Alessandro Grussu

SPECTRUMPEDIA

English edition

INDEX

VOLUME 1

Foreword

On 23 April 1982, Clive Sinclair announced his new home computer, the ZX Spectrum, which would open the doors of computing and digital entertainment to millions of people. The writer is one of them.

In January 1984, when I first got my hands on a Spectrum, I was a curious kid of ten and a half, immediately fascinated by the possibilities that unfolded on the screen before my eyes. I avidly read the Italian translation of its user manual, published by Gruppo Editoriale Jackson, trying to understand as much as possible, and experimented with BASIC by interrupting the execution of the *Horizons* cassette programs to examine their inner workings. This was only the beginning.

The Spectrum, with its sleek, compact appearance and crisp, vibrantly colourful graphics, would capture my senses and firmly plant itself in my imagination, to this day. It would teach me a lot about fascinating concepts such as 'algorithm' or 'subroutine'. It was this kind of knowledge that, fourteen years later, prompted me to learn the basics of HTML and compose the pages of my first personal web site. Besides, hours spent manipulating existing images or producing completely new ones with *Melbourne Draw* familiarized me with graphics and photo editing software, which still form a substantial part of my PC usage.

In addition to this, of course, there were games. I spent many afternoons having fun with my Spectrum, from text adventures to fast shoot-em-ups. Among other things, adventures greatly improved my knowledge of English, in terms of both vocabulary and grammar (and thanks to them I became able to type in both Italian and English without even looking at the keyboard). Spectrum games come from an era when simplicity, playability and creativity were the rule. For this reason, many of them aged well and I still enjoyed them every now and then in the years following the end of the 8-bit era.

Since 1998, by getting involved in the popularization of the Internet and the consequent revival of 'old systems' through emulation, I had the pleasure of rediscovering the Spectrum and becoming part of a scene spread throughout Europe and in various other countries. I became aware, by reading magazine articles, personal accounts collected on forums and newsletters and more, that in the end Clive Sinclair had won his bet. Many of those who owned a Spectrum made it their springboard towards the era that was still in its infancy in 1982, dividing themselves between the recreational and didactic aspect. Some would have kept on training themselves and found jobs in the information technology field. Others, like myself, would have benefited from their familiarity with the 'new technologies' and reached the digital age without 'adaptation traumas'.

This work, which appeared for the first time in 2012 for the thirtieth anniversary of the Spectrum's launch, has a never attempted before aim: to gather in a single work everything essential to know about the Spectrum, not only regarding the past, but also the present and future. It should provide an adequate account of the importance this computer assumed in accompanying an entire generation towards the 'digital revolution' of the 1990s.

If I had never come across the Spectrum, my life would have been different, and, I dare to say, not for the better, but for the worse. It is amazing to think about how many creative inputs I received from that 'contraption'!

Once spread online, *Spectrumpedia* attracted the attention of Fabio D'Anna and Marco Accordi Rickards of VIGAMUS, the video game museum in Rome. Thanks to their Foundation, the book was published in its entirety in October 2012 in a full colour edition. It was a challenge for all of us, crowned with a great success.

Since then, 'retromania' has been made socially acceptable; it is no longer a 'nerd-only matter'. On the contrary, it became a hallmark of mass culture, an object of study for human sciences, and – whether we like it or not – a formidable profit opportunity for the cultural and videogaming industry, as well as for those who sell cathode-ray tube televisions, cassette recorders, obsolete home computers and old generation consoles at exorbitant prices on the web. In an era that seems to look more to a mythical past than to an often considered dark and uncertain future, 'vintage' reassures and is re-proposed in a rapidly usable (or rather, consumable) form, for those who were around at the time and for those who were not.

I must admit that I let myself be somehow touched by this wave. I refined my knowledge of BASIC and learned the fundamentals of the Z80 Assembly language, tried my hand at creating some games that received more than positive feedback from fans and took part in retrocomputing events and live broadcasts on YouTube. Since 2020 I published online an Annual in Italian, English and Spanish containing analysis of various aspects of the 'retro' Sinclair world, games reviews and discussions about the background of titles I made. In short, the Spectrum continues to be present in my spare time as a creative entertainment.

Therefore, forty years after the launch of the Spectrum, I present *Spectrumpedia* in a new edition, significantly revised and expanded compared to the first, which was written straight away in just forty days, and translated into English by myself. Not only previously unavailable information, or related to what occurred after 2012, has been added, but also what was already present was emendated by factual and formal errors and standardized in style.

In doing so, I would like to reiterate what I affirmed several times since the appearance of the first edition, namely that this work is not an exercise in nostalgia or – even worse – in 'commodity fetishism'. The book's main purpose is to preserve the historical memory of an important piece of the IT revolution that from the 1980s onwards brought computers into our lives, also passing through videogame entertainment. This is all the more true for the Spectrum, a machine created with the deliberate intention of encouraging the user to learn more than just the commands needed to load a game.

At the same time, in showing how much interest the Spectrum continues to arouse in retrocomputing and retrogaming scenes, with the development of new hardware, games, graphics, demos, emulators and utility programs, I would like to highlight that the capacity of stimulating creativity continues to be the most distinctive feature of the impact on the public of Sinclair's best-known computer, even in the 21st century.

In delivering my work to the English-speaking public, after a patient work of review, expansion and translation, I would like once again to thank all those who, since the composition of the first Italian edition, provided material, offered suggestions, advanced observations and in general helped to make it better. In addition to those who are expressly mentioned in this regard in the text, my gratitude goes to Rick Dickinson, Stefano Guida, Urs König, Roelof Koning, Giovanni Lagorio,

Massimo Raffaele, Rui Ribeiro, Einar Saukas, Thierry Schembri, Stefan Walgenbach and Gunther Wöigk. For this English translation in particular, I should thank Peter Jones for his help in revising the text.

Messina, November 2022

Alessandro Grussu

Introduction

This work stems from the aspiration to bring together 40 years of activity and knowledge of the Spectrum from several points of view: historical, technological, cultural and so on. It was originally designed specifically for the Italian public, since the vast majority of the documentation used as a source is exclusively available in English, Spanish and Russian. That said, it can be valuable for everyone interested in the Spectrum or in retrocomputing and retrogaming in general.

The four chapters of this volume are arranged in the following order:

1. *History:* the story of how Clive Sinclair, starting from an early experience as an inventor in the field of microelectronics, came to conceive the Spectrum, and how his decisions influenced its diffusion. The focus then moves on to the transfer of every related right in the hands of Alan Sugar, founder and director of Amstrad, until the exit from the market in 1993 and the 'resurgence' thanks to new systems and emulation. This chapter is completed by a document of exceptional historical value: the transcription of *Who's Who At Sinclair in 1982,* a booklet published at the time of the Spectrum's launch, provided by Urs König of the Sinclair QL Preservation Project.
2. *Technology:* here, the historical Spectrum are presented in chronological order, each with its own technical specificities, followed by a wide selection of peripherals produced by Sinclair Research, Amstrad and third parties.
3. *Software Houses:* a list in alphabetical order of the main companies that produced games and utility applications for the Spectrum during the years of its 'commercial life'

(1982-1993). For each one of them, a profile is outlined, with a list of the most representative titles and a dedicated analysis of one of them.

4. *Clones:* a presentation of industrially manufactured computers derived from the Spectrum and of their most important peripherals, grouped together according to their country of origin. The chapter also deals with the SAM Coupé, an 8-bit computer designed as a Spectrum-compatible platform, but with many specific and exclusive features.

Chapter One
HISTORY

THE MAN BEHIND THE MACHINE

Clive Sinclair aged 18

No-one would question that Sir Clive Sinclair single-handedly created the British home computer market.
(John Gilbert, *Sinclair bows out: the life of Clive,* in *Sinclair User* 51, June 1986)

Born on 30 July 1940 near Richmond in Surrey (England), Clive Marles Sinclair descends from a family of engineers, but after completing his high school studies he chooses not to go to the University, being confident that he can learn by himself what he wants to know.

He starts working at miniaturized radio receivers and founds his first company, *Sinclair Radionics*, as early as 1961. Sinclair scores several hits with the manufacturing and sale of different products, most notably the *Micromatic* mini-radio, which was sold in assembled and in kit form, for the experienced – a formula that will be recurring in Sinclair's marketing strategy up to the ZX80 and ZX81 – and the *Project 60* hi-fi amplification system.

First appearance of the Sinclair logo, 1964

Sinclair Micromatic radio in kit form and assembled, 1967

In the first half of the 1970s, Sinclair still sets himself apart from his competitors, keeping to the 'small is beautiful' principle and devising a wide range of pocket calculators, cheaper and less cumbersome than the first Japanese-made models released at the start of the decade. The first series was the *Executive:* the first model appeared in June 1972 and had revolutionary features for its time, measuring just 56×138×9 millimeters and weighing only 71 grams. Other series would follow, like more advanced calculators for scientific purposes, up to the *Sovereign,* the top model which came out in 1977.

Clive Sinclair presents the first Executive pocket calculator, 1972

Other, even more ambitious projects, were less successful or ended up in resounding failures. The *Microvision MTV-1* micro-TVs, equipped with a 2" screen, an in-built rechargeable battery and able to work with both PAL and NTSC standards, were hindered by the high manufacturing costs, which made a higher retail price necessary, with a negative impact on sales as a consequence.

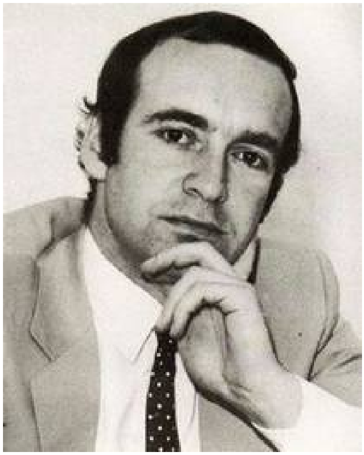
Things went even worse with the *Black Watch,* the digital wristwatch introduced in 1975, which revealed itself to be an authentic disaster due to an unbelievable thread of design and manufacturing faults – such as an awkward assemblage of the components, an extremely short life span of the batteries (just ten days), or the influence of external temperature on the inner quartz clock, so that the watch went faster or slower depending on it.

Microvision MTV-1, 1978

Black Watch, 1975

The Black Watch failure and the less than encouraging outcome of the Microvision caused huge financial losses to Sinclair, who had, very unwillingly, to accept State help from the National Enterprise Board, a public agency created by Harold Wilson's Labour government in order to manage State participations in British industry. Sinclair, politically close to the Conservative Party, soon tried to free himself from what he regarded as a suffocating protection and decided to start anew by founding a new company in 1977, *Science of Cambridge Ltd,* a follow-up to *Ablesdeal Ltd,* a side enterprise he created four years before. In 1979 Sinclair completely left Sinclair Radionics behind, turning it over to the NEB with almost £8 million of losses, while receiving £10,000 for it.

With Science of Cambridge, Sinclair was surrounded by a handful of trusted collaborators including a young technician and designer called Chris Curry who had been working for him since the Micromatic. This enabled Sinclair to start turning his efforts towards the fledgling computer industry. In the late 1970s most people from laymen to microelectronics enthusiasts saw computers as huge, cumbersome and insanely expensive machines that were mainly good for scientific and military applications. Sinclair came up with the idea of applying the 'small is beautiful' principle to this production sector too, aiming at the most knowledgeable part of the public first. This approach led, at the end of 1977, to the *MK (Microcomputer Kit) 14*, a very simple programmable calculator sold in kit form at £39.95.



Chris Curry in 1981

It should be underlined that Sinclair did not expect to achieve a considerable success with this product. He believed it to be a low-profile digression before tackling other projects he held much dearer, like the micro-TVs. However, the MK14 was unexpectedly well received, with more than 50,000 units sold. This pushed him to reconsider the question and taking into account the possibility of introducing into the market a 'real' home computer, built around the Z80 processor made by *Zilog*, the Californian company founded by Italian 'father' of CPUs Federico Faggin. Curry, who wished to develop the MK14 further instead, came into conflict with Sinclair and left him. He then established his own enterprise, *Cambridge Processor Unit Ltd*, together with his friend Hermann Hauser, a Physics researcher of Austrian origin. In March 1979 the company took a name that would become famous, *Acorn Computers Ltd.* Sinclair saw Curry's defection as an authentic betrayal, and the malevolence which came out of that made the competition between him and his former collaborator quite fierce.

MK14, 1977

Zilog Z80 processor

THE ‘ANCESTORS’: THE ZX80 AND ZX81

Sinclair ZX80, 1980

The new directives took a shape with the first real Sinclair computer, the *ZX80*, designed by Jim Westwood. Despite its minimal features – just one KB RAM and 4 KB ROM, lack of dedicated video circuitry and RAM –, the ZX80 actually filled a space which had not been occupied by any product till then, since home computers of the time had much higher costs and larger sizes. The ZX80 was the first real low-cost computer for users who wished to learn how such machines worked. Notwithstanding the fact that its objective limits prevented its use to be little more than educational, the ZX80 was a gamble that paid off. Launched at £99.95 already assembled and at £79.95 in kit form, the ZX80 obscured the success of the MK14, selling until the end of its production in August 1981 more than 100,000 units, about 60% of which were exported in other countries.

The path Sinclair had taken was revealing itself to be the right one. In November 1979 his enterprise was renamed *Sinclair Computers Ltd,* and in 1981 the *ZX81*, successor to the ZX80, appeared. This machine, largely based on the previous one, had its roots in Sinclair's attempt to answer the request publicly advanced in December 1980 by the *British Broadcasting Corporation* (BBC), the notorious British state television network, about a low-cost and easy-to-use computer for a forthcoming TV show related to a grandiose computer literacy project carried out by the government. The new computer would in addition have been marketed under the BBC name, and this would have granted a financial and advertising backup of incomparable entity.

BBC Micro, 1981

Sinclair, then the major European home computer manufacturer, could not miss the enormous potential of such an opportunity and decided to improve the ZX80 in time to offer the BBC a product able to satisfy their requests. Therefore, in January 1981 he showed the BBC technicians the prototype of the *ZX81.* Unluckily for him, Chris Curry's Acorn Proton, which also descended from a previous machine (the Atom) was chosen instead, although its initial price was set at £235 against the £110 Sinclair asked for the ZX81. The Proton would then go into production as the BBC Micro.

In spite of the blow he suffered, Sinclair did not lose his heart, and in March 1981 the ZX81 was introduced to the market, once again with low cost and simplicity of use as its strong points.

Sinclair ZX81, 1981

Initial retail prices were £49.95 for the kit form version and £69.95 for the assembled one, against, for example, almost USD 300 for the Commodore VIC-20, a much better performer in graphics and sound (the ZX81 featured neither sound nor colour), but less flexible in terms of BASIC interpreter and connectivity. The ZX81 in fact, like the previous machine and the subsequent Spectrum, adopted the common Compact Cassettes as its mass memory. They could be used with any tape recorder, while Commodore computers required the purchase of the dedicated Datassette device.

Much more than the ZX80, the ZX81 met with a resounding success. After 10 months from its launch, 300,000 units were sold through mail order and 700,000 with direct purchase. When its production ceased to make way for the Spectrum, about 1,500,000 ZX81s were around. Emblematically, the ZX81 was the first European computer to be licensed for manufacturing in the United States, namely by Timex Corporation. A joint-venture with Sinclair's company – which on the occasion of the launch of the ZX81 changed its name to *Sinclair Research Ltd* – produced two slightly modified versions of the machine, the Timex Sinclair TS 1000 and TS 1500. Time was ripe for a qualitative leap.

Advertising for the Timex Sinclair TS 1000

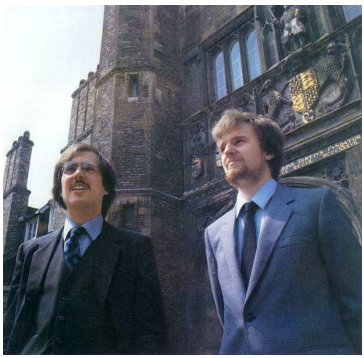
A LIGHTNING START

Rick Dickinson in his studio, 1982

Between the end of 1981 and the beginning of 1982, experimentations with Sinclair's new computer are underway. Sinclair's aim is to give the 'man in the street' a device that, contrarily to the previous ones, would also be of actual use, other than understanding what a computer is and which potential it could offer, while maintaining an affordable price, under £200.

The ZX82 – codename of the project – is developed by a highly qualified team: among others, Steven Vickers codes the operative system and the new Sinclair BASIC, an enhanced version of the interpreter supplied with the ZX81, while designer Rick Dickinson and engineer Richard Altwasser respectively deal with the physical appearance and hardware features of the machine.

Vickers and Altwasser will however leave Sinclair Research shortly after the release of the Spectrum,



Steven Vickers (left) and Richard Altwasser (right) in front of Trinity College, Cambridge (from* Sinclair User *4, July 1982)

Spectrum prototype, 1981

wishing to follow new roads in full autonomy upon the basis of the experience acquired while working on the ZX81 and its successor. Their Cantab company will manufacture another computer, the Jupiter Ace, a clone of the ZX80 with Forth in place of BASIC. Dickinson will instead work at all Spectrums up to the 128, and to Sinclair's last microcomputer, the Cambridge Z88.

Preliminary mock-up of the ZX82

On 23 April 1982, on the premises of the luxurious Churchill Hotel in London, Clive Sinclair officially presents his new product: the *ZX Spectrum*. Its main technical specifications are:

- Zilog Z80A processor at 3.5 Mhz;
- 16 KB ROM;
- 16 KB or 48 KB RAM;
- high resolution at 256×192 pixels;
- low resolution in a grid of 32×24 blocks, each one consisting of 64 (8×8) pixels;
- a total of 15 colours: blue, red, magenta, green, cyan, yellow and white, each one configurable at normal or high brightness and as static or flashing, plus black;
- membrane keyboard with 40 rubber elements;
- inner 40 Ohm, 1-channel loudspeaker.

The computer's launch price stays under £200, as dictated by Sinclair: £125 for the 16 KB RAM model and £175 for the 48 KB one.

Sinclair ZX Spectrum 16/48K, 1982-1984

Together with the Spectrum, the *ZX Printer,* a small thermal printer inherited from the ZX81, is offered at £59.95. Presented as a preview, there are also the *ZX Interface 1* and the *ZX Microdrives,* small and fast mass memory drives working with ring-tape cartridges. The Interface 1 expands the computer's connectivity, allowing the use of Microdrives and the connection in a local area network of up to 64 Spectrums.

Simple and fairly reliable for the standards of the time, Microdrives are Sinclair's answer to the need for a data storage medium that has to be faster and more reliable than cassettes. Back then, it was still somewhat unclear which direction 'advanced' mass memories would take – many roads were open. Technical evolution won't follow Sinclair's ideas, and in the subsequent years several third-party peripherals will be introduced, built around other media like 5" ¼ floppy disks, that will definitely establish themselves during the first half of the decade as the most widespread storage medium, their place being subsequently taken by 3" ½ disks. Microdrives will remain a niche product instead.

Interior of the Spectrum launch advertising brochure. In this first phase, the only way to get the latest addition to the Sinclair family was mail order, which, it was promised, would be processed within 28 days of receipt.

Some 'competitors' of the Spectrum at the moment of its release: from left to right and top to bottom, Texas Instruments TI99/4A, Atari 800 XL, Tandy TRS-80 CC, Commodore VIC-20

The Spectrum must immediately face a fierce competition, mainly composed with machines like the already mentioned BBC Micro, the Texas Instruments TI-99/4A, the Atari 400 and 800 or the Commodore VIC 20, which in August 1982 will be joined by the all-time 'arch-rival' of the Spectrum, the Commodore 64.

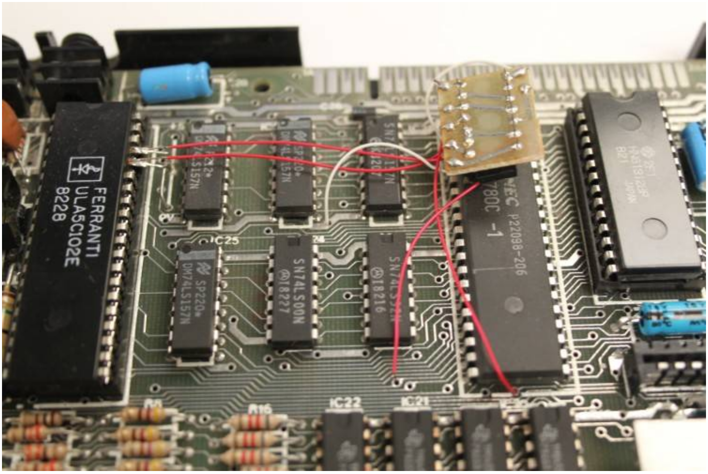
The new brainchild of Sinclair and his team is not, in fact, free from defects. The need for curbing costs in order to keep a noticeably low starting price in the home computer range and, partially, the tight development times assigned by Sinclair in order to exploit the favourable moment created by the ZX81's success, are the reasons behind some design choices which at first are considered questionable at best. They however become less concerning as soon as the Spectrum proves to be a flexible machine, relatively easy to program and supported by an extremely wide offer of software titles in terms of quality and quantity, thus allowing a whole generation of 'bedroom programmers' to emerge.

As it happened with previous Sinclair computers, the Spectrum was, at the time of its market launch, only available directly from the manufacturer by mail order. Sinclair's poor ability to meet the customers' demand, already seen with the ZX80 and ZX81, raised more than one eyebrow, when at the presentation at the Churchill Hotel he confidently stated that the Spectrum would be delivered 28 days after the order receipt. He also added that the Microdrive would probably arrive in early autumn.[1]

In fact, the very first batch of machines had already rolled off the production lines while the specialized press was eagerly waiting for Sinclair's announcement. Unfortunately, most of them suffered from a flaw in the implementation of the ULA (Universal Logic Array), the circuit that manages the system's architecture, from the logic gates to the video signal. The first model of the ULA, called 5C102E and produced by Ferranti between March and April 1982, employed an incorrect signal line, causing an internal conflict when it had to read or write from the data bus and at the same time manage the display. This corrupted the data transferred from the input/output ports, making operations such as reading from the keyboard or interacting with peripherals practically impossible. To force the ULA to operate according to the correct timing, an additional circuit was manually mounted. It was hosted on a base often turned upside down with the pins in plain sight, which earned it the sarcastic nickname of 'dead cockroach'.[2] The first batch of Spectrums modified this way was only available in early June, when quite a few machines had in the meantime been

[1] Stephen Adams/Ian Beardsmore/John Gilbert, *The Complete Sinclair Database,* Big Brother Publishing 1984, p. 151.
[2] C. Smith, *The ZX Spectrum ULA: How To Design A Microcomputer,* ZX Design and Media 2010, pp. 249-250.

returned to Sinclair Research as faulty. Subsequent revisions of the Spectrum ULA incorporated this change without the need for additional parts.



A Spectrum modified with the addition of the 'dead cockroach'

Also in June 1982, Commodore became the protagonist of a curious fact, bordering on industrial espionage. Kit Spenser, vice president of the Canadian company, 'acquired' a ZX Spectrum through his former employee, Robin Bradbeer, the editor of the Spectrum user manual written by Steven Vickers. Bradbeer had travelled to the Commodore Fair on 3 June, taking a Spectrum with him because he knew his old co-workers would be interested in it. Spenser convinced Bradbeer to lend it to him so that he could take a look at it during the evening, promising to return it the following day. On 4 June, at lunchtime, Bradbeer noticed that Spenser seemed nowhere to be found. At four in the afternoon, he learned that Spenser had flown to America the night before, taking the Spectrum with him. Understandably annoyed, Bradbeer walked away from the event, taking a colour television and a VIC-20 computer with him, in place of his Spectrum. At the same time, Commodore executives pressured representatives of the free *Micro Forecast* magazine to remove a Sinclair flyer from every copy displayed on their stand, threatening to expel them from the show within a quarter of an hour. The advent of the Spectrum had clearly been a shock for Commodore – the North American giant did not seem able to respond to its competitor's move. Interestingly, at ZX Microfair, four weeks earlier, no one from Sinclair had dealt such a low blow to an equally small Commodore presence – at Sinclair, they weren't afraid of the competition.

Nonetheless, new problems were surfacing. As early as the end of June, Sinclair was seeing the newly modified Spectrums return, many for the second time. Another problem had occurred, due to circuitry overheating, which led to video image corruption and a total system hang. As if that were not enough, more and more orders arrived as production lines were busy repairing and returning faulty machines to users. Sinclair was again finding himself unable to meet requests on schedule, so that, in an attempt to appease his customers, he announced that a cassette with demonstration programs, called *Horizons* and produced by Psion, would be offered free with every computer sold.[3]

Throughout the summer of 1982, the supply of Spectrums to the market proceeded slowly, in a context where the ZX81 still remained popular, to the point that software houses continued to release programs for this platform. In September, however, a fact widely reported by the British media reinforced the impact of the Spectrum on the general public.

[3] *The Complete Sinclair Database* cit., pp. 152-153.

During a state visit to Japan, Margaret Thatcher, then Prime Minister of the United Kingdom, showed her local counterpart Zenkō Suzuki a Spectrum running a demonstration program. It was written by John Mathieson, who was present at the scene as a *deus ex machina* when it came to telling the two leaders how to 'make the computer work'. The Spectrum had been chosen to represent the state of the art of British technology to the highly advanced Japanese. It was a great personal success for Sinclair, however the usual 'grumblers' complained that he was able to have a Spectrum delivered in a short time to the Prime Minister of Japan, but not to customers in his own country.[4]

Margaret Thatcher shows the Spectrum to the Prime Minister of Japan, Zenkō Suzuki, September 1982

Initial criticism of the Spectrum is mainly focused upon three aspects. First of all, the display system, devised and patented by Altwasser, although being paradoxically easy to manage due to the absence of hardware sprites, only allows for two colours for each block of the low-resolution grid. This causes a limitation in the movement of objects on the screen: they take different

[4] *The Complete Sinclair Database* cit., p. 154.

colours according to the block they are located in. This is the ill-famed *colour clash,* an effect that will be limited by the most skilled programmers, but will also be an unavoidable feature, lasting through the whole commercial life span of the Spectrum.

Moreover, the rubber keys do not allow for adequate feedback during typing, up to the extent that they earn themselves the hardly enviable nickname of 'dead flesh'.[5] As if it was not enough, the underlying membranes are not of exceptional quality and tend to break under intense use.

Finally, some features are lacking, such as a dedicated sound chip, which limits the basic audio output to a monophonic beeper (techniques of 'false polyphony' are only possible by programming the computer directly in machine code), or a power switch.

In its favour, the Spectrum can however count on a large base of potential users, thanks to the road already paved by its two predecessors, and consequently by a fledgling software industry, well-disposed towards Sinclair's project.

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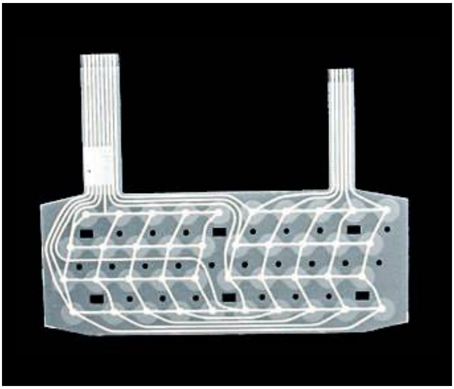
[5] Rick Dickinson stated about this point: 'I love reactions like dead flesh – you could certainly relate it to that. People seem to forget what they've paid for an instrument or a product. At the time there was probably no other way around it to meet the cost targets. Even if some sort of miracle we had theoretically designed a better product I don't suppose for a moment it would have been any more successful and that we would have sold any more. I don't think there was anything I would change or have since regretted'. Source: Leo Kelion, *ZX Spectrum's chief designers reunited 30 years on,* 22 April 2012, *www.bbc.com/news/technology-17776666*

System made up with a ZX Spectrum, ZX Interface 1, ZX Microdrive and ZX Printer, the latter inherited from the ZX81. The 10" monitor is part of a series marketed by Rebit Computer, a subsidiary of GBC Italiana S.p.A. which was in charge of distribution and technical assistance in Italy for the Spectrum and the products associated with it.

The Spectrum was launched in Italy in March 1983 at a price of ITL 360,000 for the 16K and ITL 495,000 for the 48K, plus 18% VAT. Only those who bought the second model would receive a complimentary copy of **Alla scoperta dello ZX Spectrum,** *the Italian translation of the original manuals, initially published by Gruppo Editoriale Jackson. Everybody else had to purchase it separately at the cost of ITL 22,000.*

Image taken from: **Enciclopedia di Elettronica e Informatica,** *Gruppo Editoriale Jackson, Vol. 7, 1984.*



A 16/48K Spectrum keyboard membrane. Broken contacts caused by film fragility were the most common technical issue with the first Spectrum models.

The BASIC interpreter, built upon the one devised by John Grant of Nine Tiles Ltd for the ZX80 and ZX81, is rigorous yet easy to use; commands and functions are immediately typed through a whole set of keywords called with the aid of specific cursor modes, a system taken from the ZX80 and ZX81, always with the aim of saving ROM space as much as possible. This is made more efficient thanks to an internal control procedure, that not only prevents typing mistakes while writing BASIC lines but, should syntax errors or inconsistencies occur, it immediately brings them to the user's attention. A large number of error messages, each one related to a specific situation, makes individuation and correction of programming bugs easier.

Regarding machine code, the presence of a reliable and popular processor like the Z80 – here in a slightly revised version, the Z80A – can't be anything but a strong point upon which the Spectrum can build its success on the market.

As we have seen, the first months of the Spectrum's life are not easy. This, strange as it might seem, is mainly due to the highly positive response of the public, despite the design flaws that

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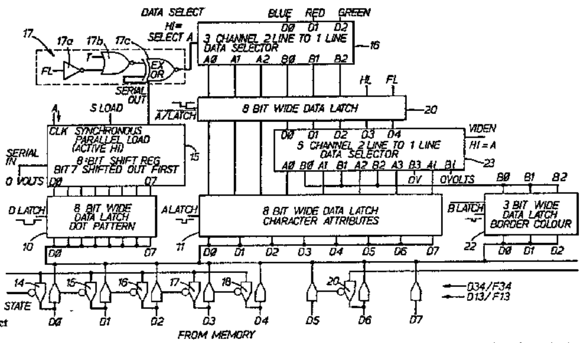
(54) Title: DISPLAY FOR A COMPUTER



(57) Abstract

A coloured display for a computer is derived using a first set of digital words representing locations in a pixel matrix for the pattern to be displayed and a second set of digital words representing foreground and background colours for the pattern on the basis of a conventional character display whereby to reduce the amount of storage required for the colour information while permitting high resolution graphics. Circuits are provided for converting digital R, G, B signals into analogue Y, U, V signals and each of these circuits comprises a control transistor in whose collector circuit is connected the base of an output transistor and in whose emitter circuit are connected parallel switches and resistances which switches are controlled by signals derived from the digital R, G, B signals whereby to alter the base bias of the output transistor.

