

# ARTISAN BASIC

MSX-BASIC extension

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## INTRODUCTION

ARTISAN BASIC is an extension of MSX BASIC. It is targeted at MSX1 machines with 64Kb memory and a disk system.

The idea for development came after competing in MSX BASIC competition.

<https://www.msxblog.es/concurso-msx-basic-go-edicion/>

I have always felt that the capabilities of the machine could have been better exploited under BASIC.

The main areas that ARTISAN extension is focusing on are:

- Extended memory support
- Bitmap operations
- Animation support
- Sound player
- Data decompression
- Disk loading
- Helper functions

Extension loads itself in page 1 at address #4000 and provides several new commands. Following sections will describe main functionality groups and details about each new command are given later. Refer to the table of contents.

Version	Date	Description
0.8		Initial version

0.9	15.12.2022	Extension available in two flavors: as commands or DEFUSR calls ARTINFO command added
0.91	8.8.2023	Added sprite update bit in MEMVRM
0.92	4.6.2024	Added UNPACK and VUNPACK
0.93	24.6.2024	Added DLOAD and DEFUSR return code

## EXTENDED MEMORY SUPPORT

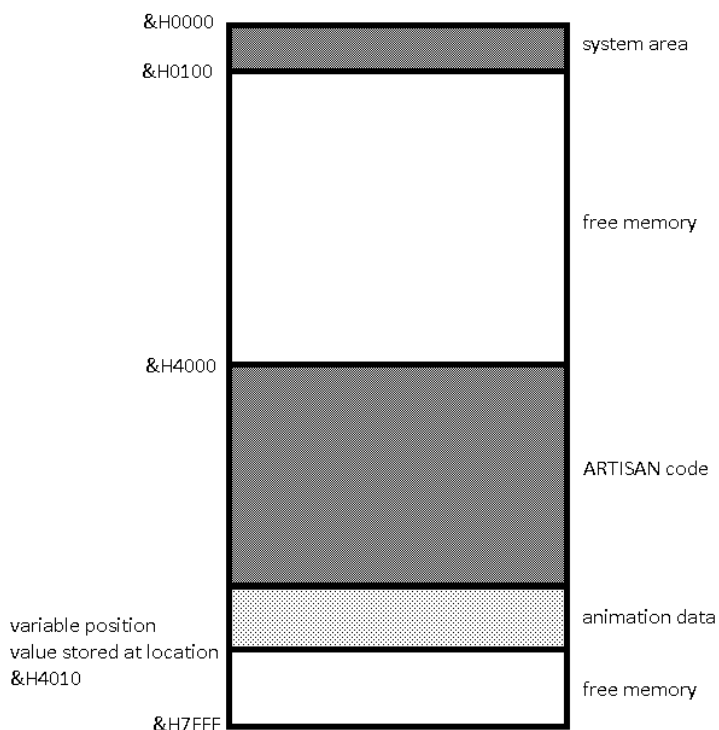
Standard MSX BASIC allows access to 32Kb of memory. In 64Kb systems there is another 32Kb hidden beneath ROM in pages 0 and 1. ARTISAN basic allows memory to be copied to and from this upper 32Kb. Additionally copying to and from VRAM can come from and to this upper 32Kb.

Commands from other sections that take memory buffers as parameters can read data from this area of memory. There are also a few commands that allow copying data from and to VRAM.

Commands included are:

- [BOXMEMCPY](#)
- [BOXMEMVRM](#)
- [FILRAM](#)
- [FILVRM](#)
- [MEMCPY](#)
- [MEMVRM](#)
- [VRMMEM](#)

Since ARTISAN BASIC code also resides in this upper 32Kb, not all of it is free for use by programs. Memory map is given below:



ARTISAN BASIC does not occupy any memory below &H8000 allowing BASIC programs to have the same amount of free memory for code and variables as without the extension.



## BITMAP OPERATIONS

Several functions are provided to allow working with software sprites and tiling. Software sprites are defined by their data and mask that gets applied to background. Tiling functions allow placing data in a memory buffer or in video memory in a sequential fashion, when you want to apply one pattern over a larger area.

Commands included are:

- [BLIT](#)
- [TILERAM](#)
- [TILEVRM](#)

## ANIMATION SUPPORT

This section allows the creation of animation definitions that execute regularly based on VDP interrupt. Animation definitions allow changing of sprite pattern number, pattern data or changing character data.

To enable sprite animations, sprite handling has been revamped. Instead of PUT SPRITE commands one needs to define an array where sprite data is kept. This is transferred to VRAM on each interrupt.

Additionally grouping of sprites is supported which allow simultaneous moves and animation.

Commands in this section are grouped into several sections:

- Basic sprite handling system
  - [SPRDISABLE](#)
  - [SPRENABLE](#)
- Group of sprites handling
  - [SPRGRPMOV](#)
- Animation definitions
  - [ANIMTEMPAT](#)
  - [ANIMTEMPTR](#)
  - [ANIMDEF](#)
  - [ANIMSPRITE](#)
  - [ANIMCHAR](#)
  - [AUTOSGAMDEF](#)
- Animation control

- [ANIMSTART](#)
- [ANIMSTOP](#)
- [ANIMSTEP](#)
- [AUTOSGAMSTART](#)
- [AUTOSGAMSTOP](#)
- [SGAM](#)
- Animation memory buffers
  - [MAXANIMDEFS](#)
  - [MAXANIMITEMS](#)
  - [MAXANIMSPRS](#)
  - [MAXAUTOSGAMS](#)

## NEW SPRITE CONTROL SYSTEM

The use of sprites is modified in ARTISAN basic in the following ways:

- Sprite attributes (location, pattern and color) are kept in an integer BASIC array of size (3,31)
- Values from the array are passed to VRAM during vertical blank if indicated by a specified integer variable
- Sprite control system is activated by SPRENABLE command
- When the system is active one should not run any commands that modify VRAM because of possible collision with sprite update
- When the system is active no new variables can be declared as this will cause corruption of the sprite control system

