

AMSpiriT – Amstrad CPC 464, 664, 6128 Emulator

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Developpement :	C++ (Microsoft Visual Studio 2021).
Version :	0.863 Bêta / 05-2023
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1. INTRODUCTION

AMSpiriT is an Amstrad CPC emulator for Windows. It has been developed from documentations and technical information freely available on the Internet, without any contribution of existing source codes.

AMSpiriT aims to reproduce as closely as possible the hardware behavior of the CPC 464, 664 and 6128 computers, commercialized in the mid-1980s. In the spirit of an Amstrad CPC, the ergonomics has been thought to be as simple and intuitive as possible.

The development of Amspirit, in its last versions, benefited from the technical assistance of talented demomakers, and in particular of Serge Querné, alias Longshot of the LOGON SYSTEM group. This technical contribution allowed Amspirit to reach a very high level of precision, without any compromise on the quality of emulation.

AMSpiriT is a 'freeware' software. It may be freely distributed for private use but **MUST NOT BE USED FOR ADVERTISING OR COMMERCIAL PURPOSES**. Any screen copy or promotion on the internet must be requested in advance from the author.

The ROM images supplied with AMSpiriT are the property of AMSTRAD PLC and Locomotive Software. Amstrad and Locomotive have kindly authorized their distribution in the emulators but keep the intellectual property.

AMSpiriT is still under development. Many features are not yet implemented. Do not hesitate to go on the excellent forum 'forum.system-cfg.com' (in French sorry) to keep you informed of the last evolutions of the emulator.

<https://forum.system-cfg.com/viewtopic.php?f=24&t=11535>

You can also communicate your requests for improvement or report any bug encountered through the contact address indicated above. I will try to satisfy your requests within the limits of my availability and/or my computer skills and/or my desires ;)

I hope in any case that you will take as much pleasure in using this emulator on a daily basis as I had in developing it.

The AMSTRAD CPC is a fabulous 8-bit machine that was largely under-exploited at the time but which still continues to surprise through the superb achievements of its many fans around the world.

I hope that AMSpiriT will allow many enthusiasts of the golden age of family micro-computing to (re)discover the AMSTRAD CPC almost 40 years after its commercialization.

Have fun :)

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2. CHARACTERISTICS OF AMSPIRiT

AMSpiriT is fully developed in C/C++ on Windows using Microsoft Visual Studio development platform.

AMSpiriT has not been tested on versions of Windows prior to Windows 10 and its operation cannot be fully guaranteed outside of Windows 10 and 11, although feedback shows that it is compatible with Windows 7 and 8.

AMSpiriT is available in 2 versions, for 64-bit (x64) and 32-bit (x86) processors.

AMSpiriT uses proprietary Windows APIs (Direct2D and X-Audio2) for video display and sound playback. It is thus not compatible with operating systems other than Windows.

AMSpiriT, in this latest iteration, faithfully emulates most of the electronic components that are part of the AMSTRAD CPC:

- **Zilog Z80A** processor, coded for T-state operation for increased emulation accuracy. It passes with success the dedicated z80 tests (ZEXALL in particular)
- **Gate Array** (AMSTRAD owner chip), which is emulated at 16 Mhz, for a fine management of memory access, color management, video display and interrupts.
- **Video controller** (CRTC) in its 4 variants 0, 1, 2 and 4 (Pre-ASIC).
- **FDC μ FD765** floppy disk controller for the management of floppy disk drives (partial emulation)
- **Sound generator** AY_3_8912
- **Intel PPI_8255A** chip (chip used as IO interface with the keyboard, the PSG, the cassette reader.)

AMSpiriT is ready to use with all the system and BASIC ROMs that have been commercialized by AMSTRAD PLC and Locomotive Software. (English, French, Spanish and Danish ROMs).

AMSpiriT emulates the cassette player through the reading of sound recordings in "WAV" or "CDT" format and emulates the floppy disk player through the reading of files in DSK format (standard and extended format).










[WORK IN PROGRESS]

For the developers, AMSpiriT is provided with an integrated debugger and some additional tools (Tape/Diskette file editor / CPU instruction test, PSG test).

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3. INSTALLATION OF AMSPIRiT

Once the archive is unpacked, the AMSpiriT installation directory contains the following files :

	DSK	29/08/2021 17:15	Dossier de fichiers	
	ROM	31/08/2021 23:36	Dossier de fichiers	
	SAVE	29/08/2021 17:15	Dossier de fichiers	
	SCREEN	15/08/2022 21:28	Dossier de fichiers	
	TAPE	29/08/2021 17:15	Dossier de fichiers	
	AMSpiriT - Guide.pdf	21/04/2022 01:17	Document Adobe ...	732 Ko
	AMSpiriT v0.677b_x64.exe	15/08/2022 21:10	Application	1 518 Ko
	CPC_Config.txt	15/08/2022 21:28	Document texte	1 Ko
	xaudio2_9redist.dll	23/02/2021 22:37	Extension de l'app...	827 Ko










Several folders are present:

- DSK folder containing the "Floppy" files (*.DSK)
- TAPE folder containing the "Cassette" files (*.WAV or *.CDT)
- SAVE folder containing the backup files
- Folder ROM containing the System and BASIC ROMs of the AMSTRAD CPC
- SCREEN folder containing screenshots of the emulator

The emulator is simply executed by double-clicking on the AMSpiriT file. It does not write to the registry and can run on any media.

It should be noted that it does not manage command lines.

At the end of the emulator execution, the file "CPC_Config.txt" is automatically created and updated. It contains the emulator's configuration backup. At each launch this file will be read to configure the emulator in its last known configuration.

	DSK	29/08/2021 17:15	Dossier de fichiers	
	ROM	31/08/2021 23:36	Dossier de fichiers	
	SAVE	29/08/2021 17:15	Dossier de fichiers	
	SCREEN	15/08/2022 21:28	Dossier de fichiers	
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	xaudio2_9redist.dll	23/02/2021 22:37	Extension de l'app...	827 Ko

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4. PRESENTATION OF AMSPIRiT

When AMSpiriT is launched for the first time, if no error message appears, the emulator window should look like the image below.

The window is composed of 3 distinct parts:

- A toolbar consisting of a row of icons on the top.
- The main window emulating the AMSTRAD CPC display
- An information bar on the lower part.



By default AMSpiriT emulates the UK version of the CPC 6128 but it is possible to choose another CPC model from the various options.

By default, AMSpiriT appears in windowed mode. It can be switched to full screen (and back to windowed mode) by pressing the **F12 key**.

















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5. PRESENTATION OF THE TOOLBAR

The toolbar allows you to control the behaviour of the emulator. It consists of several icons whose functions are detailed below.



