Texas Instruments

# Programmable Calculator News

Volume 1, Number 1

# Letter From The Editor

Texas Instruments welcomes you to the first edition of Programmable Calculator News. We're excited about advancements like "Menu Windows", redefinable function keys, and BASIC problem-solving power that make this a new era in calculator technology.

Our publication will regularly feature program listings, technical articles, question and answer segments, new product reviews, and user comments. Information on new products will be included in future issues. Though articles in this edition have been contributed by members of our technical staff, we invite your knowledge and experience. Simply address articles, questions, or comments to:

The Editor
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# TI-95 PROCALC™

## A New Standard of Comparison

The thrust of TI-95 PROCALC™ design was to provide as much computing power as possible while improving ease of use by introducing "menu windows" to programmable calculators. Menus of functions are used to avoid difficult-to-remember key sequences and symbol-cluttered keyboards. Extensive prompting in the alphanumeric display guides the user through otherwise complex functions. Messages are also used to provide an explanation when errors occur. These techniques allow state-of-the-art capability to be presented to the user in an easy-to-learn, easy-to-use manner.

## IC Technology

To minimize system complexity, the TI-59 used a custom set of integrated circuits that was designed specifically for calculator computations. Custom calculator chips are still required for complete integration on single chip calculators. However, the increased amounts of memory in the TI-95 made system flexibility and standard memory interface more important design considerations. Because of these factors, the TI-95 uses a TMS-70C46 microprocessor which is a custom version of TI's standard TMS7000 family. Smaller IC geometries were the key to the development of improved architectures, like the TMS70C46, which are more flexible than the TI-59 chip set and also allowed production of ROMs and RAMs with much larger capacities. The switch from PMOS calculator chips in 1977 to CMOS in newer designs has improved battery life enormously in new products.

## RAM Cartridges Replace Magnetic Cards

One of the most difficult aspects of the TI-59 design was to provide a convenient, low-cost method of saving programs and data. The TI-59 solution was a magnetic card reader/writer which could save 480 program steps per card. Magnetic cards were inexpensive and small enough for users to carry their entire library of programs in a pocket. Although this provided a workable solution, the magnetic card mechanism required very careful alignment and testing procedures and was, therefore, difficult to manufacture.

Because of the availability of large static RAMs, the TI-95 is able

### In This Issue:

to offer convenient storage without the need for a magnetic card mechanism. Instead, it has a system for saving programs and data as named files in RAM. Up to 6200 bytes or program steps can be saved in the built-in RAM, and additional capacity is provided by Constant Memory™ Cartridges which offer convenient, removable file storage. These cartridges contain an 8K byte RAM and a lithium battery to maintain data for up to five years when the cartridges are unplugged from the calculator.

The number of programs which can be saved varies with program size. For example, one Constant Memory cartridge can save 8 programs with over 1000 steps each or 40 programs with about 200 program steps each. Since keystroke programs tend to be compact, each cartridge can save many useful programs and associated data. The CI-7™, a cassette interface cable, is also available to save programs and data on an audio cassette recorder.

Programs can be run directly from either the built-in file space or a Constant Memory cartridge. When the Run key is pressed, the user is given the choice of runnng programs from any of the available memory areas. After choosing the cartridge or built-in file area, program names appear in the menu windows and the user pushes one of the function keys to run the desired program. This makes all stored programs easy to access and eliminates the need to download before execution.

## TI-95 PROCALC Features

In addition to providing the scientific functions of the TI-59, the TI-95 adds factorial, hyperbolic trigs, metric conversions, permutations and combinations, roots of cubic and quadratic equations, random-number generation, prime factors, greatest common divisor, and least common multiple. It also adds the capability to convert between number bases and perform calculations in decimal, octal, or hexadecimal.

The TI-95 has extensive alphanumeric capability and easy-to-use keystroke programming functions that allow the user to create his own messages to be displayed. The alpha keys are also used to enter program labels, register names, and file names. To support the use of

| | TI-59 1977 | TI-95 1986 |
|---|---|---|
| **MEMORY:** | | |
| ROM | 6K x 13 bits | 36K x 8 bits |
| ROM Cartridges | 5K bytes | 32K bytes |
| RAM | 1K bytes | 8K bytes |
| Maximum Program Size | 960 steps | 7200 steps |
| Maximum Registers | 100 | 900 |
| Program Storage | Magnetic cards:<br>480 steps/card | Built-in files:<br>6200 steps maximum<br>RAM cartridges:<br>8K steps/cartridge |
| **DISPLAY:** | | |
| Type | 7 segment LED | 5 x 7 Dot-matrix LCD |
| Number of characters | 12 | 31 |
| Special indicators | 0 | 17 |
| **KEYBOARD:** | | |
| Number of keys | 45 | 65 |
| Arrangement | Vertical | Horizontal: QWERTY |
| **FUNCTIONALITY:** | | |
| Number of functions | Over 100 | Over 200 |
| Number of program codes | 100 | 251 |
| Printable characters | 64 | 95 ASCII |
| **SPEED:** | | |
| Bond program benchmark | 38.5 sec | 8.0 sec |
| **BATTERY LIFE:** | | |
| Continuous Execution | 5 hours | Over 100 hours |
| **INTEGRATED CIRCUITS:** | | |
| | 9 PMOS 4 bit | 5 CMOS 8 bit |
| | 1 TMC0501 CPU<br>4 240 byte RAM<br>2 2.5K word ROM<br>1 1K word ROM<br>1 Mag Card Chip | 1 TMS70C46 CPU<br>1 8K byte RAM<br>1 32K byte ROM<br><br>2 Display Drivers |

alphanumeric features, the TI-95 has a large, positive-response keyboard with the alphabet arranged in a typewriter (QWERTY) format.

## Expansion

Application programs are available on 32K byte ROM cartridges—more than six times the size of the application cartridges that were available for the TI-59. Math, Statistics, and Chemical Engineering are the first to be offered, but cartridges covering other subjects are being developed. RAM cartridges are used for saving programs and data. In addition, a general purpose input/output system is built into the TI-95 and an I/O port on the back of the unit is used for attaching peripherals. The peripherals presently available are the CI-7 audio cassette interface and the PC-324™, a 24-column, portable, thermal printer.

## Operation Speed

The TI-95 PROCALC executes similar calculator functions much faster than the TI-59. The benchmark program referred to in Figure 1 calculates the present value of a bond. It is mostly arithmetic execution and the TI-95 completes the evaluation in about one fifth the time taken by the TI-59. In operations that involve mostly data transfers and manipulation, the TI-95 operates about ten times the TI-59 speed.

## Summary

The technology of advanced calculators has changed significantly in recent years. The features that were a triumph for the TI-59 are now easily accomplished. Although the TI-59 was considered the standard for comparison in 1977, the TI-95 PROCALC has more memory, more speed, and about twice as many functions. The challenge today is to present this formidable power to the user in a manner which makes it easy to understand and use. The TI-95 uses an alphanumeric display and menus of functions to accomplish this and, in the process, sets new standards by which advanced scientific programmables will be judged. ■



The previous information, excerpted from an article by Arthur C. Hunter, is reprinted with permission from the July-August Edition of *TI Technical Journal*.

