



# sinclair

## ZX computers

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<http://decafbad.net>

Presented at Penguincon 2016



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**A confession**



A little computer crazy?

Tell them about how you would draw  
monitors and keyboard on every box in  
the house and drove your parents insane  
until they got you a computer...

**Problem #1**

**Computers were expensive**



# What kind of man owns his own computer?

Rather revolutionary, the whole idea of owning your own computer? Not if you're a diplomat, printer, scientist, inventor... or a kite designer, too. Today there's Apple Computer. It's designed to be a *personal* computer. To un-complicate your life. And make you more effective.

## It's a wise man who owns an Apple.

If your time means money, Apple can help you make more of it. In an age of specialists, the most successful specialists stay away from uncreative drudgery. That's where Apple comes in.

Apple is a real computer, right to the core. So just like big computers, it manages data, crunches numbers, keeps records, processes your information and prints reports. You concentrate on what you do best. And let Apple do the rest. Apple makes that easy with three programming languages—including Pascal—that let you be your own software expert.

## Apple, the computer worth not waiting for.

Time waiting for access to your company's big main-frame is time wasted. What you need in your department—

on *your* desk—is a computer that answers only to you... Apple Computer. It's less expensive than timesharing. More dependable than distributed processing.

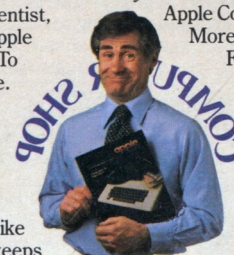
Far more flexible than centralized EDP. And, at less than \$2500 (as shown), downright affordable.

## Visit your local computer store.

You can join the personal computer revolution by visiting the Apple dealer in your neighborhood. We'll give you his name when you call our toll free number

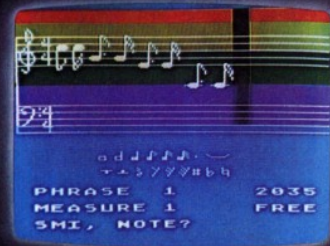
(800) 538-9696. In California, (800) 662-9238.

Apple Computer, 10260  
Bandy Drive,  
Cupertino,  
CA 95014.





# MORE COLOR. MORE SOUND. MORE GRAPHICS CAPABILITIES.



ATARI 400



ATARI 800

Compare the built-in features of leading microcomputers with the Atari personal computers. And go ahead, compare apples and oranges. Their most expensive against our least expensive: the ATARI® 400.\*

Start with graphics capabilities. The ATARI 400 offers 128 color variations. 16 colors in 8 luminance levels. Plus 29 keystroke graphics symbols and 8 graphics modes. All controlled from a full 57 key ASCII keyboard. With upper and lower case. And the system is FCC approved with a built-in RF modulator. That's just for openers.

Now, compare sound capabilities. Four separate sound channels and a

built-in speaker. With the optional audio/digital recorder, you can add Atari's unique Talk & Teach® Educational System cassettes.

Here's the clincher: Solid state (ROM) software. For home management, business and entertainment. Or just plug in an Atari 10K BASIC or Assembler language cartridge and the full power of the computer is in your hands.

Memory? 8K expandable to 16K. And that's just for the ATARI 400 at a suggested retail of only \$549.99.

The ATARI® 800™ gives you all that and much more.

User-installable memory to 48K. A full-stroke keyboard.

With a high-speed serial I/O port that allows you to add a whole family of smart peripherals. Including up to four individually accessible disk drives. And a high speed dot-matrix impact printer. And, the Atari Program Recorder is included with the 800 system. Suggested retail price for the ATARI 800 (including recorder) is \$999.99.

Make your own comparison whenever personal computers are sold.

Or, send for a free chart that compares the built-in features of the ATARI 400 and 800 to other leading personal computers.



## PERSONAL COMPUTER SYSTEMS

1265 Borregas Ave. Dept. C, Sunnyvale, California 94086. Call toll-free 800-538-8547 (in Calif. 800-672-1404) for the name of your nearest Atari retailer.

© Atari 1979  
 Warner Communications Company

**The first encounter...**



# The first encounter

## The first personal computer for under \$200.

**The Sinclair ZX80.**  
A complete computer—  
only \$199.95 plus \$5.00 shipping.

Now, for just \$199.95, you can get a complete, powerful, full-function computer, matching or surpassing other personal computers costing several times more.

It's the Sinclair ZX80, the computer that independent tests prove is faster than all previous personal computers. The computer that "Personal Computer World" gave 5 stars for 'excellent value.'

The ZX80 cuts away computer jargon and mystique. It takes you straight into BASIC, the most common, easy-to-use computer language.

You simply take it out of the box, connect it to your TV, and turn it on. And if you want, you can use an ordinary cassette recorder to store programs. With the manual in your hand, you'll be running programs in an hour. Within a week, you'll be writing complex programs with confidence.

All for under \$200.

**Sophisticated design makes the ZX80 easy to learn, easy to use.**

We've packed the conventional computer onto fewer, more powerful LSI chips—including the Z80A microprocessor, the faster version of the famous Z80. This makes the ZX80 the world's first truly portable computer (6½" x 8½" x 1½" and a mere 12 oz.). The ZX80 also features a touch sensitive, wipe-clean keyboard and a 32-character by 24-line display.

Yet, with all this power, the ZX80 is easy to use, even for beginners.



### Your course in computing.

The ZX80 comes complete with its own 128-page guide to computing. The manual is perfect for both novice and expert. For every chapter of theory, there's a chapter of practice. So you learn by doing—not just by reading. It makes learning easy, exciting and enjoyable.

### The ZX80's advanced design features.

Sinclair's 4K integer BASIC has performance features you'd expect only on much larger and more expensive computers.

These include:

- Unique 'one touch' entry. Key words (RUN, PRINT, LIST, etc.) have their own single-key entry and are stored as a single character to reduce typing and save memory space.
- Automatic error detection. A cursor identifies errors immediately to prevent



entering programs with faults.

- Powerful text editing facilities.
- Also programmable in machine code.
- Excellent string handling capability—up to 26 string variables of any length.
- Graphics, with 22 standard symbols.
- Built-in random number generator for games and simulations.

Sinclair's BASIC places no arbitrary restrictions on you—with many other flexible features, such as variable names of any length.

And the computer that can do so much for you now will do even more in the future. Options will include expansion of 1K user memory to 16K, a plug-in 8K floating-point BASIC chip, applications software, and other peripherals.

### Order your ZX80 now!

The ZX80 is available only by mail from Sinclair, a leading manufacturer of consumer electronics worldwide. We've already sold tens of thousands of units in Europe, so demand will be great.

To order by mail, use the coupon below. But for fastest delivery, order by phone and charge to your Master Charge or VISA. The ZX80 is backed by a 30-day money-back guarantee, a 90-day limited warranty with a national service-by-mail facility, and extended service contracts are available for a minimal charge.

Price includes TV and cassette connectors, AC adapter, and 128-page manual.

All you need to use your ZX80 is a standard TV (color or black and white). The ZX80 comes complete with connectors that easily hook up to the antenna terminals of your TV. Also included is a connector for a portable cassette recorder, if you choose to store programs. (You use an ordinary blank cassette.)



The ZX80 is a family learning aid. Children 10 and above will quickly understand the principles of computing—and have fun learning.

Phone orders only: (203) 265-9171. We'll refund the cost of your call.  
Information: General and technical—(617) 367-1988, 367-1909, 367-1898, 367-2555.  
Phones open Monday-Friday from 8 AM to 8 PM EST.

# sinclair

Sinclair Research Ltd., 475 Main St.,  
P.O. Box 3027, Wallingford, CT 06492.

To: Sinclair Research Ltd., 475 Main St., P.O. Box 3027, Wallingford, CT 06492.

Please send me \_\_\_\_\_ ZX80 personal computer(s) at \$199.95\* each (US dollars), plus \$5 shipping. (Your ZX80 may be tax deductible.)

I enclose a check/money order payable to Sinclair Research Ltd. for \$ \_\_\_\_\_.

Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

Occupation: \_\_\_\_\_ Age: \_\_\_\_\_

Intended use of ZX80: \_\_\_\_\_

Have you ever used a computer?  Yes  No.

Do you own another personal computer?  Yes  No. \*For Conn. deliveries, add sales tax.

IA-12-0

~~\$200~~ for a computer?

## Yes, but...

- 1k of RAM

- Well, the Atari 400 had 8K of memory initially
- Expandable with 16K memory module

- Membrane keyboard

- Atari 400 had a membrane keyboard
- I had tiny fingers

- Kit computer

- I could totally build a kit computer

**Note: I still don't solder to this day**

**Time passes...**

**The second encounter...**



# The \$149<sup>95</sup> personal computer.



## Introducing the Sinclair ZX81

If you're ever going to buy a personal computer, now is the time to do it.

The new Sinclair ZX81 is the most powerful, yet easy-to-use computer ever offered for anywhere near the price: only \$149.95\* completely assembled.

Don't let the price fool you. The ZX81 has just about everything you could ask for in a personal computer.

### A breakthrough in personal computers

The ZX81 is a major advance over the original Sinclair ZX80—the world's largest selling personal computer and the first for under \$200.

In fact, the ZX81's new 8K Extended BASIC offers features found only on computers costing two or three times as much. Just look at what you get:

- Continuous display, including moving graphics
- Multi-dimensional string and numerical arrays

\*Plus shipping and handling. Price includes connectors for TV and cassette, AC adaptor, and FREE manual.

- Mathematical and scientific functions accurate to 8 decimal places
- Unique one-touch entry of key words like PRINT, RUN and LIST
- Automatic syntax error detection and easy editing
- Randomize function useful for both games and serious applications
- Built-in interface for ZX Printer
- 1K of memory expandable to 16K

The ZX81 is also very convenient to use. It hooks up to any television set to produce a clear 32-column by 24-line display. And you can use a regular cassette recorder to store and recall programs by name.

**If you already own a ZX80**  
The 8K Extended BASIC chip used in the ZX81 is available as a plug-in replacement for your ZX80 for only \$39.95, plus shipping and handling—complete with new keyboard overlay and the ZX81 manual.

So in just a few minutes, with no special skills or tools required, you can upgrade your ZX80 to have all the powerful features of the ZX81. (You'll have everything except continuous display, but you can still use the PAUSE and SCROLL commands to get moving graphics.)

With the 8K BASIC chip, your ZX80 will also be equipped to use the ZX Printer and Sinclair software.

### Order at no risk\*\*

We'll give you 10 days to try out the ZX81. If you're not completely satisfied, just return it to Sinclair Research and we'll give you a full refund.

And if you have a problem with your ZX81, send it to Sinclair Research within 90 days and we'll repair or replace it at no charge.

\*\*Does not apply to ZX81 kits.



**NEW SOFTWARE:** Sinclair has published pre-recorded programs on cassettes for your ZX81, or ZX80 with 8K BASIC. We're constantly coming out with new programs, so we'll send you our latest software.



**ZX PRINTER:** The Sinclair ZX Printer will work with your ZX81 or ZX80 with 8K BASIC. It will be available in the near future and will cost less than \$100.



**16K MEMORY MODULE:** Like any powerful, full fledged computer, the ZX81 is expandable. Sinclair's 16K memory module plugs right onto the back of your ZX81 (or ZX80, with or without 8K BASIC).



**ZX81 MANUAL:** The ZX81 comes with a comprehensive 104-page programming guide and operating manual designed for both beginners and experienced computer users. A \$10.95 value. It's yours free.

# The \$99<sup>95</sup> personal computer.



## Introducing the ZX81 kit

If you really want to save money, and you enjoy building electronic kits, you can order the ZX81 in kit form for the incredible price of just \$99.95\* It's the same, full-featured computer, only you put it together yourself. We'll send complete, easy-to-follow instructions on how you can assemble your ZX81 in just a few hours. All you have to supply is the soldering iron.

### How to order

Sinclair Research is the world's largest manufacturer of personal computers.

The ZX81 represents the latest technology in microelectronics, and it picks up right where the ZX80 left off. Thousands are selling every week.

We urge you to place your order for the new ZX81 today. The sooner you order, the sooner you can start enjoying your own computer.

To order, simply call our toll free number, and use your MasterCard or VISA.

To order by mail, please use the coupon. And send your check or money order. We regret that we cannot accept purchase orders or C.O.D.'s.

**CALL 800-543-3000.** Ask for operator # 509. In Ohio call 800-582-1364. In Canada call 519-729-4300. Ask for operator # 509. Phones open 24 hours a day, 7 days a week. Have your MasterCard or VISA ready.

These numbers are for orders only. For information, you must write to Sinclair Research Ltd., 2 Sinclair Plaza, Nashua, NH 03061.

AD CODE	Q51A	PRICE†	QTY.	AMOUNT
		ZX81		\$149.95
		ZX81 Kit		99.95
		8K BASIC chip (for ZX80)		39.95
		16K Memory Module (for ZX81 or ZX80)		99.95
		Shipping and Handling		4.95
TOTAL				\$4.95

MAIL TO: Sinclair Research Ltd., One Sinclair Plaza, Nashua, NH 03061.

NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

CITY/STATE/ZIP \_\_\_\_\_

**sinclair**



**Clive done did it again!**

## Yes, but...

- Still only 1k of RAM

- Well, the Atari 400 now had 16K

- Expandable with 16K memory module

- Membrane keyboard

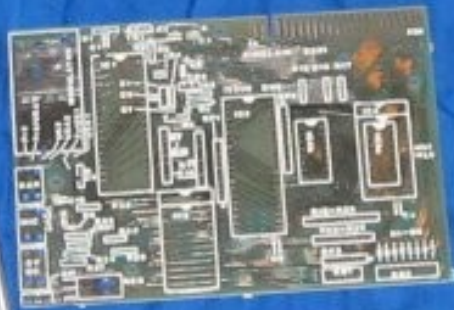
- Atari 400 had a membrane keyboard

- I still had tiny fingers

- Kit computer

- I still could totally build a kit computer







# THE POWER IS WITHIN YOUR REACH.



## TIMEX INTRODUCES THE POWER OF THE COMPUTER FOR JUST \$99<sup>95</sup>\*

**TIMEX Sinclair 1000**

Now Timex brings you a real computer at an unreal price with these sophisticated features:

- Unique "one-touch" entry of key words like RUN, LIST, PRINT eliminates tiresome typing.
- Full range of mathematical and scientific functions accurate to nine and a half decimal places.
- Graph drawing and animated display facilities.
- Multidimensional string and numerical arrays.
- 2K RAM expandable to 16K with

the optional accessory RAM module.

- Cassette LOAD and SAVE with named programs.
- Advanced 4-chip design: micro-processor, ROM, RAM, plus Master Chip.
- Ability to imbed Z80A machine code within BASIC programs.
- Full data address and control buses access provided.
- Powerful data string-slicing mechanism.

The power of the computer is within your reach today. Visit your local retailer or call our toll-free

number 1-800-248-4639 for the Timex computer dealer nearest you.



**TIMEX COMPUTERS**

**THE POWER IS WITHIN YOUR REACH**

\*Suggested retail price.

