# EXTENDED BASIC COMPILER

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06/04/18

The Extended BASIC language is arguably the most versatile of the languages available for the TI99/4A. Programs are easy to write, relatively understandable, and simple to modify and edit, with lots of error checking to facilitate program development. The main drawback is that the double interpreted nature of Extended BASIC makes it extremely slow.

The intent in writing my Extended BASIC compiler was to make it possible to take full advantage of the simple program development offered by XB, then make an end run around the speed limitations. The goal was to implement Extended BASIC as fully as possible within the time limits of the programmer and the memory limits of the machine. There *are* limitations and you will probably need to adjust your programming style a bit, but in general, all the major features of XB run the same when compiled. This means that you can concentrate on writing the XB code and testing it in the XB or XB256 environment. After the program has been perfected in Extended BASIC it can then be compiled into an equivalent code that functions at a speed approaching that of assembly language. The average Extended BASIC program will run at least 30 times faster after being compiled, and certain operations will run up to 70 times faster.

There are several methods by which the compiler achieves this speed increase. First, Extended BASIC must perform a lengthy prescan operation before a program can even start. This is done in advance by the compiler and becomes part of the compiled code. Second, an XB program is interpreted twice by the computer; once by the Extended BASIC interpreter, and a second time by the GPL interpreter. The compiler generates "threaded code" which needs its own interpreter (the runtime routines), but at least only one interpreter is involved, and it's a fast one! Third, integer arithmetic is used throughout instead of floating point arithmetic. This alone makes the code run at least 5 times faster, albeit without the versatility of 13 digit floating point accuracy. Fourth, to increase the speed even more, virtually no error trapping is done. Any error reports that are given are not very helpful anyway because you won't know the line number where the error happened. Therefore it is *imperative* that the Extended BASIC program be thoroughly debugged before you attempt to compile it!

The compiler has been expanded to include all the XB256 assembly language extensions except for CAT and SL2VDP. XB256 removes most of the graphics restrictions imposed by Extended BASIC. It lets you toggle between two independent screens. Screen1 is the graphics mode normally used by Extended BASIC; Screen2 lets you define 256 characters, more than double the number normally usable in XB. When in screen2, you can use up to 28 double sized sprites using the patterns available to Screen1. You can scroll screen characters left, right, up, or down and specify a window area for scrolling, leaving the rest of the screen unchanged. Other routines let you scroll smoothly one pixel at a time to the left, right, up or down. There are miscellaneous subroutines that let you hilight text, set the sprite early clock, print in any direction on the screen using all 32 columns, read from or write to the VDP RAM, write compressed strings to VDP, move sound tables into VDP, and more. With XB256 you can test your program in the XB environment, then use the compiler to get a huge performance increase. Once compiled an XB256 program is stand alone. It does not need XB256 to run.

The compiler is part of the XB Game Developer's Package. This is designed to work with Mike Brent's Classic99 emulator which is an easy, fast and powerful development tool. It eliminates many of the annoyances that come when you are running on a real TI99, such as slowness, limited room in the disk drives, difficulty in reading text files, etc. Follow the directions in *Using XBGDP* to set up the Game Developer's Package on your equipment.

The steps you need to follow in developing, compiling, assembling, and loading an XB or XB256 program are described in *Using XBGDP*.

The rest of this manual will describe the compiler, what instructions are supported, etc.

Starting at page 13, there is a section that describes how to use Asm994a, which is one of the cross assemblers available for the TI99.

If the program being compiled was written in TI BASIC, it is possible to use the runtime routines from the original TI BASIC compiler. This is limited to BASIC only, but it generates a program that is more compact and a wee bit faster than those created by the newer compiler. This is described starting at page 17.

## Differences from Extended BASIC

An ideal compiler would be able to take any Extended BASIC program and compile it with no changes necessary so that it would run exactly the same only faster. This compiler falls short of that ideal, but does come close.

Following is a short overview of the differences between the compiler and Extended BASIC.

The biggest difference that you will have to deal with is that all numbers are integers from -32768 to 32767.
Here are some examples showing how the compiled code differs from the XB code:

32767+1=32768 in BASIC

32767+1=-32768 in the compiled code

200*200=40000 in BASIC; -25536 in compiled code because of the integer arithmetic.

If an operation such as dividing or SQR can give a non integer result, then you should use INT in the BASIC program to be sure that the BASIC and compiled programs function the same.

Because RND returns a number between 0 and 1, the INT of RND is always 0. Because of this, the following line of code won't work properly in the compiled code:.

```
10 IF RND>.5 THEN 100 ELSE 200
```

There is a work around built into the compiler that deals with this problem. You have to multiply the RND by some number and then INT the result. Instead of the example above you should use:

```
10 IF INT(RND*2)=1 THEN 100 ELSE 200
```

This gives either a 0 or a 1 in both Extended BASIC and the compiled code.

The timing of delays loops has to be modified. FOR I=1 TO 500::NEXT I gives a delay of several seconds in XB or BASIC; a fraction of a second in the compiled code. One way to have the same delay in both compiled and XB programs is to use CALL SOUND. For a 2 second delay you would use CALL SOUND(2000,110,30)::CALL SOUND(1,110,30). Neither XB nor the compiler can process the second call sound until the first has finished, so you get the full 2 second delay whether in XB or compiled code. Another way is to use CALL LINK("DELAY",2000) in XB256.

IF-THEN-ELSE now can use the more versatile Extended BASIC format, with one exception; you cannot use nested IF-THEN-ELSE statements such as this:

```
100 IF A=1 THEN IF B=2 THEN C=3 ELSE D=4 ELSE E=5
```

Except for this, if it will run in XB then it should run when compiled.

