 counts 8 vertical lines / character row plus two for spacing, and X4 counts 16 character rows. G13, G14 & G15 form 5 input AND to decode the frame flyback on the last blank line.

Two versions of the 2513 ROM are used, selected by DB6 to give lower case characters (control ASCII codes appear blank). X5 serialises the line data, loaded by G8,G9 latch during the negative MCK phase of the first clock pulse in each character frame. Video output is gated with positive MCK, allowing time for all the negative edge triggered counters to settle. Video and timebase outputs are positive with seperated supplies V1,V2 for the output circuits so that different signal levels can be provided.

RV1 can be used to adjust picture size, whilst RV2 will adjust the proportions. For gross changes,RX, RY or CX,CY can be changed.

ACC AGM SEE PAGE 8

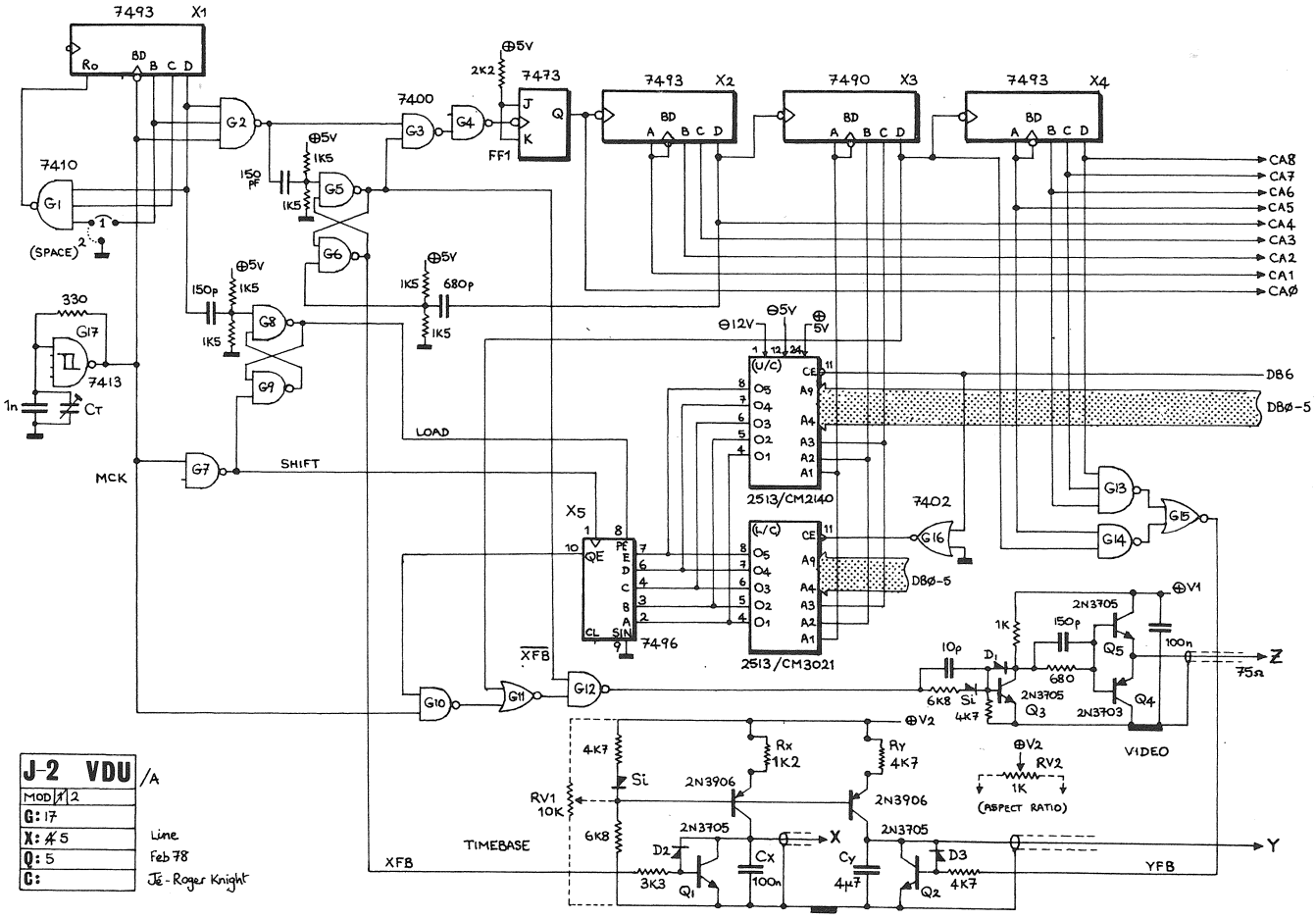
IN THIS ISSUE

Diodes D1,D2,D3 are anti-saturation clamps to prevent charge storage, and should be Schottky Barrier or Ge point-contact types; the prototype used AAZ17 (gold bonded Ge). CA0-8 address a memory similar to Bill Marshall's design.

Part B will describe phase locking MCK to 50Hz or MPU clock, a two-chip 1k memory, and light pen, with page scroll mode operation.

The prototype uses V1 = V2 = 5V to drive a Tektronix 604 monitor with 1V signals.

J Roger Knight



LIBRARIES

SC/MP USER GROUP

PRELIMINARY LITERATURE COLLECTION

		SOURCE
S001	SC/MP System Introduction	National
S002	" Technical Data (PMOS chip)	"
S003	" Technical Description (4200079A)	"
S004	" Programming & Assembly Manual	"
S005	" Introkit Users Manual (4200079A)	"
S006	SUPAK ISP-8F/111 (MINIAS,SCEDT,PROM)	Summary
S007	Guide To SC/MP Programming.	Crofton/Kemitron
S008	KITBUG Listing & Summary	UGL
S009	Programming a Microprocessor (SC/MP)	P.E. 4-77
S010	SC/MP Introkit Reviewed	P.E. 3-77
S011	(Several Small Test Programs)	JRK
S012	J-2 System Description	ACCN
S013	" VDU for CRO/Monitor	JRK
S014	" I/O Commands/Modes	"
S015	" Selfscan Display Interface	"
S016	SCAMP - A simple system	ACCN
S017	SIMPLE SC/MP R	"
S018	SUPER SC/MP R VDU	"
S019	SC/MP II Technical Data (NMOS)	National
S020	Using 9131A memory with SC/MP **	JRK
S021	SC/MP System (Eurocard)	Elector
S022	Extended-speed operation/timing **	JRK
S023	Undefined Opcodes ? **	UGL
P001	NIBL BASIC	National

** in preparation.
Photocopies @ 2.5p/side if required (where no copyright infringed).

* CONTRIBUTIONS OF MATERIAL ?? *

All items are loan material, for which 32p postage should be sent (surplus refunded) and, preferably, a large envelope, to;

J.Roger Knight
Dept. of Meteorology, University of Reading,
Earley Gate, Whiteknights, Reading RG6 2AU

ACC 8080/Z80 LIBRARY

The Library is still growing steadily thanks to members' support and now has over 120 items for loan. New entries in the Software section include an unproved Palo Alto Tiny Basic, a Z80 resident assembler and an 8080 floating point package. For those more interested in the Hardware side there are RAM board designs, details of the new 8085 from Intel and cassette interface circuitry to name but a few recent additions.

The Library has been in a state of siege following the launch of NASCOM 1 and other Z80 based systems. The result has been an increased waiting time for the more popular items. For this I can only apologise and ask Library users to return items as soon as possible.

Sadly the GPO have managed to lose my only copy of 5K BASIC by Processor Technology. If anyone can help me obtain another copy for the Library I'd be grateful.

The Library can always use more items, particularly software however large or small, so keep them coming in. Just send a 9" x 4" minimum SAE for the latest Library contents.

Neil Harrison, 15 Hill Rd.,Watchfield,Swindon,Wilts.

6800 LIBRARY SPLITS

This library has now grown to a size as to be beyond the limits of one person to look after.

Technical Discussion & Queries;

Tim Moore
15 College Rd.,Maidenhead,Berks. SL6 6BW
0628 29073

Hardware Information (B Series):

Bob Forster
18A The Barons,St. Margarets,Twickenham,Middx
01 892 1873

Software,Interface & Memory Information (S,K&M);

Roy Hall
4 Hart Grove,Ealing Common,London W5 3NB
01 992 6017

To use this free service send an A4 SAE & 32p in stamps to the appropriate person.

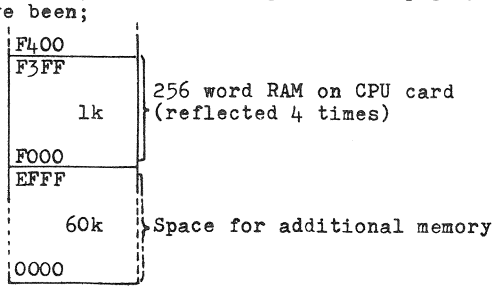
In its first year of operation the library has serviced over 400 requests for information. All contributions, particularly in the software field, are very welcome.

