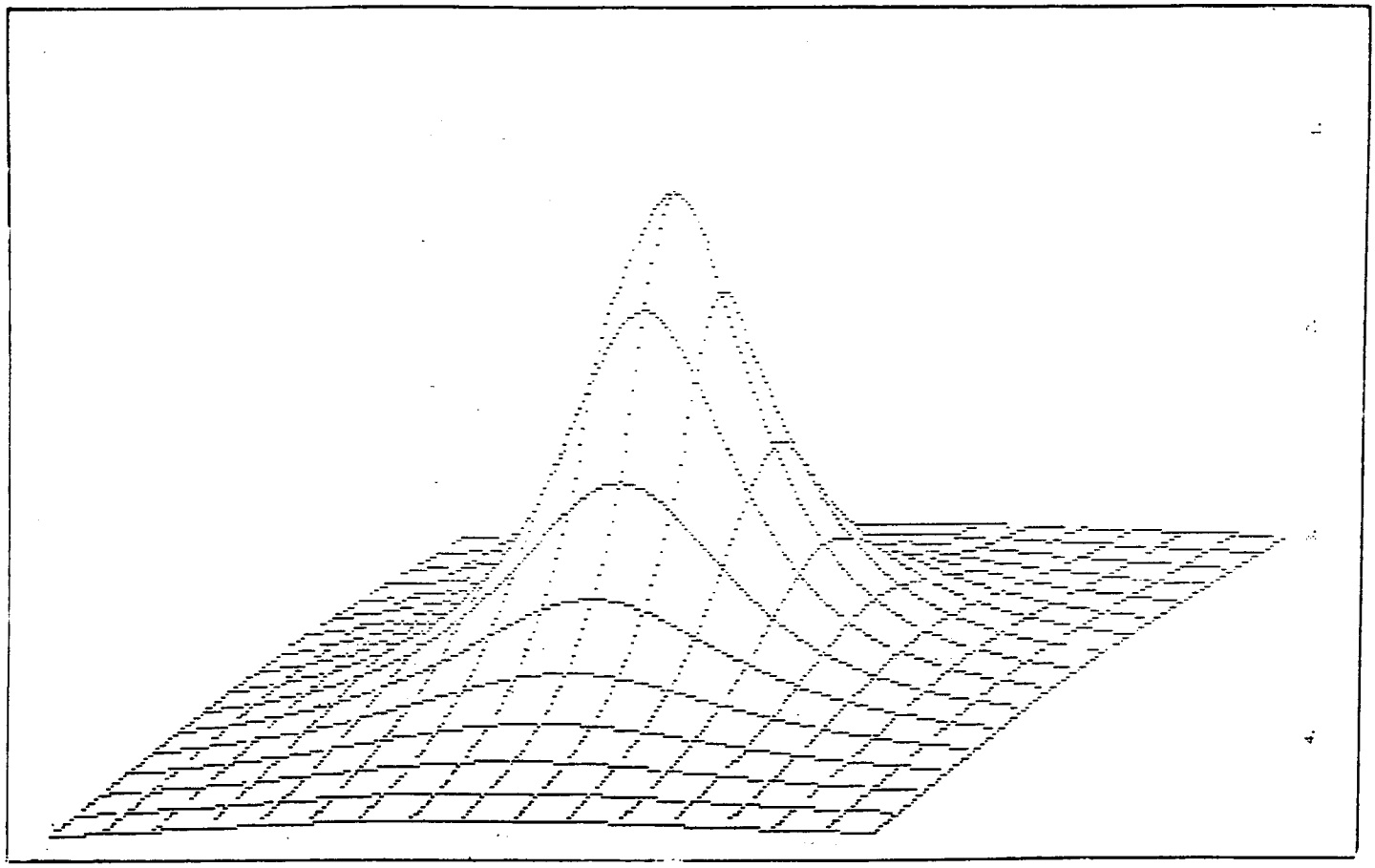
TI PPC NOTES

NEWSLETTER OF THE TI PROGRAMMABLE CALCULATOR CLUB

P.O. Box 1421, Largo, FL 34294

Volume 10, Number 1 First Quarter 1985

Improved Fast Mode High Resolution 3-D Graphics - see page 10.



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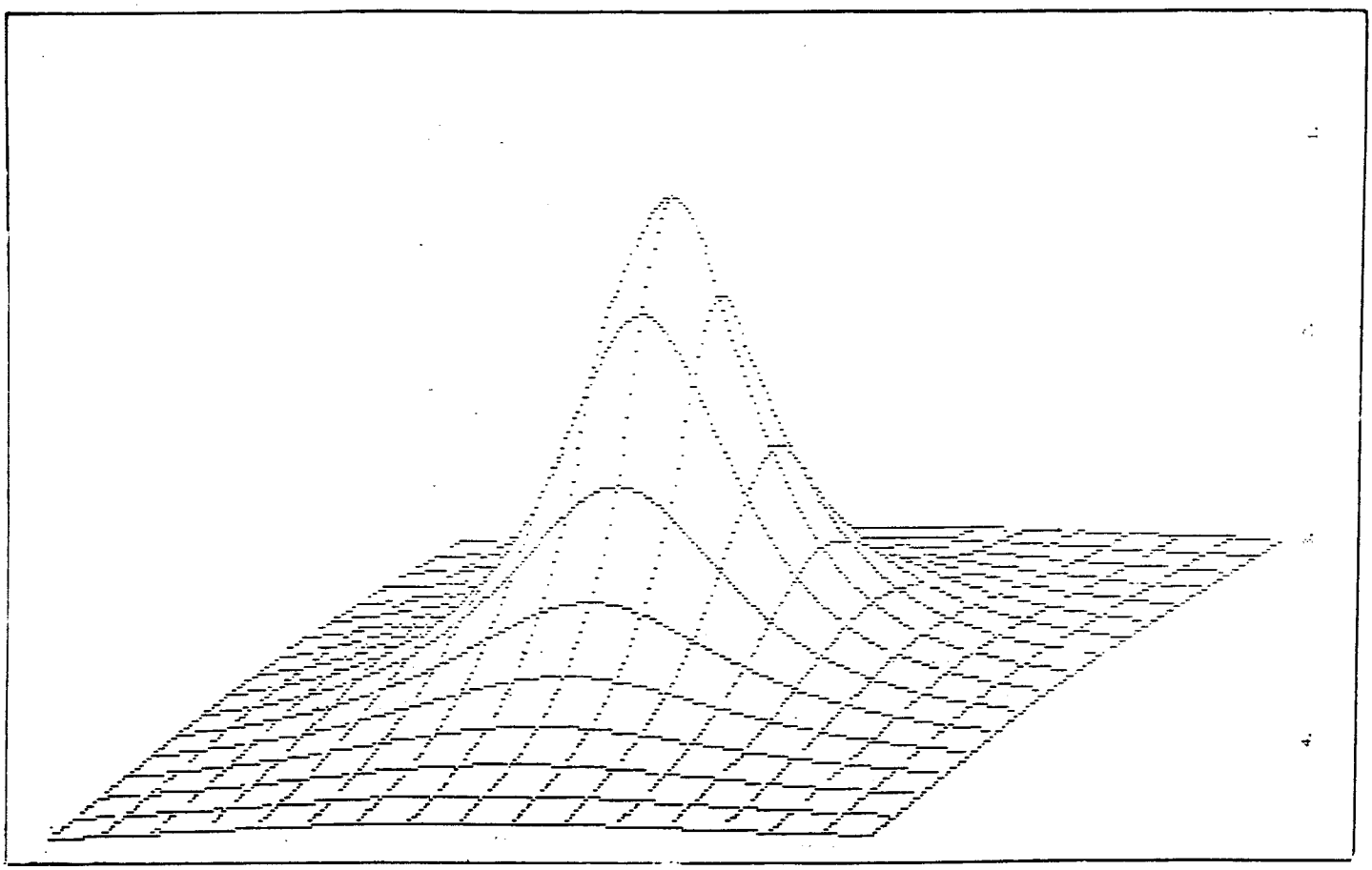


ERRATA:

Modulo 210 Speedy Factor Finder in BASIC - George Thomson observes that the data lists for the CC-40 program on V9N6P4 and the Model 100 program on V9N6P5 are different, when the remainder of the two programs are equivalent. The data list for the CC-40 program is correct. The data list for the Model 100 program became scrambled when the program was pasted up for printing. The first line is correct, but the second and third lines of the data statement must be interchanged.

List is a Valid Label for the TI-66 - Page 11 of the Quick Reference Guide for the TI-66 indicates that List cannot be used as a label. Tests indicate that List is a valid label, which is consistent with page 3-12 of the TI-66 manual.

Systems Analysis Program Availability - V9N6P18 described a pair of systems analysis programs which had been discussed in the January 1985 issue of Microwaves & RF. To obtain copies of the programs readers were asked to send a stamped, self-addressed envelope to the author. The "Feedback" column on page 13 of the March 1983 issue of Microwaves & RF notes that the response from readers was so great that he couldn't keep up with the volume of mail, and apologized for the delay. The author also asked that readers send one dollar, rather than the SASE, as the program would not fit in a letter-size envelope and weighs quite a lot.

KEY BOUNCE ON THE TI-55II, TI-57LCD, and BA-55 - V9N6P2 reported the editor's problems with key bounce on the LCD calculators and asked for help. Laurance Leeds forwarded some foam for replacement of the factory installed foam. That reduced, but did not eliminate, the key bounce. Does anyone else have any ideas. Incidentally, I use my TI-66 many times each day and have yet to experience any keyboard problems with that unit.

ANOTHER SUCCESS FOR THE CCL-144 CLEANING STRIP - A friend at Honeywell where I work reported problems with his TI-59 card reader. He couldn't even enter the calculator diagnostic program provided with the calculator. The use of the CCL-144 cleaning strip eliminated his reading problem. The cleaning strips are still available for two dollars.

ELLIPTIC TRANSFER FUNCTION FOR LOW PASS FILTERS - Maurice Swinnen called my attention to this program which appeared on pages 234 ff of the December 27, 1984 issue of Electronic Design. The article is by David Baez-Lopez and J. Manual Ramirez-Cortes of Puebla, Mexico. Program listings are included.

ML-02 MATRIX INVERSION WITH DOUBLE DIVIDES - Palmer Hanson. V9N2P15 and the following pages discussed the non-commutative multiply quirk with the TI-59, and described a workaround which replaces multiplies with double divides. V9N6P19 presented modifications to downloaded ML-02 routines to include the double divide technique for the solution of simultaneous equations (Modes A through A' of ML-02). An order of magnitude improvement in the results for certain benchmark problems was obtained.

This program extends the double-divide capability to the matrix inversion option of ML-02, the B' and C' modes. In addition to replacement of the multiplies with double divides the B' routine was modified such that the downloaded program would run with partitioning 8-Op-17, thus permitting inversion of matrices up to 8 x 8. The changes included the use of more subroutines (A and E') and replacement of 1 Sum XX and 1 INV Sum XX routines with Op 2x and Op 3x where possible. Note that the A and E' subroutines are not ML-02A and ML-02E'. The ML-02 C' routine is a straightforward downloading of the module routine, with appropriate changes in the direct addresses.

Program Listings:

Program B' - Record it in banks 1 and 2 using partitioning 8-Op-17.