# Introducing the Concept of Menu Functions

by Ash Osmani

The TI-95 PROCALC™ is the first programmable calculator to introduce the concept of "menu windows". Redefinable function keys (F1-F5) select function definitions from five menu windows located below the display line. This allows both experienced and inexperienced users quick access to any desired program location.

## System Menu Functions

The system functions have been organized by menus. To select a function, depress one of 9 menu keys, such as "CONV", then use F1-F5 to choose the desired function. Functions can be accessed quickly since menu organization allows a maximum of 2-levels in selection.

## Creating Custom Menus

Display Windows and Function Keys can be used to create custom menu functions. Menu windows allow the user to select any desired program from user memory, built-in file, or application cartridge. Stored programs are easy to access and the need to download before execution is eliminated.

Table 1 shows an example program that creates a menu to determine the nature of the number in display, odd or even (O/E), the number of digits in display (DIG), and the sum of digits in display (SUM). The program has been designed so that each function key (F1-F3) transfers control to a specific program segment which computes one of the above functions. After computations, a return (RTN) is used to transfer control back to the main menu. The menu window corresponding to F5 has been used for escape (ESC) to clear the display and menu windows.

Figure 1 illustrates our created menu. Two keystrokes, RUN and PGM, activate the program. The menu windows have been defined using the DFN function (see Table 1). The DFN function is used to label keys F1, F2, F3, & F5 using display windows and defines the program labels AA, AD, AG, and AJ. The DFN function can be used repeatedly in any program to update definitions of the functions as choices are selected. User-defined menus of custom functions can, therefore, be created even in problems requiring multiple menus.

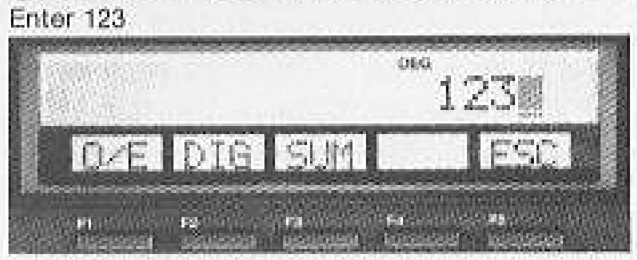
The number 123 has been used as an input (Figure 1B). Output display of computations is shown in Figure 1 (C, D, E, & F). Please note: the program accepts only positive integers. Any other will result in the error message "INVALID NUMBER".

```
0000 LBL AC CE 'EXAMPLE'
0011 ' PROGRAM' DFN CLR
0021 DFN F1:O/E@AA
0028 DFN F2:DIG@AD
0035 DFN F3:SUM@AG
0042 DFN F5:ESC@AJ RTN
0050 LBL AA SBL AK TF 00
0058 RTN (( STO B /2)
0066 INT *2) IF= B
0072 GTL AB CE 'ODD NUM'
0083 'BER' RTN
0087 LBL AB CE 'EVEN NU'
0098 'MBER' RTN
0103 LBL AD SBL AK TF 00
0111 RTN x~t 0 STO B 1
0117 STO X x~t
0120 LBL AE (/10)INT
0129 IF= B GTL AF INC X
0136 GTL AE
0139 LBL AF RCL X COL 06
0146 MRG X COL 06 ' DIG'
0154 'ITS' RTN
0158 LBL AG SBL AK TF 00
0166 RTN x~t 0 STO B
0171 STO C x~t
0174 LBL AH (/10)STO A
0184 ( FRC *10) ST+ C
0192 RCL A INT IF= B
0197 GTL AI GTL AH
```

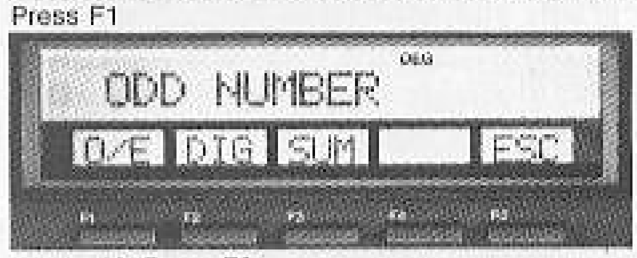
```
0203 LBL AI CE ' SUM='
0212 COL 14 MRG C COL 14
0218 RTN
0219 LBL AJ DFN CLR 0
0225 RTN
0226 LBL AK RF 00 STO B
0233 ABS INT INV IF= B
0238 GTL AL 0 IF= B
0244 GTL AL RCL B RTN
0250 LBL AL 'INVALID NU'
0263 'MBER' SF 00 RTN
```

Press RUN, PGM


Enter 123



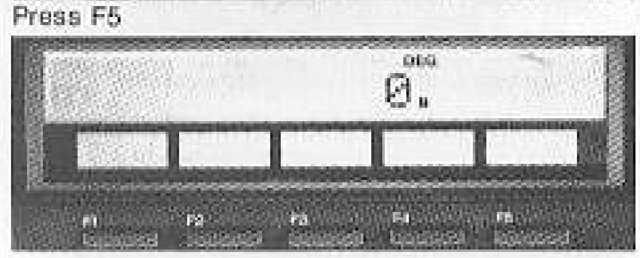

Press F1




Enter 123, Press F2


Enter 123, Press F3


Press F5




■

# Indirect Addressing

By Rena Gillis

Indirect addressing can be very useful when you are going to have a number of entries and wish to store each entry in the calculator for future calculation. In the following example, indirect addressing is used to store and then subsequently recall as many entries as the unit is partitioned to accept. If addressed directly, the program would become uncommonly bulky and complicated, making it difficult to store as well as run.

Indirect addressing uses one memory register as a "pointer" which directs any subsequent data to be stored or recalled to the memory address contained in this register. This number can be incremented or decremented by the program. In this program, a number 11 is stored in our "pointer" register (I) at the beginning. At LBL CC we see this same register being incremented by 1, bringing its total to 12. The amount paid for this first transaction is then stored in register 12. We see register I being incremented again by 1. The grain weight is recalled and then stored in register 13 as directed by our "pointer" register. Later in the program, at LBL TA, indirect addressing is used to print out a tally of the daily grain receipts and cash outflows.

AAA Grain Mills, Inc. receives several truck loads of grain per day from area farmers during the harvest season. After weighing the full vehicles, the load is emptied, the grain evaluated for grade, and the vehicle reweighed. The following program calculates the weight of the grain and amount due to the carrier then stores the data for later retrieval when it gives the day's total receipts.

This program allows a daily change of price per cwt. (hundredweight) for two different grades. At the end of the day, the operator needs only to hit "TOT" and the calculator will give a grand total of all grain received and monies paid out with a listing of each individual transaction. Each time the program is run, all memories are cleared, therefore, no data from the previous run will be retained. If a full weight is less than an empty weight, an error message will be displayed and the calculator will ask you to re-enter that particular transaction.