77·68

A couple of minor corrections to the description of the 7768 MON 1 board given in the last newsletter;

- The note "(although 'LS versions given ..." on p2 is irrelevant & crept in from another, as yet unprinted, drawing !
- The $\overline{DCD}$ board input to ACIA(b) should come in via edge connector pin 58, not 5 as shown.

My personal decimal - hex - binary algorithm had a bug in it, the memory map shown on page 3 should have been;



Apart from the above, all is well; several boards have been made and, as far as I know, all work.

The VDU board development is well under way and with luck should appear in the next newsletter. Also being designed is a general purpose parallel I/O board, using the new 6821 PIA and providing a large area for custom designed interface circuits.

LATE NEWS

VDU FOR D2

Motorola plan to introduce the MEK6800R2 Add-on-Kit during April. It is primarily a CRT interface, which allows the user to connect a TV or monitor to the D2 board.
Built around the MC6845 CTRC chip it allows up to 80 x 24 5 x 7 characters, and also includes a PIA to interface with an ASCII keyboard. In alphanumeric mode, it can be operated in a paging mode, requiring 2k memory per page (max 2 pages). Graphic capability is also available in a 256 x 256 matrix, requiring 8k bytes of RAM.
R2 is designed to operate with JBUG II, a new monitor ROM under development. This will incorporate JBUG and MIKBUG operations with CRT functions.

E78 Bus Spec

Eurobus Specified (Well Nearly Anyway)

The aim of this specification was outlined in the June 1977 issue of ACCN. To summarize, it sets out a standardized set of control and address lines for double Eurocard circuit boards, in the hope that this will facilitate the interchange of hardware. The definition is as independent as possible of any specific processor, to the extent that it is possible to use the same static memory cards with the 6800 and the Z80.

MECHANICAL

The specification is based on the double Eurocard. This is rapidly becoming a European standard, and is even beginning to penetrate the U.S. The same connector and pin configuration can be used with single Eurocards, but these are not recommended, as very little space is available after control and buffering logic has been installed.

The connector to be used is the 64 way indirect connector to DIN 41612. This is available in two versions, known as 64/64 and 64/96. The latter has more space between the two rows of pins, which makes it much easier to produce a printed circuit backplane. For this reason the 64/96 connector is prefered, but boards can and should be designed to accept either.

ELECTRICAL

The pin assignments are as follows:-

Pin	Row a Signal	Type	Note	Row b/c Signal	Type	Note
1	Ground	1		Ground	1	
2	Ground	1		Ground	1	
3	+12V	1		+12V	1	
4	-12V	1		-12V	1	
5	$\overline{A0}$	2	1	$\overline{A1}$	2	
6	$\overline{A2}$	2		$\overline{A3}$	2	
7	$\overline{A4}$	2		$\overline{A5}$	2	
8	$\overline{A6}$	2		$\overline{A7}$	2	
9	$\overline{A8}$	2		$\overline{A9}$	2	
10	$\overline{A10}$	2		$\overline{A11}$	2	
11	$\overline{A12}$	2		$\overline{A13}$	2	
12	$\overline{A14}$	2		$\overline{A15}$	2	
13	$\overline{BAI}$ ($\overline{A16}$)	3,2	3	$\overline{BAO}$ ($\overline{A17}$)	3,2	3
14	$\overline{IEI}$ ($\overline{A18}$)	3,2	3	$\overline{IEO}$ ($\overline{A19}$)	3,2	3
15	$\overline{MI}$,$\overline{\phi 2}$	2,4	4	$\overline{\phi}$	4	4
16	$\overline{DWAIT}$	5	5	$\overline{INTAK}$	2	6
17	$\overline{DMAR}$	5	7	$\overline{DMAG}$	4	7
18	$\overline{NMI}$	5	8	$\overline{INT}$	5	8
19	$\overline{MREQ}$	2	9	$\overline{WR}$	2	11
20	$\overline{RESET}$	5	13	$\overline{WAIT}$	5	14
21	$\overline{IORQ}$	2	10	$\overline{RD}$	2	12
22	$\overline{INHR}$	5	15	$\overline{RFSH}$	2	16
23	$\overline{D0}$	2	2	$\overline{D1}$	2	
24	$\overline{D2}$	2		$\overline{D3}$	2	
25	$\overline{D4}$	2		$\overline{D5}$	2	
26	$\overline{D6}$	2		$\overline{D7}$	2	
27	$\overline{D8}$	2		$\overline{D9}$	2	
28	$\overline{D10}$	2		$\overline{D11}$	2	
29	$\overline{D12}$	2		$\overline{D13}$	2	
30	$\overline{D14}$	2		$\overline{D15}$	2	
31	-5V	1		-5V	1	
32	+5V	1		+5V	1	

Signal Types

1) Power Supplies
Two pins are used for each power supply, four for ground. This permits a fairly solid printed circuit backplane to be produced. The current rating is 2A per pin, so the maximum current per supply into any one card is 4A. Ground and +5V are at the end of the connector so that these traces can be made a lot wider.

2) Tri-state lines
Used for synchronous signals which may be driven from several sources. May be driven by LS, standard or shottky TTL buffers. LS buffers are recommended for most systems. Each card should preferably present only one LS TTL load to the bus.

3) Daisy-chains
On cards not using these signals the in and out pins should be wired together. On other cards the output should be driven by one standard TTL output or the equivalent. Inputs should be TTL compatible.

4) Lines driven from one source only
Used for the system clocks. Driven by permanently enabled tri-state buffers or the equivalent.

5) Open-collector lines
Used for asynchronous signals which can be driven from more than one source. Should be driven by devices capable of sinking at least 16mA.

Signal Polarity

All signals should be negative true. This convention should be rigidly followed for the control signals, as it ensures that they will be pulled up to an inactive level when they are not being actively driven. The use of a negative true convention for the address and data has advantages in that cheap 74LS04s can be used to buffer off the bus, giving a non-inverted address for PROMs, which may make life simpler. Otherwise the use of positive true address and data conventions will cause very little difficulty for the individual.

Notes on the Bus Signals

1) $\overline{A0}$ to $\overline{A15}$ These constitute the address bus. $\overline{A15}$ is the most significant bit.

2) $\overline{D0}$ to $\overline{D15}$ These constitute the data bus. $\overline{D15}$ is the most significant bit. 16 bits have been specified to allow for existing and future 16 bit machines. 8 bit systems can use $\overline{D8}$ to $\overline{D15}$ for other functions, but bear in mind that this may make it difficult to change to a 16 bit processor.

3) $\overline{BAI}$,$\overline{BAO}$,$\overline{IEI}$,$\overline{IEO}$ These signals are to be used for daisy-chained functions (i.e. $\overline{IEO}$ from one card goes to $\overline{IEI}$ on the next). These particular signals are specific to the Z80, being used to control bus access and interrupt priority. SC/MP also uses $\overline{BAI}$ and $\overline{BAO}$ equivalent functions, and any other processor requiring daisy- chained signals should use these pins. As memory cards will not use these signals, these pins may also be used to extend the addressing range to 1Mbyte for them as can afford it.

4) Clocks For systems which generate a signal to indicate that the first byte of an instruction is being fetched (e.g. $\overline{MI}$ for the 8080 and Z80), this should be placed on pin 15a. Otherwise this pin can be used for the less important system clock in a two phase system, or for any other function. Pin 15b/c should be used for the most important system clock (i.e. $\phi 2$ for the 6800 and 8080).

5) $\overline{DWAIT}$ This signal is used to hold the processor via the $\overline{WAIT}$ line, and disable the CPU card tri-state buffers. This signal may be used by a single card dynamic RAM controller to provide for dynamic RAM refresh, often invisibly. It is also necessary for the implementation of virtual memory.

6) $\overline{INTAK}$ This signal is generated by the CPU to indicate that it has accepted an interrupt.

7) DMAR and DMAG These signals are used to control bus access during DMA. DMAR is generated by the peripheral to indicate that it wants to use the bus, while DMAG is used by the CPU to signify that the request has been granted.

8) NMI and INT Non-maskable and standard interrupt requests. The method of response to an interrupt will inevitably be processor dependent, but if possible it is suggested that the CPU should be configurable to respond to an interrupt consisting solely of INT going low until INTAK goes low.

9) MREQ This signal signifies that a memory access is in progress, and that the address bus carries a valid address. For the Z80 MREQ may be used directly, while for the 6800 the suggested logic is (VMA.ø2.IOBLOCK), where IOBLOCK indicates that a memory-mapped input-output block of 256 bytes is being accessed.

10) IORQ This signifies that an I/O access is being performed, and that the lower 8 bits of the address bus carry a valid I/O address. For the Z80 IORQ may be used directly, while the suggested logic for the 6800 is (VMA.ø2.IOBLOCK).

11) WR Write strobe, indicating that the data bus carries valid data to be written to memory or I/O. For the Z80 WR may be used directly, while the suggested logic for the 6800 is (VMA.ø2.R/W).

12) RD Read strobe, indicating that the addressed memory or peripheral should place data on the data bus. For the Z80 RD may be used directly, while for the 6800 the suggested logic is (VMA.ø2. R/W).