## ANIMATION DATA MEMORY HANDLING

Defining animations requires some memory usage. This is located directly after the ARTISAN basic code in the segment &H4000-&h7FFF. That is why free memory in this segment depends on how many animations are defined. It is necessary to declare the maximum amount of each type of animation information before the use of definition commands. There are 4 types of definitions:

- Animation item – defines a single state
  - Sprite pattern, color and duration
  - Sprite/character pattern definition pointer and duration
- Animation definition – list of animation items to run
- Sprite/Character animation – link between which sprite/character to animate and with which animation definition
- Automatic Sprite Group Animation and Movement – automatic animation and movement between defined bounds of a sprite group

## BASIC PROGRAM OVERALL STRUCTURE

The layout of the program that uses the sprite control system and animations is as follows:

- Declaration of all variables
- Declaration of sprite attributes array and the sprite update variable
  - `SU%=0:DIM SA%(3,31)`

- Reset of memory buffers for animations by defining zero size
- Resizing of memory buffers to required values
- Obtain free memory location in page 1 using MEMCPY(&H4010,VARPTR(A%),2) where A% was previously defined or using [ARTINFO](#)
- SPRENABLE (SA%,SU%,0/1,32)
- ON ERROR GOTO definition
- ON STOP GOSUB definition
- Main program
- On end/error/stop run:
  - Stop animations
  - SPRDISABLE

## SOUND PLAYER

ARTISAN basic includes the AKG player from ARKOS tracker

<https://www.julien-nevo.com/arkotracker/>

in version 2.01

Sound data should be exported from the Arkos tracker in binary format. Memory location can be in the first two memory pages.

Commands included in this section are:

- [SNDPLYINI](#)
- [SNDPLYOFF](#)
- [SNDPLYON](#)
- [SNDSFX](#)

## DATA DECOMPRESSION

Commands in this section are related to ZXo format

<https://github.com/einar-saukas/ZXo>

Standard Z80 decompressor is implemented with ability to decompress into RAM or VRAM.

Commands included here are:

- [UNPACK](#)
- [VUNPACK](#)

## DISK LOADING

An alternative to BLOAD is provided which allows loading from disk directly into upper 32k as well as below.

Command in this section is:

- [DLOAD](#)



## HELPER FUNCTIONS

This includes various functions that do not belong in previous sections and provide various functionality.

Commands included here are:

- [ARTINFO](#)
- [GENCAL](#)
- [COLL](#)

## BUILDING BINARIES

Code is segmented in several function groups which can be excluded or included. By default, all functions are included.

Flags controlling which sections are included can be found in file main.asm at the beginning.

Additionally, code allows access to functionality via basic CALL command or via DEFUSR command.

This is controlled via compiler options

-DBASIC\_EXTENSION=0/1

-DDEFUSR\_EXTENSION=0/1

Unfortunately, both types of access would result in binary that is over 16Kb and thus unusable.

Because of this, by default, two types are provided in the disk image as:

ARTISANE.bin – for BASIC commands

ARTISAND.bin – for DEFUSR access

More information can be found in sections [INFORMATIONAL DATA](#) and [APPENDIX A](#)

## ALPHABETICAL LIST OF COMMANDS

### ANIMCHAR

Defines single character animation sequence.

Format:

```
ANIMCHAR (byte ID, integer  
character_number, byte  
animation_definition_id, byte  
cyclic_flag)
```

Where:

ID is between 0 and MAXANIMSPRS-1 value

character\_number specifies the character to animate  
(0-767)

animation\_definition\_id is between 0 and  
MAXANIMDEFS-1

cyclic\_flag of 0 means that the animation will run one  
time only, other values mean a looping animation

Prerequisites:

- MAXANIMSPRS reserved memory for definition
- Animation definition prepared with ANIMDEF

Errors:

- Invalid type if incorrect type passed

- Subscript out of bounds if parameters outside of allowed range

Example:

```
_ANIMCHAR(0,255,0,1)
```

Sample code:

- ANIMTEST.BAS
- GAME.BAS

## ANIMDEF

Defines a list of animation items which is later associated with a character or a sprite.

Format:

```
ANIMDEF (byte ID, byte size, integer[] values)
```

Where:

ID is between 0 and MAXANIMDEFS-1 value

size is number of animation items (1-15)

values holds animation item IDs that form this animation definition

Prerequisites:

- MAXANIMDEFS reserved memory for definition

- Animation items prepared with ANIMITEMPTR/ANIMITEMPAT

Errors:

- Invalid type if incorrect type passed
- Subscript out of range if ID invalid
- Overflow if size outside 1-15 range
- Index out of bounds if values array smaller than size parameter

Example:

```
DIM V% (1) : V% (0) = 0 : V% (1) = 1
```

```
_ANIMDEF (0, 2, V%)
```

Sample code:

- ANIMTEST.BAS
- GAME.BAS

## ANIMITEMPAT

Defines a single animation state where sprite pattern and color are specified. Usable for sprites only.

Format:

```
ANIMITEMPAT (byte ID, integer ticks, byte  
pattern, byte color)
```

Where:

ID is between 0 and MAXANIMITEMS-1 value

ticks is number of interrupts that this animation item lasts before stepping over to the next state as defined in animation definition (>0)

pattern specifies sprite pattern to apply to a sprite

color specifies the color to apply to a sprite

Prerequisites:

- MAXANIMITEMS reserved memory for definition

Errors:

- Subscript out of range if ID invalid
- Overflow if ticks=0

Example:

```
_ANIMITEMPAT (0, 4, 5, 6)
```

Sample code:

- ANIMTEST.BAS
- GAME.BAS

## ANIMITEMPTR

Defines a single animation state where pattern data is specified. Applicable to sprites and characters.

Format:

ANIMITEMPTR (byte ID, integer ticks,  
integer pointer)

Where:

ID is between 0 and MAXANIMITEMS-1 value

ticks is number of interrupts that this animation item lasts before stepping over to the next state as defined in animation definition (>0)

pointer is a memory location where pattern data is located, can be in pages 0 and 1.