© Timex Computer Corporation, 1982

VINTAGE COMPUTING AND GAMING  
Retro Scan of the Week

Original Scan by VC&G for entertainment purposes. We claim no rights over this image, but if you use it, we would appreciate some credit. Thanks in advance!  
[www.vintagecomputing.com](http://www.vintagecomputing.com)

**Finally my parents purchase a  
computer...**

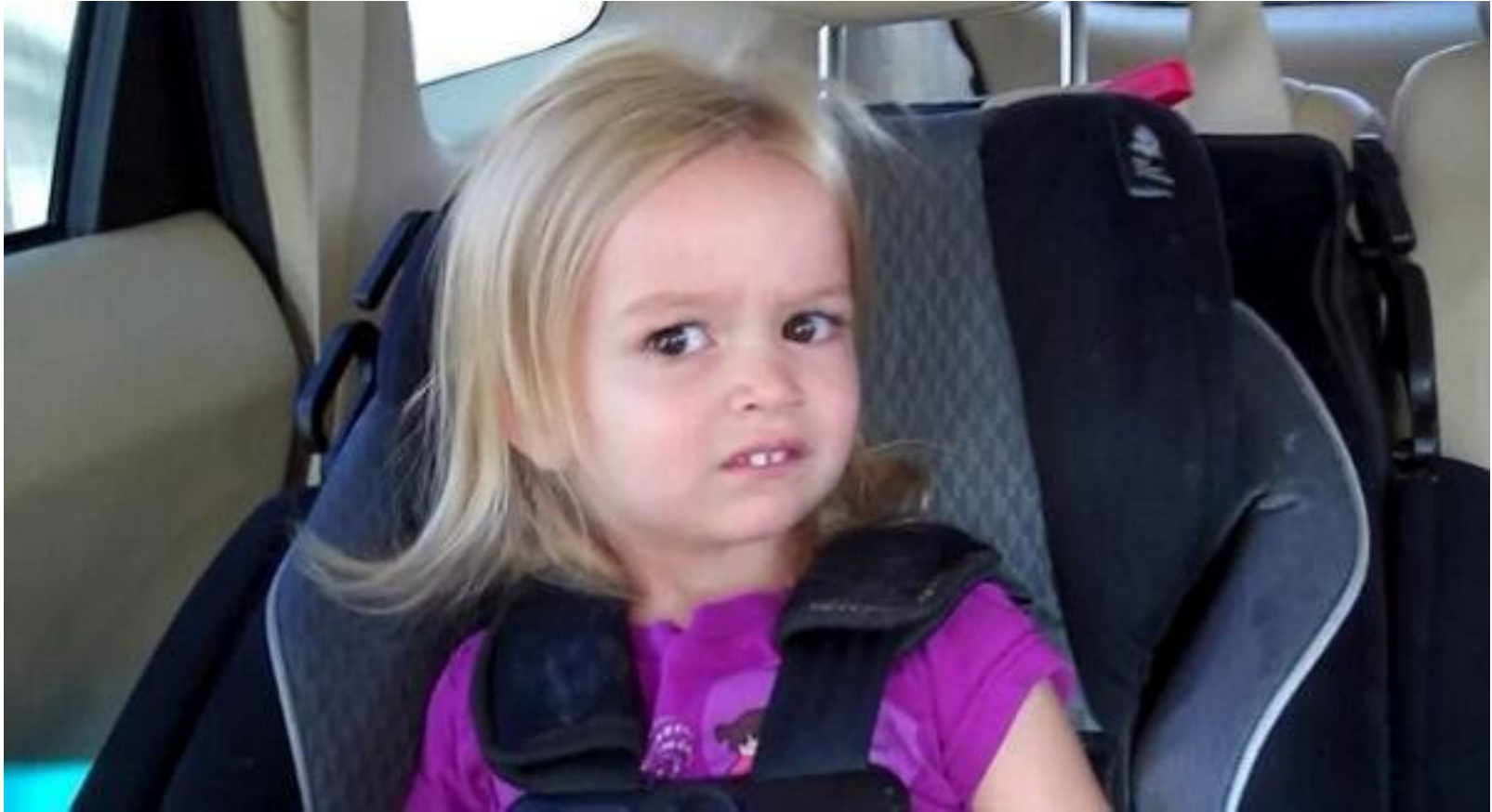






re-enactment







<http://www.oldcomputers.net/zx81.html>

TIMEX sinclair 1500





## Timex TS1500

- 16K memory
- Chicklet keyboard
- Nicer case (unused ZX Spectrum cases)
- Still a TS1000 / ZX81 underneath with a custom ULA
- Released at the same time as TS2068



# T52068

- 70K of memory
- ROM cartridge slot
- Joystick ports
- COLOR!
- Plastic keys

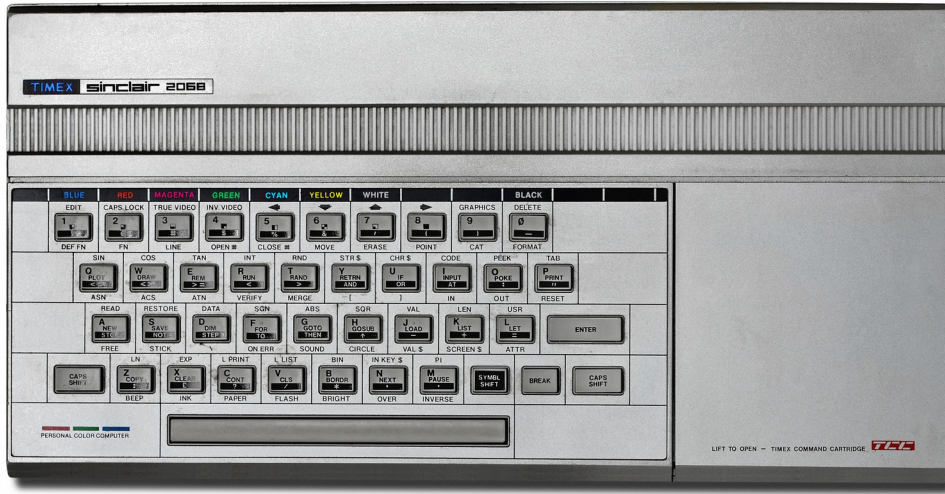
**But...**





## ZX Spectrum

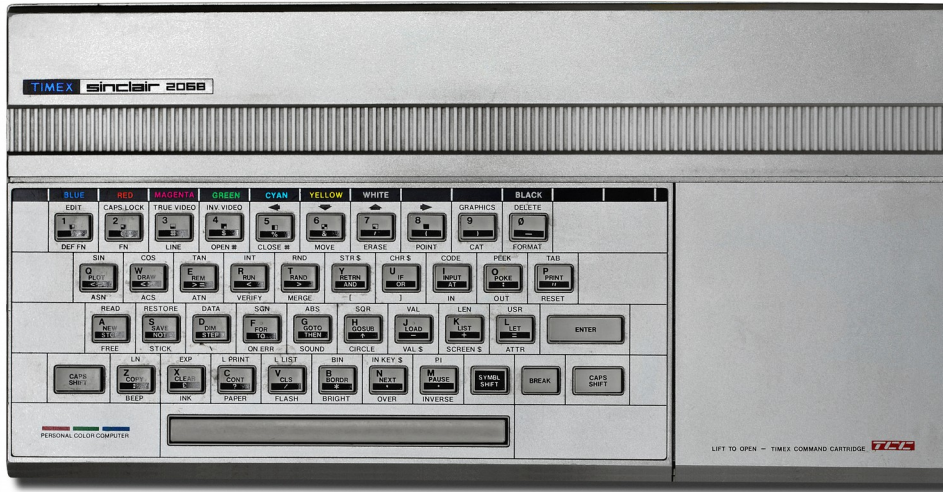
- Released in 1982 (one year before TS2068)
- 16K / 48K memory
- No joystick ports, no ROM cartridge
- Chicklet keyboard
- Only released in the UK