13) RESET Resets processor and peripherals.

14) WAIT Used by slow memory and peripherals to delay processor read or write cycles. The WAIT line should not normally be held low for extended periods as this could cause refresh problems for dynamic memories and processors.

15) INHR Used to inhibit reads from RAM boards to allow 'shadow' PROMS to be temporarily placed in the same memory locations during system initialization. Does not prevent writing to RAM.

16) RFSH This signifies that the lower order address bits carry a valid address for use by dynamic memories for refresh purposes. RFSH.MREQ may be used for the Z80, while the 6800 will require a separate controller.

Control Logic For Specific Processors

As indicated above, the details of the control logic have been worked out for the Z80 and the 6800. The authors of this standard have checked that, as far as we are aware, other popular processors can also be used with this bus configuration without serious problems. As they will have much more detailed knowledge of the specific processors, members of the user's groups for these machines are asked to suggest suitable logic for them. We should be pleased to provide any assistance possible in this task.

Dave Howland,
186, Courthouse Road,
Maidenhead, Berks. Maidenhead 38222

Pat Crowe,
22, Ringsbury Close,
Purton, nr. Swindon,
Wilts. Purton 770555

Bob Cottis,
Pippins, Boulters Lane,
Maidenhead,Berks. Maidenhead 22445

LETTERS

HELP

I have a large quantity of 1103 1k dynamic memory. Any suggestion re circuitry for use with 6800 ? Postage refunded. Also help required with ICL VDU & K/B 7181/2 - this requires strings of command characters prior to sending/receiving data. Any way of overcoming this to simplify the software ?
Terry Mitchell G8EMY 33 Greenfield Rd.,
Waverton, Chester tel Chester 36105

HELP WANTED & OFFERED

Would like to know of anybody who is, or has developed floppy disc software from scratch, preferably on the 6800. I have a Calcomp 140 drive connected to a 6800 with 18k via a 6852 SSDA, but have no software beyond the SEEK,RESTORE,READ and WRITE block stage.

Also, for anybody who was unlucky enough to buy one of those heavy 667 line printers from Chiltmeads, I am working on a system using a separate 6800 plus PIA,ACIA (for serial input) and 12 8212's to drive the hammers. This should be ready by the time this comes to print. If anybody is interested or has any suggestions please contact me.

E Insam 11 Nelson Rd.,Harrow on the Hill, Middx.

Z80 NOTES

For those members who have copies of my Z-80 cross assembler, I would like to draw attention to the following error, which only affects the NEG instruction. In line 04140 (in DATA IOPC of BLOCK DATA OPCODES) change 355200B to 355104B (this is the octal code for NEG).

I now have my own Z80 system running, with calculator style keyboard and display, 1k of RAM and a 256 byte homebrew monitor (to suit the keyboard-display).Also a somewhat unusual peripheral, viz a 61 note piano keyboard. This is a precursor of 'phase 2', hopefully arriving shortly, in which I will have a Z80 controlled digital music synthesiser.

H Comins

HELP

I am writing on behalf of Kings College School, Wimbledon, who have recently acquired a minicomputer, together with a Friden paper tape punch model 1405759, serial No. 101-419, an which they have no information. Going through the usual channels has met with no success, so if anyone has any information this would be much appreciated.

V Harper 64 Cromford Way,New Malden,Surrey KT3 3BA
01 942 1251

LOW COST TRI-STATE BUFFERS

Those people who find the price of 81LS97s a trifle on the high side, and are prepared to go to a little more trouble, might consider the 74LS365-8. These are the low power shottky versions of the 8095-8 series, pin outs for which where given in ACCN for Oct 1977. The cost of these is about half that of the octal devices (also 16 pin sockets are a lot easier to get hold of). On a point of detail, a check of the spec. sheets shows that the 8097 and 8T97 are not the same, contrary to the suggestion in the otherwise excellent series on busses. The 8T97 is faster, and has a lower input current (8ns instead of 12ns, and 0.4 mA instead of 1.6mA). Bob Cottis.

SHOP

FOR SALE

Cossor DIDS 402-2A VDU's, do not need control unit £125.

Catronics teletext decoder (X887) completed except for video switching; you finish it, all parts included. £125.

Carriage by arrangement.

M.Rowat 44 Broadwheel Rd.,Helpston,Peterborough

FOR SALE OR EXCHANGE

ICT 65 col card punch.
Transdata 1563B tape drive test unit.
Correx 2000g & 500g tension guages.
A quantity of ¼" ribbons; not sure what they fit.
Some ex-LeoIII power supplies.

Graham Taplin 52 Florida Rd.,Thornton Heath, Surrey CR4 8EW 01 679 0557

FOR SALE

Offers are invited for the following Computer equipment;

DEC PDP-9 with; 8k x 18 bit store, 1uS instruction cycle time, 4 DEC Tapes type TU55, teletype keyboard and 2LT19 TTY interfaces, Paper tape reader/punch. This equipment is offered in a working condition with some spares, extensive software and a considerable quantity of paper tape.

3 off Olivetti TTY type TE 318. Approximately four years old, have been on Olivetti maintenance contract from new.

Some IBM Golfball printers & keyboards, complete but not working.

For further details please contact E.P.Strudwick, Department of Electrical Engineering Science, University of Essex, Wivenhoe Park,Colchester.

FOR SALE

I have about five hundred prime NatSemi 81LS95 available at the following prices; 1 up 105p, 10 up 95p. To cover postage please enclose two 9p stamps per order.
J.Hawthorne,23 Iver Lane,Cowley,Middx UB8 2JD

LOW COST MEMORY

I have a limited quantity of the following components which I can offer to ACC members at the favourable prices indicated;

2102-L1 1k static low power RAM £1.20 each (+VAT)
16 pin low profile IC sockets .16 each (+VAT)

If any of your members use S100 machines I also have the following;

8k static memory kits £85 (+VAT); 4k static memory kits £58 (+VAT). 2102L design. Low power Schottky support chips.Tri-state buffers.Vector interrupt provision.Slide switches for MWRITE/PWR and 0/1 wait.DIP switch address selection of each 4k. Available off the shelf. (add £1.50 regd. post).

Please ring me at 01 248 4584 to check availability of components.
P.E.Norman, Computer Centre, 20 Durnsford Avenue, Fleet,Hants GU13 9TB

BROWSER'S DELIGHTS

Can I recommend my favourite electronics shops via the newsletter, these are of the type where you can rummage through boxes of cheap components. Linway Electronics of 843 Uxbridge Rd.,Hayes End, Middx often have useful TTL boards and power supplies. They are not far from the Wool Shop (!) at 230 High St.,Harlington, recommended in the June newsletter. Keytronics at 332 Ley St.,Ilford also have the occasional bargain. Mail order firms I have found reliable include Watford Electronics, Maplin,Technomatic and, in California, James Electronics.

If anyone needs information on the Model 38 Teletype I have a full set of manuals.

Colin Brickell

WANTED

Connectors for Westrex high speed paper tape punch, american bayonet mains connector & double sided straight plug for solenoid drive.
Also, 12 & 18 way Plessey connectors for Elliot high speed paper tape reader.

L.S.Warner 62 Beech Rd.,St.Albans,Herts AL3 5AT St. Albans 56833

FOR SALE

Olivetti accounting machine model 1731/32, contains full electric keyboard, print head with a linked paper tape punch. Also includes a built in adding machine plus the remainder of my stock of paper tape. Closest offer to £150. Buyer must be willing to collect.
A Secker 209 Albury Drive,Pinner,Middx HA5 3RH 01 428 0844

FOR SALE

Magnetic Drum Store. Japanese made,working with all electronics but no data. Free.

IBM 1130 Card Reader. FREE.

Viatron microprocessor system, cards only but included memory and VDU controller. £25

Plessey 4k x 9bit core stores. £10 each.

Olivetti TE300 series terminal. ASCII,RS232 upper and lower case with tape reader/punch. £200

Ferranti CDU 11 VDU £60

Modern VDU, 9inch CRT, with all electronics MOS store and character gen.Latest type design but no keyboard or case. £100

IBM 1130 system, any offers, please phone.

Power supply units - lots going - some free, some up to £10, please ring if interested.

WANTED: Spare M series cards for PDP8/L, especially M220,M700,M310. Good maintenance manual for PDP8/L and MC8/L.

Nigel Dunn 21 Campion Rd.,Widmer End,High Wycombe, Bucks 049 47 4483 evenings/weekends

UN-JUNK

I have discovered a very good source of surplus ICL computer bits & pieces in Canterbury; Cursons Industrial, 78 Northgate, Canterbury. He has, at present, a load of VDU's in various conditions, some complete with all electronics, tube, power supplies etc.,but minus keyboard & top cover. All this for about £34 !! I picked up a chassis, video circuits, tube & power supplies for £20, the chassis being large enough to contain a complete home system and the power supplies are sufficient to power it (+15V, +5V 7A, -5V, -12V 1A). He also has keyboards unencoded and fully encoded, readers and punches, core stores, stacks of PSU's (literally!) a couple of mag tape units & much more. On my last visit I even noticed an old ICL card punch lurking under the junk. Prices are also very reasonable.