Description of the icons :

	Cold restart of the emulator. Equivalent to a "hard RESET".
	Hot restart of the emulator. Equivalent to a "Soft RESET".
	Pause the emulator. When the pause mode is active, the icon turns red (F1 key).
	Turns the sound on or off. When sound is muted, the icon turns red.
	Access to the emulator's control panel
	Loads a floppy image (F5 key)
	Allows you to load a tape image
	Enables saving of a tape recording
	Enables the playback of a tape recording
	to stop the playback of a tape recording
	Enables fast rewind of a tape recording
	Enables fast forwarding of a tape recording
	Accesses the joystick configuration menu (F9 key to activate mapping)
	Accesses the keyboard configuration menu (not activated on this version)
	Accesses the emulator debugging menu (developer mode only)
	Access to the emulator information menu

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Emulator configuration menu

This icon gives access to the emulator's control panel

The screenshot shows the 'AMSpiriT - Control Panel' window with the following sections:

- General information:** CPC Model (AMSTRAD CPC 6128), EN (English), CRTIC Type (2 - MC6845), Brand (AMSTRAD).
- Video:** Video Output (PAL 50Hz), Monitor (COLOR), Video Filtering (LINEAR INTERP.).
- Extensions:** Memory Extension (empty), Printer Extension (Oui/Non), Extension DDI (CPC464) (Oui/Non).
- Sound:** Sound Output (STEREO), Mixing channels (SOFTWARE), Frq Read (Hz) (62500, Auto, Init).
- ROMs:** A list of 16 ROM slots. ROM SYSTEM is set to 6128\OS_6128[ENG].ROM. ROM 0 (BASIC) is set to 6128\BASIC_6128[ENG].ROM. ROM 7 (AMSDOS) is set to AMSDOS.ROM. Other slots are empty.

Buttons at the bottom: Default values, Validate, Cancel.

It is divided into 5 distinct areas.

The "General" area allows you to select the "hardware" characteristics of the CPC

The drop-down menu "CPC model" allows you to choose the model of AMSTRAD CPC (464, 664 or 6128) and its version (English, French, Spanish or Danish). The corresponding ROMS will be automatically loaded in memory after the selection.

The drop down menu "CRTIC type" allows you to choose one of the 4 CRTIC types implemented in the AMSTRAD CPC. Their behaviour is almost identical in normal use. Only the "demos" will allow to distinguish one type of CRTIC from another. By default, type "0" is selected.

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The "Brand" drop-down menu allows you to select the brand that will be displayed on the start-up screen.

The "Extensions" area allows you to emulate the extensions present on the AMSTRAD CPC

The drop-down menu "Memory extension" allows you to emulate the additional memory. 4 choices are proposed: 64 KB, 128 KB, 256 KB and 512 KB.

It should be noted that on an Amstrad 6128, the 64 KB extension is already activated by default.

The DDI extension is specific to the AMSTRAD CPC 464. It allows to emulate the presence of the floppy controller. This extension is useless on the Amstrad 664 and 6128 which have it by default.

The "Video" field allows you to select the characteristics of the video screen emulating the CPC

The drop-down menu "Video Output" allows to choose between the "PAL" mode (50 Hz) and the "NTSC" mode (60 Hz). The latter mode is not used in practice.

The "Monitor" drop-down menu allows you to choose between a "Colour" monitor or a "monochrome GREEN" monitor.

The "Video Filtering" drop-down menu allows you to choose between the "LINEAR INTERPOLATION" mode (filtering of adjacent colours) and the "NO FILTERING" mode. By default, the interpolation mode is activated. It allows a blurred effect between pixels that convincingly reproduces the effect of a real CRT monitor. Without interpolation, the image appears very chiselled, almost too precise.

The 'Sound' area allows you to select the characteristics of the CPC sound emulation

The "Sound Output" drop-down menu allows you to choose between "MONO" and "STEREO" (default).

The "Channel mix" pull-down menu allows you to choose between "SOFTWARE" (default) and "HARDWARE" channel mix mode. The CPC has 3 sound channels which are mixed when playing back sound to the speakers. The software mode allows to mix these three channels into one via a software mixer before sending the resulting sound signal to the PC sound card. In hardware mode, the three channels are mixed directly by the PC sound card. This last mode seems to give a less convincing sound than the software mode which is to be preferred.

The "Frq Playback" field is used to adjust the sound buffer playback frequency. By default the sound buffer is read at a frequency of 62.5 kHz. On some PCs with multi-core processors, there may be periodic "crackling" of the sound due to the fact that the CPC emulation speed is not exactly set to 4000 Mhz. The "Auto" button allows you to set the sound buffer playback frequency in phase with the real CPC emulation frequency.

The "ROMs" area allows you to add additional ROMs

15 additional ROM slots (16K each) are now available. The files must have the extension ".ROM". To remove a ROM from any of the 15 slots (except for system ROMs), simply click on cancel in the ROM selection window.

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Loading a disk image

This icon is used to load a disk image in "DSK" format.

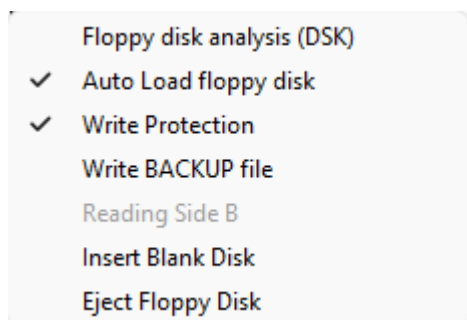
Once a valid file is loaded, the icon changes to indicate the presence of a floppy disk.

Description of the icons :

	Shows that a diskette is present.
	Yellow icon: Shows that the diskette drive motor is running
	Green icon: Shows a read operation on the diskette
	Red icon: Shows a write operation on the diskette

AMSpiriT can only read standard formatted diskettes at the moment. Non-standard formatted diskettes will not be recognised.

By right-clicking on the icon, a conceptual menu allows you to access new options:



The choice "Floppy disk Analysis (DSK)" allows you to access the diskette analysis panel (in experimental version. Will not be explained in this guide).

The "Auto Load Floppy disk" choice allows you to automatically load the last loaded floppy file when the emulator starts.

The "Write Protection" choice allows to protect or unprotect the disk file against writing.

The choice "Write Backup disk" allows to write the modifications on a floppy file "copy" of the original in order to protect the contents of the original against undesired operations.

The choice "Insert Blank Floppy Disk" allows you to create a blank floppy disk formatted in Standard AMSDOS format (9 sectors per track, single sided). Its default name will be "BLANK_DISK.DSK".

The choice "Read Side B" allows to force the reading on the side B of the diskette for diskettes formatted on both sides (side A and B on the same DSK media)

The choice "Eject Floppy Disk" allows you to unload a diskette image

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Loading a tape image

This icon is used to load an image of a tape recording in "WAV" or "CDT" format.)

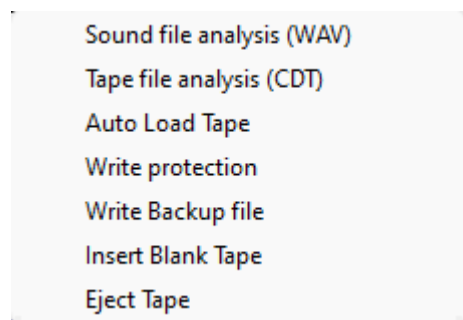
Once a valid file has been loaded, the icon changes to indicate the presence of a cassette.

Description of the icons :

	Shows that a tape is present
	Yellow icon: Shows that the tape player motor is running
	Green icon: Shows a read operation on the tape
	Red icon: Shows a write operation on the tape

AMSpiriT reads the audio stream on the fly like a real CPC. It can therefore play protected and unprotected tapes indiscriminately.

By right-clicking on the icon, a conceptual menu gives you access to new options:



The choice "Sound file analysis (WAV)" allows you to access the analysis panel of a sound recording in WAV format (in experimental version. Will not be detailed in this guide).

The "Tape File Analysis (CDT)" choice allows you to access the analysis panel of a tape file in CDT format (in experimental version. Will not be detailed in this guide).

The "Auto Load Tape" choice allows you to automatically load the last loaded tape file when the emulator starts.