Patent for Richard Altwasser's Spectrum display design, 1983

appear from the first weeks of distribution, with the inevitable immediate corrections. Consequently, Sinclair is unable to meet the demand, and the starting production of 20,000 machines per month is insufficient to cover the requests. It is therefore mandatory to license manufacturing to other plants in British territory, in addition to the one owned by Timex Corporation in Dundee, Scotland, and to create a sales network relying on large retail chains such as John Menzies and Dixons as well. Sinclair also signs an agreement with South Korean giant Samsung, which is entrusted with part of the production of Spectrum, already from Issue 2 (started in August 1982): for the first time, a Sinclair computer is manufactured in Asia. One year after its launch, in the UK alone, 15,000 Spectrums are sold each week, also thanks to the drop in the price of the 48K to £129, and the computer is starting to appear in other countries, including Italy.

Female workers of the Timex plant in Dundee manufacturing Spectrums

In October 1984, the old and by now inadequate 16K is put out of production and the 48K gets redesigned, again by Rick Dickinson. The intervention focuses on what had been the main object of criticism: the keyboard. Thus, the *Spectrum + (Plus)* appears, a 48K in a larger case, still with a membrane-operated keyboard, but this time with elements made with hard plastics and in a larger number (58 against 40 of the previous model). A reset button is also added.

Between 1982 and 1985 about 5 million Spectrum units are sold, finding considerable favour, as well as at home, in countries such as Spain, Portugal, Ireland, Greece and France.

Sinclair ZX Spectrum +, 1984-1986

In Italy, Germany and Argentina, it has to deal with a strong Commodore presence, which in the first country becomes overwhelming after 1985, while in Northern Europe its impact is greater in Sweden. Outside its continent of origin, it establishes itself in Chile, Uruguay and India. In Brazil it takes second place, behind the MSX system.

In the United States, the local version produced by Timex, the Timex Sinclair TS 2068, underwent some changes in the components and in the operating system, causing serious compatibility problems with the already available software. In a difficult market like that of the USA, already dominated by the widespread penetration of Apple, Commodore and Atari, this choice proved to be counterproductive. Fearful of not being able to withstand a price war (which did not happen), Timex closed its computer division in April 1984, thereby blocking any further attempts by Sinclair to make its way into the USA with its machines. The Portuguese subsidiary of Timex, on the other hand, remained active, producing a local version of the TS 2068, the Timex Computer TC 2068, as well as a simplified variant of the same, called TC 2048, until the late 1980s.

Furthermore, in those years the phenomenon of 'clones' began to take shape. These were machines derived in a more or less 'unauthorized' way from the Spectrum, mostly manufactured in the part of Europe then gravitating in the political and military orbit of the Soviet Union. Often smuggled from the West, the Spectrums, due to their low cost and ease of use, found fertile ground for diffusion in those countries, to the point that local microelectronics companies made 'their' versions of the machine, some of which would have outlived their 'forefather'. Dozens of clones from Central and Eastern Europe, either semi-officially built like the Unipolbrit Komputer 2086 (Poland), or bypassing copyright – from the Didaktik series (Czechoslovakia/Slovakia) to the CIP (Romania), up to the Pentagon, Scorpion and Sprinter (USSR/Russia) –, will expand, even to this day, the influence of the Spectrum in a huge area, that no other Western manufacturer could ever have reached.

SUCCESS AND MISSTEPS

Clive Sinclair with a Spectrum

The enormous success of the Spectrum is certainly seen by Sinclair with satisfaction. In 1983 he receives the knighthood for industrial merits, becoming then 'Sir' Clive Sinclair, although he still prefers to be addressed to as just 'Clive' by his associates, while the British press affectionately nicknames him 'Uncle Clive'. He is proud of having brought information technology in the homes of 'common people', but not satisfied with the fact that a good deal of the Spectrum's affirmation is due to videogames. Sinclair did not conceive the Spectrum as a gaming platform, and the technical features of his 'creature' actually left little room, at least from an immediate and initial glance, for electronic entertainment. But videogames took the lion's share in Spectrum software sales indeed, even though not at the expense of other uses.

Maybe the main reason behind the popularity of the Spectrum lies in the fact that although not particularly excellent in any field, it is nonetheless an overall useful product for a wide variety of purposes: learning BASIC, other programming languages like Forth or, for the most ready and willing, Z80 Assembly; word processing; tracing vectorial graphs; carrying out complex mathematical calculations; making inventories; and, above everything else, killing aliens in shoot-'em-ups, jumping across the screen in platform games, or hunting treasures in text adventures. All of this for a price affordable for everyone, even those who aren't 'made of money'.

Cover of the Sinclair software and peripherals catalogue, June 1983. In spite of the presence, inside the booklet, of a large quantity of utilities and educational programs, games are prevailing on the outside.

As Richard Altwasser will say, almost thirty years later,

whilst as engineers we were hoping that people would turn on the computer and find out within a few minutes they could write a simple program and become programmers, clearly a lot of people wanted to use the computer for playing games. By providing them with computer programs that they could either read from a little book and type in or load from a cassette, I think that we bridged the gap between those that wanted to learn a little bit about programming – perhaps starting with someone else's programs and making modifications – and those that wanted to primarily just have a usable game.[6]

Be that as it may be, Sinclair is no man to rest on his laurels. He wants to invest the considerable earnings coming from

[6] Kelion, *ZX Spectrum's chief designers reunited* cit.

Spectrum sales into other projects, ideas he had been cherishing for a long time: a 16-bit computer for professional use, able to compete with the likes of Apple, and an electric engine powered vehicle, one of his oldest dreams, even from the time of Sinclair Radionics. Both of them will materialize between 1984 and 1985.

Clive Sinclair officially presents the QL, 12 January 1984

On 12 January 1984, Sinclair presents with great pomp his new computer, the QL, i.e. *Quantum Leap,* meaning a 'leap forward'. In opposition to the Spectrum, the QL is not aimed at a generic base of users, but at small and medium enterprises. Designed around a processor belonging to the Motorola 68000 family – which includes CPUs installed on the Apple Macintosh, Amiga and Atari ST – and equipped with a 128 KB RAM, the QL is hastily commercialized by Sinclair in the attempt to beat the competition in the United Kingdom and subsequently tackle the foreign markets, as he already did with the Spectrum. Haste makes waste though, and for the QL there was no exception.

Unlike what happened with the Spectrum, that in April 1982 was a nearly finished product that underwent several later revisions without any radical redesign of its base functions, the inability of Sinclair Research of facing the ever-pressing request from the market gave way, concerning the QL, to a resounding defeat, because as the machines rolled out of the production lines, some heavy deficiencies in manufacturing, much more substantial than those which had affected the first generation

Sinclair QL, 1984-1986

of the Spectrum, began to surface. Their correction would have required a considerable amount of time and resources.

Contrarily to what has been believed for years, the QL firmware had already been tested sufficiently before the machine's release, but a certain number of units were shipped with a preliminary ROM due to the rushed production start, and this anomaly would in some cases still occur even after the problem had been pinpointed. For the same reason, some of the first QLs had less physical ROM installed than expected and had to be supplied with an additional 16 KB card, the so-called 'kludge' or 'dongle', to be inserted in the back of the machine. Such units, once they were sent by customers to the technical assistance in order to integrate the lacking chips on them, were actually scrapped and substituted with updated ones.

More serious problems concerned the proprietary ZX8301 and ZX8302 logical circuits, plagued by defects which affected RAM management and the internal clock, plus video and data storing peripherals management.[7]

[7] Account by Tony Tebby, in: *QL Today* vol. 14 n. 1, 2009, p. 13.

Moreover, Sinclair assigned the Microdrive cartridges to the QL as its mass memory. This could have been acceptable in 1982, but in 1984, with the undergoing affirmation of 5” ¼ floppy disks, they were only perceived as inadequate by the public, especially from the part of it intended to be the machine’s target. Even worse, they had been revised from those used with the Spectrum, but without a proper testing, and this caused noticeable malfunctioning problems. The ‘leap’ the QL was meant to be turned therefore into a ruinous fall, and the overall positive impressions coming from those fortunate enough not only to gain hold of one of these machines, but to obtain a fully working one as well, were not enough to turn the tide in its favour. Among those owners there was a Finnish youngster from Helsinki who, stimulated by the lack of software support for the QL in his country, would learn with its aid his first programming notions, which would mark the start of his involvement into the field of information technology. Some years later, he would lay a deep path in the same field. That youngster was Linus Torvalds.

Troubles with the QL found a way into Sinclair’s certainties, even though he forced himself to keep looking secure in public. Agitation reached its height in December 1984, when he became enraged after finding on the *Daily Mirror* an Acorn advertisement where the superiority of the BBC Micro and Electron towards the Spectrum was explicitly declared by using surveys on home computers returned to assistance due to manufacturing faults as a parameter. Sinclair

went out of his office in Cambridge and looked for Chris Curry in order to ask him an explanation. As soon as he found Curry at the *Baron of Beef* pub Sinclair heavily insulted and repeatedly hit him with the rolled-up newspaper. The following day, the press reported the fact as 'the battle of the boffins'. Relations between the two would slowly improve after this episode, but it was a sign of the unavoidable tension creeping into Sinclair at the time.

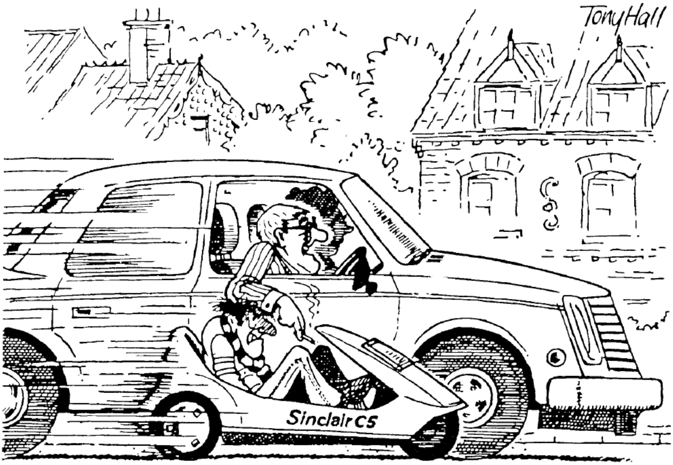
Without enough time to recover from the incident and the QL affair, Sinclair would have soon embarked on an even more futuristic enterprise. Since the beginning of his entrepreneurial activity, he had taken interest into the problem of city traffic. From the first half of the 1970s on, he was seriously considering the possibility of producing a means of transport that should have been easy to drive, non-polluting and nimble enough to move among cars without hindrance. When, having gained enough confidence due to the success of the Spectrum, Sinclair believed it was the right time to translate such aspirations into reality, he gave birth to the C5, which was to be remembered as his worst move ever.

Like the QL, the C5 seemed on paper quite the opposite of a potentially ill-fated product. It was an electric tricycle powered by a motor manufactured by Polymotor, an Italian company, and assembled by Hoover. This probably provided the basis for the false rumor according to which it was originally designed for a washing machine. The C5 was steered with handlebars placed under the driver's legs and equipped with a single-piece polypropylene body shell. It could reach a top speed of just 15 miles (little more than 40 kilometers) per hour, because a higher value would have meant the need for a driving license. The power source was a lead, 12V/36Ah battery; its runtime was not specified, but in case of running out of power while driving, the journey could have been completed anyway, thanks to two pedals provided just for that purpose.

During the first public test drive in the presence of the press, on 11 January 1985 – almost exactly a year after the launch of the QL –, the C5 made all of its limitations clear; they would have been the target of harsh criticisms and heavy scorn, with a not always completely justified hostility.

Clive Sinclair driving the C5, 1985

The mere fact of carrying out the test drive in midwinter, under such conditions as coldness, rain and frozen roads, proved itself to be counterproductive. The battery discharged easily, particularly at low temperatures. The cockpit provided little protection against atmospheric factors. The motor struggled while driving uphill, and the lack of gears certainly did not help. The most negative impression, however, arose from the perception of a vehicle that, just due to its diminutive size, conveyed very little confidence to drivers circulating amid the crowded traffic flow of British cities. Reception abroad was, if possible, even worse, when considering that in the Netherlands, where the flat terrain and the presence of many bicycle lanes could have emphasized the vehicle's qualities, it was banned from import right on the grounds of security motivations.



One of the cartoons which made fun of the C5: 'Apparently they're marvellous little vehicles – though I've yet actually to see one...' Source: Rodney Dale,* The Sinclair Story, *Duckworth 1985, p. 165.

Ridiculed by media, labelled as an absurd invention by a mad scientist, the C5 brought a terrible damage in both financial and public image terms to Sinclair, destroying a reputation he had built in the previous years with a lot of hard work. It was no wonder, then, the announcement that on 13 August of the same year, just eight months after its official presentation, production of the C5 had ceased. Only about 12,000 units were sold; thousands of them were left in stores, later to become collector's items, highly sought after even nowadays, due to their rarity.

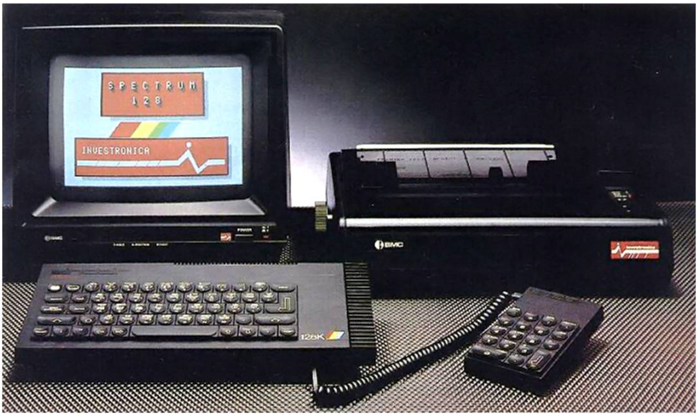
FROM THE LATE REMEDY TO THE HANDOVER

After six years, Clive Sinclair has left the home computer market
(Editorial by Graeme Kidd in *Crash* 28, May 1986)

June 1985: Sinclair Research is in the red for £15 million, without counting the £6.4 million of debts accumulated by subsidiary Sinclair Vehicles Ltd, expressly created to manage the electrical vehicles line the C5 should have started. The vehicle should have been followed by the C10 and C15 models, that will remain just a vague intention. Sinclair tries to save his group in several ways, but without any result. First, he turns for help to media mogul Robert Maxwell, who, after a series of meetings with him, initially states to be willing to acquire Sinclair Research, then drops the idea on 9 August.

After that, Sinclair gets support from a Spanish company, Investronica SA, in order to design and produce an updated Spectrum model. He believes that in such a serious situation it would be preferable to stake everything on a sure bet, instead of taking other new and potentially disastrous roads, and that the solution lies in a new version of his 'warhorse', to be partially developed abroad in order to curb costs.

Thus, the *Sinclair/Investronica ZX Spectrum 128* appears in Spain in September 1985, followed by a slightly modified version, the *Sinclair ZX Spectrum 128*. It is, in several ways, a computer with several interesting features, which in hindsight would have better been available already in 1982, were they not blocked by Sinclair's determination in keeping the launch price under £200. The Spectrum 128 is hosted into a similar case to that of the +, but differs from it, other than for the larger RAM amount, for the presence of a heatsink placed on the right side, that will earn the machine the colloquial nickname of 'toastrack', various input ports (MIDI, RS232, optional numeric keypad), video RGB output and a three-channel sound chip, the popular General Instrument AY-3-8912. The operative system was redesigned too. The old cursor modes were abolished and replaced with a more traditional character-by-character keyword typing. The international version featured a start menu including a calculator mode and a utility to test the tape recorder head azimuth.



Sinclair/Investronica ZX Spectrum 128, 1985-1986.
Of all the peripherals here shown, the numeric keypad was the only one to be distributed in the United Kingdom.

The 128 represented then the best that could be taken, at that time, from the obsolescent technology the Spectrum was based upon. Once again, however, another misjudgement by Sinclair made things go the opposite way of what he wanted. Instead of taking advantage of the Christmas season, traditionally profitable for the sales of home computer systems, Sinclair, hoping not to hinder the selling off of Spectrum +'s, which were still present in large numbers on shop shelves, postponed the release of the 128 on the British market to January 1986, that is to say in a 'dead' period for that kind of trade. As a consequence, the new computer had a low sales volume record, partially caused by its not exactly attractive price of £179.95.

Sinclair ZX Spectrum 128, 1986

It was the end. Sinclair Research was sinking in a sea of debts, and it was not 1977 anymore: this time, there would have been no State enterprise to act as a safety net in order to avoid the imminent collapse. There was no other possibility than selling everything and make an exit. For this reason, as soon as his competitor Alan Sugar held out a helping hand and offered him to buy all the rights upon present and future Sinclair computers, including names and logos, for £5 million, 'Uncle Clive' couldn't do anything but accept.

In 1986, Alan Michael Sugar is a 39-year-old businessman who made his fortune starting practically from nothing. He began by selling aerials at street corners in the same years when Sinclair was scoring hits with his micro radio receivers. In 1968, he founds *Alan Michael Sugar Trading*, better known as *Amstrad*.

The Amstrad logo in 1986. The company was bought by Sky in 2007; since then, it exists only as a brand.

From his debut, Sugar follows a diametrically opposite policy to that of Sinclair. Whereas the latter counts on innovation in terms of performance and design, Sugar produces low-range consumer electronics goods; in the field of hi-fi systems in particular, where Sinclair collects his first important achievements, Sugar limits himself to placing the Amstrad brand on low-end, low-priced amplifiers and tuners, manufactured in Hong Kong and Taiwan.

Amstrad CPC 464 system, 1984

1984 is the year when Amstrad enters the home computer market, releasing its *CPC (Colour Personal Computer)* 464 in the United Kingdom, France, Australia, New Zealand, Germany, Spain and Italy. The 464 will be followed by enhanced and revised models, the CPC 664 e 6128. However, in the rivalry between the Spectrum and the C64, the CPC won't always be able to play the role of the 'third force'. It will in countries like France, Spain – where it won't undermine the predominancy of the Spectrum anyway – or Germany, where it will be distributed under license by Schneider and the C64 will maintain its hegemony until the rise of the Amiga.

That being the case, Sugar certainly wouldn't have missed the great opportunity of ousting his most dangerous adversary, who notwithstanding the false steps of 1984-85 was still alone in dominating the majority of the British home computer market, with a 40% share. At the beginning of 1986, during one of his frequent visits in the East, Sugar is contacted by telephone in his office of Kowloon (Hong Kong) by Mark Souhami, managing director of Dixons, a large retail store chain specialized in consumer electronics, for a meeting at Mandarin Hotel in Hong Kong. There, Souhami and Dixons chairman Stanley Kalms inform him about Sinclair's buyout proposal. Sugar then decides to fly back to the United Kingdom and discuss the matter personally with Sinclair.

The two meet for the first time in London at the Liverpool Street station restaurant. Despite their completely different approaches to the concept of home computer, the conversation goes on warmly. Sinclair appreciates Sugar's straightforwardness, while the latter is relieved to know that his competitor, a larger-than-life figure, wishes to remain independent. During their talks, they contemplated the idea of joining forces, but, as Sinclair himself later explained,

I don't think it would have worked, because we're both too independently minded […] I think the difference really comes down to this: Alan makes products in order to make money, whereas I make money in order to make products.[8]

The agreement is then signed on 7 April 1986. As previously reminded, Sugar obtained the rights on all Sinclair Research present and future computers, including both hardware and firmware, together with the historical brand and logo. The financial side of the operation is valued in £5 million for the takeover alone, plus other £11 million for the development of

[8] David Thomas, *Alan Sugar: The Amstrad Story*, Century 1990, p. 206.

future projects. A further £25,000 were paid to John Grant for giving up any rights to Sinclair BASIC.

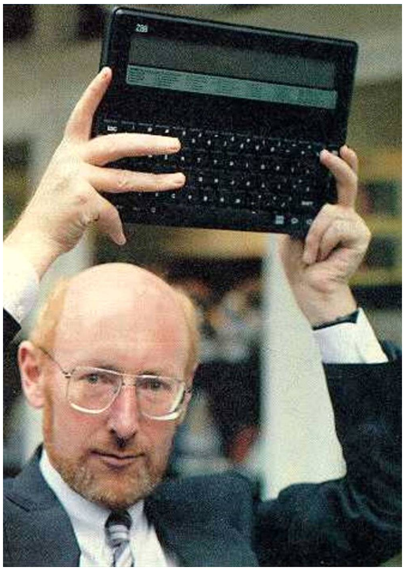
7 April 1986: the handshake between Clive Sinclair and Alan Sugar ratifies the cession to Amstrad of all rights upon Sinclair computers.

Following the agreement, Sinclair Research personnel underwent an authentic diaspora. Some of them set up business on their own account, like Alan Miles and Bruce Gordon, founders of Miles Gordon Technology. Until then classified plans surfaced: the *Low-Cost Colour Computer* – also known as *Loki* –, a machine whose technical specifications were so ambitious (custom graphic chip able to render a 512×256 pixels resolution with 256 colours, video recorder and video disc interface, stereophonic sound both in input and output, three MIDI ports etc.) to require such huge quantities of time and money for its development Sinclair couldn't dispose of at all; the *Pandora,* a portable Spectrum which would have been equipped with a flat projection screen derived from the one installed on the Sinclair 3" TV; the even more nebulous *Janus,* little more than just a name. The practical, down-to-earth

Sugar immediately threw all of these imaginative designs into the dustbin.

Since then, Clive Sinclair won't venture into widely scoped undertakings anymore. Nonetheless, Sinclair Research was stille existing, and by 1990 was a single-member company. It focused on other kinds of products like the Zike and A-bike bicycles. Its subsidiary Cambridge Computers will distinguish itself for the *Z88*, a small office machine with an LCD screen, devised and manufactured upon the basis of the Pandora project. The Z88 met with a positive reception by the market and the specialized press, contributing to improve its designer's public image after the disasters of the recent past. From that 7 April, anyway, Sinclair won't have anything more to do with his most successful and appreciated 'creature' until the start of the ZX Spectrum Vega gaming console project in 2012.

17 February 1987: Clive Sinclair launches the Cambridge Z88, a microcomputer conceived for office applications. The project of a machine aimed to satisfy managerial and business needs finally finds an achievement in line with Sinclair's expectations, after the fruitless QL attempt. This small but well-made tool will also mark the inventor's last foray into the information technology sector.



SUNSET BOULEVARD

Business had positively overcome innovation, following the principle, always adopted by Sugar, according to which a product, as long as the marked liked it, could even *operate 'on an elastic band'*, without any ambition *'to get national awards for the greatest technology'*. From his side, Sinclair stopped being interested in his own products as soon as their successful commercial outcome made them mass consumer goods: *'Personally I don't like controlling a business that makes commodity products'*, he would have said in those days.[9]

Alan Sugar's moves were indicative of the turn the subsequent events would have taken. Sugar did not want to compete with himself; in his plans, the Spectrum should occupy the lower sector of Amstrad's home computer range, whereas the CPC would make the middle one. The sketch of the first machine of the new course was drawn in the Kowloon office by a young Chinese designer following instructions coming from Sugar himself and his collaborator Bob Watkins, just one day after the phone call from the Dixons representatives. The result was a computer which strongly reminded of the CPC 464: large dimensions, semi-professional keyboard, in-built tape recorder on the right side. It was a definite departure from the Sinclair style and at the same time an approach to the Amstrad one, more conventional and for this reason more anonymous. Hardware redesign was conducted with assistance by Richard Altwasser, whom had joined Sugar in the meantime. Altwasser's contribution was valuable in avoiding that the new computer would suffer from problems and manufacturing defects.

[9] All quotations are from Thomas, *The Amstrad Story* cit., p. 205.

Top: Sinclair ZX Spectrum +2, 1986-1988.
Bottom: Sinclair ZX Spectrum +2A, 1988-1993.

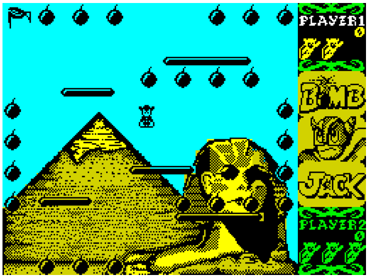
The ZX Spectrum +2 went into production in July 1986, while the 128 and the QL were completely dropped. The initial price was set at just £149, in accordance with Sugar's policies, aimed at exploiting the large quantity of available software, mainly games, to make the Spectrum the entry level product of the Amstrad range. Like other 8-bit machines, no more up-to-date and threatened by the rise of the Commodore Amiga and the Atari ST, the Spectrum would have been downgraded to the rank of entertainment platform targeted at younger users first. Hence, the large number of games licensed from cartoon series and children TV shows, typical of the last years of that home computer market sector.

Deprived of its original purposes, the Spectrum would irretrievably lose its specific feature of being the *Ford T* of information technology. That happened in spite of the release, even after the Amstrad takeover, of new versions of historical utility applications, like the *Tasword* word processor or the two-dimensional graphics program *The Artist II*. Third party peripherals, ranging from light pens to the Datel Electronics robot arm, almost completely disappeared at the end of the 1980s, while a new one was introduced from 1989 on by Amstrad itself, the *Magnum Light Phaser* light gun. It was emblematic that one of the last official peripherals for the Spectrum was expressly designed for gaming, as it was the fact that the +2 and the subsequent models were often distributed within the so-called *Action Packs*, bundled with a set of games of various genres and the Magnum gun.

Sinclair ZX Spectrum +3, 1987-1990

In May 1987, the *ZX Spectrum +3* was launched. This computer, revised in the organization of the ROM and in the RAM paging and simplified in its components, regained the traditional black colour of the casing and was fitted with a built-in floppy disk drive in place of the tape recorder. The drive was managed by the +3DOS additional operating system, compatible with the CP/M *(Control Process Monitor)* designed by Gary Kildall in the 1970s and widely used also on machines of an even higher range than the +3. CP/M, incidentally, was the basis of Tim Paterson's 86-DOS (1980), that Microsoft bought and partially adapted in 1981 to resell it as *MS-DOS.*

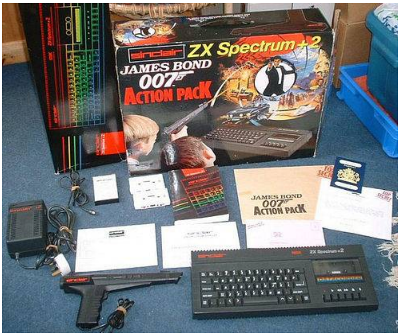
A Spectrum with a built-in floppy disk drive and CP/M compatibility sounded like an attempt to reawaken a minimum of interest from more mature users. But instead of the 3” ½ floppy disk drives, which at the time were establishing themselves on the market as the *de facto* standard, being adopted by the Amiga, Atari ST and IBM PC and compatibles, Amstrad decided to pair the +3 with a 3” proprietary drive developed by Hitachi and already employed with the CPC 664 as well as the integrated word processing system PCW. It’s easy to imagine which stream of criticism came from the specialized press as a result, while reception by potential users was rather lukewarm.



The incompatibility between the +3 and a classic such as* Bomb Jack *was a bitter surprise for many users.

Scan routines for the keypad, a peripheral that in any case never knew any luck other than an almost nil diffusion, had disappeared from the ROM of the +3. Even more important were the different RAM handling and the removal of an input/output port from the ULA, that resulted in various incompatibilities – reset upon loading, system freezes and more – between the +3 and dozens of games, including classics like *Bomb Jack, Hysteria, Cyclone, Mikie, Fairlight, Arkanoid, Bubble Bobble, Paperboy and Starglider.* Some were re-released in budget editions made compatible with the new Spectrum, but many others remained inaccessible to its users. These drawbacks further limited the impact of the +3, which went out of production as early as the end of 1990.

The +2, despite its grey Amstrad-style case, consisted inside almost entirely of the same components as the 128. Only the ROM had partially been modified, showing a simplified start menu and an *Amstrad Consumer Electronics plc* copyright notice. In order to make production even more homogeneous, in the first months of 1988 the +2 was replaced by the *ZX Spectrum +2A.* It was a +3 derivative with a simplified tape recorder, compared to the more complex and expensive one mounted on the +2. With the +3, it also shared the compatibility problems with not a few titles of the pre-existing catalogue. The +2A and its slight +2B revision would roll out of factories in Hong Kong and Taiwan until 1993.



A Spectrum +2A within a* James Bond 007 Action Pack. *Note the Magnum gun and the presence of a false passport and 'top secret' envelope. This product is squarely aimed at younger users, whose idea of the Spectrum is limited to that of a gaming platform.

The historical Sinclair brand met an inglorious end. In October 1988, it was placed on the *PC 200,* an IBM PC compatible, with substandard features for its time: no hard disk drive, to be purchased separately; no VGA card, also optional; equipped with a keyboard prone to break inside due to key pressure, an internal CGA chipset, monitor and TV output and a simple beeper for sound, like early Spectrums.

The last computers to bear the Sinclair name were two rebranded Amstrad IBM compatibles, the *PC 500* and *Amstrad/Sinclair APC386SX,* originally known as the Amstrad PC 1512 SD and PC 3386 SX respectively.

Sinclair PC 200, 1988

Up: Sinclair PC 500.
Right: Amstrad/Sinclair APC386sx.

Taking all of these factors into account, it seems undeniable that Alan Sugar was responsible for letting the Spectrum survive until its definitive withdrawal from the market. The other side of the coin was that the Spectrum had certainly survived, but itself, sharing with its 8-bit competitors the fate of becoming little more than a gaming console with a keyboard. This was undoubtedly caused by the scarce impact made by the +3 on its potential users as well.

It was clear then that until the Spectrum would follow the market policies dictated by Sugar, it would still be restrained inside such narrow borders. The return to a dimension of use closer to its origins would only start from the same ‘enthusiast’ user base that was the reason, many years before, behind its success.