! =

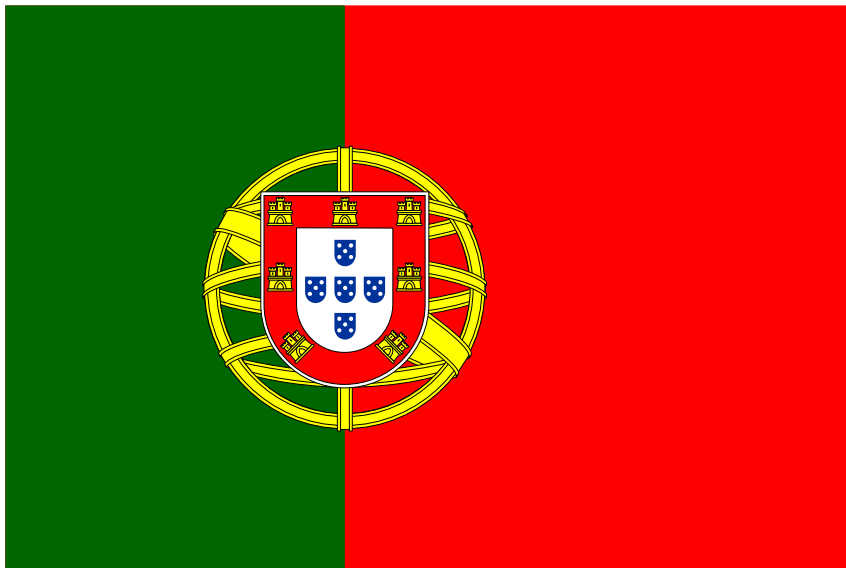




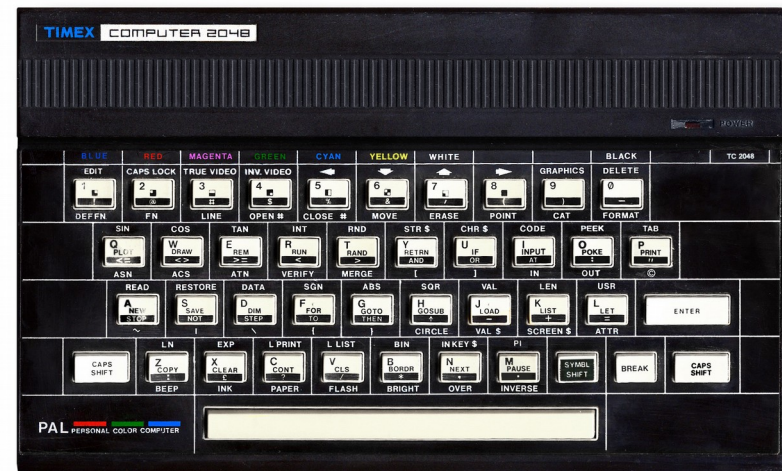


Screw America,  
I'm going to Portugal

[https://en.wikipedia.org/wiki/Timex\\_Sinclair\\_2068#/media/File:Timex\\_Sinclair\\_2068\\_Manipulated.jpg](https://en.wikipedia.org/wiki/Timex_Sinclair_2068#/media/File:Timex_Sinclair_2068_Manipulated.jpg)



Oi



[https://en.wikipedia.org/wiki/Timex\\_Computer\\_2048#/media/File:Timex-Computer-2048-Manipulated.jpg](https://en.wikipedia.org/wiki/Timex_Computer_2048#/media/File:Timex-Computer-2048-Manipulated.jpg)

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Best selling home computer in the UK

Started the cottage video game industry in the UK





[https://en.wikipedia.org/wiki/ZX\\_Spectrum#/media/File:ZX\\_Spectrum%2B.jpg](https://en.wikipedia.org/wiki/ZX_Spectrum#/media/File:ZX_Spectrum%2B.jpg)



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**Amstrad buys Sinclair**







[https://en.wikipedia.org/wiki/ZX\\_Spectrum#/media/File:ZX\\_Spectrum\\_Plus2.jpeg](https://en.wikipedia.org/wiki/ZX_Spectrum#/media/File:ZX_Spectrum_Plus2.jpeg)



[https://en.wikipedia.org/wiki/ZX\\_Spectrum#/media/File:ZX\\_Spectrum\\_Plus3.jpeg](https://en.wikipedia.org/wiki/ZX_Spectrum#/media/File:ZX_Spectrum_Plus3.jpeg)



**That's nice, Grandpa...**

## Brief Recap

- Craig wanted a ZX80 / ZX81 before he got an Atari 400
- Craig thought the TS1000 / ZX81 was kind of janky compared with the Atari 400
- Craig never saw a TS2068 / TC2048 in the wild
- Craig didn't see a ZX Spectrum until recently

**Conclusion**

**Craig is an idiot**



Fin

**So why are you so interested in janky  
foreign computers?**

**(No giving away the answer, people who were at the emulators talk)**

**Ams trad**

1) What exactly do you have to do to use Sinclair ROMs in an emulator, such as acknowledgements etc?"

Amstrad are happy for emulator writers to include images of our copyrighted code as long as the (c)opyright messages are not altered and we appreciate it if the program/manual includes a note to the effect that "Amstrad have kindly given their permission for the redistribution of their copyrighted material but retain that copyright".

"2) Can you charge a shareware fee for an emulator that uses the Sinclair ROMs?"

No. No one should be charging for the ROM code because (as a result of the point above) there are loads of freely available images anyway. If I ever thought someone was charging for the ROM images then I'd make them available as a free download on the [www.amstrad.com](http://www.amstrad.com) web site. Naturally I imagine that some emulator writers want to charge a shareware fee for the code they have written and we have absolutely no problem with that as long as they aren't, in any sense, charging for the parts of the code that are (c)Amstrad and (c)Sinclair.

"3) Can you modify the ROMs, for instance to enable tape loading and saving, and if so what are the requirements?"

The ROM code is simply a tool to let the emulator writers make a program that works as close to the original machine as possible. If they choose to modify the behaviour in any way then that's entirely up to them (I guess you could say that that is exactly what an emulator IS doing (ie modifying the screen output and keyboard input to go via the PC bits)!!)



"8) What is the legal position with regard to distributing ROMs from illegal Spectrum clones such as the Russian Scorpion and Pentagon machines?"

Anyone pirating hardware/software should be shot.... though that may be to quick a death for them. Perhaps nailing them up by the testicles using rusty nails would be the best thing to do to them?

"10) What is Amstrad's policy on the distribution of electronic versions of Sinclair documentation?"

The more the merrier. People scanning, OCRing, HTMLing & PDFing any manuals that are genuinely (c)Amstrad are actually doing us a favour because if someone asks for a copy we can just point them at a URL (please keep me informed!! ;-). So we'd welcome as many of them to be put online as possible if people can take out the time and trouble to do it.





<https://flic.kr/p/hM6dx>



So every emulator out there can have the  
Sinclair ZX Spectrum ROMs

# Nine Tiles Networks

## (Developer for Sinclair BASIC) made their code GPL Licensed

Sinclair BASIC is copyright © 1980-81 Nine Tiles Networks Ltd, © 1982-87 Amstrad PLC, © 1983 Sinclair Research Ltd, © 1983 Timex Corporation.

The copyright is horribly complicated because Sinclair never owned the rights to Sinclair BASIC. All rights remained with Nine Tiles until Amstrad bought the ZX Spectrum rights. After the sale, the ZX80 and ZX81 rights stayed with Nine Tiles, the Interface I rights stayed with Sinclair and the T52000 BASIC rights stayed with Timex. The upshot of which is that the Spanish version of the Spectrum 128 ROMs is technically owned, in part, by all of the above companies.