000	69	OP	054	85	+	108	43	RCL	162	43	RCL	216	01	1	270	05	05
001	31	31	055	53	(	109	04	04	163	04	04	217	42	STO	271	43	RCL
002	43	RCL	056	24	CE	110	19	D'	164	19	D'	218	04	04	272	04	04
003	07	07	057	75	-	111	42	STO	165	42	STO	219	43	RCL	273	19	D'
004	22	INV	058	01	1	112	01	01	166	01	01	220	04	04	274	85	+
005	44	SUM	059	54	)	113	75	-	167	85	+	221	42	STO	275	01	1
006	02	02	060	65	×	114	43	RCL	168	43	RCL	222	05	05	276	95	=
007	92	RTN	061	43	RCL	115	03	03	169	03	03	223	19	D'	277	42	STO
008	22	INV	062	07	07	116	42	STO	170	42	STO	224	42	STO	278	03	03
009	97	DSZ	063	85	+	117	05	05	171	05	05	225	03	03	279	43	RCL
010	05	05	064	07	7	118	95	=	172	95	=	226	43	RCL	280	05	05
011	00	00	065	95	=	119	42	STO	173	42	STO	227	05	05	281	19	D'
012	24	24	066	92	RTN	120	02	02	174	02	02	228	19	D'	282	42	STO
013	75	-	067	76	LBL	121	10	E'	175	73	RC*	229	42	STO	283	02	02
014	69	OP	068	10	E'	122	94	+/-	176	02	02	230	01	01	284	43	RCL
015	21	21	069	73	RC*	123	71	SBR	177	94	+/-	231	43	RCL	285	03	03
016	43	RCL	070	01	01	124	00	00	178	71	SBR	232	03	03	286	42	STO
017	07	07	071	55	÷	125	25	25	179	00	00	233	42	STO	287	01	01
018	44	SUM	072	73	RC*	126	95	=	180	08	08	234	02	02	288	11	A
019	02	02	073	02	02	127	55	÷	181	65	×	235	11	A	289	10	E'
020	10	E'	074	35	1/X	128	71	SBR	182	01	1	236	73	RC*	290	94	+/-
021	61	GTO	075	24	CE	129	00	00	183	44	SUM	237	03	03	291	71	SBR
022	00	00	076	92	RTN	130	00	00	184	01	01	238	94	+/-	292	00	00
023	08	08	077	76	LBL	131	73	RC*	185	95	=	239	71	SBR	293	08	08
024	92	RTN	078	17	B'	132	02	02	186	72	ST*	240	00	00	294	95	=
025	22	INV	079	01	1	133	35	1/X	187	01	01	241	08	08	295	94	+/-
026	97	DSZ	080	42	STO	134	24	CE	188	69	OP	242	95	=	296	72	ST*
027	05	05	081	04	04	135	95	=	189	23	23	243	94	+/-	297	03	03
028	00	00	082	43	RCL	136	72	ST*	190	43	RCL	244	72	ST*	298	01	1
029	24	24	083	04	04	137	01	01	191	03	03	245	03	03	299	44	SUM
030	75	-	084	19	D'	138	69	OP	192	32	X:T	246	43	RCL	300	03	03
031	71	SBR	085	95	=	139	23	23	193	43	RCL	247	07	07	301	85	+
032	00	00	086	42	STO	140	43	RCL	194	07	07	248	44	SUM	302	32	X:T
033	00	00	087	01	01	141	04	04	195	75	-	249	03	03	303	95	=
034	10	E'	088	73	RC*	142	32	X:T	196	43	RCL	250	32	X:T	304	42	STO
035	61	GTO	089	01	01	143	43	RCL	197	04	04	251	85	+	305	05	05
036	00	00	090	35	1/X	144	03	03	198	95	=	252	01	1	306	32	X:T
037	25	25	091	72	ST*	145	22	INV	199	77	GE	253	95	=	307	43	RCL
038	76	LBL	092	01	01	146	67	EQ	200	01	01	254	42	STO	308	07	07
039	11	A	093	69	OP	147	01	01	201	62	62	255	05	05	309	77	GE
040	43	RCL	094	24	24	148	08	08	202	01	1	256	32	X:T	310	02	02
041	07	07	095	43	RCL	149	01	1	203	44	SUM	257	77	GE	311	79	79
042	75	-	096	04	04	150	42	STO	204	04	04	258	02	02	312	69	OP
043	43	RCL	097	32	X:T	151	03	03	205	42	STO	259	26	26	313	24	24
044	05	05	098	43	RCL	152	69	OP	206	03	03	260	32	X:T	314	61	GTO
045	85	+	099	07	07	153	34	34	207	43	RCL	261	43	RCL	315	02	02
046	01	1	100	77	GE	154	43	RCL	208	07	07	262	04	04	316	19	19
047	95	=	101	00	00	155	04	04	209	32	X:T	263	67	EQ	317	98	ADV
048	48	EXC	102	82	82	156	32	X:T	210	43	RCL	264	03	03	318	01	1
049	05	05	103	69	OP	157	01	1	211	04	04	265	17	17	319	92	RTN
050	32	X:T	104	34	34	158	22	INV	212	22	INV	266	85	+			
051	92	RTN	105	01	1	159	67	EQ	213	67	EQ	267	01	1			
052	76	LBL	106	42	STO	160	01	01	214	01	01	268	95	=			
053	19	D'	107	03	03	161	08	08	215	62	62	269	42	STO			

ML-02 Matrix Inversion with Double Divides - (cont)

Program C' - Record it in bank 1 using partitioning 8-0p-17.

000	76	LBL	015	85	+	030	00	00	045	65	×	060	73	RC*	075	43	RCL
001	18	C'	016	42	STO	031	40	40	046	43	RCL	061	01	01	076	03	03
002	61	GTO	017	05	05	032	01	1	047	07	07	062	99	PRT	077	95	=
003	00	00	018	33	X²	033	22	INV	048	85	+	063	92	RTN	078	18	C'
004	06	06	019	85	+	034	44	SUM	049	07	7	064	43	RCL	079	61	GTO
005	92	RTN	020	07	7	035	01	01	050	95	=	065	04	04	080	00	00
006	42	STO	021	95	=	036	97	DSZ	051	42	STO	066	32	X:T	081	55	55
007	03	03	022	42	STO	037	05	05	052	01	01	067	43	RCL	082	00	0
008	32	X:T	023	01	01	038	00	00	053	32	X:T	068	07	07	083	00	0
009	43	RCL	024	00	0	039	27	27	054	92	RTN	069	22	INV	084	00	0
010	07	07	025	42	STO	040	43	RCL	055	01	1	070	67	EQ	085	00	0
011	22	INV	026	04	04	041	05	05	056	44	SUM	071	00	00	086	00	0
012	77	GE	027	73	RC*	042	75	-	057	01	01	072	55	55	087	00	0
013	00	00	028	01	01	043	01	1	058	44	SUM	073	01	1	088	00	0
014	05	05	029	67	EQ	044	95	=	059	04	04	074	85	+	089	00	0

Instructions:

All of the instructions for modes A through C, B' and C' on pages 9 through 12 of the Master Library manual apply, except that you must remember to enter the appropriate cards as needed.

1. Set the partitioning to 8-0p-17.
2. Load the two cards for the first part, program ABC from page V9N6P19. If you are a new subscriber for 1985 send a stamped and self-addressed envelope and I will send a copy of the program.
3. Enter the order of the matrix and press A.
4. Enter a "1" and press B. A "1" will be returned to the display. Enter the elements of the matrix column by column, pressing R/S to enter each element. If you are using a PC-100 the input elements will be printed.
5. Press C to find the determinant. The determinant is printed.
6. Loand the two magnetic cards for the next part, program B'.
7. Press CLR and then 2nd-B'. When the inversion has been completed a "1" will be returned to the display.

8.a. If you have the Master Library module installed you do not need to enter the magnetic card for the third part. Rather, you may simply enter a "1" into the display, and press 2nd-Pgm-2-2nd -C'. A "1" is returned to the display. Press R/S as many times as needed to read out the inverse of the input matrix. If a PC-100 is used the elements will be printed.

8.b. If you do not have the Master Library module installed, then load the magnetic card for the last part, program C'. Then proceed as in step 8.a.

The results for some benchmark problems are presented in the following article on comparative matrix inversion routines. The execution time is typically slightly more than twice that you would have if you used ML-02 from the module.

USED HARDWARE - Former member Brent Sampson reports he has a TI-59, PC-100C, three modules, several pakettes, extra magnetic cards, extra paper and complete documentation including PPX, 52 Notes, and TI PPC Notes for sale, preferably as a unit. Call 419-423-9225 or write to 15900 TR-172 R#3, Findlay, Ohio 45840.

A MATRIX INVERSION BENCHMARK - P. Hanson. The paper "Mathematics Written in Sand" by W. Kahan in the 1983 Proceedings of the Statistical Computing Section of the American Statistical Association has been a rich resource for benchmark problems. See V9N2P15 and V9N4P6 for examples. Page 24 of the paper invites the reader to consider the 4x4 matrix A and its inverse:

$$A = \begin{vmatrix} 6 & -1 & -3 & 1 \\ -2 & 0 & 1 & 3 \\ 2 & -1 & 0 & 1 \\ -3 & 2 & -1 & 0 \end{vmatrix} \qquad A^{-1} = \begin{vmatrix} -5 & -6 & 23 & 9 \\ -11 & -13 & 50 & 20 \\ -7 & -8 & 31 & 12 \\ -1 & -1 & 5 & 2 \end{vmatrix}$$

Kahan presents the solution for the inverse from the HP-15C on page 25 of the paper. Those results are reproduced column by column below, together with results from the ML-02 program of the TI-59 Master Library, from the Matrix Inversion routine in the Mathematics module of the CC-40, and from the ML-02 program modified to include the double-divide workaround for the non-commutative multiply on pages 3-4 of this issue. Appropriate readout techniques were used to obtain thirteen significant digits for the TI-59 and CC-40 solutions. Without those techniques, the rounding to the display features of those devices makes it appear that they had all arrived at exact solutions.

Exact	HP-15C	ML-02	CC-40	ML-02 Plus
-5	-5.000000049	-5.000000000099	-4.999999999961	-4.999999999973
-11	-11.00000011	-11.00000000026	-10.99999999992	-10.99999999995
-7	-7.000000067	-7.000000000168	-6.999999999947	-6.999999999973
-1	-1.000000011	-1.000000000030	-0.9999999999925	-0.9999999999955
-6	-6.000000059	-6.000000000122	-5.999999999956	-5.999999999973
-13	-13.00000013	-13.00000000031	-12.99999999991	-12.99999999995
-8	-8.000000080	-8.000000000201	-7.999999999942	-7.999999999973
-1	-1.000000013	-1.000000000035	-0.9999999999917	-0.9999999999955
23	23.00000022	23.00000000044	22.99999999982	22.99999999989
50	50.00000048	50.00000000115	49.99999999962	49.99999999980
31	31.00000030	31.00000000075	30.99999999976	30.99999999988
5	5.000000048	5.000000000130	4.999999999966	4.999999999980
9	9.000000085	9.000000000155	8.999999999930	8.999999999957
20	20.00000019	20.00000000042	19.99999999985	19.99999999993
12	12.00000012	12.00000000027	11.99999999991	11.99999999995
2	2.000000019	2.000000000050	1.999999999987	1.999999999993
Relative error:				
RMS	1.00e-08	2.41e-11	7.49e-12	4.29e-12
Max	1.30e-08	3.50e-11	8.30e-12	5.40e-12
Relative Inaccuracy	2331	5.6	1.7	1

where the relative inaccuracy was determined by the ratio of the RMS of the relative errors for the HP-15C, ML-02, and CC-40 routines to the relative error for the ML-02 Plus routine. For this problem the use of the double-divide technique provides a performance improvement by a factor of over five.

MATRIX INVERSION ON THE CC-40 - Palmer Hanson.

In the discussion of the matrix operations of the CC-40 Mathematics module in V8N5P14 I noted a an important deficiency in running the routines from the keyboard -- the output values are brought to the display in a manner such that the user cannot perform chain calculations on the result without reentering the displayed value. Any digits not displayed are lost. Subsequent pages in V8N5 contained demonstration programs calling the solution for simultaneous equations in the Mathematics module as subroutines from a user program. A note on V8N5P16 explained how to modify the demonstration programs to solve for the inverse of an input matrix. The HX-1000 Printer/ Plotter was not available at the time, so the demonstration programs only provided for return of the solution values to the display.