Example:

Grade A is selling at $2.87/cwt.
Grade B is selling at $2.65/cwt.

| Full Wt. | Empty Wt. | Grade |
|---|---|---|
| 5,283 | 3,532 | A |
| 11,263 | 6,453 | A |
| 12,422 | 6,250 | B |
| 10,890 | 5,750 | A |

```
0000 'DLY GRAIN REC"TS'
0016 PAU FIX 2 CMS 11
0022 STO I 'ENT GRADE A'
0035 '$' BRK /100=STO A
0044 'ENT GRADE B$' BRK
0057 /100=STO B
0064 LBL MI CLR 'ENT FU'
0074 'LL WT'
0079 DFN F1:ENT@CL
0086 DFN F5:TOT@TL HLT
0094 LBL ER 'ERROR' PAU
0103 CLR 'RE-ENTER FIGU'
0117 'RES' PAU CLR
0122 GTL MI
0125 LBL CL PRT STO C
0131 CLR 'ENT EMPTY WT'
0144 BRK PRT STO D CLR
0149 RCL C - RCL D =
0155 STO E PRT IF< K
0160 GTL ER ST+ F CLR
0166 'GRADE?' DFN CLR
0174 DFN F1: A @CA
0181 DFN F5: B @CB HLT
0189 LBL CA RCL E *
0195 RCL A = GTL CC
0201 LBL CB RCL E *
0207 RCL B =
0210 LBL CC STO G ST+ H
0217 PRT INC I STO IND I
0223 INC I RCL E
0227 STO IND I ADV
0231 GTL MI
0234 LBL TL ADV CLR '# '
0241 'GRAIN' PRT RCL F
0249 PRT ADV '$ PAID OU'
0260 'T' PRT RCL H PRT
0265 ADV 1 STO J 12
0271 STO I
0273 LBL TA RCL J PRT
0279 RCL IND I IF= K
0284 GTL TB PRT INC I
0290 RCL IND I PRT ADV
0295 INC I INC J GTL TA
0302 LBL TB 'END' PRT
0309 ADV HLT
```

■


# TI-74 BASICALC™

The TI-74 BASICALC™, designed for students, engineers, and scientists, combines advanced BASIC language programmability and scientific calculator functions in a battery operated portable unit with system expansion capability.

## BASIC Programmability

The BASIC mode provides access to a full featured, high level programming language. BASIC on the TI-74 has been implemented in close compliance with ANSI minimal standards for BASIC language computers. This means that the TI-74's BASIC language is similar to the BASIC language implementations on larger computers rather than the reduced capabilities which are usually associated with calculator-type BASIC machines. For example, many BASIC programs written for the TI 990 mini-computer will run on the TI-74 with few or no modifications.

In addition to being designed with ANSI standards in mind, many enhancements have also been specifically included for use on a portable calculator. Numeric or

BASIC expressions entered without line numbers are executed in an immediate mode, whereas expressions entered with line numbers become entries into the BASIC program. This ability to switch quickly from program entry to immediate execution makes the product more versatile.

The TI-74 has 8K Constant Memory™ RAM for medium sized applications. The unit's storage capacity can be doubled with the addition of an 8K Constant Memory™ cartridge. Programs or data can be stored off-line with the CI-7 Audio Cassette Interface. The TI-74 system includes the optional PC-324, a 24 column thermal printer for applications requiring hard copy of program listings or results.

## Scientific Calculator

In the calculator mode, the TI-74 offers 70 scientific functions, alphanumeric error messages, and 13-digit accuracy which spans a numeric range of ±9.999999999999E127. Features include logarithmic, hyperbolic, and trigonometric functions, two variable statistics, and probty calculations. Ten user registers are available for saving intermediate results or constants.

## Ease of Use

The TI-74 system includes several features to facilitate operation and use. The large 31 digit alphanumeric LCD is easy to read and software scrolling with cursor keys supports a maximum of 80 characters per line. Fourteen annunciators indicate errors, modes of operation, and machine status. INSERT and DELETE keys assist in source program editing. The keyboard consists of 62 keys arranged in a QWERTY (typewriter) layout with large format keys and a numeric keypad. Common BASIC language keywords are defined on the keyboard and can be entered with only two keystrokes. The system includes a durable carrying case which also holds a quick reference card. The documentation that is provided consists of two books, a User's Guide and a Programming Guide.

## Expansion

The TI-74 console contains a cartridge port to augment standard memory. An 8K RAM cartridge can be software configured to double the amount of memory available for programs/data or configured as an 8K mass storage device. Another option is the use of 32K ROM cartridges which contain application programs designed to solve specific problems. Mathematics, Statistics, Chemical Engineering, Finance, and Learn Pascal ROM cartridges are currently available.

The console interfaces to a battery operated thermal printer and audio cassette interface via an I/O port. When connected to the printer, the TI-74 and cassete interface are powered by the printer's batteries or AC adapter, allowing the entire system to operate from one power source. These accessories round out a complete system designed to introduce the beginning user to the world of programming and solve complex problems for engineers and other advanced users. ■

*The previous article by Bob Hanschke is reprinted with permission from the March/April 1986 TI Engineering Journal.*

# Using the ACCEPT Statement

by Stephen L. Reid

The ACCEPT statement is a very versatile feature of TI-74 BASIC. With its many options, ACCEPT can provide keyboard data entry filtering for nearly any application. The main purpose of this article is to demonstrate use of the ACCEPT statement when several inputs are desired with all prompts displayed at the same time. This type of application occurs when prompts are short, the information to be read is related, and all information is to be displayed at once.

For example, let's request that the user enter height, weight, and age. We want all prompts to be visible at the same time. The user can move from one field to the next while data from the previous response remains displayed. Prompts for this example can be entered by using PRINT or DISPLAY statements. While multiple statements may be needed, remember that these PRINT and DISPLAY operations should be PENDING PRINT or DISPLAYs. This is done by placing a semi-colon (;) at the end of the print list associated with PRINT or DISPLAY. If prompts are not left in a pending condition, ACCEPT clears the display prior to waiting for data.

For our height, weight, and age example, the PRINT statement to place a prompt in the 31 column display would be:

```
100 Print "Ht:5' 11""
Wt:155lbs  Age:  yrs";
```

This prompt has 4 fields. One field is in column 4 and is one character wide (the Feet Field). The next field begins in columnn 7 and is 2 characters wide (the Inches Field). Next is the Weight Field which begins in column 15 and consists of three characters. The last field is the Age Field, two characters wide, beginning in column 27. To ACCEPT data from these fields, the following ACCEPT statements are used:

```
110 ACCEPT AT(4) SIZE(-1)
VALIDATE (DIGIT),FEET$

120 ACCEPT AT(7) SIZE(-2)
VALIDATE(DIGIT),INCH$

130 ACCEPT AT(15) SIZE(-3)
VALIDATE(DIGIT),WT$

140 ACCEPT AT (27) SIZE(2)
VALIDATE(DIGIT)
NULL("00"),AGE$
```

In each ACCEPT Statement, the AT( ) option specifies the beginning column of the field. The SIZE( ) option specifies the width, and the VALIDATE( ) option specifies DIGIT, limiting accepted keys to digits 0 through 9. Other key presses (except for BREAK) will be ignored by ACCEPT. A minus sign in the SIZE( ) option tells ACCEPT not to clear the input field prior to accepting data. This allows default values to be displayed with the prompt. If SIZE is used with a non-negative field width, the field is cleared before data entry begins.

The ACCEPT Statement in line 140 has a NULL( ) option. The value of the NULL parameter will be assigned to the variable used with ACCEPT if the user presses ENTER when ACCEPT is on an empty field. The Age Field was left blank by the prompt, so if the user presses ENTER in response to this prompt, the string value "00" will be assigned to the variable AGE$.