Prerequisites:

- MAXANIMITEMS reserved memory for definition

Errors:

- Subscript out of range if ID invalid
- Overflow if ticks=0

Example:

```
_ANIMITEMPTR (1, 3, &H2000)
```

Sample code:

- ANIMTEST.BAS
- GAME.BAS

## ANIMSPRITE

Defines single sprite animation sequence.

Format:

```
ANIMSPRITE (byte ID, integer  
sprite_number, byte  
animation_definition_id, byte  
cyclic_flag)
```

Where:

ID is between 0 and MAXANIMSPRS-1 value

sprite\_number specifies the sprite to animate (0-31)

animation\_definition\_id is between 0 and  
MAXANIMDEFS

cyclic\_flag of 0 means that the animation will run one  
time only, other values mean a looping animation

Prerequisites:

- MAXANIMSPRS reserved memory for definition
- Animation definition prepared with ANIMDEF

Errors:

- Invalid type if incorrect type passed
- Subscript out of bounds if parameters outside of  
allowed range



Example:

```
_ANIMSPRITE (0,5,0,1)
```

Sample code:

- ANIMTEST.BAS
- GAME.BAS

## ANIMSTART

Starts animation sequence.

Format:

```
ANIMSTART (byte ID)
```

or

```
ANIMSTART (byte item_number, integer[]  
sprite_animations)
```

Where:

ID is between 0 and MAXANIMSPRS-1 value

`item_number` specifies the number of animations in the array

`sprite_animations` array holds animation ids to start simultaneously

Prerequisites:

- Animation definition prepared with ANIMDEF

Errors:

- Invalid type if incorrect type passed
- Subscript out of bounds if parameters outside of allowed range

Example:

```
_ANIMSTART (1)
```

Or

```
DIM A% (2) : A% (0) = 0 : A% (1) = 1 : A% (2) = 2
```

```
_ANIMSTART (3, A%)
```

Sample code:

- ANIMTEST.BAS
- GAME.BAS

## ANIMSTEP

Manually progresses animation which is not started with ANIMSTART.

Format:

```
ANIMSTEP (byte ID)
```

or

```
ANIMSTEP (byte item_number, integer[]  
sprite_animations)
```

Where:

ID is between 0 and MAXANIMSPRS-1 value

`item_number` specifies the number of animations in the array

`sprite_animations` array holds animation ids to step simultaneously

Prerequisites:

- Animation definition prepared with ANIMDEF

Errors:

- Invalid type if incorrect type passed
- Subscript out of bounds if parameters outside of allowed range

Example:

```
_ANIMSTEP (1)
```

Or

```
DIM A% (2) : A% (0) = 0 : A% (1) = 1 : A% (2) = 2
```

```
_ANIMSTEP (3, A%)
```

Sample code:

- ANIMTEST.BAS
- GAME.BAS

## ANIMSTOP

Stops animation sequence.

Format:

`ANIMSTOP (byte ID)`

or

`ANIMSTOP (byte item_number, integer[]  
sprite_animations)`

Where:

`ID` is between 0 and `MAXANIMSPRS-1` value

`item_number` specifies the number of animations in the array

`sprite_animations` array holds animation ids to stop simultaneously

Prerequisites:

- Animation definition prepared with `ANIMDEF`

Errors:

- Invalid type if incorrect type passed
- Subscript out of bounds if parameters outside of allowed range

Example:

```
_ANIMSTOP (1)
```

Or

```
DIM A% (2) : A% (0) = 0 : A% (1) = 1 : A% (2) = 2
```

```
_ANIMSTOP (3, A%)
```

Sample code:

- ANIMTEST.BAS
- GAME.BAS

## ARTINFO

Provides information about ARTISAN basic extension. This includes version, flags used to build it and free memory start position in page 1.

Note that this command is always available regardless of how ARTISAN basic was compiled and can be used to test if the extension is installed.

Format:

```
ARTINFO (int variable version, int  
variable flags, int variable free_memory)
```

Where:

`version` is a variable receiving version info in the form as described under [INFORMATIONAL DATA](#)

`flags` variable holds build flags for the solution as described under [INFORMATIONAL DATA](#)

`free_memory` variable holds memory location in page 1 where free memory begins.

Prerequisites:

- None

Errors:

- Invalid type if incorrect type passed

Example:

```
V%=0:F%=0:M%=0
```

```
_ARTINFO(V%,F%,M%)
```

Sample code:

- AUTOEXEC.BAS

## AUTOSGAMDEF

Defines automatic sprite group animation and movement between specified bounds.

Format:

```
AUTOSGAMDEF (byte ID, integer variable x,  
integer variable y, integer minimum,  
integer maximum, integer delta, integer  
direction, integer ticks, byte
```

```

sprite_group_size, integer[2][] variable
sprite_group, byte item_number, integer[]
variable
sprite_animations_negative_direction,
integer[] variable
sprite_animations_positive_direction )

```

Where:

ID is between 0 and MAXAUTOSGAMS-1 value

X is integer variable that holds horizontal sprite group location

Y is integer variable that holds vertical sprite group location

minimum is the low range value of possible locations

maximum is the high range value of possible locations

delta is the step value for movement

directions defines horizontal (=0) or vertical (!=0) direction

ticks is the number of interrupts between sprite group movement and stepping through animations

sprite\_group\_size defines number of sprites in a sprite group

sprite\_group is an array describing a sprite group, for details refer to SPRGRPMOV command

`item_number` defines number of animations to step through

`sprite_animations_negative_directions` holds animations for when sprite group is going backwards

`sprite_animations_positive_directions` holds animations for when sprite group is going forward

Prerequisites:

- MAXAUTOSGAMS reserved memory for definition
- Animations prepared with ANIMSPRITE

Errors:

- Invalid type if incorrect type passed
- Subscript out of range if ID invalid

Example:

```
DIM AL%(2):AL%(0)=0:AL%(1)=1:AL%(2)=2
```

```
DIM AR%(2):AR%(0)=3:AR%(1)=4:AR%(3)=5
```

```
DIM SG%(2,1):SG%(0,0)=0:SG%(1,0)=0:SG%(2,0)=0
```

```
SG%(0,1)=1:SG%(1,1)=0:SG%(2,1)=0
```

```
X%=0:Y%=0
```



```
_AUTOSGAMDEF (0,X%,Y%,0,100,1,0,1,2,SG%,3,  
AL%,AR%)
```

Sample code:

- ANIMTEST.BAS
- GAME.BAS

## AUTOSGAMSTART

Starts automatic sprite group movement and animation.