The "Write Protection" choice allows to protect or unprotect the tape file against writing.

The "Write Backup file" choice allows you to write modifications to a "copy" of the original tape file in order to protect the content of the original against unwanted operations.

The "Insert Blank Tape" choice allows you to create a "blank" tape image. Its default name will be "BLANK_TAPE.WAV".

The "Eject Tape" choice allows you to unload a tape image.

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Using the tape player

Like a real AMSTRAD CPC 464, the playback of tape recordings is done with the following icons:

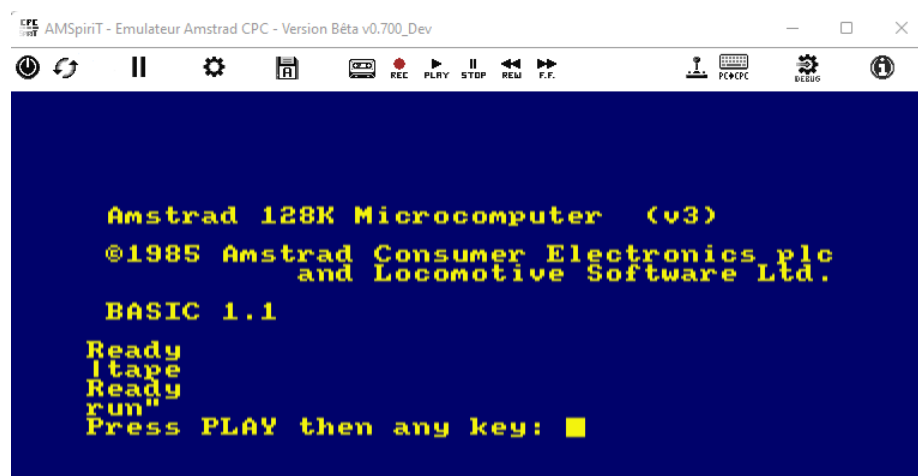


Once a tape file is loaded, a counter and the name of the first file present are displayed to the right of the row of icons.

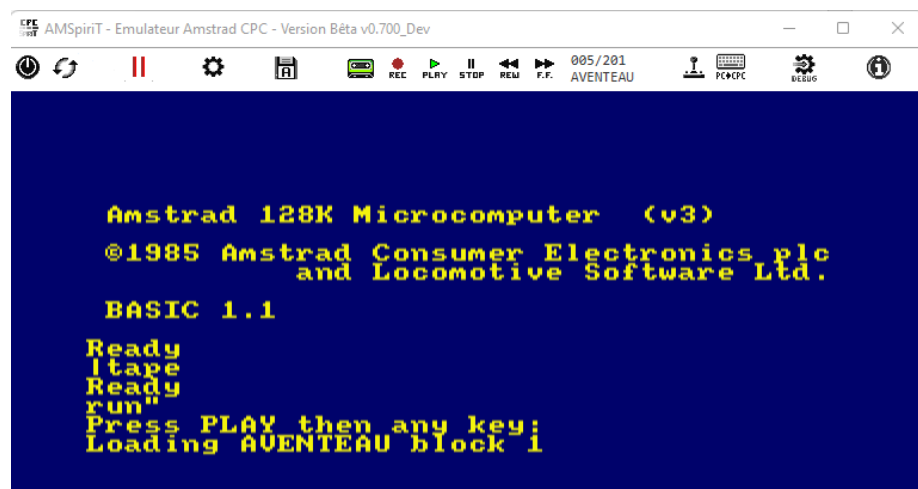


Loading a tape recording is done like on a real CPC.

When the BASIC instruction "RUN" is started and the message "Press PLAY then any key" is displayed, pressing the ENTER key will start the tape player motor. The "cassette" icon will turn yellow and will be waiting for the "PLAY" key to be pressed.



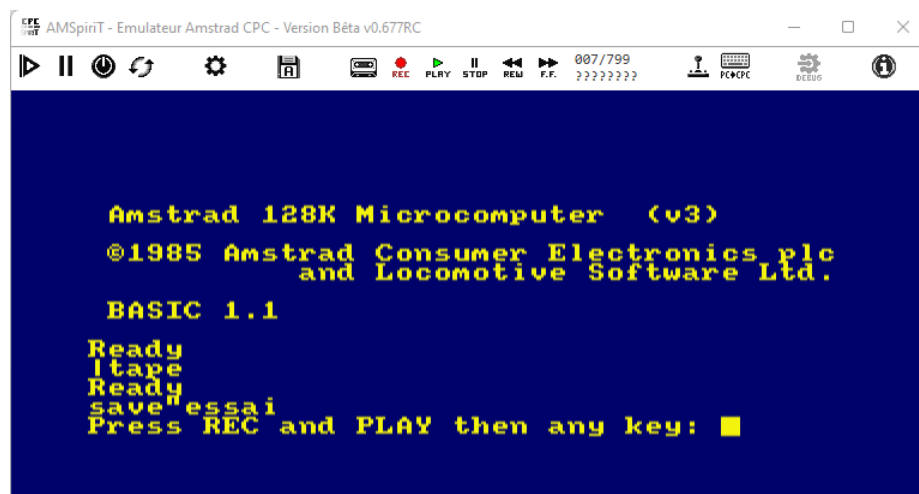
After clicking on the "PLAY" icon, it will turn green, as well as the tape player icon. The counter will start to increment until it is fully loaded.



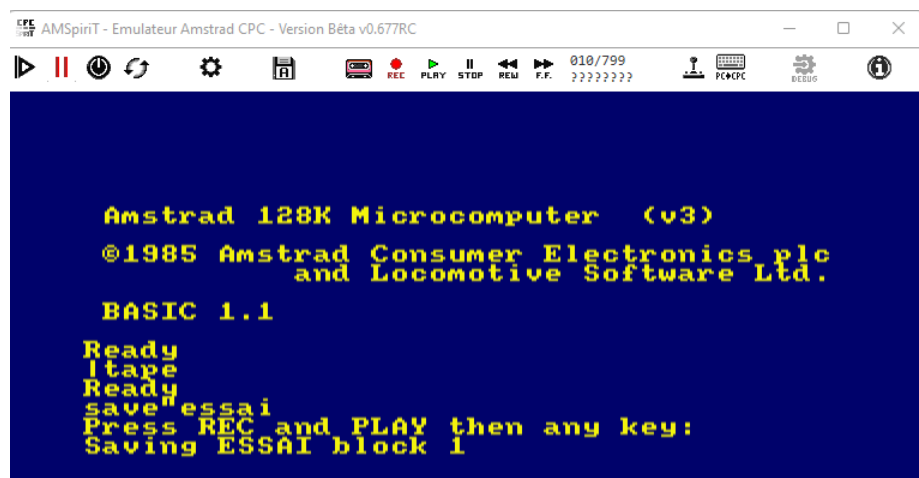
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Recording a tape file is also done like on a real CPC.

Once the BASIC instruction "SAVE "XXXX" is started and the message "Press REC and PLAY then any key" is displayed, the "REC" and "PLAY" icons become red and green respectively and pressing the ENTER key will start the tape drive motor.








The counter will start incrementing until the end of the recording.



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Like a real CPC, AMSpiriT also allows you to fast-forward, rewind and stop the playback of a recording.