Minor changes in options of the ACCEPT statement will change the way in which it works. For example, if we want to limit the acceptable range in the Feet Field to 4 through 7, then changing the VALIDATE( ) option to VALIDATE("4567") will accomplish this. The user could no longer enter 0 to 3, 8, or 9 as input to the Feet Field. This single feature can save a lot of additional testing with IF statements after inputting data, since the data has already been verified within the program range. Multiple test fields can be given to the VALIDATE option separated by commas. If only digits and certain characters, such as "Y", "N", and spaces are wanted, the VALIDATE( ) option could become VALIDATE(DIGIT, "YN").

Combined with clear and precise prompts, the ACCEPT statement and its options provide a powerful and flexible keyboard data input tool for the TI-74. It can handle all data entry and validation that most programs require while reducing program size by eliminating the need for input testing code. ■

# Trig in BASIC?

by Patrick Hicks

When I discovered there was to be a user newsletter for the TI-74, I was elated. I have been exposed to this machine for only a short time, but have become addicted to its unique features. How could those guys squeeze so much into such a small package? The manual just can't begin to cover everything the TI-74 can do.

One of the first things I noticed was the CONVERSION FEATURE in Calculator Mode. One of its uses is a conversion from Degrees-Minutes-Seconds into Decimal Degrees—a pretty important feature since all Trig calculations are interpreted as Decimal Degrees. Anyone in Engineering, Surveying, or Navigation will readily agree that such a feature is a must.

Much to my disappointment, I was unable to find a comparable conversion in the BASIC Mode. Had the design department brains simply overlooked this one? Apparently not. When I researched my query further, I could not find the conversion in any BASICs I checked. Therefore, I decided to write a subprogram to do the "dirty work" for me and here it is.

```
100 INPUT "ANGLE(DMS)=";A
110 CALL CONVERT(A)
120 PRINT "CONV. ANGLE(DD)=";
A:PAUSE
300 SUB CONVERT(X)
310 IF X=INT(X)THEN 400
320 TEMP$=STR$(X)
330 FOR I=1 TO LEN(TEMP$)
340 IF SEG$(TEMP$,I,1)="."
THEN 355
350 NEXT I
355 IF I=1 THEN X=0:GOTO 370
360 X=VAL(SEG$(TEMP$,1,I))
370 X=X+(VAL(SEG$(TEMP$,I,
3))/.6)
380 TEMP$=".00"&SEG$(TEM
P$,I+3,LEN(TEMP$))
390 X=X+(VAL(TEMP$)/.36)
400 SUBEND
```

In line 100, the program will prompt you to enter any angle in Degrees-Minutes-Seconds Format (DD.MMSS) and press ENTER. Next, line 110 calls the subprogram CONVERT (lines 300-400) then passes the entered variable (A) to the routine. Finally, the subprogram returns (A) back to the calling program to display the angle in its converted form. To use this simple subprogram in your applications, simply add the contents of lines 300-400 to the END of your program and use the CALL CONVERT(numeric variable) whenever you need to convert an angle from Degrees-Minutes-Seconds to Decimal Degrees. ■

# Can I Really Afford It?

by Patrick Hicks

Since interest rates available on new automobiles are at record lows, I've been out there like most of you looking at new cars. If you are like me, you can't afford to pay cash for a twelve-thousand-dollar car. You do know about how much you can afford for a monthly payment, but one question arises, "How does the payment I can afford relate to dealer sticker price?"

I realized that my faithful TI-74 could help on this one, and after a bit of research I found the following equations. The first determines the sticker price to find when I know my affordable payment amount, the annual interest rate (APR), and the total number of payment periods in the contract.

$$PV = PMT \left( \frac{1 - (1+i)^{-n}}{i} \right)$$

The next one shows payment amount if I know the annual interest rate (APR), the purchase amount of the auto, and total number of payment periods.

$$PMT = PV \left( \frac{i}{1 - (1+i)^{-n}} \right)$$

The following program incorporates these formulas into TI-74 BASIC. Lines 100-150 are simply a menu that outlines your options. Lines 160-210 are used to calculate the amount you can afford to finance (or PV). Lines 220-250 calculate the payment. Finally, line 260 ends the program and returns you to the BASIC Immediate Mode. The program is simple so it does not account for zero percent financing, down payments, or any fees associated with your purchase. It is meant to give ideas on what you can or can not afford.

```
100 PRINT "PRESS:" :PAUSE 1
110 PRINT "1) TO COMPUTE PV":
PAUSE 2
120 PRINT "2) TO COMPUTE PAYMENTS":
PAUSE 2
```

```
130 PRINT "3) TO SEE OPTIONS
AGAIN":PAUSE 2
140 PRINT "4) END":PAUSE 2
150 INPUT X:ON X GOTO 160,160,
100,260
160 INPUT "INTEREST=";I:I=I/1200
170 INPUT "# OF MONTHS = ";N
180 IF X=1 THEN INPUT "PAYMENT= ";
PMT ELSE 220
190 PV=PMT*(1-(1+I) (-N))/I
200 PRINT USING "PV= ######.##";
PV:PAUSE
210 GOTO 100
220 INPUT "PV= ";PV
230 PMT=PV*I/(1-(1+I) (-N))
240 PRINT USING "PMT= ######.##";
PMT:PAUSE
250 GOTO 100
260 PRINT "BYE":PAUSE 2:
END
```

I designed the program so that data must be entered as follows:

- Enter the interest rate as stated. For example, if the newspaper states APR 2.9%, enter 2.9, not .029.
- Enter the total number of months in your contract. If financing your purchase over a term of 4 years, enter 48 as the number of months. (For you technical types, this program assumes a standard annuity, fully amortized over the life of the term with twelve periods per annum.)

Of course, the program can also help with purchase decisions for houses, boats, trailers, or anything that requires periodic payments over a given amount of time. ■

# Cartridges and Accessories

The current library of application cartridges for programmable calculators includes:

**TI-74**
Mathematics
Statistics
Learn Pascal
Chemical Engineering
Finance

**TI-95**
Chemical Engineering
Mathematics
Statistics

## Accessories for the TI-74 and TI-95

8K Constant Memory Cartridge. An internal battery maintains contents when removed from the calculator.

CI-7 Cassette Interface. Allows users to store and retrieve information from any standard cassette recorder.

PC-324 Dot Matrix Thermal Printer. Can print 24 characters per line at 48 lines per minute. An adapter (AC9201) is available to provide power for both the printer and calculator.

# Moving?

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Programmable Calculator News

Volume 2, Number 1

# The TI-95 "ASM" Function

By Ash Osmani

The assemble function represented by the ASM key increases the program execution speed of the TI-95 PROCALC™ by converting label addresses used by the program into absolute addresses. This facilitates a faster execution of the assembled program since the calculator transfers control to the absolute address immediately instead of searching for a label before transferring control. In an assembled program, all the GTL, SBL, and DFN instructions are converted to GTO, SBR, and DFA instructions respectively (TI-95 Programming Guide, pages 4-25 & 4-29).

Pressing INV ASM disassembles the program, restoring references to labels in the program. Please note: If your program needs to be edited, it should first be disassembled to prevent the calculator from transferring control to an incorrect address generated by an increase or a decrease in the number of programming steps after editing.

The following program illustrates the use of the ASM function. The program increments the value in register A in each pass of the loop, stops when register A equals 150, and displays the "DONE" message. Program steps 0019 through 0849 are NOP's (No Operation, page 1-19). Absolute addresses generated by ASM are shown in parentheses. Do not enter these as part of the program.