THE COMEBACK

Sprinter clone with box and assembled in a minitower case

Two essential factors are behind the continuation of user activity with the Spectrum. On one hand, in Central and Eastern Europe and in the former USSR, Spectrum clones like the Didaktik and the Sprinter keep being manufactured well into the third millennium. These machines often show deep modifications in comparison with the originary hardware: more RAM, alternative video modes or data storing peripherals that do not follow standards imposed by Amstrad. The latter are particularly interesting: the use of the *Beta Disk* interface for the management of standard floppy disks is widespread among the largest group of clones, those hailing from Russia. First produced in the United Kingdom by Technology Research, the Beta Disk, with its internal TR-DOS operative systems, prevails in the East and becomes the privileged means for the diffusion of games (either

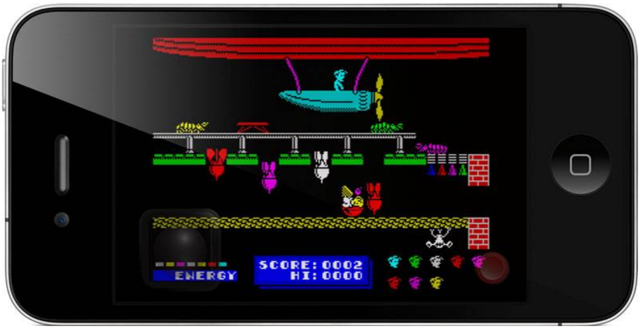
Twilight Krajina Tienov, ***published by Slovak software house Ultrasoft in 1995, is one of the titles that even after the end of the Spectrum production came out for its clones, in this case for the Didaktik Kompakt.***

locally developed or cracked), applications and demos exploring visual and sound modes unimaginable before.

An excerpt from a multicolour full-screen animation of the* Shock Megademo, *by Polish duo Etanol Soft Inc., published on a tape enclosed with* Your Sinclair *85, October 1992

On the other hand, and at the same time, thanks to the spreading of the World Wide Web, such productions go through the borders of their countries of origin and become known by hundreds of thousands of users. The 1990s witness not only the penetration of the Internet among the general public, but the explosion of emulation and retrogaming as well.

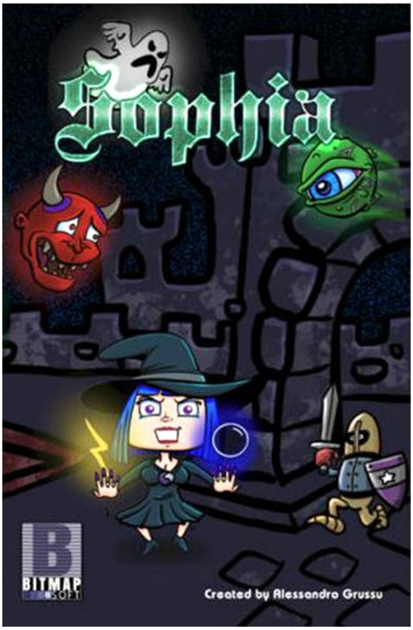
The Spectrum, the most widespread 8-bit machine worldwide after the Commodore 64, can rely on a large base of 'nostalgic' fans, people who had their first grasp of information technology thanks to it or to another Sinclair machine. An authentic chain reaction pushes not a few of them to engage themselves in programming emulators. They bring Spectrum emulation to an impressive variety of different platform and systems, from the Amiga to the PlayStation, from Linux to the Nintendo DS. Others begin creating even more games and demos.



Dynamite Dan *emulated on an iPhone by* Spectaculator

When, at the dawn of the new century, the industrial production of Spectrum clones ends, a considerable number of independent developers carries on with the creation of machines derived from it, especially taking advantage of programmable FPGA motherboards. The most advanced clones from the 2000s, like the Russian *ATM Turbo* series, are now physically undistinguishable from PCs, but their original 'soul' is always there, beyond the astonishing graphic and audio modes devised by their creators. Here, the Internet plays a crucial role too, allowing for the sharing and comparison of different experiences.

On the pages of magazines and websites either specialized in retrogaming or that dedicate space to it, the Spectrum occupies a prominent place. Since the second decade of the 21st century, various texts on the Spectrum have been published in both printed and digital format, although their approach is for the most part focused upon gaming. At the same time, the notable spread of emulation and social networks gives rise to a large number of Facebook pages and Twitter and YouTube channels dedicated to the Spectrum. The new games arrive in the order of three digits per year, also thanks to development tools such as *Arcade Game Designer* (*AGD* for short) and *MT Engine,* which make it possible to create a game, most often an arcade, even for those who are no coding experts. New software houses are established to distribute dozens of such games and others made ‘from scratch’ on tape. Likewise, credit must be given to ‘demo parties’, modern storage systems based on Compact Flash and SD cards such as the DivIDE and DivMMC interfaces and game coding competitions if the Spectrum continues to attract attention.



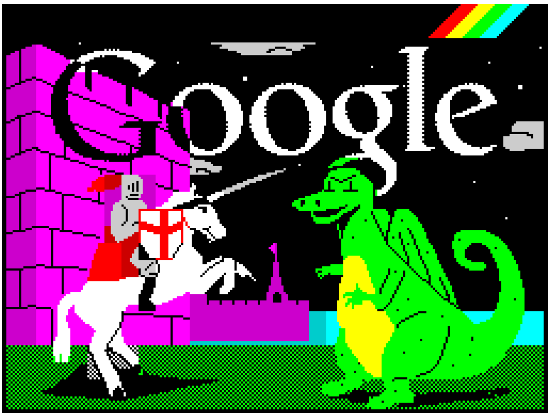
Sophia***, a game mainly developed with AGD and released on cassette by Bitmap Soft in 2020***

The most tangible aspect of the interest in the Spectrum in the 21st century is however represented by the new hardware systems, of which the ZX Spectrum Next – also based on a FPGA architecture and with a casing designed by Rick Dickinson –, the result of a public funding campaign started in 2016 and repeated in 2020 after the enormous success of the first, represents the ideal point of continuity with the past.

On 24 April 2018, a day after the thirty-sixth anniversary of the Spectrum’s launch, Rick Dickinson passes away in Texas, where he was receiving treatment for the cancer he had been struggling with for a long time. On 16 September 2021 it is the turn of Clive Sinclair, who had been ill for some time too.

Sinclair ZX Spectrum Next

Condolence messages come from all over the world, not only from the enthusiasts’ community, but also from personalities of the calibre of Alan Sugar, Elon Musk and the Microsoft president and CEO, Satya Nadella.



The ‘doodle’ dedicated by* google.co.uk *to the thirtieth anniversary of the Spectrum’s launch, 23 April 2012.
It depicts St. George because on the same day he is celebrated as the patron saint of England.

WHO'S WHO AT SINCLAIR, 1982

King's Parade Office

Jane Bloom
Rick Dickinson
Stuart Honeyball
Adrian Hoodless
Rose Lockwood
John Mathieson
Peter Maydew
Gaye Murfitt
David Park
Mollie Pearson
Clive Sinclair
Jim Westwood

The Mill

Mervyn Alston
Shirley Bell
Ben Cheese
Walter Davey
Ian Poskitt
John Simonds
David Southward
Robert Venn
John Williams
Lindsey Woodley

Bridge Street Office

Jane Boothroyd
Ruth Bramley
Dave Chatten
Olwen Crowe
Donna Ellis
Jane Fannon
David Fuller
Mary Goodman
Sally Guyer
Judith Hooper
Tony Rand
Nigel Searle
Kevin Thomas
Dominique Wallace

London Office

Vicky Deigman
Bill Sinclair

Winchester Office

Graham Beesley
Michael Pye

U.S. Office

Cynthia D'Angelo
Leonie Baldwin
Susan Cockrell
Beth Elliott

King's Parade Office

Sinclair Research Limited, 6 King's Parade,
Cambridge CB2 1SN

Tel No: 0223 311488
Telex: 81609

Jane Bloom
Telephonist/Receptionist
Jane deals with all aspects of incoming and outgoing post. She also deals with customers' queries both by telephone and with personal callers to the office. She receives visitors and does general typing and clerical work. Jane was formerly employed with the Cambridgeshire County Council as Secretary to the Head of the Printing Department at CCAT.

Richard Dickinson
BA (Hons) DipSIAD
Industrial designer for Sinclair Research
Rick designs the appearance of our products – shape, colour, graphics. ergonomics, injection mouldings, metal pressings, packaging. mechanics, components requiring custom tooling, books, instructions, models, artwork, component drawings, specification and use of material, etc, etc. Rick graduated with first-class honours in industrial design and engineering and practised as a freelance designer somewhere in Wales before joining Sinclair Research in 1979 as product designer, graphic designer and design draughtsman.

Stuart Honeyball
BSc Electronics and Computer Science
Electronics Engineer
Stuart joined Sinclair in December 1981 to work on computer hardware – designing, developing and testing peripherals. He previously worked for 2 years at Ferranti, designing a microprocessor for the Military.

Adrian Hoodless
Chartered engineer
Integrated Electronics Designer
Adrian is at present designing and developing the integrated circuitry for the flat screen TV. Cost benefit trade-offs have to be established and a close liaison kept with subcontractors to ensure that the project is developed along the correct

lines. Adrian has previously worked at Texas Instruments in Bedford, Mullard in Southampton and Marconi in Chelmsford. With each of these companies he worked on developing integrated circuits for a whole variety of applications – colour TVs, radios, domestic appliances, cameras, etc.

Rose Lockwood
Business Systems Analyst
Rose has joined Sinclair as an internal consultant on organisational and administrative systems. As part of the reorganisation and relocation of the Computer Division of Sinclair Research, she will be responsible for assessing existing business systems, choosing information processing equipment, and implementing somewhat more formal methods for recording and transmitting management information. As Sinclair Research expands through development of new products and support of other ventures, she will be available to evaluate and monitor business systems for new divisions and/or new businesses. Rose joined Sinclair from the Gibbs Consulting Group in New York, where she was senior consultant for office systems and office automation. Prior to joining Gibbs she was an independent consultant associated for several years with the Evaluation Section of the United Nations Development Programme.

John Mathieson
BA Hons Cambridge
Computer Engineer (Software)
John graduated in June 1981 and joined Sinclair in December 1981 to work on software. He is also involved with the development of software for future computers.

Peter Maydew
Research Engineer
Peter has rejoined Sinclair to work on the design and development of the flat screen TV. He first joined Sinclair Radionics service department in 1973, where he worked as chief service engineer on hi-fi and digital multimeters. After this he

moved to the research department to develop the Microvision TVs and the flat TV tube. Later, with Sinclair Research, Peter helped with the ZX80, the RAM pack, the printer and again on the flat TV tube. He has recently rejoined sinclair after 6 months as technical editor for the Electronics and Music Maker magazine.

Gaye Murfitt
Telephonist/Receptionist
Gaye's duties include answering customer queries both on the telephone and in person, receiving representatives for Sinclair personnel, keeping written records of refunds which are sent out to customers and filing correspondence concerned with this. She checks off invoices with service requisitions and keeps written records of this also. Gaye operates the telex machine, types weekly despatch sheets and fulfils other general office duties. Gaye previously worked in the Cambridgeshire County Council School Meals office.

David Park
Project manager, electric car
David is concerned with the electric car project. He is also carrying out a feasibility study of a 'microlight' aeroplane. Flying is David's obsession. He has over 500 hours flying time in 53 different types of aircraft – from hang gliders to 250mph "twins" during the past 20 years. David has previously acted as Sales Manager at Sinclair Radionics, St Ives (1970-79), and as Product Manager in a steel fabrication company (1979-81) specialising in dedicated mobile facilities (loos, outside broadcast units, weapons systems, workshops, etc).

Mollie Pearson
Company Secretary and Secretary to Clive Sinclair
Apart from dealing with all the people, paper work and phone calls connected with Clive's work, Mollie's job content and location depend very much on which side of the business is occupying Clive's attention at any time. Work varies from keeping in

touch with the day to day running of the business, to getting new ideas and projects off the ground, to involvement in all Sinclair's PR and publicity, as well as persuading other people to get things done (sometimes known as delegation!). Before Mollie joined Clive in 1977, when he was still based at Sinclair Radionics at the Mill in St Ives, she worked for five years in personnel and management training for a vast American bank in the City.

Clive Sinclair
Director
Clive founded Sinclair Research in July 1979 to conceive and develop new products in the consumer electronics field. Sinclair Research is a private company and is 95% owned by Clive and his wife Ann Sinclair. Clive is actively involved in the management of the computer business and in the strategic planning for its direction in the future. He also directs the development of all new consumer electronic products – the flat screen TV, the integrated workstation, the electric car and no doubt a few more. Clive's interests outside Sinclair Research include his publishing company, Sinclair/Browne, his chairmanship of the British Mensa Society, music and his work as a trustee of the Cambridge Symphony Orchestra, theatre, poetry, mathematics and jogging.

Jim Westwood
Jim is building a new laboratory and developing the flat screen TV electronics, especially the tuner. He joined Sinclair Radionics Ltd in 1963 and worked on the electronic development of most products – radios, amplifiers, calculators, microvision TV. Jim's employment transferred to Sinclair Research in 1979. Involved in project management and development of hardware and display system of the ZX80 personal computer. Designed the master chip for the ZX81 and animated display system and design of the RAM pack.

The Mill

Sinclair Research Limited, The Mill, 50 London Road,
St Ives, Cambridgeshire
Tel No: 0480 61222

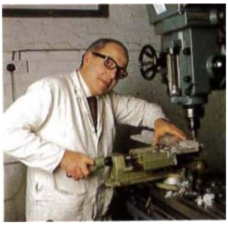
Mervyn Alston
Chemical Laboratory Manager
Mervyn is currently engaged on problems and procedures associated with the chemical aspects of the flat tube. This includes screen application, preparation and application of emissive coatings, thick film printing, treatment of piece parts, electroforming, frit sealing and photographic work in connection with the flat tube. Background – since 1947 R&D on radio valves, monochrome and colour cathode ray tubes. Last twelve years on colour tubes in conjunction with Sylvania and RCA. Joined Sinclair Radionics in 1976 to work on the flat tube.

Shirley Bell
HNC Applied Physics
Research Technician
Shirley helps manufacture and test the pilot plant TV tubes, i.e. silk screening bases, metallising covers. She researches the ageing and life patterns of the tubes and conducts various experiments as the need arises. She assists with making electronic equipment. Previously spent 6 years at Royal Aircraft Establishment, Farnborough. Joined Sinclair Radionics (Service Dept – calculators) in 1972. Spent several years in Reliability Dept (Radionics) before joining this project in 1978.

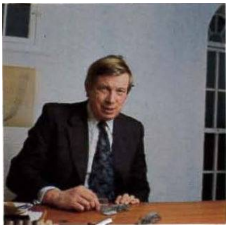
Ben Cheese
Electronic Design Engineer
Ben does design work for computer-related products. He is currently designing the Micro Floppy electronics and supervising the construction of Printer Test Equipment for Timex.

Walter Davey
HND in Electrical and Electronic Engineering, CE1 Part II
Senior Electronic Engineer
Walter designs, produces and maintains test and experimental equipment and any other equipment required. Previous employment – Pye TVT, as test engineer, later as development engineer. Tonac, as Senior Engineer. More lately, the system design of Radio Telemetry Systems for the control of loading and unloading equipment installed on oil rigs, tankers and buoys. This was with Oceantech in London.

Ian Poskitt
Design Engineer
lan is involved in research and development in glassware production for Cathode Ray Tubes. Previously he worked as an electrical designer for a firm making machinery for the glass industry.



John Simonds
Engineering Technician
John was originally employed by Clive Sinclair eleven years ago on the Liquid Crystal Project, but in the last few years, has been actively involved in the Flat Screen Tube work. His work includes making up prototypes, models, moulds, jigs, tools and accessories for these using a wide variety of engineering techniques. John served an apprenticeship as an Instrument Maker at the Department of Engineering, University of Cambridge. During service in the Department he became involved with high vacuum techniques; and later after leaving the Department of Engineering was employed by a private research and development company.



David Southward
MA Chemical Engineering
Chief Engineer
David joined the company in 1977 when it was known as Sinclair Radionics. He is now responsible for all projects tackled at the Mill – development of the flat TV tube, the printer, etc. This includes establishing the appropriate production techniques of each product. Prior to joining Sinclair. David co-founded and acted as Managing Director of Cambridge Consultants. He also worked on electron beam microfabrication and blood analysis equipment at the Cambridge Instrument Company.

Robert Venn
BSc
Development Engineer
Robert is currently engaged on the development of the flat cathode ray tube system. Background – ex-Smiths Industries Electronic Products Unit Chief Chemist working on development of thin film and powder. Direct current electroluminescent display devices, for motor vehicle dashboard application.

John Williams
BSc Mechanical Engineering
Design Engineer
John is currently engaged with mechanical and mechanism design for Sinclair products and for assembly equipment. He has worked mainly on the flat tube project and more recently on the ZX Printer. Background – previously with BAC (Stevenage) and Pye Unicam (Cambridge).

Lindsey Woodley
Research Assistant, Orders Clerk and Typist
Lindsey prepares and assembles electrodes to make electron guns. She prepares and welds the cathode. In addition to this Lindsey orders and processes all purchases at the Mill plus any other typing, e.g. reports etc. She generally assists with other processes such as wiring and soldering whenever needed. Previously employed with Sinclair Radionics as a Process Controller on the calculator and TV lines.

The Bridge Street Office

Sinclair Research Limited, 27/28 Bridge Street, Cambridge

Tel No: 0480 61222

Jane Boothroyd
BSc Psychology and ancillary Pure Maths
Marketing
Jane assists Nigel on the marketing side of the computer business. This involves working on the launch of new products, liaising with the advertising, public relations and packaging agencies and organising our stands at exhibitions. She also does various projects for Clive on an ad hoc basis. Jane previously worked as brand manager of food products with Reckitt and Colman in Norwich. Before this she worked for Reckitt and Colman Group as a Corporate Personnel Assistant.

Ruth Bramley
BSc (Pure Mathematics)
Technical Adviser
Ruth answers customers' technical enquiries – phone calls and letters; exhibition work and demonstrations at press conferences, etc, proof-reading (ZX81 manual and learning lab), testing ZX81s, etc for reviews/replacements; some research work. Before joining Sinclair, Ruth worked as a programmer (COBOL) with a small software house in Coventry writing business programs (e.g. stock control. ledgers, purchase orders, etc) on Honeywell Level 6 computers.

David Chatten
Production Controller
Dave is responsible for all aspects of production control. This includes purchasing of product components, production planning and the production process itself, servicing and quality control. Previous employment: Technician at Pye Telecom, Cambridge. Quality Control and Assistant Works Manager at Escol Products Ltd. Dave joined Sinclair Radionics in 1974 and worked in various positions – Planning Manager, Materials Controller, Purchasing Manager and Production Controller. He carried over his responsibilities as Production Controller when the company became Sinclair Electronics limited and again when it became Sinclair Research limited.

Olwen Crowe
Secretary to Tony and Nigel

Olwen gives general secretarial support to Tony in his administration of ROW markets and to Nigel in his administration of the Computer Division. She joined Sinclair Research immediately after completing a six-month secretarial course at the Cambridge Marlborough Secretarial College, where she attended as a TOP's student. Previous to this course, she worked at the National Institute of Agricultural Botany in Cambridge and for the Ministry of Agriculture, Fisheries and Foods on an experimental husbandry farm.

Donna Ellis

Donna is Judith and Dave's secretary and acts as a relief receptionist. She also has some general accounting duties such as entering invoices into a purchase ledger, and writing out cheques. Donna previously worked at Parkside Police Station. Here she had some secretarial duties and also helped to deal with queries from solicitors and the public.

Jane Fannon
Assistant on sales side

Jane's work mostly entails dealing with customer problems – delayed orders, refunds, replacements, etc. She handles general enquiries about the use of computers in the UK and overseas. Most of her work is done by telephone or through letters. Before joining Sinclair, Jane gained ten years' experience of book-keeping.

David Fuller
MA (Engineering, Oxon), MBIM
Quality Control

David is responsible for ensuring that quality requirements are fully considered at design and production phases of all projects. He ensures that suppliers and subcontractors exercise proper quality control at all times. Before joining Sinclair, David spent 16 years as an Electronic Engineer in the RAF. Subsequent to this he was Quality Manager/General Manager for the Aviation Division of BOC – International.

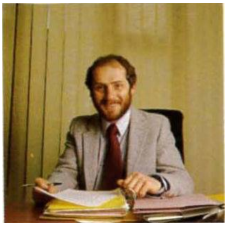
Mary Goodman
Assistant on sales side
Mary's work mostly entails dealing with customer problems –delayed orders, refunds, replacements, etc. She handles general enquiries about the use of computers in the UK and overseas. Most of her work is done by telephone or through letters.

Sally Guyer
Assistant on sales side
Jane's work mostly entails dealing with customer problems –delayed orders, refunds, replacements, etc. She handles general enquiries about the use of computers in the UK and overseas. Most of her work is done by telephone or through letters. Before joining Sinclair, Sally worked as a Secretary to the Sales Manager and Regional Sales Manager of Chloride International Marketing.

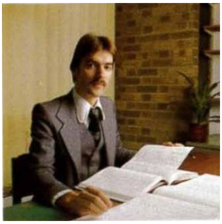
Judith Hooper
Financial Controller
Judith oversees the daily routines of the finance function. She produces monthly and management accounts reports. Judith also liaises with Taxation, Customs & Excise and VAT authorities and works with auditors to provide information on company performance. In addition to this, she oversees the general administration of Bridge Street.

Anthony Rand
MA, ACCA
Export Manger
Tony is responsible for ROW markets including France, Germany and Japan. He previously worked as a Financial Analyst at the Ford Motor Company, as a Senior Business Analyst at Rank

Xerox and as the assistant to the Managing Director of Trident Television providing general financial support.



Nigel Searle
BA Mathematics and Computer Science, PHD Mathematics
Head of Computer Division Worldwide
Responsible for all aspects of Sinclair's computer business, Nigel has worked for Sinclair in various capacities since 1972. From January 1980 to February 1982, he ran Sinclair Research limited in the USA. Before coming to Sinclair, Nigel was a project leader with Cambridge Consultants.



Kevin Thomas
Assistant Accountant
Kevin assists Judith Hooper with her work as the Financial Controller. He controls the Purchase Ledger and is responsible for reconciling statements from suppliers and for paying invoices. He deals with all the cash and cheques coming into the company and holds the petty cash.

Dominique Wallace
Sales Office Manager
Dominique manages the Sales General Office and Reception at Bridge Street. Her responsibi lities include ensuring that customers' letters and telephone enquiries are handled fast and efficiently, liaison with Jaserve and Primary Contact regarding UK sales, handling admin of distribution of Sinclair items from suppliers, liaison with UK retail outlets, also general office management. Dominique previously set up an employment agency in London, worked for the internal communications company Michael Barratt Ltd (Michael Barratt formerly of Nationwide) and worked for OSL and Exchange Travel – both tour operators.

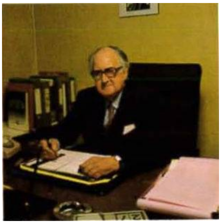
The London Office

Sinclair Research Limited, 23 Motcomb Street, London SW1X 8LB

Tel No: 01-235 9649

Telex: 918966

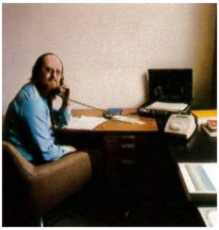
Vicky Deigman
Vicky handles export documentation. order control and customer reception.



Bill Sinclair
Consultant
Bill is acting as our overseas marketing consultant and advises on marketing strategies and the selection of foreign distributors.

The Winchester Office

Sinclair Research Limited, 29 Southgate Street,
Winchester, Hampshire SO23 9EB
Tel No: 0962 55925



Graham Beesley
MA (CANTAB), MIERE CEng (BA Hons Electrical Science 1972)
Senior Electronic Engineer
Graham's work is concentrated mostly on semiconductor based products. Before joining Sinclair Graham spent 7 years with Motorola in Basingstoke. Prior to this he was with UMIST for 3 years working in design and development of specialised instrumentation for Cloud Physics.

Michael Pye
MA, CEng MIEE
Director of Sinclair Research in Winchester
Michael is responsible for the design and development of semiconductor based consumer products. Prior to joining Sinclair at the beginning of 1982, Mike was Director of Engineering for Honeywell Control Systems Ltd. He has also been Technical Director and Managing Director of Sinclair Radionics Ltd and Director of Electronic Development for the Gillette Company in the USA.

The U.S. Office

Sinclair Research Limited, 50 Staniford Street, Boston, Massachusetts MA 02114, USA

Tel 0101 617 7424826

Telex: 230951074

Cynthia D'Angelo
Director

Cynthia has overall responsibility for Sinclair Boston Office operations. She is responsible for dealing with all Boston banks and dealing with the bank in Nashua, New Hampshire. She is also responsible for keeping Boston monthly accounts in order (paying outstanding bills and determining costs), and for all wire transfers among banks and to the UK. She is the contact person to the Boston Advertisement Agency and relays necessary information back to the UK.

Leonie Freo Baldwin
Customer Relations Interface/Technical Information Coordinator

Leonie deals with all non-routine customer communications – telephone, mail, technical and general. She formulates policies on customer relations to be administered by the Boston office and by the customer service department at the shipping warehouse. She collects technical information about Sinclair computer products from all sources and coordinates this information to ensure that it is made available to customers. With help from temporary and part-time workers, she replies to customers' queries and requests.

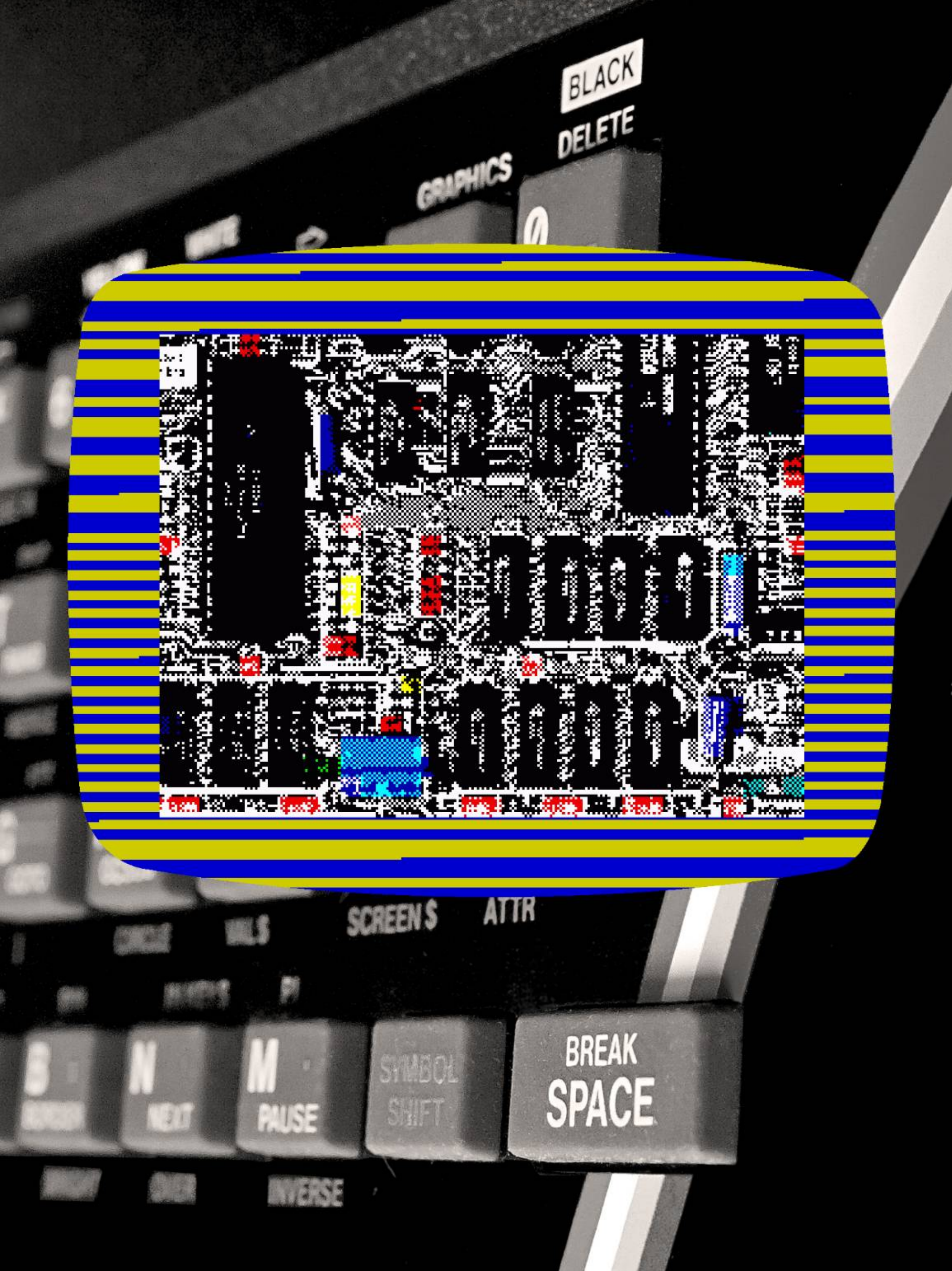
Susan Cockrell
BA Sociology
Assistant to General Manager and Coordinator of US Product Operations

Susan coordinates US sub-contractors: repair service, warehouse shipping and customer service, customs brokers, accessory suppliers, printers, customer ordering process, product information. She also oversees warehouse inventory and products coming from England to customers. Susan acts as the General Manager's assistant/secretary. Previous employment – MIT Economics Department, Boston Symphony Orchestra, Public Television, worked with Apple and Radio Shack computers.

Beth Elliott
Telephone Receptionist

Beth handles all the incoming telephone calls to the Boston office. Her job is one of a receptionist as well as a customer information source. The customer queries she resolves by keeping track of changes in our methods, and by being informed in matters related to ordering and shipping procedures, as well as technical revisions. As a result of these calls she follows up customer queries with the warehouse customer service department, with the parts department, and with the customer relations manager.

Chapter Two
TECHNOLOGY



This chapter is articulated into the following sections:

- Spectrum models, in chronological order;
- peripherals produced by Sinclair Research;
- peripherals produced by Amstrad;
- main peripherals produced by third-party companies.

Each model is described by means of a detailed technical specifications list, together with notes and information regarding construction features, variations and specific peculiarities.

Peripherals made for clones are dealt with in the fourth chapter, while those developed by enthusiasts after the end of the Spectrum's production are illustrated in the first chapter of the second volume.