P Mapp

FOR SALE

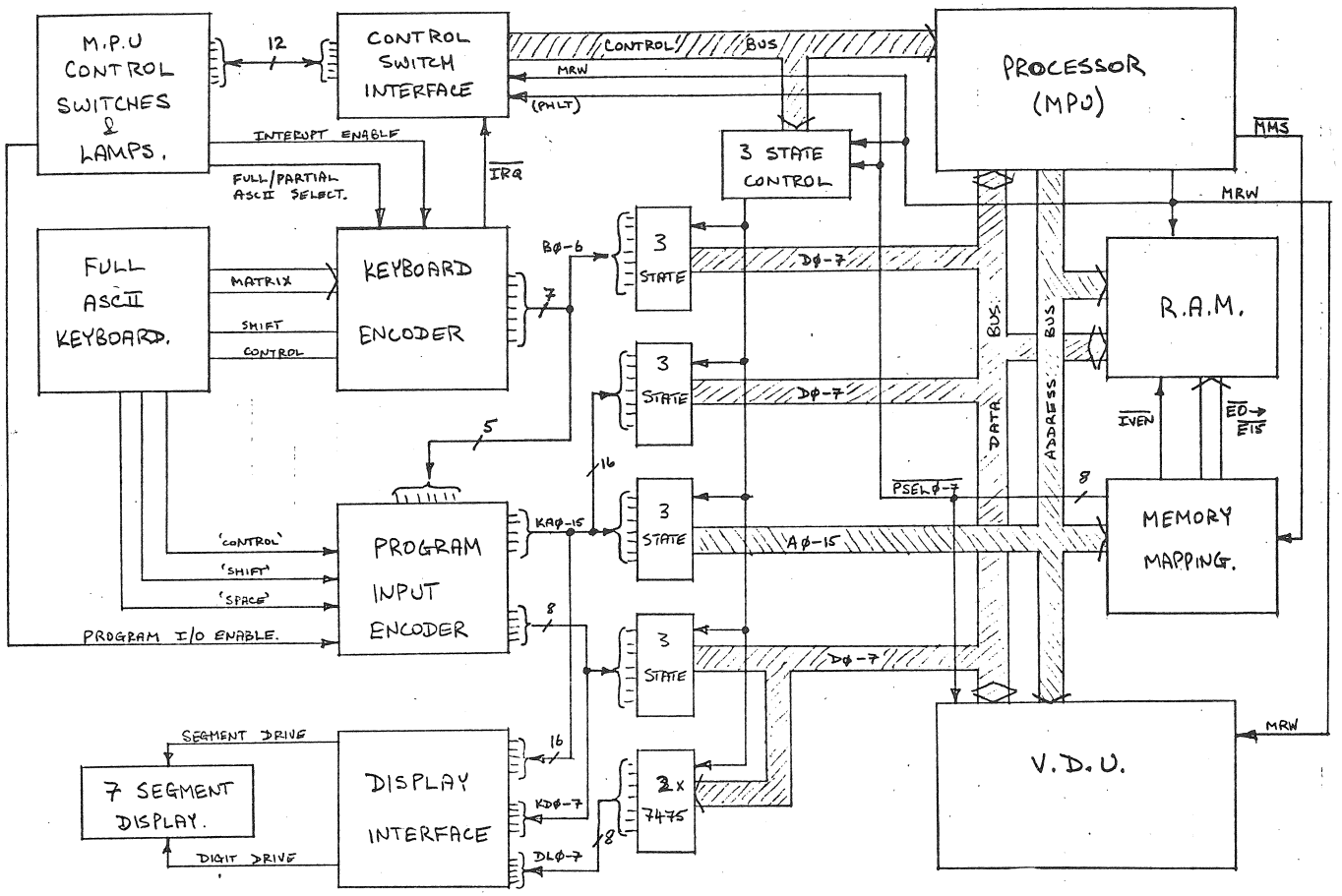
1) 20 Carpenters relays including bases. 50p each.
2) Super sensitive photo diodes + schmidt trigger IPL17A or IPLPS12 inc data 50p each.
3) 1k (256 x 4) RAM's GI RA-3-4256B 1uS 75p each.
4) 2708 PROM's 1k x 8 450nS £10.24 each
5) Octal latches 74LS259 £1.35 each.
6) 1k RAM's 2102 450nS low power £1.00 each.
7) 12 note tone gen AY-1-0212 £1.00 each.
8) 4k bipolar PROM,fused link,70nS 74S472 £6.50ea.
9) Octal buffer 74LS241 £1.35 each
10) 3 to 8 decoder 74LS251 £1.35each.

Cash with order, SAE for return of goods.
B Kirk Byfield House,Bisley St.,Painswick,Gloucs.

Direct Electronics, 627 Romford Rd.,Manor Park, London E12 5AD (01 553 1174) have some brand new cassette mechanisms in stock for £6. They include all the mechanical sections plus the Mono heads.

Jim Turner

PAUL MAPP'S SYSTEM *Part 1*



My system, centred around the 6800 chip, is being constructed in an old VDU chassis, which removes much of the 'metal bashing' required in constructing such a project. So far I have completed the VDU, based on a modified version of Bill Marshalls circuits in the ACCN, this gives 29 lines of 32 characters. No composite video is required by the video circuits as line, frame and video inputs are separate and TTL compatible (O/C outputs required). VDU data words are 8 bits long, 7 as per Bill's circuits plus a bit to disable the 2513 and select a graphics ROM, to be added later.I hope to be able to use a 1702 EPROM or similar to produce a simple graphics set.

All data and program entry is via a full ASCII keyboard, encoded by the circuits published in ACCN V4 Iss 1, but modified to provide complementary 10mS strobes. At the outset I decided against relying on a monitor program such as MIKBUG to ease program entry as this relies on the processor running correctly. Instead I have added a simple unit to the keyboard encoder to give Hex Address & Data directly from 0-9 & A-F on the keyboard. This consists of taking the four L.S. ASCII bits (B0-3)(see program I/O circuit) & latching these directly as address or data, selected by the 'shift' key on my keyboard, if bit 6 is set, as for A-F entry, decimal 9 is added to (B0-3) thus producing decimal 10-15 for entry into the address or data latches. My keyboard conveniently has 2 sets of contacts for 'Control' 'Shift' and 'Space', and I have utilised these as follows for program entry;

0 - F enters data latch - 2 digits
SHIFT 0 - F enters address counter - 4 digits
CONTROL decrements address counter
SPACE increments address counter.

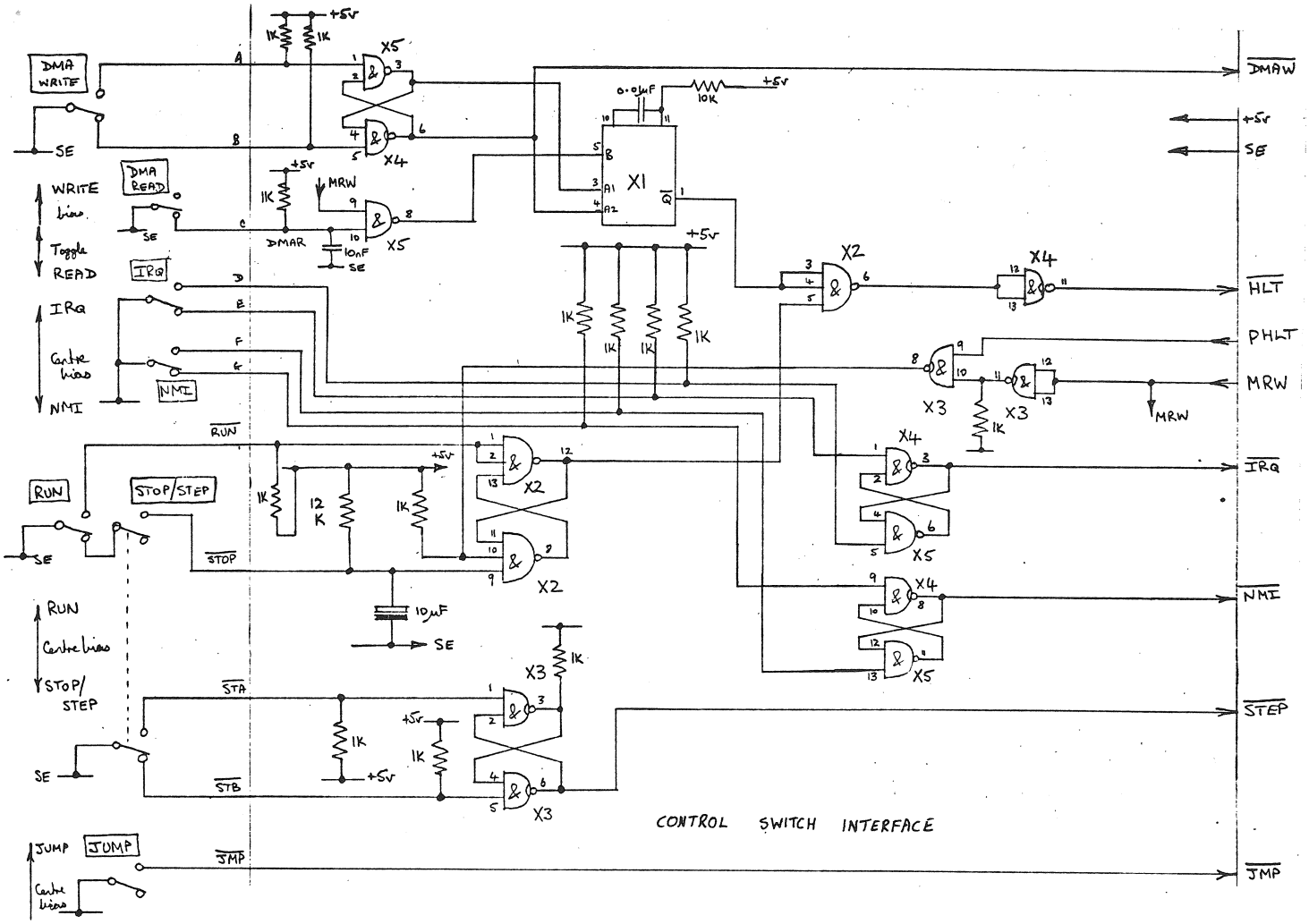
Hence program entry is very easy, directly in Hex ready for writing into memory without any use of the processor. Tri-state buffers selected as appropriate route data & address from the program I/O latches onto the busses to the memory. A nine digit ex calculator seven segment display is multiplexed to provide a Hex display of 4 digit address, 2 digit 'write' data entered from the keyboard and 2 digit 'read' data accessible by the processor when running. The 'read' data display is latched by 2 7475's which are held transparent during any processor Halt mode, thus displaying the data bus contents directly. The only 'funny' with this system is that when incrementing the address counter by 'Space', it also enters data 0 to the data latch. This has, in fact, been found to be convenient as it effectively clears the 'write' data display to 00 when stepping through the contents of the memory and displaying on the 'read' data output. This avoids confusion on my display as 'write' & 'read' data are not separated by a space.