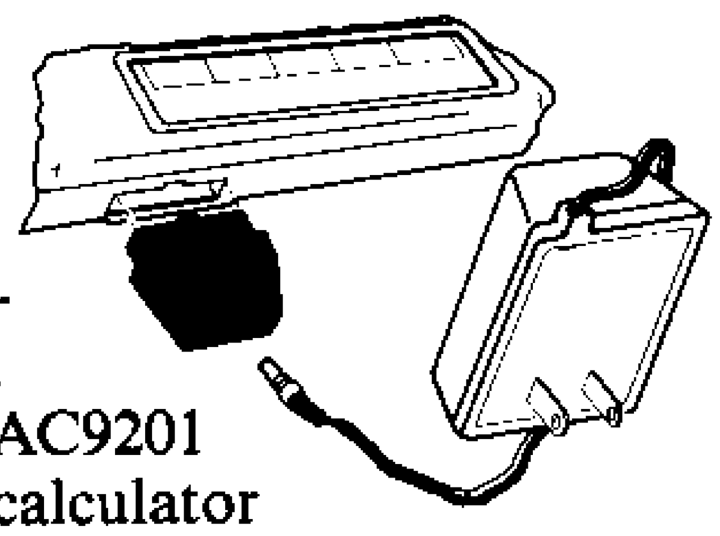
```
0000 LBL XX 0 STO A
0006 LBL XY 150 IF= A
0014 GTL XZ(GTO 0861) GTL ZZ(GTO 0853) NOP
0020 NOP NOP NOP NOP NOP
 .
 .
 .
0845 NOP NOP NOP NOP NOP
0850 LBL ZZ INC A
0855 GTL XY(GTO 0009)
0858 LBL XZ 'DONE' RTN
```


This program was first run without assembling (key sequence: RUN, PGM), and the execution time was approximately 15 seconds. The program was then assembled and run (key sequence: 2nd, ASM, RUN, PGM) with execution time reduced by more than half (6.5 seconds). In the unassembled program, the calculator had to scan through all NOP's before transferring control to the correct labels. In the assembled program, control is transferred directly to the absolute address.

The ASM function is very useful when its use in a program is valid. The value in any particular program depends on the extent to which the GTL, SBL, and DFN instructions are used. If your program is lengthy and uses these instructions extensively, the ASM speeds program execution considerably. The ASM function is more useful, too, in a program format where all subroutines follow the main program than in a program format where subroutines are within the main body of the program.

# Letter From The Editor

Welcome to the second issue of Programmable Calculator News. Many of you have inquired about application cartridges for the TI-74 BASICALC™ and TI-95 PROCALC™. A complete listing of programs available within each cartridge begins on page 3. There's information on accessories, too. Our new PA-201 connector will allow you to use the AC9201 adapter with your TI-74 or TI-95 for operation from a standard electrical outlet. Using the PA-201 and AC9201 adapter, you can also change calculator batteries without losing memory contents.



An article beginning on page 2 illustrates menus and subroutines for the TI-74. TI-95 owners can become more familiar with the ASM key (page 1) and calculate logarithms quickly and easily (page 2).

We hope you enjoy this issue and welcome your comments. If you've written a program you'd like to share with our readers, write for submission details to:

Programmable Calculator News
P.O. Box 53
Lubbock, TX 79408

# Logarithms On The TI-95

By Patrick Hicks

I was recently faced with a situation where I needed to find the exponent necessary to raise the number 4.4 to 83, or in technical terms, the log base 4.4 of 83. As you may recall, a log is the exponent necessary to raise a number to a power.

Here's a formula that uses the natural log, base e, to calculate the exponent necesary to raise any positive number to any positive power:

$$\log_B (X) = \log_e (X) / \log_e (B)$$

where X is the number and B is the base. For example, the log base 4.4 of 83 equals 2.982 or:

$$\log_{4.4} (83) = \log_e (83) / \log_e (4.4)$$

The following program incorporates this formula and also demonstrates use of the TI-95 ALPHA mode to display numbers along with alpha messages (pages 3-4 to 3-6 of the TI-95 Programming Guide). If you have a PC-324 printer, the program will print your results as well as display them.

To calculate the base 4.4 log of 83, enter the program then press [RUN] and <PGM>. Next, press 4.4 and <BAS> followed by 83 and <NUM>. Finally, press <LOG> and your TI-95 will display the log, in this case 2.982. If you have more logs to determine, simply press <GO>.

```
0000 LBL ST 'BASE/LOG P'
0013 'ROG' PRT
0017 LBL AA DFN CLR
0022 DFN F1:BAS@BB
0029 DFN F2:NUM@CC
0036 DFN F3:LOG@DD HLT
0044 LBL BB STO A 'BASE'
0053 '=' COL 15 MRG A
0058 PRT GTL AA
0062 LBL CC STO B 'NUM='
0071 COL 15 MRG B PRT
0076 GTL AA
0079 LBL DD RCL B LN /
0086 RCL A LN = STO C
0092 'LOG=' COL 15 MRG C
0100 PRT ADV BRK CLR
0104 GTL ST
```

## Correction

Lines 190 and 230 of "Can I Really Afford It?" in Volume 1, Number 1 should have read as follows:

```
190 PV=PMT*(1-(1+I)^(-N))/I
230 PMT=PV*I/(1-(1+I)^(-N))
```

# Menus And Subprograms On The TI-74

By Stephen L. Reid and Rena Gillis

The TI-74 and its optional 8K RAM cartridge will each store one program, limited only by the space available. Program functionality can easily be expanded through the use of menus and subprograms, and programs stored in a cartridge can be interchanged with the program in the TI-74 RAM using the CALL PUT subprogram.

As an example, the program included with this article contains several unrelated subprograms and could be expanded further by adding conversions to/from metric, Degrees-Minutes-Seconds to Decimal Degrees, or other needed conversions. The additional routines would be added as subprograms to the end of the program, with the menu table being appropriately updated.

Scientific functions available in the TI-74 CALC (calculator) mode that are not provided in the BASIC mode may be programmed as add-on routines to the program described in this article. A listing of functions available in both CALC mode and BASIC mode appears in Appendix A of the TI-74 Programming Reference Guide.

The menu is the first portion of the program. It provides a listing of all routines available prefaced by a corresponding number. Lines 140-210 handle the display of the menu and obtain the menu selection from the user. All selections are in uppercase letters, so the keypress must be in uppercase. Line 230 handles routing the program to the appropriate subprogram based on the key pressed. Lines 240-260 pass control to the subprogram and then back to the menu routine upon subprogram completion.

To add other subroutines, you need only add the names of new menu items as DATA statements after line 310 and increase the number of menu items on line 280. Add the correct line number to the ON GOTO statement on line 230 and the CALL to the new subprogram after line 260. The actual subprogram may appear anywhere in the program after line 310.

You may want to use the RENUMBER feature (page 2.103 of the TI-74 Programming Reference Guide) to renumber lines. It will keep your program line numbers in an orderly sequence thus making the program easier to read.

Subroutines included in this program are: Fahrenheit to Celsius/Celsius to Fahrenheit conversions (460-550); Permutations (320-380); and Factorials (390-450). Please note that the Permutations and Factorials subprograms use a common subprogram, "SUB FACTORIAL" (570).