I wanted to include the CC-40 results in the benchmark matrix inversion exercise on page 5 of this issue. When I used the matrix inversion program from the keyboard with the Printer/Plotter attached I encountered the same situation often encountered with the TI-59. The contamination of the solution due to roundoff errors did not extend into the displayed digits, so the printed solution appeared exact. The printout is at the upper right. I could verify that it was not exact using the techniques on V8N5P16, but I needed a way to print all the digits of the solution. I decided to write a matrix inversion program which would emulate the options of the operation from the keyboard, and which would also make maximum use of the routines from the module. The program listed on page 7 is the result. The printout from the program for the matrix inversion problem on page 5 is at the lower right.

```
MATRICES

0-Menu   1-Add      2-Mult...
3-Det.   4-1/A      5-AX=B...
6-Exit.

*****  Inverse Matrix  *****
Order=  4

A(1,1)= 6
A(1,2)=-1
A(1,3)=-3
A(1,4)= 1
A(2,1)=-2
A(2,2)= 0
A(2,3)= 1
A(2,4)= 3
A(3,1)= 2
A(3,2)=-1
A(3,3)= 0
A(3,4)= 1
A(4,1)=-3
A(4,2)= 2
A(4,3)=-1
A(4,4)= 0

Determinant= 1.

X(1,1)=-5.
X(1,2)=-6.
X(1,3)= 23.
X(1,4)= 9.
X(2,1)=-11.
X(2,2)=-13.
X(2,3)= 50.
X(2,4)= 20.
X(3,1)=-7.
X(3,2)=-8.
X(3,3)= 31.
X(3,4)= 12.
X(4,1)=-1.
X(4,2)=-1.
X(4,3)= 5.
X(4,4)= 2.
```

```
*****  Matrix Inversion  *****
Order =          4
A(1,1)= 6
A(1,2)=-1
A(1,3)=-3
A(1,4)= 1
A(2,1)=-2
A(2,2)= 0
A(2,3)= 1
A(2,4)= 3
A(3,1)= 2
A(3,2)=-1
A(3,3)= 0
A(3,4)= 1
A(4,1)=-3
A(4,2)= 2
A(4,3)=-1
A(4,4)= 0

C(1,1) =  -.4999999999961E+01
C(1,2) =  -.5999999999956E+01
C(1,3) =   .2299999999982E+02
C(1,4) =   .8999999999930E+01
C(2,1) =  -.1099999999992E+02
C(2,2) =  -.1299999999991E+02
C(2,3) =   .4999999999962E+02
C(2,4) =   .1999999999985E+02
C(3,1) =  -.6999999999947E+01
C(3,2) =  -.7999999999942E+01
C(3,3) =   .3099999999976E+02
C(3,4) =   .1199999999991E+02
C(4,1) =  -.9999999999925E+00
C(4,2) =  -.9999999999917E+00
C(4,3) =   .4999999999966E+01
C(4,4) =   .1999999999987E+01
```

Program Description:

The program has a full set of prompts which emulates operation from the keyboard.

Line 105 - The IMAGE statement sets up a nine character string field for annotation of the output, and an exponential field to display thirteen significant digits and the exponent. Line 230 prints the output using the format set by the IMAGE statement.

Line 115 - The UP routine from pages 100-101 of the Mathematics module manual is used to select either the printer or the display for output. For output to the display the routine sets PN = 0. For output to the printer file #1 is opened for the device number entered by the user (10 for the HX-1000) and PN = 1. The value of PN is used as a branching control through the remainder of the program.

Matrix Inversion on the CC-40 (cont)

Line 120 - The WR routine from page 101 of the manual is called to print the message "Matrix Inversion" with five asterisks at either side.

Line 150 - The MI routine from pages 95-96 is used to enter and edit the elements of the input matrix. Prompting is provided exactly like that which is available when running the matrix routines from the keyboard. If PN = 1 the elements are printed with appropriate annotation. Note that the CC-40 accepts the elements row by row, not column by column as with the TI-59.

Line 170 - The MATS routine from page 94 of the manual is used to solve for the inverse. As explained on V8N5P14 the inverse appears in matrix C, properly located for readout in sequence.

Lines 200-250 - These statements control the output of the inverse to either the printer or the display depending on the value of PN. As with the routine when run from the keyboard, the output is row by row. It would have been convenient to be able to use the output routine from the module, but I have not yet been able to identify an appropriate call.

```
100 DIM A(8,8),B(8
),C(8,8)
105 IMAGE ########
# #.##############^
^^^^
110 PRINT "Matrix
Inversion":PAUSE 2
115 CALL UP("MI",P
N)
120 IF PN=1 THEN C
ALL WR("Matrix Inv
ersion",1)
130 INPUT "Enter o
rder of matrix:  "
;N
140 IF PN=1 THEN P
RINT #1,"Order = "
,N
150 CALL MI("A",A(
,),1,N,N,PN)
160 PRINT "Solving
"
170 CALL MATS(A(,)
,C(,),B(),1,1,4,0,
N,0,R)
200 FOR I=1 TO N
210 FOR J=1 TO N
220 A$="C("&STR$(I
)&","&STR$(J)&") =
 "
230 PRINT #PN,USIN
G 105,A$,C(I,J)
240 IF PN=1 THEN 2
50 ELSE PAUSE
250 NEXT J:NEXT I
900 CLOSE #1
999 END
```

A NEW ANOMALY WITH THE CC-40 MATHEMATICS MODULE

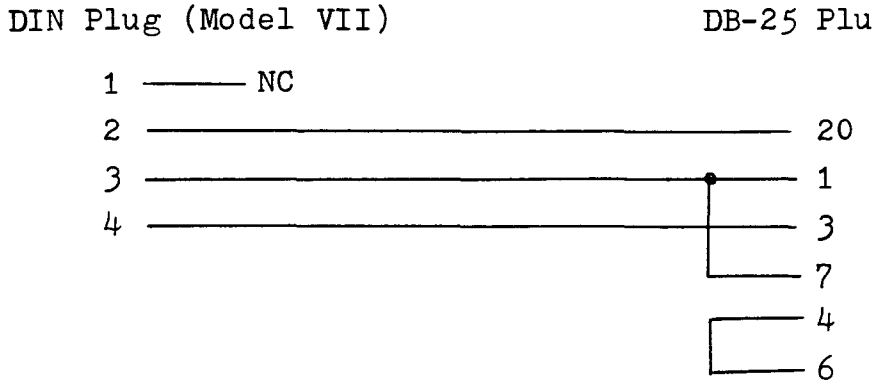
Examine the upper printout on page 6. The determinant for the matrix is shown as positive 1. The determinant output from ML-02 on the TI-59 is negative 1, which agrees with my hand determination of the determinant. So far I have not found another determinant with a wrong sign, but it seems that we must remain unsure about the sign of any output of the determinant from the matrix routines of the CC-40.

BACK ISSUES OF 52-NOTES - Richard Vanderburgh reports that he will continue to provide copies of back issues of 52 Notes at a price of $1.50 each in the US, and $2.00 each abroad. Write to:

Richard Vanderburgh
9459 Taylorsville Road
Huber Heights OH 45424

The issues from Volume 2 Number 6 through Volume 4 Number 3, a total of 22 issues and 130 typewritten pages, are of primary interest to TI-58/59 users. The earlier issues make interesting reading. Some of the anomalies seen with the 58/59 were reported earlier with the SR-52.

LOAN PAYMENT SCHEDULE FOR THE CC-40 - This little BASIC program was originally written by my long time friend Merle Lundeen for the Radio Shack Model III. I had previously modified the program for use with the Radio Shack Model 100. The program on the next page is a conversion for use with the CC-40, the HX-3000 RS-232 peripheral, and the Radio Shack Model VII line printer. With no experience in RS-232 interfacing I tried to use the the connections described on page 2 of the Jan/Feb/Mar 1984 issue of TISOFT for connecting the Radio Shack CGP-115 four color plotter to the TI-99/4A RS-232 output. The manuals for the Model VII and the CGP-115 suggest that their interfaces are similar, but I could not obtain any printing. I then added a jumper between pins 4 and 6 at the output of the HX-3000 and obtained some printing, but there was still a problem. If two PRINT #1 statements occurred too closely together in time then the second statement would not perform properly. After some experimenting I found a workaround (I love workarounds, see V9N2P17 for another). I simply added a delay loop after each PRINT #1 statement. The interconnect cabling between the Model VII and the HX-3000 was:



Program Description:

The program provides a full set of prompts at the CC-40 display.

Line 10 - Assigns a file number for output to the HX-3000, and matches the RS-232 output from the HX-3000 with the input to the Model VII.

Line 11 - Selects double width printing on the Model VII.

Line 12 - Prints the heading in double width letters.

Line 13 - Returns the Model VII to normal printing.

Lines 20-24 - Prompts are provided for the user to enter the principal, the interest, and the number of monthly payments.

Lines 30-34 - Print out of the input data with annotation.

Lines 40-50 - Calculate and print the monthly payment.

Lines 52-72 - Print the table of payments.

Lines 74-80 - Calculate and print the total payments.

Line 90 - The delay loop used to obtain proper printing. The subroutine is called immediately after each PRINT #1 statement; for example, see lines 11 through 13.

Lines 95-98 - IMAGE statements for use with with the PRINT #1 Using statements at lines 30, 50, 80, and 70.

A reduced printout for a sample problem appears on the next page.

Loan Payment Schedule for the CC-40 (cont)

```
10 OPEN #1,"20.8=600,P=N,E=N,S=2,N=99,D=7",OUTPUT
11 PRINT #1,CHR$(31):GOSUB 90
12 PRINT #1,"  ***   LOAN PAYMENT SCHEDULE   ***":GOSUB 90
13 PRINT #1,CHR$(30):GOSUB 90
20 INPUT "Principal ? ";P
22 INPUT "Rate (%) ? ";R
24 INPUT "Number of Months ? ";N
30 PRINT #1,USING 95;P:GOSUB 90
32 PRINT #1,"  RATE (%)            ";R:GOSUB 90
34 PRINT #1,"  TERM (Months)       ";N:GOSUB 90
40 RP=R/1200
42 W=(1+RP)^N
44 M=P*RP*W/(W-1)
46 M=INT(100*M)/100
50 PRINT #1,USING 96;M:GOSUB 90
52 PRINT #1:GOSUB 90
56 PRINT #1,"  PAYMENT         BALANCE         INTEREST         ACCRUED INTEREST"
58 GOSUB 90
60 PRINT #1:GOSUB 90
62 FOR I=1 TO N
64 IN=INT(P*RP*100)/100
66 IS=IS+IN
68 P=P-(M-IN)
70 PRINT #1,USING 98,I,P,IN,IS:GOSUB 90
72 NEXT I
74 TP=M*N+P
76 PRINT #1:GOSUB 90
80 PRINT #1,USING 97,TP:GOSUB 90
85 CLOSE #1:STOP
90 FOR J=1 TO 1000:NEXT J:RETURN
95 IMAGE "  PRINCIPAL       $########.##"
96 IMAGE "  MONTHLY PAYMENT    $#####.##"
97 IMAGE "  TOTAL PAYMENTS      $########.##"
98 IMAGE "    ##         $########.##        $#####.##             $#######.##"
99 END
```

```
   ***      LOAN PAYMENT SCHEDULE      ***

PRINCIPAL       $   1000.00

RATE (%)             12.5

TERM (Months)        18

MONTHLY PAYMENT   $  61.21


PAYMENT         BALANCE         INTEREST         ACCRUED INTEREST

   1         $    949.20       $  10.41          $    10.41
   2         $    897.87       $   9.88          $    20.29
   3         $    846.01       $   9.35          $    29.64
   4         $    793.61       $   8.81          $    38.45
   5         $    740.66       $   8.26          $    46.71
   6         $    687.16       $   7.71          $    54.42
   7         $    633.10       $   7.15          $    61.57
   8         $    578.48       $   6.59          $    68.16
   9         $    523.29       $   6.02          $    74.18
  10         $    467.53       $   5.45          $    79.63
  11         $    411.19       $   4.87          $    84.50
  12         $    354.26       $   4.28          $    88.78
  13         $    296.74       $   3.69          $    92.47
  14         $    238.62       $   3.09          $    95.56
  15         $    179.89       $   2.48          $    98.04
  16         $    120.55       $   1.87          $    99.91
  17         $     60.59       $   1.25          $   101.16
  18         $       .01       $    .63          $   101.79


TOTAL PAYMENTS      $   1101.79
```

IMPROVED FAST MODE HIGH RESOLUTION 3-D GRAPHICS - Robert Prins

V8N2P11 presented Peter Poloczek's fast mode version of Josef Schnieder's high resolution, three dimensional graphics program. V9N5P16 presented a fast mode Plot 60 program by Robert which not only increased the speed of the plot program, but seems to have eliminated the curious little printout (⊤) which detracted from quality of some of the plot programs. This improved version of Peter's program reduces the storage requirement for the second part of the program from three card sides to two, and also seems to have eliminated the undesireable print characteristic. The instructions are similar to those for the V8N2P11 program.

User Instructions:

1. Enter the programs as listed on pages 12 and 13. Save each program using 6-Op-17 partitioning. In the second part of the program (page 13) be sure to use 2nd-CLR to obtain the code 20 at location 019. If you wish you can change the code 56's at locations 158/159 to Nop. The initialization process for the second part pushes those two commands out of memory anyway.