Nine Tiles Networks permits distribution under the GNU GPL. Sinclair has not stated its position, but has not sought to prevent distribution. Timex permits distribution. Amstrad permits distribution in software only providing it is accompanied by an equivalent of the following statement:

"Amstrad has kindly given its permission for the redistribution of its copyrighted material but retains that copyright"

<http://www.worldofspectrum.org/sinclairbasic/>



# Open ROM (ZX80 / ZX81)

<https://sourceforge.net/p/sz81/code/HEAD/tree/sz81/open8x/>



<http://www.computinghistory.org.uk/det/423/sinclair-zx80/>



<https://commons.wikimedia.org/wiki/File:Sinclair-ZX81.png>

# World of Spectrum

World of Spectrum - Google Chrome

World of Spectrum x

www.worldofspectrum.org

Apps Morning - Work Games Logitech Media S My Books Google Fit YNAB Jitsi Meet # general | PyOhio Other bookmarks

**WORLD OF SPECTRUM**

The official world archive for the Sinclair ZX Spectrum and the largest on-line gaming center on the Internet

Officially endorsed by [Amstrad plc](#)  
(Yup, I think the site's great - Cliff Lawson)

Last update on 5th January  
[ [What's new?](#) | [Best games](#) | [Random](#) ]  
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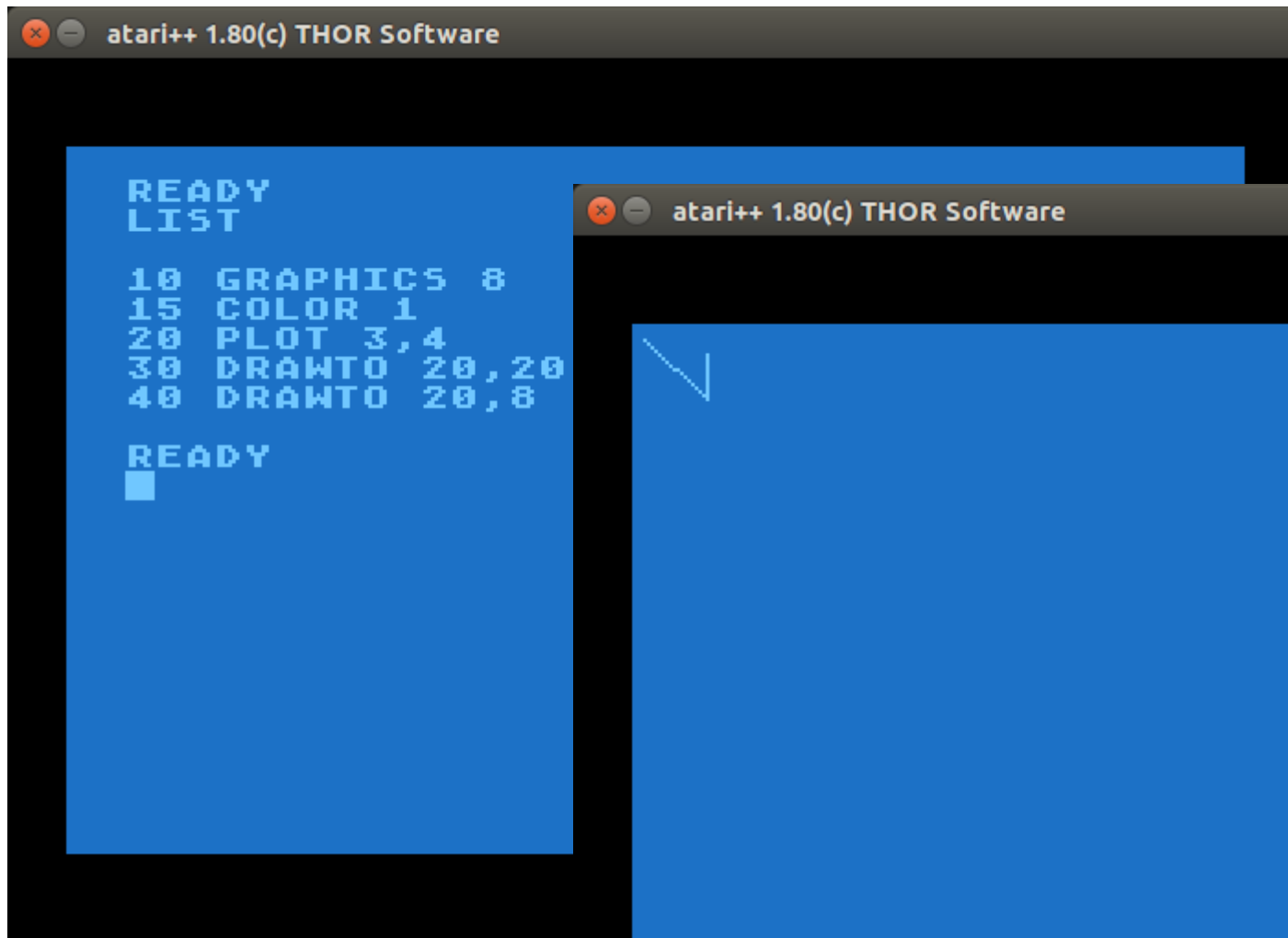
Please note: The forums are now back online. You may see some issues with the site that we are aware of and are working hard to fix. Please bear with us.  
www.worldofspectrum.org, [copyright](#) © 1995-2014 [Martijn van der Heide](#), ThunderWare Research Center

Co-maintainers: [Andy's ZX Spectrum Pages](#), [TZK Vault](#), [ZXSoftware](#), [SPA](#), Philip Kendall

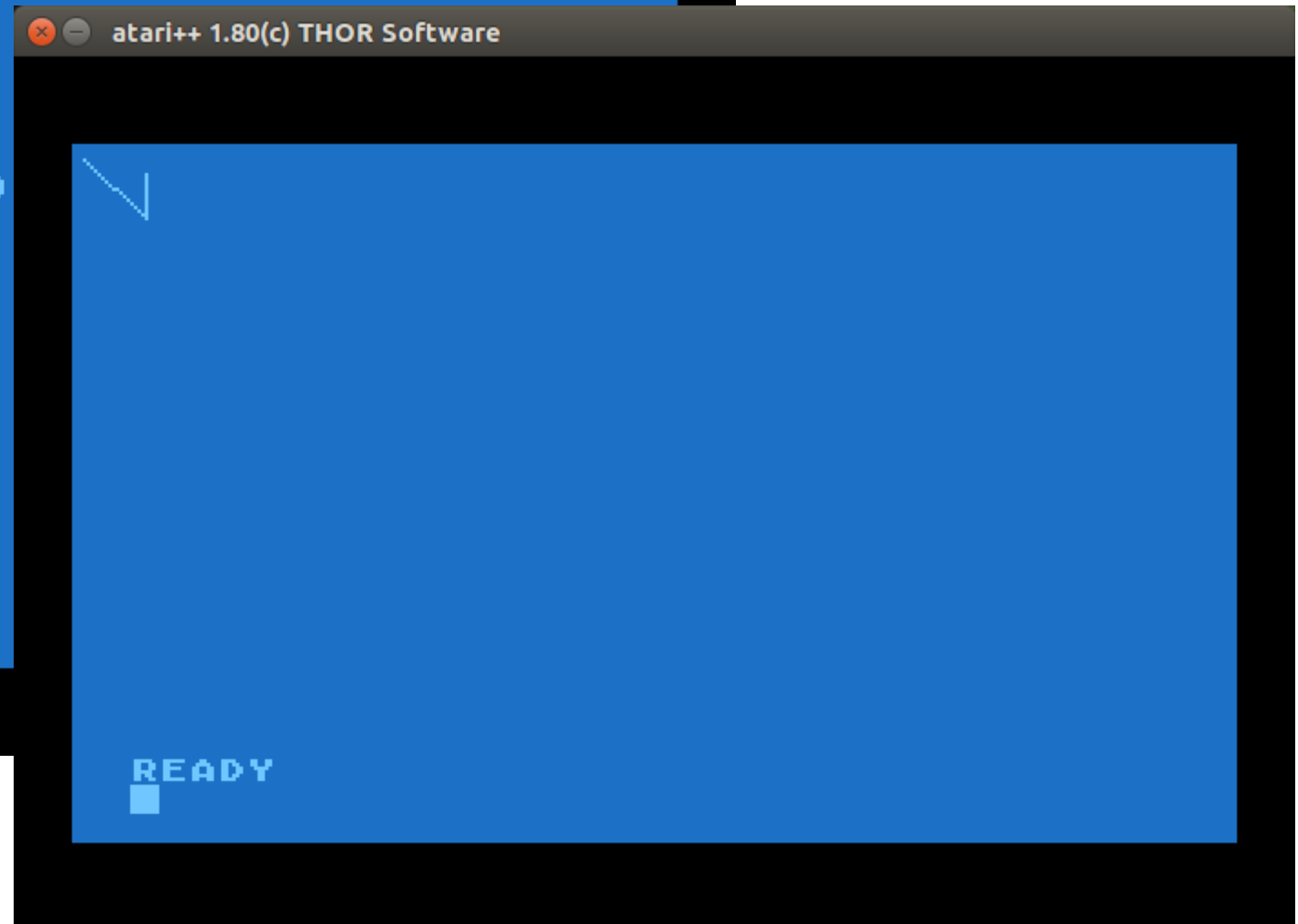
Associates: [SPOT #0n](#), [TTFn](#), [YS ROCK 2008 YEARS](#), [Tipshop](#), [ZX CERTIFIED](#)