Nested arrays cannot be used. See discussion below.

User defined subprograms are not supported.

Trig functions, LOG and DEF not supported.

Speech is not supported.

Assembly language subroutines cannot be used except for those included in XB256.

Only one variable can be assigned at a time in a LET statement. A line like:

```
10 A$,B$,C$="B"
```

will crash the compiler.

## Supported Instructions

Following is a list of the TI Extended BASIC operations supported by the compiler:

Multiple statement lines can be used, with the statements separated with a double colon. Parentheses can be used to change the mathematical hierarchy used to evaluate expressions.

The arithmetic operators + - * / ^ work as they do in XB within the limits of integer arithmetic. Remember that because of the integer arithmetic, dividing 5/2 will give 2, not 2.5. You can use INT in the XB program when dividing (for example INT(5/2) to be certain that XB and the compiler give the same results.

The logic operators NOT, AND, XOR, OR work the same as in XB.

The relational operators < > = <> <= >= work the same as in XB.

GOTO and GO TO *But do not GOTO a DATA statement*
GOSUB and GO SUB
ON-GOTO and ON-GO TO
ON-GOSUB and ON-GO SUB
RETURN
END
STOP
FOR-TO-STEP – The step is optional; +1 is assumed if no step is specified.
NEXT
READ
DATA *But you cannot GOTO a DATA statement*
RESTORE *But RESTORE cannot point to a comment; it* must *point to a DATA statement*

ABS
MAX
MIN
INT
SGN
SQR – gives same number as INT(SQR(N)) in XB
ASC
LEN
POS
VAL
CHR$
SEG$
STR$
RPT$ – the string is truncated if over 255 characters and no warning is given.

RANDOMIZE can be used, but has no effect; it is done automatically
RND returns a value of 0. RND is only useful when it is multiplied by another number. i.e. INT(RND*6) gives the same results (0,1,2,3,4,5) when compiled as it does when used in XB. The order is not important – it can be (RND*6) or (6*RND)

String concatenation (i.e. A$&B$) works the same as in XB. The string is truncated if over 255 characters but no warning is given.

IF-THEN-ELSE now can use the more versatile Extended BASIC format. The following line of code will compile and run the same as it does in XB:

```
100 IF X=7 THEN Y=3::Z=12::GOSUB 100::PRINT A ELSE Y=5::Z=14::GOSUB 200:: PRINT B
```

You do have to be a bit cautious when using complicated IF-THEN-ELSE statements. If you use ELSE you should only use **one** IF, **one** THEN and **one** ELSE as in the example above. If you do not use ELSE the line will just run like in XB. The following two lines run properly:

```
100 S=S+1 :: IF S=60 THEN S=0 :: M=M+1 :: IF M=60 THEN M=0 :: H=H+1 :: IF H=13 THEN H = 1
100 IF X=3 THEN IF Y=1 THEN IF Z=4 THEN PRINT "PI"
```

(but you cannot use ELSE)

By using AND you eliminate the multiple IF statements and then you *can* use an ELSE:

```
100 IF X=3 AND Y=1 AND Z=4 THEN PRINT "PI" ELSE PRINT "NOT PI"
```

The line below using multiple IF-THEN-ELSE statements does not run properly if compiled:

```
100 IF A=1 THEN IF B=2 THEN C=3 ELSE D=4 ELSE E=5
```

(line is from the XB manual)

INPUT works almost exactly like in XB, with the following differences. You can use the optional prompt. You can input more than one variable, but you must use the optional prompt to do this, even if it is just a question mark.. If inputting more than one variable, data being inputted is separated by the first comma the compiler comes to. Quotation marks will not behave as they do in XB. Rather, they are simply input as part of the string. You cannot use quotation marks to input leading or trailing spaces.
LINPUT works exactly like in XB.
ACCEPT works almost exactly like it does in XB. AT, BEEP, ERASE ALL, SIZE and VALIDATE are all supported with one difference: VALIDATE requires that you provide a string expression., which can be numbers, upper case characters, etc. UALPHA, DIGIT, NUMERIC are not supported.

PRINT works like TI Extended BASIC. You can use TAB, commas, semicolons and colons. *Do not print more than 20 variables in a print statement.* See page 11 for more information.

DISPLAY works just like in XB. You can use AT(row,col), BEEP, ERASE ALL, and SIZE(length) as well as TAB, commas, semicolons and colons. DISPLAY USING is not supported. (An XB trick to save memory is to use DISPLAY ERASE ALL to clear the screen. This crashes the compiler which expects DISPLAY to actually display something. Use CALL CLEAR if you just want to clear the screen.)

DIM and OPTION BASE are optional, as is in XB, but using them can reduce the size of the compiled program.

ARRAY LIMITATION – Important!! The program being compiled cannot use nested arrays. For example, if you have two arrays DIM A(10),DIM B(10); you can use Q=A(X+Y-Z) but you can't nest the arrays like this: Q=A(B(7)). ***Use of nested arrays will cause the compiled program to crash!!!*** For the above example you have to split up the statement like this:
Instead of using: `Q=A(B(7))`
you should use: `X=B(7)::Q=A(X)`

**The following CALL subprograms function just like in Extended BASIC except as noted:**

CALL COLOR
CALL CLEAR
CALL SCREEN - saves the screen color like CALL LINK("SCREEN") in XB256
CALL CHAR
CALL HCHAR
CALL VCHAR
CALL SOUND - cannot handle frequencies greater than 32767. (Neither can my ears!)
CALL GCHAR
CALL KEY
CALL JOYST
CALL CHARPAT
CALL CHARSET
CALL SPRITE
CALL MAGNIFY
CALL DISTANCE
CALL COINC
CALL LOCATE
CALL DELSPRITE
CALL POSITION
CALL PATTERN
CALL MOTION
CALL PEEK
CALL LOAD – can only be used to load values in RAM. Will not load assembly subroutines.
CALL LINK – only works with the assembly language subroutines provided by XB256.