2. Load the first part of the program as on page 12. Press A and the printer will ask for definition of the plotting parameters:

X-MIN	The starting value for X
X-MAX	The final value for X
Y-MIN	The starting value for Y
Y-MAX	The final value for Y
Z-MIN	The range for Z. The scale is not exact.
Z-MAX	
DIF-X	The distance between the X grid lines
DIF-Y	The distance between the Y grid lines
LINES	The number of lines (along the tape)
TAPES	The number of tapes
X-Y-ANGLE	The perspective angle
HIDDEN?	Whether to plot hidden points; 1=no, 0=yes

In response to each prompt the user enters the desired value and presses R/S. The input value is printed, followed by the next prompt. After the HIDDEN? selection is made the program determines the number of function values which must be calculated for the plot, and prints the value following the notation F-VALUES. The larger the value the longer the plot will take.

3. Load the second part of the program as listed on page 13, and proceed to implant the hexadecimal codes for high resolution graphics and fast mode. Press 10 Op 17 CLR GTO 016 Pgm 19 Sbr 045 P/R LRN and see 016 55 in the display. Press Ins and see 016 55 in the display. Press SST sixteen times and see 032 65 in the display. Press Ins LRN RST CLR 6 Op 17. At this point you have altered the program steps from 016 through 159. Steps 016 through 039 have been changed. The commands formerly in 038 through 157 have been pushed down two steps by the two Ins commands in the initialization sequence. The commands which were in locations 158/159 have been pushed out of

Improved Fast Mode High Resolution 3-D Graphics - (cont)

memory. If you list the first 160 steps after initialization after initialization you will get

000	92	RTN	027	01	1	054	43	RCL	081	77	GE	108	01	1	135	65	×
001	76	LBL	028	34	fX	055	07	07	082	01	01	109	54	)	136	53	(
002	11	A	029	33	X²	056	48	EXC	083	27	27	110	65	×	137	94	+/-
003	61	GTO	030	35	1/X	057	08	08	084	53	(	111	43	RCL	138	65	×
004	00	00	031	86	STF	058	42	STO	085	53	(	112	26	26	139	43	RCL
005	40	40	032	12	12	059	10	10	086	32	X:T	113	65	×	140	28	28
006	76	LBL	033	68	NOP	060	98	ADV	087	75	-	114	44	SUM	141	85	+
007	12	B	034	43	RCL	061	97	DSZ	088	32	X:T	115	25	25	142	43	RCL
008	61	GTO	035	19	19	062	09	09	089	54	)	116	43	RCL	143	10	10
009	00	00	036	61	GTO	063	00	00	090	55	÷	117	15	15	144	55	÷
010	18	18	037	00	00	064	40	40	091	32	X:T	118	54	)	145	43	RCL
011	76	LBL	038	66	66	065	92	RTN	092	43	RCL	119	22	INV	146	15	15
012	13	C	039	54	)	066	42	STO	093	15	15	120	44	SUM	147	54	)
013	25	CLR	040	12	B	067	25	25	094	54	)	121	23	23	148	44	SUM
014	69	DP	041	13	C	068	42	STO	095	44	SUM	122	43	RCL	149	27	27
015	05	05	042	97	DSZ	069	27	27	096	27	27	123	17	17	150	43	RCL
		0	043	08	08	070	43	RCL	097	53	(	124	61	GTO	151	22	22
017	92	RTN	044	00	00	071	16	16	098	53	(	125	01	01	152	85	+
018	22	INV	045	40	40	072	42	STO	099	53	(	126	56	56	153	43	RCL
019	58	FIX	046	98	ADV	073	05	05	100	32	X:T	127	53	(	154	16	16
020	60	DEG	047	43	RCL	074	42	STO	101	55	÷	128	32	X:T	155	54	)
021	61	GTO	048	09	09	075	23	23	102	43	RCL	129	55	÷	156	42	STO
022	00	00	049	99	PRT	076	43	RCL	103	24	24	130	43	RCL	157	21	21
023	26	26	050	43	RCL	077	10	10	104	54	)	131	22	22	158	43	RCL
024	54	)	051	13	13	078	32	X:T	105	52	EE	132	54	)	159	10	10
025	00	0	052	44	SUM	079	43	RCL	106	59	INT	133	53	(			
026	93	.	053	12	12	080	18	18	107	85	+	134	59	INT			

where the unusual printout where location 16 should be illustrates the difficulty the printer sometimes has with hexadecimal codes.

4. Enter the function you wish to plot starting at location 435. Your function should bring the value of Z to the display register; then add x≠t RCL 29 GTO 293. The values of X and Y are available from memory registers 38 (x) and 39 (y). Memory registers 31 through 37 may be used as you wish. You can use = in your function. The calculator is in the Degree mode as it calls your function.

5. Press A to start plotting. The program annotates each tape as it is completed.

Sample Plot:

The printouts at the right are the results of the definition of plotting parameters with the first part and the function to be used with the second part to obtain the plot on the cover page.

When entering the plotting parameters you will note that the sequence of entry is not the same as for the program in V8N2P11. Also, Robert has changed all the annotation to English.

Even in fast mode the program is slow. The plot required over 20 hours of calculator run time.

X-MIN	-4.
X-MAX	4.
Y-MIN	-4.
Y-MAX	4.
Z-MIN	0.
Z-MAX	12.
DIF-X	0.5
DIF-Y	0.5
LINES	400.
TAPES	4.
X-Y-ANGLE	60.
HIDDEN?	1.
F-VALUES	27200.

435	01	1
436	02	2
437	55	÷
438	53	(
439	01	1
440	85	+
441	43	RCL
442	38	38
443	33	X²
444	85	+
445	43	RCL
446	39	39
447	33	X²
448	95	=
449	32	X:T
450	43	RCL
451	29	29
452	61	GTO
453	02	02
454	93	93
455	00	0
456	00	0
457	00	0
458	00	0
459	00	0

Improved Fast Mode High Resolution 3-D Graphics - (cont)

First Part Program Listing:

000	76	LBL	060	44	SUM	120	06	6	180	02	2	240	42	STO	300	69	DP
001	10	E'	061	05	05	121	02	2	181	00	0	241	00	00	301	02	02
002	69	DP	062	04	4	122	04	4	182	01	1	242	03	3	302	69	DP
003	01	01	063	05	5	123	02	2	183	03	3	243	04	4	303	05	05
004	69	DP	064	02	2	124	01	1	184	10	E'	244	49	PRD	304	53	(
005	05	05	065	00	0	125	02	2	185	42	STO	245	00	00	305	53	(
006	00	0	066	03	3	126	00	0	186	14	14	246	03	3	306	53	(
007	91	R/S	067	00	0	127	04	4	187	30	SIN	247	04	4	307	32	X:T
008	99	PRT	068	01	1	128	05	5	188	48	EXC	248	08	8	308	65	×
009	92	RTN	069	03	3	129	10	E'	189	14	14	249	44	SUM	309	32	X:T
010	76	LBL	070	04	4	130	42	STO	190	39	COS	250	00	00	310	43	RCL
011	11	A	071	04	4	131	24	24	191	49	PRD	251	43	RCL	311	20	20
012	47	CMS	072	10	E'	132	42	STO	192	24	24	252	18	18	312	54	)
013	69	DP	073	44	SUM	133	26	26	193	22	INV	253	44	SUM	313	65	×
014	00	00	074	05	05	134	02	2	194	49	PRD	254	11	11	314	53	(
015	04	4	075	04	4	135	07	7	195	28	28	255	43	RCL	315	43	RCL
016	04	4	076	06	6	136	02	2	196	53	(	256	11	11	316	18	18
017	02	2	077	02	2	137	04	4	197	42	STO	257	35	1/X	317	55	÷
018	00	0	078	00	0	138	03	3	198	15	15	258	32	X:T	318	43	RCL
019	03	3	079	03	3	139	01	1	199	65	×	259	43	RCL	319	22	22
020	00	0	080	00	0	140	01	1	200	43	RCL	260	07	07	320	85	+
021	02	2	081	02	2	141	07	7	201	05	05	261	22	INV	321	01	1
022	04	4	082	04	4	142	03	3	202	54	)	262	49	PRD	322	54	)
023	03	3	083	03	3	143	06	6	203	42	STO	263	11	11	323	85	+
024	01	1	084	01	1	144	10	E'	204	20	20	264	43	RCL	324	53	(
025	10	E'	085	10	E'	145	42	STO	205	42	STO	265	09	09	325	00	0
026	42	STO	086	42	STO	146	07	07	206	11	11	266	22	INV	326	32	X:T
027	16	16	087	12	12	147	42	STO	207	53	(	267	49	PRD	327	65	×
028	22	INV	088	22	INV	148	08	08	208	43	RCL	268	13	13	328	43	RCL
029	44	SUM	089	44	SUM	149	03	3	209	05	05	269	53	(	329	18	18
030	18	18	090	13	13	150	07	7	210	65	×	270	43	RCL	330	54	)
031	04	4	091	04	4	151	01	1	211	43	RCL	271	14	14	331	65	×
032	04	4	092	06	6	152	03	3	212	14	14	272	65	×	332	53	(
033	02	2	093	02	2	153	03	3	213	54	)	273	43	RCL	333	43	RCL
034	00	0	094	00	0	154	03	3	214	44	SUM	274	19	19	334	05	05
035	03	3	095	03	3	155	01	1	215	13	13	275	54	)	335	55	÷
036	00	0	096	00	0	156	07	7	216	03	3	276	44	SUM	336	43	RCL
037	01	1	097	01	1	157	03	3	217	01	1	277	12	12	337	26	26
038	03	3	098	03	3	158	06	6	218	07	7	278	02	2	338	85	+
039	04	4	099	04	4	159	10	E'	219	01	1	279	01	1	339	01	1
040	04	4	100	04	4	160	42	STO	220	00	0	280	02	2	340	54	)
041	10	E'	101	10	E'	161	09	09	221	00	0	281	00	0	341	54	)
042	42	STO	102	44	SUM	162	03	3	222	00	0	282	04	4	342	65	×
043	17	17	103	13	13	163	01	1	223	00	0	283	02	2	343	43	RCL
044	44	SUM	104	01	1	164	02	2	224	00	0	284	01	1	344	07	07
045	18	18	105	06	6	165	02	2	225	00	0	285	03	3	345	65	×
046	04	4	106	02	2	166	02	2	226	69	DP	286	02	2	346	43	RCL
047	05	5	107	04	4	167	07	7	227	02	02	287	07	7	347	09	09
048	02	2	108	02	2	168	01	1	228	02	2	288	69	DP	348	54	)
049	00	0	109	01	1	169	07	7	229	03	3	289	01	01	349	52	EE
050	03	3	110	02	2	170	00	0	230	02	2	290	04	4	350	22	INV
051	00	0	111	00	0	171	00	0	231	04	4	291	01	1	351	57	ENG
052	02	2	112	04	4	172	69	DP	232	01	1	292	01	1	352	59	INT
053	04	4	113	04	4	173	02	02	233	06	6	293	07	7	353	99	PRT
054	03	3	114	10	E'	174	04	4	234	01	1	294	03	3	354	69	DP
055	01	1	115	42	STO	175	04	4	235	06	6	295	06	6	355	00	00
056	10	E'	116	22	22	176	02	2	236	01	1	296	00	0	356	69	DP
057	42	STO	117	42	STO	177	00	0	237	07	7	297	00	0	357	05	05
058	19	19	118	28	28	178	04	4	238	10	E'	298	00	0	358	92	RTN
059	22	INV	119	01	1	179	05	5	239	94	+/-	299	00	0	359	00	0

LABELS FOR THE TI-66 - Jack Rubin entered Robert Caldwell's Speedy Factor Finder program from V5N9-10P9 into his TI-66. He forced in the sequence GTO LBL at locations 000/001 and LBL LBL at locations 053/054 using edit commands, and found the program would return the Error state when trying to run the program. This confirms that LBL is not a valid label as stated on page 3-12 of the TI-66 manual. Additional experiments show that the merged indirect commands such as GO*, EX*, ST*, etc., can be used as labels. Page 11 of the Quick Reference Guide for the TI-66 has one error -- List can be used as a label.