SUBBEND is the last statement of a subprogram. It instructs the calculator to return to the statement after the CALL statement. Parentheses following the CALL statement contain the argument list. These assigned values pass data to and from the subprogram. In the "FACTORIAL" subprogram, "B" is the value being passed to the subprogram and "F" is the name of the value being returned to the original routine. Another useful feature of subprograms is that variables named in one subprogram are not the same variable in another subprogram. This is why variable "F" in the "FACTORIAL" subprogram and variable "F" in the "PERM" subprogram are not the same variable, even though they have the same name.

For more information on subprograms, refer to the TI-74 Programming Reference Guide for SUB (page 2.120), SUBEND (page 2.124), SUBEXIT (page 2.125), and CALL (page 2.17) statement documentation.



```
100 !Menu-Subprogram Functions
110 READ N:N=N-1
120 !Menu section
130 PVAL=ASC("A"):RESTORE 290
140 DISPLAY ERASE ALL AT(1),"Press:( ) for";
150 READ SUBJECT$:DISPLAY AT(8)SIZE(1),CHR$(PVAL);
160 DISPLAY AT(15),SUBJECT$;
170 PAUSE .5:CALL KEY(KVAL,KST):IF KVAL<>255 THEN 190
180 PVAL=PVAL+1:IF PVAL-ASC("A")>N THEN 130 ELSE 150
190 IF KVAL>=ASC("A")AND KVAL<=ASC("Z")THEN 200
    ELSE 180
200 IF KVAL-ASC("A")>N THEN 180
210 KVAL=KVAL-ASC("A")+1
220 !Routine selection/execution
230 ON KVAL GOTO 240,250,260
240 CALL FACT:GOTO 130
250 CALL PERM:GOTO 130
260 CALL TEMP:GOTO 130
270 !Menu table
280 DATA 3
290 DATA Factorials
300 DATA Permutations
310 DATA Temperature Conv.
320 !Permutations Subprogram
330 SUB PERM:PRINT:INPUT "Total number=";N
340 INPUT "Number of groups=";R:IF N<R THEN
    NPR=0:GOTO 380
350 B=N:CALL FACTORIAL(B,F):NF=F
360 B=N-R:CALL FACTORIAL(B,F):NRF=F
370 NPR=NF/NRF
380 PRINT NPR;"=total permuations":PAUSE:SUBEND
390 !Factorials Subprogram
400 SUB FACT:PRINT:PRINT "X=   X!=";
410 ACCEPT AT(3)SIZE(2)VALIDATE(DIGIT),X;:IF X>84
    THEN 440
420 CALL FACTORIAL(X,F):DISPLAY AT(9),F;
430 PAUSE:SUBEXIT
440 DISPLAY AT(9),"Value out of range";
450 PAUSE:SUBEND
460 !Temperature Conversions
470 SUB TEMP:D$=CHR$(223)
480 PRINT:PRINT "          "&D$&"F =
    "&D$&"C";
490 ACCEPT AT(2)SIZE(8)VALIDATE(NUMERIC),F$
500 IF F$=""THEN ACCEPT AT(16)SIZE(8)VALIDATE
    (NUMERIC),C$ ELSE 520
510 IF C$=""THEN 480 ELSE 530
520 F=VAL(F$):C=(F-32)/1.8:GOTO 540
530 C=VAL(C$):F=(C*1.8)+32
540 DISPLAY AT(2)SIZE(8),F;:DISPLAY AT(16)SIZE(8),C;
550 PAUSE:SUBEND
560 !Common factorial subprogram
570 SUB FACTORIAL(B,F):F=1:FOR I=2 TO
    B:F=F*I:NEXT:SUBEND
```

## Moving?

Please send the label from this issue along with your new address to:

**Programmable Calculator News**
**P.O. Box 53**
**Lubbock, TX 79408**

# TI-95 Application Cartridge Library

Application software cartridges can provide powerful programs for a specific application without the need for user programming. These cartridges contain 32K bytes of ROM and include programs which are generated through hundreds of hours of research, consultation and programming by TI staff members or experts in the field. Although no programming skill is required, an understanding of the application is needed to fully utilize the software. Chemical Engineering, Math and Statistics cartridges are presently available for the TI-95, with others being developed.

## Chemical Engineering Library

- Properties table program
- Properties estimation programs, including:
  - Gas properties
    - A. Gas viscosity estimation of polar and nonpolar gases according to high and low pressure models. Hydrogen-bonding and non-hydrogen-bonding polar gases are treated separately.
    - B. Gas thermal conductivity estimation of pure gases according to high and low pressure models.
  - Liquid properties
    - A. Liquid viscosity estimation for hydrocarbons and nonhydrocarbons according to high and low temperature models, as well as binary mixtures at moderate temperatures.
    - B. Liquid thermal conductivity of pure liquids using the Robbins-Kingrea method and of mixtures using the Power Law rule.
    - C. Liquid density for pure liquids and mixtures.
  - Other chemical properties
    - A. Vapor pressure using the Frost-Kalkwarf-Thodos method and/or Raoult's Law K-Value.
    - B. Critical properties estimation for critical temperature, pressure and volume using Lydersen's method instead of the built-in table of compounds.
    - C. Latent heat of vaporization estimated using the Riedel-Plank-Miller method.
- Pipe design for liquid flow to evaluate the pressure drop for flowing liquids in a pipe when the liquid flow rate, physical properties and a definition of the pipe geometry are given. Also calculates the liquid flow rate, given pressure drops.
- Thermodynamics
  - Soave-Redlich-Kwong method to calculate the compressibility factor and saturated vapor density for a pure component or mixture.
  - Peng-Robinson method for calculating the compressibility factor, vapor density, vapor enthalpy and the fugacity coefficient of each component of a mixture which does not contain hydrogen.
  - Specific heat estimation of the ideal heat capacity for hydrocarbons and nonhydrocarbons in the gas and liquid phases.
- Absorber design using the Edmister method to solve heat and material balances for multicomponent, multistage absorption.
- Distillation design to calculate the minimum number of ideal trays, the minimum reflux ratio and the actual number of ideal trays for a multicomponent distillation column using the Fenske-Underwood-Gilliland short-cut distillation method.
- Heat exchanger design using a modified Kern method to design shell and tube heat exchangers. Options include log mean dt, geometry, and pressure drop.
- Heat transfer coefficient estimation to estimate heat transfer coefficients for four different geometries: internal fluid-to-wall coefficients in turbulent flow; external fluid-to-wall coefficients in a heat exchanger bundle; external condensing coefficients on vertical tubes; and external condensing coefficients on horizontal tubes.
- Other chemical engineering solutions:
  - Equilibrium flash taking a feed stream at a given composition, pressure and temperature, to perform a single-stage, equilibrium flash calculation.
  - Activity coefficient estimates liquid-phase activity coefficients for mixtures using the Wilson equation.