All the assembly language subroutines in XB256 are supported except for CAT and the IV254 utilities RUN, RUNL1, and SAVEIV.

LET is optional

REM and ! – All remarks are removed from the compiled program, but you can GOTO a REM statement just like in XB. Use of REM will not increase the size of the compiled program. (Remember that RESTORE cannot point to a remark; it must point to a DATA statement.)

Peripheral access is now supported for DISPLAY, VARIABLE files. See page 13 for more information.

From the command mode in Extended BASIC:
CALL LINK("RUN") functions the same as RUN in XB. You cannot use RUN or RUN line # within a program.
CALL LINK("CON") functions the same as CON in XB

<FCTN 4> breaks the program as in XB except during INPUT or ACCEPT. <FCTN 4> has no effect when running in EA5.

**NOT SUPPORTED:**

RUN or RUN line #.- use CALL LINK("RUN") if running the compiled program from XB.
DEF
ATN
COS
EXP
LOG
SIN
TAN
DISPLAY USING

The following have no meaning in a compiled program:
LIST
NUM
RES
BREAK
UNBREAK
CON – use CALL LINK("CON") if running the compiled program from XB.
TRACE
UNTRACE
EDIT

The compiler uses a string that can be up to 255 bytes long for processing lines of code. This is almost always large enough..However, too many semicolons, commas or colons in a PRINT statement can cause the compiler to generate a string longer than 255 bytes. Although the compiler does not crash, the line is truncated and the code generated will not run properly.

```
10 PRINT A,B,C,D,E,F,G,H,I,J,K,L,M,N,O,P,Q,R,S,T,U,V,W
```

This compiles properly, but adding one more variable will be too long. You should be safe as long as there are no more than 20 variables in a print statement.

## Embedding SINE values in a string:

Due to the integer arithmetic, trig functions are not supported by the compiler. However, there is a way to use them in a program. You can produce a 91 byte long MERGE format program line that contains a string with the values for sine from 0 to 90 degrees multiplied by 255, then use SEG$ to extract the sine value for any degree from 0 to 90 and convert it to a number with ASC. Such a string would contain characters that cannot be input from the keyboard, so we have to use a program to generate it.

A program can be used to generate a merge format file consisting of just one line:

```
10000 S$="a string containing 91 values for sine from 0 to 90, multiplied by 255"
```

Here is the program:

```
10 OPEN #1:"DSK3.SINE255",DI
SPLAY ,VARIABLE 163,OUTPUT
19 A$=CHR$(39)&CHR$(16)&CHR$          Line number - 39*256+16=10000
(83)&CHR$(36)&CHR$(190)&CHR$          S$ and =
(199)&CHR$(91)                        string constant; length of string
20 FOR ANGLE =0 TO 90
40 SINE=INT(255*SIN(ANGLE*PI          convert from radians to degrees and multiply
/180)+.5)                             by 255
50 A$=A$&CHR$(SINE)                   keep building string
80 NEXT ANGLE
90 A$=A$&CHR$(0)                      a zero at the end of the string
100 PRINT #1:A$
105 A$=CHR$(255)&CHR$(255)::
 PRINT #1:A$::PRINT #1:A$             Write >FFFF twice to write EOF
110 CLOSE #1
```

Let's say you wanted to launch a sprite with a velocity (VEL) and at an angle(ANG) between 0 and 90 degrees. (0 degrees is to the right, 90 degrees is straight up)
The column velocity (CVEL) is given by: VEL*COS(30) and the row velocity (RVEL) is given by: -VEL*SIN(30). But what do we do about the missing cosine functions? Well, it turns out that COS(angle) is the same as SIN(90-angle), which gives us a solution:

Run the above program, type NEW, then merge SINE255. Then add line 10010 to get the following subroutine:

```
10000 S$="a string containin
g 91 values for sine from 0 t
o 90, multiplied by 255"
10010 RVEL=INT(-VEL*ASC(SEG$
(S$,ANG+1,1))/255):: CVEL=IN
T(VEL*ASC(SEG$(S$,91-ANG,1))
/255):: RETURN
```

Save this in MERGE format for future use. You would call this from an XB program like this:

```
10 VEL=50::ANG=53::GOSUB 10000::CALL MOTION(#1,RVEL,CVEL)
```

The above subroutine is included on the compiler disk under the file name "SINE255"

The program above beginning with 10 OPEN #1 should have enough comments to give you ideas on how to write something similar that can generate strings containing character definitions, sprite data, or sound lists. You should know that the strings generated contain characters that cannot be input from the keyboard. These will run fine, but XB will complain if you try to edit the line. Besides speed, one advantage to using a string like this for defining characters is that the string is more compact. It uses 8 bytes per character while the normal CALL CHAR uses 16 bytes per character. But you lose the ability to easily edit the line or even to understand what is in it. The COMPRESS utility in XB256 automates the creation of this type of DATA line.

## Disk Access

Disk and other peripheral access is now supported with some limitations:
DISPLAY, VARIABLE is the only file type recognized, but you can use any length desired from DV1 to DV254.
Up to three files can be open at a time. You must use #1, #2, or #3 – do not use other file numbers.
You can only use colons in a print statement. Commas and semicolons will not save as in XB.
10 PRINT #1:"Now, is, the, time " will print the entire string contained in the quotes.
20 PRINT #2:"Hello":"World" or 20 PRINT #2:"Hello"::PRINT #2:"World" are equivalent.
Use LINPUT for reading strings – INPUT will be treated as LINPUT if used
LINPUT will read the entire entry including any ASCII characters (like in XB)
Use INPUT for reading numbers (like in XB)
Specify INPUT or OUTPUT when opening a peripheral for reading or writing files.

