# Macintosh HD:Users:andrewowen:Desktop:OpenSE BASIC 3.04:docs:logo.png

# VERSION IV

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SE BASIC is an open source implementation of [Sinclair BASIC](http://scratchpad.wikia.com/wiki/Sinclair_BASIC_History) including many improvements over the original, while retaining a high level of compatibility. It includes more than 100 new features:

* 128 RAM cleared on hard reset.
* 15 new commands.
* 3 new functions.
* 7-bit character support: UDG 7.
* 8-bit character set support: UDG 8.
* 8-bit mode can be used to provide an additional 128 UDGs.
* 80 column text: MODE 1.
* Abbreviated command entry: GO. 100.
* All symbols accessed via symbol shift only.
* ANSI BASIC-78 / ECMA-55 Minimal BASIC standard compliant.
* Assembly compiles with GNU binutils.
* Assembly file includes X80 virtual co-processor definitions.
* AY silenced on BASIC report.
* AY supported on Timex and 128 ports.
* AY-3-891x support: SOUND 1,2;3,4.
* Based on the ZX81 ROM by John Grant & Steve Vickers, who wrote the Spectrum ROM.
* Built-in support for Spectranet syntax.
* CALL command for calling machine code.
* Chloe font specially designed for maximum legibility in hi-res mode.
* CLEAR performs a RESTORE.
* CLUT command allows in-line changing of CLUTs.
* CLUT command includes old BRIGHT functionality.
* COLOR command enables in-line setting of attributes.
* Cursor down repeatedly to jump to the end of a line.
* Cursor jumps to an error in the line.
* Cursor up repeatedly to jump to the start of a line.
* Cursors can move up and down in an edit line.
* Decimal to hexadecimal string function: ~9
* Default high-contrast white on black display.
* Default ULAplus palette.
* Designed specifically for the Chloe 280SE.
* Detokenizer simplifies editing lines.
* Edit any line: EDIT 10
* Enhanced floating point library.
* Enter tab stops directly.
* Error escaping: ON ERROR STOP.
* Error skipping: ON ERROR CONTINUE.
* Error trapping: ON ERROR GOTO 100.
* Extend mode is not required.
* FAST command sets CPU to full speed.
* Fast lo-res text printing.
* Fast pilot signal sync.
* Fast reset.
* Four channel sound possible by combining BEEP and SOUND commands.
* Full support for BASIC editing in hi-res mode.
* Full support for block graphics in hi-res mode.
* Full support for UDGs in hi-res mode.
* Fully open source (GPLv2 licensed).
* Geneva Mono font suitable for 32 or 40 column lo-res displays.
* Hexadecimal to decimal function: &F.
* Includes legally machine reverse engineered replacements for critical routines.
* Incorporates elements of SAM BASIC by Andy Wright, creator of BETA BASIC.
* Increased line range: 0-16383.
* Invalid lines generate an error sound.
* INVERSE support in 80 column mode.
* Inverted cursor for Timex hi-res.
* IY register available in interrupt mode 1
* Key click is silent by default.
* Key response is mode dependent.
* Keyword mode is not required.
* Load ULAplus screens with LOAD "" CODE 16384: RESET.
* Lower 16K ROM can be used on its own in all existing Sinclair, Timex and Amstrad models.
* Maintains support for software that uses ROM IM2 vectors with well-behaved hardware.
* Maintains support for software that uses the first two bytes of the ROM as a JP instruction.
* More room for BASIC programs.
* Newton-Raphson square root function.
* No keyword locations to memorize.
* No redundant legacy code.
* Not affected by more than 40 bugs that were present in the original ROM.
* Number codes dropped from error reports.
* Octal to decimal function: /7.
* Only 32K ROM supported by devices that force USR 0 mode.
* Optimized for speed.
* OVER support in 80 column mode.
* PAPER sets color pair in hi-res mode.
* PAUSE defaults to PAUSE 0 without a parameter.
* PEN sets color pair in hi-res mode.
* Prevents accidental deletion of edit line on older keyboards.
* Quick entry for common functions.
* Quick entry for most common tape commands.
* Quick start guide, including memory map, system variables, flags, and command summary.
* Recover from crashes with NMI.
* Remove multiple lines: DELETE 10,100.
* Renumber with step: RENUM 5,5.
* Reset ULAplus palette from buffer: RESET.
* Retained support for embedding control codes.
* SAM style cursors.
* Save ULAplus screens with SAVE "screen" 16384, 6976
* SCREEN$() supports UDGs and 8-bit character sets.
* Scroll counter increased.
* Set the permanent attribute: COLOR 7.
* Sets the standard video mode on reset.
* Shift in CAPS mode gives lower case letters.
* Simple code page support in hi-res mode.
* Simplified error messages.
* Simplified flags.
* Simplified key tables.
* Single code-base for lo-res and hi-res ROMs.
* SLOW command sets CPU to 3.5Mhz.
* STOP token accessible during INPUT with cursor down.
* Supports a large number of legacy devices.
* Supports most existing programs in lo-res mode.
* Supports some existing programs in hi-res mode.
* Switching to INSERT mode before entering a line prevents tokenizing lower case characters.
* Text after a REM statement is not tokenized.
* Tokenized command entry.
* ULAplus palette buffer following the default screen area.
* ULAplus support: PALETTE 64,1.
* Use REM at the start of a line to clear an unwanted edit line.
* Use reserved words as variable names during tokenization.
* User system variable space accessible via IY register.
* Works with esxDOS on divIDE.
* Z80 LDIR block copy: PUT 49152, 16384, 6912.

## New Command Summary

You will find here a brief description of the 15 new commands in SE BASIC. A single letter is used to represent a numeric expression. Check the given section for a full explanation of the syntax offered.

|  |  |
| --- | --- |
| CALL a | A command used to call a machine code routine without assigning the value returned in BC. |
| CLUT n | A command used to set the CLUT. See *ULAplus Support*. |
| COLOR p | A command used to set the permanent attribute. See *ULAplus Support*. |
| DELETE f, l | You would use this command to delete a block of program lines, where f is the first line number of the block and l is the last. If the value of f is greater than l then the error message “Integer out of range” is displayed on-screen. |
| EDIT l | Use this command to display line l in the input line and activate the line-editor. If no line number is provided, the last line entered is used. See *The Editor*. |
| FAST | A command used to enable maximum CPU speed on the Chloe 280SE. |
| PUT s, d, l | A command to enable access to the Z80’s LDIR (block copy) instruction. A total of l bytes are copied from the source address s to the destination address d. Use with extreme caution as overwriting the system variables or the BASIC program will probably cause a crash. |
| MODE n | Used to switch between normal screen mode (0) and 80x24 text mode (1). |
| ON ERROR ... | Use ON ERROR GOTO n to go to line ‘n’ when an error is trapped.  Use ON ERROR CONTINUE to continue the program without displaying the error message.  Use ON ERROR STOP to display the error message.  See Error Trapping |
| PALETTE ... | A command used to set the colours in computers fitted with the ULAplus display chip. See *ULAplus Support*. |
| RENUM ... | A command used to renumber the current program. See *RENUMbering*. |
| RESET | Use this command to reset the default palette. See *ULAplus Support*. |
| SLOW | A command used to set the CPU speed to 3.5Mhz on the Chloe 280SE. |
| SOUND ... | A command used to produce sound effects and three channel tunes in computers fitted with an AY-3-8912 sound chip. See *Programmable Sound Generator*. |
| UDG b | A command used to toggle 8-bit character set support on and off where b is 7 or 8. By default 7-bit character sets are used and characters above 127 are displayed as block graphics, UDGs, and tokens. |

## New Function Summary

The following new function symbols work in much the same way as the BIN function.

|  |  |
| --- | --- |
| & | Used to enter 16-bit hexadecimal positive integers (in upper or lower case), for example 10 PRINT &FFFF |
| \ | Used to enter 16-bit octal positive integers, for example 10 PRINT \177777 |
| ~ | Used to convert 16-bit decimal positive integers to a hexadecimal string, for example 10 PRINT ~65535 |

A much larger number of functions can be added using the [DEF FN](http://scratchpad.wikia.com/wiki/DEF_FN) command.