Format:

```
AUTOSGAMSTART (byte ID)
```

Where:

ID is between 0 and MAXAUTOSGAMS-1 value

Prerequisites:

- Animation definition prepared with AUTOSGAMDEF

Errors:

- Invalid type if incorrect type passed
- Subscript out of bounds if parameters outside of allowed range

Example:

```
_AUTOSGAMSTART (1)
```

Sample code:

- ANIMTEST.BAS
- GAME.BAS

## AUTOSGAMSTOP

Stops automatic sprite group movement and animation.

Format:

`AUTOSGAMSTOP (byte ID)`

Where:

ID is between 0 and MAXAUTOSGAMS-1 value

Prerequisites:

- Animation definition prepared with AUTOSGAMDEF

Errors:

- Invalid type if incorrect type passed
- Subscript out of bounds if parameters outside of allowed range

Example:

`_AUTOSGAMSTOP (1)`

Sample code:

- ANIMTEST.BAS
- GAME.BAS

## BLIT

Command implements software sprite functionality. It applies monochrome object of defined size onto defined memory background with 1 pixel precision. Object is defined with mask and data. Mask will be ANDed with background and then data will be ORed with background. All memory locations can be in pages 0 and 1.

Format:

```
BLIT (integer x, integer y, integer  
object_data_pointer, integer  
object_mask_pointer, integer width,  
integer height, integer  
background_pointer, integer  
background_width)
```

Where:

X is location in the background ( $\geq 0$ )

Y is location in the background ( $\geq 0$ )

object\_data\_pointer is a memory location where object foreground is defined

object\_mask\_pointer is a memory location where object mask is defined

width is object width in characters (8 pixels)

height is object height in characters (8 pixels)

`background_pointer` is a memory location where `background` is located

`background_width` is background width in characters (8 pixels)

Prerequisites:

- None

Errors:

- Invalid type if incorrect type passed

Example:

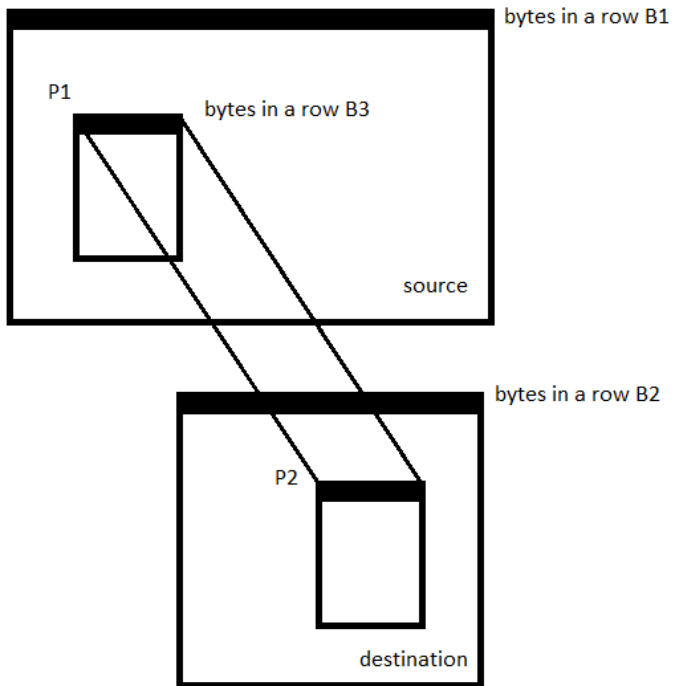
```
_BLIT(55, 31, &h7000, &h7800, 12, 5, &h100, 32, 24)
```

Sample code:

- DEMO2.BAS
- FONT2.BAS
- GAME.BAS

## BOXMEMCPY

Copies window like data segment from one location into another. Locations can be in pages 0 and 1.



Format:

```
BOXMEMCPY (integer P1, integer B3,
integer number_of_rows, integer B1,
integer P2, integer B2)
```

Where:

P1 is memory location where source data begins

B3 is number of bytes in a single row of source data

`number_of_row` is number of rows of source data

`B1` is number of bytes of a source window row

`P2` is memory location where to copy data

`B2` is number of bytes of destination window row

Prerequisites:

- None

Errors:

- Invalid type if incorrect type passed

Example:

```
_BOXMEMCPY (&H1000, 80, 256, 5, &H7000, 80)
```

Sample code:

- DEMO2.BAS

## BOXMEMVRM

Copies window like data segment from one location in RAM into another in VRAM. Source location can be in pages 0 and 1. Command parameters are the same as for BOXMEMCPY. `B2` value should be 256 for SCREEN 2 mode.

Format:

BOXMEMVRM (integer P1, integer B3,  
integer number\_of\_rows, integer B1,  
integer P2, integer B2)

Where:

P1 is memory location where source data begins

B3 is number of bytes in a single row of source data

number\_of\_rows is number of rows of source data

B1 is number of bytes of a source window row

P2 is memory location where to copy data

B2 is number of bytes of destination window row

Prerequisites:

- None

Errors:

- Invalid type if incorrect type passed

Example:

```
_BOXMEMVRM (&H1000, 80, 256, 5, BASE (12), 256)
```

Sample code:

- DEMO2.BAS

## COLL

Collision detection between one rectangular object and a list of other rectangular objects.