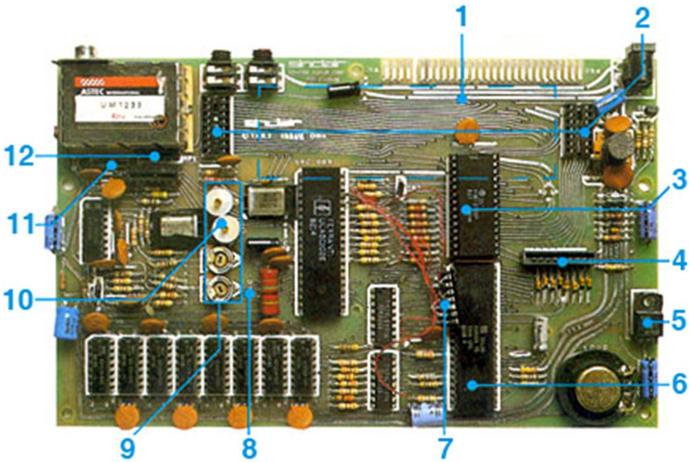
SINCLAIR ZX SPECTRUM 16/48K

Considered the Spectrum *par excellence*, the first model became an icon of the 1980s for its compact, stylistically unique and immediately recognizable appearance, especially in comparison with other home computers of the same era. The external look, apart from its synthetic rubber keyboard mat, which changed from a light grey to a grey-bluish hue in the transition between the first and the second issue, was left untouched during its two years of commercialization. The interior underwent several modifications and revisions instead. Spectrum issues before the 128 were eight in total, including those of the subsequent + model.

TECHNICAL SPECIFICATIONS	
Release date	23 April 1982
End of production	October 1984
Processor	Z80A at 3.5 MHz
RAM	16 or 48 KB
ROM	16 KB
Low resolution	32×24 blocks of 64 (8×8) pixels each
High resolution	256×192 pixels
Colours	7 normal + 7 with high brightness + black; difference between the central area and border of the screen, foreground and background, static and flashing
Audio	1-voice inner monophonic 40 Ohm loudspeaker with 10 octaves extension
Keyboard	40 keys from a single synthetic rubber element, with an underlying 3-layer contact membrane; multi-function cursor; automatic repetition on all keys, with user-definable interval and acoustic signal
Character set	Standard ASCII plus 16 graphic low-resolution characters and 21 user-defined graphics
Connectivity	RF output (UHF channel 36); EAR 3.5 socket; MIC 3.5 socket; expansion port; 9V DC power input at 1.4A
Operating system	Sinclair BASIC
Dimensions (mm)	233×144×30

REVISIONS OF THE 16/48K SPECTRUM

Issue 1 (April 1982)



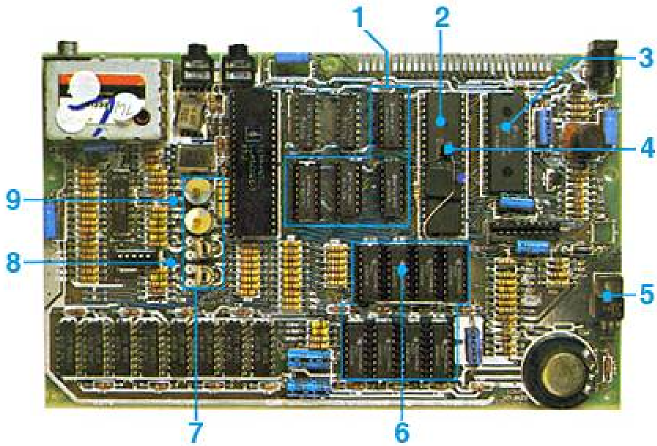
1. On the 48K version, you can easily spot the capacitors on the RAM board that hangs upside down, just inside and above the edge connector. These boards were originally flogged by Sinclair Research as part of a £60 upgrade but because this meant Spectrums had to be returned to the factory, few took up the kind offer and the idea was eventually dropped.
2. These IC sockets remained empty on the 16K version; for the 48K model, chips were provided to upgrade the on-board memory.
3. The device's ROM. Early versions of the Issue 1 Spectrum contained EPROMs, which were very thirsty for power, tending to turn them into radiators and cause problems with overheating. These EPROMs can be recognised by a little 'window' in the top of the chips.
4. The keyboard address sockets.
5. The device's regulator.
6. The Z80A CPU.

7. The ‘dead cockroach’ 74LS(X) IC. This extra IC appeared between two pins on the ULA and the printed circuit board, its job being to stop the CPU and the TV interface fighting over the data bus. This alteration was later incorporated into the Issue 2’s ULA.
8. The teletext colour straps: Y, V and U.
9. The colour controls. A problem on the Issue 1 and 2 Spectrums was that as the ULA warmed up, it caused the sync pulse to lose frequency.
10. On the Issue 1 Spectrums, to bring the colour back to its former glory, you could adjust the colour crystal frequency – with the help of a screwdriver and via the hole in the underside of the machine.
11. The ‘VID’ strap.
12. The keyboard data sockets.

Issue 1 also had a zig-zag shaped heatsink placed in the lower left corner of the machine, right where the regulator lied.

Issue 1 sold about 60,000 units and is one of the rarest Spectrum versions, if not the rarest ever. This means its exchange prices on auction web sites are particularly high.

Issue 2 (August 1982)



1. The decoding chips. Space is provided for these chips in the 16K version so that other manufacturer's chips can be readily inserted.
2. The Z80A CPU. Notice how it has changed position from the earlier model.
3. The device's ROM. This too has changed position from the Issue 1 Spectrum.
4. A patch was introduced on the Issue 2 to cope with ULA decoding problems.
5. The device's regulator. Still in the same position as on the Issue 1 board.
6. The RAM chips – this area remains unoccupied on the 16K version of the Issue 2, although it did allow users the option of being able to insert the chips. But this modification was again supplied cheaper by Sinclair Research's competitors and the price for the 32 KB upgrade had now dropped to around £22 for a DIY kit.
7. The colour controls. On the Issue 2 model, no access was provided from the bottom of the unit – thus tempting

frustrated owners to break the guarantee in search of the perfect screen display.

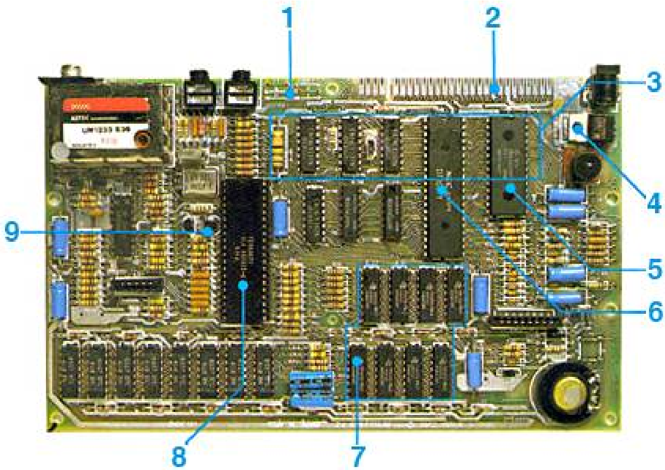
8. The Teletext colour straps: Y, V and U.
9. The 'VID' strap. The monitor interface which Sinclair Research once boasted of is, in fact, only available on specially modified versions of the Issue 1s and 2s.

Issue 2 featured the same heat sink equipped by Issue 1. The rubber keyboard mat changed its colour, as previously said, from a light grey to a grey-bluish hue with the aim of improving the readability of the commands placed on the keys under artificial light.

Issue 2 sold more than 500,000 units.

Comparison between Issue 1 (left) and Issue 2 (right) key colours

Issue 3 (July 1983)



1. The Issue 3 now incorporates straps to allow the manufacturers to select from three different types of RAM; the original Texas chips became unavailable and alternative chips featured different pin layouts. It's possible therefore, when buying a RAM kit, to find that one of the decoding chips' legs is bent or even soldered to a different pin.
2. To link the Spectrum to a composite signal monitor, run a lead to the VIDEO and 0 volts connections as shown in the manual – preferably via an edge connector. The other connections only give out colour difference signals (B-Y, R-Y and Y) and not the normal RGB; for these, a special monitor is needed.
3. The heat sink has been moved nearer the expansion port and, in fact, can easily be seen through the back of the machine's edge connector port.
4. The device's regulator has been moved from its former position on the Issue 1 and 2 versions.
5. The device's ROM.
6. The Z80A CPU.
7. The RAM chips.

8. Both overheating and voltage variations in the mains supply have tended to plague the ZX Spectrum. Some of this was cured in part when Sinclair Research switched to a new low-powered version of the ULA for the Issue 3.
9. The colour adjustment controls and Teletext colour straps were removed on the Issue 3 to be replaced by a facility within the ULA to make the colour self-adjusting. This was very important because one of the complaints about the Issue 1 and 2 was that, however much you tweaked around, they simply refused to work with some German and Japanese TVs.

Perhaps the most significant change between issues was that the Issue 3's printed circuit board was re-designed by computer. This improvement led to a reduction in 'noise'. But it also drew complaints from various software houses that, when using machine code, they couldn't access the keyboard via I/O instructions as fast as on the Issue 1.

Issue 3 also included a more powerful loudspeaker and, due to an influence from a value read from the keyboard input port connected to the EAR connector, a value that floated until the ULA had warmed up, some older programs wouldn't work on it. This was anyway caused by programmers' laziness most of the times, because it wasn't necessary to read the whole keyboard input byte (which value was always 1 binary in the previous issues), and programs affected by this glitch were few and far between. This explains why in several emulators an option for choosing between Issue 2 and Issue 3 emulation can be selected, should the (remote) case arise that a program affected by such feature must be loaded. Issue 3 is the most common among Spectrums: more than 3 million units were sold.

Issues 3B/4S. It features minor revisions, mainly consisting in different components and circuitry in comparison with Issue 3. The motherboard can be usually found inside Spectrum +'s. Issue 4S is the 3B manufactured in South Korea by Samsung.

Issues 4A/4B/4S. They differ from Issue 3B only for the presence of a ULA 6C001E-7 chip and the ULA's RAS line passing through IC24, in order to be delayed.

Issue 5. It is an important revision, or a tidying-up to be more precise: six decoder/multiplexer chips (IC3, IC4, IC23, IC24, IC25 and IC26) were replaced by a Mullard ZX8401 ULA. A 74LS04 (IC28) hex inverter chip provides the six inverters required for the new circuit. As it might be expected, these modifications greatly altered the appearance of the board. However, there were no resulting significant changes in its operation at software level. Only about 1,000 units were manufactured.

Issue 6A. The final version of the 48K Spectrum differs only in fairly minor ways from its immediate predecessor. Some units were fitted with an AMI SAGA-1A ULA. This chip seems to cause timing problems with the RAM, so that Issue 6A Spectrums are extremely rare – only one still exists. Other components, primarily capacitors and resistors, were changed.

Several 48K Spectrums mount defective 64 KB 4164 RAM chips, purchased to curb costs and with 32 KB available, employed in the 32768-65535 range (8000h-FFFFh, the 'upper RAM') Affected ICs are the Texas Instruments TMS4532-15NL3/15NL4/20NL3/20NL4 and the OKI M3732H-20RS.[10]

[10] *www.spectrumcomputing.co.uk/forums/viewtopic.php?f=22&t=4071*

THE KEYBOARD

From left to right and top to bottom: the motherboard (Issue 3), the outer grid, the synthetic rubber mat and the upper shell, upon which the keyboard membrane is placed.

The need to limit the initial retail price of the Spectrum below the £200 threshold made containing the costs of several components unavoidable. Major economies came from the keyboard, that consisted in a simple membrane mechanism with a synthetic rubber mat including 40 flexible elements. Each one of them, under the pressure of the user's finger, makes the two terminals of the circuit printed on the two layers of the membrane, spaced by a third in-between layer, touch. Since the membrane is connected to the motherboard by two flat ribbon cables, this action closes the circuit so that the computer 'acknowledges' the contact.

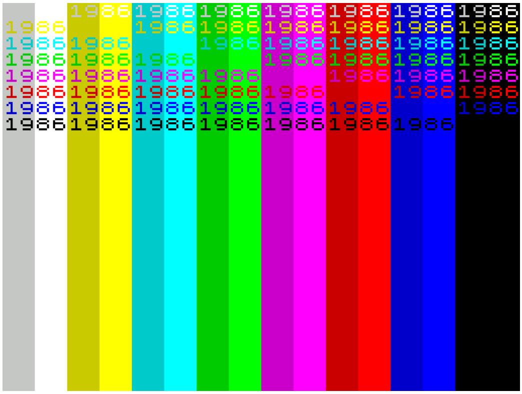
The keyboard was the most criticized part of the Spectrum, both for its not optimal functionality and the fragility of the membrane. This was no obstacle to the machine's diffusion, but it was nonetheless the main feature Sinclair Research intervened upon at the time of designing the computer's second generation, the ZX Spectrum +.

DISPLAY MANAGEMENT

The video image generated by the Spectrum ULA is split into two parts, the central area and the border. The first can be modified in several ways, while the second can normally undergo a colour change only, through the BORDER BASIC command. The central area can also be split, namely in two different 'grids': high resolution, at 256×192 pixels, and low resolution, in 32×24 blocks of 8×8 pixels each, containing the 'attributes', that is to say, information about the foreground colour, (altered by the INK BASIC command), background colour (PAPER), flashing (FLASH), i.e. a fast alternation between the foreground and background colours, and brightness (BRIGHT), which can be normal or high. The Spectrum features a total of 8 colours with normal brightness, plus other 7 with high brightness, because black does not change, according to the following scheme:

Colour code	Binary value	Normal brightness	High brightness	Name
0	000			black
1	001			blue
2	010			red
3	011			magenta
4	100			green
5	101			cyan
6	110			yellow
7	111			white

Attributes of each block are then represented by 8 bits. Starting from the least significant one: 3 for the background colour, 3 for the foreground colour, one for brightness (0 = normal, 1 = high) and one for flashing (0 = off, 1 = on).



Colour map embedded in the ROM of the ZX Spectrum 128 and following models. It is activated by pressing BREAK at system boot and has the purpose of making TV tuning easier.

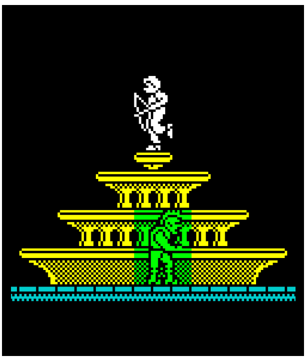
In the Spectrum memory map, video contents start at location 16384 and finish at location 23296, 6,912 bytes in total. This interval is split between 6,144 bytes for high resolution and 768 bytes (starting at location 22528) for the attributes. High resolution bytes are not memorized one after the other, but are arranged in 'lines' and fill, going forward inside the memory map, the screen at the upper third first, then at the middle third and finally at the lower third, until all 256 pixel lines and 24 attribute block lines are covered. A simple BASIC program might help understanding this segmentation better:

```
10 FOR n = 16384 TO 22528
20 POKE n,255
30 NEXT n
40 PAUSE 0
```

The screen will be seen filling itself with black lines which will obscure it entirely; the PAUSE 0 command stops the computer until a key is pressed, in order to let the final result be seen better, as the last two lines are reserved for the command prompt and error messages. By changing the 255 value with others between 0 and 254, different patterns will appear, because when translated into binary digits, they indicate the contents of each pixel line for each attribute block, following the logic: 0 = pixel off (PAPER or background) and 1 = pixel on (INK or foreground), going from the leftmost bit in the block to the rightmost one.

As mentioned earlier, such a configuration allows, for each one of the 768 low resolution blocks the attribute map is divided into, only one colour for the background and one colour for the foreground. In addition, since the brightness attribute does not apply to single pixels but to the entire block, the brightness value is always the same for the background colour, or PAPER, and for the foreground colour, or INK.

In other words, within each one of the 768 attribute map blocks no more than 2 colours can be present at a time, both with the same brightness level. These limitations of the colour combinations available on the Spectrum are the reason behind the so-called 'colour clash' (also known as 'attribute clash') phenomenon, well known to every user of that computer.



A colour clash example taken from the game* Everyone's A Wally. *The sprite for character Tom, walking in front of the fountain (yellow), 'contaminates' it with its own background colour (green), because its priority is higher than that of the object drawn on the background. Surrounding attribute blocks take the same background colour as a consequence.

THE CURSOR MODES

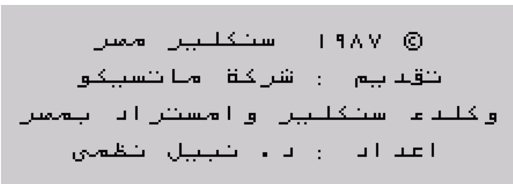
The Spectrum BASIC interpreter borrows from its forerunners, the ZX80 and ZX81, the characteristic keyword (commands, instructions, functions) recall system through specific cursor modes. This has a double purpose: on one hand, it saves up memory, associating each keyword a single position in the ROM character map instead of associating each single character of them. On the other, it makes typing errors impossible. Each cursor mode is characterized by a flashing capital letter. There are five of them:

K (Keyword)	enters BASIC commands; always present at the start of the command line, after program line numbers and after a colon (:); lasts for a single keystroke
L (Letters)	enters lower case alphanumeric characters; with CAPS SHIFT, it enters upper case characters; with SYMBOL SHIFT characters or commands written in **red** on the keys
C (Capitals)	obtained by pressing CAPS SHIFT and 2 together; activates the capital letters mode; lasts until being called again
E (Extended)	obtained by pressing CAPS SHIFT and SYMBOL SHIFT together; allows for the typing of commands, functions or symbols written in **green** over the keys or (by pressing SYMBOL SHIFT together with the desired key) in **red** under them; lasts for a single keystroke
G (Graphics)	obtained by pressing CAPS SHIFT and 9 together; allows for the typing of low-resolution graphic characters on numeric keys and of the 21 user-defined graphics

For instance, pressing the 'L' key has the following effects:

- under K mode, the LET command appears;
- under L and C modes, a lower case and upper case 'L' letter appear respectively; with CAPS SHIFT, the upper case letter appears, while with SYMBOL SHIFT the equals sign (=) appears;
- under E mode, the USR function, with multiple uses (execution of a machine code program, calling user-defined graphics and so on) appears when pressed alone; together with SYMBOL SHIFT the ATTR function appears, that returns the attributes of a specified (line, column) screen zone;
- under G mode, the user-defined graphic with ASCII code 155 appears, if existent, otherwise an upper case 'L'.

In Sweden, the Spectrum was distributed by Beckman Innovation AB with a modified ROM including the *å, ä, ö, Å, Ä* and *Ö* characters and error messages translated into Swedish. In recent times, the existence of versions of the Spectrum ROM and customized machines for use with the Arabic alphabet, with right-to-left character input, has been confirmed. These changes were carried out in Saudi Arabia by Autoram in Jeddah (which also modified the ROM of the ZX81 for this purpose) and in Egypt by Matsico Corp. of Dr. Nabil Nazbi, the local distributor of Sinclair and Amstrad products; from the latter came the 'Arabic' +2, + 2A and +3.



Start-up message of the Egyptian ROM ver. 1, 1987

Left: advertising for the 16/48K Spectrum with the Beckman custom ROM.

Down: advertising for the 'Saudi' 16/48K Spectrum with ROM and keyboard modified by Autoram.

THE RAM MAP

The RAM (*Random Access Memory*) is the computer's 'notepad'; while performing an operation, it continuously checks what the RAM contains, 'reading' from it, and alters its content by 'writing' in it. Despite its name, this notepad is not randomly used, because different parts of the RAM are used to store different kinds of information. A BASIC program, for instance, is kept inside a part of the RAM, while its variables are stored elsewhere. The 16K Spectrum includes 16,384 RAM locations, while the 48K has 32,768 more, which added to the former give a total of 49,152. Every location can contain a single value in the range between 0 and 255 and is identified by its address. Addresses from 0 to 16383 are reserved for the Spectrum ROM, while the RAM starts from address 16384.

The following page shows the memory map. The first five addresses are assigned a fixed amount of space. The area reserved for the ZX Microdrive is not used when the peripheral is not connected, therefore the sixth area (channel information, regarding possible connections to the screen, printer or Microdrive) can 'float' up to the fourth, in order to save space wherever possible. As a consequence, the starting address of all areas from the fourth one on is 'mobile' and can go up and down the RAM. Such addresses are registered into system variables, whose names are purely conventional and mnemonic – that is to say, they are not 'variables' like those employed in BASIC programming. In order to know their contents, it is necessary, as it is customary in BASIC, to type the PEEK function followed by the address number of the system variable, or a combination of two addresses in the case of two-byte variables.

Starting address or system variable	**System variable location**	**Contents**
16384	–	Display file
22528	–	Screen attributes
23296	–	Printer buffer
23552	–	System variables
23734	–	Microdrive maps
CHANS	23631	Channel information
PROG	23635	BASIC program
VARS	23627	Variables
E-LINE	23641	Command or program line being edited
WORKSP	23649	INPUT data
STKBOT	23651	Calculator stack
STKEND	23653	Spare
sp	–	Machine stack and GOSUB stack
RAMTOP	23730	Machine code routines
UDG	23675	User-defined graphics
P_RAMT	23732	End of RAM

Some commonly used system variables include (address between parentheses):

- REPDEL (23561): time in 50th of a second that a key must be held down before it repeats (starts off at 35);
- CHARS (23606): 256 less than address of character set; used to change the on-screen character set;
- PIP (23609): length of keyboard click;
- FRAMES (23672): 3 bytes indicating the number of seconds passed from start-up;
- SCR CT (23692): number of screens to be shown before the Spectrum stops and asks *scroll?* to show the following one.

CONTENDED MEMORY AND 'FLOATING BUS'

The RAM area between addresses 16384 and 32767 of the 48K, corresponding to the entire allocation of the 16K, has on average a longer access time than the rest, being shared between the ULA, that has higher priority, and the CPU. If a program tries to access this area or read from an input/output port for which the result is provided by the ULA, execution will be slowed down if the ULA is sending data to the video memory. This effect only occurs when the screen centre is being drawn, not if the edge is affected. In this case, the ULA does not have to access video memory, so the ULA data bus is idle and holds the value 255 (FFh). It is the so-called 'floating bus', used in some games such as *Arkanoid, Cobra, Short Circuit* or *Sidewize* to synchronize the display with greater fluidity, as it is possible to query the state of the data bus of the ULA and check if it is sending a bitmap byte, an attribute byte, or if it is idle.

Delays begin to occur when that RAM area is used by the CPU if at least 14,336 T-states pass after an interrupt. A T-state is the timing of a Z80A clock cycle, equal to 1/3,500,000 of a second in 16/48/+ Spectrums and to 1/3,546,900 in 128/+2/+2A/+3s. This phenomenon is called 'early timing'. A further T-state is then 'lost' due to the heating of the ULA and the consequent variations in the shape of the INT signal. In this case, delays start at 14,335 T-states, which is known as 'late timing'. In the 16/48/+/128/+2, delays range from 1 to 6 T-states and do not happen when the RAM is accessed at 14,341/14,342 and 14,349/14,350 T-states onwards after the interrupt. +2A/+3 Spectrums mount an ASIC circuit in place of the traditional ULA and are therefore unaffected by the 'early/late' transition: delays range from 1 to 7 T-states and occur on slightly different access times.

THE 'SNOW EFFECT'

Sharing part of the RAM between the ULA and the CPU originates a side effect, a video memory corruption reminiscent of a pixel 'snowfall' or 'rainfall' arranged in columns across the screen while rapidly exchanging their place. This is caused by a conflict occurring when the ULA retrieves pixels and attribute data from the screen while the CPU recalls data from the contended memory.

(MIS)ADVENTURES OF A BASIC

The Spectrum's BASIC is a variant called, no surprise, Sinclair BASIC. Its origins date back to the ZX80 BASIC developed in 1979 by John Grant of Nine Tiles Network Ltd. BASIC was a widespread language at the time since 1975, when two then little-known American programmers, Paul Allen and Bill Gates of Micro-Soft (later Microsoft), coded for the popular Altair 8800 microcomputer a version of it, which would provide the basis for the ANSI (X3.60-1978) standard. Sinclair wished to keep the price as low as possible for the end user, and this meant that paying a license to Microsoft was out of the question. Hence the idea of turning to Grant, who made a quite functional BASIC version, taking the ZX80's severely limited available resources into account. It was Grant that, among other things, implemented the recognition of syntax errors right at the command prompt, that makes learning and using BASIC much easier. The ZX81 was then provided with a largely redesigned BASIC by Steve Vickers, whom had joined Nine Tiles in January 1980.

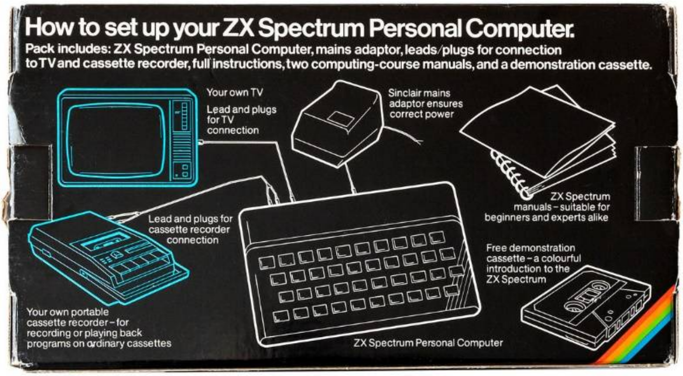
As soon as the time of the Spectrum BASIC came, neither to Vickers nor to Richard Altwasser was however possible to turn all of their ideas into reality, because of Sinclair's obstinacy in putting everything together into an already set, cost-based frame and of insufficient time for applying the finishing touches. In addition, there were financial clashes between Sinclair and Nine Tiles about the royalties of the Spectrum ROM, and the fact that Vickers and Altwasser had finally left Sinclair Research to found their own Cantab company. The Spectrum was then released in April 1982 with a not yet entirely completed BASIC, upon which Nine Tiles kept working even after the computer's launch, but without achieving any significative result.[11]

INSIDE THE PACKAGE

The package for this first version included:

- the 16/48K ZX Spectrum itself;
- a 9V DC power supply unit;
- a RF cable for the TV connection;
- a double 3.5" jack cable for the tape recorder connection, for loading and saving data;
- a 32-page introductory booklet;
- a 192-page BASIC programming manual;
- a guarantee certificate;
- the starter *Horizons* tape, with a series of brief lessons on Spectrum use on side A, while side B hosted some demonstration programs, the first one being *Thro' The Wall,* a *Breakout* clone coded in BASIC that for a large number of users was the first videogame ever experienced on their machine.

[11] Adapted from: Andrew Owen, *Sinclair BASIC History.* Complete document: *sinclair.wiki.zxnet.co.uk/wiki/Sinclair_BASIC_history*



Back of the 16/48K Spectrum box

A 48K Spectrum loads the* Horizons *tape

SINCLAIR ZX SPECTRUM +

The ZX Spectrum + (Plus) was launched two years and a half after the previous model. Only available in the 48 KB RAM configuration – which marked the definitive drop of the 16K, unable to stand the competition anymore –, the + contained, most of the times, Issue 3B and later motherboards.

The only actual change concerned the new case and keyboard. The former showed a QL-inspired line – the QL having been launched on 12 January 1984 –, while the latter borrowed the construction from it. All of them were manufactured by the same firm, Celluloid, based in Gislaved (Sweden). The keys, 58 independent plastic elements, are placed on a synthetic rubber mat presenting a 'bubble' under each key. The mat lies in turn upon a membrane, more complex than the one found in earlier Spectrums since it consists of five layers instead of three. Unfortunately, it would show the same tendency to break.

TECHNICAL SPECIFICATIONS Same as the previous model, except for:	
Release date	15 October 1984
End of production	September 1986
RAM	48 KB
Keyboard	58 independent plastic elements on a synthetic rubber mat and underlying 5-layered contact membrane; multi-function cursor; automatic repetition for all keys, with user-definable interval and acoustic signal
Dimensions (mm)	320×150×40
Notes	reset button on the left-hand side

Announced by Sinclair to the press as a 'surprise', the + caused not a few grumbles when it showed clearly what really it was: a much more superficial than substantial evolution. Moreover, changes did not seem to improve anything, notwithstanding Sinclair's desire to intervene on the Spectrum's most controversial hardware part. Chris Bourne's review of it, published on *Sinclair User* 33 in December 1984, was particularly unforgiving (maybe even too much) in turning the spotlight on the new keyboard's weak points:

[…] Because of the rubber mat, there is a certain amount of bounce in the keys, which is a cunning way of obtaining a semi-professional effect without paying professional prices for the parts. However, the weight required is not as even as it should be and the slight difference in give between different keys is mildly irritating for fast typing.

[…] There is a proper SPACE bar, although it is not as long as it would be on a real typewriter keyboard.

[…] The “ and ; are tucked away in the bottom left corner, where nobody who had ever learned to type would think of looking for them.

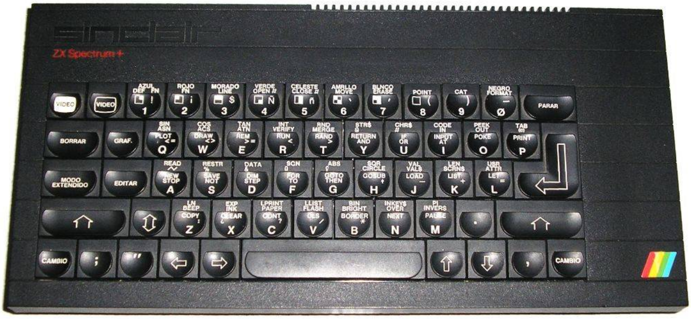
[…] Sir Clive says that if he had used that process [i.e. moulding words within the keys] with three colours, the whole keyboard would have been much more expensive. That makes the keyboard much more confusing to read and undoubtedly will take away some of the speed advantage gained by using hard plastic keys. Novice programmers in particular will find it more frustrating to learn their way about the keyboard than they do with the help of those colours as a prompt.

[…] On the new version the distance between the centre of two keys is fractionally less [than the old one]. The original keyboard was criticised for being small and cluttered, and in that respect the new one is no improvement.

There was even the possibility to convert old-style Spectrums into a + by buying a new case and keyboard at just £20. This option was however chosen less often than it could have been, due to the presence on the market of third-party professional keyboards, better performing than the Sinclair one, although more expensive as well.

Close-up of the Spectrum + keyboard. Commands and functions are all written in white, but the cursor modes system is unchanged. Their position is no more over and under each key, but on them, following this order: simple E mode/ Symbol Shift-ed E mode/ K mode/ L and C modes.

THE SPANISH ZX SPECTRUM +



ZX Spectrum + with 'Hispanicized' ROM and keyboard

In Spain, Investronica SA, the local distributor of Sinclair products, decided to build upon its own experience with the combined development of the Spectrum 128 to supply the Spectrum + with a keyboard featuring modified indications: BORRAR instead of DELETE, CAMBIO in place of SYMBOL SHIFT, arrows in places of CAPS SHIFT and ENTER writings and so on. Changes came together with a revised version of the ROM, now including Spanish-translated error messages and the typical graphic characters of that language *(¿, ¡, Ñ, ñ, ü, ç)*, in order to comply with the Real Decreto (Royal Decree) 1250 of June 19, 1985, which required the presence of such characters in every computer sold in the country (this provision was repealed in 1993). The 'Hispanicized' Spectrum + appeared in February 1986.