# Getting Started‬

SE BASIC is the firmware for the Chloe 280SE (also known as the ZX Spectrum SE). It consists of two 16K ROM files. ROM 0 provides an 80x24 character display using the 280SE’s hi-res video mode. ROM 1 is a standalone ROM supporting the normal 32x24 character display and can be used with ZX Spectrum emulators or real machines as a replacement ROM or Interface II cartridge. For instructions on how to use alternate ROMs or Interface II cartridges, refer to your emulator documentation. ROM 1 does not work with the Editor, Syntax, or OS ROMs used by 128K ZX Spectrums. In a 32K-ROM computer you should put the original Sinclair ROM in the other 16K. In a 64K-ROM computer you should use the +2B ROM set (available in the World of Spectrum archive). This will ensure you are able to run the widest range of software.

On a 32K ROM computer:

OUT 32765, 0  = select ROM 0

OUT 32765, 16 = select ROM 1

On a 64K ROM computer:

OUT 8189, 0: OUT 32765, 0  = select ROM 0

OUT 8189, 0: OUT 32765, 16 = select ROM 1

OUT 8189, 4: OUT 32765, 0  = select ROM 2

OUT 8189, 4: OUT 32765, 16 = select ROM 3

**NOTE**: The computer may crash part way through changing ROMs if either OUT instructions causes a ROM other than a version of BASIC to be paged in. When SE BASIC is used on a 128K machine it is effectively in ‘USR 0’ mode.

# The Keyboard

When you switch on your computer you will be greeted by the standard copyright message. Try typing a few characters on the keyboard and you will notice that the keys are not producing their usual keywords; instead you see just single characters. From now on, you will have to type out each command in full rather than use the infamous keywords; a facility which transforms your computer keyboard into something approaching that of a ‘normal’ computer.

Although removing the keyword system has many advantages, the change does have a drawback. Certain commands such as ‘PRINT’ could be typed in just by pressing the ‘P’ key, whereas now you will have to type out ‘P’, ‘R’, ‘I’, ‘N’, and ‘T’; for that reason, SE BASIC allows you to abbreviate many of the keywords.

Here follows a complete list of keywords and their new abbreviations; you can assume that keywords omitted from the list cannot be abbreviated and therefore must be typed out in full. Also note that an abbreviated keyword must finish with a full stop; for example, the abbreviation for ‘CONTINUE’ is ‘CON.’.

A.SIN

AC.OS

BE.EP

B.IN

BO.ORDER

CA.LL

CH.R$

CI.RCLE

CLE.AR

CL.OSE

CO.DE

COL.OR

CON.TINUE

DA.TA

D.EFFN

DEL.ETE

DR.AW

ED.IT

E.XP

FA.ST

GOS.UB

G.OTO

INK.EY$

INP.UT

I.NVERSE

L.EN

LI.NE

ME.RGE

M.ODE

N.OT

ON.ERROR

OP.EN

OV.ER

PA.PER

PAL.ETTE

PAU.SE

PE.EK

PL.OT

PO.INT

PR.INT

RA.NDOMIZE

REN.UM

RE.SET

REST.ORE

RET.URN

R.ND

SA.VE

S.CREEN$

SL.OW

SO.OUND

ST.R$

T.AB

TH.EN

U.SR

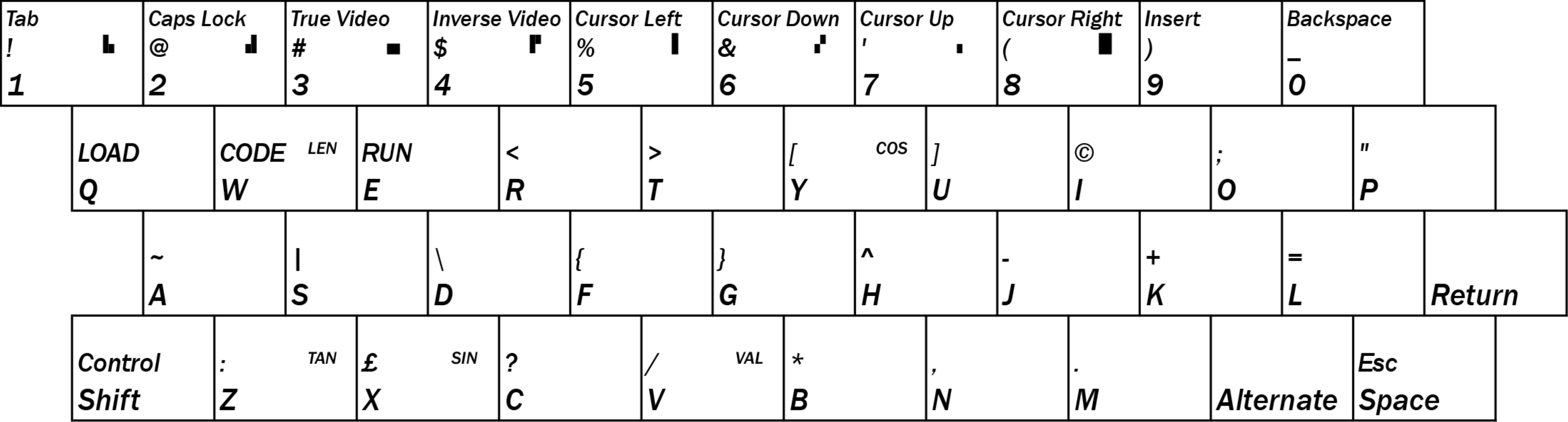
V.AL$

VE.RIFY

[S]+Q = LOAD [S]+W = CODE [S]+E = RUN [I]+V = VAL

[I]+W = LEN [I]+X = SIN [I]+Y = COS [I]+Z = TAN

If you are going to be typing commands such as ‘DEF FN’ and ‘ON ERROR’, you do not have to remember to insert the spaces. The commonly used keywords LOAD, CODE, and RUN are available as Alternate and ‘Q’, ‘W’, and ‘E’.



# The Editor

The line editing capabilities have been greatly enhanced by SE BASIC. The cursor shows the current mode:

[.]  CAPS OFF

[’]  CAPS ON

[I]  INSERT

You will notice that [E] (EXTENDED mode) is missing. You can still use Control (Shift+Alternate) and the number keys to insert control codes, but all symbols are now accessed with Alternate and a key, for instance Alternate ‘I’ produces the copyright symbol. Holding down Shift in caps mode will produce a lower case letter and you can now cursor up and down in an EDIT line.

Because the placement of the EDIT key on some keyboards can cause you to frequently lose lines of code, it is replaced with the TAB key, enabling you to enter tab stops directly in a string. Instead, it is possible to edit any line in the program by using the ‘EDIT’ command. This command is followed by a numeric expression that shows which line is to be edited. If the required line does not exist, then the next program line is used. If no parameter is supplied, the last line entered is used; the equivalent of pressing the EDIT key.

In the original ROM it was possible to use keyword names as variable names. This is still supported if you switch to [I]nsert mode before pressing RETURN to enter the line, providing the variable name contains at least one lowercase character (remember that variable names are case insensitive). In this mode keywords must be uppercase or they will be ignored by the tokenizer.

The valid line range has been increased from 1-9999 to 1-16383. Programs using line numbers above 9999 will also work with the original ROM.

**Video Modes**

The Chloe 280SE has four video pages offset at 0x0000 and 0x6000 in home banks 5 and 7. These can be used to display three different display modes:

* 256x192 pixels with cell attributes using one page.
* 256x192 pixels with byte attributes using two pages.
* 512x192 pixels in monochrome using two pages.

SE BASIC uses two of these combinations to provide the following video modes:

* MODE 0 — 32x24 characters, cell attributes, offset 0x0000 in home bank 5.
* MODE 1 — 80x24 characters, monochrome, offset 0x0000 and 0x6000 in home bank 7.