Improved Fast Mode High Resolution 3-D Graphics - (cont)

Second Part Program Listing (before hex code implanting):

```
000  92 RTN    080  01  01    160  44 SUM    240  02  02    320  86 STF    400  22 INV
001  76 LBL    081  27  27    161  23  23    241  64  64    321  04  04    401  57 ENG
002  11  A     082  53  (     162  32 X:T    242  32 X:T    322  82 HIR    402  82 HIR
003  61 GTO    083  53  (     163  43 RCL    243  42 STO    323  07  07    403  05  05
004  00  00    084  32 X:T    164  20  20    244  39  39    324  82 HIR    404  53  (
005  40  40    085  75  -     165  77  GE    245  43 RCL    325  08  08    405  73 RC*
006  76 LBL    086  32 X:T    166  01  01    246  21  21    326  32 X:T    406  05  05
007  12  B     087  54  )     167  74  74    247  42 STO    327  82 HIR    407  55  ÷
008  61 GTO    088  55  ÷     168  22 INV    248  38  38    328  18  18    408  82 HIR
009  00  00    089  32 X:T    169  44 SUM    249  02  2     329  32 X:T    409  16  16
010  18  18    090  43 RCL    170  05  05    250  05  5     330  77  GE    410  22 INV
011  76 LBL    091  15  15    171  32 X:T    251  05  5     331  03  03    411  28 LOG
012  13  C     092  54  )     172  44 SUM    252  61 GTO    332  46  46    412  33 X²
013  25 CLR    093  44 SUM    173  05  05    253  04  04    333  32 X:T    413  82 HIR
014  69 DP     094  27  27    174  53  (     254  33  33    334  82 HIR    414  45  45
015  05  05    095  53  (     175  53  (     255  43 RCL    335  17  17    415  54  )
016  74 SM*    096  53  (     176  43 RCL    256  22  22    336  22 INV    416  53  (
017  90  90    097  53  (     177  23  23    257  22 INV    337  77  GE    417  22 INV
018  12  B     098  32 X:T    178  75  -     258  44 SUM    338  40 IND    418  59 INT
019  20 CLR    099  55  ÷     179  43 RCL    259  21  21    339  30  30    419  65  ×
020  30 TAN    100  43 RCL    180  05  05    260  43 RCL    340  32 X:T    420  04  4
021  30 TAN    101  24  24    181  54  )     261  28  28    341  82 HIR    421  54  )
022  61 GTO    102  54  )     182  55  ÷     262  44 SUM    342  07  07    422  59 INT
023  54  )     103  52 EE     183  43 RCL    263  27  27    343  61 GTO    423  22 INV
024  00  0     104  59 INT    184  24  24    264  97 DSZ    344  03  03    424  67  EQ
025  93  .     105  85  +     185  85  +     265  06  06    345  48  48    425  40 IND
026  01  1     106  01  1     186  02  2     266  02  02    346  82 HIR    426  30  30
027  34 ΓX     107  54  )     187  54  )     267  10  10    347  08  08    427  82 HIR
028  33 X²     108  65  ×     188  52 EE     268  00  0     348  32 X:T    428  15  15
029  35 1/X    109  43 RCL    189  59 INT    269  48 EXC    349  01  1     429  74 SM*
030  86 STF    110  26  26    190  42 STO    270  01  01    350  32 X:T    430  05  05
031  71  71    111  65  ×     191  06  06    271  69 DP     351  77  GE    431  83 GO*
032  35 1/X    112  44 SUM    192  53  (     272  01  01    352  40 IND    432  30  30
033  54  )     113  25  25    193  53  (     273  00  0     353  30  30    433  42 STO
034  80 GRD    114  43 RCL    194  43 RCL    274  48 EXC    354  29 CP     434  29  29
035  50 I×I    115  15  15    195  21  21    275  02  02    355  22 INV
036  92 RTN    116  54  )     196  75  -     276  69 DP     356  77  GE
037  23 LNX    117  22 INV    197  43 RCL    277  02  02    357  40 IND
038  12  B     118  44 SUM    198  05  05    278  00  0     358  30  30
039  13  C     119  23  23    199  54  )     279  48 EXC    359  53  (
040  97 DSZ    120  43 RCL    200  55  ÷     280  03  03    360  53  (
041  08  08    121  17  17    201  43 RCL    281  69 DP     361  53  (
042  00  00    122  61 GTO    202  22  22    282  03  03    362  52 EE
043  40  40    123  01  01    203  54  )     283  00  0     363  65  ×
044  98 ADV    124  56  56    204  52 EE     284  48 EXC    364  04  4
045  43 RCL    125  53  (     205  22 INV    285  04  04    365  85  +
046  09  09    126  32 X:T    206  57 ENG    286  69 DP     366  01  1
047  99 PRT    127  55  ÷     207  59 INT    287  04  04    367  75  -
048  43 RCL    128  43 RCL    208  44 SUM    288  43 RCL    368  59 INT
049  13  13    129  22  22    209  06  06    289  11  11    369  42 STO
050  44 SUM    130  54  )     210  43 RCL    290  44 SUM    370  05  05
051  12  12    131  53  (     211  27  27    291  10  10    371  54  )
052  43 RCL    132  59 INT    212  32 X:T    292  92 RTN    372  65  ×
053  07  07    133  65  ×     213  43 RCL    293  42 STO    373  05  5
054  48 EXC    134  53  (     214  25  25    294  30  30    374  82 HIR
055  08  08    135  94 +/-    215  77  GE    295  53  (     375  06  06
056  42 STO    136  65  ×     216  02  02    296  53  (     376  94 +/-
057  10  10    137  43 RCL    217  42  42    297  32 X:T    377  75  -
058  98 ADV    138  28  28    218  42 STO    298  85  +     378  59 INT
059  97 DSZ    139  85  +     219  39  39    299  43 RCL    379  82 HIR
060  09  09    140  43 RCL    220  43 RCL    300  39  39    380  36  36
061  00  00    141  10  10    221  23  23    301  65  ×     381  54  )
062  40  40    142  55  ÷     222  42 STO    302  43 RCL    382  65  ×
063  92 RTN    143  43 RCL    223  38  38    303  14  14    383  03  3
064  42 STO    144  15  15    224  02  2     304  75  -     384  54  )
065  25  25    145  54  )     225  03  3     305  43 RCL    385  53  (
066  42 STO    146  44 SUM    226  00  0     306  12  12    386  59 INT
067  27  27    147  27  27    227  61 GTO    307  54  )     387  85  +
068  43 RCL    148  43 RCL    228  04  04    308  55  ÷     388  01  1
069  16  16    149  22  22    229  33  33    309  43 RCL    389  75  -
070  42 STO    150  85  +     230  43 RCL    310  13  13    390  50 I×I
071  05  05    151  43 RCL    231  24  24    311  54  )     391  65  ×
072  42 STO    152  16  16    232  22 INV    312  83 GO*    392  02  2
073  23  23    153  54  )     233  44 SUM    313  00  00    393  01  1
074  43 RCL    154  42 STO    234  23  23    314  22 INV    394  85  +
075  10  10    155  21  21    235  43 RCL    315  87 IFF    395  04  4
076  32 X:T    156  43 RCL    236  26  26    316  04  04    396  07  7
077  43 RCL    157  10  10    237  44 SUM    317  03  03    397  54  )
078  18  18    158  56 DEL    238  25  25    318  26  26    398  52 EE
079  77  GE    159  56 DEL    239  61 GTO    319  22 INV    399  94 +/-
```

FINDING PI WITH RANDOM NUMBERS - Past issues of TI PPC Notes have covered many aspects of pi-finding, ranging from calculating many digits of pi (see V8N1P21 and V8N3P8) to the accuracy of pi returned from the formula 4*ATN(1) in V8N3P25. A. K. Dewdney's column "Computer Recreations" in the April 1985 issue of Scientific American discusses the finding of pi through the use of random numbers. The analogy is to a cannon firing into a square field which includes an inscribed circular pond. If the cannon is fired many times the ratio of the shots landing in the pond to the total number of shots in the field should approach the ratio of the area of the circle to the area of the square, which is pi/4.

Dewdney proposes a simplification for the programmer by considering only one quadrant of the field, and defining each shot by two random numbers constrained to fall between zero and the radius of the circle. In practice it is convenient to use a radius of one. By counting the number of shots which fall in the circle, that is the number of times that the square root of the sum of the squares of the two random numbers is less than one, the programmer can calculate the approximation to pi. The TI-59 program at the right is one solution to the problem which takes advantage of the ML-15 random number generator capability to deliver uniformly distributed random numbers on the interval from 0 to 1 in response to the subroutine call Pgm-15-Sbr-D.MS. To use the program simply enter the number of shots and press A.

```
000  76 LBL
001  11  A
002  47 CMS
003  42 STO
004  02  02
005  99 PRT
006  76 LBL
007  12  B
008  36 PGM
009  15  15
010  71 SBR
011  88 DMS
012  33 X²
013  85  +
014  36 PGM
015  15  15
016  71 SBR
017  88 DMS
018  33 X²
019  95  =
020  34 √X
021  42 STO
022  03  03
023  01  1
024  74 SM*
025  03  03
026  97 DSZ
027  02  02
028  12  B
029  04  4
030  65  ×
031  43 RCL
032  00  00
033  55  ÷
034  53  (
035  43 RCL
036  00  00
037  85  +
038  43 RCL
039  01  01
040  95  =
041  99 PRT
042  98 ADV
043  91 R/S
044  00  0
045  00  0
```

A BASIC program which will perform the same function on the CC-40 is:

```
10  INPUT N
20  FOR I = 1 TO N
30  IF SQR(RND^2 + RND^2) < 1 THEN
    J = J + 1
40  PRINT 4*J/I:PAUSE 1
50  NEXT I
60  PRINT 4*J/N
70  END
```

where line 40 is needed only if you want to watch the convergence, but slows the execution of the program greatly. Similar programs can be written for other computers, where the argument of the SQR function in line 30 must be changed to accomodate the particular computer.

Dewdney asks readers to send the results of 1,000 shots to him. I sent the results for the two programs described on this page, plus solutions for the Radio Shack Model 100 and Radio Shack Color Computer. I also accumulated the results for 10, 000 shots. My results were:

Finding Pi with Random Numbers (cont)

	1,000 shots		10,000 shots	
Model 100	787/1000	3.148	7883/10,000	3.1532
Color Computer	791/1000	3.164	7866/10,000	3.1464
CC-40	777/1000	3.108	7907/10,000	3.1628
TI-59	788/1000	3.152	7925/10,000	3.1700

Readers who obtain results for other machines can forward their answers to A. K. Dewdney, Department of Computer Science, University of Western Ontario, London, Ontario, Canada N6A 5B9.

RESIDENTIAL HEATING AND COOLING

Page 545 of the NASA STAR index for 1983 lists a two volume program description of TI-59 programs for calculating the annual energy requirements for residential heating and cooling. The publications were for the National Bureau of Standards. The abstracts from STAR are at the right.

These documents are available from the National Technical Information Service (NTIS). Volume I is $14.50 in hard copy and $4.50 in microfiche. Volume II is $20.50 in hard copy and $4.50 in microfiche.

If you would like an order form for NTIS send a stamped, self-addressed envelope.

N83-13594# National Bureau of Standards, Washington, D.C.
TI-59 PROGRAM FOR CALCULATING THE ANNUAL ENERGY REQUIREMENTS FOR RESIDENTIAL HEATING AND COOLING. VOLUME 1: USERS MANUAL
F. A. Costello, T. Kusuda, and S. Aso Jul. 1982 132 p 2 Vol.
(Contract DE-AD01-76PR-06010)
(DE82-010174; DOE/NBB-0011-Vol-1) Avail: NTIS HC A07/MF A01

The program documentation and user's manual for the TI-59 pocket calculator program for determining annual heating and cooling energy consumption of residential buildings are given. The program embodies the Variable-Base-Degree-Day Method, which was proven to yield equivalent results as obtained by the comprehensive hour-by-hour simulation calculation, such as DOE-2. Given are step-by-step calculation procedure information on input data, sample calculations, and mathematical basis of the procedure.
DOE

N83-13595# National Bureau of Standards, Washington, D.C.
TI-59 PROGRAM FOR CALCULATING THE ANNUAL ENERGY REQUIREMENTS FOR RESIDENTIAL HEATING AND COOLING. VOLUME 2: PROGRAM REFERENCE MANUAL
T. Kusuda, F. A. Costello, S. T. Liu, and J. P. Barnett Jul. 1982 235 p 2 Vol.
(Contract DE-AI01-76PR-06010)
(DE82-020275; DOE/NBB-0011-Vol-2) Avail: NTIS HC A11/MF A01

Basic mathematical formulation, program listing, and input data for the subject pocket calculator energy analysis procedure are given. The data include solar and surface weather parameters, degree-days to variable bases, sunlit factors and Earth temperature.
DOE

ELECTROSTATIC PRECIPITATION

The 1984 NASA STAR index lists a program for EPA-s electrostatic precipitator (ESP) model for the TI-59. The abstract from STAR appears at the right.