### Checking for errors

Error checking only works with peripheral access. It should be set up just like in XB with the following limitations:

ON ERROR line number transfers control to the desired line number
If you are not using ON ERROR and an error is encountered:
If running from an XB loader, the program will end and return to the line editor. No disk error message is printed.
If running as an EA5 program the program will return to the master title screen.

RETURN line number – this only works to return to a specific line number. Do not use RETURN or RETURN NEXT

Other peripheral devices should work if they can use DISPLAY VARIABLE format.

# MODIFYING THE XB LOADER

EA5 programs cannot be changed, but there are modifications you can make to the XB program created by the loader. It consists of one XB line followed by the compiled program embedded in a way that is is invisible to the user. Here is the line of XB code:
10 CALL INIT :: CALL LOAD(8192,255,158):: CALL LINK("RUN")
This is a legal XB line which can be modified as desired. You can add a comment or any legal XB command. If you needed to pass a number to the compiled program, you could add to line 10 **CALL HCHAR(1,1,NUMBER)::**CALL INIT etc. When the compiled program runs the first thing it does should be CALL GCHAR(1,1,NUMBER) and now NUMBER is available to the compiled program.

The compiled program is treated as a giant assembly language subroutine, invoked by CALL LINK("RUN"). When the compiled program ends, or F4 is pressed, control is returned to XB. If you needed to pass a number back to XB the compiled program could do CALL HCHAR(1,1,NUMBER). You would add to the loader: 20 CALL GCHAR(1,1,NUMBER). When the compiled program ends, control returns to XB which executes line 20 and retrieves the number put there by the compiled program..

When RUN is performed, it initializes the XB256 screen2 by loading the standard character patterns and colors, and then it starts the compiled program. Besides RUN there are two other possibilities to start the compiled program.

**CALL LINK("RUNEA")** - The compiled program behaves exactly the same as if you were running from EA5. The character sets are loaded and the colors are set. The only real difference is that no F4 scan is performed, so you can't accidentally break the program, and it will run a *very* tiny bit faster.

**CALL LINK("RUNV")** - This is the same as RUN, but none of the screen2 graphics are initialized.

## HOW TO CHAIN COMPILED PROGRAMS

Here's a ridiculously simple program that chains to another equally simple program:

```
10 PRINT "Program One"::RUN "DSK1.PROGRAM2"        (saved as PROGRAM1)
10 PRINT "Program Two"                             (saved as PROGRAM2)
```

Is there any way to do the same thing in a compiled program? Not directly, because RUN cannot be used within the compiled code. But there *is* a way to do it. Compile these two programs:

```
10 PRINT "Program One"::END          (compiled and saved as PROGRAM1-X)
10 PRINT "Program Two"               (compiled and saved as PROGRAM2-X)
```

Now add line 20 to the XB portion of PROGRAM1-X

```
10 CALL INIT :: CALL LOAD(8192,255,158):: CALL LINK("RUN")
20 RUN "DSK1.PROGRAM2-X"
```

When the compiled PROGRAM1 ends, it returns to XB. Since the XB program is still running, it goes on to the next instruction which is RUN "DSK1.PROGRAM2-X"

If PROGRAM1 modifies the screen2 screen, character patterns and colors and you want to preserve them in PROGRAM2, then you should change line 10 of PROGRAM2-X from CALL LINK("RUN") to CALL LINK("RUNV"). Also, to avoid scrambling screen2, PROGRAM2-X must be saved in IV254 format. To do this, after saving PROGRAM2-X, start up XB256 and type:

```
OLD DSK1.PROGRAM2-X
CALL LINK("SAVEIV","DSK1.PROGRAM2-X")
```

## Adjusting the timing in a game program

One frustration in developing an XB program intended for compilation is that is can be rather tedious to adjust the speed of the gameplay. You try a value in a FOR/NEXT loop, save the program, compile, assemble, load, only to find that it is too fast. Then you go back to XB, try a larger value, repeat the process; find that it is still too fast, try another value, etc, etc.

If you are using XB256 to develop the game there is an easy way to streamline the process. Let's say you are working in screen2. All you have to do is set up a “hot key” to go to a diagnostic menu in screen1, where variables can be modified without disturbing screen2. When done simply return to screen2 and resume where you left off.

In the simple demo program below, lines 100-200 define a ball and put it on the screen. The ball can be moved with the ESDX keys. If you press <Fctn 1> line 160 will go to line 210 where the delay value can be modified. After pressing <Enter> control returns to the main program loop with the modified delay value.

```
100 CALL LINK("CHAR2",65,"3C7EFFFFFFFF7E3C"):: R=12 :: C=16 :: DLY=1
110 CALL LINK("SCRN2")
120 CALL HCHAR(R,C,65)
130 FOR I=1 TO DLY
140 CALL KEY(0,K,S):: IF S=1 THEN 160
150 NEXT I
160 IF K=3 THEN 210
170 RN=R-(K=69)*(R>1)+(K=88)*(R<24):: CN=C-(K=83)*(C>1)+(K=68)*(C<32)
190 IF RN=R AND CN=C THEN 130
200 CALL HCHAR(R,C,32):: R=RN :: C=CN :: GOTO 120
210 CALL LINK("SCRN1"):: CALL CLEAR :: INPUT "DELAY VALUE? ":DLY :: GOTO 110
```

## In case of trouble...

Here are some steps that you can take to try to sort things out if there is a problem with the compiler.