**So what?**

# Designed for beginners



```
atari++ 1.80(c) THOR Software  
  
READY  
LIST  
  
10 GRAPHICS 8  
15 COLOR 1  
20 PLOT 3,4  
30 DRAWTO 20,20  
40 DRAWTO 20,8  
  
READY  
■
```



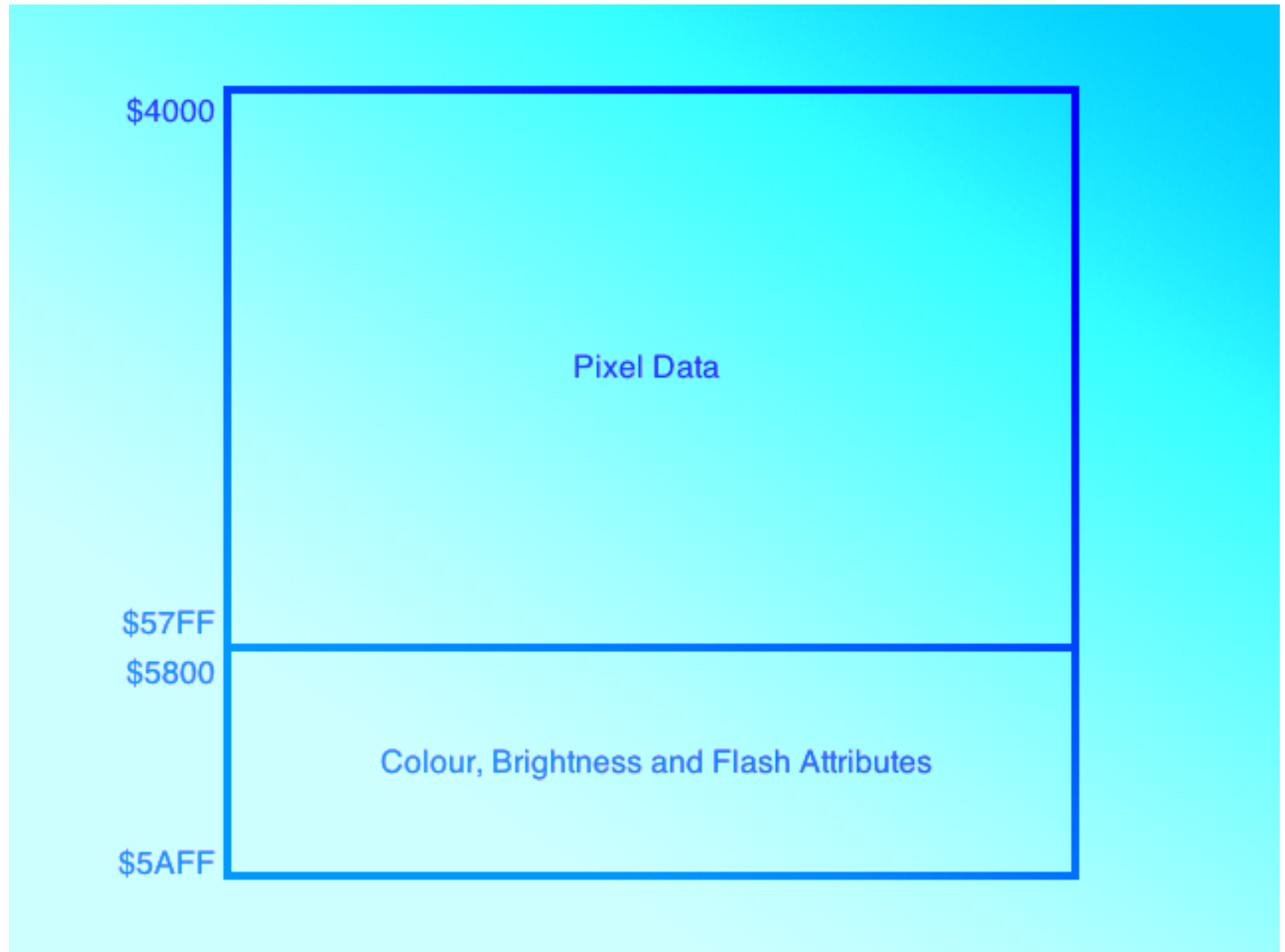
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atari++ 1.80(c) THOR Software  
  