Format:

```
COLL (integer variable result, integer x,  
integer y, integer width, integer height,  
integer list_size, integer[7][] objects)
```

Where:

`result` is an integer variable where the result is stored, -1 if no collision, 0..list\_size-1 if collision

`x` is horizontal location of upper left edge

`y` is vertical location of upper left edge

`width` is the last column of an object, for a 16x16 sprite this is 15

`height` is the last row of an object, for a 16x16 sprite this is 15

`list_size` is the number of objects to check collision against and stored in `objects` variable

`objects` is a two dimensional array that describes collidable objects. These can either be static or sprites. For of a single array element is:

(o,n) – active flag, if o collision will not be checked



(1,n) – is horizontal location of upper left edge OR sprite ID depending on (7,n)

(2,n) – is horizontal location of upper left edge OR not used depending on (7,n)

(3,n) – horizontal offset where actual object begins, for example if a sprite pattern does not actually begin at (0,0)

(4,n) – vertical offset where actual object begins, for example if a sprite pattern does not actually begin at (0,0)

(5,n) – width or the last column of the object

(6,n) – height or the last row of the object

(7,n) – type, 0=generic, <>0 sprite

Prerequisites:

- None

Errors:

- Invalid type if incorrect type passed
- Subscript out of bounds if parameters outside of allowed range

Example:

(X% and Y% already defined)

```
R%=0 : DIM O% ( 7 , 1 )
```

`O%(0,0)=1:O%(1,0)=100:O%(2,0)=80:O%(3,0)=  
0:O%(4,0)=0:O%(5,0)=9:O%(6,0)=9:O%(7,0)=0`

`O%(0,1)=1:O%(1,1)=31:O%(3,1)=4:O%(4,1)=4:  
O%(5,1)=5:O%(6,1)=5:O%(7,1)=1`

`_COLL(R%,X%,Y%,15,15,2,o%)`

Sample code:

- COLLTEST.BAS
- GAME.BAS

## DLOAD

Loads a file from disk, with possibility to skip data at the beginning and to write data to upper 32k of RAM. Makes a raw read ignoring BLOAD header.

Format:

`DLOAD (string filename, integer skip,  
integer destination, integer size)`

Where:

filename is file name on disk in 8+3 format. Allowed formats are:

- FILENAME.EXT
- D:FILENAME.EXT
- FILENAME
- D:FILENAME

Note that when using DEFUSR form another parameter needs to be passed to identify the string type used. For MSX-BASIC set it to 0 and for X-BASIC non zero. MSX-BASIC string type consists of size byte followed by a pointer to ASCII data. X-BASIC string type consists of a size byte followed by actual ASCII data. Check DEMO2USR basic program for example.

`skip` designates the number of bytes to skip at the beginning of the file before starting to read. This is mostly used to skip BLOAD header with a value of 7.

`destination` is the destination in memory where to store data

`size` is the number of bytes to read

Prerequisites:

- None

Example:

```
_DLOAD("FOREST.BIN", 7, &H100, 6293)
```

Sample code:

- UNPACK.BAS
- DEMO2USR.BAS

## FILRAM

Fills memory block with a specified value. Can be used for pages 0 and 1.

Format:

```
FILRAM (integer address, integer count,  
byte value)
```

Where:

`address` is the starting memory block location

`count` is the number of bytes to write

`value` is the number to fill the block with

Prerequisites:

- None

Errors:

- Invalid type if incorrect type passed

Example:

```
_FILRAM (&h1000,1024,0)
```

Sample code:

- None

## FILVRM

Fills video memory block with a specified value.

Format:

`FILVRM (integer address, integer count,  
byte value)`

Where:

`address` is the starting video memory block location

`count` is the number of bytes to write

`value` is the number to fill the block with

Prerequisites:

- None

Errors:

- Invalid type if incorrect type passed

Example:

```
_FILVRM (BASE(12), 6144, 0)
```

Sample code:

- BLIT.BAS
- FONT2.BAS

## GENCAL

Generic assembly call. Allows specifying registers AF, BC, DE, HL, IX and IY before calling specified address. Resulting register values are store back in the input array. Routine does not put RAM in pages 0 and 1 so one can call BIOS routines.

Format:

```
GENCAL (integer address, integer[5]  
registers)
```

Where:

`address` is the location of the routine to call

`registers` in an array holding input and output register values. Order of registers in the array is: AF, BC, DE, HL, IX, IY

Prerequisites:

- None

Errors:

- Invalid type if incorrect type passed
- Subscript out of bounds if register array too short

Example:

```
REM COPY MSX FONT TO VRAM IN SCREEN 2
```

```
DIM R% (5)
```

```
R% (1) = 2048 : R% (2) = 256 * PEEK (5) + PEEK (4) : R% (3)  
)=BASE (12)
```

```
_GENCAL (&H5C, R%)
```

Sample code:

- COLLTEST.BAS

## MAXANIMDEFS

Allocates or deallocates memory for animation definitions.

Each definition consumes 16 bytes.

Format:

```
MAXANIMDEFS (integer number)
```

Where:

`number` is the maximum number of animation definitions.

Prerequisites:

- None

Errors:

- Invalid type if incorrect type passed

Example:

```
_MAXANIMDEFS (5)
```

Sample code:

- ANIMTEST.BAS
- GAME.BAS

## MAXANIMITEMS

Allocates or deallocates memory for animation items.

Each definition consumes 5 bytes.

Format:

```
MAXANIMITEMS (integer number)
```

Where:

`number` is the maximum number of animation items.

Prerequisites:

- None

Errors:

- Invalid type if incorrect type passed

Example:

```
_MAXANIMITEMS (5)
```

Sample code:

- ANIMTEST.BAS
- GAME.BAS



## MAXANIMSPRS

Allocates or deallocates memory for sprite or character animations.

Each definition consumes 8 bytes.

Format:

```
MAXANIMSPRS (integer number)
```

Where:

`number` is the maximum number of sprite or character animations.

Prerequisites:

- None

Errors:

- Invalid type if incorrect type passed

Example:

```
_MAXANIMSPRS (5)
```

Sample code:

- ANIMTEST.BAS
- GAME.BAS

## MAXAUTOSGAMS

Allocates or deallocates memory for automatic sprite group animation and movement definitions.

Each definition consumes 24 bytes.