Sometimes the compiler does not like one or more of the statements in the XB program. Normally it will say "compiling Line 10" (or whatever the first line number is). If successful in compiling that line it will then say "compiling Line 20" and so on until it is done. If it gets stuck on a line number then there is something in that line that it doesn't like. Check the XB program and try to see which statement is unsupported.

The compiler will report if it was able able to successfully compile your XB program. If so it will return to the menu where you can choose to assemble the code. The assembler might issue an error message during the assembly process. If so then the error is probably in the source code file the compiler just made, not in the runtime routines. The message will be something like this: `undefined symbol 0141.` This tells you that there is something wrong in line 141 of the compiled source code. Examine it to see if you have used an unsupported statement or if there is something that doesn't look right. This is another good reason to use Classic99, because the files are in windows format and can be opened and viewed with a text editor such as Notepad. Except for B @RUNEA5 there should be nothing but DATA statements, something like the following compiled code:

```
       DEF RUN,CON
RUNEA  B @RUNEA5
FRSTLN
L100
FOR1
       DATA FOR,NV1,NC1,NC2,ONE,0,0
       DATA COLOR,NV1,NC3,NC4
       DATA NEXT,FOR1+2
L110
       DATA DISPLY,NC1,NC5,SC1,NC6,NC7
L130
       DATA AT,NC8,NC9
       DATA SIZE,NC3
       DATA ACCEPT,SV1

LASTLN DATA STOP
- - - - (lines are omitted)- - - -
SC0
SC1    DATA SC1+2
       BYTE 9,98,97,99,107,103,114,111,117,110
       EVEN
SV0
SV1    DATA 0 Z$
- - - - (lines are omitted)- - - -
       COPY "DSK1.RUNTIME1"
       END
```

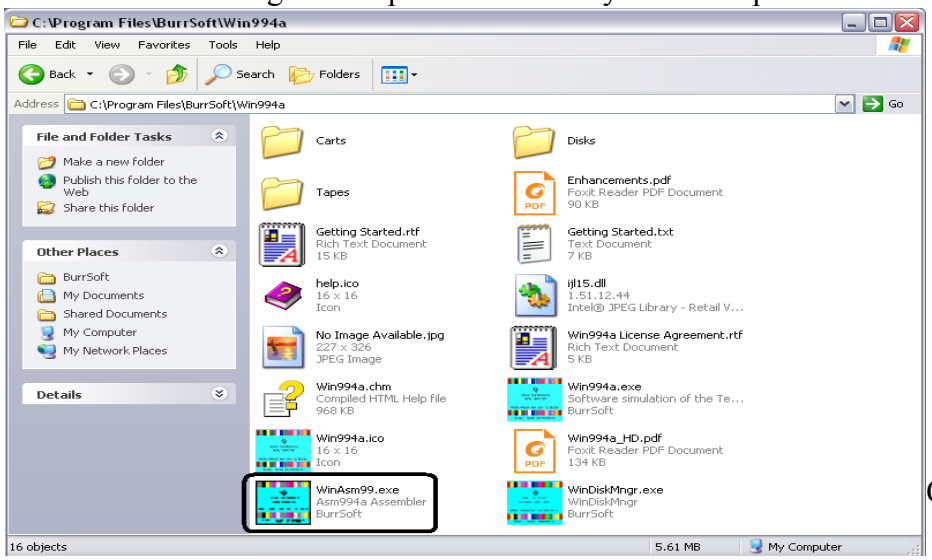
The code the compiler creates should be understandable when compared to the original XB program. Look for a missing DATA statement or something that doesn't look right. If the assembler gives a line number you should be able to find the error easily.

# USING ASM994A WITH CLASSIC99 AND XBGDP

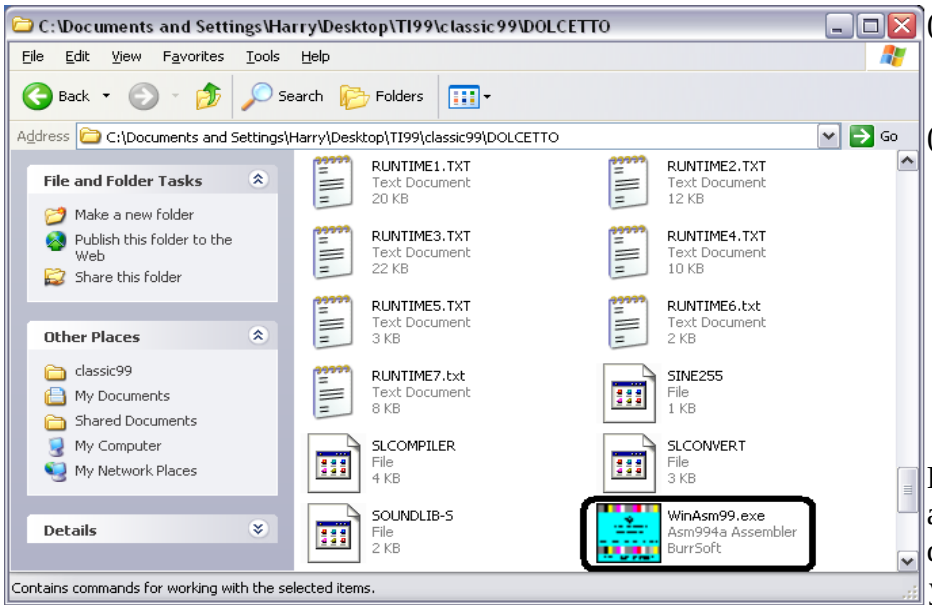
Be sure you have the latest version of Win994a, which is v3.010. It can be found at www.99er.net on the home page, on the left under emulation. Install the Win994a package just like any other windows program. Asm994a is part of the Win994a package and will be installed along with Win994a.