Some time after the takeover of Sinclair Research by Amstrad, Investronica replaced it with a new computer of its own production, the *Inves Spectrum* +.

SINCLAIR/INVESTRONICA ZX SPECTRUM 128

The pressing financial hardships sparked from the QL and C5 failures urged Sinclair to try to recover funds by putting every stake on an enhanced revision of his most successful product. At the same time, the need for economy made it necessary to recycle existing technology as much as possible and carry out the development partially abroad. Spanish partner Investronica SA was involved with the project, which had the Sinclair/ Investronica ZX Spectrum 128 as its first outcome. It would provide the basis for the British and international model released on 13 February 1986.

The official presentation took place at the Barcelona Computer Fair on 23 September 1985.

TECHNICAL SPECIFICATIONS	
Release date	23 September 1985
End of production	October 1986
Processor	Z80A at 3.54690 MHz
RAM	128 KB in 8 banks of 16 KB each
ROM	32 KB in 2 banks of 16 KB each, ROM 0 for 128 mode and ROM 1 for 48 mode
Low resolution	32×24 blocks of 64 (8×8) pixels each
High resolution	256×192 pixels
Colours	7 normal + 7 with high brightness + black; difference between the central area and border of the screen, foreground and background, static and flashing
Audio	3-voices AY-3-8912 sound chip with 8 octaves extension
Keyboard	58 independent plastic elements on a synthetic rubber mat and underlying 5-layered contact membrane; multi-function cursor (in 48 mode)
Character set	Standard ASCII plus 16 graphic low-resolution characters and 19 user-defined graphics
Connectivity	RF socket (UHF channel 36); RGB video socket; EAR 3.5 socket; MIC 3.5 socket; 9V DC power input at 1.85A; expansion port; 2 RS232 6-pin ports (1 for printer/MIDI + 1 for the keypad)
Operating system	Sinclair BASIC, available either as a revised (128, default) or a traditional version (48)
Dimensions (mm)	330×140×40

At first sight, the 128 looks identical to the +, except for two noticeable details: the white '128K' writing placed in the lower right corner, between the keys and the four-colour strip, and the heat sink fitted on the right-hand side. A closer inspection reveals that the 3.5 MIC and EAR connectors are now placed high on the left-hand side, together with the presence of the RGB monitor socket and of the two RS232 ports, one of them being reserved to the numeric keypad, which presents the same construction of the keyboard. The keypad was bundled with the computer, while in the British version it would be available as an add-on at £19.95, but its diffusion will remain extremely scarce.

The numeric keypad measures 82×150×18 mm and is composed of 18 keys, to be used as numbers as well as for cursor control (marked by arrows). The connecting cable is 350 mm long. Among the uses the keypad was designed for there was game control too.

The Spanish 128 input system is unique among Spectrums. At boot start the message © *1985 Sinclair Research Ltd* appears, with an *ESPAÑOL* writing right under it. BASIC is accessed by pressing a key: the lower screen line shows the cursor mode (MAYUSCULAS, EXTENDIDO), because the cursor is no more characterized by flashing letters showing the writing mode – it is now a simple high brightness blue and white flashing square. What is more important is that command and function typing must be done character by character, eliminating all the combinations seen in the previous models;

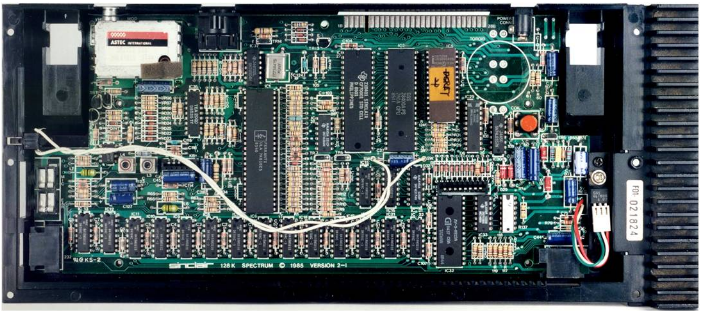
for this reason, the capital letters mode is on by default, otherwise the computer won't recognize the keywords. Other specific features include:

- a ROM 0 in-built text editor: by typing EDIT followed by the name of an already assigned string variable, the user enters a composition mode, where all text typed until the pressure of the enter key will be memorized in that variable;
- an automatic calculation mode: by typing a mathematical operation and pressing the enter key, the result is displayed on the screen;
- the presence of two new commands, RENUM for program line renumbering and DELETE to eliminate all program lines in a given interval between two of them;
- typing errors are no more indicated by a flashing question mark, but by a flashing sprite depicting a 'bug'. The BASIC program editor will remain untouched in the British 128 instead.

```
10 PRENT "Hello, world!"
```

THE MEMORY

The ROM is divided into two 16 KB banks, called ROM 0 and ROM 1. The first holds the BASIC editor with the new commands and the integrated calculator, the second a (not identical) copy of the original Spectrum ROM, in order to ensure backward compatibility. Switching to ROM 1 is done by entering the SPECTRUM command, which causes the switch to the usual cursor mode typing as well. This should also keep the current BASIC program (if any) in memory, but the differences from the original ROM cause some undesired effects, as it shall be seen later.



128 Sinclair/Investronica ZX Spectrum motherboard (ver. 2-1)

Another significative new feature, which will also be preserved in the subsequent models, is the availability of a RAM virtual disk to memorize any kind of data. The usual SAVE, LOAD, MERGE, CAT and ERASE commands can be used with the RAM disk, as long as they are followed by an exclamation mark. For instance:

```
SAVE! “Bloggs” LINE 10
```

will save the ‘Bloggs’ program in the RAM disk. Once loaded with this command:

```
LOAD! “Bloggs”
```

the program will automatically start from line 10.

Strangely, the VERIFY! command is not contemplated; the introductory booklet enclosed with the international version will later explain that it is not possible to use it with the RAM disk. The truth is that, due to a bug at ROM 0 location 4765 (129Dh), VERIFY! is recognized by the computer, but it has the effect of loading a file instead of comparing it with one already in memory. It is then practically identical to LOAD!.

Other ROM 0 bugs include: error messages after entering some commands like LPRINT INK 4 (bug at memory location 2086/0826h) and LPRINT INK 1; (2097/0831h); the content of variables with a name beginning with Z is not shown by typing their name at the command prompt (5755/167Bh); the ZX Printer cannot even be used in 48K mode due to the impossibility of moving the 'P' channel data stream from the RS232 port (unavailable on the 48K) to the expansion port, thus causing a system crash (6879/1ADFh); the renumbering routine is unable to find the end of the BASIC program if variables are present in memory, so that a CLEAR command must be entered before (13510/34C6h); typing THEN LET makes an additional space appear between the two keywords (14115/3723h). Some will be corrected during the development of the international ZX Spectrum 128, some other will remain, and there will even be new ones.[12]

The RAM is controlled by logic port 32765 (7FFDh). Paging is achieved by changing the bits of the value of that port and affects the highest 16 KB of RAM, from 49152 to 65535. The 128's specific system variable at address 23388 contains the last value written to port 32765, whereby by altering the bits, the desired memory page is switched into RAM. Bits 0-2 determine the number of the page entered at address 49152 (C000h). Other modifiable bits are: 3, to select between the normal screen (value 0), in bank 5, or the 'shadow' screen (value 1), a video memory buffer located in bank 7; 4, to alternate between ROMs 0 and 1; 5, to disable memory paging until the system is reset. Here follows the memory map:

[12] The detailed lists of bugs in ROM 0 of both Sinclair/Investronica and international Spectrum 128 have been compiled by Paul Farrow. They can be found on his web site: *www.fruitcake.plus.com*

65536 (FFFFh)								
49152 (C000h)	B. 0	B. 1	B. 2	B. 3	B. 4	B. 5 SCR	B. 6	B. 7 SCR
32768 (8000h)	B. 2							
16384 (4000h)	B. 5 SCR							
0 (0000h)	ROM 0	ROM 1						

Bank 2 is also present at address 32768 and bank 5 at address 16384. In 128 BASIC, banks 1, 3, 4, 6 and part of 7 are used for the virtual disk. The rest of bank 7 contains buffer memory for the BASIC editor. In addition, banks 1, 3, 5 and 7 are shared between the CPU and the ULA, which reduces their access speed.

From BASIC 128, memory paging is obtained with the syntax:

```
POKE 23388,16+b: OUT 32765,16+b
```

where *b* is the desired bank number.

An undocumented feature, which will later turn out to be useful to enhance compatibility with 48K software, especially in later Amstrad models, is the so-called ‘USR 0’ (or ‘USR0’) mode. By entering USR 0 at the command prompt, ROM 1 is activated, but without reserving, as it would otherwise happen by typing SPECTRUM, part of RAM Bank 7 for the virtual disk, that cannot be used by 48 BASIC anyway. That way, ROM 1 can be employed without any RAM paging limitation. In other words, under USR0 mode, the RAM is entirely available to ROM 1 without running the risk that a program could attempt to read or write data in the locations of Bank 7 reserved for the virtual memory, which would in turn lead to a conflict and therefore to a system crash.

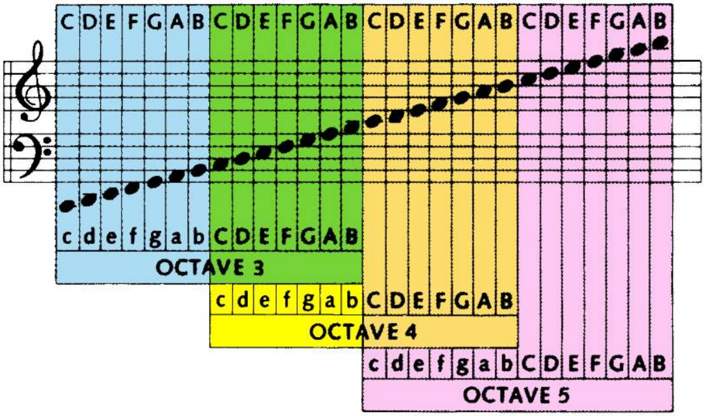
THE AY-3-8912 SOUND CHIP

Another much awaited improvement present in the 128 concerns audio. In contrast to several other computers of the same era, the Spectrum was not provided with a PSG *(Programmable Sound Generator),* a particularly criticized absence in comparison with the notorious *Sound Interface Device* (commonly shortened to SID), equipped by the Commodore 64 and produced by MOS Technology, the same manufacturing firm of that computer's 6510 CPU. The implementation of a dedicated sound chip was therefore seen with understandable favour; the popular *General Instruments AY-3-8912* was chosen, a 28-pin variant of the base AY-3-8910 model. The AY-3-8912 is able to communicate with various 8-bit and 16-bit processors: it can in fact be found, besides all Spectrums from the 128 on, in other home computers such as the Amstrad CPC, Oric-1, Atari ST, MSX, in the notorious Mattel Intellivision consoles as well as on the motherboards of many coin-operated videogames dating from the end of the 1970s to the second half of the 1980s.

The chip is operated by PLAY, a new BASIC command, with the following base syntax:

```
PLAY a$,b$,c$
```

where the three string variables refer to the three voices the AY-3-8912 is able to employ. Such variables can contain a series of



AY-3-8912 note extension scheme

notes, together with various other codes representing volume, length, sharp or flat notes, time measured in beats per second, triplets and so on.

The presence of the sound chip does not exclude the availability of the monophonic beeper sounds emitted by the Z80A – the old BEEP command is in fact still there. AY and beeper sound can be produced at the same time and are sent to the TV through the RF cable. This allows for Spectrum audio to be heard from the TV loudspeaker. Of course, this does not happen when connecting the computer to a monitor through the RGB socket, even if the monitor is equipped with a loudspeaker, because the RGB output does not carry any audio signal at all.

The chip can emit square waves sounds or noises by using from one to all of its three voices simultaneously. CPU control of the AY-3-8912 is achieved by means of sixteen 8-bit registers:

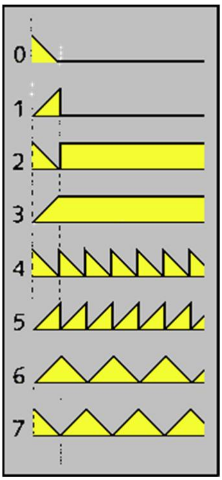
- **R0, R1, R2, R3, R4, R5:** tone generator for the three voices;

- **R6:** noise generator;
- **R7:** noise/tone mixer;
- **R10, R11, R12:** volume control for the three voices;
- **R13, R14, R15:** envelope generator control (attack-sustain-decay-release cycle);
- **R16, R17:** intermediate data storage registers between the PSG/CPU bus data (DA0-DA7) and I/O port A (IOA7-IOA0).

The envelope generator can combine the volume regulation for each voice in order to activate the attack, decay and release effects for tones and noises. The program:

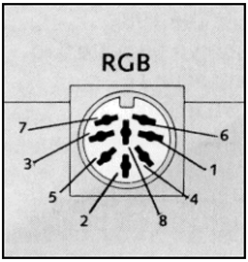
```
10 LET a$="UX1000W0C&W1C&W2C&W3C&W4C&W5
C&W6C&W7C"
20 PLAY a$
```

demonstrates these effects according to the following scheme:



single decay then off
single attack then off
single decay then hold
single attack then hold
repeated decay
repeated attack
repeated attack-decay
repeated decay-attack

THE RGB VIDEO OUTPUT



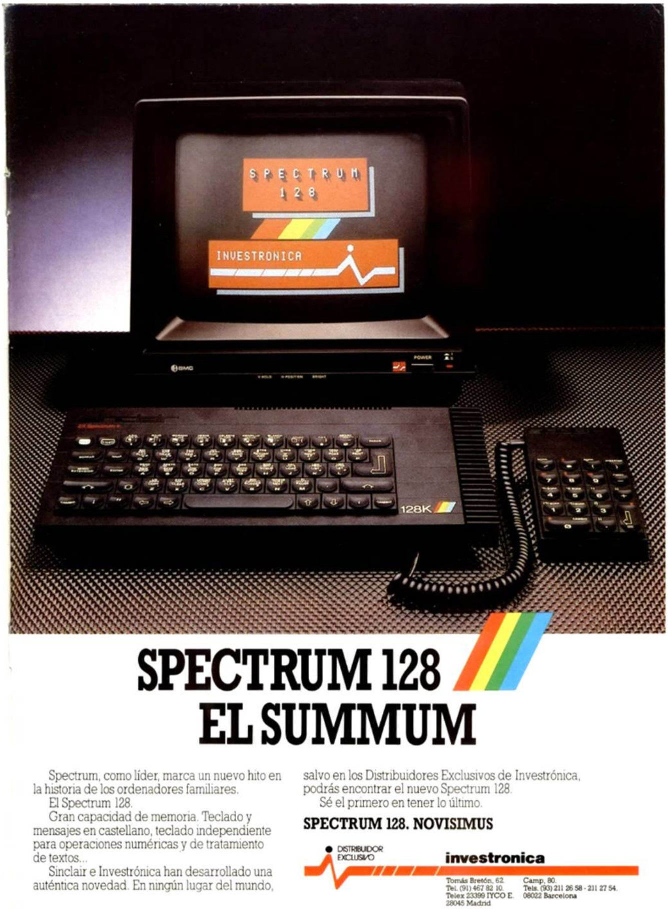
Pin	Signal	Level
1	Composite PAL	75 Ohm; 1.2 Volt pk-pk
2	0 Volt DC	
3	Bright output	TTL
4	Composite sync	TTL
5	Vertical sync	TTL
6	Green	TTL
7	Red	TTL
8	Blue	TTL

By means of the RGB video socket, the 128 can be connected to a monitor, thus ensuring a largely superior image quality in comparison to what can be achieved on a common TV connected through the RF cable. Even nowadays, cables allowing the RGB socket to be connected to any TV equipped with a SCART socket can be purchased. This is particularly important, because traditional cathode ray tube TVs have not been sold anymore since long time, and tuning on UHF 36 channel is often problematic, when not impossible, on modern LCD screen TVs, the signal emitted by Spectrums rarely being as precise as required by them.

DIFFUSION OF THE 128 SINCLAIR/INVESTRONICA

Having been manufactured and commercialized for the Spanish market only with a later international version in the pipeline – as in fact it later happened – the 128 coming out of the agreement between Sinclair Research and Investronica is one of the less common Spectrum models ever. Prices on the collector's market are higher than those of the international 128, this being a not so easy to find machine either.

The rarity of this Spectrum model was also due to its short commercial life span: after little more than a year from its launch, production was stopped for the same reason that led to the introduction of the Inves Spectrum, that is, to avoid the risk of possible legal actions taken up by Amstrad against third-party exploitation of Sinclair-branded products. Its place was taken by the +2, released by Amstrad in a Spanish version.



Advertisement for the Sinclair/Investronica ZX Spectrum 128

SINCLAIR ZX SPECTRUM 128

Presented in the luxurious setting of the Crystal Room at the Mayfair Hotel in London, the 128 had to be, in Clive Sinclair's intentions, the machine which would provide rescue for Sinclair Research. It was its 'swan song' instead, giving way, not even seven months after its release, to the ZX Spectrum +2, the first of the Amstrad era.

The British version was also distributed in overseas markets, except of course for Spain, where the 128 jointly developed with Investronica stayed on shop shelves until October 1986, when the wish to avoid conflicts with Amstrad made its withdrawal and substitution with a localized +2 necessary.

TECHNICAL SPECIFICATIONS Same as the previous model, except for:	
Release date	13 February 1986
End of production	September 1986
ROM	32 KB in 2 banks of 16 KB each, ROM 0 for 128 BASIC and ROM 1 for 48 BASIC

Apart from the fact that its keyboard bears the same keywords as the British +, the exterior of the international 128 is different from that of the Spanish one in several details. The Sinclair logo is red instead of black, the '128K' writing red instead of white and connection ports names are written in English instead of Spanish. Major differences are immediately noticeable at start-up though.

THE MENU SYSTEM

The 128 start menu from the ROM revised by Rupert Goodwins. The menu system would remain in use, with some variation, also in Amstrad-manufactured Spectrums and even in some clones such as the Pentagon or the Scorpion.

Sinclair Research was rather perplexed about the redesign of the 128's operative system command interface carried out by Investronica. A young Rupert Goodwins was then assigned the task of modifying the computer's ROM 0 in order to make the interface more user-accessible. The result is a system of menus placed in the screen centre; the message © *1986 Sinclair Research Ltd* is visible on the lower part of it at system boot. The start menu shows a header with a '128' writing and the familiar four-colour strip on a black background, then the following options from top to bottom, which can be highlighted in cyan with the up and down arrow keys and selected by pressing ENTER.

Tape Loader. Loads the first program on tape (identical to LOAD "").

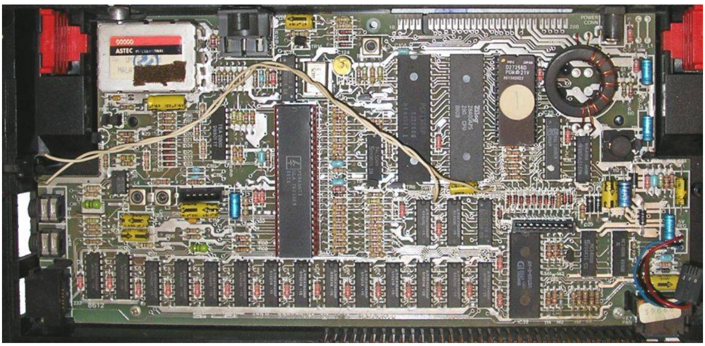
128 BASIC. Opens the BASIC command prompt. Command typing occurs in the top part of the screen, except when the 'Screen' option has been selected (see below). Keywords can be typed either in upper or in lower case letters – the BASIC interpreter converts them in upper case letters and aptly distances them. The text editor for string variables, automatic calculation mode, RENUM and DELETE commands have been removed, as well as the 'bug' warning sign, replaced by a less fancy high brightness red and white flashing square. By pressing EDIT (CAPS SHIFT + 1), an 'Options' submenu is accessed:

- **128 BASIC:** returns to the command prompt;
- **Renumber:** renumbers program lines, including internal references of GO TO and GO SUB instructions, starting from 10 and proceeding in steps of 10; replaces the Sinclair/Investronica 128's RENUM command;
- **Screen:** this mode constraints typing to the two lower lines of the screen only as in 16/48/+ Spectrums, preserving the display in order to save it or to print it. Reselecting this option returns to the previous condition;

- **Print:** prints the display;
- **Exit:** returns to the start menu; the program will remain in the RAM, unless the 48 BASIC option is selected in such menu.

Calculator. Replaces the previous model's automatic calculation mode. With EDIT, another 'Options' submenu appears, allowing the user to return to the command prompt or the start menu.

48 BASIC. Activates the 48K Spectrum's ROM, resetting the computer. Alternatively, it is always possible, from the 128 BASIC command prompt, to type the SPECTRUM command or to enter USR 0 mode.



ZX Spectrum 128 international version motherboard

Tape Tester. Verifies that the tape recorder volume is adequate, should difficulties in loading a tape arise. It shows at about one third of the screen a horizontal blue bar, along which a cyan square moves. After starting the tape, the volume must be set so that the square moves as far to the right as possible. Pressing EDIT here will cause a return to the start menu.

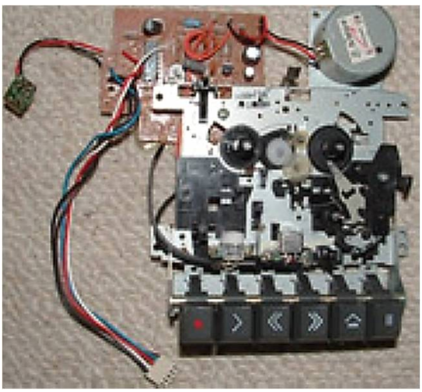
SINCLAIR ZX SPECTRUM +2

The first Spectrum of the Amstrad era, presented at the 1986 Personal Computer World Show in London, shows a resolute break with the previous tradition, beginning from its colour: it is the only one to feature a grey case instead of a black one. External hardware has been totally redesigned according to Alan Sugar's dictate, with little consideration for aesthetic and functional uniqueness. From the first sketch made by an unknown Chinese designer of the Amstrad branch in Kowloon, even before the takeover of Sinclair Research, to the definitive project Richard Altwasser was also involved with, the +2 acquired an appearance which was deliberately inspired by that of the CPC 464, starting from the Datacorder, the in-built tape recorder. However, the +2 almost completely kept the same components of the international 128 inside, to the extent that it is commonly regarded as a transition stage between the Spectrums devised by Sinclair Research and the +3 and +2A, redesigned by Amstrad in a much more radical way.

TECHNICAL SPECIFICATIONS	
Release date	4 September 1986
End of production	March 1988
Processor	Z80A at 3.54690 MHz
RAM	128 KB in 8 banks of 16 KB each
ROM	32 KB in 2 banks of 16 KB each, ROM 0 for 128 BASIC and ROM 1 for 48 BASIC
Low resolution	32×24 blocks of 64 (8×8) pixels each
High resolution	256×192 pixels
Colours	7 normal + 7 with high brightness + black; difference between the central area and border of the screen, foreground and background, static and flashing
Audio	3-voices AY-3-8912 sound chip with 8 octaves extension
Keyboard	58 independent plastic elements and underlying contact membrane; multi-function cursor (in 48 BASIC)
Character set	Standard ASCII plus 16 graphic low-resolution characters and 19 user-defined graphics
Connectivity	RF socket (UHF channel 36); RGB video socket; 3.5 audio socket; 9V DC at 2.1A power input; expansion port; 2 RS232 6-pin ports (1 for printer/MIDI + 1 for keypad); 2 SJS joystick ports
Operating system	Sinclair BASIC, available either as a revised (128, default) or a traditional version (48)
Read/write device	2-head tape recorder, with record, play, rewind, fast forward, stop/eject, pause functions; fixed volume; adjustable tape head azimuth
Dimensions (mm)	435×170×55

THE DATACORDER

The +2 is the first Spectrum not to have the EAR and MIC 3,5 jack sockets, made redundant by the Datacorder. This in-built tape recorder, borrowed from the CPC 464, was initially rather clumsily adapted to the 128 hardware, but a subsequent revision improved its features. It was however criticized due to the absence of some features such as the tape counter (present on the 464) or the automatic tape stop at the end of rewind/fast forward.



It should be noted that the 'DATACORDER' writing on the tape recorder lid is the only part of the computer to host the four-colour strip, the symbol of the Spectrum since its first appearance: it was another sign of the already changed times.

THE KEYBOARD

Key arrangement is identical to that of the 128, but apart from this, many things have been changed. First of all, keyboard construction itself is the same as the CPC 464: keys are made of hard plastics and provided with individual springs, which allow for real feedback during typing. Pressure on each key pushes some plastic elements, that in turn make circuits placed on an underlying membrane come in contact, similarly to what even today happens in many PC keyboards. This means it is, after all, a membrane keyboard, but much more ergonomic and functional of the previous ones, whose build simplicity, due to the necessity of containing the final costs, had a negative impact on their convenience of use.

Keyword indications have completely disappeared, except for RUN, CODE and LOAD, that is to say those needed in 48 BASIC to load data and execute programs. This shows the will to push users to drop 48 BASIC mode altogether, limiting it to the compatibility with older software, and dedicate themselves to write their programs under 128 BASIC only. Regarding to this, it is interesting to note that the computer's user manual, written by Rupert Goodwins, draws for about 70% from the 128's one, derived in turn from the first BASIC manual for the 16/48K. Many of the graphic symbols have also been omitted from the keyboard, although they can still be typed in both of the available BASIC modes.

CONNECTIVITY

The +2 shares the following ports with the previous model: expansion port, RS232/MIDI, keypad (these two are however placed on the back together with all the others instead of being on the right-hand side and on the front respectively), RGB and TV. EAR and MIC sockets, as already seen, are missing, while a new 3.5 jack marked 'SOUND' has been added. Its purpose is to connect the computer to an external loudspeaker when the RGB video exit is in use.

Power is still 9 Volt DC, but maximum amperage has increased at 2.1 A from the 128's 1.85 A, because of the higher requirements due to the presence of the Datacorder.

However, the really new feature here is represented by the two joystick ports placed on the left-hand side, aside the reset button. Sugar's idea of exploiting the large available base of Spectrum gaming software, in order to commercialize a computer which had to be primarily focused on entertainment, finds its most tangible fulfilment in the two joystick ports. These are mapped with the Sinclair system already known from the time of the ZX Interface 2 (discussed later in this chapter), therefore they read keyboard inputs according to the traditional scheme that follows:

Port 1		**Port 2**	
Command	**Key**	**Command**	**Key**
Left	6	Left	1
Right	7	Right	2
Down	8	Down	3
Up	9	Up	4
Fire	0	Fire	5

Although they look similar to ordinary Atari 9-pin serial ports, their pins are arranged in a different way, so that an adapter for using joysticks other than the SJS *(Sinclair Joystick System)* ones becomes essential.

THE MENUS AND START-UP MESSAGES

In comparison with the international 128, the start menu differs in the absence of the Tape Tester, since the Datacorder volume is fixed. Copyright messages for 128 and 48 BASIC have been changed to © *1986,* © *1982 Amstrad Consumer Electronics plc* and © *1982 Amstrad* respectively.

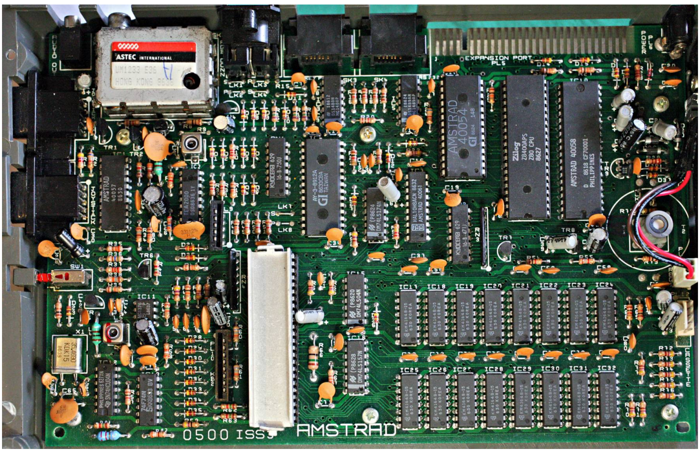
LOCALIZED VERSIONS

Amstrad, due to its strong presence in France and Spain, manufactured versions of the +2 with the ROM menus and the message to start loading from tape in the languages of the two countries. In the Spanish +2, the characters *Ñ, ñ, ¡* and *¿* plus the peseta sign in place of that of the pound sterling were present. All of them were indicated on the keyboard, whose markings were also in Spanish. Later +3 and + 2A models were officially released in English and Spanish versions only. In Egypt, Matsico Corp. modified the ROM and keyboard of the +2, +2A and +3 by introducing Arabic characters and typing from right to left.

Detail of the keyboard of a Spanish +2

+2 ISSUES

Component updates for the +2 mainly concerned the Datacorder, besides – presumably – some of the inner ICs. At least three issues of +2s are known.



+2 motherboard, Issue 3

SINCLAIR ZX SPECTRUM +3

Like the +2, the +3 also draws on the basic lines of a pre-existing Amstrad product, the CPC 6128 in this case, and like that machine, it is not meant as a substitute for the previous model – rather like a complementary product instead. Externally, the +3 goes back to the traditional black colour, and has the 3” floppy disk drive as its main feature, the same as that installed on the 664. At the time of its launch – on 17th May 1987, at the Brown Goods Show in London –, this disappointed not a few among those who hoped the +3 would actually have been an updated Spectrum.

Being more oriented to the past than to the future, the +3 did not meet with great success in fact, although the most important companies still producing software, mainly games, for 8-bit machines at the time often included disk versions for the +3 in their catalogues. In addition to that, other factors, such as a fault in the sound circuits of the first production batch which caused some sound distortion, and incompatibilities with dozens of programs due to the revised logic circuits, simplified with the adoption of the Amstrad LGA *(Logical Gate Array)* 40077 ASIC, accelerated its departure from the scene.

