Texas Instruments
USERS GROUP
TORONTO

FOR THE TI-99/4A COMPUTER

MAY 1985

NINE T NINE USERS GROUP

29 INGLESIDE DR.
DOWNSVIEW, ONTARIO
M3K 1V2

Edmonton Users Group
P O Box 11983
EDMONTON ALTA T5J 3L1

E X E C U T I V E   C O M M I T T E E

PRESIDENT	Emile Verkerk	(633-1451)
VICE-PRESIDENT	Dave Rust	(449-2576)
SECRETARY	Randy Rossetto	(469-3468)
TREASURER	Peter Sandford	(820-7389)
OFFICER AT LARGE	Boyd Brown	(793-3761)
PAST-PRESIDENT	Lloyd Lindsay	(743-3868)

N E W S L E T T E R   E D I T O R

Emile Verkerk

L I B R A R Y   C O M M I T T E E

Randy Rossetto

M E M B E R S H I P   F E E S

FULL MEMBERSHIP	$25.00 / year
ASSOCIATE MEMBERSHIP	$12.50 / year

All memberships are household memberships. An associate membership is only for those who live beyond the consulting distance of Toronto, but wish to receive our newsletter and have access to our library. You are welcome to visit one of our general meetings before joining the group. If you wish more information contact our secretary in writing at the club address on the front cover or call and leave a message with his answering machine.

N E X T   M E E T I N G

The meetings are held on the last Tuesday of each month. The next meeting will be held on June 25, 1985 at Shoreham Public School, 31 Shoreham Dr. in Downs-view, starting at 7:30 pm. Shoreham Dr. runs east/west from Jane St. north of Finch Ave. The entrance to the school is a few hundred yards east of Jane on the south side of Shoreham.

C O M M E R C I A L   A D V E R T I S I N G

Any business wishing to reach our membership may advertise in our newsletter. The rates are as follows. (width by height):

FULL PAGE	(6" x 7 1/2")	$40.00
HALF PAGE	(6" x 3 1/2")	$20.00
QUARTER PAGE	(3" x 3 1/2")	$10.00

Please have your ads camera ready and paid for in advance. For more information contact the treasurer.

Don't forget, that any member wishing to place ads, may do so free of charge as as long as they are not involved in a commercial enterprise.

N E W S L E T T E R   A R T I C L E S

Members are encouraged to contribute to the newsletter in the form of articles, mini programs, helpful tips, jokes, cartoons and questions. Any article may be submitted in any form by mail or modem. We welcome the reprinting of any article appearing in this newsletter providing credit is given to the author and 9T9. If more information is required, call Emile Verkerk.

D I S C L A I M E R

Opinions expressed in this newsletter are those of the writers and are not nec-essarily those of the 9T9 USERS' GROUP. 9T9 cannot assume liability for errors or omissions in articles, programs or advertisements.

ON THE DRAWING BOARDS.

We are developing several other enhancements for the TI-99/4 AT. All components will be mounted on a board INSIDE the computer. (An additional external power supply will be required later.)

The projects will include :-

Extensive CRU decoding to allow for new faclities.

Provision of a CRU selectable 8K CMOS RAM chip in the DSR area of CPU RAM from >4000->5FFF.

Console ROM to be hardware switchable between ROM and battery backed CMOS RAM.

(We just might end up with an 80K computer, or better!)

Installation of an EPROM copier-programmer in the computer. Two Zero Insertion Force sockets to be mounted above the ventilation slots at the rear, right hand side of the console. (That'll really COOK em!)

Provision of a GROM and ROM selector for access to external module cards.

Some of the mods will require M/L routines and we will list those when apropriate.

VAPOUR WARE.

Other improvements to be investigated (straight from the DREAM TIME) include :-

A RAM DISK, large enough to load a full, double sided, double density disk (1440 sectors or 368640 bytes.) that's 45 HM6264 chips which would cost $1197.00! Well maybe next year. Just think, they might even come down to $4.95 ea. That would be about $80 for a SS-SD RAM DISK or $250 for a DS-DD RAM DISK.

Relocation of the 32K CMOS RAM expansion on the 16 bit data bus to eliminate the 16 to 8 bit bus conversion for operations in CPU RAM. (Too fast for existing software ???)

Replacing the VDP processor with a TMS 9228 and building VDP RAM up to 256K. WOW! An 80 column MULTICOLOUR text mode. A bit map mode where every pixel can be any one of 16 colours from a palette of 512 colours. Sixteen sprites in any row.....

Replacing the TMS9900 with a TMS9995 running at 12 MHz. (We've done a ROM & RAM 'BRAIN' exchange, why not a 'HEART' transplant too ???)

This would be tough. The experts say it's IMPOSSIBLE but having acquired a TMS 9995 processor in some recent 'horse trading' we might just be crazy enough to try. After all, the experts didn't tell us we could put 32K of CPU RAM into the console.....

If we ever get this far, Phil will have re-written just about all the TI software and we will change the name of the computer to the 'WESTRALIAN INSTRUMENTS'.

'TURBO WI-99/9 AT+'

IMPORTANT DISCLAIMER.

These articles are written by 'AMATEUR COMPUTER HOBBYISTS'. (Amateurs by our definition are happy souls who learn less and less, about more and more, as distinct from experts, who rarely smile and learn more and more about less and less.)