Mode 0 is the same as a normal ZX Spectrum, and this is the default mode. Mode 1 provides a high resolution text display, but in this mode the following commands either have no effect or return zero or null:

* ATTR (x,y)
* CIRCLE
* DRAW
* POINT (x,y)
* PLOT
* SCREEN$ (x,y)

Although these commands are of no practical use in mode 1, it is still useful to be able to edit programs that will run in mode 0 using an 80-column display.

In mode 1, the foreground colour must be the opposite of the background colour so the following commands will set both the PEN and PAPER:

* PAPER
* PEN

# ULAplus Palette Support‬

SE BASIC sets a default 64-colour mode palette for ULAplus, although this mode is off by default.

This program tests if ULAplus hardware is present:

10 OUT 48955,0: OUT 65339,0: PAUSE 1: LET i = IN 65339

20 IF i = 0 THEN PRINT “ULAplus detected”

To switch on 64-colour RGB mode:

PALETTE 64,1

To switch on 64-colour HSL mode:

PALETTE 64,2

To switch on 64-colour CMYK mode:

PALETTE 64,3

To switch off 64-colour mode:

PALETTE 64,0

The following program will display the default palette.

10 FOR x=0 TO 255

20 COLOR x

30 PRINT CHR$ 131;

40 NEXT x

The palette is designed to work well with existing software, and to be easy to use from BASIC. The fourth CLUT (3) is an approximation of a grey scale and has the same colours for PEN and PAPER enabling you to combine any of the colours in a character cell.

To restore the default palette:

RESET

To set one of the 64 colours:

PALETTE c, BIN gggrrrbb

where c is a colour (0-63), and g, r, and b are colour bits for green, red, and blue. For example, bright red is BIN 00011100. The value of c corresponds to the colour values 0-7 in each colour look-up table (CLUT)

0-7  non-bright PEN

8-15  non-bright PAPER (BORDER in lo-res)

16-23  bright PEN

24-31  bright PAPER (BORDER in hi-res)

32-39  flash PEN

40-47  flash PAPER

48-55  flash/bright PEN

56-63  flash/bright PAPER

You may prefer to use hex (&)

&00-&07  non-bright PEN

&08-&0f  non-bright PAPER (BORDER in lo-res)

&10-&17  bright PEN

&18-&1f  bright PAPER (BORDER in hi-res)

&20-&27  flash PEN

&28-&2f  flash PAPER

&30-&37  flash/bright PEN

&38-&3f  flash/bright PAPER

or octal (\)

\00-\07  non-bright PEN

\10-\17  non-bright PAPER (BORDER in lo-res)

\20-\27  bright PEN

\30-\37  bright PAPER (BORDER in hi-res)

\40-\47  flash PEN

\50-\57  flash PAPER

\60-\67  flash/bright PEN

\70-\77  flash/bright PAPER

You can set the permanent attributes with a single command using COLOR n. Using the octal (\) you can set the CLUT, PAPER, and PEN as follows:

COLOR \cpi

where c is the CLUT (0-3), p is the PAPER selection (0-7), and i is the PEN selection (0-7).

You may want to set the PAPER colours in the first three CLUTS (0-2) to be the same. While this gives only eight background colours, it enables you to use 24 foreground colours without worrying about what the background colour is. The following command will prevent the background colour being changed when you PRINT or PLOT to the screen:

PAPER 8: CLUT 8

When creating your own palettes, you can also use PEN 8: CLUT 8 to set up a palette with 32 PAPERs and 8 PENs if you prefer.

For further information, see: <http://sites.google.com/site/ulaplus/>

The most requested command to add to SE BASIC was PLAY. But there was no room. Instead, the AY is supported by the SOUND command, which enables you to send a set of register pairs to the AY chip. Unlike the PLAY command, the SOUND command will keep playing until an error, or the end of the program, are encountered. When an error report is printed, the AY is silenced. The AY is supported simultaneously on the Spectrum+ 128K and the TS2068 ports. For example, to play the note of A for one second on a 50Hz machine:

10 SOUND 0,124;1,0;8,13;7,62

20 PAUSE 50

The SOUND command allows you to compose music in harmony, with three channels instead of BEEP’s one at your disposal. It can also produces some interesting sound effects to add to your programs.

The SOUND command is followed by pairs of numbers, the pairs separates by semicolons and the individual numbers within the pairs by commas. You can include up to 15 pairs of numbers in each SOUND statement. In each pair, the first designates one of fifteen registers—storage locations—within the special sound/music synthesizer chip. These registers control pitch, duration, and volume of the sound being produced. The following examples are from the Timex Sinclair TS2068 User Manual:

Gunshots

10 SOUND 6,15;7,7;8,16;9,16;10,16;12,16;13,0

20 PAUSE 50

30 GOTO 10

Explosion

10 SOUND 6,6;7,7;8,16;9,16;10,16;12,56;13,8

20 PAUSE 75

30 SOUND 8,0;9,0;10,0

Whistling Bomb

10 SOUND 7,62;8,15

20 FOR I=50 TO 100

30 SOUND 0,I: PAUSE 2.5

40 NEXT I

## AY-3-891x Note Tables

Note that the discrepancies in the tables in the TS2068 User Manual and the TS2068 Intermediate/Advanced Guide are due to the former being calculated against a 1.75 Mhz chip with truncation instead of rounding, and the latter being calculated on the TS2068 ROM which contains floating point errors that were present in the original ROM.

1.75000 Mhz

(TC2068, Spectrum 16K/48K with external AY)