TECHNICAL SPECIFICATIONS Same as the previous model, except for:	
Release date	17 May 1987
End of production	December 1990
ROM	64 KB in 4 banks of 16 KB each, ROM 0 for +3 BASIC and ROM 0 for 48 BASIC
Connectivity	RF socket (UHF channel 36); RGB video socket; tape/audio 3.5 socket; 5V DC at 2A, +12V at 700mA and -12V at 50mA power input; expansion port; printer port; external floppy drive FD-1 port; 2 RS232 6-pin ports (1 for printer/MIDI + 1 for auxiliary device); 2 SJS joystick ports
Read/write device	Floppy disk drive for 3” AMSOFT CF-2 2-sided, 40 tracks, 9 sectors, 512 bytes per sector disks; +3DOS internal operative system, compatible with CP/M Plus and CP/M 2.2 files
Dimensions (mm)	435×170×50

+3 Issue 1 motherboard. It is easy to see that it has been noticeably simplified in comparison to that of the +2. The Amstrad LGA 40077 ASIC, visible down left, replaces the traditional Spectrum logic circuitry, inherited from the previous models.

THE FLOPPY DISK DRIVE

The device allows for the use of AMSOFT CF-2 floppy disks, already employed by Amstrad for its CPC and PCW systems, and it is managed by the +3DOS internal operative system, derived from AMSDOS and stored in ROM bank 2. This internal compatibility choice taken by Amstrad seemed unreasonable to many, who hoped for support of the ever more widespread 3" ½ floppy disks, and was a source of discontent to such a degree that it gave rise to an urban legend, circulating until a few years ago, according to which Amstrad had stores filled with 3" drives and the +3 would have been a great chance to finally get rid of them.

+3DOS is in practice a long series of machine code routines, fully explained in the substantial Chapter 27 of the computer manual, which reading is recommended to all those wishing to know more about this subject. Its basic features are:

- support for one or two floppy disk drives and a RAM disk;

- CP/M Plus and CP/M 2.2 file compatibility;
- AMSTRAD CPC range and PCW range files and media compatibility;
- up to 16 files open at the same time;
- reading and writing files to or from any page in memory;
- byte level random access;
- deleting disk files; renaming disk files; changing disk files' attributes;
- selecting the default drive and user;
- booting a game or operating system;
- low level access to floppy disk driver;
- optional mapping of two logical drives (A: or B:) onto one physical drive (unit 0).

The drive could also be used in a more user-friendly manner by means of a third-party operative system, *Mallard BASIC* by Locomotive, the company responsible for the CPC BASIC interpreter. The package, released in April 1988, included a version of CP/M Plus and was sold at £29.95. This made direct running of CP/M programs written for all systems based on the Z80, and on CPUs derived from it, possible.

From +3 BASIC it is possible to manage the drive through the usual LOAD, SAVE and MERGE commands, together with FORMAT, CAT and ERASE, previously assigned to the Microdrive, which cannot be used with the +3 due to ROM modifications. File management on floppy and RAM disks is achieved with the following syntax:

```
[command] “[drive letter]:[filename]”
```

where [drive letter] can be *a* for the main drive (default), *b* for the external drive (if connected) or *m* for the RAM disk. Therefore, typing at system boot under +3 BASIC:

```
LOAD "squares"
```

the ‘squares’ program on disk will be loaded from the default drive and not from the cassette, as it would happen with all the other Spectrums. The current save or load device can be changed by specifying it in the first used SAVE or LOAD command. This is especially true for tape operations, so typing, for example:

```
SAVE "t:"
SAVE "Bloggs"
```

from that moment on, each saving operation will be carried out on tape. To load the same program from cassette, you must type:

```
LOAD "t:"
LOAD "Bloggs"
```

This situation persists until either a different device letter is specified, BASIC 48 is switched to, SPECTRUM or USR0 are entered, or the computer is reset. In the latter case, the default configuration is re-established, while in the others the tape is selected.

Notice that the different BASIC syntax for RAM disk management compared to the 128/+2 requires that all SAVE! “filename” and LOAD! “filename” instructions in programs must be changed to SAVE “m:filename” and LOAD “m:filename” respectively to make them compatible with the +3 (and the +2A/+2B as they follow the same convention). Otherwise, a *C Nonsense in BASIC* error will occur.

THE MEMORY

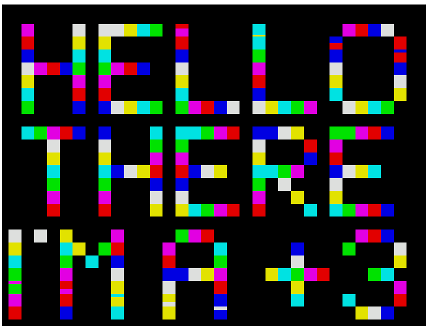
The +3 ROM includes four 16 KB banks. Each one of them has different functions:

- ROM 0: 128 BASIC editor, menu system and system test program (accessible by pressing Q, A, Z, P, L and M in the TV tuning screen);
- ROM 1: 128 BASIC syntax checker;
- ROM 2: +3DOS;
- ROM 3: 48 BASIC.

ROM 1 also contains a curious 'Easter egg'. When typing:

```
COPY RANDOMIZE
```

at the +3 BASIC prompt and pressing C, J and L almost at the same time as ENTER, a full-screen writing will appear, made with rapidly colour changing squares on a black background:



Keypad scanning routines have been removed from the +3 ROM; the port previously assigned to it is now a generic 'auxiliary port'. Furthermore, while in the original Sinclair ROM the memory area at addresses 14591 (38FFh), 14847

(39FFh), 15103 (3AFFh) e 15359 (3BFFh) contains the 255 (FFh) value, +3 ROMs hold other values at the same addresses, due to the revision carried out by Amstrad. When, on the +3, the values of those addresses are loaded in the I register, the IM2 interrupt vector looks for the others, but is unable to find them. A similar problem occurs because of the modifications to the logic circuits: the IN 255 I/O port, used in the old architecture to differentiate between the border and the central screen area, or to synchronize the image by exploiting the 'floating bus' effect, no longer exists. Hence, the incompatibilities between the +3 and several programs written for the 48K, among which some well-known games.[13]

RAM bank switching is controlled by the CPU through the 32765 (7FFDh) port, as in the 128/+2. Besides controlling the ROM in use (bit 2), the printer port synchronization signal (bit 4) and the drive motor (bit 3, 1 = on, 2 = off), 32765 port bits 1 and 2, in their four possible combinations, originate four RAM configurations, when bit 0 (special mode) is set to 1:

65535 (FFFFh)	Bit 2 = 0 Bit 1 = 0	Bit 2 = 0 Bit 1 = 1	Bit 2 = 1 Bit 1 = 0	Bit 2 = 1 Bit 1 = 1
49152 (C000h)	Bank 3	Bank 7 screen	Bank 3	Bank 3
32768 (8000h)	Bank 2	Bank 6	Bank 6	Bank 6
16384 (4000h)	Bank 1	Bank 5 screen	Bank 5 screen	Bank 7 screen
0 (0000h)	Bank 0	Bank 4	Bank 4	Bank 4

[13] On the Author's website, at the page *www.alessandrogrussu.it/plus2A-en.html* there is a list of +3-compatible versions of such games, freely available for download.

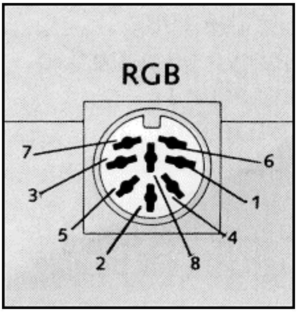
RAM banks 1, 3, 4 and 6 are used for disk cache and RAM disk, whereas bank 7 holds the BASIC editor buffer and +3DOS workspace. In addition to that, unlike previous 128 KB RAM Spectrums, banks 4, 5, 6 and 7 are contended, that is, they are alternatively used by the circuitry displaying the on-screen picture, or by the CPU, while all the other ones are exclusively reserved to the CPU.

CONNECTIVITY

The +3 is provided with two new ports, DISK B and PRINTER; the former is assigned to the Amstrad FD-1 auxiliary floppy disk drive, while the latter connects the computer to any Centronics compatible printer.

Power input now comes through a 6-pin DIN connector, compatible with the new power supply unit, different from all the previous, Sinclair-designed, ones. The expansion port has been modified by removing 9 Volts as well as IORQGE and video signals and by adding specific signals for ROMs and disk drive management.

As a consequence, peripherals such as the ZX Interfaces and Microdrives or the ZX Printer cannot be used with the +3. The RGB socket, now bearing the French *Péritel* audio-video standard connection – better known as SCART – as well, has also been modified, according to the following scheme:



Pin	Function
1	+12V
2	GND
3	audio out
4	composite sync
5	+12V
6	green
7	red
8	blue

If the monitor the +3 is connected to does not have a loudspeaker, it is still possible to employ an external one through the 3.5 TAPE/SOUND socket. In fact, unlike the +2, the +3 must load tapes from an external cassette recorder, which is connected by means of a specific cable supplied with the computer. This cable has a single jack on one side, that must be inserted into the TAPE/SOUND connector, and two jacks on the other side, bearing the usual EAR and MIC denominations. The +3 can be hooked to a common TV through the usual RF output anyway.

THE START MENU

The Amstrad copyright message now lists the available drives, identified, as it has already been mentioned, by the A, B and M letters. The first option is not 'Tape Loader' anymore, but simply 'Loader', because the +3, should such option be chosen, checks if a disk is in the A: drive first, then does the same for drive B:, if connected. In case no disk is found, loading from tape is then set. Furthermore, apart from the addition of '+3' to the '128' header and the '+3 BASIC' denomination in place of '128 BASIC', the start menu has been left untouched.

The +3's start menu. Note the indications about floppy drives A: and B: and the virtual RAM disk M:

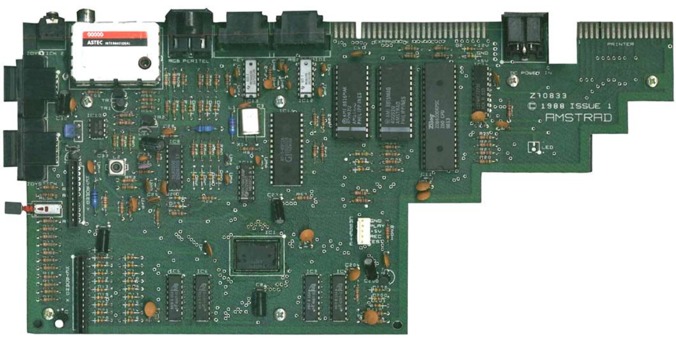
Detail of a +3 'Arabicized' by Matsico Corp.

SINCLAIR ZX SPECTRUM +2A/+2B/+3B

The ZX Spectrum +2A, the last of the official series, derives from the +3 and is provided with a slightly modified Datacorder (single-pulley mechanism instead of the two-pulley one equipped by the +2) in place of the floppy disk drive. It inherits the +3's hardware and software incompatibilities. Most of the times, it was sold within 'packs', i.e. bundled with joysticks, light guns and various games. The +2A underwent a minor revision, the +2B, that fixed the sound distortion found in earlier +3s and in some +2As as well, because motherboards initially meant for +3s were then diverted to +2A assembly lines when the +3 was withdrawn from the market at the end of 1990. The +2A/+2B went out of production three years later. The same revision originated a Spectrum +3B, which for a long time was only known by the Amstrad +2B technical manual. In April 2013, Jaime Tejedor Gómez ('Metalbrain') confirmed its existence in a post on the *World Of Spectrum* forum.[14] Based upon a Z70835 Issue 1 motherboard, it was manufactured in very small numbers, probably due to the +3's modest success.

[14] *worldofspectrum.org/forums/discussion/comment/693743/#Comment_693743*

TECHNICAL SPECIFICATIONS **Same as the previous model, except for:**	
Release date	March 1988
End of production	1993
Connectivity	RF socket (UHF channel 36); RGB video socket; 3.5 audio socket; 5V DC at 2A, +12V at 200mA and -12V at 50mA power input; expansion port; printer port; external port for additional FD-1 floppy drive; 2 RS232 6-pin ports (1 for printer/MIDI + 1 for auxiliary device); 2 SJS joystick ports
Read/write device	2-head tape recorder, with record, play, rewind, fast forward, stop/eject, pause functions; fixed volume; adjustable tape head azimuth
Notes	the majority of +2As (and presumably all +2Bs), like later +3s, are supplied with a revised 4.1 ROM, whereas the majority of +3s feature a previous 4.0 version
Dimensions (mm)	435×170×55



+2A Issue 1 motherboard

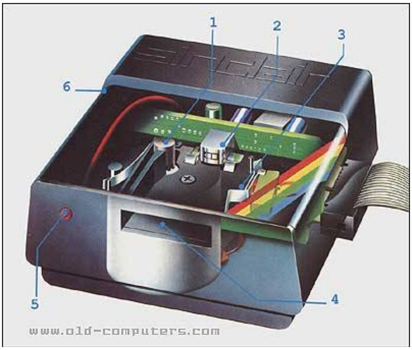
SINCLAIR PERIPHERALS

ZX INTERFACE 1 AND ZX MICRODRIVE

Marketed in 1983 at £49.95 (£79.95 in a kit with one ZX Microdrive), the ZX Interface 1 has two purposes: giving the Spectrum a better means of mass storage than tapes – the Microdrive cartridge – and expanding its connectivity with other peripherals, through a RS232 serial port, and other Spectrums. Two sockets placed on the back of the device allow in fact for cable connection of two Spectrums, forming a local network able to connect up to 64 of them at the same time.

The ZX Microdrive was Sinclair's attempt to provide the Spectrum with a fast and low-cost mass storage. However, few software producers made Microdrive versions of their programs, while the device experienced a good diffusion among users, particularly in the first years of the Spectrum commercial life span.

Fairly reliable for the standards of its own time, the Microdrive was permanently dropped after Amstrad's takeover of Sinclair Research in April 1986.



Inside the Microdrive: 1-tape driving roller, 2-read/write magnetic head, 3-read/write protection switch, 4-cartridge housing, 5-power LED, 6-extension connector.

Microdrive cartridge (without lid)

The Microdrive is a small cartridge drive. Cartridges host a ring tape 6 meters long and 1.9 mm wide, sliding at a speed of 76 cm/sec. Standard data storage capacity is 85 KB at a reading speed of 15 KB/sec. Up to 8 Microdrives can be serially connected to the Interface 1.

Although Microdrives suffered from various problems and malfunctions, caused by high speed and excessive tape thinness, preliminary versions of never commercialized programs stored on cartridges are still being found after decades. For example, *Trojan,* a conversion from the eponymous Capcom coin-op, developed by Clive Townsend for Durell in 1986, which resurfaced in 2009.

ZX INTERFACE 2 AND ZX ROM CARTRIDGES

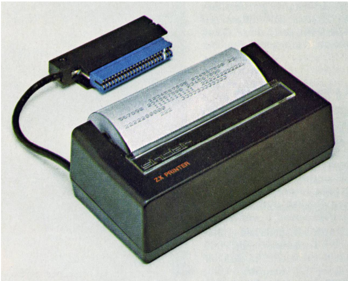
September 1983 witnessed the launch of the second Sinclair interface, more aimed towards 'casual' users in comparison to the first. In fact, it allowed two joysticks and a ROM cartridge to be connected to the Spectrum, so that programs stored inside them could be instantly loaded at system start. The cartridges themselves were manufactured by Sinclair. Only ten were released, each one containing a game already published within the Sinclair catalogue for the 16K Spectrum:

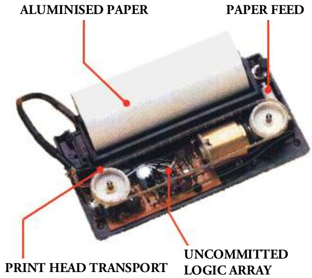
- *Backgammon* (Psion)
- *Chess* (Psion)
- *Cookie* (Ultimate)
- *Horace and the Spiders* (Melbourne House)
- *Hungry Horace* (Melbourne House)
- *Jetpac* (Ultimate)
- *Planetoids* (Psion)
- *Pssst* (Ultimate)
- *Space Raiders (*Psion)
- *Tranz Am* (Ultimate)

Unlike the Interface 1, the Interface 2 wasn't well received by the public and was withdrawn less than one year later, although its price had dropped to £9.95 against the initial £19.95. Cartridges were expensive: £14.95 each against £5.95 for tape versions. Paying a more than double price just to avoid waiting less than three minutes to load each game (since all titles were for the 16K) was not, understandably, considered a bargain – even less so when considering that the joystick ports did not adhere to the widespread Kempston and Atari standards, whereas many third-party offers allowed for the use of gaming peripherals conforming to them.

Cover of the 'New ZX ROM Cartridge Software' catalogue, 1983

ZX PRINTER





Already existing from the time of the ZX81 – precisely from November 1981, at the cost of £49.95 –, the small thermal paper printer drew characters by burning an aluminum coating placed on a black paper sheet. Its main purpose, given its diminutive size reflecting the ZX81's and the Spectrum's 32 characters wide low-resolution display, was the keeping of program listings. Paper was delicate and prone to stains or fading, so that it was common to make photocopies out of its prints.

Due to its low cost, the ZX Printer had a noticeable success; however, its limitations made it unfit for word processing applications. This gap was filled by third-party products too – for instance, a particular diffusion was experienced in this sense by Seikosha GP-50 series dot matrix printers.

SINCLAIR/AMSTRAD PERIPHERALS

SINCLAIR JOYSTICK SYSTEM 1/2 AND SPJ-1

Amstrad, in accordance with Alan Sugar's directives meant to turn the Spectrum into an essentially gaming-oriented platform, produced the first Sinclair branded joysticks starting from 1986. The first two series, SJS *(Sinclair Joystick System)* 1 and 2, were sold on their own as well as, more often, bundled with Spectrums. They did not meet with much favour among videoplayers, being digital joysticks, thus providing low feedback, and also because their construction was not very solid. Nonetheless, it is not rare to find working exemplars of them even today.

The SPJ series had just one representative instead, an analog joystick of a much more professional type, which was associated to the PC 200 rather than to the Spectrum. It was produced in few numbers.

MAGNUM LIGHT PHASER

It is one of the easiest to find peripherals ever on the used market, due to its bundling with Spectrums sold from 1988 on. Few titles are compatible with it; the majority of them are simple 'shooting gallery' arcade games included within commercialization 'packs'. Even scarcer are titles of some appeal expressly modified for use with the Magnum gun: among them, Ocean's *Operation Wolf* coin-op conversion is without any doubt the most renowned. Together with other 5 games, it was part of the *Sinclair Action Pack Lightgun Games* collection, supplied with +2As or +3s. Since the computer identifies the target by comparing the brightness of the point indicated by the player by pressing the trigger of the gun with the horizontal scan of the image on a cathode ray tube screen, neither the Magnum nor similar peripherals also compatible with the Spectrum, such as the Cheetah Defender or the MHT Ingenieros Gun Stick, can work with a modern digital TV.

THIRD-PARTY PERIPHERALS

ROTRONICS WAFADRIVE
(SMT/Rotronics, 1984)

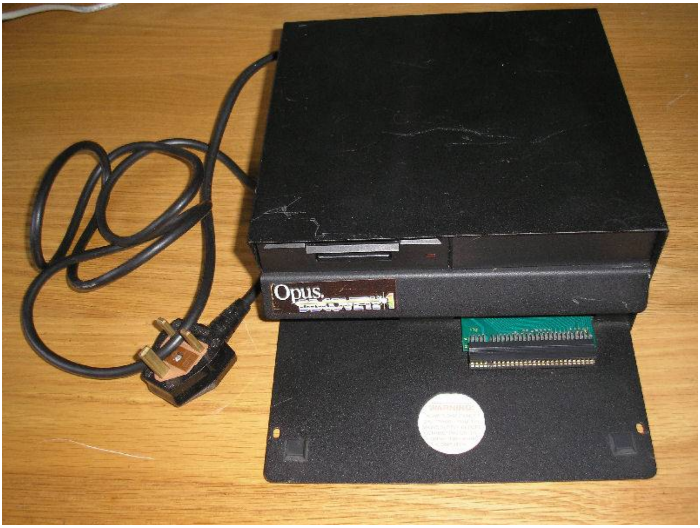
The Wafadrive was the first real alternative to the ZX Microdrive as an intensive use mass data storage unit. Powered by two inner motors, it could save up to 128 KB of data on two 'wafers' (cartridges), similar to those used with the Microdrive, but sturdier. The drawback of the Wafadrive in comparison to the Sinclair product lied in its lower speed, but as a compensation it had a larger data storage capacity and was free from the faults that sometimes affected Microdrive cartridges. A complimentary copy of Softek's *Spectral Writer* word processor was issued with the device. At the time of its release the Wafadrive had a retail price of £129.95.

BETA DISK INTERFACE
(Technology Research, 1984/1987)

Equipped with the TR-DOS, a proprietary operative system, this interface is able to connect the Spectrum to a maximum of 4 double density 5” ¼ and/or 3” ½ floppy disk drives through a standard Shugart port. A ‘magic button’ saves a RAM snapshot on disk, which can later be loaded at much higher speeds than tape or Microdrive cartridge. Release price was £109.25.

The Beta was notoriously fast and reliable, and its compatibility with several kinds of disk drive paved the way for its success, to the extent that three years after its launch Technology Research issued a specifically tailored version of it for 128 KB RAM Spectrums. This version was (unofficially) imported in the Soviet Union and soon became quite popular, being adopted as the standard disk interface for Spectrum clones produced there. The diffusion of the Beta 128 and TR-DOS among Spectrum and related machines enthusiasts of the former USSR is, even nowadays, very wide.

OPUS DISCOVERY
(Opus Supplies, 1985)



At a cost of £199.95, dropped to £99.95 a year after its release, the Discovery was the first real Spectrum disk drive devised for use with 3" ½ floppy disks that in a few years' time would impose themselves as the *de facto* standard, ousting 5" ¼ ones. Unlike the Wafadrive, which came with an internal operative system running aside that of the Spectrum, the Discovery entirely relied upon Microdrive commands. The interface also included a number of elements, placed on the right-hand side, aimed at expanding the Spectrum's connectivity: composite video output, Centronics printer parallel port, Atari standard joystick port, and an expansion port identical to the Spectrum edge connector the device was attached to.

MULTIFACE 1/128/+3
(Romantic Robot, 1986/1987)

With its different versions, the Multiface was, among Spectrum third-party peripherals, one of the most successful. The device is provided with a button that, when pushed, blocks the program execution, allowing for several operations to be performed, such as saving RAM snapshots on tape, Microdrive, Wafadrive, Beta or Opus and ‘peeking’ inside RAM itself, looking for values to change, for instance infinite lives or energy, unlimited time and/or ammunition in videogames. Spectrum-centered British magazines published entire pages of POKE commands to be inserted for such purposes, while the Multiface was activated. The interface is completed by a standard joystick port.

The initial version (£39.95) was then joined by one for Spectrums with 128 KB RAM, including the Genie in-built disassembler (£44.95), and finally by one for the +3 (at the same price), due to that computer’s modified ROM and expansion port, which made it incompatible with the Multiface 128.

DISCiPLE
(Miles Gordon Technology/Rockford Products, 1987)

Similar in its appearance to the ZX Interface 1, to the extent that it is installed the same way, the DISCiPLE also draws on its objectives, widely amplifying the capabilities of the Spectrum. It includes two Shugart ports for single or double density 5” ¼, 3” ½ and 3” floppy disk drives; a button for saving a RAM snapshot on disk; a Centronics parallel printer port; two Atari-compatible joystick ports that can be both switched from Sinclair to Kempston and vice versa; two connectors for two other Spectrums equipped with a DISCiPLE, allowing for the creation of a local network including a maximum of 64 elements. The internal operative system is named GDOS and is an extension of Sinclair BASIC. Starting retail price for the DISCiPLE was £89.95.

MGT PLUS D
(Miles Gordon Technology, 1988)

The Plus D is an interface mainly aimed at the use of 5” ¼ and 3” ½ floppy disk drives with any Spectrum. Here too, a button saves the RAM contents on disk; a 48K snapshot is loaded back in about 7 seconds. The interface is com-pleted by a Centronics parallel printer port.

The Plus D was available at the cost of £49.95 alone or £129.95 with a 3” ½ floppy disk drive. Its low cost and simplicity of use favoured its diffusion.

CURRAH MICROSPEECH
(Currah Computer Components, 1983)

Speech synthesis device based on the General Instrument SP0256-AL2 processor. Could also redirect sound output to the TV. A fair number of games exploited its features; among them: *Lunar Jetman, Twin Kingdom Valley, Moon Alert, Max Headroom, Booty, Pogo, Maziacs, Starbike.* It costed £29.95.

CHEETAH SPECDRUM
(Cheetah Marketing, 1985)

Digital percussion system with 8 default sounds and real-time programming. It is able to store more than 1000 rhythm patterns, that can be loaded from and saved to tape. Three alternative drum kits, *Afro, Electro* and *Latin,* were made available later. Its price was £29.95.

FULLER BOX
(Fuller Micro Systems, 1983)

Sound interface equipped with the AY-3-8912 chip, controlled by BASIC or machine code. Comes with an in-built adjustable speaker to amplify the sound emitted by both the chip and the internal buzzer of the Spectrum. It needed special programming. and only very few games exploited its features, such as *Invasion Of The Body Snatchas, Delta Wing, Starbike.* It included a standard 8-pin Atari joystick port, but it too required support from games: only Imagine and (partly) Softek took it into consideration. It costed £29.95.

SLOMO
(Nidd Valley Micro Products, 1985)

The Slomo is a device that allows the user to slow down the Spectrum's CPU speed by turning a special knob. Typical use scenarios include program debugging, slowing down the execution of educational software for children or management software for inexperienced users, and making fast-moving games easier. Price: £14.95.

DK'TRONICS KEYBOARD
(DK'Tronics, 1983)

SAGA 1 EMPEROR KEYBOARD
(Saga Systems, 1984)

LO>>PROFILE PROFESSIONAL KEYBOARD
(Advanced Memory Systems, 1984)

Three of the most popular alternative keyboards for 16/48K Spectrums. Starting prices were £45.00, £59.95 and £49.95 respectively.

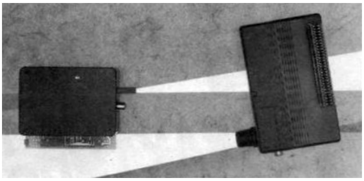
AMX MOUSE (Advanced Memory Systems, 1985)

KEMPSTON MOUSE (Kempston Micro Electronics, 1986)

GENIUS MOUSE (Datel Electronics, 1989)

Three mouse systems. AMX and Kempston are emulated by various programs. Clones of the latter also exist, manufactured by several producers in the Czech Republic, Slovakia and Russia. Original prices: £79.95 (including *OCP Art Studio* or *AMX Art*), £49.95 and £39.99 (including *OCP Art Studio* or *The Artist II*) respectively.

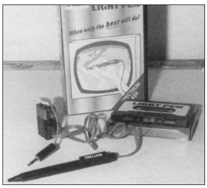
VIDEOFACE DIGITIZER
(Data-Skip/Romantic Robot, 1986)
ROMBO VIDI-ZX (ROMBO, 1988)



Two interfaces for acquiring video images from TV. The Videoface was made in the Netherlands by Data-Skip and initially sold through mail order, then imported in the United Kingdom by Romantic Robot. It could capture both static images and sequences at 6 frames per second. Its price was £69, later lowered to £39.50. In the Czech Republic a modified version of it was manufactured for the Didaktik series Spectrum clones.

The Vidi-ZX was a product of the Scottish company ROMBO instead and was sold at £34.95, later £29.95. It worked in a similar way to the Videoface, but at 10 frames per second and with a SHADE optional function to preserve midtones. It could save images on tape, Microdrive cartridge, +3 disk or through the DISCiPLE.

DK'TRONICS LIGHT PEN
(DK'Tronics, 1983)



CAD-MASTER LIGHT PEN
(Trojan Products, 1984)

DATEL LIGHTWRITER
(Datel Electronics, 1984)

Three light pen models. They costed £19.95, £17.95 and £16.99 respectively at the time of their release.

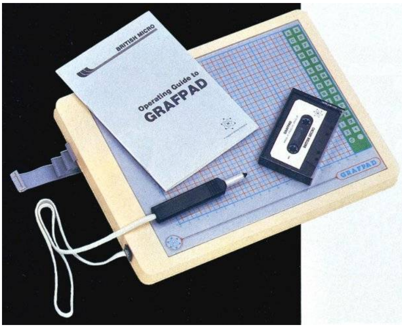
RD DIGITAL TRACER
(RD Laboratories, 1983)

The RD Tracer is a peripheral which can scan a picture and send it to the Spectrum through a cable. The joints host some transducers that, together with the related software, obtain the tracking crosshair position. Maximum scanning area is 300×300 mm with automatic scaling, but normally the ordinary mode at 256×176 mm is used.

Management is performed by means of four programs bundled with the device: DRAW for generic drawing and copying, SCALE to enlarge, shrink or rotate the on-screen drawing, RETRACE to memorize a pattern of scanning movements for later use and GRAPHICS to draw user-defined graphics.

Upon release, its price was £59.95.

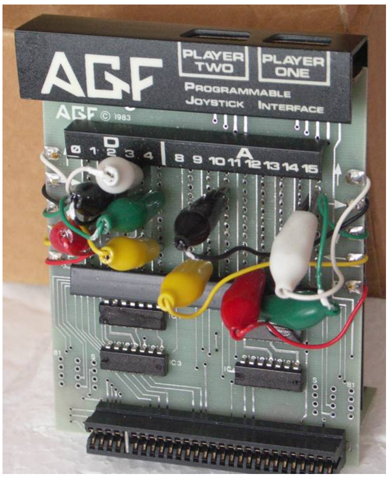
GRAFPAD
(British Micro, 1984)



Graphic tablet with an optical pen for freehand drawing. A supplied program allows to create and colour windows, circles and other figures. A drawing previously made on paper can also be traced. Drawings and UDGs are saved on cassette or Microdrive. Also offered for the Commodore 64 and BBC Micro (model B). Dimensions (mm): 25×55×260. Weight: 1.2 kg. It costed £143.75.

AGF JOYSTICK PROGRAMMABLE INTERFACE
(AGF Hardware, 1984)

Programmable joystick interface with a 9-pin Atari connector. It is programmed by means of coloured pins to be connected to the device circuit, following a combination scheme capable of emulating keyboard input through the lever's movements. Price: £26.95.



KONIX LIBERATOR
(Konix Computer Products, 1986)

The Konix Liberator is a multi-function interface based on a custom chip made by Ferranti, from which the Spectrum ULA also came. It expands the computer's features by adding ten new functionalities:

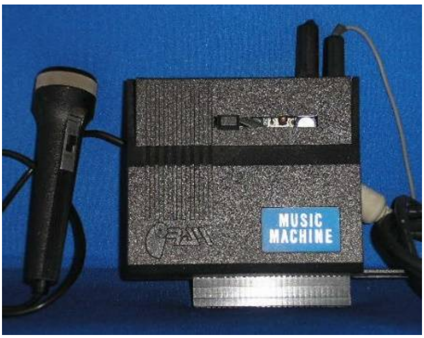
- Centronics printer port;
- RS232 serial port
- audio output for TV speaker;
- adjustable CPU slowdown;
- monitor connection port;
- multi-standard joystick port (Kempston, Protek, Sinclair);
- reset button;
- expansion port to connect other peripherals;
- save/load switch, to use only one cable at a time;
- power indicator.