A hard copy is $14.50, and a microfiche copy is $4.50, both available from the National Technical Information Service.

N84-13695# Southern Research Inst., Birmingham, Ala.
MATHEMATICAL MODEL OF ELECTROSTATIC PRECIPITATION FOR THE TEXAS INSTRUMENTS PROGRAMMABLE 59 CALCULATOR Final Report, Jul. - Dec. 1981
M. G. Faulkner and J. R. McDonald Sep. 1983 132 p refs
(Contract EPA-68-02-2683)
(PB83-261669; SORI-EAS-81-232; EPA-600/7-83-050) Avail: NTIS HC A07/MF A01 CSCL 13B

The report describes a version of EPA's electrostatic precipitator (ESP) model suitable for use on a Texas Instruments Programmable 59 (TI-59) hand-held calculator. This version of the model allows the calculation of ESP collection efficiency, including corrections for non-ideal effects and rapping reentrainment in five size bands. Program input data and the individual and total collection efficiencies are printed on a TI Thermal Printer. This model is described in detail, including program steps for its use. This version and the full-scale model are compared. Author (GRA)

1984/1985 FEDERAL INCOME TAX RETURN - V9N4P19 and V9N5P12 presented earlier versions of this program by Hewlett Ladd. This program includes improvements which:

* Permit the program to be used with tax schedules from either 1984 or 1985.
* Provide annotation to indicate which year is being used.
* Print out two decimal places for all outputs.

The use of HIR 08 commands with appropriately scaled constants provides easy annotation of the results while remaining in the FIX 2 output mode (for example, compare steps 061 through 067 of this program with steps 059 through 065 of the program on V9N5P13). The addition of the value 0.5 to the schedule identifier in R00 permits the initialization routine to not only indicate which schedule is being used, but which year is being used. The highest bracket information for the single taxpayer schedule is stored in bank 2 at R74 for 1984, and at R75 for 1985. The appropriate values are transferred to R70 for use by the program as a part of the initialization routine.

Program Listing - Bank 1 and part of Bank 2

```
000  91 R/S    054  43 RCL    108  06  06    162  52 EE     216  43 RCL    270  00  0
001  25 CLR    055  31  31    109  22 INV    163  42 STO    217  37  37    271  00  0
002  43 RCL    056  95  =     110  58 FIX    164  30  30    218  22 INV    272  00  0
003  14  14    057  44 SUM    111  98 ADV    165  43 RCL    219  59 INT    273  00  0
004  59 INT    058  30  30    112  66 PAU    166  31  31    220  65  ×     274  00  0
005  22 INV    059  58 FIX    113  81 RST    167  65  ×     221  01  1     275  00  0
006  77  GE    060  02  02    114  43 RCL    168  43 RCL    222  00  0     276  00  0
007  01  01    061  43 RCL    115  37  37    169  32  32    223  85  +     277  00  0
008  14  14    062  69  69    116  59 INT    170  95  =     224  42 STO    278  00  0
009  01  1     063  82 HIR    117  32 X:T    171  44 SUM    225  72  72    279  00  0
010  42 STO    064  08  08    118  42 STO    172  30  30    226  02  2     280  00  0
011  00  00    065  32 X:T    119  35  35    173  61 GTO    227  01  1     281  00  0
012  73 RC*    066  69 OP     120  06  6     174  00  00    228  02  2     282  00  0
013  00  00    067  06  06    121  03  3     175  59  59    229  01  1     283  00  0
014  59 INT    068  35 1/X    122  22 INV    176  43 RCL    230  01  1     284  00  0
015  77  GE    069  65  ×     123  67  EQ    177  70  70    231  00  0     285  00  0
016  00  00    070  43 RCL    124  01  01    178  42 STO    232  01  1     286  00  0
017  23  23    071  30  30    125  36  36    179  36  36    233  95  =     287  00  0
018  69 OP     072  95  =     126  43 RCL    180  43 RCL    234  69 OP     288  00  0
019  20  20    073  42 STO    127  35  35    181  71  71    235  04  04    289  00  0
020  61 GTO    074  33  33    128  32 X:T    182  42 STO    236  69 OP     290  00  0
021  00  00    075  43 RCL    129  43 RCL    183  32  32    237  05  05    291  00  0
022  12  12    076  68  68    130  70  70    184  61 GTO    238  07  7     292  00  0
023  69 OP     077  82 HIR    131  59 INT    185  01  01    239  00  0     293  00  0
024  30  30    078  08  08    132  22 INV    186  44  44    240  44 SUM    294  00  0
025  73 RC*    079  43 RCL    133  77  GE    187  76 LBL    241  72  72    295  00  0
026  00  00    080  30  30    134  01  01    188  10 E'     242  73 RC*    296  00  0
027  22 INV    081  69 OP     135  76  76    189  08  8     243  72  72    297  00  0
028  59 INT    082  06  06    136  43 RCL    190  69 OP     244  42 STO    298  00  0
029  52 EE     083  43 RCL    137  14  14    191  17  17    245  70  70    299  00  0
030  05  5     084  67  67    138  42 STO    192  73 RC*    246  98 ADV    300  00  0
031  95  =     085  82 HIR    139  36  36    193  00  00    247  60 DEG    301  00  0
032  22 INV    086  08  08    140  43 RCL    194  42 STO    248  91 R/S    302  00  0
033  52 EE     087  43 RCL    141  29  29    195  34  34    249  00  0     303  00  0
034  42 STO    088  32  32    142  42 STO    196  43 RCL    250  00  0     304  00  0
035  30  30    089  65  ×     143  32  32    197  00  00    251  00  0     305  00  0
036  32 X:T    090  01  1     144  43 RCL    198  42 STO    252  00  0     306  00  0
037  75  -     091  00  0     145  35  35    199  37  37    253  00  0     307  00  0
038  32 X:T    092  00  0     146  75  -     200  76 LBL    254  00  0     308  00  0
039  73 RC*    093  95  =     147  32 X:T    201  15  E     255  00  0     309  76 LBL
040  00  00    094  69 OP     148  43 RCL    202  43 RCL    256  00  0     310  11  A
041  59 INT    095  06  06    149  36  36    203  34  34    257  00  0     311  32 X:T
042  95  =     096  43 RCL    150  59 INT    204  69 OP     258  00  0     312  08  8
043  42 STO    097  66  66    151  95  =     205  00  00    259  00  0     313  69 OP
044  31  31    098  82 HIR    152  42 STO    206  69 OP     260  00  0     314  17  17
045  01  1     099  08  08    153  31  31    207  01  01    261  00  0     315  04  4
046  05  5     100  43 RCL    154  43 RCL    208  43 RCL    262  00  0     316  05  5
047  44 SUM    101  33  33    155  36  36    209  64  64    263  00  0     317  30 TAN
048  00  00    102  65  ×     156  22 INV    210  69 OP     264  00  0     318  33 X²
049  73 RC*    103  01  1     157  59 INT    211  02  02    265  00  0     319  86 STF
050  00  00    104  00  0     158  52 EE     212  43 RCL    266  00  0
051  42 STO    105  00  0     159  05  5     213  65  65    267  00  0
052  32  32    106  95  =     160  95  =     214  69 OP     268  00  0
053  65  ×     107  69 OP     161  22 INV    215  03  03    269  00  0
```

1984/1985 Federal Income Tax Return - (cont)

Program Constants - Bank 2

Be sure to note that some of the constants contain more than ten digits; for example, R66 through R69 and R75.

2532242937.	60
2316632336.	61
2863361733.	62
3624292227.	63
37131427.	64
1700000000.	65
1.000013424061	66
1.000037323361	67
1.0000371344	68
1.00003740244	69
0.	70
0.5	71
0.	72
0.	73
81800.28835	74
85130.300091	75
0.	76
0.	77
0.	78
0.	79

Tax Schedules - Bank 4

Joint		Head of Household		Married Filing Separate		Single	
60.5	00	61.5	00	62.5	00	63.5	00
3540.	01	2390.	01	1770.	01	2390.	01
5720.002398	02	4580.002409	02	2860.001199	02	3540.001265	02
7910.005026	03	6760.005025	03	3955.002513	03	4580.002513	03
12390.011298	04	9050.008231	04	6195.005649	04	6760.005565	04
16650.018114	05	12280.013722	05	8325.009057	05	8850.0087	05
21020.02598	06	15610.019716	06	10510.01299	06	11240.012524	06
25600.036056	07	18940.026376	07	12800.018028	07	13430.016466	07
31120.049856	08	24460.039624	08	15560.024928	08	15610.020826	08
36630.065284	09	29970.055052	09	18315.032642	09	18940.028485	09
47670.101718	10	35490.072716	10	23835.050858	10	24460.042837	10
62450.15788	11	46520.111321	11	31225.07894	11	29970.059367	11
89090.269768	12	63070.180831	12	44545.134884	12	35490.078135	12
113860.381233	13	85130.280101	13	56930.1902125	13	43190.107395	13
169020.651517	14	112720.412533	14	84510.3257585	14	57550.167707	14
0.	15	0.	15	0.	15	0.	15
0.11	16	0.11	16	0.11	16	0.11	16
0.12	17	0.12	17	0.12	17	0.12	17
0.15	18	0.14	18	0.14	18	0.14	18
0.16	19	0.17	19	0.16	19	0.15	19
0.18	20	0.18	20	0.18	20	0.16	20
0.22	21	0.2	21	0.22	21	0.18	21
0.25	22	0.24	22	0.25	22	0.2	22
0.28	23	0.28	23	0.28	23	0.23	23
0.33	24	0.32	24	0.33	24	0.26	24
0.38	25	0.35	25	0.38	25	0.3	25
0.42	26	0.42	26	0.42	26	0.34	26
0.45	27	0.45	27	0.45	27	0.38	27
0.49	28	0.48	28	0.49	28	0.42	28
0.5	29	0.5	29	0.5	29	0.48	29

These schedules are for 1985 as extracted from the 1985 Estimated Tax for Individuals (Form 1040-ES). For 1984 use the listings from V9N5P12, but with 0.4 added to each value in R00. New 1985 members can obtain a copy of V9N5P12 by sending a stamped, self-addressed envelope.

Instructions:

1. Set the partitioning to 8 Op 17 and enter banks 1 and 2.

2. Select the bank 4 which corresponds to the schedule to be used. Enter it into bank 4.

3. Initialize by pressing 2nd-E'. A heading will be printed which identifies the schedule and year being used.

1984/1985 Federal Income Tax Return - (cont)

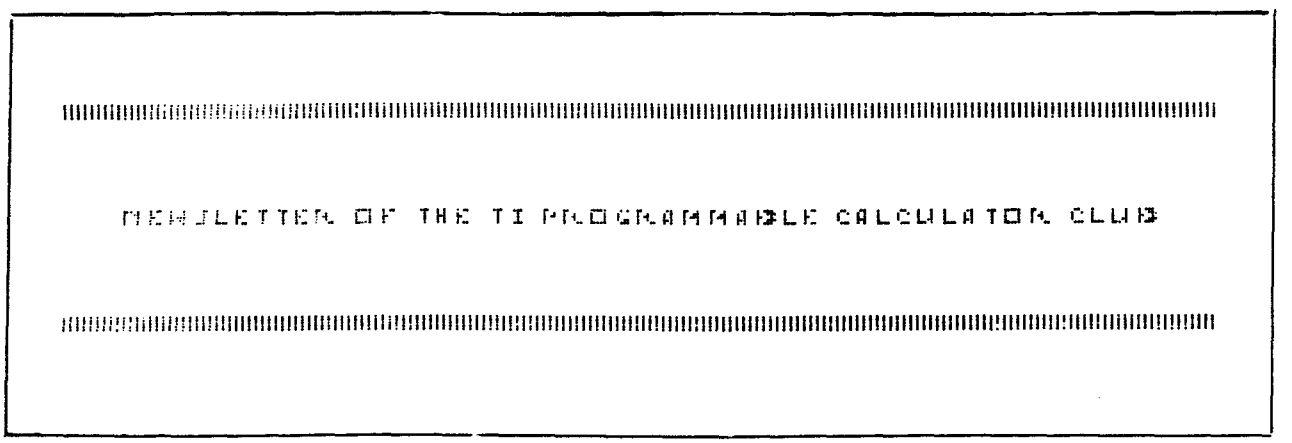
4. Enter the taxable income and press A. See a flashing "1" in the display. Press 7 and then EE and wait for the printout. Repeat as many times as desired for other taxable incomes.