Description of the icons when using a cassette recording:

	The PLAY icon turns green when the sound recording is playing.
	The REC icon turns red when writing of the sound recording is activated. The tape file must be unprotected for writing beforehand.
	The STOP icon turns red after 2 clicks on it. This feature will be used in combination with "Fast forward" and "Fast reverse".
	The Fast Forward icon turns green when fast forwarding through the recording. In combination with the red "STOP" button, it allows you to go directly to the next file on the tape.
	The Fast Rewind icon turns green when "rewinding" the recording. In combination with the red "STOP" button, it allows you to go directly to the previous file on the tape.

Please note the sound will be played during the playback of the sound recording, as on a real CPC.

In the case of loading 'commercial' protected games, the file name may not be readable. In this case, '???????' will appear under the counter.

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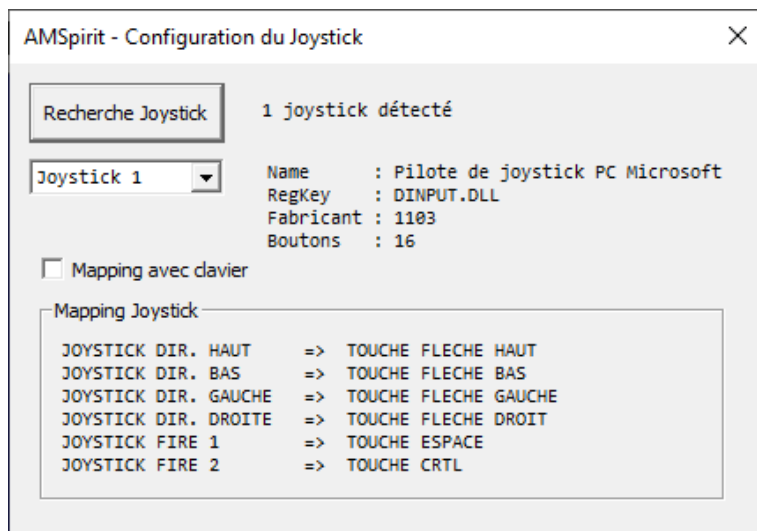
Gestion du joystick

AMSpiriT can detect the presence of a joystick as soon as it is connected to a PC. In this case, the icon changes color and turns green. The joystick is then active.

To check if the joystick is recognized correctly, use the joystick or press the 'FIRE' key, the 'arrow' characters, 'X', 'Z' should appear on the screen as shown below.




By clicking on the icon, a Joystick configuration panel appears. This panel allows you to know if one or more joysticks are connected to the PC and to select the joystick that will be used by the emulator.



If you don't have a joystick, the "Mapping with keyboard" checkbox allows you to associate a keyboard key with each joystick action. For now, this version of the emulator does not allow you to customise keys.

Note also that mapping can be activated directly by right-clicking on the Joystick icon or by pressing the F9 function key on the PC.

In this case the joystick icon will look like this: 

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Gestion du clavier


By default AMSpiriT enables automatic keyboard mapping so that text input on the emulator is as transparent as possible, regardless of the the selected ROM country.

If the character typed on the PC exists on the CPC keyboard, it will be displayed on the screen, otherwise no character will be displayed.

Note that the COPY key on the CPC, which has no equivalent on our modern keyboards, is mapped to the "Insert" key on the PC.

It is possible to deactivate the automatic mapping by right-clicking on the icon.

If the country of the input keyboard (PC) is recognised by the emulator, mapping will be disabled and for each key typed on the PC keyboard the character corresponding to the key placed in the same location on AMSTRAD CPC will be displayed. For now the supported PC keyboards are : France, US, UK, Spanish and Danish. Other types of regionalized keyboards can be added upon request.

The icon displayed will change as follows : 

This version of AMSpiriT does not allow you to customise the keyboard mapping.

Keyboard shortcuts :

F1	Enables/Disables the emulator to be paused
F2	Captures a screen image of AmspiriT (in SCREEN directory)
F3	Capture a reduced screen image of AmspiriT
F5	Load a DSK file
F9	Activate / deactivate the JOYSTICK (via keyboard mapping)
F12	Switch to FULL SCREEN mode / Windowed mode

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Debugger (only available in Developer mode)

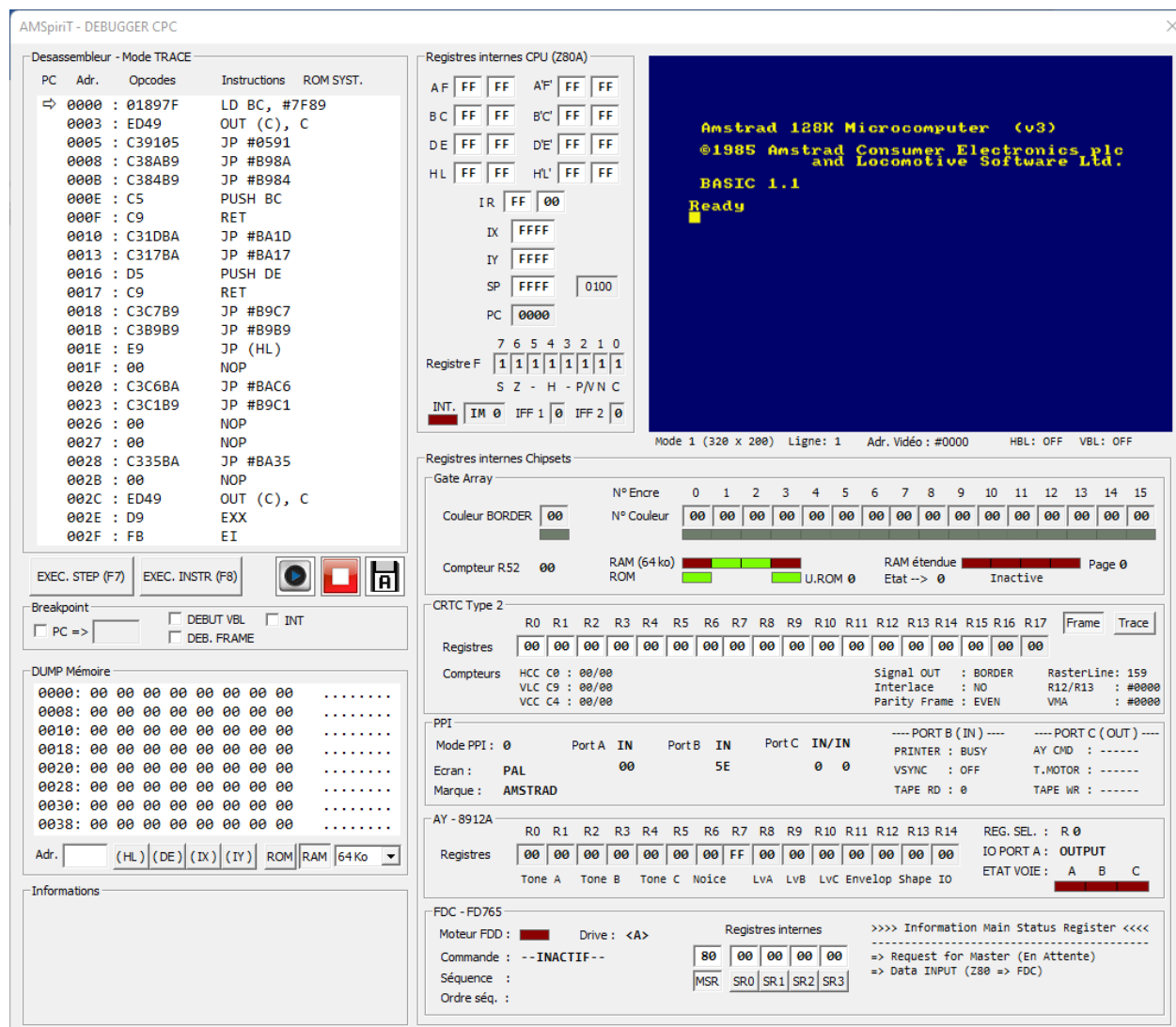
AMSpiriT contains a powerful debugging tool to trace instructions step by step, to track the contents of the processor and the different CPC components: Gate Array, CRT, PSG, PPI and FDC.