Dimensions (mm): 230×70×30. Cost: £34.95.

RAM TURBO INTERFACE
(Ram Electronics, 1984)

Multi-function interface for loading programs from ZX Interface 2 ROM cartridges and connecting two joysticks. The right port is compatible with the Kempston standard. The second can be set as Protek by keeping the fire button of the joystick connected to it pressed when the computer is started. Both can work simultaneously with two Sinclair joysticks. Units launched on the market from Christmas 1985 onwards are also fitted with a reset button. It is not compatible with the +3. Price: £22.95.

MUSIC MACHINE
(Ram Electronics, 1986)

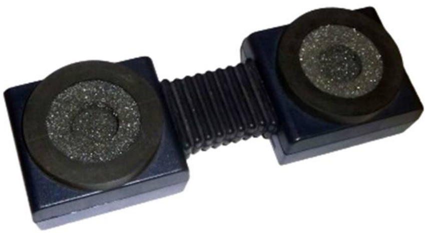


System for sound sampling and musical composition consisting of a MIDI-compatible interface that can also be used as an electronic battery, a microphone and a program to manage every function of the device, from altering recorded sounds to writing a song in a mixed music/drums mode using the Spectrum keyboard or an external MIDI instrument. Launched at £49.99.

PRISM VTX 5000
(O.E., 1983)

Modem with direct connection at 1200/75 baud. It was expressly designed to allow Spectrum users to connect to Micronet 800, part of the British Prestel videotex network, and later also to other similar services. Since the computer does not have a serial RS232 interface, the VTX 5000 connects to the expansion port via a ribbon cable and contains, in the internal ROM, the firmware necessary to access services or exchange data with other users equipped with the same device. It also works at 1200/1200 half duplex. Starting price of £74.95, dropped to £49.95 in 1985.

PROTEK 1200
(Protek, 1984)



Acoustically coupled modem at 1200/75 baud or 1200/1200 half duplex. It connects to any network compatible with the CCITT V23 standard. To work with each system, Spectrum included, it requires a dedicated RS232 interface (the one coming with the ZX Interface 1 is not suitable) and to load a special supplied software. Powered by 4 AA batteries. Prices were £59.95 for the modem and £24.95 for the Spectrum interface.

ROBOTEK
(Datel Electronics, 1984)

Control interface for robotic mechanisms. Allows for independent control of 4 outputs, to send commands, and 8 inputs, for sensors. Signals are sent through a 66 cm long ribbon cable. Compatible with Lego robotic kits. Release price: £29.99.

DATEL ROBOTARM
(Datel Electronics, 1988)

This robotic arm is arguably the most unusual peripheral ever produced for the Spectrum. It had five movement axes, was operated by 2 joysticks or the Robotek interface, and came with many accessories. It costed £39.99.

HILOW DATA DRIVE
(HiLow, 1986)

The HiLow Data Drive is a peripheral for fast data save and load manufactured in Uruguay in 1986. It was developed by Juan J. Arias Carlos Galucci, Roberto Eimer, Ramiro Arias, and Alfredo Mussio. Actually, it consists of two parts. The first is the read/write unit, made from components of Data Drive units for the Coleco Adam system, imported at low cost in the South American country after the end of sales in the USA in January 1985, due to lack of success (in Uruguay, on the other hand, reception was very positive). The second is an interface acting as a link between the Spectrum and the tape drive and is equipped with a shadow ROM, written by Galucci, which replaces the original Coleco one.

The Data Drive is similar in operation to a Microdrive. It uses common cassettes, that must be formatted before use, on one side only or on both sides. A 60-minute cassette can hold 368 KB of data. Three LEDs on the front of the tape drive indicate the operation in progress: green for stand-by, yellow for reading and red for writing. In addition to individual files, the entire contents of the RAM can be saved by pressing a special button to generate a non-maskable interrupt: the resulting 48 KB of data load in about 50 seconds.

Chapter Three
SOFTWARE HOUSES

This chapter presents the profiles of 77 software houses in alphabetical order, chosen as the most important among those that released titles for the Spectrum. Most of the times they are mentioned individually, but certain software houses are grouped together with their labels or subsidiaries when present, unless their importance requires a separate entry. The majority of them made video games, but there are some that produced many of the best-known and enduring utility programs, which on the Spectrum have been synonymous with word processing or freehand drawing.

For each software house, the years of start and end of activity are indicated, followed by a question mark when presumed, and a profile is outlined, indicating its most representative products in the writer's opinion. One of the titles in particular is the object of specific attention as it is considered exemplary in the global production for the Spectrum from each software house.

At the end of the chapter, there are some notes on the companies that created and marketed programs in those countries where the Spectrum was not officially imported or clones of it were manufactured. Italian software houses will be dealt with in the seventh chapter.

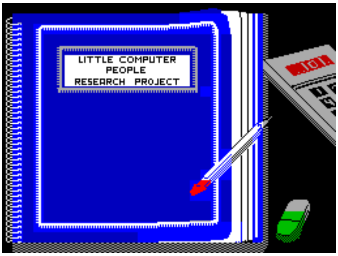
ACTIVISION
1979-in activity

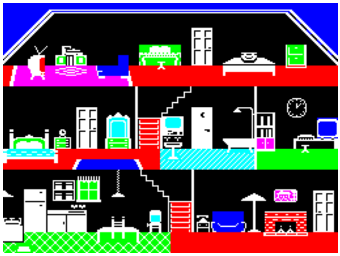
One of the longest-running videogame makers still in business (the parent company was founded in Santa Monica, California, in 1979), Activision has been on the market with Spectrum titles ever since that computer's launch. The first ones were adapted from the Atari 2600 console *(River Raid, H.E.R.O.),* then it turned to the creation of original games and coin-op conversions. Among the latter, *After Burner, Dragon Breed, Enduro Racer, Power Drift, Rampage* and *Super Wonder Boy* are particularly interesting.

The rest of Activision's output for the Spectrum is composed of arcade games *(Ghostbusters, Ghostbusters II, Hammerfist),* strategy games *(Guadalcanal, High Frontier),* simulations *(Sailing, Space Shuttle, Fighter Bomber),* text adventures *(Mindfighter, Mindshadow),* first-person view exploration games *(The Eidolon, Koronis Rift, Rescue On Fractalus)* and titles so original as to be difficult to classify *(Hacker, Hacker II, Little Computer People).*

Electric Dreams, a subsidiary of Activision, is covered in a separate entry.

LITTLE COMPUTER PEOPLE (1986)





The ‘Little Computer People Research Project’ deals with taking care of a sentient being living inside a computer, in a three-storey house with three bedrooms, kitchen, bathroom and attic. This character has various needs the player must care for, from food to contacts with other individuals and leisure (you can even play poker together). If he is not satisfied, he will end up getting sick, and regaining control of the situation won’t be an easy task.

Will Wright, author of *The Sims,* explicitly admitted in a 2000 interview with CNN[15] the influence that *Little Computer People* and its creator, Rich Gold (together with David Crane), had on his work. Ten years earlier, in fact, a ‘virtual buddy’ already existed under the Activision brand.

[15] *edition.cnn.com/chat/transcripts/2000/1/wright/index.html*

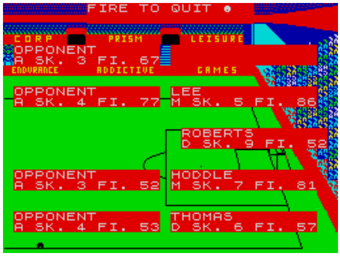
ADDICTIVE GAMES
1982-1992

Addictive is, and will always be, first and foremost, the software house of the *Football Manager* series of football simulations, the best known of all 8-bit home computer users. Founded in 1982 by Kevin Toms, who was also one of the first video game authors to make himself known to the public by having his photo printed on the covers of game cassettes, Addictive debuted with *Football Manager.* It was a BASIC title already programmed by Toms for the ZX80 and ZX81 in a text-only version, while the Spectrum one included some very simple animations to illustrate games highlights. Extremely minimal in appearance, it immediately attracted great attention from gamers, was converted for a large number of other platforms and paved the way for managerial football – and general sports – simulations.

For the successor *Football Manager II,* six years later, the formula and the interface were redesigned, while maintaining the player's ability to intervene in practically every aspect of the game. *Football Manager II* was considered the best of the series, as neither its expansions and special versions, nor the third instalment, released in 1992 and programmed not by Toms, but by Brian Rogers of Bedrock Software, managed to leave a greater impact.

Other Addictive titles to remember are *Kirel,* an isometric 3D puzzle, and *Hot Shot,* an interesting variation on the *Breakout* theme presented as a kind of future sport.

FOOTBALL MANAGER II (1988)



Developed by Kevin Toms with the assistance of Brian Rogers, *Football Manager II* is, unlike its predecessor, entirely programmed in machine code, resulting in significantly faster calculation processing and interface management. Even the graphics for the matches' highlights, although still minimal, have been revised.

The underlying reason that determined the success of *Football Manager* and the influence exerted on dozens of other similar titles is always there: entrusting a football team in the player's hands, seeing it grow and following it through its 'high' and 'low' moments, and taking part in tournaments hoping to end up at the top.

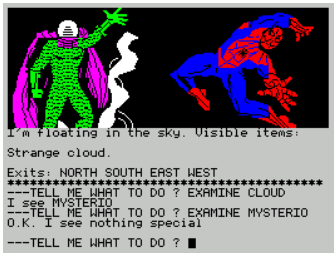
ADVENTURE INTERNATIONAL/ ADVENTURE SOFT U.K.

1978-1987

Founded by Scott Adams, the 'father' of text adventures, Adventure International drew attention from Spectrum users to itself for *Questprobe,* a joint project with Marvel Comics. It had to be a series of twelve games, each one centred upon a different superhero or supergroup from the House of Ideas. A story, narrated throughout a collection of 32-page special comic book issues included in every game package, would act as a link between the titles. Adventure International folded in 1985, thus ending *Questprobe* after publishing just three episodes *(The Hulk, Spider-Man* and *The Human Torch and the Thing).* Its British subsidiary, Adventure Soft U.K., kept producing some highly regarded games: the most outstanding was *Kayleth,* based on a story by Isaac Asimov and released by US Gold.

Other noteworthy titles are: *Adventureland, Blizzard Pass, Gremlins, Masters of the Universe - The Super Adventure, Rebel Planet, Robin Of Sherwood, Seas Of Blood, Secret Mission, The Sorcerer Of Claymorgue Castle, Temple Of Terror.*

QUESTPROBE FEATURING SPIDER-MAN (1984)



The second adventure in the *Questprobe* series sees the player impersonating the famous Spiderman. As it often happens in Scott Adams' games, *Spider-Man* does not follow a main narrative line, maybe connected with some subplots that end up joining it, but is a compound of sub-adventures, puzzles and enigmas which must be singularly and separately handled in order to reach the final solution.

The aim of the game is to collect a certain number of Gems scattered throughout the game world – the offices of the *Daily Bugle,* the newspaper Peter Parker works for as a freelance photographer – and bring them to Cassandra Webb, also known as *Madame Web,* a blind psychic who often helped our hero in the past, and that can provide him with some cryptic clues when properly addressed. The problem is that the Gems are either hidden or in possession of several villains, Spiderman's enemies, so that expecting them to hand him the Gems only because he asks them to is out of the question. He will then have to find a way to defeat them, but this will require a pretty intense brain effort.

ALTERNATIVE
1986-in activity

Alternative, founded by Roger Hulley in 1986 and still operating, holds in its Spectrum catalogue mainly budget re-releases of full-price games from past years. Original games are mostly licensed from children's TV shows; none of them are particularly noteworthy. Other titles include puzzle game *Reckless Rufus,* maze arcade *Hideous,* the platform/collect-em-up *Henry's Hoard* (partially based on the code of *Jet Set Willy*), bizarre platform game *Slug, Punch & Judy,* an arcade adventure inspired by the eponymous characters of English puppet shows and the text adventures *Excalibur Sword Of Kings, Life Term, Wiz-Biz* and *Star Wreck,* the latter a parody of the renowned TV series *Star Trek.*

RECKLESS RUFUS (1992)

Reckless Rufus is a funny being who sneaks into the mining spacecraft Astro Cruiser hoping to reach Earth without paying the ticket. However, he is discovered, and as a punishment, Admiral Greave forces him to recover a large number of crystals on the dangerous planet Killey, full of traps and hostile aliens.

On each of the game's 130 screens, Rufus must collect 5 crystals by walking on blocks and avoiding enemies. To defend himself, he has a laser pistol with limited ammunition at his disposal. Common blocks are marked with a number and are generated according to Rufus's movements, so if for example a block bears the number 3, Rufus can move from beyond another three steps. There are also particular blocks, which force Rufus to move in a certain direction, block enemies for a while, activate a time mine, are only practicable for a certain time and so on. Each screen is marked with a code revealed upon completion, so that you can resume playing from there if all lives are lost.

Reckless Rufus is a dynamic puzzle with a great variety of situations and surprises for the player: each screen must be tackled with care, trying to find the right way to get through it.

A'N'F
1983-1987

The fame of A 'n' F is related to one of the most representative games of the golden years of the Spectrum: *Chuckie Egg,* a platform game of such complexity and playability to make it a great classic of this genre even nowadays. Its follow-up, *Chuckie Egg II,* oriented towards arcade adventure tones, was not as convincing and was penalized by an appearance which was already dated by 1985 standards. Although some interesting titles came out after them, like the futuristic sports game *Xeno* or the dynamic adventure *C.O.R.E.,* A 'n' F was never able to equal the success of the first *Chuckie.*

CHUCKIE EGG (1983)

As Hen-house Harry, the player must collect all the eggs placed along the platforms across the various screens, before running out of time. The giant chickens do not like Harry's presence, therefore he must be very careful not to bump into them, as well as avoiding the bottomless pits lying on the hen-house floor.

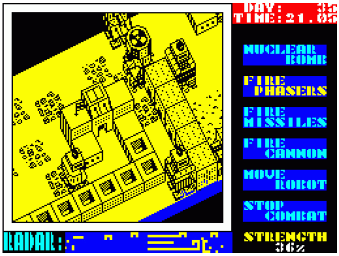
Chuckie Egg is a frantic platform game, of great finesse and fun for all lovers of the genre. It is no surprise, then, that it is considered a classic.

ARGUS PRESS/MIND GAMES
1984-1987

Not much to say about Argus, but one of its later titles – at the end of 1987 it would have been re-established as Grandslam Entertainment – is an extraordinary and involving first example of a 4X *(eXplore, eXpand, eXploit, eXterminate)* real-time strategic game: *Nether Earth.*

The catalogue of its Mind Games label is more interesting. *Alien* is a complex strategy game based on the film of the same name, where the player controls its main characters (each one with his/her own physical and psychological peculiarities), moving them upon a top-view representation of the *Nostromo* starship, looking for the Alien itself. In *Mission Omega* you must devise and build, with limited resources, some robots to be sent aboard a giant starship in collision course with Earth: within a real-time hour its engines must be found and destroyed. Lastly, *Pi-R Squared* is an original puzzle with an arcade-like rhythm.

NETHER EARTH (1987)



The player guides a resistance movement against the Insignans, mighty and merciless sentient beings emerged from the bowels of Earth to enslave mankind. One of the four Insignan bases has been taken over and the aim is to conquer or destroy the other three. The player pilots a control vehicle which can land on bases in order to build or command robots, the weapons used in fighting. They are produced thanks to the automatized factories scattered around the play area, and that must be captured by the robots. Everything happens in real-time; robots can be either assigned orders or put under direct control, one at a time, by landing upon them.

Even if the computer's artificial intelligence is relatively limited, being based more upon numbers and initial advantage rather than refined tactics like diversions or ambushes, and there are neither new technologies nor units to discover, but those already available must be used, the sense of involvement and challenge coming from the game is such to entice the player to eagerly pursue a victory.

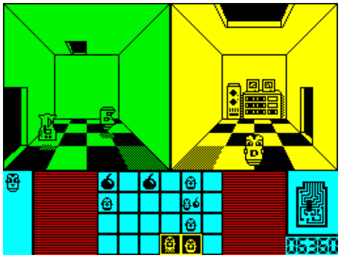
ARIOLASOFT UK/39 STEPS/REAKTÖR
1985-1990

Ariolasoft UK appears in the mid-1980s as a British branch of German software house Ariolasoft GmbH. Spectrum titles include flight simulator/shoot-em-up hybrid *Skyfox,* puzzle *Think!,* maze arcade game *Tujad* and text adventure *Terrors Of Trantoss.*

The three cubes, symbol of Ariolasoft, can also be found on covers of other games, published by its 39 Steps and Reaktör labels. Among them there are: *Triaxos,* an unusual arcade-adventure characterized by a moving orientation isometric 3D play area; *They Stole A Million,* a curious bank breaking simulator; arcade adventure *Bride Of Frankenstein; Starfox,* a vector graphics space shoot-em-up by Ian Oliver and Graeme Baird of Realtime, a development team specialized in this kind of games.

Its most representative game is however, in our judgement, the original *Deactivators* puzzle.

DEACTIVATORS (1986)



The Gravitational Research Institute has been assaulted by a terrorist commando which placed several bombs around it. The player must guide a squad of bomb disposal robots in order to clear the place, making the explosive devices bounce with great care between the different rooms up to the exit. The task is made difficult due to several factors, for instance security droids re-programmed by the terrorists in order to attack our squad – they can be eliminated only by making them fall from one floor to another – or the different gravity pull and spatial orientation of rooms. Some doors or teleporters will initially be out of order, and printed circuit boards, scattered around the building, will be required to repair them.

Two rooms at a time can be observed. The game includes five different versions of the Institute, of increasing complexity and difficulty.

ARTIC COMPUTING
1980-1986

Based in Hull, Artic was founded by Richard Turner and Chris Thornton and began operations with games for the ZX80 and ZX81. Some were later converted for the Spectrum, Commodore 64 and Amstrad CPC. It was one of the first software houses to offer text adventures, a series of games marked with a letter from A to G next to the title. The first ones were extremely simple, being designed for less powerful machines. It was only with adventure E, *The Golden Apple,* planned for the Spectrum from the beginning, that they became more complex and articulated.

Various arcade titles also appear in its catalogue, but few are worthy of particular attention: *3D Combat Zone,* a *Battlezone* clone programmed by Jon Ritman (who will later move to Ocean, where he will work to *Match Day, Batman* and *Head Over Heels*); collect-em-up *Mutant Monty; Galaxians,* an unofficial conversion of the Namco coin-op of almost the same name; *Paws,* where the player guides the cat Selwyn in search of his lost kittens in the depths of a city, against a band of really hostile dogs. *Paws* was to be called *Cats* after the famous musical by Andrew Lloyd Webber based on a book by Thomas Stearnt Eliot, but Artic was unable to obtain the relative rights and had to rework it with a new plot and a different name. Another subject of controversy was the mediocre football game *World Cup Football.* Released in 1984, it was 'foisted' to US Gold two years later, because the latter had bought the rights to the 1986 World Cup, but Ocean, which was supposed to code the related game, had not produced anything up to three months before the beginning of the tournament. So, US Gold bought *World Cup Football* from Artic and relaunched it at a higher price under the *World Cup Carnival* title. Predictably, it was a colossal fiasco.

Artic also produced several computerized versions of Chess and one of Reversi, two machine code assemblers and a Forth language compiler.

ADVENTURE F: THE EYE OF BAIN (1984)

The protagonist of this text adventure is Tarl, a brave warrior in search of a legendary emerald, the Eye of Bain, kept in a temple in the land of Alvania. The locals do not like Tarl's intrusion and capture him as he is about to enter the temple. The player's task is to free Tarl and guide him in search of the precious stone.

The Eye Of Bain, like other Artic text adventures, has a simple parser, set to verb-object syntax. Location descriptions are concise and accompanied by schematic, but pleasant enough images, while puzzles are fairly challenging. It is therefore a typical adventure of the early 1980s, somewhat linear and suitable for both beginners and more experienced players.

ATLANTIS
1984-1992

Among the main software publishers in the 'budget' range (£1.99-2.99), Atlantis owes much of its fame to the brothers Adrian, David and Graham Shaw, whose games – more than half of the house's catalogue – are immediately recognizable by colourful and detailed graphics and a creative use of the limited 48K sound capabilities.

Most Atlantis games are arcade platform/shoot-em-up hybrids, but there are exceptions. Several of them are of above average or good quality, in particular: *Cerius, Gunfighter, Heartbroken, Hypa Raid, Kosmos, The Last Vampire, Moontorc, Nuclear Countdown, Satcom, Sceptre Of Bagdad, Seahawk, Skatin' USA, Superkid, Superkid In Space, Survivors*. Also noteworthy are text adventures *El Dorado, Moron* and *Return To Ithaca.*

MOONTORC (1991)

This platform arcade adventure, where the player controls a brave warrior searching for the mythical Moontorc amulet and attempting to rescue Princess Lalena, exemplifies the typical 'Shaw Brothers' style in an exemplar way. Colourful and detailed graphics and gameplay taking elements from different genres are their most distinctive 'trademarks'.

AUDIOGENIC
1985-1996

Founded by Peter Carver in the wake of Martin Maynard's pre-existing company of the same name, Audiogenic has in its not vast catalogue for the Spectrum some valuable titles, including the best, according to the writer, football game available for that platform, *Emlyn Hughes International Soccer.* Also noteworthy are puzzles *Loopz* and *Helter Skelter,* the conversion of Gottlieb's bizarre coin-op *Exterminator,* bat-and-ball arcade *Impact* and another interesting sports game, *World Class Rugby*, programmed by veteran Denton Designs team.

In 1996, Audiogenic merged almost entirely into the Codemasters group. The rights to the name are still held by Peter Carver, who however changed his field of interest, and definitely left the gaming industry.

EMLYN HUGHES INTERNATIONAL SOCCER (1990)

A sophisticated arcade soccer game, with unique features like the ability to kick the ball forwards in 5 directions and 3 different heights, player movement at different speeds, dribbling and heel strike. It also includes a managerial part, where you can classify and choose the players to send on the field according to their characteristics and skills, and take part in tournaments.

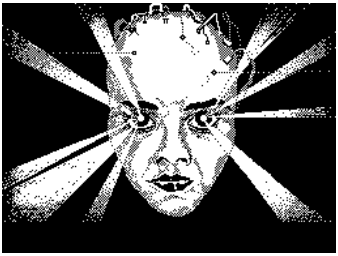
AUTOMATA UK
1982-1985

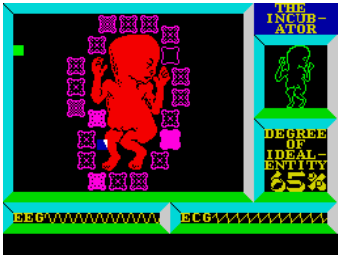
Perhaps the most out-of-the-ordinary software house among those mentioned in this book, Automata UK is the ‘creature’ of English writer, cartoonist, musician, journalist and IT expert Mel Croucher. Active since the days of the ZX81, it distinguished itself for an unusual, anti-business policy of direct mail-order distribution of its products, but above all for innovative and humorous games. The house’s mascot, the Piman – a funny pink humanoid with a huge nose, created by cartoonist Gremlin Evans – appears in several of them, alone or together with other equally wacky characters.

Automata, despite recognition and praise from the press, specialized and not, due to its definitely creative way of employing the video game medium, was instead opposed by wholesalers, due to Croucher’s and his partner Christian Penfold’s policy that made them pay the same prices as customers. This sparked a boycott, because wholesalers refused to market its products. The resulting growing resentment of Croucher and Penfold towards the software industry ended up in the dissolution of the company.

Among the most interesting titles are *Pi-Balled, Pi-In ’Ere* and *Pi-There,* in addition to its masterpiece, *Deus Ex Machina,* a sequel of which was released by Croucher in 2015, with Christopher Lee lending again his voice for his original role, the programmer.

DEUS EX MACHINA (1984)





Deus Ex Machina is one of the very first examples of multimedia interactive storytelling. Basically, it is a set of sub-games united by a story, whose background and setting are narrated in the instruction booklet, unfolding through narration, music and singing heard, upon loading the game, from an audio cassette. synchronized with the action. Voices are provided by Mel Croucher himself, who also composed the music, together with leading characters of British show business, such as Ian Dury (lead singer of proto-punk band Blockheads), Jon Pertwee (formerly in the roles of Doctor Who and Worzel Gummidge) and film veteran Frankie Howerd. The game is inspired by Jaques' monologue about the seven ages of man in William Shakespeare's *As You Like It* (II, 7).

In a 1994 dominated by a totalitarian state, the super-computer controlling the life of its population revolts and decides to program an autonomous life itself starting from DNA nuclei kept in its databases. The creature develops and it is up to you to guide it towards freedom, through a series of intermediate stages from gestation to old age. You will have to fight not only against the Defect Police, the force in charge of stopping all those who are 'defective' (i.e. different from the imposed standards), but also against the aging of the creature's own cells.

BEYOND
1984-1988

Beyond was born on the initiative of publishing group EMAP (acronym for East Midland Allied Press; today Ascential), which published, among others, *Sinclair User,* the longest-running British magazine dedicated to Sinclair computers. Its catalogue is of great importance for Spectrum history and includes the classic *Lords Of Midnight,* the work – like its sequel, *Doomdark's Revenge* – of a former English teacher with a passion for programming, whose name soon became synonymous with strategy videogaming: Mike Singleton. Another famous pair of Beyond games are icon-driven adventures *Shadowfire* and *Enigma Force,* programmed by Denton Designs, where you lead a team of special agents, each with their own skills, in the service of a space empire, against renegade general Zoff and his forces. No less important are: *Psytron,* where the player commands the defenses of a futuristic city against internal and external enemies, in a series of increasingly complex missions; *Sorderon's Shadow,* an illustrated text adventure noticeably inspired by *Lords Of Midnight;* the last title, *Dark Sceptre,* also by Singleton, an imposing real-time tactical fantasy wargame with sumptuous graphics, published by Firebird, whose owner Telecomsoft had acquired Beyond in 1985. *Spy Vs Spy* deserves a separate mention: it was produced under license from the famous strip by Alex Prohías published in *MAD Magazine*. The game, where the white spy and his black counterpart have to escape from an embassy taking confidential documents with them, while hindering each other in every way, fully brings the zany spirit and minimalist graphic style of the original cartoon strip to the Spectrum.

LORDS OF MIDNIGHT (1984)

The continent of Midnight is under threat from the armies of the mighty sorcerer-king Doomdark. Four heroes stand against him: Luxor the Lunar Prince, Morkin, son of Luxor, Rothron the Wise and Corleth the Arcanum. To win, they must conquer Doomdark's home citadel in Ushgarak, in the north of Midnight, or destroy the Ice Crown, the source of Doomdark's power, kept in the Tower of Doom northwest of Ushgarak.

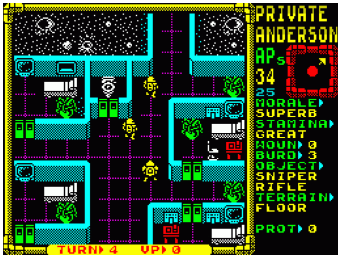
Luxor is in possession of the moon ring, a symbol of his power, that protects him from Doomdark's evil influence, but above all grants him an important diplomatic role. In fact, the numerical superiority of the enemy armies is overwhelming at the beginning, and the quest will meet with certain failure if Luxor fails to find allies to support him in his undertaking.

A mixture of strategy and exploration whose setting owes not a little to John R. R. Tolkien's *Lord of the Rings*, *Lords of Midnight* is an epic title, for its width and depth, like few others.

BLADE
1988-1991

Blade has an even smaller catalogue than the previous software house: only two titles, both of enormous importance. Sci-fi *Laser Squad* is the direct precursor to the acclaimed turn-based *UFO Enemy Unknown* strategy game for the PC, Amiga and PlayStation, as well as the inspiration for other successful titles, from *Jagged Alliance* to *Tom Clancy's Ghost Recon Shadow Wars* for the Nintendo DS. The authors are brothers Julian and Nick Gollop, also behind *Lords Of Chaos,* a strategic fantasy setting and expansion to the highest degree of that *Chaos* – a battle between wizards as minimal in its appearance as it is complex and varied in its gameplay – released by Games Workshop in 1984 and still loved by many Spectrum fans.

LASER SQUAD (1988)



Laser Squad is set in a hypothetical future where progress, far from bringing well-being and equal opportunities, exacerbated social differences between individuals to the point of sparking a civil war, where the Rebels (the 'good') are pitted against the Empire and the Corporations (the 'bad'). In each of the seven scenarios it is divided into, certain objectives must be achieved, ranging from the assassination of an enemy, to the rescue of comrades taken prisoners, or defending an outpost. The opponents – who can be commanded by the computer at increasing levels of difficulty, or by another human player – will more often than not simply have to make the Rebels' mission fail. The combination of scenarios, difficulty levels, choice of weapons and equipment for the troops, initial arrangement of the units on the battlefield, tactics and so on can be changed in endless ways.

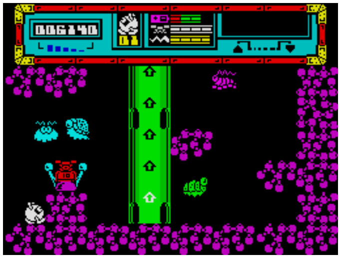
The modular structure is what makes *Laser Squad*'s gameplay extremely multifaceted, resulting in a huge variety of possible situations. Its flawless technical implementation, remarkable complexity, strong sense of involvement for the player and practically infinite longevity make *Laser Squad,* in the writer's opinion, the best game for the Spectrum ever.

BUBBLE BUS
1984-1988

Founded by Mark Meakins in Tonbridge, Kent, Bubble Bus owes its fame among Spectrum users especially to *Starquake,* one of the most popular games for that machine since its release.

Other titles from the software house include: *Classic Muncher,* a clone of evergreen *Pac-Man;* quirky *Moonlight Madness,* where you have to open a safe in a nutty scientist's mansion filled with strange presences, in order to find the pills that can save his life; *The Ice Temple,* a colourful and vast sci-fi exploration game; *Wizard's Lair,* clearly inspired by Ultimate's *Atic Atac.*

STARQUAKE (1985)



A large planet with an unstable core, suddenly emerged from a black hole, is going to explode, threatening the entire galaxy. Commading a droid called BLOB *(Bio-Logically Operated Being),* you have the thankless task of exploring and stabilizing it in order to prevent the catastrophic event.