We cannot guarantee that any modifications or enhancements described will work on YOUR computer.

We develop our projects on old equipment and accept the risk that it may be damaged. If you have never taken your computer apart, handled CMOS chips or used a soldering iron you should NOT attempt any of the projects described (unless you can obtain assistance from someone who has.)

By modifying your equipment you will void any manufacturers' warranties still in force.

```
*************** WARNING ***********
*                                 *
* IF YOU ATTEMPT ANY OF THE       *
* MODIFICATIONS DESCRIBED IN      *
* THIS SERIES OF ARTICLES YOU     *
* DO SO AT YOUR OWN RISK !!!!!    *
*                                 *
***********************************
```

32K MATCHBOX EXPANSION.

Our 32K matchbox expansion works fine with the major software packages. (This article is being written with TI-WRITER using the prototype.)

EXTENDED BASIC, TI-WRITER, TI-MULTIPLAN, TI-LOGO 1 & 2, TI-FORTH, EDITOR ASSEMBLER and the RS232, P.....E, TI-DI.. CONT.. CORCOMP DD DISK CONT. cards, have all been used without any 'APPARENT' problems. However, we pause for another important message :-

```
******* SOFTWARE WARNING *******
*                              *
* Moving CPU RAM into the      *
* computer is a major change   *
* to the TI-99/4A expansion    *
* system and may cause some    *
* software problems. Machine   *
* language programs that use   *
* SPEECH or are dependent on   *
* critical timing, MAY NOT     *
* operate correctly.           *
*                              *
********************************
```

This project should be regarded as a 'BUDGET' MEMORY EXPANSION for the unexpanded TI-99/4A user rather than as a replacement for existing 32k expansion cards'

If you wish to add the 32K expansion but don't have a disk drive or controller, you should also be aware that the extra memory is not fully useable by cassette based users.

For instance, you may only SAVE Extended Basic programs up to 12K in size to cassette, though the programs will have a much larger operating space for arrays etc. (You could for example, read a 12K Text file into a 12K program - If you're the patient type....)

If you have a MINI MEMORY module the project has some interesting potential, using EXPMEM1 and EXPMEM2 and also for Machine Language programs.

Later, using the 'Westralian Instruments' MAXI MEMORY and with a battery backed 32K memory expansion on board, it will be possible to create a TI-BASIC program that utilises a 24K data file located in EXPMEM2 assisted by 8K of M/L routines ('Display At', 'Accept At' etc.) located in the 'MAXI MEMORY'. If the TI-Basic program was less than 8K in size it could be saved in EXPMEM1.

EVERYTHING WOULD BE INSTANTLY AVAILABLE ON POWER UP AND WOULD OPERATE WITH THE ACCESS SPEED OF A RAM DISK!

(Although not documented, it is possible to save programs to EXPMEM1, before doing so, you must CALL LOAD(8192,90,165). EXPMEM1 can also be used for data files by loading similar values to those used for EXPMEM2 into location 0194.)

Whilst pondering these 'fringe' ideas we lept hearing a ghostly chorus crying in the distance.

"TI.....OH....TI.....WHY.....DID ....YOU....DESERT...US....?"

PROTOTYPE.

The project was developed on an old TI-99/4 (without case) and the four RAM chips were ALL 'PIGGY-BACKED' in one 28 pin socket! It was suprisingly easy to do and and took up an

unbelievably small amount of space. Hence the name 'MATCH BOX' expansion.(TI's 32K memory expansion card uses 33 chips.)

To make it more reliable we mounted the four RAM chips in two sockets on a small piece of strip board soldered to the grom extender. This made a tight fit in the space where the speaker used to be in the old TI-99/4 computer.

To allow for future projects we have decided to mount everything on a single piece of STRIPBOARD, 23 cm. wide by 9 cm. deep and up to 2.5 cm. high, which can be mounted on (self adhesive) NON-CONDUCTING stand-offs, on top of the shielding covering the main computer board. (In the empty space between the keyboard and the back of the computer.)

For 'ONE OFF' construction, stripboard is faster to use than printed circuits and cheaper than wire wrap or other connection methods. It is also permanent enough for use, whilst allowing quick alterations if necessary.

Whether you end up with a 'RATS NEST' or a neat job, depends on the care you take. If you work carefully and neatly the whole project can be finished in a few hours. Much less time than it takes to write (or read) this article.

Only a small portion of the board is needed for the 32k expansion and you may find it easier to mount the four RAM chips in separate sockets. This would increase the amount of wiring required but eliminate the tricky PIGGY-BACK soldering.