## Mathematics Library

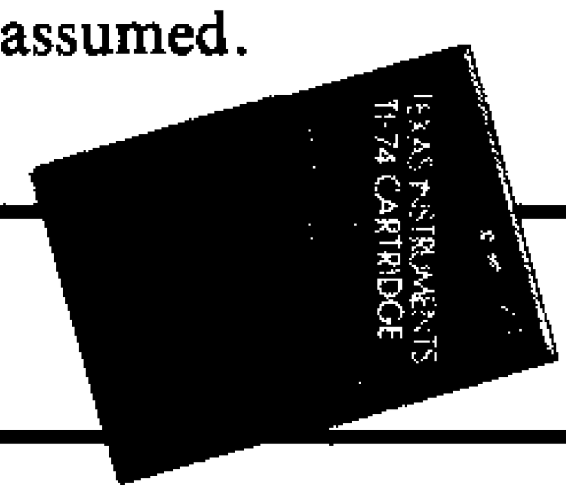
- Complex functions consisting of four categories:
  - Arithmetic
  - Power, root and log
  - Trigonometric
  - Hyperbolic functions
- Cubic splines for use with:
  - Known data points ("new" data)
  - Known second derivatives ("old" data)
- Exact polynomials for use with:
  - Known data points
  - Known coefficients
- Gamma function calculation as well as the natural log of gamma for a given number.
- Gauss Quadrature for computing the definite integral of a function defined in program memory.
- Matrix Algebra consisting of four programs:
  - Matrix product for multiplying two matrices.
  - Inversion/linear systems to perform matrix inversion, solve a system of simultaneous equations or calculate the determinant of a matrix.
  - Tridiagonal systems to solve simultaneous equations whose coefficients form a tridiagonal matrix.
  - Eigenvalues and eigenvectors determined for a symmetric matrix.
- Polynomial multiplication of two polynomials where the result is less than 95th order.
- Finding roots consisting of Q-D, Bairstow, Bisection and Newton's methods.

- Differential equations/Runge-Kutta to solve a system of differential equations. Higher-order equations must be broken down into first-order equations.
- Number theory selections including:
  - Totient function
  - Divisor function
  - Congruences
  - Rational approximation
- Coordinate transforms of three-dimensional coordinates between rectangular, cylindrical and spherical coordinate systems.
- Analytic geometry programs, including:
  - Conic sections to analyze the six coefficients of the general second-degree equation to identify the type of conic section.
  - Quadric surfaces to analyze the ten coefficients of the general second-degree equation, identifying the type of quadric surface.
  - Nonlinear systems approximating the roots of a system of up to eight simultaneous equations using Newton's method. The solution is a point that occurs at the intersection of all the entered functions.

### Statistics Library

- Means and Moments to determine the means, central moments, skewness and kurtosis for a set of sample data.
- Theoretical Distributions, including:
  - Normal—calculate Q(z), the right-tailed area and f(z), height under curve.
  - Inverse Normal—calculate z, the number of standard deviations a value is away from the mean.
  - Student's t-distribution—calculates the alpha risks for hypothesis testing.
  - F-distribution—calculates Q(f), the area under the curve to the right of the F-statistic.
  - Chi-square—calculates Q(x), the right-tailed area under the Chi-square distribution.
  - Weibull—If you know (w) of a sample, this solves for P(w).
  - Inverse Weibull—If you know P(w), this will solve for (w).
  - Binomial—determines the probability that an event will occur a certain number of times in a given number of trials.
  - Poisson—determines the probability that an event will occur a certain number of times if the event is Poisson-distributed.
  - Hypergeometric—determines the probability of obtaining a certain number of successes in a given sample, when the sample is taken from a population containing a specific number of successes.
- Analysis of variance offering three programs:
  - One-Way ANOVA
  - Two-Way ANOVA
  - Two-Way ANOVA with replication
- Regression analysis to perform multiple linear calculations and Bivariate Data Transforms.
- Hypothesis testing containing Unpaired t-Test and Paired t-Test programs.
- Histogram program allowing users to construct or enter a histogram and perform Goodness-of-Fit tests for distributions, including:
  - Normal
  - Uniform
  - Weibull
  - Poisson
  - Binomial
  - Exponential
- Nonparametric programs, including:
  - Friedman test—similar to the Two-Way Analysis of variance but does not assume population normality.
  - Wald-Wolfowitz runs test—used to check for randomness by testing the hypothesis that all outcomes are equally likely.
  - Kruskal-Wallis test—similar to the One-Way Analysis of Variance except it does not require the assumption of population normality.
  - RxC Contingency table—enables the user to test the hypothesis that row-column occurrences of an event are independent of one another.
  - Tolerance limits—determines one- or two-sided tolerance limits.
  - Kendall's Tau—used to test the hypothesis that the observations are mutually independent.
  - Rank function—determines the rank order of the elements.
  - Mann-Whitney test—used to test the hypothesis that the means of two populations are equal when population normality is not assumed.

# TI-74 Application Cartridge Library



Available for the TI-74 are five application cartridges: Chemical Engineering, Mathematics, Statistics, Finance and Learn Pascal. The Chemical Engineering, Mathematics, Statistics and Finance modules are all written in BASIC.

### Chemical Engineering Library

- Properties estimation programs, including:
  - Gas properties
    - A. Gas viscosity estimation of pure gases and gas mixtures, polar and nonpolar, according to high and low pressure models. Hydrogen-bonding and non-hydrogen-bonding polar gases are treated separately.
    - B. Gas thermal conductivity estimation of pure gases according to high and low pressure models.
  - Liquid properties
    - A. Liquid viscosity estimation for hydrocarbons and nonhydrocarbons at various temperatures, as well as binary mixtures at moderate temperatures.

# TI-74 Application Cartridge Library

B. Liquid density for pure liquids and mixtures.
C. Liquid thermal conductivity of pure liquids using the Robbins-Kingrea method and of mixtures using the Power Law rule.

- Properties at the phase boundary
  - Vapor pressure using the Frost-Kalkwarf-Thodos method and/or Raoult's Law K-Value.
  - Latent heat of vaporization estimated using the Riedel-Plank-Miller method.
  - Critical properties estimation for critical temperature, pressure and volume using Lydersen's method.
- Thermodynamics
  - Specific heat for estimating the ideal heat capacity for hydrocarbons and nonhydrocarbons in the gas and liquid phases.
  - Soave-Redlich-Kwong method for calculating the compressibility factor and saturated vapor density for a pure component or mixture.
  - Peng-Robinson Thermodynamics for calculating the compressibility factor, vapor density, vapor enthalpy and the fugacity coefficient of each component of a mixture that does not contain hydrogen.
- Liquids in interaction
  - Activity coefficient estimating liquid-phase activity coefficients for mixtures using the Wilson equation.
  - Reaction order program using the chemical-reaction kinetics data of concentration or partial pressure versus time to determine the order of the reaction. As an alternative procedure, after the program selects an appropriate reaction mechanism, it computes the reaction rate constants.
- Equipment analysis
  - Heat transfer coefficient estimation to estimate heat transfer coefficients for four different geometries: internal fluid-to-wall coefficients in turbulent flow; external fluid-to-wall coefficients in a heat exchanger bundle; external condensing coefficients on vertical tubes; and external condensing coefficients on horizontal tubes.
  - Equilibrium flash taking a feed stream at a given composition, pressure and temperature, and performing a single-stage, equilibrium flash calculation.
  - Pipe analysis for liquid flow to evaluate the pressure drop for flowing liquids in a pipe when the liquid flow rate, physical properties and a definition of the pipe geometry are given. Also calculates the liquid flow rate, given pressure drops.
  - Absorber analysis using the Edmister method to solve heat and material balances for multicomponent, multistage absorption.
- Equipment design
  - Distillation design for calculating the minimum number of ideal trays, the minimum reflux ratio and the actual number of ideal trays for a multicomponent distillation column using the Fenske-Underwood-Gilliland short-cut distillation method.
  - Heat exchanger design using a modified Kern method to design shell and tube heat exchangers. Options include log mean dt, geometry, and pressure drop.