Set up the Game Developer's Package as described in *Using XBGDP*. The folder with the programs is called ENCRUZADO and it should be used as DSK1.

The easiest way to get started is to have all the files on DSK1. Let's begin by putting a copy of Asm994a on DSK1. Find the Asm994a file. (My Computer>(C:)Local Disk>Program Files>BurrSoft>Win994a) and you will see a file called WinAsm99.exe. Then, using Classic99, open DSK1 (Disk>DSK1>Open DSK1) Copy WinAsm99.exe and and paste it into DSK1 which windows knows as ENCRUZADO. Create a shortcut to this copy of WinAsm99.exe. Drag and drop the shortcut to your desktop.




Copy from here.




(ENCRUZADO)

(ENCRUZADO)

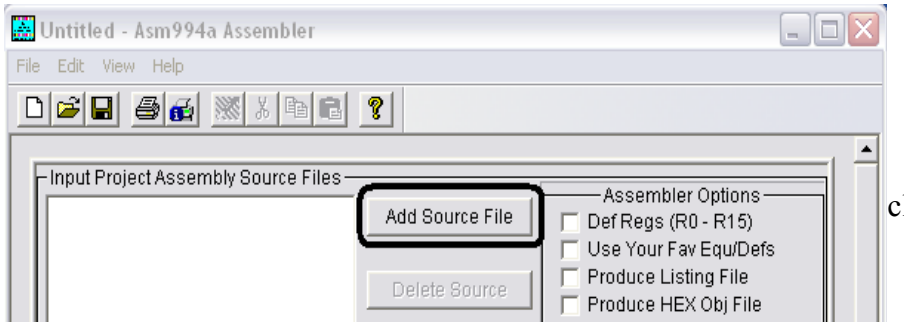
Paste here, then create a shortcut. Drag and drop the shortcut onto your desktop

Because Assm994a is a windows program it does not know anything about DSK1, DSK2, etc. The only way it can find the runtime routines is if they are in the same folder as the source code produced by the compiler. You can see above that the runtime routines are on DSK1 which is the windows file ENCRUZADO. Now if we use DSK1 for the XB256/XB program, then all the pieces will be in place. Let's test it by recompiling *HELLO*.

The steps for compiling HELLO were described in *Using XBGDP*. Follow them up to the point in the Compiler where you are asked:
**`Using Asm994a?`** Press Y and Enter, then Enter again to Proceed.
When the compiler is finished the menu program comes back pointing to LOADER

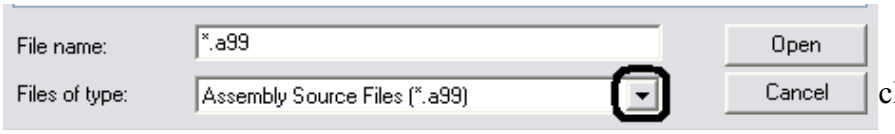
Now it's time to try out Assm994a. Windows 10 will look a little different from the XP screen shots shown here, but the steps are exactly the same.

Double click on the desktop shortcut to start it up. When it starts, click on ***Add Source File***



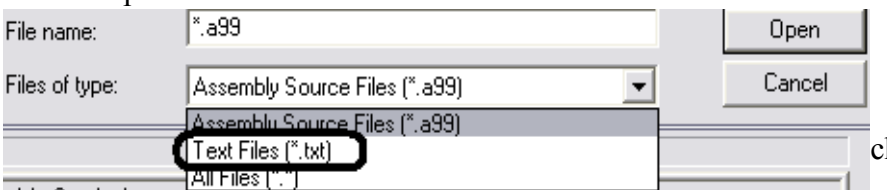
click here.

In the window that opens up:



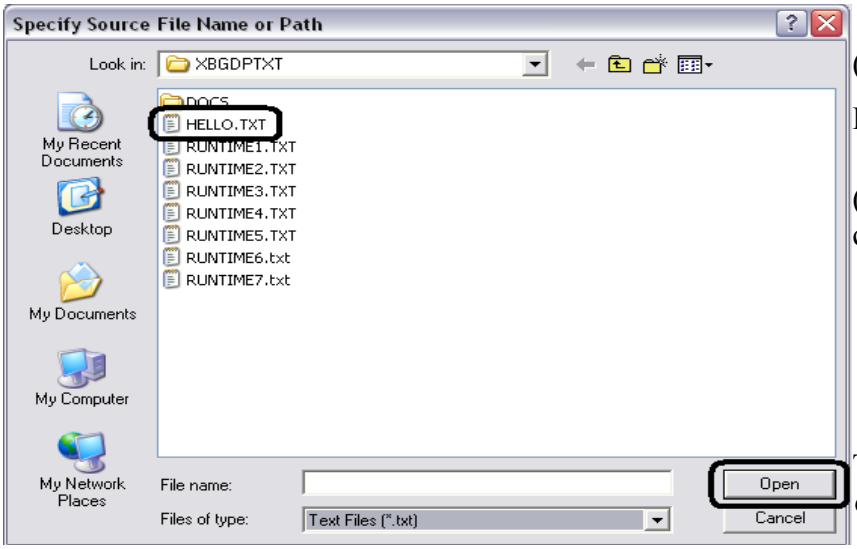
click here.

In the drop down menu choose “Text Files”



choose Text Files

The dropdown menu shows all the .TXT files in the selected folder. Here it is XBGDPTXT. Choose *HELLO.TXT* and then click on *Open.* The dropdown menu goes away.