FIG. 3C.
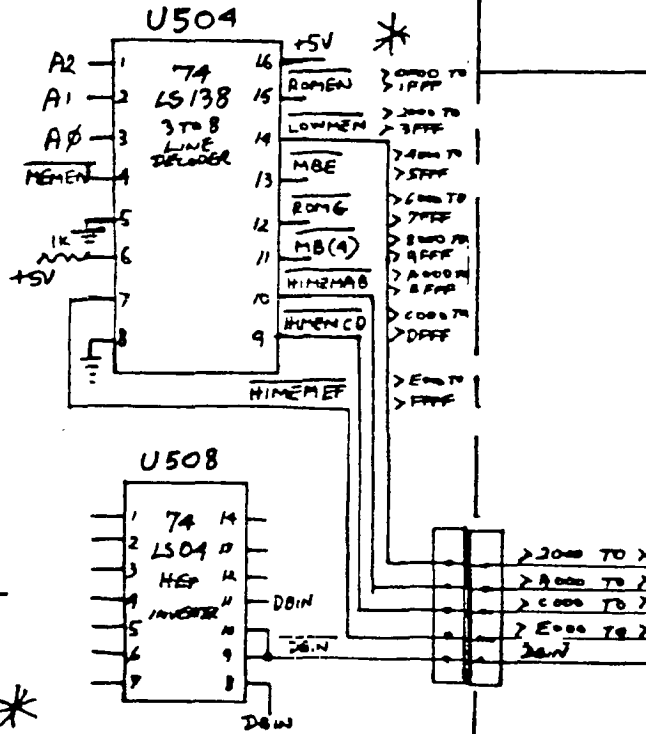
EXISTING TI-99/4(A) "MOTHER BOARD"

ROMEN ENABLES CONSOLE ROM.
ROMG ENABLES MODULE PORT.
MBE ENABLES DSR ROMS
MB(4) ENABLES PAD.

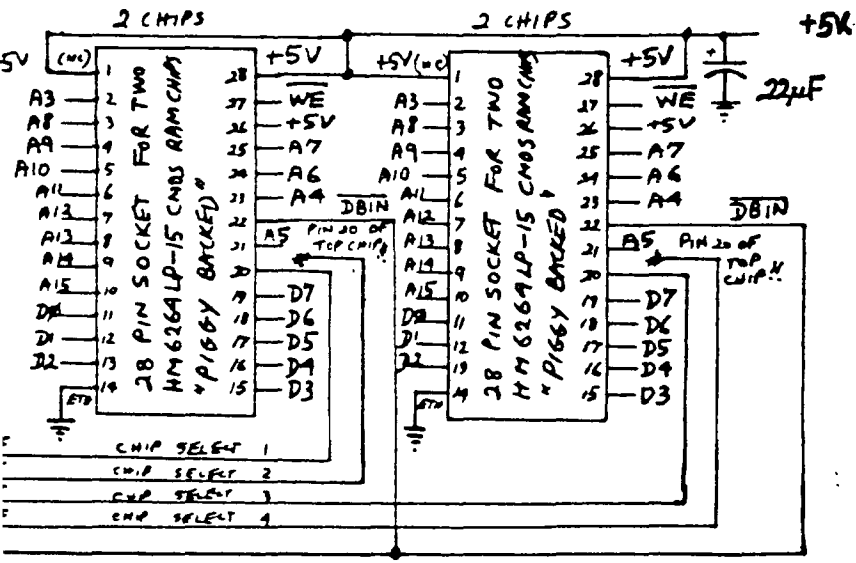| A | RE DRAW SCHEMATIC 25-2-85· |
| B | FORMAL RELEASE |

REVISIONS

D

VIEW OF GROM "EXTENDER" SHOWING PIN NUMBERING
FUNCTION OF THE WIRES REQUIRED BY THE MEMORY CHIPS.

WE	A4	A5	A6	A3	A7	A8	A9	A10	A11	A12	A13	A15			EMT. +2
32	30	28	26	24	22	20	18	16	14	12	10	8	6	4	2
				A14		+5V	DØ	D1	D2	D3	D4	D5	D6	D7	
31	29	27	25	23	21	19	17	15	13	11	9	7	5	3	1

VIEW OF GROM EXTENDER.   A- INDICATES ADDRESS BUS
                          D- INDICATES DATA BUS.

CONNECT THE WIRES MARKED IN HEAVY OUTLINE TO THE
APROPRIATE WIRES OF THE TWO SOCKETS BELOW.

CONNECTIONS
TO REAR OF
GROM EXTENDER
FIG. 3A.

C

32K EXPANSION
FIG. 3B.

2 CHIPS — 28 PIN SOCKET FOR TWO HM 6264 LP-15 CMOS RAM CHIPS "PIGGY BACKED"

+5V (WE) A3 A8 A9 A10 A11 A13 A13 A14 A15 DØ D1 D2   — WE +5V A7 A6 A4 D7 D6 D5 D4 D3

2 CHIPS — 28 PIN SOCKET FOR TWO HM 6264 LP-15 CMOS RAM CHIPS "PIGGY BACKED"

+5V (WE) A3 A8 A9 A10 A11 A13 A13 A14 A15 DØ D1 D2 — WE +5V A7 A6 A4 D7 D6 D5 D4 D3

+5V   22µF

A5 PIN 20 OF TOP CHIP.   DBIN
A5 PIN 20 OF TOP CHIP.   DBIN

CHIP SELECT 1
CHIP SELECT 2
CHIP SELECT 3
CHIP SELECT 4

B

| ITEM NO	PART NO	DESCRIPTION	MATERIAL	REMARKS	
			PHIL WEST	WESTRALIAN INSTRUMENTS	
			BERNIE ELSNER	PROJ-Ø1 TI-99/4 AT	
			T.I.U.P. — W.A.	32K. MATCHBOX EXP.	
	360		21-3-85	D 108539716842 3 OF 3	

A

Contrary to popular belief, I did not take off to discover a new world and I definitely did not fall off the end of world. To prove it, you now have your new issue of the 9T9 newsletter in your hot little hands.