                Ideal            Tune Registers   Actual

Note  Octave  Frequency  Period   Coarse  Fine   Frequency

 C      1       32.703    3344      13     16      32.708

 C#     1       34.648    3157      12     85      34.645

 D      1       36.708    2980      11    164      36.703

 D#     1       38.891    2812      10    252      38.896

 E      1       41.203    2655      10     95      41.196

 F      1       43.654    2506       9    202      43.645

 F#     1       46.249    2365       9     61      46.247

 G      1       48.999    2232       8    184      49.003

 G#     1       51.913    2107       8     59      51.910

 A      1       55.000    1989       7    197      54.990

 A#     1       58.270    1877       7     85      58.271

 B      1       61.735    1772       6    236      61.724

 C      2       65.406    1672       6    136      65.416

 C#     2       69.296    1578       6     42      69.312

 D      2       73.416    1490       5    210      73.406

 D#     2       77.782    1406       5    126      77.792

 E      2       82.407    1327       5     47      82.423

 F      2       87.307    1253       4    229      87.291

 F#     2       92.499    1182       4    158      92.534

 G      2       97.999    1116       4     92      98.006

 G#     2      103.826    1053       4     29     103.870

 A      2      110.000     994       3    226     110.035

 A#     2      116.541     939       3    171     116.480

 B      2      123.471     886       3    118     123.448

 C      3      130.813     836       3     68     130.831

 C#     3      138.591     789       3     21     138.625

 D      3      146.832     745       2    233     146.812

 D#     3      155.563     703       2    191     155.583

 E      3      164.814     664       2    152     164.721

 F      3      174.614     626       2    114     174.720

 F#     3      184.997     591       2     79     185.068

 G      3      195.998     558       2     46     196.013

 G#     3      207.652     527       2     15     207.543

 A      3      220.000     497       1    241     220.070

 A#     3      233.082     469       1    213     233.209

 B      3      246.942     443       1    187     246.896

 C      4      261.626     418       1    162     261.663

 C#     4      277.183     395       1    139     276.899

 D      4      293.665     372       1    116     294.019

 D#     4      311.127     352       1     96     310.724

 E      4      329.628     332       1     76     329.443

 F      4      349.228     313       1     57     349.441

 F#     4      369.994     296       1     40     369.510

 G      4      391.995     279       1     23     392.025

 G#     4      415.305     263       1      7     415.875

 A      4      440.000     249       0    249     439.257

 A#     4      466.164     235       0    235     465.426

 B      4      493.883     221       0    221     494.910

 C      5      523.251     209       0    209     523.325

 C#     5      554.365     197       0    197     555.203

 D      5      587.330     186       0    186     588.038

 D#     5      622.254     176       0    176     621.449

 E      5      659.255     166       0    166     658.886

 F      5      698.456     157       0    157     696.656

 F#     5      739.989     148       0    148     739.020

 G      5      783.991     140       0    140     781.250

 G#     5      830.609     132       0    132     828.598

 A      5      880.000     124       0    124     882.056

 A#     5      932.328     117       0    117     934.829

 B      5      987.767     111       0    111     985.360

 C      6     1046.502     105       0    105    1041.667

 C#     6     1108.731      99       0     99    1104.798

 D      6     1174.659      93       0     93    1176.075

 D#     6     1244.508      88       0     88    1242.898

 E      6     1318.510      83       0     83    1317.771

 F      6     1396.913      78       0     78    1402.244

 F#     6     1479.978      74       0     74    1478.041

 G      6     1567.982      70       0     70    1562.500

 G#     6     1661.219      66       0     66    1657.197

 A      6     1760.000      62       0     62    1764.113

 A#     6     1864.655      59       0     59    1853.814

 B      6     1975.533      55       0     55    1988.636

 C      7     2093.005      52       0     52    2103.365

 C#     7     2217.461      49       0     49    2232.143

 D      7     2349.318      47       0     47    2327.128

 D#     7     2489.016      44       0     44    2485.795

 E      7     2637.020      41       0     41    2667.683

 F      7     2793.826      39       0     39    2804.487

 F#     7     2959.955      37       0     37    2956.081

 G      7     3135.963      35       0     35    3125.000

 G#     7     3322.438      33       0     33    3314.394

 A      7     3520.000      31       0     31    3528.226

 A#     7     3729.310      29       0     29    3771.552

 B      7     3951.066      28       0     28    3906.250

 C      8     4186.009      26       0     26    4206.731

 C#     8     4434.922      25       0     25    4375.000

 D      8     4698.636      23       0     23    4755.435

 D#     8     4978.032      22       0     22    4971.591

 E      8     5274.041      21       0     21    5208.333

 F      8     5587.652      20       0     20    5468.750

 F#     8     5919.911      18       0     18    6076.389

 G      8     6271.927      17       0     17    6433.824

 G#     8     6644.875      16       0     16    6835.938

 A      8     7040.000      16       0     16    6835.938

 A#     8     7458.620      15       0     15    7291.667

 B      8     7902.133      14       0     14    7812.500

1.76400 Mhz

(TS2068)

                Ideal            Tune Registers   Actual

Note  Octave  Frequency  Period   Coarse  Fine   Frequency

 C      1       32.703    3371      13     43      32.705

 C#     1       34.648    3182      12    110      34.648

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 D#     1       38.891    2835      11     19      38.889

 E      1       41.203    2676      10    116      41.200

 F      1       43.654    2526       9    222      43.646

 F#     1       46.249    2384       9     80      46.246

 G      1       48.999    2250       8    202      49.000

 G#     1       51.913    2124       8     76      51.907

 A      1       55.000    2005       7    213      54.988

 A#     1       58.270    1892       7    100      58.272

 B      1       61.735    1786       6    250      61.730

 C      2       65.406    1686       6    150      65.391

 C#     2       69.296    1591       6     55      69.296

 D      2       73.416    1502       5    222      73.402

 D#     2       77.782    1417       5    137      77.805

 E      2       82.407    1338       5     58      82.399

 F      2       87.307    1263       4    239      87.292

 F#     2       92.499    1192       4    168      92.492

 G      2       97.999    1125       4    101      98.000

 G#     2      103.826    1062       4     38     103.814

 A      2      110.000    1002       3    234     110.030

 A#     2      116.541     946       3    178     116.543

 B      2      123.471     893       3    125     123.460

 C      3      130.813     843       3     75     130.783

 C#     3      138.591     796       3     28     138.505

 D      3      146.832     751       2    239     146.804

 D#     3      155.563     709       2    197     155.501

 E      3      164.814     669       2    157     164.798

 F      3      174.614     631       2    119     174.723

 F#     3      184.997     596       2     84     184.983

 G      3      195.998     563       2     51     195.826

 G#     3      207.652     531       2     19     207.627

 A      3      220.000     501       1    245     220.060

 A#     3      233.082     473       1    217     233.087

 B      3      246.942     446       1    190     247.197

 C      4      261.626     421       1    165     261.876

 C#     4      277.183     398       1    142     277.010

 D      4      293.665     375       1    119     294.000

 D#     4      311.127     354       1     98     311.441

 E      4      329.628     334       1     78     330.090

 F      4      349.228     316       1     60     348.892

 F#     4      369.994     298       1     42     369.966

 G      4      391.995     281       1     25     392.349

 G#     4      415.305     265       1      9     416.038

 A      4      440.000     251       0    251     439.243

 A#     4      466.164     237       0    237     465.190

 B      4      493.883     223       0    223     494.395

 C      5      523.251     211       0    211     522.512

 C#     5      554.365     199       0    199     554.020

 D      5      587.330     188       0    188     586.436

 D#     5      622.254     177       0    177     622.881

 E      5      659.255     167       0    167     660.180

 F      5      698.456     158       0    158     697.785

 F#     5      739.989     149       0    149     739.933

 G      5      783.991     141       0    141     781.915

 G#     5      830.609     133       0    133     828.947

 A      5      880.000     125       0    125     882.000

 A#     5      932.328     118       0    118     934.322

 B      5      987.767     112       0    112     984.375

 C      6     1046.502     105       0    105    1050.000

 C#     6     1108.731      99       0     99    1113.636

 D      6     1174.659      94       0     94    1172.872

 D#     6     1244.508      89       0     89    1238.764

 E      6     1318.510      84       0     84    1312.500

 F      6     1396.913      79       0     79    1395.570

 F#     6     1479.978      74       0     74    1489.865

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 A      6     1760.000      63       0     63    1750.000

 A#     6     1864.655      59       0     59    1868.644

 B      6     1975.533      56       0     56    1968.750

 C      7     2093.005      53       0     53    2080.189

 C#     7     2217.461      50       0     50    2205.000

 D      7     2349.318      47       0     47    2345.745

 D#     7     2489.016      44       0     44    2505.682

 E      7     2637.020      42       0     42    2625.000

 F      7     2793.826      39       0     39    2826.923

 F#     7     2959.955      37       0     37    2979.730

 G      7     3135.963      35       0     35    3150.000

 G#     7     3322.438      33       0     33    3340.909

 A      7     3520.000      31       0     31    3556.452

 A#     7     3729.310      30       0     30    3675.000

 B      7     3951.066      28       0     28    3937.500

 C      8     4186.009      26       0     26    4240.385

 C#     8     4434.922      25       0     25    4410.000

 D      8     4698.636      23       0     23    4793.478

 D#     8     4978.032      22       0     22    5011.364

 E      8     5274.041      21       0     21    5250.000

 F      8     5587.652      20       0     20    5512.500

 F#     8     5919.911      19       0     19    5802.632

 G      8     6271.927      18       0     18    6125.000

 G#     8     6644.875      17       0     17    6485.294

 A      8     7040.000      16       0     16    6890.625

 A#     8     7458.620      15       0     15    7350.000

 B      8     7902.133      14       0     14    7875.000

1.77345 Mhz

(Spectrum 128K)