Format:

```
MAXAUTOSGAMS (integer number)
```

Where:

`number` is the maximum number of automatic sprite group animation and movement definitions.

Prerequisites:

- None

Errors:

- Invalid type if incorrect type passed

Example:

```
_MAXAUTOSGAMS (5)
```

Sample code:

- ANIMTEST.BAS
- GAME.BAS

## MEMCPY

Copies a memory block from source to destination address.  
Can be used for pages 0 and 1.

Format:

```
MEMCPY (integer source, integer  
destination, integer count)
```

Where:

`source` is the memory block location start location

`destination` is the address where to copy

`count` is the number to bytes to copy

Prerequisites:

- None

Errors:

- Invalid type if incorrect type passed

Example:

```
REM GET FREE MEMORY START ADDR IN PAGE 1
```

```
MB%=0
```

```
_MEMCPY (&H4010, VARPTR(MB%), 2)
```

Sample code:

- DEMO2.BAS
- GAME.BAS

## MEMVRM

Copies a memory block from source address in RAM to destination address in VRAM. Can be used for pages 0 and 1.

Format:

```
MEMVRM (integer source, integer
destination, integer count, byte flag)
```

Where:

`source` is the memory block location start location in RAM

`destination` is the address where to copy in VRAM

`count` is the number to bytes to copy

`flag` to wait for vblank to copy data (0=no, >0 yes). If yes, then assembler command HALT is issued before data copy. Also, if bit 2 is set, and sprite system is active, it will set sprite update flag before HALT command.

Prerequisites:

- None

Errors:

- Invalid type if incorrect type passed

Example:

```
_MEMVRM (&H100, BASE(12), 6144,0)
```

Sample code:

- DEMO2.BAS
- GAME.BAS
- FONT2.BAS

## SGAM

Sprite group animation and movement based on a description of a sprite group and animations.

Format:

```
SGAM (integer x, integer y, byte  
sprite_group_size, integer[2][] variable  
sprite_group, byte item_number, integer[]  
variable sprite_animations )
```

Where:

X is horizontal sprite group location

Y is vertical sprite group location

sprite\_group\_size defines number of sprites in a sprite group

sprite\_group is an array describing a sprite group, for details refer to SPRGRPMOV command

`item_number` defines number of animations to step through

`sprite_animations` holds animation definitions for each sprite of a group

Prerequisites:

- Animations prepared with ANIMSPRITE

Errors:

- Invalid type if incorrect type passed
- Subscript out of range if ID invalid

Example:

```
DIM AL%(2):AL%(0)=0:AL%(1)=1:AL%(2)=2
```

```
DIM
```

```
SG%(2,1):SG%(0,0)=0:SG%(1,0)=0:SG%(2,0)=0
```

```
SG%(0,1)=1:SG%(1,1)=0:SG%(2,1)=0
```

```
_SGAM(50,60,2,SG%,3,AL%)
```

Sample code:

- ANIMTEST.BAS
- GAME.BAS

## SNDPLYINI

Initializes the sound player with music and optional sound effects data.

Format:

```
SNDPLYINI (integer music_data, integer  
sfx_data)
```

Where:

`music_data` is a memory location where music for AKG player is located

`sfx_data` is a memory location where sound effects for AKG player are located, if -1 no sound effects

Prerequisites:

- None

Errors:

- Invalid type if incorrect type passed

Example:

```
_SNDPLYINI (&H100, &H1000)
```

Sample code:

- GAME.BAS

## SNDPLYOFF

Disables sound player and stops any running sounds.

Format:

`SNDPLYOFF`

Prerequisites:

- None

Errors:

- None

Example:

`_SNDPLYOFF`

Sample code:

- `GAME.BAS`

**`SNDPLYON`**

Starts the music player and disables key click.

Format:

`SNDPLYON`

Prerequisites:

- Player initialized with `SNDPLYINI`

Errors:

- Out of data if `SNDPLYINI` not called

Example:



`_SNDPLYON`

Sample code:

- `GAME.BAS`

## SNDSFX

Plays sound effect on a specified channel.

Format:

```
SNDSFX (byte sfx_number, byte channel,  
byte volume)
```

Where:

`sfx_number` is the ID of the sound effect (>0)

`channel` is the channel number on which to play the effect  
(0, 1 or 2)

`volume` is the inverted volume scale (0-16), where 0 is full  
volume and 16 is silent

Prerequisites:

- Player initialized with `SNDPLYINI` and sound effects

Errors:

- Out of data if `SNDPLYINI` not called with sound effect data specified
- Illegal function call if `SNDPLYINI` not called at all

Example:

```
_SNDSEFX (5,0,0)
```

Sample code:

- GAME.BAS

## SPRDISABLE

Disables sprites system.

Format:

```
SPRDISABLE
```

Prerequisites:

- None

Errors:

- None

Example:

```
_SPRDISABLE
```

Sample code:

- GAME.BAS
- SPRITES.BAS
- ANIMTEST.BAS

## SPRENABLE

Initializes the sprite system.

Format:

```
SPRENABLE (integer[3][] variable  
sprite_attributes, integer variable  
sprite_update, byte flicker, byte  
num_sprites_handled)
```

Where:

`sprite_attributes` is an array describing sprite attributes in the form:

(0,n) – y coordinate

(1,n) – x coordinate

(2,n) – pattern

(3,n) - color

`sprite_update` is a variable to trigger VRAM update from `sprite_attributes`, when set to `<>0` an update will occur, and value set to 0. The use of animations will updates this flag to 1 as needed too.

`flicker <>0` will cause that sprite attributes are not applied to VRAM in the same order as in `sprite_attributes` but cyclically effectively alleviating 4 sprites per line limitation.

`num_sprites_handled` sets how many sprites are updated in each cycle. Use this for performance reasons if you do not work with full 32 sprites. Valid range is  $0 \leq \text{num\_sprites\_handled} \leq 32$ .