May was a busy month and I would first like to thank George Brown College for lending us their display for the Computer Show and to those selfless volunteers from the club (you know who you are) who gave their all to let Toronto know that the TI is not dead (not by a long shot).

Secondly, June 25th is the last time we meet at Shoreham Public School and we are making arrangements to meet elsewhere. Should anybody know of a meeting place the club can use (cheap!!), please don't hesitate to let the executive know.

To mark the event, so to speak, we are planning a swap meet on June 25th (coffee and donuts supplied), so dig out all of that stuff you don't use any more and bring it to the meeting. The more there is, the merrier it will be.
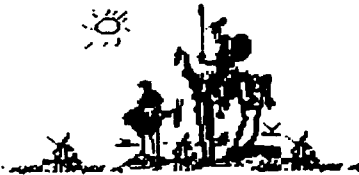
The newsletter this month has taken a bizzare turn. Looking through the stack of material sent to us by other clubs, I noticed an article, originally from Australia, dealing with modifications that should have ben made to the TI before it even left the factory.

I was so enthralled, that I reprinted the complete article in this newsletter. (that is why there are more pages - the article is quite long). My thanks to Northwest Ohio 99'er News for a great idea.

Speaking of freebies, The World's Largest Bookstore gave the club six books FREE at the Computer Show. They all deal with the TI and have been placed in our library. See the librarian about borrowing them.

Running out of stuff, have a good month and Happy Computing...

* * * * * * * * * * * * * * * * *
BOOKS IN THE LIBRARY

James Hunter and Gregory Guntle - TI 99/4A TRIVIA DATA BASE
Timothy Knight and Darren LaBatt - TI 99/4A BASIC PROGRAMS
Gregory Schmalhofer - TI 99/4A CALC
Alvin Schneider - PROFESSIONAL'S GUIDE TO THE TI PROFESSIONAL COMPUTER
Allen Wyatt - BASIC TRICKS FOR THE TI 99/4A
Allen Wyatt - TI 99/4A GAMES

Our thanks to the World's Largest Bookstore for this donation
* * * * * * * * * * * * * * * * *

```
100 ! *********************
110 ! *
120 ! *      LOTTO 649
130 ! *      by Tom Arnold
140 ! *      Hamilton, Ont
150 ! *
160 ! *    Extended Basic
170 ! *********************
180 DIM K(49)
190 RANDOMIZE
200 CALL CLEAR
210 DISPLAY AT(3,10):"LOTTO 6-
220 DISPLAY AT(23,1):"HOW
TICKETS?(6-MAX)"
230 ACCEPT AT(23,26):VALIDA
(DIGIT)BEEP:N
240 FOR M=1 TO N*4 STEP 4
250 GOSUB 340 :: GOSUB 410
260 FOR I=1 TO 12 STEP 2
270 DISPLAY AT(6*I,N+M-5):K(I)
280 NEXT I
290 NEXT M
300 DISPLAY AT(24,1):"ANOTH
CARD? (PRESS Y/N)"
310 CALL KEY(0,KEY,ST) :: IF ST
THEN 310
320 IF KEY=89 OR KEY=121 THEN  2
ELSE CALL CLEAR
330 STOP
340 RESTORE 370 :: FOR I=1 TO 49
350 READ K(I)
360 NEXT I
370 DATA 1,2,3,4,5,6,7,8,9,10,1
12,13,14,15,16,17,18,19
380 DATA 20,21,22,23,24,25,26,
28,29,30,31,32,33,34,35
390 DATA 36,37,38,39,40,41,4
44,45,46,47,48,49
400 RETURN
410 FOR S=1 TO 49
420 A=INT(RND)+1
430 H=K(S)
440 K(S)=K(A)
450 K(A)=H
460 NEXT S
470 RETURN
480 END
```

32K MATCHBOX EXPANSION –

Special Feature

THE TI-99/4 AT

(ADVANCED TECHNOLOGY)

PART 1.

32K OF CMOS RAM
INSIDE THE TI-99/4AT
(The 'MATCHBOX' expansion!)

By Bernie Elsner and Phil West.
TI-99/4AT 'AB-USERS' of PERTH.
WESTERN AUSTRALIA. (T.I.U.P.)

THE 'ISADUDD' CLUB.

Anyone using a computer which has been discontinued by the manufacturer, automatically qualifies for free membership of the rapidly expanding International Society of Amalgamated Dodo Users and Dead Ducks. (ISADUDD's)

TISADUDD's are luckier than most. Despite the 'DODO' image, there are some real advantages in belonging to this group.

New, and sometimes 'PRE-LOVED' hardware and software are often available at bargain (DUMPED) prices.

Initial awe and fear of damaging expensive equipment has disappeared. (Who's afraid of a $49.95 computer ?)

Tons of software, books and technical information are readily available.

Contact with many other users has been established.

Creating useful programs is a lot easier than when you first started.

The 'BANK ACCOUNT' has had a chance to recover some lost condition.

At this stage, like us, you may develop an interest in the computer hardware. How it operates, how to fix some of the things that annoy you and how to provide extra features.

*　　　*　　　*

SUCCESSFUL MODS.

Hardware enhancements that we have added include :-

Installation of a great UTILITY device called 'FINGER PRINT' and the addition of five EXTERNAL dip switches for the TI-(MX 80)- PRINTER. (For changing Baud Rate and 7-8 Data Bits quickly.)