## Mathematics Library

- Complex functions including 19 mathematical operations and functions on complex numbers. This program will calculate REAL(Z), IMAG(Z), R and THETA, dependent upon which function or operation is in use.
- Gamma functions to compute the value of the gamma functions for positive integers and positive and negative non-integers; also in(gamma(x)).
- Polynomial multiplication to perform multiplication of two polynomials.
- Prime factors to factor an integer into prime numbers.
- Cubic splines fitting a sequence of cubic polynomials to m input data points (a maximum of 100 data points using cubic spline interpolation).
- Relative minimums for finding a value at which a function is minimum within an interval. The minimum of the interval is not necessarily the absolute minimum.
- Root finder-bisection to approximate the roots of a function.
- Root finder-Newton to converge on the roots of a function.
- Convolution, given the impulse response for a linear system, using the convolution integral to find the output for a specified input waveform. The program uses the trapezoidal rule to generate outputs at intervals of delta t.
- Differential equations/Runge-Kutta using a fifth-order Runge-Kutta method to solve a system of differential equations of the type $y' = f(x,y)$.
- Gauss quadrature to approximate the integral of a specified function over an interval, a to b.
- Complex system to solve a system of n by n simultaneous equations with complex coefficients. Rows and columns are assigned in a traditional matrix.
- Matrices allowing five different operations using: matrix addition, matrix multiplication, matrix inversion, solution of linear simultaneous equations and evaluation of the determinant of a matrix.
- Tridiagonal matrix for use when a matrix in tridiagonal form has non-zero elements only along the main diagonal and the diagonals on either side.

## Statistics Library

- Histograms to determine the number of counts per cell, means and moments.
- Means and Moments for a given set of input data with associated frequencies. Calculates the means, moments, skewness and kurtosis of a sample distribution.
- t-Test: Paired Observations to evaluate the t-statistic with $n - 1$ degrees of freedom to test the hypothesis

that two normally distributed populations of paired data with the same unknown variance have the same mean.

- t-Test: Unpaired Observations to provide the capabilities of the t-Test: paired observations program; the two samples do not need to contain the same number of data points.
- Contingency Table Analysis to evaluate two-way contingency tables.
- MANN-WHITNEY RANK SUM TEST to compare the mean of two populations having the same distribution. This program will test that the mean of populations are equal, or that the mean of the populations differ by an unknown constant.
- One-way Analysis of Variance (ANOVA) to compare the mean of various sets of data with different variances and test the hypothesis that a number of populations have the same mean. One-way ANOVA is used to analyze several sample populations where only one factor varies.
- Two-way ANOVA for use in situations which involve two or more varying factors and a possible influence of one factor upon another.
- Binomial distribution for use when variables comply with the following conditions: the experiment consists of a fixed number of statistically independent trials; each trial results in either success or failure; and, each has a constant probability of success and failure.
- Chi-squared distribution of variance for a normally distributed random variable. Often used to establish confidence intervals for the standard deviation of a population since its distribution depends on the deviation of a sample.
- F-distribution, the statistical ratio of two variances, may be used to compare the variances of two normal populations.
- Normal distribution for use with normally distributed data with populations of at least 100 elements and a sample size greater than 30.
- Poisson distribution for use when the probability of a specific event occurring is very small.
- Student's t-distribution, similar to normal distribution, allows for small samples. The t-curve is most commonly used when the sample size is less than 30.

## Finance Library

The TI-74 Finance Library allows users to perform financial calculations quickly and easily. Programs include:

- Finance—performs time-value-of-money, rate conversion, bond, depreciation, cash-flow and date calculations.
- Data Forecasting—to estimate and revise forecasting model coefficients and forecast future data.
- Learning Curve—computes the learning factor, number of units, cost of first unit, cost of Nth unit, and average unit cost of production processes that vary in close relation to the learning curve.
- Rent or Buy—compares the cost of buying or renting a residence.
- True Cost of Insurance—calculates the cost per $1000 of whole life insurance or comparison with term life insurance.

## Learn Pascal

The TI-74 Learn Pascal Solid State Software™ cartridge is both a learning aid and a tool for writing programs. Pascal is characterized by a highly disciplined, formal syntax and structure. In addition to the memory module, the TI-74 Learn Pascal software package includes user and reference guides, a keyboard overlay and a quick reference card.

Suggested retail price for all TI-95 and TI-74 Application Cartridges is $50.00. Texas Instruments reserves the right to make changes in materials, specifications and prices of any product without notice.

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## Calculator Club

The TI Programmable Calculator Club is a group of hand-held programmable calculator and computer users. The club's newsletter, TI PPC Notes, supports several calculators including the TI-59, TI-74, and TI-95.

While the Club emphasizes support of devices manufactured by Texas Instruments, it is not sanctioned by or financially supported in any way by Texas Instruments. For information contact:

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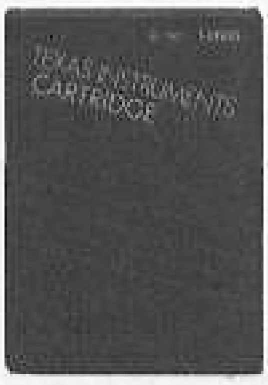
# TI-95/74 Accessories




■ 8K Constant Memory™ Solid State Software™ modules maintain their contents when removed from the calculator. An asset for storing programs, the modules contain an internal battery providing a typical service life of more than five years. Suggested retail price: $50.00.

■ The PC-324 dot matrix thermal printer prints up to 24 characters per line at a speed of 48 lines per minute. The PC-324 will print the contents of each calculator's display under keyboard or program control and can provide a printed record of calculations at any time. Paper can be advanced at any time. Four AA batteries and two rolls of thermal paper are packaged with the unit. Suggested retail price: $115.00.

■ Accessories for the PC-324 printer:
- The AC9201 adapter provides power for both the printer and the calculator. Suggested retail price: $18.95.
- TP-324 thermal paper is available in three-roll packages. Suggested retail price: $5.95.

■ The CI-7 Cassette Interface cable connects the TI-95 or TI-74 to any standard cassette recorder, allowing users to store and retrieve information on cassette tape. Tape operations can be performed directly from the keyboard or from within a program. Suggested retail price: $35.00.

■ The PA-201 connector can be used with the AC9201 adapter to operate the TI-95 or TI-74 from a standard electrical outlet. It is also possible, using the PA-201 and AC9201 adapter, to change calculator batteries without losing memory contents. Suggested retail price: $7.95.

■ Documentation
- The TI-95 and TI-74 are packaged with user and programming guides. In addition, a Learn BASIC Guidebook is available for the TI-74. Suggested retail price for the Learn BASIC Guidebook: $9.99.
- The TI-74 Technical Data Manual documents the hardware design and software system. It is available from TI for $10.00. Call 1-800-TI CARES.


As always, we ask that you purchase Texas Instruments products and accessories at a retailer in your area. If you are unable to locate a specific item, phone 1-800-TI CARES.

TEXAS INSTRUMENTS
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