Prerequisites:

- None

Errors:

- Invalid type if incorrect type passed
- Subscript out of range if incorrectly sized array provided

Example:

```
DIM SA%(3,31):SU%=0
_SPRENABLE (SA%, SU%, 1, 32)
```

Sample code:

- GAME.BAS
- SPRITES.BAS
- ANIMTEST.BAS

## SPRGRPMOV

Command moves a group of sprites at the same time.

Format:

```
SPRGRPMOV (integer x, integer y, byte
sprite_group_size, integer[2][] variable
sprite_group )
```

Where:

X is horizontal sprite group location

Y is vertical sprite group location

sprite\_group\_size defines number of sprites in a  
sprite group

sprite\_group is an array describing a sprite group.

(0,n) – sprite number

(1,n) –  $\Delta Y$

(2,n) –  $\Delta X$

Prerequisites:

- Sprite system enabled

Errors:

- Invalid type if incorrect type passed
- Subscript out of range if array too small
- Illegal function call if sprite system disabled

Example:

DIM

SG% (2,1) : SG% (0,0)=0 : SG% (1,0)=0 : SG% (2,0)=0

`SG% (0,1)=1:SG% (1,1)=0:SG% (2,1)=0`

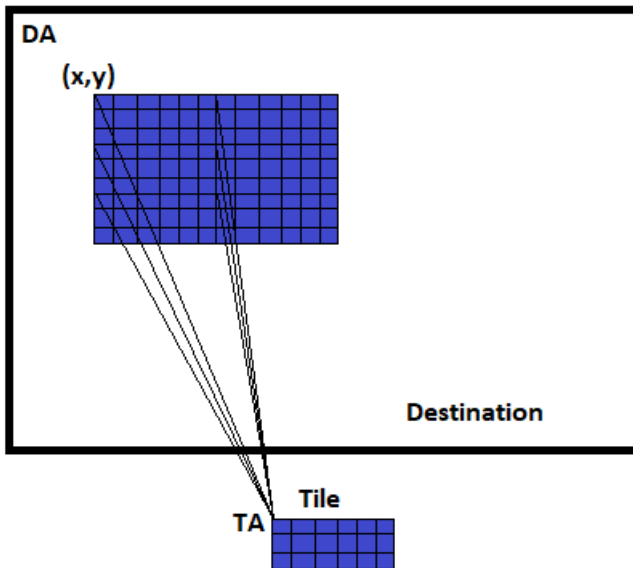
`_SPRGRPMOV (50,60,2,SG%)`

Sample code:

- ANIMTEST.BAS
- GAME.BAS
- SPRITES.BAS

## TILERAM

Copies rectangular shape (tile) several times to destination location in RAM in a tiled fashion.



Format:

```
TILERAM (integer TA, integer  
tile_columns, integer tile_rows, integer  
DA, integer dest_columns, integer  
dest_rows, integer x, integer y, integer  
num_tiles_horizontally, integer  
num_tiles_vertically)
```

Where:

TA is memory location where tile data begins

tile\_columns is the number of 8x8 pixel columns in a tile

tile\_rows is the number of 8x8 pixel rows in a tile

DA is memory location where destination window begins

dest\_columns is the number of 8x8 pixel columns in  
destination

dest\_rows is the number of 8x8 pixel rows in destination

X is column in destination where to start applying tiles

Y is row in destination where to start applying tiles

tiles\_horizontally is the number of tiles to apply in  
horizontal direction

tiles\_vertically is the number of tiles to apply in  
vertical direction

Prerequisites:

- None

Errors:

- Invalid type if incorrect type passed

Example:

```
_TILERAM (&HB000, 1, 1, &H100, 32, 24,
0, 0, 32, 24)
```

Sample code:

- DEMO2.BAS
- FONT2.BAS

## TILEVRM

Copies rectangular shape (tile) several times to destination location in VRAM in a tiled fashion. Function is used exclusively in SCREEN 2.

Format:

```
TILEVRM (integer TA, integer
tile_columns, integer tile_rows, integer
x, integer y, integer
num_tiles_horizontally, integer
num_tiles_vertically)
```

Where:

TA is memory location where tile data begins

tile\_columns is the number of 8x8 pixel columns in a tile



`tile_rows` is the number of 8x8 pixel rows in a tile

`X` is column in destination where to start applying tiles

`Y` is row in destination where to start applying tiles

`tiles_horizontally` is the number of tiles to apply in horizontal direction

`tiles_vertically` is the number of tiles to apply in vertical direction

Prerequisites:

- None

Errors:

- Invalid type if incorrect type passed

Example:

```
_TILEVRM(&HB000,1,1,0,0,32,24)
```

Sample code:

- DEMO2.BAS

## UNPACK

Decompresses data in ZXo format.

Format:

`UNPACK (integer source, integer destination)`

Where:

`source` is the memory block start location in RAM

`destination` is the address where to decompress in RAM

Prerequisites:

- None

Errors:

- Invalid type if incorrect type passed

Example:

```
_UNPACK (&HA000, &H100)
```

Sample code:

- `UNPACK.BAS`

## VRMMEM

Copies a memory block from source address in VRAM to destination address in RAM. Can be used for pages 0 and 1.

Format:

`VRMMEM (integer source, integer destination, integer count)`

Where:

`source` is the memory block start location in VRAM

`destination` is the address where to copy in RAM

`count` is the number to bytes to copy

Prerequisites:

- None

Errors:

- Invalid type if incorrect type passed

Example:

```
_VRMMEM (BASE(12), &H100, 6144)
```

Sample code:

None

## VUNPACK

Decompresses data in ZXo format directly to VRAM.