The processor is based around a 6800 chip, and was built last to avoid any temptation to 'patch it in' and risk blowing it up in the process.

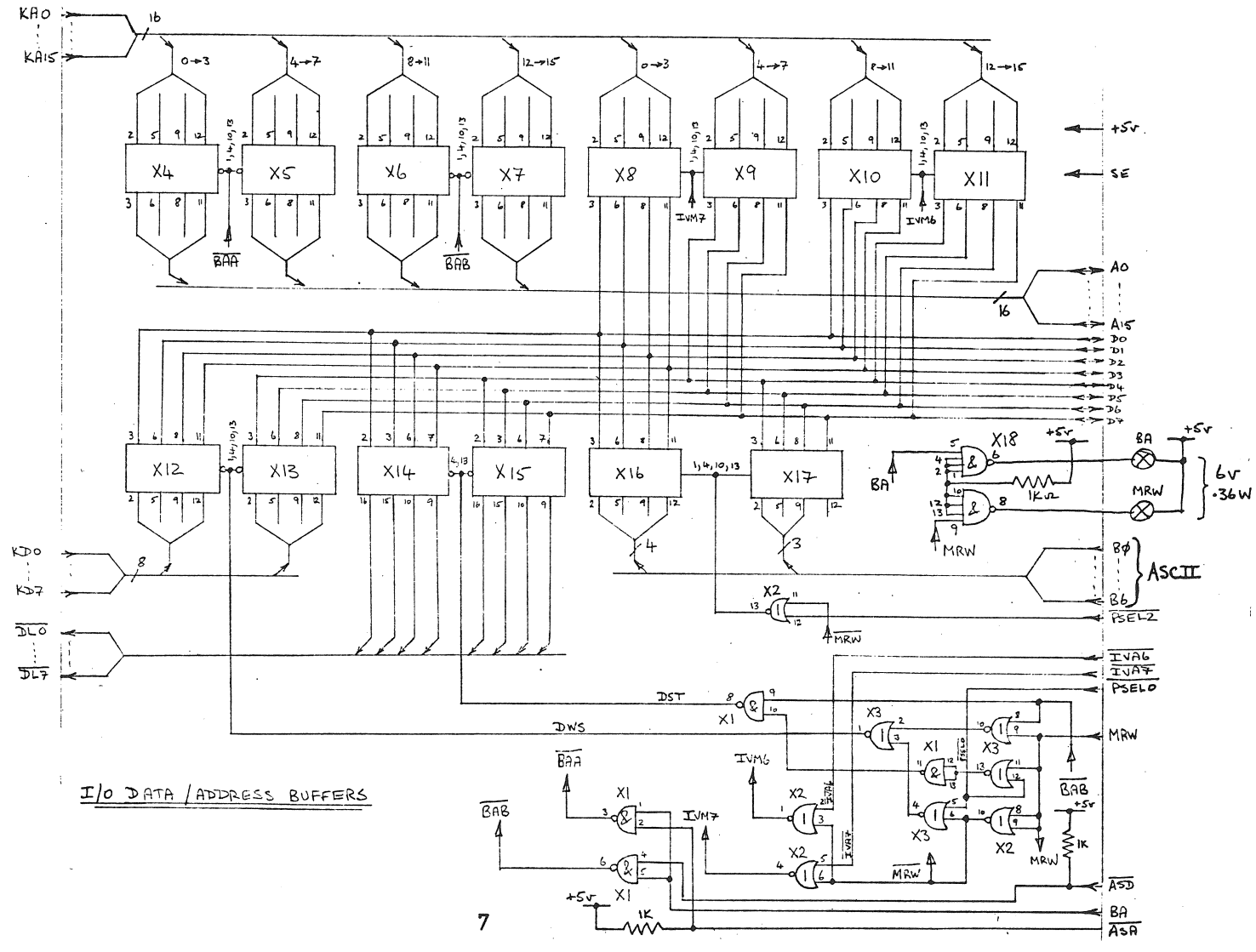
Processor and system control is implemented by using four keyswitches providing RUN/STOP/SINGLE STEP/JUMP/LOAD/DMA Read & DMA Write operations, plus initiation of either of the interrupt IRQ & NMI. Full DMA is available by halting the processor for about 100uS, or during any HALT mode. A DMA write is automatically followed by a read to verify data entry, and a DMA read can be produced following every 'write' to memory by the processor if desired. This effectively allows any memory location to be selected and continuously monitored during program execution, but at the expense of slowing down the processor.

A JUMP to any specified address, held by the program I/O address counter, can be produced by using the processor RESET input & forcing the processor to obtain its new PC contents from the program I/O address counter, effectively specified in two bytes by addresses FFFE & FFFF. The software interrupt does exactly the same but uses addresses FFFA & FFFB to access the address counter. I envisage using this facility as an operator selectable subroutine jump selected by entering the appropriate address. What else can you use the SWI instruction for ?

... to be continued



CONTROL SWITCH INTERFACE



I/O DATA / ADDRESS BUFFERS

ED'S BIT

Here endeth the fifth year of the ACC.

So, please try and come along to the AGM. Not only to tell us how you would like to see the ACC develop, but also to volunteer to serve the other members in some way, on or off the committee, we need your active support.Or failing that, you can buy me a pint in the pub afterwards.

Also, now is the time for members to re-subscribe for the coming year. You should find a tastefully coloured application form with this issue, if not then complain, shout abuse from the housetops, write to your MP, or even take legal action - but don't forget to renew your membership. Seriously, though, if you feel that you don't want to keep up your membership, I'd appreciate it if you'd let me know why. Not because I would want to try to persuade people to join the ACC if they felt they didn't want to, but because the reasons why people drop out help us get a feel for what members need from the club.

Another request, if I may, for articles for the newsletter. Particularly those dealing with the fundamental aspects of computing, which are common knowledge to the old hands, but which cause beginners so much difficulty before they get the 'knack'.

One subject that has cropped up a few times recently is that of formats, or structures, for cassette files. Assuming that CUTS (Kansas City) is an accepted standard way of recording bytes onto cassette tapes, then do we need a standard specifying how the records & files are put onto the tape ? Your views please.

Another aspect of standards; would anyone who has any information on the S50 bus (SWTPC 6800 system) please let me have it as I'm trying to get together a file on the subject for the ACC library. Also, I'd still like an article on the H-P instrument bus, as also found on PET. Provided that someone comes up with a simple and reasonably cheap way of connecting onto this bus, then it could become popular in amateur, as well as industrial, circles.

Finally, could I have all contributions for the next newsletter by April 15th please.