READY  
■
```

# Designed for Beginners





# Designed for Efficiency

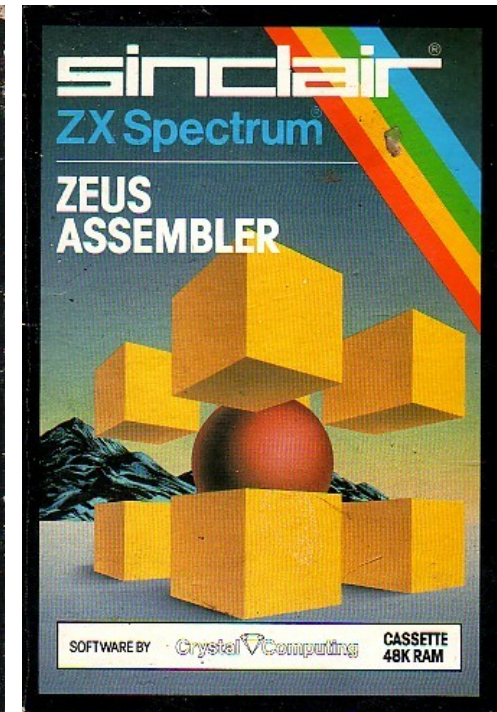
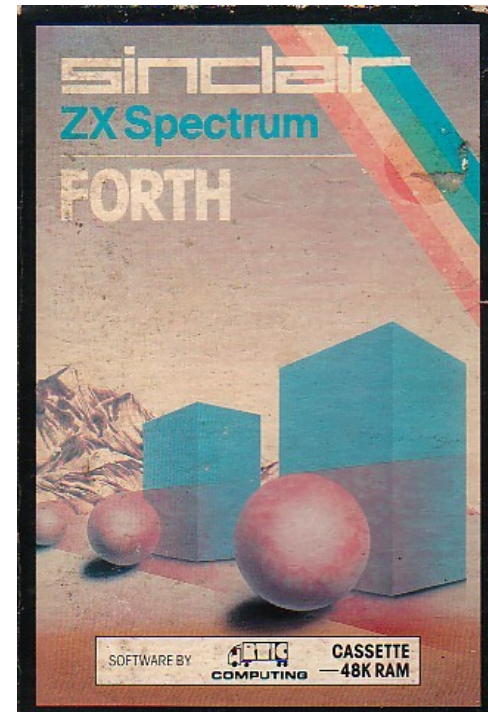
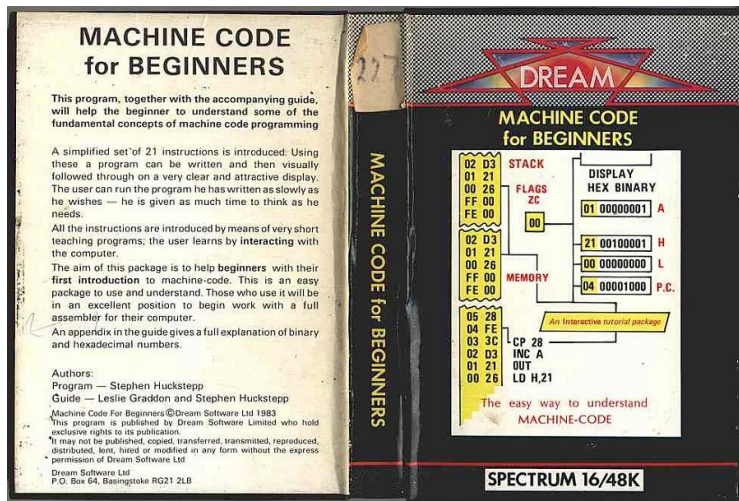
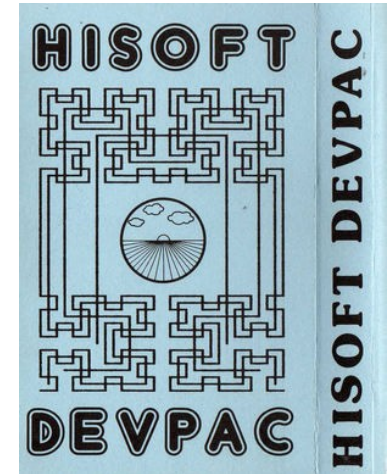


# Designed for Efficiency





# Designed with programming in mind



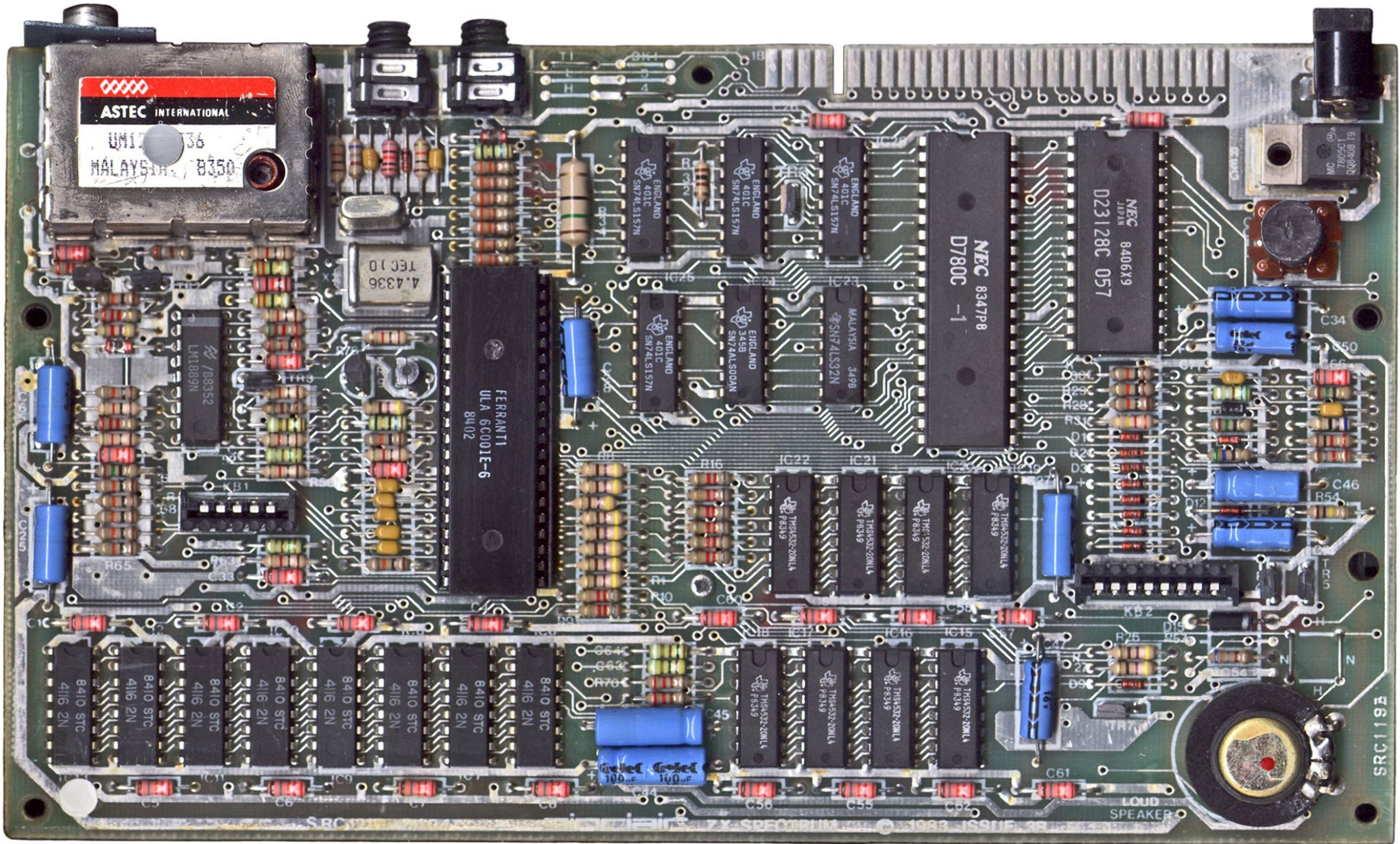
**Excellent books for learning how to code**

**(Mostly) Off-the-shelf hardware**









**Community**





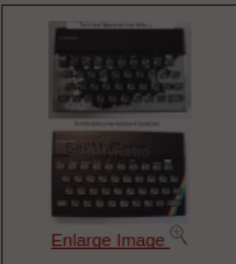


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\*NEW\* Rubber Key Sinclair ZX Spectrum Replac



Category:  
Listing type:  
Item Condition:  
Seller location:  
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Quantity Available  
Latest buyer:  
Fixed price:  
  
Number Sold:  
Shipping Costs:  
Payment methods:

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- Positive a\*\*\*t (3)
- Positive a\*\*\*s (38) Great value. Prompt seller.
- Positive v\*\*\*i (13) Fast shipping as always, tha
- Positive M\*\*\*a (4) prompt delivery, arrived unda

Description Picture gallery Questions and answers

Description

We are pleased to be able to offer new replacement keyboard faceplate (also known as a keyboard fascia) is the metal overlay which sits over the top of the rubber keyboard mat on the original Sinclair ZX Spectrum keyboard. The faceplate is made of metal and has the keys embossed on it. This means that the keys are not worn and the text is clear. The faceplate is also made of metal and has the keys embossed on it. This means that the keys are not worn and the text is clear.



\*NEW\* Rubber Key Sinclair ZX Spectrum Replacement 16K / 48K Keyboard Faceplate

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Info List

Item Number : 2690

Meet the seller

rwap software (2514)

Feedback received in last 120 days : 1334 times

- Positive: 1334 (100%)
- Neutral: 0 (0%)
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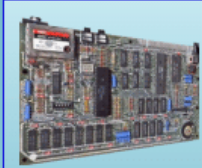
Fixed price: £18.00

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faceplate (also known as a keyboard fascia) is the metal overlay which sits over the top of the rubber keyboard mat on the original Sinclair ZX Spectrum keyboard. The faceplate is made of metal and has the keys embossed on it. This means that the keys are not worn and the text is clear. The faceplate is also made of metal and has the keys embossed on it. This means that the keys are not worn and the text is clear.





## The ZX Spectrum ULA Book

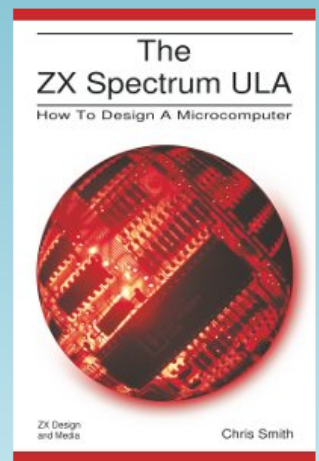
The design behind the most successful home computer of the 1980s

- ### Other Links
- [Buy the ULA Book](#)
  - [Inside the ULA](#)
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- ### News
- 17 Feb, 2013
- A +D disk containing the original cassette master maker for my unpublished game Skyway has been found, and uploaded to the ZXDesign website!
- [Read More](#)
- 30 Jul, 2010
- The writing and production of The ZX Spectrum ULA: How to design a microcomputer has been completed and the book is with the printer. Once proof copies have been checked, distribution will begin!
- [Read More](#)

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## The ZX Spectrum ULA: How to design a microcomputer

by Chris Smith

**Web Price:** £24.95 ~~£23.50~~

**Pages:** 324  
**ISBN-13:** 978-0-9565071-0-5  
**Publisher:** ZX Design and Media (Aug 2010)

Read the fantastic reviews on [amazon.co.uk](#)

Choose your location:  
UK Web Price £23.50

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Handling & Shipping: £2.75 international

"If you have ever wanted to design your own computer or wondered what was behind the most successful microcomputer of the 1980s, then this is the book for you.

For the first time, the inner working of the Sinclair ZX Spectrum's custom chip and heart of the computer, the Ferranti ULA, is exposed in minute detail.

Packed with over 170 illustrations and circuit diagrams, this book takes the reader through the cutting edge technology that was the Ferranti ULA and the design of the ZX Spectrum home computer, illustrating the principles and techniques involved in creating a cost effective computer that required nothing more than a television set and a cassette recorder.