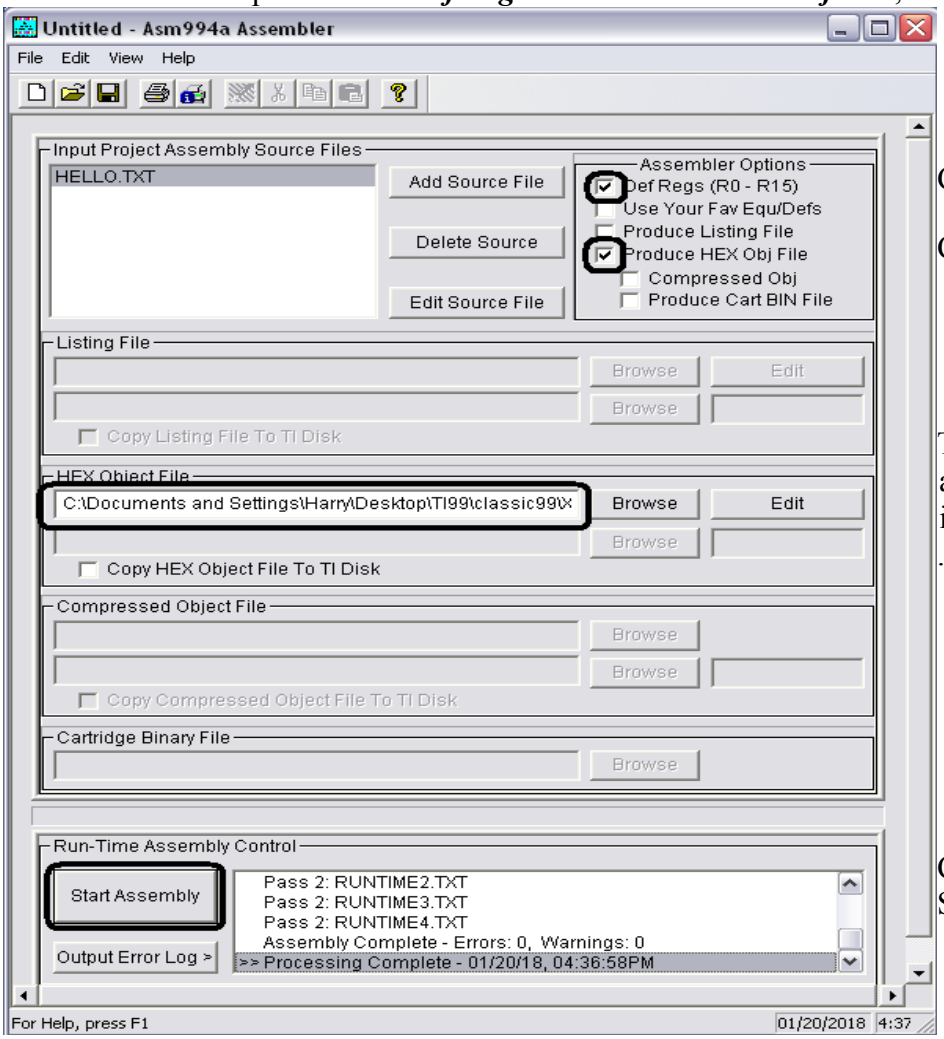

(Any folder can be used.)

First click here

(The runtime routines were copied to XBGDPTXT)

Then click here. The drop down menu goes away.

Under Assembler Options click ***Def Regs*** and ***Produce HEX Obj File***, then ***Start Assembly***.




Click here.

Click here.

The Object File is automatically filled in for you with the .obj extension

Click here to Start Assembly

If all goes well you see the message ***Assembly Complete – Errors: 0, Warnings: 0***

Move Assm994a so it isn't in front of Classic99 or minimize it. Click on the Classic99 window and you are back to familiar territory.

Press Enter for the LOADER then press Enter at the prompts:
DSK1.HELLO.OBJ
CALL LINK("EA5,"DSK1.HELLO-E")
SAVE DSK1.HELLO-X
RUN  Set CPU speed to normal and press Enter.

You can see there is some set up to use Asm994a the first time, and you may wonder whether it's worth it when a just few keystrokes will have the TI Assembler up and running.

Let's find out. Normally you'd be making a number of changes to the XB program and recompiling. Let's try changing HELLO. Break the program with Fctn4, Quit, press a key, press 2 for XB. The menu comes up pointing to EXTENDED BASIC. Press Enter, and press Enter again to load HELLO. Change the text in line 10.
10 A$=" Hello World! How are you doing???"
Type SAVE and follow the prompts to recompile. When the menu comes up pointing to LOADER don't forget to assemble. Asm994a is already filled in for you and you just have to click ***Start Assembly.*** Then back to Classic99 to load, save and run the program.

See how much faster that is? Assembling the second time it only took a few seconds.

As noted earlier, this is the easiest way to use Asm994a, but I do not particularly like the way DSK1 gets cluttered up when using this method. After you get used to using Asm994a, I would suggest setting up a different disk for this purpose. I use DSK4 with the windows name *WorkingDisk,* but you can call it whatever you want. You have to copy the runtime routines to DSK4 or WorkingDisk and this is where you will have the original programs written for XB or XB256, as well as all the compiled files.

I have tested this with Windows 10 and it works as described above. One person reported that it would not assemble properly, but found that it *did* work properly when WinAsm99.exe was copied to the working disk with a shortcut made to the new location. I do not know why it would behave differently. Try it my way first and only if it fails then try moving WinAsm99.exe to the working disk.

There are three more BASIC and XB256 programs on the disk that you can practice compiling.