Beefing up the Expansion Box power supply to permit the use of two internal, CHINNON low power, double sided, slimline, disk drives, PLUS, two optional external drives and WITHOUT ANY FAN in ELSNER's 'MEGA-CRAZY' supermod! (Foundation member of 'NOFANS' - The Noise Of Fans is Against Nature Society.)

Installation of a 'GRONOS' load interrupt button. (The MARK 2 'LA-USERS' version.)

Addition of the 'NEW HORIZON'S USERS GROUP' real time (battery backed) clock.

Conversion of a MINI MEMORY to a 'WESTRALIAN INSTRUMENTS' MAXI MEMORY, by replacing the 4K ROM and 4K RAM with an 8K RAM chip. Retaining the MM GROM and battery backup circuit. The ROM data can be restored from cassette with a m-1 routine (or from disk, using a CORCOMP DD disk controller card. (To be featured in Part 2.)

Location of 'CONSOLE ROM' in an 8K (battery backed) RAM CHIP on the 8 bit data bus. Slowed things down by 25% but has some interesting potential.

Expansion of CPU memory with a 'MATCHBOX' 32K CMOS RAM EXPANSION inside the TI-99/4AT. (Described in this article.)

These last three mods were made possible by substantial price reductions of a great memory chip, the :-

HITACHI HM6264LP-15

This is a 28 pin - 8K * 8 bit CMOS RAM chip. A Big brother to the 2K * 8 bit HM6116LP-4 used in the MINI MEMORY.

There are several versions of the chip. The one we used is LP (for Low Power - which is required if you intend to use battery backup) and 15 (for 150 nanoseconds) which is plenty fast enough for ol' TORTOISE-TI....

A year ago, in PERTH, the chip would have cost you $140.00 and two months ago it varied in price from $42.00 to $75.00. It is now available, in sticks of TEN chips from :-

'PROMARK ELECTRONICS'

P.O. Box 381,
CROWS NEST, NSW 2065. or,

P.O. Box 115,
NUNAWADING, VIC 3131.

For $256.00 ($25.60 per chip.) (This includes 20% sales tax and $4.00 for postage!)

The HM6264 chip is just made for the TI-99/4AT hacker. It is STATIC RAM which does not need the complex refresh circuitry etc. of DYNAMIC RAM and the size is just right for the 8K blocks of CPU RAM.

The 'easiest' way to connect to these five lines is to solder wires (with a fine tipped iron) directly on to the pins of the console chips. We know this is crude but it sure is easy!

What else do you expect from a TIN-POT outfit like 'WESTRALIAN INSTRUMENTS' ??? (When the cover is back on, no one will ever know and it will work just fine....)

To make future mods easier, bring all lines through some type of connector. One with as many pins as you can find for future projects. (Sixty wires should be enough....) If you can only obtain smaller connectors, you can use more than one.

Mount the connector at the rear of the STRIP BOARD and use flexible wires or ribbon cable to connect between the grom extender, main computer board and the edge connector. (It is a good idea to anchor them somehow (?) to prevent movement breaking connections.)

FIG. 2 shows where to connect the 5 wires on the TI-99/4AT and FIG. 3A shows the numbering of the pins at the back of the grom extender.

The complete expansion is shown in FIGS. 3A, 3B, 3C and tables A & B list the 29 wires needed to connect the various bus lines to the RAM sockets.

The exact layout to use is up to you. Just keep sockets as compact as possible while still allowing access for connections.

Cut the strip board where necessary to isolate active lines and be as neat as you can with your wiring. (Thin, single conductor wires are easiest to keep neat.)

Although we didn't use one on our prototype (slack) it is probably a good idea to add a 22 uF Tantalum capacitor between +5V and earth, at the sockets, to decouple the power supply.

Don't plug any RAM chips in until everything is completed and checked. Leave connection of the chip select lines (pin 20) for the TOP TWO (piggy-back) chips till last.

TABLE-A.

WIRE NAME AND FUNCTION TI's BUS	PIN NOs. ON REAR OF THE GROM EXTENDER	PIN No. ON BOTH RAM CHIP SOCKETS	WIRE NAME ON HITACHI RAM CHIP
+5 VOLT	19	28, 26, 1	VCC, CS2, NC
⏚ EARTH	2	14	GND
W̄Ē WRITE ENABLE	32	27	W̄Ē
A3	24	2	A12
A4	30	23	A11
A5	28	21	A10
A6	26	24	A9
A7	22	25	A8
A8	20	3	A7
A9	18	4	A6
A10	16	5	A5
A11	14	6	A4
A12	12	7	A3
A13	10	8	A2
A14	23	9	A1
A15	8	10	A0
D0	17	11	I/O1
D1	15	12	I/O2
D2	13	13	I/O3
D3	11	15	I/O4
D4	9	16	I/O5
D5	7	17	I/O6
D6	5	18	I/O7
D7	3	19	I/O8

Note on A3–A15: 13 WIRES OF THE ADDRESS BUS
Note on D0–D7: DATA BUS

TABLE - B.