                Ideal            Tune Registers   Actual

Note  Octave  Frequency  Period   Coarse  Fine   Frequency

 C      1       32.703    3389      13     61      32.706

 C#     1       34.648    3199      12    127      34.649

 D      1       36.708    3020      11    204      36.702

 D#     1       38.891    2850      11     34      38.891

 E      1       41.203    2690      10    130      41.205

 F      1       43.654    2539       9    235      43.655

 F#     1       46.249    2397       9     93      46.241

 G      1       48.999    2262       8    214      49.001

 G#     1       51.913    2135       8     87      51.916

 A      1       55.000    2015       7    223      55.008

 A#     1       58.270    1902       7    110      58.276

 B      1       61.735    1795       7      3      61.750

 C      2       65.406    1695       6    159      65.393

 C#     2       69.296    1600       6     64      69.275

 D      2       73.416    1510       5    230      73.404

 D#     2       77.782    1425       5    145      77.783

 E      2       82.407    1345       5     65      82.409

 F      2       87.307    1270       4    246      87.276

 F#     2       92.499    1198       4    174      92.521

 G      2       97.999    1131       4    107      98.002

 G#     2      103.826    1068       4     44     103.783

 A      2      110.000    1008       3    240     109.961

 A#     2      116.541     951       3    183     116.552

 B      2      123.471     898       3    130     123.431

 C      3      130.813     847       3     79     130.863

 C#     3      138.591     800       3     32     138.551

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 E      3      164.814     673       2    161     164.696

 F      3      174.614     635       2    123     174.552

 F#     3      184.997     599       2     87     185.043

 G      3      195.998     566       2     54     195.831

 G#     3      207.652     534       2     22     207.567

 A      3      220.000     504       1    248     219.922

 A#     3      233.082     476       1    220     232.858

 B      3      246.942     449       1    193     246.861

 C      4      261.626     424       1    168     261.417

 C#     4      277.183     400       1    144     277.102

 D      4      293.665     377       1    121     294.007

 D#     4      311.127     356       1    100     311.350

 E      4      329.628     336       1     80     329.883

 F      4      349.228     317       1     61     349.655

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 G#     4      415.305     267       1     11     415.133

 A      4      440.000     252       0    252     439.844

 A#     4      466.164     238       0    238     465.717

 B      4      493.883     224       0    224     494.824

 C      5      523.251     212       0    212     522.833

 C#     5      554.365     200       0    200     554.203

 D      5      587.330     189       0    189     586.458

 D#     5      622.254     178       0    178     622.700

 E      5      659.255     168       0    168     659.766

 F      5      698.456     159       0    159     697.111

 F#     5      739.989     150       0    150     738.938

 G      5      783.991     141       0    141     786.104

 G#     5      830.609     133       0    133     833.388

 A      5      880.000     126       0    126     879.688

 A#     5      932.328     119       0    119     931.434

 B      5      987.767     112       0    112     989.648

 C      6     1046.502     106       0    106    1045.666

 C#     6     1108.731     100       0    100    1108.406

 D      6     1174.659      94       0     94    1179.156

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 E      6     1318.510      84       0     84    1319.531

 F      6     1396.913      79       0     79    1403.046

 F#     6     1479.978      75       0     75    1477.875

 G      6     1567.982      71       0     71    1561.136

 G#     6     1661.219      67       0     67    1654.338

 A      6     1760.000      63       0     63    1759.375

 A#     6     1864.655      59       0     59    1878.655

 B      6     1975.533      56       0     56    1979.297

 C      7     2093.005      53       0     53    2091.333

 C#     7     2217.461      50       0     50    2216.813

 D      7     2349.318      47       0     47    2358.311

 D#     7     2489.016      45       0     45    2463.125

 E      7     2637.020      42       0     42    2639.063

 F      7     2793.826      40       0     40    2771.016

 F#     7     2959.955      37       0     37    2995.693

 G      7     3135.963      35       0     35    3166.875

 G#     7     3322.438      33       0     33    3358.807

 A      7     3520.000      31       0     31    3575.504

 A#     7     3729.310      30       0     30    3694.688

 B      7     3951.066      28       0     28    3958.594

 C      8     4186.009      26       0     26    4263.101

 C#     8     4434.922      25       0     25    4433.625

 D      8     4698.636      24       0     24    4618.359

 D#     8     4978.032      22       0     22    5038.210

 E      8     5274.041      21       0     21    5278.125

 F      8     5587.652      20       0     20    5542.031

 F#     8     5919.911      19       0     19    5833.717

 G      8     6271.927      18       0     18    6157.813

 G#     8     6644.875      17       0     17    6520.037

 A      8     7040.000      16       0     16    6927.539

 A#     8     7458.620      15       0     15    7389.375

 B      8     7902.133      14       0     14    7917.188

Programs written in SE BASIC will run on the original unmodified ROM providing you restrict yourself to the original commands, although you can safely use line numbers beyond 9999. However, you may want to determine if the SE BASIC ROM is present, either to branch or to inform the user that their ROM is not supported. The following program determines if SE BASIC is present:

10 LET r$ = CHR$ (PEEK 43) + CHR$ (PEEK 44)

20 IF r$ = “SE” THEN PRINT “SE BASIC detected”

To determine the version number:

PRINT CHR$ (PEEK 37) + “.” + CHR$ (PEEK 38) + CHR$ (PEEK 39)

Versions prior to 3.00 are not open source.

## IF ... ELSE

Although SE BASIC does not include an ELSE command, IF ... ELSE can be constructed as follows:

10 IF a = true THEN GOTO lineA

20 IF b = true THEN GOTO lineB

30 IF c = true THEN GOTO lineC

40 GOTO lineD

## WHILE ... DO

In this kind of loop the test is carried out first. For example:

10 IF i =< 100 THEN GOTO 40

20 INPUT “Enter a number above 100: “; i

30 GOTO 10

40 REM END

## REPEAT ... UNTIL

In this kind of loop the commands are carried out first. For example:

10 INPUT “Enter a number above 100: “; i

20 IF i =< 100 THEN GOTO 10

30 REM END

## NAMED PROCEDURES

Although SE BASIC does not allow you to create named procedures, you can use definitions to make your programs more readable. For example:

10 LET HISCORE = 1000

20 GOSUB HISCORE

1000 REM PROC: HISCORE

**NOTE**: If you RENUMber your program you will have to manually change your definitions. Therefore you should use the REM statement to label your procedures.

## BOOLEAN LOGIC

SE BASIC provides three Boolean operators, AND, OR, and NOT. The result of testing these operators is always 1 (true) or 0 (false). To make programs easier to read it may be worth defining variables for these results as follows:

10 LET true = 1 : LET false = 0

For example:

100 IF a AND b = true THEN GOSUB procedure

## DPOKE

The double POKE command can be implemented as follows:

10 POKE address, number - INT(number/256)\*256

20 POKE address + 1, INT(number/256)

‬

## FREE ()

This will return the same result as DEF FN F()=65536-USR 7962 does on the original ROM:

DEF FN F()=(PEEK 23731\*256)+PEEK 23730-((PEEK 23654\*256)+PEEK 23653)-110

# Error Trapping

ON ERROR can be used to prevent the user BREAKing into a program, or to trap errors. Note, OK and STOP are not treated as errors, but STOP in INPUT is. The following commands are accepted:

ON ERROR GOTO n

ON ERROR CONTINUE

ON ERROR STOP

These statements allow the programmer to disable automatic program termination upon encountering an error condition. The ON ERROR GOTO line number allows the programmer to cause the transfer to the specified line number to handle the encountered error. The ON ERROR CONTINUE statement causes the program to resume execution at the statement in which the error originally occurred. The ON ERROR STOP command disables this feature causing the program to report errors and terminate in the usual manner.

The errors ‘OK’ and ‘STOP’ are not treated as errors and the program will terminate if they are encountered. ‘STOP in INPUT’ is. ON ERROR CONTINUE has the side effect of preventing a user accidentally BREAKing into a program. However, if the program does not encounter an ‘OK’ or ‘STOP’ error, it is possible to get stuck in an infinite loop. The only way to BREAK out of this loop is by triggering a warm restart using the NMI button. To completely prevent the user breaking into the program the NMI BREAK can be disabled by setting the NMIADD system variable to zero.

# Renumbering

The following commands change the line numbers of your program:

RENUM

This instruction will renumber all your program lines in steps of ten, starting with the first line as 10.

RENUM l

makes number ‘l’ the first new line number

RENUM l,s

uses numbers in whatever step ‘s’ you instruct.