Mike Lord

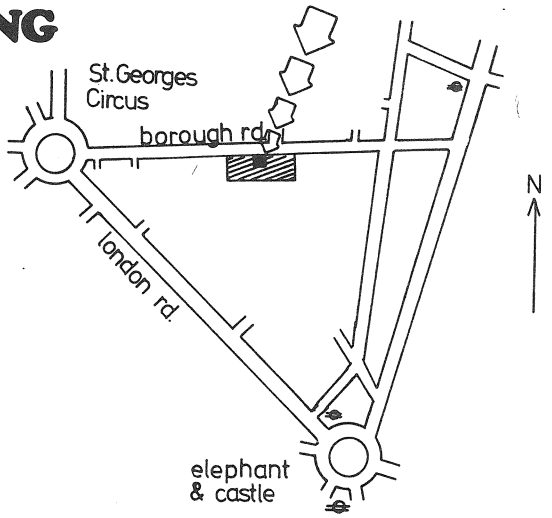
ANNUAL GENERAL MEETING

The Amateur Computer Club Annual General Meeting for 1978 will be held on

Thursday April 13th. 7.30pm

at

Polytechnic of the South Bank
Borough Road



AGENDA

a) Retiring Officers' reports and statement of the Club's accounts.

b) Election of Officers and Committee members for 1978/9.

c) Discussion of special projects for 1978/9.

d) Visit and lecture programme for 1978/9

e) A.O.B.

CONSTITUTION OF THE ACC

as revised and agreed at the AGM of 31 March 1977

1) The Club shall be known as the Amateur Computer Club.

2) The aims of the Club are to promote and co-ordinate interest in the design, construction or programming of computers and allied equipment.

3) Membership of the Club shall be open to anyone subject to;
   a) The approval of the ACC committee, who have the right to reject any application for membership.
   b) Payment of the annual membership fee.

4) The membership fee shall be £2 per annum except for members who are resident in the UK and who are also 16 years of age or under on the 1st April, in which case a reduced fee of £1 shall be allowed.

5) The membership fee shall only be changed by resolution at a general meeting.

6) Membership shall last from April 1st until March 31 of the following year.

7) The committee of the Club shall consist of not more than 5 officers and not more than 10 other committee members, all of which are honarary appointments.

8) Any member of the ACC is eligible for election to the committee, provided that he or she is proposed and seconded by two other ACC members.

9) Officers of the Committee must be 18 years of age or older.

10) Elections for officers and committee members shall be held at the AGM.

11) The activities of the Club shall be coordinated by the commitee in accordance with the constitution.

12) All resolutions shall be carried by a simple majority of those present and voting. In the case of a tie the chairman has the casting vote.

13) All general meetings shall be held within 10 miles of the centre of London.

14) Notice for any general meeting shall be sent to members of the Club not later than 2 weeks before the date of the meeting.

15) An extra-ordinary general meeting may be called by 10 members provided that they give 6 weeks notice to the chairman and pay any costs incurred in informing all Club members of the proposed meeting, and also the costs of the meeting.

16) At any general meeting a quorum shall consist of 10 members, including 3 members of the committee, at least one of who shall be an officer.

17) A resolution for the dissolution of the Club shall require a three quarters majority as a result of a postal ballot of all current members. Any assets of the Club remaining on dissolution shall be distributed among the current members, pro-rata according to their subscription for that year.

18) The address for all communications to the Club shall be 7 Dordells, Basildon, Essex.

19) A resolution to change this constitution shall only be approved at a general meeting.

... ---------- ...

MEETING POINTS

SOUTHAMPTON UNIVERSITY AMATEUR COMPUTER CLUB

We have started a special interest group (SIG99) which is currently engaged in the design of our 16 bit 9900 based minicomputer. Later this term we hope to start building the hardware & front panel. The 'Union' is paying for most of the electronics so we want to make it look like a computer, with lots of switches and flashing lights.The hardware will enable us to control, almost completely, most of the micro's operations, which will help us in our initial testing of the system "Benchmark".

Our initial hardware plans are, therefore;

1) NASCOM 1 system inc. video display, ASCII keyboard & cassette interface. Used for program development, 'teaching' members etc.

2) Building a 9900 based minicomputer. Used initially to satisfy us 'hardware' buffs. Later uses could be as a 2 or 3 terminal time-share system. (It could be as powerful as the PDP-11 series). Of course that will require a fair amount of software development also. A further major club project.

3) Acquisition of peripherals e.g. Teletypes, keyboards, possibly a disc (floppy ?) and lots more memory (core stores ?).

4) Members 'pet' projects.

Some of these plans are long term, and are general aims of the club. We hope to get our NASCOM system running before Easter, and I will report on any further deveolopents.

Paul Maddison

MIDLANDS SECTION

Yet another bumper meeting on Sunday 5th Feb. We seemed to have more equipment than people, and there was no shortage of people!

The first item was Alistair Nicol's Z80 system. This has developed much further than when we last saw it. It now has a Digital Group VDU board feeding a 14" portable TV via a modulator. This, combined with the 'Zapple' monitor makes a very powerful tool. Alistair demonstrated the 'Zapple' which is a 2k monitor ROM. The facilities include a Search routine, Break-point setting, Register Display, two different cassette formats, Interrogate Ports, direct handling of ASCII code, etc. A real time clock display is handled by means of the CTC chip, which also controls the baud rate. Memory is with 4k dynamic chips which are refreshed using the on board facility of the Z80 chip.

Nick Wright then gave us a demonstration of an XY plotter coupled up to his 7768, this was a commercial model, not his meccano device. Several patterns were drawn to demonstrate the operation.

Dave Goadby then showed us his updated system which now has the 64 char/line VDU together with a new VDU monitor and his new DG BUG. This is a 2k byte ROM (2-2708's) crammed full of useful routines similar to those in 'Zapple' and using the 3F (SWI) system discussed in his article 'Freedom At Last' in the last newsletter. This was a very impressive device and I think there will be many people following his lead. Another new addition is the SWTP 'Number Cruncher' module using the N.S. programmable calculator chip (as used in the Sinclair Programmable Scientific). This saves a great deal of program memory when mathematical routines are required.

Next meeting Saturday 18th. March 2.30pm.
Anyone interested contact Ray Diamond, 27 Loweswater Rd.,Coventry CV3 2HJ tel Coventry 454061

LONDON GROUP

A packed meeting on 24th January heard John Miller Kirkpatrick discuss the problems that had arisen with the ETI System 68 design; mainly due, it appeared, from the fact that he had to meet very tight publishing deadlines and also because "I do not know one end of a transistor from another". In the course of an excellent talk, he gave some useful advice to EPROM enthusiasts; that the best UV eraser is obtainable from Boots under the code 'Philips Sun Lamp', and that tired EPROM's,which have been programmed and erased so many times that their insides are all confused, can sometimes be revived by baking in a moderate oven (250 - 300°C) for about ½ hour. Not guaranteed, but what have you got to lose ? SCRUMPI 3 was demonstrated for SC/MP enthusiasts.

At an almost secret meeting held at City University on Saturday 18th Feb.,there were about 6 home brew machines being put through their paces, including Neil Harrison's Z80 system running some nice games programs. After an agonising wait, Lynx turned up with TWO NASCOM 1 systems, and told the surrounding hordes thatthe first batch of production PCB's had just been received so kits were, at last, starting to flow forth. This was the first time that I had seen NASCOM, and my impression was that it is a solid piece of engineering, worth the money, but with the possible small criticism that the tracks on the production PCB are very narrow, and could therefore be prone to almost invisible hairline breaks. Anyway, the ACCN looks forward to comments from anyone who builds one of these systems. Commodore arrived a bit later with a live PET.They are now taking your money (£695 inc. VAT) for delivery at an unspecified date. PET's graphics capabilities are superb, pity the same couldn't be said for the keyboard which uses what looks like a pocket calculator style keyboard, with the keys a bit too closely spaced for comfort. The software appears to be well thought-out and powerful.

ACC NORTHWEST

The Northwest Group seems to be getting well on its feet now. At the last meeting we had 32 people present, and we had a talk about the ETI System 68 and a simple lecture on Flip-Flops, Counters and Shift Registers. At the moment we are running a series of elementary lectures which occupy the first ½ hour of each meeting, followed by a more advanced talk. Details of our program are as follows;

9	March	Arithmetic Units
13	April	Logic Families
4	May	Computer Arithmetic
8	June	Computer Architecture
6	July	MPU Interface Circuits
3	Aug	MPU I-O Circuits (UART's etc.)

As usual all meetings are 6.30 for a 7.00 prompt start in the National Computing Centre,Oxford St., Manchester. Anyone interested should confirm the dates / times and subjects with Ken Horton, 50 Lymfield Drive,Worsley 061-799-0192 (home) or 061-228-6333 ext 372 (work).

THAMES VALLEY GROUP

The first meeting of the Thames Valley Group will be held at the Fulmer Research Institute Sports and Social Club, Stoke Poges, on Tuesday March 7th at 7.30pm. Tim Moore will be showing some of his merchandise, but no formal talks are planned- just come along, trade ideas/software/hardware and tell us what you want to do next time. For details on how to get there telephone or send an s.a.e. to Bob Cottis, Pippins, Boulters Lane, Maidenhead, Berks, SL6 8JT. Maidenhead 22445.