WIRE NAME + FUNCTION	FROM COMPUTER CHIP NUMBER + PIN No.	TO RAM CHIP No. + PIN No.	WIRE NAME ON HITACHI RAM CHIP
D̄B̄IN DATA BUS IN	U508 / 9 or 10	22 ON ALL	ŌĒ
LOWMEM	U504 / 14	20 ON CHIP 1	C̄S̄1
HIMEMA8	U504 / 10	20 ON CHIP 2	C̄S̄1
HIMEMCD	U504 / 9	20 ON CHIP 3	C̄S̄1
HI MEM EF	U504 / 7	20 ON CHIP 4	CS1

(see notes next page)

NOTES

(1) PIN No.1 ON RAM CHIPS NOT USED (CONNECT TO +5V)

(2) PINS 1, 4, 6, 21, 25, 27, 29, 31 AND 33 TO 36 ON GROM EXTENDER NOT USED HERE.

(3) TEXAS INSTRUMENTS NUMBER THEIR BUS LINES IN REVERSE ORDER TO MOST OTHER MANUFACTURERS!

(4) DBIN IS AVAILABLE ON GROM PIN 25 BUT WOULD NEED TO BE INVERTED TO GET $\overline{DBIN}$

(5) RAM CHIPS ARE 'PIGGY BACKED' IN PAIRS. OR MOUNTED INDIVIDUALLY.

Which chips eventually connect to which chip select lines doesn't matter although it's an idea to use some system so you can fault find if necessary.

When you have connected all the wires except for the two chip select lines mentioned earlier,

```
***********************************
*                                 *
*  CHECK EVERYTHING - TWICE!      *
*                                 *
***********************************
```

Check that every termination is correct and that there are no short circuits between adjacent pins or tracks.

Would you back yourself for $100 not to make at least one mistake in 150 odd connections ???

```
***** ANOTHER WARNING *********
*                             *
* NEVER MAKE ANY CONNECTIONS  *
* OR CHIP CHANGES WITH POWER  *
* CONNECTED TO, OR TURNED ON  *
* AT, THE COMPUTER. ALLOW TIME*
* AFTER SWITCHING THE POWER   *
* OFF FOR ALL CAPACITORS ON   *
* THE POWER LINE TO DISCHARGE. *
*                             *
*******************************
```

DON'T use all four chips at once, just try low memory on its own. If that works Ok you can proceed with the others.
(ONE BLOWN CHIP IS CHEAPER THAN FOUR!)

Various precautions are advised for handling CMOS chips. We've never had problems with static electricity or lost any chips but it is probably a good idea to acquaint yourself of the correct procedures before handling your own chips.

The quickest way to try each 8K block is with 'EASY BUG' in the MINI MEMORY. If you don't have a MM then you can use Extended Basic or Editor Assembler to 'CALL INIT', 'CALL LOAD' and 'CALL PEEK' into each block of memory. If you don't have those, why go on ?

If the first block tests OK, you can 'PIGGY-BACK' the top two chips and connect their CS lines. Carefully bend pin 20 of each upper chip out at right angles and solder the CS line direct to the pin.

Do a minimum of bending to the pins and use as little solder as possible, you might want to use the chips again elsewhere.

As mentioned previously our original protoype had all four chips 'PIGGY-BACKED' in one socket. Initially the chips were NOT SOLDERED, their pins were carefully bent to exert just the right amount of tension to make firm contact with the chip below. They were then carefully aligned and placed on top of each other. Finally the chip select lines were soldered to pin 20 of each chip.

Yes I know, this article gets worse and worse as you go along. Want to buy my 32K card ???

When you have tested all four blocks, carefully solder the 27 pins (not pin 20) of the top chip, to the matching pins of the lower chip of each pair.

This is the most difficult part of the whole job. If possible, practise with some cheaper chips to get the idea. Use a fine tipped soldering iron, take your time and be careful. Shaky hands are out. If you spread solder between adjacent pins use 'solder wick' to remove it.

If any pin fails to make contact with its lower partner or short circuits to a neighbour you will end up with some nasty faults to find...or worse...COOKED CHIPS!

That was added just to get your hands shaking......

POWER CONSUMPTION.

The +5V power supply of OUR TI-99/4 & 4A computers proved to be capable of supplying the extra load of the 32k expansion. If you modify your computer you should verify that YOUR power supply can also support the added load.

CMOS RAM chips mainly use power when they are being 'ACCESSED' or 'CHANGING STATE' therefore only ONE chip at a time, will present any significant load to the power supply.

Data sheets for the HM6264LP RAM chips state that the typical operating current consumption is 60 mA (110 mA MAX.)

Load on the +5V supply varies depending on whether the SPEECH SYNTHESIZER is attached, which module is plugged in, (the Extended Basic module appears to use most power) and which particular function is being performed by the processor.

We measured current drain on the +5V supply with a digital meter to get some idea of the average (NOT PEAK) current consumption and obtained the following results.

Bare Console	925 mA
Extended Basic Module	90 mA
Speech Synthesizer	45 mA
Total	1060 mA

We then measured the 'apparent' extra current used by the 32K memory expansion, whilst using the computer for some typical tasks. (When idle the 32K expansion produced a negligible load of 25 Micro Amps.)