When RENUMbering, all your instructions like GOTO, GOSUB, RESTORE, RUN, LINE, ON ERROR GOTO etc. are dealt with, but any expressions such as GOTO VAL “100”, EDIT 100, DELETE 100,100, and RENUM 100,100,100,100 will be ignored.

# Extended Character Set

Character sets may contain eight additional characters on character codes 24 to 31. No definitions are provided by default but you may use these characters in your own user defined character sets.

## 8-bit Character Set Support

This is controlled by bit 3 of the system variable FLAGS. You can enable 8-bit character set support from BASIC with UDG 8 and switch it off again with UDG 7. SE BASIC defaults to UDG 7 after program execution has completed to ensure listings are displayed correctly.

When the mode is enabled, instead of printing block graphics, UDGs, and tokens, the print routine will expect to find a further 128 character definitions after the © character (addressed by the CHARS system variable).

Characters 24-255 are printable but the CHARS system variable (23606-23607) should be set to point to the zero character.

## Terminal Code Page Support

In MODE 1 it is possible to load an extended character set into the memory location where the screen is stored in MODE 0. If you switch back to MODE 0 the extend character set will be replaced with the contents of the screen. You must set UDG 8 to display the full character set.

# Keyword Reference

This reference contains full descriptions of all the keywords available in SE BASIC. Each entry includes:

* abbreviation
* class
* purpose
* use
* format

Keywords fall into one or more of the following classes:

* **Command**  
   A keyword which causes an action to occur and can be used to form a direct command. It is carried out on being entered. Examples — RUN, LOAD
* **Statement**  
   A keyword which causes an action to occur and which can be used in a program line. It is carried out only when the program is run. Examples — DRAW, INPUT
* **Function**   
  A keyword which produces a value of some kind. It forms part of a command or statement. Examples — RND, INT.
* **Logical Operator**   
  A keyword which is used to express logic in a statement or command. It can determine or change the truth of certain conditions. SE BASIC has three logical operator keywords — AND, OR and NOT.

Numbers are stored to an accuracy of 9 or 10 digits. The number handling range is about 1038 to 4 \* 10-39. Three types of variables are accepted:

* **Number**   
  Any length, starting with a letter. Spaces are ignored and all letters are converted to lower-case letters. Capital and lower-case letters are not distinguished. You can use keywords as variables, only if you enter keywords in capitals and variables in lower or mixed case and enter G mode before entering a line.
* **String**   
  Any single letter followed by $. Capital and lower-case letters are not distinguished.
* **Array**  
   For array variables and subscripts, see DIM.

The following abbreviations are used in the keyword descriptions:

* num-const — a numeric constant, such 24.5.
* num-var — a variable that may contain a numeric constant, such as sum.
* num-expr — any valid combination of numeric constants, variables and keywords that gives a number, such as RND\*7.
* int-num-const, int-num-var, int-num-expr — a numeric constant, variable or expression whose value is rounded to the nearest integer.
* string-const — a string constant or string, such as “SE BASIC”.
* string-var — a variable that may contain a string, such as a$.
* string-expr — any valid combination of string constants, variables and keywords that gives a string, such as a$(6 TO 8).
* letter — any capital or lower-case letter.
* letter$ — any capital or lower-case letter followed by $.
* cond — a condition or sub-condition within a condition, such as x=10 AND t<10.
* statement — any SE BASIC statement that is valid when used with another statement, such as PRINT PEN 2;x.
* prompt — [string-const][(String-expr)][AT int-num-expr,int-num-expr][statement][:][,][’]
* [ ] — an optional item that may be repeated.

The following signs are used in SE BASIC:

* $ string variable.
* ‘ begins new line.
* ( open bracket.
* ) close bracket.
* <= is less than or equal to.
* <> is not equal to.
* >= is greater than or equal to.
* < is less than.
* > is greater than.
* ^ raise to the power.
* - subtraction or negative.
* + addition, positive, string concatenation .
* = is equal to.
* : separates statements in the program line.
* / division.
* \* multiplication.
* . decimal point.
* ; displays at next column, separates statements within a program statement.
* “ open and close string.
* , displays at column 0 or 16, separates values following keywords
* & converts the following four characters from a hex string to decimal
* ~ converts the following positive integer into a hex string
* \ converts the following positive integer from octal to decimal

## Keywords

**ABS**

ABSolute value

Function

ABS num-const  
ABS num-var  
ABS (num-expr)

**ACOS**

Arc COSine

Function

ACOS num-const  
ACOS num-var  
ACOS (num-expr)

**AND**

Logical Operator/Function

cond AND cond  
num-expr AND num-expr  
string-expr AND num-expr

**ASIN**

Arc SiNe

Function

ASIN num-const  
ASIN num-var  
ASIN (num-expr)

**AT**

See INPUT, PRINT.

**ATN**

Arc TaNgent

Function

ATN num-const  
ATN num-var   
ATN (num-expr)

**ATTR**

ATTRibutes

Function

ATTR (num-expr,num-expr)

**BEEP**

Statement/Command

BEEP num-expr,num-expr

**BIN**

BINary number

Function

BIN [0][1]

**BORDER**

Statement/Command

BORDER int-num-expr

**CALL**

Statement/Command

CALL int-num-expr[;]

**CHR$**

CHaRacter (string)

CHR$ int-num-const[;]  
[+] CHR$ int-num-var[;]  
[+]CHR$ (int-num-expr)[;][+]

**CIRCLE**

Statement/Command

CIRCLE [statement;]int-num-expr,int-num-expr,int-num-expr

**CLEAR**

Statement/Command

CLEAR [num-expr]

**CLOSE**

Statement/Command

CLOSE #int-num-expr

**CLS**

Statement/Command

CLS

**CLUT**

Statement/Command

CLUT int-num-expr[;]

**CODE**

Function

CODE string-const  
CODE string-var  
CODE (string-expr)

**COLOR**

Statement/Command

COLOR int-num-expr[;]

**CONTINUE**

Command

CONTINUE

**COS**

COSine

Function

COS num-const  
COS num-var  
COS (num-expr)

**DATA**

Statement

DATA num-expr[,num-expr][,string-expr]  
DATA string-expr[,num-expr][,string-expr]

**DEF FN**

DEFine FuNction

Statement

DEF FN letter([letter][,letter]) = num-expr  
DEF FN letter$([letter$][letter][,letter][,letter$]) = string-expr

**DELETE**

Command

DELETE int-num-const,int-num-const  
DELETE int-num-var,int-num-var  
DELETE (num-expr),(num-expr)

**DIM**

DIMension array

Statement

DIM letter (num-expr[,num-expr])  
DIM letter$ (num-expr[,num-expr])

**DRAW**

Statement/Command

DRAW [statement;]int-num-expr,int-num-expr[,int-num-expr]

**EDIT**

Command

EDIT int-num-const  
EDIT int-num-var  
EDIT (int-num-expr)

**EXP**

EXPonent

Function

EXP num-const  
EXP num-var  
EXP (num-expr)

**FAST**

Statement/Command

FAST

**FN**

FuNction

FN letter([num-expr][,num-expr])  
FN letter$([string-expr][num-expr][,num-expr][,string-expr])

**FOR**

Statement/Command

FOR letter = num-expr TO num-expr [STEP num-expr]

**GOSUB**

GO to SUBroutine

Statement/Command

GOSUB int-num-expr

**GOTO**

GO TO line

Statement/Command

GOTO int-num-expr

**IF**

Statement/Command

IF num-expr THEN statement[:statement]  
IF cond THEN statement[:statement]

**IN**

Function

IN num-const  
IN num-var  
IN (num-expr)

**INKEY$**

INput Key (string)

Function

INKEY$

**INPUT**

Statement/Command

INPUT [prompt][;][,][']num-var  
INPUT [prompt][;][,][']string-var  
INPUT [prompt][;][,]['] LINE string-var

**INT**

INteger

Function

INT num-const  
INT num-var  
INT (num-expr)