5. To reprint the heading press E. Note: If you press E' a second time the highest two brackets of the single taxpayer schedule will not operate properly, and the year annotation will be incorrect. It will be necessary to reenter the appropriate bank 4 card side and re-initialize, or enter the appropriate constant (60.X through 63.X) for the schedule being used into R00 and re-initialize.

6. To change to another schedule, enter the appropriate bank 4 card side, and re-initialize by pressing 2nd-E'.

Note: The use of the calculations defined in this program are required for taxable incomes over $50,000 . The statutory tables which must be used for taxable incomes under $50,000 are based on the same calculations where the taxable income has been rounded to multiples of $50 . Thus, the results found with this program will not match those in the statutory tables, but should be within a few dollars.

EXTENDED MINI-BANNER - Hewlett Ladd writes: "...I discovered that the program wouldn't print loads beyond R28... ... I hit upon changing locations 049/050 to STO 49 and locations 056/057 to RCL 49 and fould that complete printout was achieved ...". Hewlett then printed out the following mini-banner:



He is continuing to experiment with this new application for high resolution graphics. We will present additional material in coming issues.

ANY TI-88's OUT THERE? - Old-timers will remember that the late issues for 1982 were filled with descriptions of the TI-88, including programs. Maurice Swinnen had an engineering model and was using it to good advantage. I was told that Richard Nelson of the PPC Journal also had a TI-88, and that a few might have been distributed in Europe. Gilbert Farrior would like to obtain a unit if someone has one available. Write to him at 1277 North Warson Road, St. Louis, Missouri 63132.

MORE PPX PROGRAM AVAILABILITY - V9N5P18 set up an informal program exchange to provide members with access to programs which were formerly listed in PPX Exchange. 606 programs were listed at that time. V9N6P3 listed 28 additional programs. 104 additional programs have been made available. The following list shows the newly available programs and includes the 28 programs listed in V9N6P3.

F 038001 - Inventory Report
F 038002 - Store Inventory Computation
9F 038004 - Inventory Control - EOQ
F 038008 - Inventory Tally File
F 058001 - Employees Earnings
F 058002 - Time Card Addition
2AF 058003 - Small Business General Payroll
C 068006 - Standard Queue Model M/M/C
C 068009 - Transit System Modelling
F 098007 - Purchasing - Quantity/Price Break Analysis
C 098012 - Advanced Cash Register
2F 108005 - Small Business Accounting
C 108007 - Straight Line/Declining Balance Depreciation
1F 128001 - Loan Analysis
9F 128011 - Skip Payment/Balloon Payment Loans
F 128026 - ATM Checking Account Random Reconciliation
F 148021 - Consumer Price Index Conversion II
C 148024 - Electric Utility Billing II
G 158004 - PWAC Cost Study
1 178012 - Federal Income Tax
AG 188023 - Market Bearer Stock Selection
CG 198012 - Net Cash Flow and Rate of Return
AG 198071 - Investment Portfolio Optimization
D* 208003 - Simple Regression, 4 variables
9D 208005 - Exponential Smoothing
1D* 208008 - Polynomial Regression (to 7th Power)
D 208011 - Regression Analysis for Four Curve Types
BD* 208013 - Best Fit to Eight Curves
D* 208014 - Testing Large Deviations
D 208015 - Comparison of Regression Lines by Covariance
AD* 208016 - Multiple Regression - 5 Ind. Variables
D* 208017 - Autocorrelation and Multicolinearity
D* 208018 - Prediction, Confidence Intervals, etc.
D* 208021 - Automatic Curve Choice - 6 Curves
8D* 208022 - Multiple Regression with Step-wise Option
D 208023 - Least Squares Parabola y = a + bx + cx^2
D* 208028 - Multiple Linear Regression Models, etc.
D* 208029 - Multiple Regression - 9 Independent Variables
3F* 208050 - Automatic Curve Fit (1 card)
D 218023 - Analysis of Variance of Several Linear Correlations
D* 228007 - Correlation Coefficient Statistics
D 228012 - Statistical Significance of Correlations
D* 228019 - Correlation Matrix - 10 Variables
2D* 258002 - Decision Tree (Probability)
C 268047 - List and Plot Data Distribution
C 308085 - Traveling Salesperson Problem
2F* 328004 - Complete Discrete Fourier Transform (1 card)
F* 368006 - Logarithmic to Linear Scale Conversion (1 card)
C 378001 - Multiple Server Queuing
1 388002 - 4 Variable Optimizing Pattern Search
1D* 398004 - Maxima and Minima

More PPX Program Availability - (cont)

1D* 398010 - Least Mean Square Fit of a Polynomial
G 398019 - Spherical Triangle Solution
G 398025 - Vector Operations
9D* 398055 - 3 Dimensional Coordinate Rotation and Translation
F 398104 - Equation of a Circle
C 398226 - Volume, Area and Circumference
G 398277 - Axis Rotation
1B 398280 - Muller Zeroes of Functions
C 398285 - Coordinate Rotation
8G 408078 - Vector Shorts
D 418002 - Cubic Crystallography
G 588006 - Diet Calculations for Kidney Patients
G 608010 - Rib and Spar Intersection at Datum
G 608020 - Airplane Weight Engineering Program
1G 628001 - Trapezoidal Channel Depth and Velocity
1G 628002 - Four Span Moment Distribution
1G 628003 - Moment of Inertia
E 628013 - Lateral Earth Pressure Coefficients
E 628020 - Moment Distribution for a Variable Number of Spans
G 628044 - Simple Span Beam - Unified Load, etc.
E 628067 - Steel Beam Column Analysis
E 628068 - AISC Allowable Column Loads
E 628069 - Continuous Beam by Three Moment Equation
E 628074 - Pole Embedment per UBC
E 628091 - Truss Design
E 628114 - Foundation Design for Pile Supported Abutment
E 628123 - Frame Analysis - Moment Distribution
E 628133 - Rectangular Biaxial Column
E 628148 - Reactions for Program 628028
G 628156 - Concrete Mix Design - (Absolute Volume)
E 628157 - Finite Beam on an Elastic Foundation
E 628159 - Dynamic Loading - Three Degrees of Freedom
E 628160 - Dynamic Analysis - Three Degrees of Freedom
E 628172 - Determination of Moment of Inertia
E 628174 - Wide Flange Shapes
E 628184 - Concrete Floor on Grade Analysis
E 628187 - AISC Composite Beam
E 628195 - Column Web Stiffeners
E 628200 - Force Distribution to Each Element from Ext Forces
E 628201 - Base Plate Design with Moment and/or Axial Load
E 628207 - Octagonal Foundation Design
E 628209 - Ringwall Foundation Design
E 628211 - Three Pile Group Foundation
E 628214 - Soil Stresses and Settlements
E 628216 - Square/Rectangle Footing Design
E 628218 - Battered Pile Foundations
E 628220 - Friction Pile Design
E 628221 - Horizontal Stress at Y from Surcharge
E 628235 - Anchored Sheet Piling - Free Earth Support
C 628061 - Open Channel Flow
G 638001 - ALC/1 Emulator
G 638002 - ALU Byte Operations
1 638003 - EBCDIC Code Converter
1G 638004 - ASCII Code Converter
1G 638005 - ASCII and EBCDIC Encoder

More PPX Program Availability - (cont)

1	638007	- TMS 9900 Disassembler
4G	638008	- Intel 8080 Disassembler
F*	658014	- Reactance - frequency (1 card)
F	658030	- Distance by Geographic Coordinates
F	658040	- Third Order Intermodulation Products
F*	658041	- T or Delta Attenuation Design (1 card)
F*	658053	- Electronic Conversion (1 card)
F	658095	- Business Band Range
F	658105	- Chebychev Active Lowpass Filter & Pole Locations
F*	658108	- The Compleat Attenuator (2 cards)
2F	658173	- Potentiometer Design
2F	658175	- Bipolar Transistor Design - Current Mode
F	658188	- Log-periodic Dipole Array Design
G	668193	- Fed Std H28 Thread Dimensions
9G	698006	- Axonometric Projection
C	698030	- Fire Sprinkler System Design
C	718003	- Illumination at a Point in Interior Space
C	718006	- Lighting Calculations (Watts/Square Foot Method)
C	718010	- Lighting Calculatons (Zonal Cavity Method)
1F	738005	- Residential Heating Load
C	738015	- Air Conditioning and Heating System
C	738020	- Solar Gain Analysis
G	758005	- BASIC Language
F*	778017	- Field Area Measurement (1 card)
G	778042	- Bearing Rotation
C	778043	- Hasty Survey
F	788031	- Geostationary Satellite Locator
G	798061	- Printing Price "20"
G	798063	- Perspective Drawings of Objects
D	908018	- Universal Plotter
D	908019	- Multiple Plot
D	908038	- Functions on Memory
D	908046	- Slides and Merry-Go-Rounds
C	908047	- Expanded Memory
F	908050	- Store and Recall Programs
D	908054	- Utility Grid
1D*	908056	- Utility Routines IV: Flags
D	908057	- Utility Routines V
D	908059	- Utility Routines VII - Register Consolidation
D	908060	- Utility Routines VIII
2D*	908061	- Program Relocator
D	908064	- Bar Graph Printer
DF	908082	- TI-59 Memory Structure
9D*	908090	- Multiple Strip Print/Plot
D	908095	- Data Register Manipulations
9F*	908132	- Telephone Number - Equivalent Name (2 cards)
F	908134	- Word Processor
F*	908140	- Superplotter (1 card)
C	908150	- Sequential Operations, Data Array
C	908210	- Utility Charges
F	928148	- Plot of F(x,y)
G	938041	- Position from Two VORTACS
F	988013	- Continuous Readout, Real Time Road Rally Ave Speed
F	998028	- Automobile owning/operating costs

More PPX Program Availability - (cont)

Some programs which were previously listed in V9N5P18 with a single source, have been listed again now that an additional source is available.

Code 1 means the programs are available on a loan basis from TI PPC Notes. Send one dollar (two dollars overseas) for each program that you wish to borrow. It is understood that the programs will be returned promptly to be available for other members.

Code C means the programs are available from Robert Ericson, 32 Ferncrest Blvd., North Providence, RI 02911. He will send copies anywhere for four dollars per program.

Code D means the programs are available from Gilbert Farrior, 1277 North Warson Road, St. Louis MO 63132. Code D* means that Mr. Farrior also has the program on magnetic cards. He also has all eleven speciality pakettes. For program documentation send 20 cents per page. If you want magnetic cards, send blank cards and a SASE.

Code E means the programs are available from Nicholas Joseph Manicone, Port Planning/Room 64 South, Port Authority of N.Y. and N.J., 1 World Trade Center, New York City, NY 10048. Send five dollars per program to cover copying and mailing. U.S. only.

Code F means the programs are available from Robert W. Mosely, 107 Hillsboro, Greenfield, TN 38230. 21 cents per page in the US and Canada, 35 cents per page elsewhere. Code F* means that minimally tested magnetic cards are available at one dollar per card.

Code G means the program is available from Michael G. Kelley, 11002 W 21st N, RR #9, Wichita KS 67212. Write for terms.

MORE DOCUMENTS AVAILABLE FROM NTIS - each available for $4.50 microfiche. Logcalc is $11.50 in hard copy; the composite materials formulas is $10.00 in hard copy.

AD-A124 580/2 PC A05/MF A01
Forest Products Lab., Madison, WI.