The Debugger control panel is independent of the emulator, which will be shut down during its use.

When starting the debugger, it is configured to start at PC address 0, like a cold reboot.

By clicking the key  the debugger will start the AMSTRAD CPC and the home screen will appear. Then you have to type the commands to load a file to start the debugging.

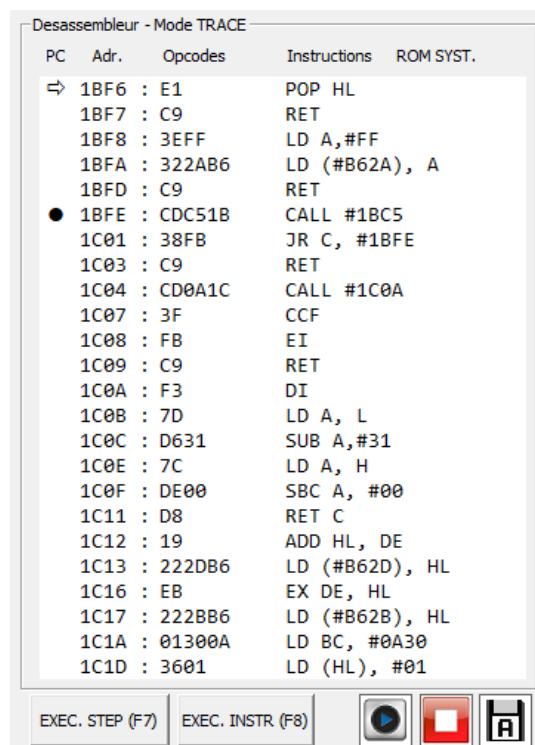
Clicking on the key  will stop the execution of the program and start the execution step by step.



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The « Disassembler » area

This area allows you to follow the progress of the program step by step with the display of the instructions being executed.



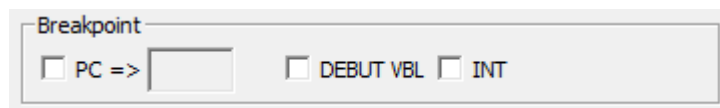
The column " PC " indicates the address where the PC register (Program Counter) of the Z80A is located. This address is indicated by the symbol ⇨

It is possible to add a breakpoint in this column by right clicking the mouse. The symbol ● will appear, indicating the address where the execution will stop.

The F7 key allows you to move forward step by step and the F8 key allows you to execute jump instructions (CALL) stopping at the instruction immediately following the jump instruction.

The « Breakpoint » area

This area allows breakpoints to be set at the desired PC address, at each new VBL signal (new screen frame) or at each interrupt (every 52 lines).



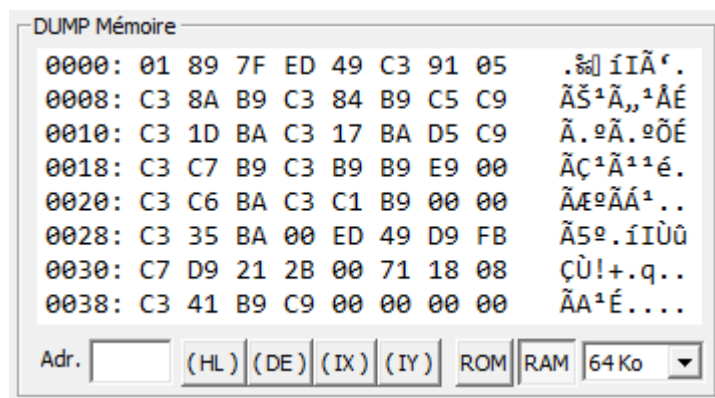
This area will be enriched with new criteria in a later version.

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The « DUMP Memory » area

This area allows the contents of a memory area to be viewed. The memory address can be chosen manually or selected automatically by clicking on the (HL), (DE), (IX) or (IY) buttons which correspond to the contents of the addresses pointed to by the HL, DE, IX and IY registers of the z80A.

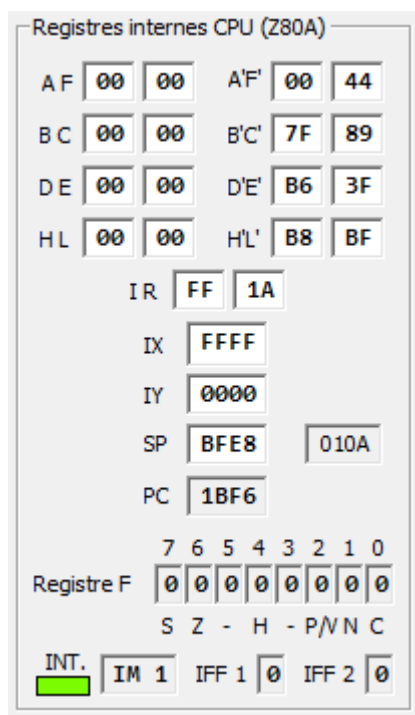
It is also possible to select the memory bank to be viewed.



The « internal Registers » area

This area allows you to view the contents of the Z80A processor's internal registers with a focus on the F (Flag) register flags.

Apart from the PC register, the contents of the registers can be modified during debugging.



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The « Information » area

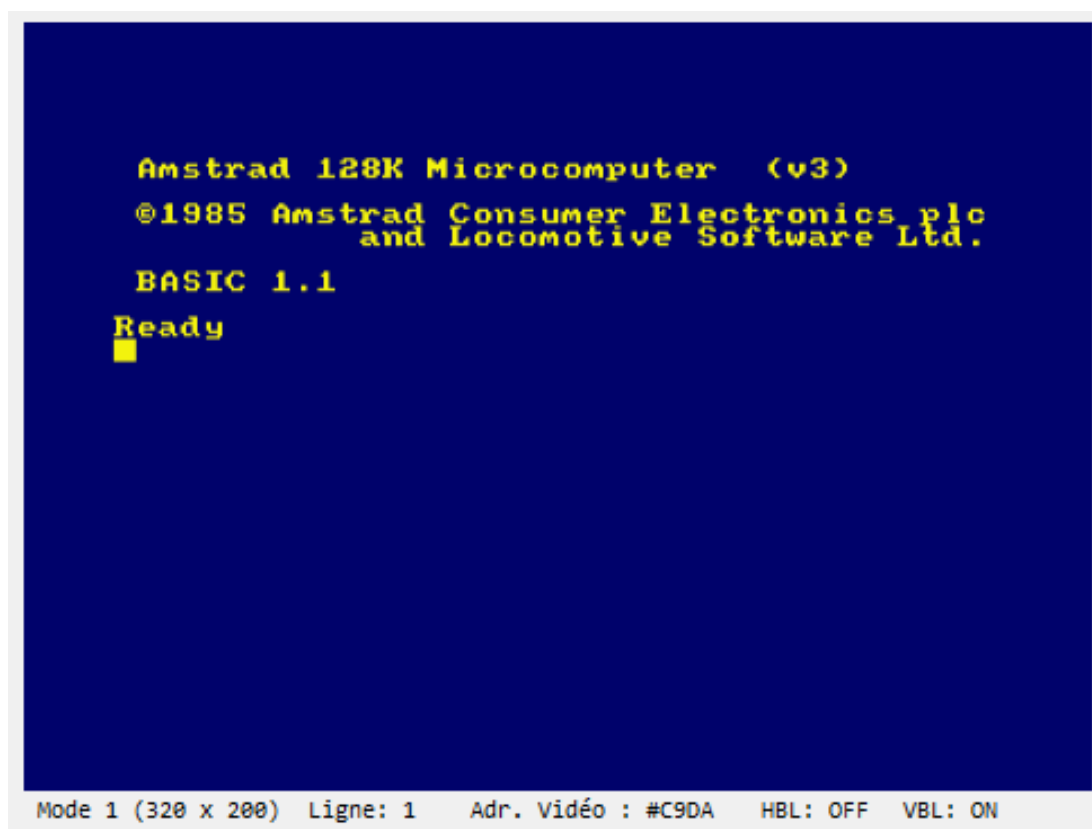
This information field is a debugging aid that clearly indicates the action of the IO instructions (OUT / IN) that have just been executed.

```
Informations
ECRITURE REGISTRE GATE ARRAY
-> ACTIVE MODE ECRAN 1
-> ACTIVE LECTURE ROM INFERIEURE 0 - #3FFF
-> DESACTIVE LECTURE ROM SUPERIEURE #C000 - #FFFF
```