8QUEENS – The classic chess problem where you put 8 queens on the board such that no queen can capture any other queen. This BASIC program was one of the first to be compiled.

256DEMO (for XB256)

256DEMO2 (for XB256) This uses compressed DATA statements to show the power and speed of that technique while running in XB

APERTURE by Adamantyr. I have modified APERTURE to be compatible with the compiler. Unfortunately, my changes have made it so it will not run in TI BASIC, but it should run in RXB if you want to try it out uncompiled.

## USING RUNTIME ROUTINES FROM THE ORIGINAL COMPILER

If your program is written in TI BASIC you can now use the runtime routines that were part of the original TI BASIC compiler. The advantage is that the program created is considerably smaller, plus it may run a bit faster due to less overhead in the interrupt routine. The big disadvantage is that it only supports TI BASIC instructions (with a few additions from XB), and there have been no improvements for many years.

Most users will not want to use this, so it is turned off by default. To enable this option type:
OLD DSK1.COMPILER
uncomment line 230
SAVE DSK1.COMPILER
Now when the compiler runs you can press "Y" when prompted "Use TI BASIC runtime?" Default for this prompt is always "N".

The procedure for compiling a program is identical to the current version described above and in *Using XBGDP*. The limitations of this earlier compiler are described below, taken verbatim from the original manual. Do *not* put the runtime routines in low memory!

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The BASIC compiler is able to compile many TI BASIC programs, although sometimes minor changes have to be made to the BASIC code. Some examples:
32767+1=32768 in BASIC
32767+1=-32768 in the compiled code
10 IF RND>.5 THEN 100 ELSE 200 won't work properly in the compiled code.
Instead, use 10 IF INT(RND*2)=1 THEN 100 ELSE 200 which gives either a 0 or a 1 in both BASIC and the compiled code.
200*200=40000 in BASIC; -25536 in compiled code.
Remember that the compiler only works with integer numbers from -32768 to 32767. If an operation such as dividing or SQR can give a non integer result, then you should use INT in the BASIC program to be sure that the BASIC and compiled programs function the same.

The timing of delays loops has to be modified. FOR I=1 TO 500::NEXT I gives a delay of several seconds in XB or BASIC; a fraction of a second in the compiled code. The best way to do a delay is to use CALL SOUND. For a 2 second delay you would use CALL SOUND(2000,110,30)::CALL SOUND(1,110,30). Neither BASIC nor the compiler can process the second call sound until the first has finished, so you get the full 2 second delay. This method makes it possible to create delays that work the same in BASIC or compiled code.

**Following is a list of the TI BASIC operations supported by the compiler:**

As in XB, simple multiple statement lines can be used, separating the statements with the double colon

CALL LINK("RUN") - same as RUN in XB Cannot use RUN or RUN line # within a program.
CALL LINK("CON") - same as CON in XB
<FCTN 4> breaks the program as in XB except during INPUT.

All relational operators work the same as in BX. These include < > = <> <= >=

Arithmetic operators all work as they do in BX. Exponentiation (|) not supported. Remember that dividing 5/2 will give 2, not 2.5. You can use INT in the BASIC program when dividing (for example INT(5/2) to be certain that BASIC and the compiler give the same results.

Logical operators from XB have been included: NOT; AND; XOR; OR

LET - optional
REM - All remarks will be removed from the compiled program, but you can GOTO a REM statement just like in BX. Use of REM will not increase the size of the compiled program.
! - the exclamation point REM from XB has been included.
END
STOP
GOTO
ON-GOTO
IF-THEN-ELSE - XB style of IF-THEN-ELSE *is now* supported, with the same minor restrictions found in the XB compiler.
FOR-TO-STEP - step optional; +1 assumed
NEXT

INPUT - Can use the optional prompt, but can input only 1 string or number per INPUT statement.
READ
DATA (Do not GOTO a DATA statement!)
RESTORE
PRINT - works like TI BASIC, including TAB and the print separators ;,:
DISPLAY - equivalent of PRINT.

CALL CLEAR
CALL COLOR - expanded to work like XB except for color of sprites.
CALL SCREEN
CALL CHAR - expanded to work like XB.
CALL HCHAR
CALL VCHAR
CALL SOUND - cannot handle frequencies greater than 32767. (Neither can my ears!)
CALL GCHAR
CALL KEY
CALL JOYST

ABS
INT
RANDOMIZE - can be used, but has no effect; it is done automatically
RND - returns a value of 0. RND is only useful when it is multiplied by another number. i.e. INT(RND*6) gives the same results (0,1,2,3,4,5) when compiled as it does in BX.
SGN
SQR - gives same number as INT(SQR(N)) in BX
ASC
CHR$

LEN
POS
SEG$
STR$
VAL

String concatenation (i.e. A$&&B$) works the same as in XB. String truncated if over 255 characters; no warning given.

DIM is optional but using it can reduce size of the compiled program.
OPTION BASE
ARRAY LIMITATION - Important!! The program being compiled cannot use nested arrays. For example, if you have the two arrays DIM A(10),DIM B(10); you can use Q=A(X+Y-Z) but you can't nest the arrays like this: Q=A(B(7)). Use of nested arrays will cause the compiled program to crash!!! For the above example you would have to split up the statement something like this: X=B(7)::Q=A(X)

GOSUB
RETURN
ON-GOSUB

**NOT SUPPORTED:**

DEF
ATN
COS
EXP
LOG
SIN
TAN

No File processing capabilities have been implemented at this time.

The following have no meaning in a compiled program:
LIST
NUM
RES
BREAK
UNBREAK
CON - use CALL LINK("CON")
TRACE
UNTRACE
EDIT