Using Disk Manager	1 to 4 mA
TI-WRITER Loaded, Idle	2 mA
" " " Loading Text	7 mA
" " " Key Pressed	19 mA
" " " Finding Strings	21 mA
Ext.Basic Run Music Prog.	19 mA
M/L Program 'Locked up'	28 mA

At no stage did the measured EXTRA current exceed 30 mA or 3% of the maximum total unexpanded consumption.
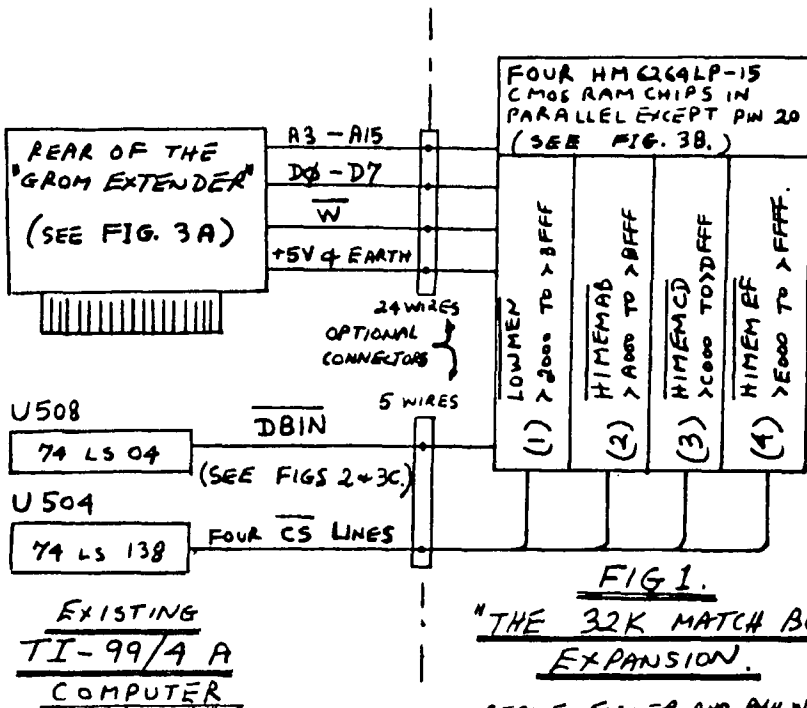
FIG 1.
"THE 32K MATCH BOX"
EXPANSION.

BERNE ELSNER AND PHIL WEST.
'WESTRAUAN INSTRUMENTS!'

FIG.1 shows a simplified block
diagram of the memory expansion.
Thirteen lines of the address
bus (A3 - A15), eight lines
of the data bus (D0 - D7), the
WE line, +5V and Earth, are all
obtained by soldering wires to
the back of the GROM EXTENDER.

(This is the 'GIZMO' that
connects modules to the main
computer board and causes all
those Extended Basic lockups
when not making proper contact.)

Five other lines are obtained
from the TI-99/4AT Mother Board.

Believe it or not, all the
decoding to separate the EIGHT
8K blocks of CPU ram is already
done in the computer! The lines
for the 32K expansion were just
left unused........Sheeeeeeeesh!

Four chip select lines are
required for the blocks :-

LOWMEM	-	>2000 to >3FFF
HIMEMAB	-	>A000 to >BFFF
HIMEMCD	-	>C000 to >DFFF
HIMEMEF	-	>E000 to >FFFF

One other line required is DBIN
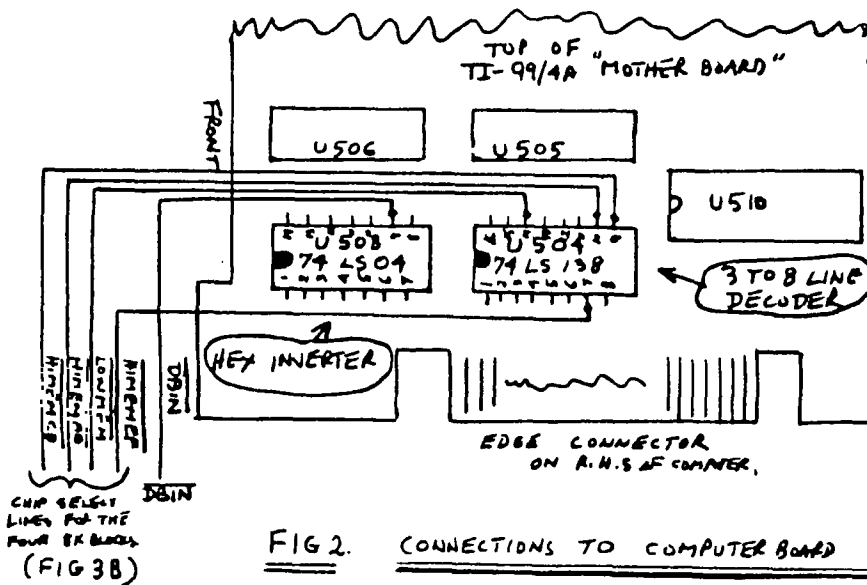(Not DBIN) and this is also
obtained from the main board.

FIG 2.   CONNECTIONS TO COMPUTER BOARD

Whilst these figures are not claimed to be comprehensive or accurate, they indicate that the power supply of the computer should be able to cope with the extra load of the RAM chips for most applications.

In our next article we will provide details of a reliable non-corrupting, self charging battery backup for the full 32k expansion.

CONCLUSION.

We would like to hear from other TI-99/4A users who have created useful mods for their computers and expansion systems or from anyone with ideas for other hardware improvements, in the 'PRACTICAL - TO - CRAZY' range.