The « Screen » area

This is the visual part of the debugger that allows you to see what is happening on the screen.

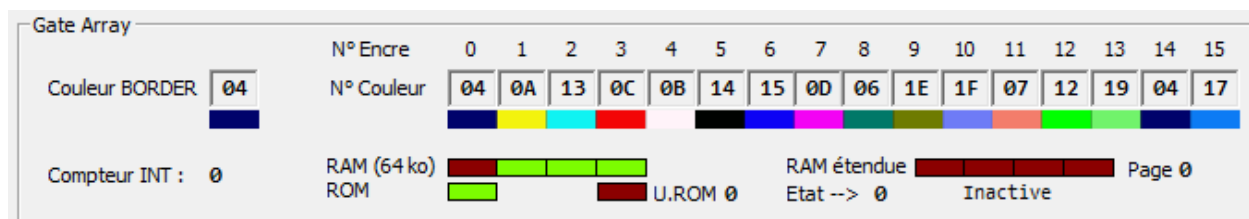
Below the visual area, additional information from the Gate Array is displayed: the current screen mode, the video line that is being updated (varies from 1 to 312), the address of the video memory that is being read at each moment, as well as the status of the HBL (line return) and VBL (new screen frame in progress) signals



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The « Gate Array » area

This area displays the contents of the Gate-Array's internal registers, namely: the colours associated with each ink, memory access management and the status of the interrupt counter.



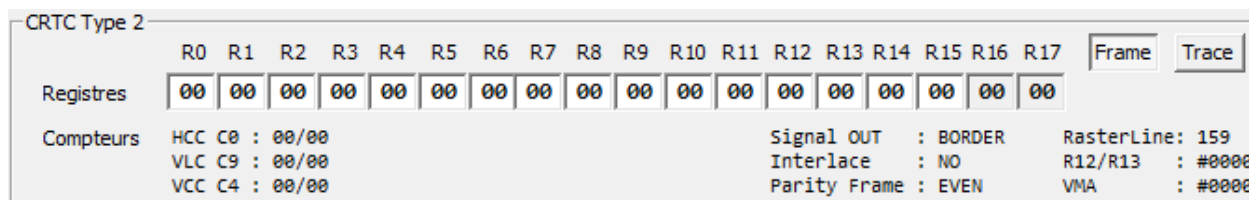
The colour codes on the memory areas indicate which 16kb blocks of memory (RAM or ROM) are accessible by the CPU

In the image above, the block at address #0000 - #3FFF will be read from ROM and the block at #C000 - #FFFF will be read from RAM.

Note that the colour numbers associated with each ink and the interrupt counter are not changeable.

La « CRTC » area

One of the most important areas for checking video timings. This area allows you to follow the evolution of the internal counters of the CRTC (video controller) which drive the horizontal and vertical sync and the addressing of the video memory.



This area also indicates the number of the raster-line being processed by the CTC, as well as the display signals being sent to the Gate Array (HSYNC, VSYNC, HSYNC & VSYNC, BORDER, DISPLAY).

The CRTC registers can be modified on the fly.

Note the presence of a "Trace" button which allows the exact video memory zone that is currently addressed to be displayed on the screen.

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CRTC "Trace" mode activated.

This button allows you to see exactly where the address of the video memory that is currently being read is located (which corresponds to the position of the electron beam of a cathode ray tube).

Registres internes CPU (Z80A)

A F	00	00	A'F	00	44
B C	00	00	B'C	7F	89
D E	00	00	D'E	B6	00
H L	B6	2A	H'L	B8	BF
IR		FF		77	
IX		FFFF			
IY		0000			
SP		BFE8		010A	
PC		1BC9			
7 6 5 4 3 2 1 0					
Registre F		0 0 0 0 0 0 0 0			
S Z - H - P/V N C					
INT.	IM 1	IFF 1	1	IFF 2	1

Registres internes Chipsets

Gate Array

Couleur BORDER	04	N° Encre	0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
		N° Couleur	04 0A 13 0C 0B 14 15 0D 06 1E 1F 07 12 19 04 17
Compteur R52	2E	RAM (64 ko)	
		ROM	
		RAM étendue	
		Etat -->	0 Inactive

CRTC Type 2

R0	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15	R16	R17
3F	28	2E	8E	26	00	19	1E	00	07	00	00	30	00	00	00	00	00

Compteurs

HCC C0	: 1A/3F	Signal OUT	: DISPLAY	RasterLine	: 80
VLC C9	: 00/07	Interlace	: NO	R12/R13	: #C000
VCC C4	: 0A/26	Parity Frame	: EVEN	VMA	: #C354

Mode 1 (320 x 200) Ligne: 151 Adr. Vidéo : #C354 HBL: OFF VBL: OFF

Amstrad 128K Microcomputer (v3)

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BASIC 1.1

Ready

The « PPI » area

This area shows the status of the 3 PPI ports A, B and C, their mode (IN or OUT) and their contents.

PPI

Mode PPI :	0	Port A	OUT	Port B	IN	Port C	OUT/OUT	---- PORT B (IN) ----	---- PORT C (OUT) ----
Ecran :	PAL	00	5E	0	0	PRINTER	: BUSY	VSUNC	: OFF
Marque :	AMSTRAD					TAPE RD	: 0	TAPE WR	: 0

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The « AY_8912A » area

This field shows the contents of the PSG's internal registers for sound generation.

AY - 8912A																
	R0	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	
Registres	00	00	00	00	00	00	00	3F	00	00	00	00	00	00	FF	REG. SEL. : R 14
	Tone A		Tone B		Tone C		Noice	LvA	LvB	LvC	Envelop	Shape	IO			IO PORT A : INPUT
																ETAT VOIE : A B C
																<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

The registers cannot be modified.

Note that the sound is disabled in the debugger.