Format:

`VUNPACK (integer source, integer destination)`

Where:

`source` is the memory block start location in RAM

`destination` is the address where to decompress in VRAM

Prerequisites:

- None

Errors:

- Invalid type if incorrect type passed

Example:

```
_VUNPACK (&H100, 0)
```

Sample code:

- UNPACK.BAS

## INFORMATIONAL DATA

Following memory locations contain useful data about ARTISAN basic extension

- &H4010 – free memory location start address in memory page 1. This is also returned by [ARTINFO](#) command
- &H4012 – ARTISAN basic version in DAA format ab.cd. This is also returned by [ARTINFO](#) command
  - &H4012 = aaaabbbb
  - &H4013 = ccccdddd

ARTISAN basic extension can be compiled with certain parts included or excluded. [ARTINFO](#) will return flags used during compilation. Meaning of flags is given below:

Bit 0 – sound related commands: [SNDPLYINI](#), [SNDPLYON](#), [SNDPLYOFF](#) and [SNDSEFX](#)

Bit 1 – main memory related commands: [MEMCPY](#) and [FILRAM](#)

Bit 2 – video memory related commands: [FILVRM](#), [MEMVRM](#) and [VRMMEM](#)

Bit 3 – bitmap operations: [BLIT](#)

Bit 4 – sprites related commands: [SPRENABLE](#), [SPRDISABLE](#) and [SPRGRPMOV](#)

Bit 5 – generic assembly call: [GENCAL](#)

Bit 6 – tiling commands: [TILERAM](#) and [TILEVRM](#)

Bit 7 – box commands: [BOXMEMCPY](#) and [BOXMEMVRM](#)

Bit 8 – animation commands: [MAXANIMITEMS](#), [ANIMITEMPAT](#), [ANIMITEMPTR](#), [MAXANIMDEFS](#), [ANIMDEF](#), [MAXANIMSPRS](#), [ANIMSPRITE](#), [ANIMCHAR](#),

[MAXAUTOSGAMS](#), [AUTOSGAMDEF](#), [AUTOSGAMSTART](#),  
[AUTOSGAMSTOP](#), [ANIMSTEP](#), [ANIMSTART](#), [ANIMSTOP](#)  
and [SGAM](#)

Bit 9 – collision detection: [COLL](#)

Bit 10 – signifies if basic extension commands are available  
through CALL or \_ syntax ([ARTINFO](#) is always available)

Bit 11 – signifies if functionality is available through DEFUSR

Sample code can be found in AUTOEXEC.BAS file

## APPENDIX A – HOW TO ACCESS FUNCTIONS VIA DEFUSR COMMAND

When extension is compiled with access through DEFUSR (compile flags bit 11 = 1) one should prepare an integer array holding function ID followed by parameters, prepare a machine language call to extension, and pass an address of the parameters array in the DEFUSR call.

The assembly code of a routine to access ARTISAN extension from basic is like this:

```
RST #30  
  
DB <SLOT ID>  
  
DW #4014  
  
EI  
  
RET
```

Where SLOT ID is the value from RAMAD<sub>1</sub> (#F<sub>342</sub>) location and #4014 is the entry point in ARTISAN basic.

In plain basic, one can use an array to hold this routine since it is fully relocatable.

```
REM JUMP ROUTINE  
  
DIM JR%(2)  
  
REM RST #30, SLOT ID
```

```
JR% (0) = &HF7 : POKE  
VARPTR (JR% (0) ) + 1, PEEK ( &HF342 )
```

```
REM ADDRESS
```

```
JR% (1) = &H4014
```

```
REM EI, RET
```

```
JR% (2) = &HC9FB
```

```
REM DEFUSR DEFINITION
```

```
DEFUSR=VARPTR (JR% (0) )
```

Note that DEFUSR needs to be run each time, before a call, if definition of JR array is not the last variable defined, since interpreter keeps changing memory locations of variables upon definition or removal.

To make an actual call, for example SPRENABLE, do the following:

```
REM PARAMETERS ARRAY
```

```
DIM ZZ% (4)
```

```
ZZ% (0) = 0
```

```
ZZ% (1) = VARPTR (SA% (0, 0) )
```

```
ZZ% (2) = VARPTR (SU% )
```

```
ZZ% (3) = 1
```

```
ZZ% (4) = 32
```



DEFUSR=VARPTR (JR% (0) )

O%=USR (VARPTR (ZZ% (0) ) )

Parameters are in the same order as if the commands are used. Any exceptions are noted in the command descriptions.

Output value from DEFUSR command indicates success if zero value returned.

Following table holds a list of function IDs.

Function ID	Function
0	SPRENABLE
1	SPRDISABLE
2	MEMCPY
3	MEMVRM
4	BLIT
5	SGAM
6	SPRGRPMOV
7	COLL
8	SNDSFX
9	ANIMSTEP (single item)
10	ANIMSTEP (multiple items)
11	ANIMSTART (single item)
12	ANIMSTART (multiple items)

13	ANIMSTOP (single item)
14	ANIMSTOP (multiple items)
15	BOXMEMCPY
16	BOXMEMVRM
17	MAXANIMITEMS
18	MAXANIMDEFS
19	MAXANIMSPRS
20	MAXAUTOSGAMS
21	ANIMITEMPAT
22	ANIMITEMPTR
23	ANIMDEF
24	ANIMSPRITE
25	ANIMCHAR
26	AUTOSGAMDEF
27	AUTOSGAMSTART
28	AUTOSGAMSTOP
29	GENCAL
30	FILRAM
31	SNDPLYINI
32	SNDPLYON
33	SNDPLYOFF
34	TILERAM

35	TILEVRM
36	FILVRM
37	VRMMEM
38	UNPACK
39	VUNPACK
40	DLOAD

Sample code can be found in:

- DEMO2USR.ASC
- GAMEUSR.ASC

## APPENDIX B – HOW TO SAFELY LOAD EXTENSION

ARTISAN basic extension should be loaded only once via BLOAD command. Doing it multiple times will lead to unexpected results. The safe way to load can be via ON ERROR and [ARTINFO](#) commands.

```
10 REM ARTISAN BASIC LOADER
20 REM CHECK IF ALREADY LOADED
30 F%=0:V%=0:M%=0
40 ON ERROR GOTO 70
50 _ARTINFO(V%,F%,M%)
60 GOTO 100
70 RESUME 80:ON ERROR GOTO 0
80 BLOAD "ARTISANE.bin",R or BLOAD
"ARTISAND.bin",R
90 _ARTINFO(V%,F%,M%)
100 PRINT "ARTISAN BASIC available"
```

Sample code can be found in AUTOEXEC.BAS file