RADIO & COMPUTER EXHIBITION

The Northern Radio Societies Association are featuring microprocessors and personal computing at their exhibition in Manchester on Sunday 2nd April. Exhibitors already booked are; ACC NorthWest Group, Computer Workshop, Comart, Lynx, Newbear and LP Enterprises. Other attractions are the amateur radio exhibition itself, inter-club quiz, raffle, and the Bell Vue fun fair for the family.

For radio amateurs there will be a talk-in on 2m & 70cm FM using callsigns GB3NRS & G8NRS/A.

The exhibition entrance is at the rear of Bell Vue, off Hyde Rd.,Manchester. Doors open 11.0.
For more information contact J.D.Clifford, 22 Jubilee Court, Bramhall Drive, Holmes Chapel, Cheshire.

Z80 USER GROUP REPORT

The group is still in its early stages yet (seems that people haven't been weaned off that 6800 yet!). Quite a few people turned up at the Lynx seminar and went away again. The group is tending to standardise on a monitor which resides in 2k. Neil Harrison has a listing in the Library but please send an SAE. Needless to say we (or some of us) are thinking of changing some of the sub-routines but still maintaining the patches for I/O and thus maintain compatibility.

I must apologise for all those people (both of you) who have been trying to reach me but without success. I have moved and the new address is c/o 19 Marlpit Lane,Coulsdon,Surrey. However this is a transitory period while I gird up my loins for a move to a new permanent address in Evesham,Worcs. When I have the address I will let you know. In the meantime any correspondence can be quite safely left at the above address.

Roger Sinden

IMPORTS

Deliveries of the TANDY (Radio Shack) TRS 80's are expected to start in the UK in March. For £500 you get a system with 4k ROM & 4k RAM. Extensions; floppy, printer, 2nd cassette & software, are expected in June. For further details contact Tandy (Cambridge), 1 Emmanuel St.,Cambridge CB1 1NE (0223) 68155.

Anyone who wants to find a safe home for £695 could, possibly, do worse than send it to CBM Business Machines Ltd., 446 Bath Rd., Slough SL1 6BB (tel 06286 3224/5/6). In return they will put your name on the waiting list for a PET ; the 8k RAM version, being the only version available in the UK at the moment. By the way, has anyone heard any rumours about the peripherals that, presumably, Commodore will be bringing out for PET ? £10 to the same address will get you a year's membership of the U.K. PET Users Club.

Alternatively, 6800 based kits MSI 6800 (£375 for 8k RAM) & SWTPC 6800 (£275 with 4k RAM) are now available through Strumech Eng. Portland House, Coppice Side, Brownhills (tel Brownhills 4321).

MECCANO PLOTTER

MECCANO AND A 7768

After having completed my 7768 I decided that some other form of output device was needed so that the microcomputer could be shown to be doing something more recognisable than just flashing a row of LEDs.

Without the luxury of either a VDU or a TTY and with no hopes of obtaining either in the near future my thoughts turned to some form of X-Y plotter.

The device had to work using the existing output port (8 bit parallel) and without any other complicated hardware, so that a conventional plotter which responds to a varying voltage on either of its inputs could not be used. It was thus decided that a device using a motor to drive a pen along in either axis was the answer, the time the motor runs in either direction being controlled to produce the desired pattern.

What has all this to do with Meccano, you might now be asking yourselves. Well, my other main hobby is Meccano modelling and I belong to the Midlands Meccano Guild which is a group of adult enthusiasts devoted to Meccano modelling.

The next step was thus obvious to me; build a plotter out of Meccano, which was readily available as I had all the necessary parts. After various experimental stages, the design was finalised as a framework about 24" square and 4" deep, inside which the plotting table (a piece of glass) was supported. An arm, along which the pen carriage runs, spans the table from front to back, the carriage being driven by a DC motor through suitable gearing. This whole assembly traverses the table from left to right similarly driven, producing the two axes of movement for the pen. The pen can also be raised from the paper using a small solenoid.

As the motors are DC by changing the polarity of their supply their direction can also be changed. Therefore to produce motion in either direction, each motor is supplied by either a +ve or a -ve current.

To make the microcomputer drive the plotter the spare data output port is used. A transistor switch is connected to each bit of the output which drives a relay which in turn supplies a +ve or -ve current to the motors or the solenoid. Thus by writing a specific byte to the output port, the pen can be driven in either direction or raised off the paper. Next, a sequencer program was written which allows a specified byte to be output for a specified time;

The disadvantage of this system is that the DC motors run at slightly different speeds in either direction. However the software is such that compensation may be made for this by making the motors run for a slightly longer time in their slower direction.

```
ADDR    CODE
 00     CE 00 2A    START   LDX *002A
 03     08          NUPLOT  INX
 04     08                  INX
 05     A6 00               LDA A 0,X
 07     27 F7               BEQ START
 09     97 25               STA A TIME
 0B     4F                  CLR A
 0C     E6 01               LDA B 1,X
 0E     D7 FF               STA B FF
 10     FF 00 27            STX 0027
 13     CE FF FF    RERUN   LDX *FFFF (decrease FFFF
                                for shorter
                                times)
 16     09          AGAIN   DEX
 17     26 FD               BNE AGAIN
 19     7A 00 25            DEC 0025
 1C     26 F5               BNE RERUN
 1E     FE 00 27            LDX 0027
 21     20 E0               BRA NUPLOT

 25     TIME
 27     INDEX
 2A     List, starts TIME,BYTE TO BE OUTPUT,TIME...
        ...00,00 repeats program
```

The most complex pattern that has been produced by the Plotter so far is 'HELLO' and it was demonstrated doing this at a Coventry ACC meeting. The resultant pattern was a very acceptable 'HELLO' about 10" long and 4" deep, especially for a system completely without feedback, emphasising the advantages of software in overcoming the inaccuracies in the mechanics which I intend to try and iron out in the near future. I have since used these inaccuracies to produce some interesting patterns by programming the plotter to draw for equal times in all four directions repeatedly. This produces a rectangular shape offset in each subsequent sequence, which produces a 3D rectangular tube effect. However, the offset tends to be uneven and it is hoped that with the mechanics more reliable, better patterns may be produced by programming rather than by chance.

Ideas for the future include a 'Pick and Place' arm made entirely from Meccano but using digital to analogue converters driven from the 7768, employing feed-back so that the position of the arm is specified by a series of voltages. A further development along these lines indicates using analogue to digital converters from the feed-back outputs so that the arm can be positioned and its position recognised by the microcomputer, allowing it to repeat movements initially put in by hand.

Nick Wright

D II IMPROVEMENT

PUTTING THE D2 EVALUATION KIT TO WORK

The D2 evaluation module is essentially a self contained unit, this being a great advantage for users without a TTY or VDU. Those of us who have such peripherals are faced with a problem; the D2 firmware (JBUG) has no provision for TTY I/O.

However there exists MIKBUG which does contain serial input/output routines and is a well known system monitor for which there is available a wealth of software. Unfortunately MIKBUG has several limitations, the main one being the use of a PIA instead of an ACIA for serial communication. The D2 has an ACIA as a serial port which is used in conjunction with a cassette interface. It was clear that with minor modification access to the ACIA could be obtained and then a modified form of MIKBUG could be used to control it.

The ACIA changes are as follows (refer to Fig 1); The Transmit Data Output (TXD) is connected in parallel to the existing cassette interface and a new TTY interface. A switch is used to simultaneously change over the Received Data Input (RXD) from cassette to TTY interfaces and also the Received Clock Input (RXC) from the regenerated clock of the cassette interface to the clock available on the CPU board. The simple TTY interface used is RS232 compatible.

It was considered essential that the new monitor (INP/MYV BUG) should retain compatibility with software written for MIKBUG systems. The new monitor is therefore basically MIKBUG but has the PIA I/O routines replaced with shorter ACIA routines this making space available to improve the control functions. Modifications included changes to the G,P & M functions. For example the G command (Go to user program) was originally preceeded by loading the start address into locations A048 & A049 by use of the M command (memory change). In INP/MYV BUG it is only necessary to enter G followed by the start address. Despite these changes, and others, the original length of 512 bytes was not exceeded.

Although the D2 has provision for a 1K EPROM(2708) a more economical solution to the problem of housing the new monitor is the use of a ½K EPROM, the 5204. However this does require an additional socket, which can be accomodated in the wire wrap area of the CPU board along with the other hardware modifications.

As can be seen from Fig 1, the new monitor coresides with JBUG and is located at address C000. By use of switching and gating as shown it is possible to disable JBUG and effectively replace it with the new monitor.

To conclude, it can be seen that these simple mods make the D2 evaluation kit into a more usable microcomputer. The basic hardware additions leave options open for individuals to write their own monitor program or use something along the lines of INP/MYV BUG.