The « FDC – FD765 » area

This area shows the contents of the floppy controller's internal registers, the sequence numbers of an instruction, and the command being executed.

FDC - FD765									
Moteur FDD : <input type="checkbox"/>	Drive : <A>		Registres internes					>>>> Information Main Status Register <<<<	
Commande : --INACTIF--			80	00	00	00	00	=> Request for Master (En Attente)	
Séquence :			MSR	SR0	SR1	SR2	SR3	=> Data INPUT (Z80 => FDC)	
Ordre seq. :									

An information area is provided for each of the 5 internal registers of the FDC allowing the meaning of the error codes encountered during disk access to be displayed clearly.

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6. PRESENTATION OF THE STATUS BAR

The status bar displays information on the operating status of the emulator. It is composed of 3 parts refreshed every second.

The items displayed in this bar are used for debugging purposes. They will be modified in a future non-beta version.

CPC 6128 @ 4.000 Mhz (100.719)	VLB/HBL/INT (ms) : 19.96 / 0.064 / 3.323	Lignes : 312 / CRTIC 0
--------------------------------	--	------------------------

The leftmost part indicates the CPC model being emulated, its execution speed (in Mhz) and the available bandwidth in brackets.

This last number is interesting because it measures the CPU reserve of the emulator. The higher this number is, the more fluid the emulator will be. On the contrary, if this number goes down to 0, the emulator will no longer be able to hold the 4 Mhz frequency and will run at a lower speed.

On my development machine (Core i9 9900K), the number displayed is around 100 but it would be interesting to have this value on other configurations in order to determine the minimum configuration required to run the emulator correctly.

Please do not hesitate to inform me of the value indicated with your configurations. 😊

The second part is more technical and describes the period of the HBL and VBL synchronisation signals and the interrupts. In the case above, there is an interrupt processed by the CPU every 3.33 milliseconds, which is normal, there is a new frame every 19.96 ms, or 50.1 frames/sec which is normal for a PAL video output.

The 3rd part indicates the number of lines displayed on the screen and the type of CRTIC that is currently in use.

A PAL screen displays 312 lines per frame but some demos may vary this number.

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7. COMMAND LINE

AMSpiriT can now be directly executed by a command line, in console mode for example, allowing to automate some starting sequences.

New commands will be progressively added as needed.

```
D:\Projets Visual C++\Emulateur AMSTRAD\Emulateur Amstrad CPC\x64\Release>"Emulateur Amstrad CPC" --joystick
```

Available commands: :

--autorun	Automatically runs a tape file
--crtcX	Set the CRTC type at startup (X = 0, 1, 1b, 2 or 4)
--dsk file	Load a dsk file (path must be complete)
--fullscreen	Launch AmspiriT in full screen mode
--joystick	Activate the joystick (keyboard mapping)
--keybPC	Keyboard in PC => CPC mapping mode
--keybCPC	Keyboard in CPC mode (no mapping) – Available on a few keyboard
--nojoystick	Disable the joystick
--nosound	Disable sound
--tape file	Load a wav or cdt tape file (path must be complete)
--romX file	Load a ROM file in a location X (X ranges from 1 to 15) Note that the loaded ROMs will not be saved by AmspiriT
--run Filename	Launch a program on a floppy disk or a Rom

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8. VERSION HISTORY

12/05/2023 : v0.863b	<ul style="list-style-type: none">- Various small fixes on FDC and CRTC emulation- Improving the implementation of the Additional Roms- Fixed a bug on PSG emulation- AMSpiriT can be executed by a command line
16/04/2023 : v0.845b	<ul style="list-style-type: none">- Full Pre-Asic CRTC 4 (Pre Asic) Emulation- Add Extended ROM management- Improvement of CTM emulation (CSYNC signal management)- Emulation Core is now available as a static library (.lib/.h)- Better HSYNC emulation (all CRTC)- CDT file: Add BLOC_ID 0x15 management: Direct Recording
19/09/2022 : v0.704b	<ul style="list-style-type: none">- Various fixes in CRTC 0, 1 and 2 emulation- Adjustment of R52 (Gate Array) update timing- Ergonomic modification (icons / English language added)- Code optimization
15/08/2022 : v0.677b	<ul style="list-style-type: none">- Full emulation of CRTC type "2"- Various corrections in the emulation of CRTC 0 and 1- Emulation of FDC write functions (WRITE DATA/ID)- Emulation of the writing of "Cassette" files- Small fixes in the FDC emulation (engine management)- Evolution in the CTM emulation (wave effects)- Possibility to make screenshots (F2/F3 keys)
21/04/2022 : v0.590b	<ul style="list-style-type: none">- Complete rewrite of CRTC 0 and 1 emulation- Code based on @longshot compendium- Universal code, no patching required- Integration of interlace management- In-depth rewriting of the GA emulation- Pixel processing at 16 Mhz- Correction of mode 2 rendering (1 pixel advance)- Correction of the GA interrupt register- Improvement of PPI emulation- Correction on z80 emulation (OTIR OTDR instructions)
11/12/2021 : v0.473b	<ul style="list-style-type: none">- z80 timing correction- CRTC emulation fix
28/11/2021 : v0.466b	<ul style="list-style-type: none">- Correction of the FDC "READ DIAGNOSTIC" function- Fix bug when loading tape in full screen- Added keyboard shortcuts (F1 - F5 and F9 keys)
27/11/2021 : v0.465b	<ul style="list-style-type: none">- Windows 11 support- Fix bug in access to PSG registers- Various bug fixes (video resolution change)- Added full screen mode (F12 key)- Added option to read side B of a double sided floppy disk- Added option for Video display method- Improved floppy controller emulation- Improved keyboard emulation.- Various improvements (control panels)
08/09/2021 : v0.429b	<ul style="list-style-type: none">- Improved high frequency sound emulation (> 20kHz)- Optimization of CDT -> WAV format conversion
01/09/2021 : v0.425b3	<ul style="list-style-type: none">- Added XAUDIO2 compatibility with Windows 7 and Windows 8
30/08/2021 : v0.425b2	<ul style="list-style-type: none">- Code improvement (memory allocation test)- Activate joystick mapping even if joystick is already connected
29/08/2021 : v0.425b	<ul style="list-style-type: none">- First public release.

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9. ACKNOWLEDGEMENTS

This emulator would certainly never have seen the light of day without the precious contribution of AMSTRAD CPC enthusiasts who allowed me to glean and exchange a lot of technical information and who allowed me to use precious test tools in order to test the robustness of the emulator.

This new version would never have been released without the amazing documentation of Serge Querné (alias LONGSHOT) from the legendary "Logon System" group, author of the "CRTC compendium", gathering a quantity of technical information with no equivalent, checked, tested, proven on various Amstrad CPC models. Thanks also to Serge for accompanying me almost daily these last months by providing me with custom-made test sets (Shaker) to perfect the emulation of different types of CRTC, including obscure and little-documented features (notably interlace).

The compendium is available at the following address : [Logon System](#)

A big thanks to Stéphane SIKORA (@Siko) for the creation of the official AmspiriT web portal : <https://amspirit.amstrad.info/>

A big thank you also to Cédric QUETIER (@CED) for the creation of the logo of the website and icons of AMSpiriT.

Thanks also to all the members of the discord, they will recognize themselves (@CheshireCat, @BDClron, @norecess464, @Fred, @tronic...) for their support and their interest in this project which exceeds from now on the simple field of the solo development.