LOGCALC: A Calculator Program Series to Calculate Log Volume, Lumber Recovery, and Log Scale (for a TI-59 Calculator with Printer),
Philip Steele, Catherine Kubitschek, Daniel Porter, and Richard Selin. Oct 81, 84p

Pocket calculators have become as efficient as early large computers. The newest programmable calculators with storage devices such as magnetic cards or tape are essentially small computers. In terms of software, the analogy between computers and calculators can be carried still further. As in the computer field, there is a general lack of special purpose programs that are well documented and easy to use. The main competitors in the programmable calculator market do offer large numbers of documented program for many applications. The applications that this publication addresses, however, are highly specialized and tailored for use by those interested in sawmilling. This calculator program series is designed to be run on magnetic cards on a TI-59 programmable calculator. The following calculations are made by the program series: Log volume by Smalian's Formula; Lumber Recovery Factor; Overlength on logs; and Log scale and percent overrun for the following log rules: Doyle; International 1/4-Inch; Scribner; Scribner Decimal-C; and Bureau Scribner.

N81-19236/ Air Force Medical Center, Wright-Patterson AFB, Ohio. Mechanics and Surface Interactions Branch.
TI-59 MAGNETIC CARD CALCULATOR SOLUTIONS TO COMPOSITE MATERIALS FORMULAS, REVISION Final Report, Jan. - Dec. 1980
Stephen W. Tsai and Aoki Rodolfo Jan. 1981 75 p
(AF Proj. 2419)
(AD-A095123; AFML-TR-79-4040-REV) Avail: NTIS HC A04/MF A01 CSCL 11/4

This volume contains the description and instructions of magnetic cards for TI-59 programmable calculators. These tapes contain the key calculations of the stiffness and strength of unidirectional and laminated composites. Both in-plane and flexural loadings can be applied. The initial stress and strain due to curing moisture adsorption are also included in the strength calculation. With the aid of the magnetic cards, instant calculations can be made for practical use. The use of cards is also an effective teaching tool. The formulas used in the cards and equation numbers have been derived in a book entitled, Introduction to Composite Materials, co-authored by S. W. Tsai and H. T. Hahn, published by Technomic Publishing Company, Westport, CT, July 1980. This TR a revised edition of the technical report bearing the same number published in April 1979. GRA

ROOTS OF A CUBIC ON THE TI-57 - Ingvar Magnusson, translated by Robert Prins. This program was originally published on page 22 of the 81-2 issue of Programbiten, the Swedish newsletter. It will find all three roots of a cubic equation, even if two of the roots are complex.
For the cubic equation of the form

$$x^3 + Ax^2 + Bx + C = 0$$

the first root is calculated with the method of Newton-Raphson where

$$x_{n+1} = \frac{2x_n^3 + Ax_n^2 - C}{3x_n^2 + 2Ax_n + B}$$

The iteration process is stopped from the keyboard when $x_{n+1} = x_n$.

After finding the first root the cubic is reduced to a quadratic form which is solved by the quadratic formula. The program listing is at the right.

00	32	0		STO 0
01	32	4		STO 4
02	33	1		RCL 1
03	34	4		SUM 4
04	33	4		RCL 4
05	32	5		STO 5
06	34	5		SUM 5
07	32	6		STO 6
08	32	7		STO 7
09	33	0		RCL 0
10	34	4		SUM 4
11	39	4		PRD 4
12	39	4		PRD 4
13	34	5		SUM 5
14	39	5		PRD 5
15	39	6		PRD 6
16	33	2		RCL 2
17	34	5		SUM 5
18	34	6		SUM 6
19	33	3		RCL 3
20	-34	4	INV	SUM 4
21	33	5		RCL 5
22	-39	4	INV	PRD 4
23	02			2
24	84			+/-
25	-39	7	INV	PRD 7
26	33	7		RCL 7
27	32	5		STO 5
28	39	7		PRD 7
29	38	6		EXC 6
30	-34	7	INV	SUM 7
31	00			0
32	-76		INV	GE
33	22			X:T
34	24			Γx
35	34	5		SUM 5
36	-34	6	INV	SUM 6
37	22			X:T
38	40			I×I
39	24			Γx
40	22			X:T
41	33	4		RCL 4
42	36			PAU
43	71			RST

User Instructions:

1. Enter the value A and press STO 1.
2. Enter the value B and press STO 2.
3. Enter the value C and press STO 3.
4. Enter an estimate for the first root and press RST R/S. Magnusson indicates that the root can always be found in the interval (0,k+1) with k = max(A,B,C) and having the opposite sign to that of C.
5. The result of each iteration is displayed using PAUSE. When the displayed result stops changing then press R/S during the pause. The number in the display, which is also in R4, is the first root x_1 .
5. Press RCL 5 to display x_2 , or if the root is complex, the real part of x_2 .
6. Press RCL 6 to display x_3 , or if the root is complex, the real part of x_3 .
7. Press RCL 7 to see a zero if x_2 and x_3 are real, or to see the imaginary part of x_2 and x_3 if they are complex.

Example: For the cubic $x^3 + 6x^2 + {}_{22}x + 6 = 0$, enter 6 and press STO 1, enter 11 and press STO 2, enter 6 and press STO 3, enter -12 and press RST R/S. The value displayed during the pause will stop changing after 11 iterations and 55 seconds. Press R/S during the pause and see -3 in the display. Press RCL 5 and see -1 in the display. Press RCL 6 and see -2 in the display. Press RCL 7 and see zero in the display since all roots of this example are real.

MORE ON RANDOM NUMBERS - In V9N4P11 George Thomson discussed the use of the mean and the standard deviation as measures of the quality of Lem Matteson's random number generator. (There was a misprint in the description of Part II of the routine --there should have been an equal sign between the Lnx and INV). In the article "The Computer Scientist - Random Numbers" in the November 1984 issue of Computers and Electronics author Forrest Mims describes another method of evaluation: if the random numbers are generated over the interval from zero to ten, and are then sorted into ten equal width "bins", then if the numbers are genuinely random the quantity of numbers in each of the ten bins may not be exactly equal to one-tenth of the total quantity sorted, but should be close. Mims provided a sample program in which he generated a random number in the interval zero to one, multiplied it by ten, and used the integer part of the result to increment one of ten variables labeled A through J. His sorting method was lengthy, perhaps because he wanted to define a routine which would work with computers which cannot use subscripts and arrays. Having found the integer between zero and 9, his sorting sequence was of the form:

```
IF X = 0 THEN A = A + 1
IF X = 1 THEN B = B + 1
IF X = 2 THEN C = C + 1
   :      :      :
IF X = 9 THEN J = J + 1
```

Such a routine will perform the required task; but for computers such as the CC-40, the Color Computer, the Radio Shack Model 100, etc., which provide the use of arrays and subscripts, a much shorter routine will accomplish the same task. Having determined the integer X between zero and nine, one simply writes:

```
A(X) = A(X) + 1
```

When the sorting is complete one reads the result by printing the variables A(0) through A(9). For computers such as the Model 100 it is not even necessary to obtain integers in the interval. The subscript which will be used is selected on the basis of the integer part of the variable X with the fractional part discarded. This is similar to the capability of the TI-59 as it was described in V5N9-10P22: " ... in extracting the indirect address from register 9 (or any other register) the calculator ignores the fractional part ...". A TI-59 program for examining the quality of the random numbers generated by the library routine Pgm 15 SBR Dms appears at the right. The use of data registers 30 through 39 avoids conflict with the Pgm 15 SBR Dms routine.

```
000  76 LBL
001  11  A
002  47 CMS
003  42 STO
004  20  20
005  04  4
006  69 OP
007  17  17
008  76 LBL
009  12  B
010  36 PGM
011  15  15
012  71 SBR
013  88 DMS
014  65  ×
015  01  1
016  00  0
017  85  +
018  03  3
019  00  0
020  95  =
021  42 STO
022  21  21
023  01  1
024  74 SM*
025  21  21
026  97 DSZ
027  20  20
028  12  B
029  03  3
030  00  0
031  22 INV
032  90 LST
033  91 R/S
```

This trick of eliminating a programmed integer function and relying on the calculator/computer to perform the integer function as part of the function of determining the subscript or indirect address will not work with the CC-40. Tests show that the CC-40 will interpret the statement A(X) = A(X) + 1 where X is not an integer by selecting the subscript on the basis of X rounded to the nearest integer.

More on Random Numbers - (cont)

Some results from this test for 1000 numbers:

	Pgm15SBRDms	Matteson	CC-40	Model 100
0<X<1	107	104	113	91
1<X<2	90	113	95	106
2<X<3	117	118	75	104
3<X<4	106	90	95	96
4<X<5	110	102	104	103
5<X<6	93	100	98	112
6<X<7	96	87	105	91
7<X<8	97	86	95	102
8<X<9	95	89	112	107
9<X<10	89	111	108	88

where the seed for the Matteson routine was a zero.

MAILBAG - The comments received with the 1985 subscription form show that there continues to be a wide range of opinions as to what should be included in TI PPC Notes. I try to cover subjects for which there is reader response. My intent for 1985 is to continue strong coverage of the TI-59, to provide increased coverage of the CC-40 and the related BASIC language programming, and to cover other programmables in proportion to submitted material. I will also continue to examine benchmark programs for comparing various machines, both those manufactured by TI and those manufactured by others. Some representative reader comments are:

"The Scientific American for December 1982 brought an interesting article by Carl Pomerance, namely "The Search for Prime Numbers", which describes a test, that has radically altered the efficiency of testing the primality of large numbers, but a useable algorithm was not brought. It was mentioned that the principle (called the Adleman-Rumely method) would work with programmable calculators. I would be interested in a TI-59 program based on that method." E.S.

"Thank you for terrific service, articles, and programs." J.E.

"Please offer more mathematical applications for the TI-59; also engineering - aero, astro and mechanical." M.B.

"Tell TI to remake (verbatim) the TI-59 with LCD; not like the TI-66 but like the TI-35 Galaxie. Either that or copy the HP71B with full BASIC and separately full TI-59. That Galaxie is beautiful..." A. L.

"... The future is undoubtedly more and more BASIC oriented--and a good thing too. All the more reason to keep hammering after internal arithmetical accuracy in view of the peculiarities of the many BASIC dialects." G.T.

"The Notes have never been more interesting, particularly the mathematical items." W.V.

"I look forward to continued majority coverage of the TI-59." D.W.

"This will probably be my last year because I am converting my software and system over to an Apple II compatible system." J.T.

"I am interested in expanded coverage of the CC-40, the availability of peripherals, and a means of adapting a tape recorder to the CC-40 to save programs." R.M.

FROM THE EDITOR - Welcome back for the sixth year of our club, and of its newsletter, TI PPC Notes. A review of the comments which accompanied your subscription forms (see the typical responses on page 25) suggests that we are approaching a turning point. Many of our members are converting to computers and have suggested that we provide more emphasis on computers, and particularly on programming languages with emphasis of BASIC. Other members want us to stay with programmable calculators. If you did not make your preferences known with the subscription form, please consider doing so now. My own inclinations are to stay much as we have been, with as balanced as possible a coverage of a wide range of topics, but always including the TI-59 applications. What do we really need to maintain the club--(1) a printer for the TI-66, and (2) a method for saving programs on a magnetic medium for the CC-40. TI now includes a notice with CC-40 material that the Wafertape TM drive will not become available.

For those who would like more computer related coverage of the type that appears in TI PPC Notes I can offer some help. Both TISOFT, the English-language newsletter from Belgium, and Programbiten, the Swedish newsletter, have largely converted to coverage of the TI-99/4. Even so, I have continued the exchange arrangements initiated by Maurice Swinnen and am able to offer back issues for loan. If you would like to examine back issues send a couple of dollars for postage and I will send a representative issue. Programbiten is in Swedish so unless you are conversant in one of the Northern European languages it will not be of much help to you. I have also continued exchange arrangements with Peter Poloczek's German-language newsletter which continues to carry substantial amounts of TI-59 material. Again, I will loan representative copies for the price of some stamps.

It was only a little more than a year ago that the TI-66 became available. Although I would dearly like to have the PC-200 printer I have found that I tend to use the TI-66 more and more in place of my TI-59. The real TI-66 advantages are the LCD display and the relief from battery problems. As noted in several issues last year I have also found that all of the mathematical idiosyncrasies of the TI-59 have been corrected. There is one disconcerting feature of the TI-66. Someone decided to alter the historical assignment of key functions. For example, the Lbl function had always been 2nd-Lbl and the Op function had always been @nd-Op. I long ago lost count of the times I have miskeyed those functions because of the habits developed with the TI-57, TI-58, and TI-59. For the life of me I can't understand why it was necessary to change!

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Magnetic card service will continue to be available for programs published in TI PPC Notes -- One dollar per card plus a stamped and self-addressed envelope.

Single CCL-144 cleaning strips are available to club members for two dollars each.