The ZX Spectrum ULA is an essential read for the electronics hobbyist, student or electronic engineer wishing to design their own retro-style microcomputer or anyone with an interest in historical micro-electronic and digital design.

All topics are explained in simple yet precise terms, building on their careful introduction towards the full functionality presented by the Sinclair computer.

Some of the topics covered are

- The architecture of the standard microcomputer
- Ferranti and their ULA, manufacturing process and structure
- The functional layout of the ZX Spectrum ULA
- Video display generation
- Memory contention and timing
- ZX Spectrum design bugs such as "The Snow Effect"
- Hidden features of the ZX Spectrum
- ULA version differences

Read the fantastic reviews on [amazon.co.uk](#)

Please support the research, reverse-engineering and writing effort that went into producing this book, by buying directly from the ZX Design website.

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## ULA chip for ZX Spectrum :: Overview

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**Tools**

Google™ Custom Sea

### Details

Name: zx\_ula  
 Created: Apr 23, 2012  
 Updated: Jan 6, 2013  
 SVN Updated: Jan 6, 2013  
 SVN: [Browse](#)  
 Latest version: [download](#)  
 Statistics: [View](#)

### Other project properties

Category: [Video controller](#)  
 Language: [Verilog](#)  
 Development status: [Beta](#)  
 Additional info: [Design done](#), [FPGA proven](#), [Specification done](#)  
 WishBone Compliant: No  
 License: GPL

### Description

This is an implementation of the Sinclair ULA chip, found in ZX Spectrum microcomputers. The project offers various implementations: both FPGA friendly (with separate input and output data buses), and CPLD ready, to be used as a replacement for the many chips that comprise the ULA found in some clones.

This project is mostly based upon the work of Chris Smith. Chris designed a ZX Spectrum clon, the "Harlequin". A PCB has been developed by Don "Superfo", which uses discrete logic to implement the ULA, as Chris did. The CPLD version of this implementation is aimed to serve as replacement for that clone.

The ULA implementation follows, where possible, the original ULA timings, as stated in "The ZX Spectrum ULA: how to design a microcomputer", written by Chris Smith and published by ZX Design and Media, ISBN 978-0-9565071-0-5

There are implementations with some enhancements such as Timex hicolour support and ULA+ support.

### Features

- CPLD (XC95144/288XL) version, with shared data bus, designed for the Harlequin clone.
- FPGA (separate input and data buses, mostly synchronous, but I cannot aassure that) version, intended for soft SoC.
  - *To test the FPGA version, several clones have been built around this ULA core. See directory branches/xilinx. These clones are ready to be used in the Spartan 3 Starter Board, both 200K and 1000K gate versions.*
- All timings according to Chris Smith's specs. Yet to be tested against a real Z80 for timing accuracy (tv80 core seems not to have exact timings, but this could be my fault, not tv80's)
- Digital IRGB output, PAL timings. Same signals as found in the 128K heatsink RGB DIN connector, that is, bright component separated from main components.
- 8 bit digital RGB output for ULA+ mode. Output signal indicate whether ULA is in normal or plus mode.

### Project maintainers

- [Rodriguez Jodar, Miguel Angel](#)

# Retro Computers

📍 London, United Kingdom

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## Campaigns I'm On



### The Sinclair ZX Spectrum Vega Plus Console

by [Retro Computers](#)

Sir Clive Sinclair and Retro Computers Ltd announce the launch of the Sinclair ZX Spectrum Vega+



### Sinclair ZX Spectrum Vega

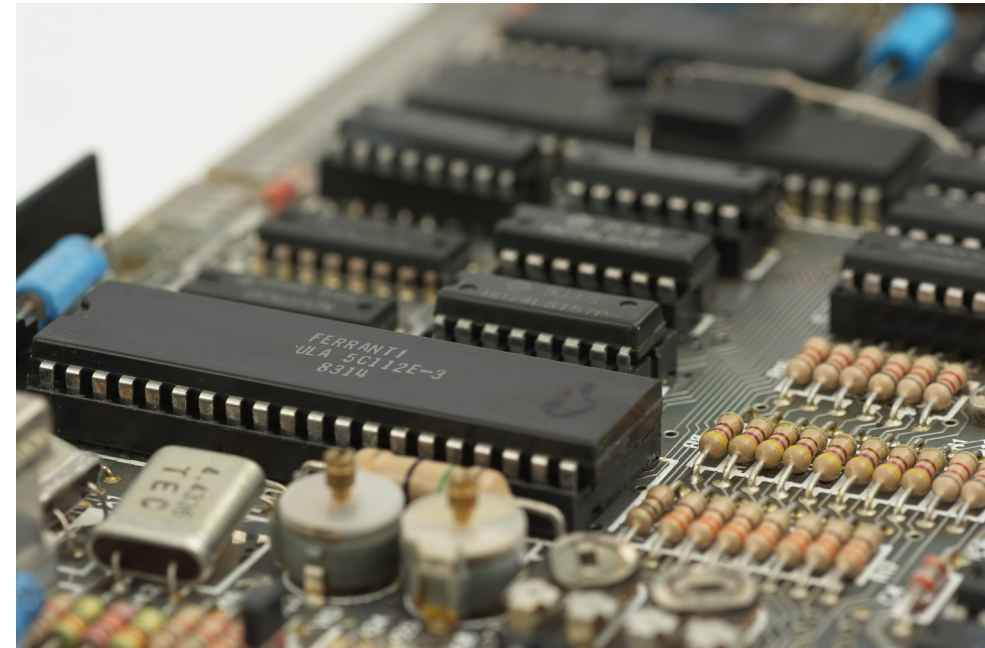
by [Retro Computers](#)

The Sinclair Spectrum Vega is a new games computer based on Sir Clive's hugely successful Spectrum.

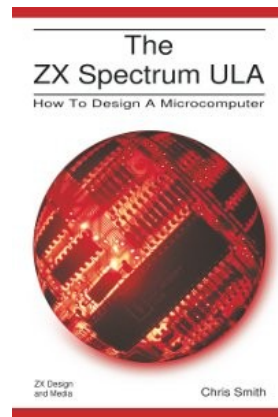
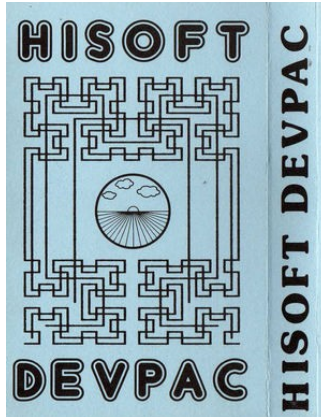
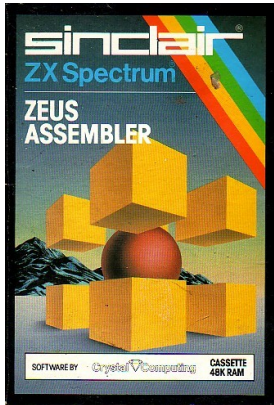








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**Demo**