**INVERSE**

Statement/Command

INVERSE int-num-expr

**LEN**

LENgth of string

Function

LEN string-const  
LEN string-var  
LEN (string-expr)

**LET**

Satement/Command

LET num-var = num-expr  
LET string-var = string-expr

**LINE**

See INPUT, SAVE

**LIST**

Command

LIST [int-num-expr]

**LOG**

LOGarithm (Natural)

Function

LOG num-const  
LOG num-var  
LOG (num-expr)

**LOAD**

Command/Statement

LOAD string-expr  
LOAD string-expr CODE [int-num-expr][,int-num-expr]  
LOAD string-expr DATA letter[$]()  
LOAD string-expr SCREEN$

**MERGE**

Statement/Command

MERGE string-expr

**MODE**

Statement/Command

MODE int-num-expr

**NEW**

Command

NEW

**NEXT**

Statement/Command

NEXT letter

**NOT**

Logical Operator/Function

NOT cond  
NOT num-expr

**ON ERROR**

Statement/Command

ON ERROR CONTINUE  
ON ERROR GOTO num-expr  
ON ERROR STOP

**OPEN**

Statement/Command

OPEN #int-num-expr

**OR**

Logical Operator/Function

cond OR cond  
num-expr OR num-expr

**OUT**

Statement/Command

OUT int-num-expr,num-expr

**OVER**

Statement/Command

OVER int-num-expr

**PALETTE**

Statement/Command

PALETTE num-expr,num-expr

**PAPER**

Statement/Command

PAPER int-num-expr[;]

**PAUSE**

Statement/Command

PAUSE [int-num-expr]

**PEEK**

Statement/Command

PEEK int-num-const  
PEEK int-num-var  
PEEK (int-num-expr)

**PEN**

Statement/Command

PEN int-num-expr[;]

**PI**

Function

PI

**PLOT**

Statement/Command

PLOT [statement:]int-num-expr,int-num-expr

**POINT**

Function

POINT (int-num-expr, int-num-expr)

**POKE**

Statement/Command

POKE int-num-expr, int-num-expr

**PRINT**

Statement/Command

PRINT [TAB int-num-expr;][AT int-num-expr,int-num-expr;][CHR$ (int-num-expr);][statement;][num- expr][string-expr][;][,][']

**PUT**

Statement/Command

PUT int-num-expr,int-num-expr,int-num-expr

**RANDOMIZE**

Statement/Command

RANDOMIZE [int-num-expr]

**READ**

Statement/Command

READ num-var[,num-var][,string-var]  
READ string-var[,num-var][,string-var]

**REM**

REMark

REM [any characters]

**RENUM**

RENUMber

Command

RENUM [int-num-expr][,int-num-expr]

**RESET**

Statement/Command

RESET

**RESTORE**

Statement/Command

RESTORE int-num-expr

**RETURN**

Statement/Command

RETURN

**RND**

RaNDom number

Function

RND

**RUN**

Statement/Command

RUN [int-num-expr]

**SAVE**

Statement/Command

SAVE string-expr [LINE int-num-expr]  
SAVE string-expr CODE int-num-expr,int-num-expr  
SAVE string-expr DATA letter[$]()  
SAVE string-expr SCREEN

**SCREEN$**

SCREEN (string)

Function

SCREEN$ (int-num-expr,int-num-expr)

**SGN**

SiGN

Function

SGN num-const SGN num-var SGN (num-expr)

**SIN**

SINe

Function

SIN num-const SIN num-var SIN (num-expr)

**SLOW**

Statement/Command

SLOW

**SOUND**

Statement/Command

SOUND int-num-expr,int-num-expr[;int-num-expr,int-num-expr]

**SQR**

SQuare Root

Function

SQR num-const  
SQR num-var  
SQR (num-expr)

**STEP**

See FOR.

**STOP**

Statement/Command

STOP

**STR$**

STRing (string)

Function

STR$ num-const  
STR$ num-var  
STR$ (num-expr)

**TAB**

TABulate See PRINT.

**TAN**

TANgetn

TAN num-const  
TAN num-var  
TAN (num-expr)

**THEN**

See IF.

**TO**

Function

string-const ([num-expr] TO [num-expr])  
string-var ([num-expr] TO [num-expr])  
(string-expr)([num-expr] TO [num-expr])

**UDG**

User Defined Graphics

Statement/Command

UDG int-num-const

**USR**

User Sub-Routine

Function

USR int-num-const  
USR int-num-var  
USR (int-num-expr)  
USR string-const  
USR string-var

**VAL**

VALue

Function

VAL string-const  
VAL string-var

**VAL$**

VALue (string)

Function

VAL$ string-expr

**VERIFY**

Command/Statement

VERIFY string-expr  
VERIFY string-expr CODE [int-num-expr][,int-num-expr]  
VERIFY string-expr DATA letter[$]()  
VERIFY string-expr SCREEN$

# Memory Map‬

+-----+---------+------------+---------+-------+-----------+-----------+...

| ROM | Display | Attributes | Palette | UDGs | User | System |

| | File\* | | | | Variables | Variables |

+-----+---------+------------+---------+-------+-----------+-----------+...

^ ^ ^ ^ ^ ^ ^ ^

| | | | | | | |

0 16384 22528 23296 23360 23528 23550 23734

...+------------+-------------+----+---------+-----------+----+...

| Microdrive | Channel | 0x | BASIC | Variables | 0x |

| Maps | Information | 80 | Program | | 80 |

...+------------+-------------+----+---------+-----------+----+...

^ ^ ^ ^ ^

| | | | |

23734 CHANS PROG VARS ELINE

...+--------------------+---+----+-------+---+------------+------------+...

| Command or program | N | 0x | INPUT | N | Temporary | Calculator |

| line being entered | L | 80 | Data | L | Work Space | Stack |

...+--------------------+---+----+-------+---+------------+------------+...

^ ^ ^ ^

| | | |

ELINE WORKSP STKBOT STKEND

...+-------+---------+-------+---+----+

| Spare | Machine | GOSUB | ? | 0x |

| | Stack | Stack | | 3e |

...+-------+---------+-------+---+----+

^ ^ ^ ^

| | | |

STKEND SP CHANS RAMTOP PRAMT

\* in mode 0. Character definitions 128-255 can be stored here in mode 1.

SE BASIC provides 25 user variables addressable via IY at the following addresses:

23528 &5BE8 (IY - &22)

23529 &5BE9 (IY - &23)

23530 &5BEA (IY - &24)

23531 &5BEB (IY - &25)

23532 &5BEC (IY - &26)

23533 &5BED (IY - &27)

23534 &5BEE (IY - &28)

23535 &5BEF (IY - &29)

23536 &5BF0 (IY - &2A)

23537 &5BF1 (IY - &2B)

23538 &5BF2 (IY - &2C)

23539 &5BF3 (IY - &2D)

23540 &5BF4 (IY - &2E)

23541 &5BF5 (IY - &2F)

23542 &5BF6 (IY - &30)

23543 &5BF7 (IY - &31)

23544 &5BF8 (IY - &32)

23545 &5BF9 (IY - &33)

23546 &5BFA (IY - &34)

23547 &5BFB (IY - &35)

23548 &5BFC (IY - &36)

23549 &5BFD (IY - &37)

23549 &5BFE (IY - &38)

23549 &5BFF (IY - &39)

23681 &5CB1 (IY + &47)

# System Variables‬

OLDSP 23550 Used by DEF FN.

KSTATE 23552 (8) Keyboard state.

LASTK 23560 Shift and key code from last key press.

REPDEL 23561 Delay before keys auto-repeat (in 50ths. of a second);

normally 25.

REPSPD 23562 Delay between key repeats (in 50ths. of a second); normally

2.

DEFADD 23563 (2) DEF FN address (offset).

KDATA 23565 Used by keyscan.

TVDATA 23566 (2) Used in handling control codes and their parameters.

STREAMS 23568 (38) For streams -3 to 15, a word gives the displacement

from the start of the channels area to the assigned channel.

If the word is zero, the stream is closed.