Thanks to the members of the FORUM.SYSTEM-CFG forum that I thank a lot for their encouragements and their contributions to the improvement of the emulator: @lone (author of the CPC SugarBox emulator), @markerror, @sebiohazard, @Zebulon...

I think I'm forgetting a lot of people and I apologize for that, in more than 5 years of development I've surfed a lot on the internet to get all the relevant information.

QUASAR.NET : <http://quasar.cpcscene.net/>

BALTASAR STUDIO : <https://baltazarstudios.com/zilog-z80-undocumented-behavior/>

AMSTRAD CPC MEMOIRE ECRITE (ACME) : <https://acpc.me/#>

GRIMWARE : <https://www.grimware.org>

LES SUCRES EN MORCEAU : <http://cpc.sylvestre.org>

CPC POWER : <https://www.cpc-power.com/>

CPC RULEZ : <https://cpcrulez.fr/>

FORUM CPC WIKI : <https://www.cpcwiki.eu/forum/index.php>

FORUM FORUM.SYSTEM-CFG : <https://forum.system-cfg.com/index.php>

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10. EMULATION ACCURACY OF AMSPIRiT

The emulation of the different chips composing the CPC (z80, GA, CRTC, FDC, AY, PPI) is gradually reaching a level of precision that is very close to the reality. It is not yet accurate, there is still a lot of work to do, but at each new iteration of AmspiriT, the emulation gets closer to the behavior of the real machine.

The emulator was tested recently on a custom written test set by @longshot (shaker) and the results were synthesized on the website "Shakerland":

<https://shaker.logonsystem.fr/welcome>

The results are really extraordinary with a fidelity rate of more than 99% compared to the hardware behavior of a real CPC for all 3 types of CRTC tested.

Architecture	CRTC 0	CRTC 1	CRTC 2	CRTC 3	CRTC 4
Real Hardware CPC	100.00% ✓	100.00% ✓	100.00% ✓	100.00% ✓	100.00% ✓
Amspirit 0.671	99.50%	99.18%	99.61%		

11. COMING SOON

Despite its 5 years of development, AMSPIRiT is far from complete and will continue to evolve, with the priority of achieving the most perfect possible emulation of the different types of CRTC.

The next big step in the development of AmspiriT will be the implementation of the Amstrad CPC Plus / GX4000 emulation and their proprietary ASIC.

A rewrite of the CTM644 monitor emulation is also planned for a more realistic management of the "distord" effects.

A last big project to finish will be the improvement of the FDC (floppy disk controller) emulation and the opening to new file formats (SNA, IPF/HFE file in particular).

For CPC developers, some changes have been made recently in order to separate the core of the Amspirit emulation in a dedicated library, and to make it independent from its physical environment. This operation will make it easier to port to other development environments than Windows.

A lot of work ahead.

Be patient, the best is yet to come 😊

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11. QUICK LAUNCH

A microcomputer emulator is not as easy to use as a game console emulator and requires you to enter keyboard commands to function.

I strongly invite you to download the user guide for an AMSTRAD CPC to discover how it works before launching the emulator.

AMSTRAD guides are easily downloadable on the internet and especially on the fabulous ACME site which lists all the docs available on AMSTRAD CPC, and in all languages.

[https://acpc.me/#ACME/LITTERATURE_MANUELS/\[FRA\]FRENCH](https://acpc.me/#ACME/LITTERATURE_MANUELS/[FRA]FRENCH)

To launch a program, it must first be downloaded. There are many Internet sites providing "floppy" or "cassette" images, the most famous and richest of which is certainly CPC POWER :

<https://www.cpc-power.com/>

Once you have found the file, you need to copy it to the "DSK" directory of AMSpiriT if it is a floppy image or to the "TAPE" directory if it is a tape image.

Running a program on a floppy dosk

To run a program on a "floppy disk", it must first be loaded into memory by clicking on the "Floppy disk" icon and then typing the BASIC command "CAT", which will display the floppy disk catalogue.



```
Ready
cat

Drive A: user 0

-SCRATCH.      3K    SCRATCH :UN1   33K
SCRATCH :UN0   33K    SCRATCH :UN2   17K

  92K free

Ready
█
```

If all is OK, you should have the catalogue displayed. You will then need to type the command "RUN filename" to run the appropriate program.

If the catalogue is not displayed, the floppy disk may be formatted in "CPM" mode. You can then type the command "|CPM" to try to run the program.

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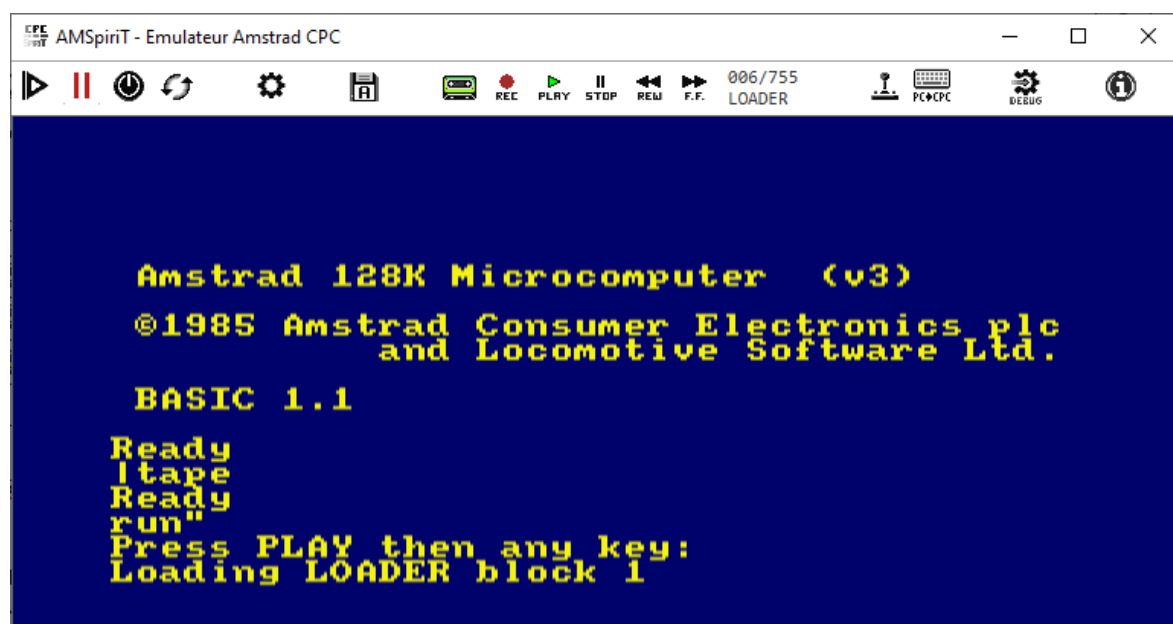
Running a program on tape

To run a program on tape, you must first load it into memory by clicking on the "Tape" icon.

If the emulated CPC model is an AMSTRAD CPC 664 or 6128, you will have to type the BASIC command "|TAPE" to activate the cassette drive command.

On an AMSTRAD CPC 464 this is not necessary because the cassette player is the default playback media.

You will then have to type the BASIC command "RUN" and the message Press PLAY Then any key will be displayed. After pressing the ENTER key and the "PLAY" icon, the file will start loading, you will hear the tape sound and the message "Loading xxxx" will appear.



Please note that the playback speed of the tape recording is the same as on a real CPC, i.e. very slow. Please be patient while waiting for the loading to finish. 😊