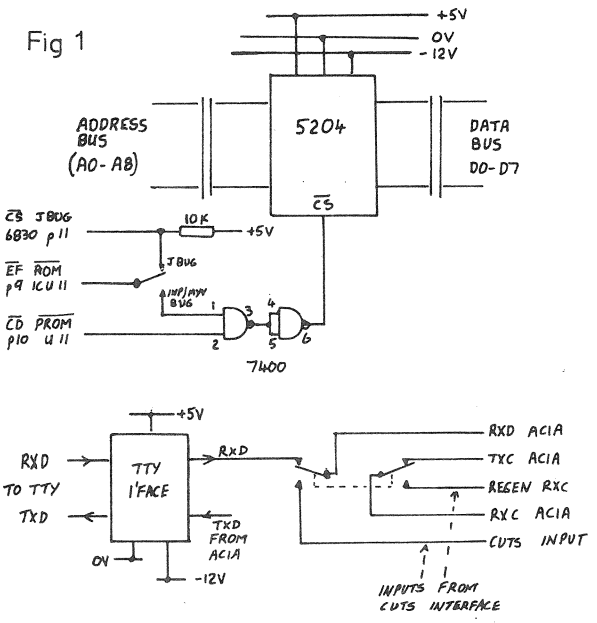
Anyone requiring further information should send a s.a.e. to Graham Webb ,91 Gallows Hill Lane, Abbots Langly, Watford, Herts.

DAVID WEBSTER G8MYV
GRAHAM WEBB G8INP

Fig 1

CIRCUIT ADDITIONS;
The following track on the D2 CPU board must be cut;

$\overline{EF}$ ROM - $\overline{CS}$ J BUG
RXD ACIA - pin W (edge connector)
RXC ACIA - " 19 " "



CALC vs COMP

CALCULATORS & COMPUTERS Part 2 J Hamilton

WHAT IS A PROGRAMMABLE ELECTRONIC CALCULATOR ?

Recently I bought an electronic calculator (not programmable). The owner's manual says "Thank you for selecting our new scientific calculator. We prefer to call it a mini-computer because of its ability to handle so extensive a range of complex assignments across a broad spectrum of basic and advanced mathematics..." (1)

Now, despite the fact that this electronic calculator has been programmed to calculate squares, square roots, logarithms to bases 10 and e, antilogs, trigonometric ratios and their inverses, and mean and standard deviations, it is not a mini-computer. Why not ? Even if it were possible to create one's own programs and make the machine obey those, it would still not be a mini-computer. Why not ?

A programmable electronic calculator is a calculator which can store instructions for executing any of its basic functions (+, -, x, ÷). The fact that some calculators accept instructions from a user and some do not is not our concern. For our purposes, all electronic calculators are programmable; some incorporate all their programs in read only memory (ROM) while others can accept new programs by storing them in random access memory (RAM), usually parallel access bistable arrays. Calculators containing RAM are more powerful than ROM only calculators. Why, then, is an electronic calculator not a computer ? For two reasons.

Firstly, an electronic calculator is designed to transform bit patterns interpreted as numbers. In other words, a calculator is designed to perform arithmetic. And note that this arithmetic is performed on the numbers input to the calculator. No arithmetic is possible on instructions other than indirect addressing and jumps. (It might be objected here that indirect addressing and jumps account for the greater part of instruction arithmetic in computers. This is true. However, the fact that arithmetic can be performed on other instructions in a computer but not in a calculator is an important point). Texas Instruments, who manufacture microprocessors as well as programmable calculators, do not pretend that their calculators are mini-computers. What is so special about arithmetic, or numerical computation, as distinct from structural computation ? (Commercial data processing is a combination of both these types).

In numerical computation a set of numbers is processed according to a program to produce one number. Fig 6 shows a representation of the calculation of x(t) from the formula

$$x(t) = 1 - e^{-at} \cos t$$

Because calculators are designed to produce answers comprising one number, a single display is sufficient to output the answer or result.

Structural computation involves analysing the relationship between different characters (whether letters, numbers or other symbols) and transforming

this relationship. The result is usually a set of characters. Hers are a few examples of structural computation.

(A) Sorting The computer analyses the sequence of characters or groups of characters and re-orders them in accordance with defined rules. The result consists of the input data in a different order;

GDACBFHE —sort→ ABCDEFGH

A programmable electronic calculator could conceivable be used to sort but it would be limited to numbers, and so few that it would not be worthwhile. Also, it would be unable to display all the numbers in their new order without intervention of the user. Computers, on the other hand, regularly sort millions of characters. This highlights another difference; computers have equipment especially designed to facilitate the rapid input and output of not only numbers, but also letters and pictures.

(B) Program Translation Translation of a program written in a programmins language such as Algol or PL/1 into machine code.

(C) Message Switching A computer analyses the data at the front of a stream of characters, and directs the stream, minus the analysed data, to a decoded destination. These computers are sometimes called soft-wired exchanges, and are extensively used in telephone networks.

(D) Record Manipulation Some magnetic tapes containing the details of all electricity accounts in a city could be used as input to a computer which would make changes dictated by more input on another magnetic tape. As output, typically, there would be a new version of the accounts, a magnetic tape or disc containing details of electricity bills to be printed, and a printed record of actual changes to the accounts with additional error reports. Although this last example would involve some calculation, it would rarely exceed the capability of a four function calculator.

(E) Chess Computers have been programmed to play chess to county standard.

The second reason why a calculator is not a minicomputer was hinted at in example (A). Although electronic calculators embody many of the programming capabilities of computers, there is one feature of computers which is never implemented; a calculator cannot change a program while it is being executed because in a calculator, data and instructions are separate. This is a subtle but important difference.

To the processor of a computer, instructions are indistinguishable from data. A processor does not distinguish between instructions and data except insofar as this is determined by the instructions themselves. Hence, separation of data and instructions is a feature of calculator architecture which a computer lacks because it does not need it. Indeed a computer benefits from this lack. Without the feature, programs can regard themselves as data, and can therefore transform themselves during execution. The chess programs referred to in example (E) are self-adaptive; when it has played a game of chess, it will analyse the game and change its strategy and tactics. The strategy and tactics are part of the program instructions. Computers which demonstrate artificial intelligence use self-adaptive programs which would not operate if the program was separate from the data.

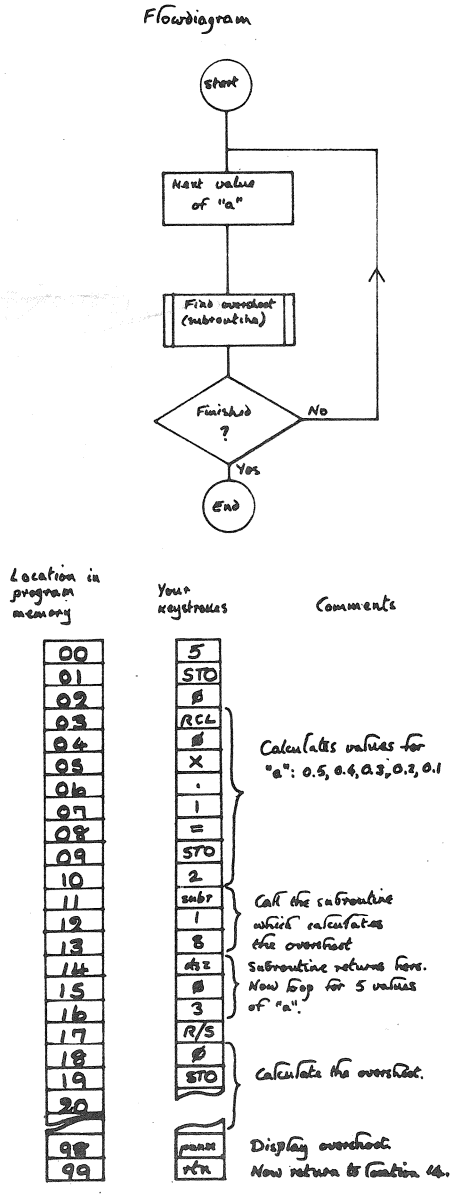


Figure 6

the overshoot calculation for a programmable calculator. (2)

CONCLUSION

Although I have tried to show the difference between an electronic calculator and a computer, there is no implied denigration of electronic calculators which are an excellent example of integrated circuit technology. For numerical computation involving not too many steps, calculators are ideal. As portable instruments, they provide on-the-spot computational power undreamed of ten years ago. However, I do not think that the programmable electronic calculator is half-way to being a computer, and that therefore we can expect to see mini-computers in the guise of calculators appearing in the next few years. There will certainly be a growth in the sales of microcomputers to help the small businessman automate his information storage and retrieval needs, as well as helping the engineer with his arithmetic.

Is a calculator a mini-computer ? No, because

(i) it can handle numbers only

(ii) it is limited to numerical computation except for trivial cases of sorting

(iii) it cannot execute self-adaptive programs.

REFERENCES

(1) Commodore Model SR4148R Scientific Electronic Calculator Owner's Manual, p6

(2) Texas Instruments Handheld Programmable Calculatots Brochure, p 11

**** This article was reproduced with permission from the BAEC Newsletter. For further information about the British Amateur Electronics Club, contact Mr. C.Bogod 'Dickens' 26 Forest Rd.,Penarth,Glam.*

AMATEUR COMPUTER CLUB NEWSLETTER
Vol 5 Iss 6 February 1978
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