CHARS 23606 (2) Address 256 bytes below start of main character set.

ERRSOUND 23608 Length of error sound in 50ths. of a second; normally 60.

CLICK 23609 Length of keyboard click (normally zero).

ERRNR 23610 Error number.

FLAGS 23611 Main flags byte.

DFLAG 23612 Display flags.

ERRSP 23613 (2) SP value to use when an error occurs.

LISTSP 23615 (2) SP value to use when an automatic list fills the screen.

MODE 23617 Cursor mode; L, C, E or G.

NEWPPC 23618 (2) New line to jump to.

NSPPC 23620 New statement to jump to, or FFH.

PPC 23621 (2) Current line number during program execution.

SUBPPC 23623 Current statement number.

BORDCR 23624 Attributes for lower screen except in MODE 2.

EPPC 23625 (2) number of line with > cursor.

VARS 23627 (2) Address of variables.

DEST 23629 (2) Used in variable assignments.

CHANS 23631 (2) start of channels area.

CURCHL 23633 (2) start of current channel.

PROG 23635 (2) Program start (address of line number of first line).

NXTLINE 23637 (2) Address of next line in Basic program.

DATADD 23639 (2) Data address used by READ command.

ELINE 23641 (2) Edit line start.

KCUR 23643 (2) Address of cursor in the edit line.

CHADD 23645 (2) Current character address.

XPTR 23647 (2) Address in the edit line of a syntax error.

STKBOT 23651 (2) Address of bottom of calculator stack.

STKEND 23653 (2) End of floating point calculator stack.

BREG 23655 Calculator’s B register.

MEM 23656 (2) Start of calculator’s memory area.

KLFLAG 23658 8 if caps lock is on, else zero.

DFSZ 23659 The number of lines (including one blank line) in the lower

part of the screen.

SDTOP 23660 (2) Line number of top line in an automatic listing.

COPPC 23662 (2) Line number that CONTINUE goes to.

COSPCC 23664 Statement number that CONTINUE goes to.

FLAGE 23665 Flags used by INPUT command and the editor.

STRIL 23666 (2) Used when variables are assigned to.

TADDR 23668 (2) Address of next item in syntax table.

SEED 23670 (2) Random number seed. Set by RANDOMIZE.

FRAMES 23672 (3) Frames since machine was switched on (LSB first).

UDG 23675 (2) Address of CHR$ 144.

XCOORD 23677 Current graphics position x coordinate, with 0 at the left.

The range is 0-255.

YCOORD 23678 Current graphics position y coordinate, with 175 at the top

of the screen and 0 at the bottom.

ERRLN 23679 (2) line to go to ON ERROR.

ONERRFLAG 23680 FFH=STOP, FEH=CONTINUE, else GOTO.

USER 23681 Not used.

ECHOE 23682 (2) 33 column number and 24 line number (in lower half) of

end of input buffer.

DFCCU 23684 (2) Address in display file of upper window PRINT position.

DFCCL 23686 (2) Address in display file of lower window PRINT position.

SPOSNU 23688 (2) Upper window position as column/row.

SPOSNL 23690 (2) Lower window position as column/row.

SCRCT 23692 (2) Counter used to give “Scroll?” prompt.

ATTRP 23693 Attributes used by mode 0.

MASKP 23694 Mask used by mode 0. Bits which are 1 make the corresponding

attribute bit be taken from the screen, not ATTRP.

ATTRT 23695 Temporary version of ATTRP.

MASKT 23696 Temporary version of MASKP.

WORKSP 23649 (2) workspace start.

PFLAG 23697 Bit 4 and 5 are set for paper 9, bit 6 and 7 for pen 9.

MEMBOT 23698 (30) Calculator’s memory area.

NMIADD 23728 (2) Address to jump to when a peripheral activates the NMI.

RAMPTOP 23730 (2) Address of last byte of BASIC system area.

PRAMT 23732 (2) Address of last byte of physical RAM.

## Flags

FLAGS

0 - set to prevent leading space

2 - set if last character detokenized was control code (temporary)

3 - set if 8-bit character set in use

5 - set if a key is pressed

6 - set if numeric result

7 - reset if checking syntax

DFLAG

0 - set when lower screen in use

3 - set if EDIT pressed

4 - set if automatic listing required

5 - set to clear lower screen

KLFLAG

0 - set to clear main screen

3 - set to enable caps lock

4 - set if K channel in use

FLAGE

0 - set if string

1 - set if variable

5 - set if INPUT mode

7 - set if INPUT line

ONERRFLAG

0-7 = set to STOP

1-6 = set to CONTINUE

6-7 = reset to GOTO

PFLAG

4 - set if pen 9

5 - set if pen 9

6 - set if paper 9

7 - set if paper 9

# Error Reports

Codes refer to the equivalent SAM BASIC error report.

CODE ERROR REPORT

**0 OK**  
No problems, successful completion, everything is OK.

**1 Out of memory**

There is not enough room in the computer's memory for what you want to do.

**2 Undefined variable**

The computer cannot find a variable, either because it has not yet been loaded, not been assigned or set up, or you have not set its dimensions.

**3 End of DATA**

You are trying to READ past the end of the existing DATA listing.

**4 Bad subscript**

Either the number of subscripts is wrong or the subscript is outside the dimensions of the array.

**5 NEXT without FOR**

Even though there is an ordinary variable with the same name, the control variable has not yet been set up by a FOR statement.

**6 FOR without NEXT**

Even though there is a FOR loop waiting to run, there is no NEXT statement to go with it.

**7 Undefined FN**

A user-defined function is missing.

**8 RETURN without GOSUB**

There is a RETURN statement without a GOSUB to welcome it back.

**14 BREAK into program**

BREAK has been hit in between two statements, and the line and statement number that are shown refer to the statement before BREAK was used. When you CONTINUE, the program goes to the statement that follows and allows for any program jumps that you have made.

**15 BREAK, CONTINUE repeats**

BREAK has been hit while a peripheral operation was taking place, so when you CONTINUE the last statement is repeated.

**16 STOP statement**

When you want to CONTINUE after this, the program will start again at the next statement.

**17 STOP in INPUT**

When you want to CONTINUE after this, the program will start again by repeating the last INPUT statement.

**18 Bad filename**

You are trying to SAVE a file but have forgotten to give it a name, or the name is longer than 10 characters.

**19 Loading error**

The file you want to LOAD has been found but there is something wrong with it and it refuses to LOAD properly or fails to VERIFY. Check your cables, volume level, cassette tape and dirty play-back heads of the cassette player.

**20 Bad device**

You are trying to SAVE or LOAD data, but you are using the wrong thing for input/output (such as a disk drive instead of a cassette recorder), or have forgotten to plug it in.

**21 Bad stream**

You are trying to use a stream number that is inappropriate. Streams 0 to 165 are the paths to the various channels, e.g. 47 "K", "S", "R"; or you are trying to use a stream number that is closed.

**22 End of file**

The end of a file has been reached, usually a disk file.

**23 Bad colour**

You have tried to specify a colour with a number that is not appropriate.

**26 Parameter error**

Either you have used the wrong number of arguments, or the wrong type of argument, like a number instead of a string.

**27 Bad argument**

You are using an argument that is not suitable for the function you want.

**28 Number too large**

Your calculations have resulted in a number that is too enormous for the computer to handle.

**29 Syntax error**

The computer is confused by your (mis)use of BASIC.

**30 Integer out of range**

A whole number (called an integer) is required, but the argument you are using has been rounded to an integer that is outside of a suitable range.

**31 Missing statement**

The computer can't make a decision or obey an instruction without the necessary statements. For example, you may have deleted statements after a GOSUB and then RETURNed.

**32 Off screen**

The graphic requirements that you have asked for cannot fit on the screen.

**33 No room for line**

There is not enough room in the available memory for the line you are trying to insert, or the line numbering requested in a RENUM is impossible.

**48 Bad CLEAR address**

You are trying to CLEAR with a number beyond the limits of memory allocated to BASIC