In return we will put you on the mailing list for details of our future projects. Write to :-

    'WESTRALIAN INSTRUMENTS.'
     P.O. Box 246, Mt. Lawley,
     WESTERN Australia. 6050.
    (Home of the America's Cup')

TEL.092718642, SOURCE-ID TIO147

This project provided a great deal of enjoyment for the staff at WESTRALIAN INSTRUMENTS and we hope that anyone attempting it will receive the same thrill we did, when we typed 'SIZE' in Extended Basic and received the message :-

13928 Bytes of Stack Free
24488 Bytes Program Space Free

Not to mention the satisfaction from being able to use TI-LOGO with 'JUST' a console, monitor and cassette recorder.

        GOOD LUCK !!!

Bernie Elsner   and   Phil West.

New Members

As of press time, here are the names of new members

Steve Mickelson	15 Kersdale Ave	TORONTO	M6M 1C9
Peter Ungar	1705-24 Eva Rd	ETOBICOKE	M9C 2B2
Allain Rochon	58 Withycombe Cres	SCARBOROUGH	M1V 2J3
Paul Granatstein	2-15 Elway Court	TORONTO	M6B 2N7
Howard Patlik	491 Winnett Ave	TORONTO	M6C 3M6
John C Luxat	505 Roselawn Ave	TORONTO	M5N 1K2
Alexander T Evelyn	1819-4001 Steeles Ave W	DOWNSVIEW	M3N 2T8

As of press time, here are the new User Groups we correspond with

| TINS | 321 Iony Hill | LOWER SACKVILLE | NS | B4E 1M6 |
| Calgary 99'ers | Box 935, Station "T" | CALGARY | | ALTA T2H 2H4 |

We at 9T9 welcome you!!!

* * * * * * * * * * * * * * * * * *
FOR SALE
Consumer Distributing computer table, like new, asking $50.00 or best offer - call Nicos (416) 690-6644.
* * * * * * * * * *
FOR SALE

Shugart single sided disk drive ($125.00), speech synthesizer ($75.00), FORTH ($30.00), Munchman cartridge ($15.00), Parsec cartridge ($15.00) - call Emile (416) 633-1451.

* * * * * * * * * *
WANTED: DEAD OR ALIVE
two RS232C cards, 1 32K card and a modem - call Neil (416) 233-0422
* * * * * * * * * * * * * * * * * *

PROGRAM TIPS

Here is a Call Load for you with XBasic and your Memory Expansion from the Fond du Lac Users Group
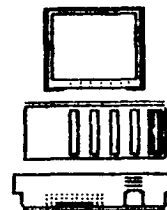
    CALL INIT :: CALL LOAD(-31866,33,0)

Now use the SIZE command and be surprised. You now have roughly 32K of program space. Originally from the Upper Pinellas 99'er Group Newsletter.

** Editor's Note **

I tried it and it works. Whether or not there actually is 32K available I had no time to test it. Will someone out there verify this Call Load and let me know?

TI 99/4(A)

THE SUPER SYSTEM

FROM OUR LIBRARY

Starting in February and hopefully continuing every month, the library committee
has been commissioned to report to the membership on the contents of the disks
in our library. Since we lack the space to give every program on every disk an
indepth description, we will be limited to giving the contents of each disk, but
only describing some of the programs. Also, copies of the described disk will be
available from the librarians in either cassette or disk form during our monthly
meetings. Many thanks to Nicos Evdeman for making this possible.

LIBRARY DISK 99LIBBCA04

Nicos Evdeman

ALIEN	BASIC	DODGEM	BASIC	TRENCH	BASIC
ASTROSTORM	BASIC	IAPETUS	BASIC	WOODS-WALK	BASIC
AWARI	BASIC	ROBOCHASE	BASIC	YATZEE	BASIC
		SPACE-WARP	BASIC		

ALIEN: You are in control of the ground-base laser gun, trying to destroy the
------ attacking Alien spacecraft. Watch out for their lasers, they are deadly
too.

ASTROSTORM: Your space ship has to pass through the asteroid belt three times.
---------- There are ten levels of difficulty and densities.

AWARI: A great ancient African game played with 36 seeds, distributed equally in
------ to 12 pits, 6 for you and 6 for the computer. The seeds are removed along
certain guidelines, which are included. The winner is the one with the most seed
left over. A challenging mind game, you can't do without.

DODGEM: CALL FILES(1) to run. Imagine yourself moving inside a grid, with obsta-
------- cles scattered all around. Try to cover as much area as possible without
hitting an obstacle or your trail. Fun and fast.

IAPETUS: I loaded this one from cassette with the PE Box off and I still got a
-------- memory full message. Where are the debuggers?

TRENCH: Even the programmers call this one an impossible game to win. Your sold-
------- iers have to advance towards the enemy trenches and six out of ten must
make it through the artillery and machine gunfire. My soldiers never made it''

WOODS-WALK: You take yourself for a walk through the magic forest collecting as
---------- many treasures as possible, but don't touch the sleeping animals.
Little kids should have fun with this one.

YATZEE: CALL FILES(1) to run. This is an excellent game of dice and up to four
------- people can play at one time. The computer rolls the dice and keeps track
of all the scores. My family wouldn't be without it.

~~~~~~
** Notice **

As we all know, there are quite a few programs in our library that either lack
proper instructions or need to be debugged. Any member, who debugs a library
program and can supply written documentation for the program (see Programming
Committee for standards), will receive FREE of charge, the contents of any disk
in our library. For all the others, we will print the modifications here so that
you can all change your versions.
                             - the Library