The planet's interior is not uninhabited. On the contrary, it is teeming with strange creatures that do not like BLOB's intrusion into their habitat at all. Fortunately, it can rely on objects scattered throughout the approximately 500 game locations. Some of them, which change each time the game is started, are necessary to stabilize of the planet's core.

The sheer size of its setting and the ability to replay it with different victory conditions even after completion, in addition to the care put into the graphics and sound design, are the best features of *Starquake,* a game much loved by Spectrum aficionados to this day.

BUG-BYTE
1980-1985

Just one title – *Manic Miner* – is enough to underline the importance that this software house had in the history of the Spectrum. Founded in Liverpool on the initiative of Tony Baden and Tony Milner, two chemistry graduates from Oxford University, the company went into voluntary liquidation in June 1985 due to financial difficulties. The rights to the brand and games were acquired by Argus Press.

Apart from *Manic Miner,* other titles to consider are: *Spectral Invaders,* one of the very first Spectrum games fully written in machine code, as well as a good example of the tendency, typical of those times, to 'clone' the most popular arcade games into unofficial conversions, in this case *Space Invaders; Twin Kingdom Valley,* a colossal 180-location text adventure, with graphics and non-player characters; another text adventure, the ironic *Search For Terrestrial Intelligence;* the challenging platform game *Turmoil;* a beat-em-up with a simple gameplay and unusual vector graphics, *Kung-Fu.*

MANIC MINER (1983)

There is no need to be afraid to exaggerate when stating that, more than any other, *Manic Miner* is the Spectrum game *par excellence*. Although over the years it has been converted for numerous other platforms, including smartphones, *Manic Miner* was 'born' on the Spectrum and finds its most typical environment on it. Fruit of the creativity of Matthew Smith, a skillful and extravagant character, it is divided into 20 screens of increasing difficulty, each one characterized by specific graphics and elements arranged in a peculiar way.

Like many successful games, *Manic Miner* builds on a simple gameplay concept translated into practice with great care. Miner Willy searches for the treasures of the lost mine in Surbiton Way, collecting every flashing object in each screen whilst avoiding dangers such as robots, poisoned plants, strange creatures and even self-moving toilets (!). There are only three controls – left, right and jump – but the pixel-perfect precision granted to the player when moving Willy is essential to negotiate the most demanding sections.

BULLDOG
1987-1988

A Mastertronic label. Over the course of its short existence it released a dozen games; some of them are of above average quality for their price range (£ 1.99). *Feud* is the best known. Other notable titles are: *Colony,* an unusual dynamic management game where you command a robot in charge of a farm on a remote planet infested with gigantic insects; *Streaker,* a bizarre dynamic adventure whose main character must return home after having been robbed of all his belongings and left him butt naked (!); the vast sci-fi text adventure Rigel's Revenge; the icon-driven adventure *The Shard Of Inovar;* the real-time tactical strategy game *Invasion;* the fast-paced shoot-em-up *The Island Of Dr. Destructo;* the colourful platform and exploration game *Scumball.*

FEUD (1987)

In a valley surrounded by a forest and crossed by a river live two wizards, brothers Learic and Leanoric, who quarreled to the point of challenging each other in a magical duel. They each have a book with 12 different spells. Each spell requires two ingredients, which can be found around the valley. Ingredients must be collected, taken to the cauldron and mixed together to ready the spell. Several of them grow in Hieke's garden, a character who does not like the brothers and will try to chase them away as soon as he sees them.

Spells have various functions. They range from fireballs, to lightning strikes, to one that temporarily transforms one of the peasants living in the valley into a dangerous zombie, to others making the caster invisible, invulnerable or faster for a while.

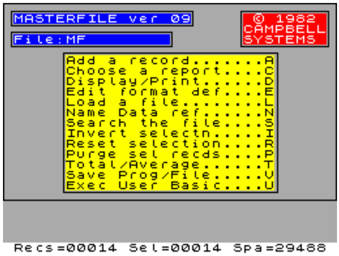
When one of the two wizards runs out of strength – shown by two statues at the bottom of the screen – he is defeated. The player acts as Learic and must therefore let this happen to Leanoric.

CAMPBELL SYSTEMS
1982-1988

John A. Campbell's software house is best known for the *Masterfile* database program, first released in 1982 and undoubtedly the most advanced of those available since the Spectrum's early days. Over the years, *Masterfile* underwent several revisions and translations into other languages, including Italian, carried out by Jacopo Castelfranchi Editore.

In 1987 Campbell Systems released a further enhanced version on disc for the +3 Spectrum only, *Masterfile +3.* The following year John Campbell ceded the its distribution rights to Tasman, which kept it in its catalogue until 1992.

MASTERFILE (1982)



Masterfile is an archive manager with automatic retrieval of information. Almost entirely written in machine code, it allows about 32 KB of RAM to be left for data storage. Data can be saved and loaded by using either tapes of Microdrive cartridges. Main features are:

- entirely menu-driven interface;
- dynamic variable-length file;
- user-defined data names and report formats;
- automatic sequencing of reports according to user-defined primary key;
- presentation and print with variable dimension characters (up to 51 per line);
- automatic file search by any number of criteria;
- automatic total and average of numeric data across all selected record.

CASES COMPUTER SIMULATIONS
1982-1992

Throughout its history, CCS produced a wide variety of management, simulation and board games. Its best offerings consist, however, in historical turn-based wargames, among which some stand out for their complexity and accuracy: Robert T. Smith's *Arnhem, Desert Rats* and *Vulcan*, about World War II, and *Encyclopedia Of War - Ancient Battles,* about warfare in the ancient world; Ken Wright's *Austerlitz 1805, Napoleon At War* and *Wellington At Waterloo*, set in the Napoleonic wars, *Blitzkrieg, Overlord* and *Stalingrad,* also centred on World War II episodes, and *Yankee,* that deals with two battles of the American Civil War (Gettysburg and Chickamauga).

Other scenarios of CCS titles include the War of the Roses *(War Of The Roses),* the British war of conquest against the Zulu Empire in South Africa in 1879 *(Zulu Wars),* the Battle of Gallipoli in 1915 *(Gallipoli)*, the invasion of Crete in 1941 *(Crete 1941),* the Italian campaign in 1944 *(Avalanche)* and the 1944-1945 winter Ardennes offensive *(Battle Of The Bulge)*.

VULCAN (1987)

An excellent strategy reenactment of the 1942-43 Tunisian campaign, with the ability to play according to historical events or to alter certain conditions to create alternative scenarios. Default scenarios are:

- The race for Tunis
- Kasserine
- The Eighth Army
- Operation Vulcan
- The Tunisian campaign (complete)

You can play either as the Allies or the Axis; the computer-controlled player's artificial intelligence can be set at increasing levels of complexity.

CODE MASTERS
1986-in activity

The name Code Masters will always remain tied, not only for Spectrum users, to its iconic character, Dizzy. Between dynamic adventures and arcade games, the strange egg-shaped being is the protagonist of as many as 14 titles, about 12% of the software house's Spectrum releases.

Code Masters (now Codemasters) was founded in 1986 by two youngsters in their twenties at the time, London twins Richard and David Darling, with the aim of producing games for 8-bit systems in the 'budget' price range (£1.99-2.99). Main authors were two other twins, Philip and Andrew Oliver, the creators, among other things, of the successful Dizzy series. Within its first year of operation, Code Masters had flooded the market with its titles, bringing in huge profits to the Darlings.

Despite the fact that Code Masters was often mocked by the specialized press for the bombastic self-congratulatory proclamations on their cassette inlays, bordering on involuntary humour, and that their games were often marked by scarce originality and/or overall below average quality, several of them performed the primary function of budget titles quite well: offering simple and affordable entertainment.

Other titles worthy of mention in addition to the Dizzy series are: *ATV Simulator, BMX Simulator, Captain Dynamo, Fruit Machine Simulator II, Ghost Hunters, Grell And Fella, The Hit Squad, Mission Jupiter, Ninja Massacre, Pro Ski Simulator, Pro Powerboat Simulator, Pub Trivia, The Race Against Time, Sergeant Seymour Robot Cop, Seymour At The Movies, Slightly Magic, Steg The Slug, Stryker In The Crypts Of Trogan, Super G-Man, Super Seymour Saves The Planet, Super Stunt Man, Tilt, Tornado ECR, Wacky Darts, Wild West Seymour*. The only full price title was the managerial simulation *Rock Star Ate My Hamster*, a satire of the British record industry.

DIZZY (1987)

The ‘cartoon adventure’, as the subtitle goes, is one of the best known games of the entire Spectrum’s ‘career’. It became so popular that it launched an entire series centred on the main character. The Dizzy saga unfolded on several platforms as well as on the main Sinclair home computer and even saw several new unofficial chapters, developed by enthusiasts.

Dizzy’s adventures revolve, in their fundamental lines, around a well-established game scheme: the protagonist, using objects scattered around the area he moves within, must solve logical puzzles, being careful to avoid lethal dangers and interacting with a variety of non-player characters.

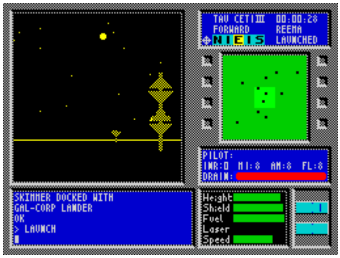
In the first title, Dizzy is looking for the ingredients of a magical potion to defeat the evil sorcerer Drax, who terrorizes the protagonist’s village. Drax will return to seek revenge on Dizzy in subsequent episodes of the saga.

COMPUTER RENTALS LIMITED
1984-1990

Created by Clement Chambers – entrepreneur, journalist and television commentator specialized in economic and financial matters – as Computers Rental Limited, it soon became known just by the CRL acronym. Its production for Spectrum is vast and includes titles of all kinds; several of them have marked that computer's history.

In addition to *Tau Ceti* and his *Academy* sequel, CRL released Rod Pike's long and complex horror-themed text adventures *(Dracula, Frankenstein, Wolfman)* and St. Bride's School's *Jack The Ripper,* the first video game to receive a 18 certificate in the UK due to some particularly gory images for the time, although the Spectrum version is much less conspicuous in this sense than the C64 one. Other interesting titles in the same genre are the curious *Bugsy,* the story of a rabbit-gangster in 1920s Chicago, *The Boggit,* a parody of John R. R. Tolkien's *The Hobbit, Murder Off Miami* and *The Very Big Cave Adventure.* Among arcade titles, the two bat-and-ball games in 3D perspective *Ballbreaker* and *Ballbreaker II,* the beat-em-up with anthropomorphic animals *Ninja Hamster,* the collect-em-up *Glug Glug*, *The Rocky Horror Show,* an arcade adventure licensed from the well-known film by Jim Sharman, and *Room Ten,* a sort of three-dimensional *Pong.* Simulation games to mention are *Formula 1* and *Endurance,* focused on car and motorcycle racing respectively, while *Samurai,* programmed by Astros Productions, is the only turn-based strategy title offered by the house. Also noteworthy is the puzzle *Sophistry.* CRL also released a creator of simple isometric 3D games, *3D Game Maker,* which achieved a certain success.

TAU CETI (1985)



Tau Ceti is a complex and articulated mix of strategy, simulation and arcade. The player drives a levitating vehicle on the surface of former Earth colony Tau Ceti III, isolated due to a meteorite impact and infested with out-of-control robots. The mission is to regain control of the planet, looking for the core of the central reactor which, once shut down, will neutralize the planetary defenses, thus allowing colonists to come back.

The playing area is viewed in first-person from the vehicle. You can explore the cities scattered on the planet's surface; each one of them presents different features and dangers. Tau Ceti's open structure also makes it possible to wander here and there without a fixed destination, searching for useful clues hidden in databases scattered around the cities that can be accessed via a special connection interface.

DIGITAL INTEGRATION
1982-1999 (until 2005 as a Titus subsidiary)

Digital Integration, or DI as it was also known, was founded in 1982 by David Marshall, who previously worked as an engineer for the Royal Air Force Airborne Computing Division. Marshall programmed a simple flight simulation and an aerial combat game on the ZX81 before moving to the Spectrum and leaving his job at the Ministry of Defence to start his own games company.

Digital Integration specialized in simulations. Flight ones in particular are among the best ever seen on the Spectrum: *Fighter Pilot, Tomahawk, F-16 Combat Pilot.* Others are *Bobsleigh* and the motorcycle racing game *TT Racer;* the latter is one of the very few titles allowing for a multiplayer mode between Spectrums connected in a local network through the ZX Interface 1. It also made some notable arcade releases: *Night Gunner, Advanced Tactical Fighter, Extreme.*

After 1992, Digital Integration focused on producing games for 16-bit platforms, namely the Commodore Amiga, Atari ST and IBM-PC compatibles. In 1999 it was acquired by Titus and Marshall left it shortly thereafter. It survived as a division of the French software house until the bankruptcy and dissolution of it in 2005.

F-16 COMBAT PILOT (1991)

One of the last full-price games released for the Spectrum, *F-16 Combat Pilot* is an extremely refined war flight simulation from every point of view: the aircraft preparation before each of the five available missions (air-to-air combat, air-to-ground combat, air raid, anti-tank action and air reconnaissance), the flight model and so on. There is no shortage of unique features, for example the ability to fly at night using the radar and an infrared visual sensor.

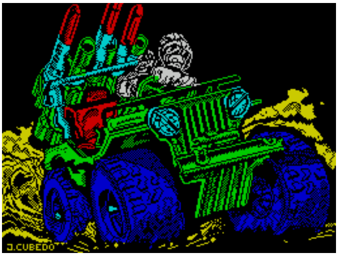
DINAMIC
1983-1992

The very name Dinamic is synonymous with the 'golden age' of the Spanish software industry. Founded in Madrid by brothers Pablo, Nacho and Víctor Ruiz Tejedor, it was the main one among a group of companies that in the 1980s produced a large number of titles for 8-bit computers, mainly for the Spectrum, which had found a 'second home' in Spain.

There are not a few noteworthy titles in the Dinamic catalogue dedicated to the Spectrum, containing above all arcade and sports titles as well as text adventures created by subsidiary Aventuras AD. Among arcades, maze games *(Babaliba),* 'pure' platform games *(Abu Simbel Profanation, Phantomas, Phantomas II, Camelot Warriors)*, platform/shoot-em-up hybrids sometimes including scrolling sections *(Army Moves, Freddy Hardest, Game Over, Phantis , Navy Moves, Astro Marine Corps, After The War, Satan),* shoot-em-ups *(Turbo Girl, Comando Tracer),* arcade adventures *(Dustin, Capitán Trueno, Rescate Atlantida)* and one-of-a-kind titles (*West Bank,* inspired by Sega's *Bank Panic* coin-op). *Fernando Martín Basket Master* is Dinamic's most notable sport game. Among text adventures: sci-fi themed *Arquimedes XXI; Don Quixote,* licensed from the Spanish animated series inspired by the famous character by Miguel de Cervantes; the *Ci-U-Than* trilogy *(Cozumel, Los Templos Sagrados, Chichen Itza)* set in pre-Columbian Mexico; *Jabato,* based on Victor Mora's comic strip of the same name; *Los Pajaros de Bangkok,* from the eponymous novel by Manuel Vasquez Montalbán, with detective-chef Pepe Carvalho as its protagonist.

Like many other software houses of the time, Dinamic fell victim to the 8-bit market crisis at the end of the 1980s and was dissolved in 1992. The following year, the Ruiz brothers founded a new company, Dinamic Multimedia, that remained in business until 2001.

ARMY MOVES (1986)



Army Moves earned among many players the dubious reputation of being a very difficult title, bordering on unplayability. This reputation is actually rather undeserved and derives from the fact that the first sections of the game, in particular the second and third, are particularly demanding, such as to discourage the occasional player, while the rest, including the entire second part, is much less arduous. The aim is to break into hostile territory in search of some secret documents hidden in a heavily defended base. In the first part you command several vehicles, while in the second you are on foot.

Army Moves is the quintessence of Dinamic arcade games: detailed and colourful graphics (with some excesses of 'colour clash'); various different sections, some seriously challenging for the player; above average length, making it inevitable to divide the game into two parts – the second can be only accessed by typing a code revealed at the end of the first.

DK'TRONICS
1982-1985

Producer of both hardware and software for the Spectrum, DK'Tronics has published more than half of the games programmed by Don Priestley, whose immediately recognizable graphic style, often characterized by large multicolour sprites, is well known to users of the most popular Sinclair computer. They include *Maziacs* and *3D Tanx* for the 16K and *Popeye, Benny Hill's Madcap Chase* and *Jumbly* for the 48K.

POPEYE (1985)

The famous cartoon character by Elzie C. Segar must collect, within a certain time limit, 25 hearts for his beloved Olive Oyl. At the same time, he must beware of many dangers, like Bluto, the Sea Hag and a fire-breathing dragon. Oddly, Popeye can only avoid them; spinach cans do not make him stronger, but indicate the available lives.

The colourful graphics and large sprites typical of Don Priestley games are well present in *Popeye.* It is also possible to move 'forwards' and 'backwards' in the screens the game world is divided into, in order to avoid contact with opponents. Some of the hearts will not be immediately reachable, but will require the opening of doors through special keys or even more refined strategies, which makes *Popeye* long-lasting and challenging.

DOMARK
1984-1996

The software house is named after its two founders, Dominic Wheatley and Mark Strachan. Its fame is mainly related to tie-ins of secret agent 007 James Bond films and conversions from Tengen (a division of Atari) coin-ops.

Games dedicated to 007 include *Licence To Kill, The Living Daylights, The Spy Who Loved Me.* Other titles to mention are *Codename MAT II,* a sequel to a first-person space shoot-em-up released by Micromega, as well as the conversions of Atari's *Star Wars, The Empire Strikes Back* and *Return Of The Jedi* coin-op trilogy and the fast-paced sliding block puzzle *Split Personalities,* the latter by Dutch programming team Ernieware. Domark is also responsible for marketing the official computer version of the popular *Trivial Pursuit* board quiz game, coded by Oxford Digital Enterprises.

In 1989 Domark signed an agreement with Atari in order to make and distribute conversions from Tengen coin-ops. However, the results are not always up to expectations. The most notable are: *All Points Bulletin, Badlands, Dragon Spirit, Escape From The Planet Of The Robot Monsters, Klax, RBI 2 Baseball, Toobin', Xybots.*

On 25 September 1995, Domark was acquired by Eidos, and on 31 March 1996 it was merged with Simis and Big Red Software to create Eidos Interactive.

LICENCE TO KILL (1989)

The game that best represents the 007 series traditionally associated with Domark. It is divided into six scenes, each based on as many moments in the eponymous film, where Bond hunts down drug trafficker Sanchez, guilty of torturing his friend Felix and killing the latter's wife.

At the beginning, the player controls a helicopter, then Bond himself, in sections on foot, on water skis and other situations always related to the filmed narration. Gameplay is however quite consistent between the various sections, and this makes *Licence To Kill* avoid the recurring flaw of many film tie-ins: the impression of experiencing a fragmentary collection of mini-games unrelated to each other, rather than an unitary context.

DURELL
1983-in activity

Durell has in its catalogue some of the most popular games among the Spectrum user community: *Harrier Attack, Scuba Dive, Saboteur, Saboteur II, Turbo Esprit* and *Thanatos.* Also worth mentioning are *Sigma 7, Chain Reaction* and *Critical Mass,* all arcade titles. Two others, *Death Pit* and *Trojan,* the latter a conversion of the Capcom coin-op of the same name, remained partially unfinished and their traces were lost. They were then recovered and made public by their author, Clive Townsend, in 2007 and 2009 respectively.

Durell sold the rights to its videogames to Elite in 1987. Today it produces software for financial administration and insurance. An attempt in 2005 by Mike Richardson, author of many of its Spectrum titles, to found a videogame label, Durell Games, was unsuccessful.

TURBO ESPRIT (1986)

At the wheel of a Lotus Turbo Esprit of a special anti-drug squad in a large city, you have the task of defeating a criminal organization responsible for the local drug trafficking. You will have to patrol the streets, being careful not to attract attention and not to bump into innocent drivers and passers-by. At the same time, you should watch your back from hitmen who from time to time the criminals you are hunting will unleash on you. Fortunately, a complete map of the city helps you to locate the position of your objectives, communicated from time to time by the operations centre.

The city the game is set in can be chosen among four of increasing difficulty, with more maze-like and claustrophobic streets. From pedestrians to traffic lights, realism is impressive, considering that this is an arcade game for a home computer of the early 1980s. It should be noted that, since the game is of British origin, you drive on the right.

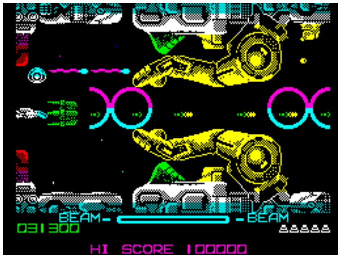
ELECTRIC DREAMS
1985-1989

This Activision subsidiary deserves a place of its own in this essay due to its Spectrum catalogue, with some notable coin-op conversions – including, in the writer's opinion, the best ever one, *R-Type* – and some superb original games.

Among conversions, in addition to the aforementioned *R-Type,* there are *Super Sprint,* its follow-up *Championship Sprint, Karnov* and *Super Hang-On,* one of the best racing arcade games for the Spectrum. Original titles include the notorious isometric 3D exploration game *Spindizzy,* the political simulation *Hijack* and the claustrophobic and intense tactical action game *Aliens,* based on the film of the same name by James Cameron.

Other titles to to mention are *Dandy,* the forerunner of *Gauntlet, Star Raiders II,* converted from a first-person space shoot-em-up for the Atari 400/800, and the extravagant dynamic adventure *Mermaid Madness,* starring Myrtle, a noticeably overweight siren.

R-TYPE (1988)



The Irem arcade game, a hectic horizontal scrolling shoot-em-up requiring considerable dexterity and control precision on the part of the player, is the basis of what, in the writer's opinion, is the best coin-op conversion for the Spectrum bar none. Not only every feature of the original – environments, enemies, power-ups and so on – has been faithfully reproduced (within the limits of the target machine, of course), but gameplay and tactics required to negotiate the eight levels are identical to those tested in the arcades. Above all else, it is a programming miracle that pushes the Spectrum's potential, in terms of technical implementation, to its limits.

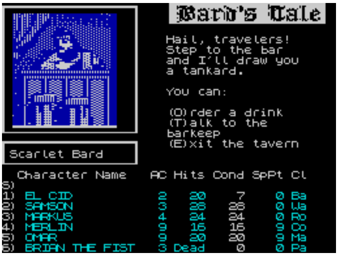
It should be emphasized in this regard that audio, unlike most of the titles here considered, does not include an improved version for the AY-3-8912 sound chip supplied to the 128 KB 'big brothers', so the 'dear old' beeper takes its revenge with pleasant and appropriate effects, far more convincing than the usual beeps and bleeps. In the end, *R-Type* is an extraordinary title, which cannot be missing in every Spectrum enthusiast's videogaming library.

ELECTRONIC ARTS
1982-in activity

The software house founded by Trip Hawkins is currently one of the leading video game producers in the world. It also left a mark in Spectrum history with some titles, of which the best known and most interesting is certainly *The Bard's Tale.* However, only the first of the three chapters of the series was converted for the Sinclair computer.

Other titles worth mentioning are the famous virtual board game *Archon,* a curious mixture of chess and board wargame, and its sequel, *Archon II The Adept. The Train Escape To Normandy* is an original title divided in various sections, set in Nazi-occupied France, where the player acts as a member of the local Resistance whose mission is to seize a train loaded with works of art the enemy wants to bring to Germany, in order to secure it by handing it over to the Allies.

THE BARD'S TALE (1988)



The Bard's Tale can be considered the epitome of the 'dungeon crawl', that is, that variant of computer role-playing games where you lead a party of different characters with the aim of exploring a labyrinth in search of the riches kept there and earning experience points for leveling up. The player starts with a default party, but if wished, one or more characters can be deleted and replaced with self-made ones to save to tape for later recall. It goes without saying that weapons and equipment must first be purchased, precisely in the city of Skara Brae, where the game begins and the first of many pitfalls that will harass the party is lurking.

The Bard's Tale, due to the size of its locations and the surprises it has in store for the player, is still very enjoyable today. It is easy to understand, when considering the evolution of this genre, how deep its influence in the following years has been.

ELITE SYSTEMS/HIT-PAK/2.99 CLASSICS
1984-in activity

At first known as *Richard Wilcox Software,* the software house changed its name to the current one after a very short time. About half of its Spectrum catalogue consists of coin-op conversions, several of then being at least of above-average quality *(Bomb Jack, Commando, 1942, Ghosts 'n' Goblins, Ikari Warriors, Space Harrier, Paperboy, Buggy Boy).*

Among the original games stand out: the company's first release, *Kokotoni Wilf,* a challenging collect-em-up; *Roller Coaster,* a complex platform game; *Beyond The Ice Palace,* another platform title with combat elements; two fast-paced action games, both licensed from animated series and produced by Gargoyle Games, *Scooby Doo* and *Thundercats.*

For a short time, Elite ran a budget label, Hit-Pak, as well. Its catalogue includes *Batty,* a very challenging bat-and-ball game, *3DC,* a dynamic adventure where you guide a diver and his trained eel (!), and *Airwolf II,* a multi-directional shoot-em-up based upon the TV series of the same name. Another low-price label, 2.99 Classics, re-released some titles from other software houses in 1986.

KOKOTONI WILF (1984)

Sorcerer Ulrich sends his trusty servant, Kokotoni Wilf, back and forth in time in search of the parts of the legendary Dragon Amulet. Wilf, with the help of a pair of wings provided by his master, must, for each of the six levels, collect all the pieces of the Amulet and find the space-time portal that will allow him to pass to the next level. From a million years BC, up to a 2001 echoing that of Stanley Kubrick, Wilf flies across the game's 63 screens whilst avoiding the many dangers that steal one of his lives at the slightest touch.

Kokotoni Wilf is one of the best representatives of this genre of games, that on the Spectrum includes illustrious titles such as *Manic Miner.* Unlike the protagonists of many collect-em-ups, Wilf does not jump, but flies, which makes it necessary for the player to adopt unusual strategies. Screens are arranged and designed with creativity despite graphics being minimal at times, however in line with standards of the time. Their uncluttered design, combined with Wilf's precise control, makes the most demanding parts negotiable.

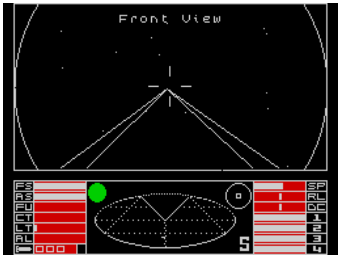
FIREBIRD/SILVERBIRD
1984-1989

Born as divisions for the software market of the former state telecommunications company British Telecom, Firebird (full price and budget range) and Silverbird (budget only), joined in 1987 by high profile label Rainbird, form together an immense catalogue, second only to that of Mastertronic and its labels.

Under Firebird and Silverbird were released: platform games (*Booty, Olli And Lissa, Soldier Of Fortune, Rick Dangerous);* shoot-em-ups *(Sidewize, Crosswize, Earthlight, I Ball);* arcade adventures *(Druid, Druid II, Rasputin);* text adventures *(Imagination, Subsunk, Seabase Delta);* tactical strategy games *(Rebelstar* and *Rebelstar II,* both by Gollop brothers of *Laser Squad* and *UFO: Enemy Unknown* fame); simulation and management games (the notorious *Elite*); hybrid or unique titles (the equally famous *The Sentinel, Gyron, Cholo, Virus, Kinetik, Magnetron, Intensity, 3D Pool, Savage, Thrust, Thrust II).* There are even some coin-op conversions, all noteworthy (*Action Fighter, Bubble Bobble, Flying Shark, Mr. Heli, P-47 Thunderbolt, Peter Pack-Rat).*

The Rainbird catalogue, due to its importance, is dealt with in a separate entry.

ELITE (1985)



The award-winning simulation-management game, where the player impersonates a space pilot in search of fortune among different planets, more or less legitimate goods, police squads and pirates, needs little introduction. 'Born' on the BBC Micro through the work of David Braben and Ian Bell, it has been converted to the Spectrum, as well as a myriad of other platforms, being appreciated everywhere and receiving accolades from all over. The Spectrum version was coded by the Torus team, also responsible for Amstrad CPC one.

What makes *Elite* a still engaging and long-lived title like few others is its open structure: once the starting rules are given, it is up to players to give a direction to their career, immersing themselves in furious fights as well as in the intricacies of the galaxy's trading system, where the action takes place.

GARGOYLE GAMES/ FASTER THAN LIGHT
1984-1987

The company of Roy Carter and Greg Hollis has a catalogue as short as its history, the duration of which is inversely proportional to the importance it holds in Spectrum gaming. Almost every game of the duo has left some mark, from the first title, the innovative space shoot-em-up *Ad Astra,* to the dynamic horizontal scrolling adventures *Tir Na Nog, Dun Darach* and *Marsport;* from the isometric 3D arcade adventure *Sweevo's World* (*Sweevo's Whirled* in its enhanced version for the Spectrum 128) to the hybrid of exploration and text adventure *Heavy On The Magick,* up to the fast-paced arcade games *Scooby Doo* and *Thundercats* coded for Elite.

Games launched under the subsidiary Faster Than Light label are also notable: the vertical scrolling shoot-em-up *Lightforce,* the extravagant *Shockway Raider,* set in a futuristic city, and *Hydrofool,* another isometric 3D arcade adventure from the *Sweevo* series, this time in an underwater setting.

The message 'See you soon - in Wunderland!' at the end of *Hydrofool* hinted at a further sequel. The shrinking of the 8-bit market at the end of the 1980s led to the withdrawal of Carter and Follis from the gaming scene instead. Neither *Wunderland,* nor *Fornax* and *Gath,* the announced chapters of the *Siege Of Earth* trilogy started with *Marsport,* ever saw the light. In all likelihood, they just remained mere names, without any real work behind them.

TIR NA NOG (1984)

Tir Na Nog is the ‘land of the young’: the otherworld of Irish mythology, where the main character, the hero Cuchulainn, mentioned in the cycles of Celtic tradition such as *Táin Bó Cúailnge* (“The Cattle Raid Of Cooley”), roams around. These details alone show the deep and unique atmosphere of the game.

At the time its appearance, *Tir Na Nog* was truly innovative: from the protagonist’s smooth movements to parallax scrolling, to a vast playing area that made it impossible to complete the mission – find four magical items and bring them back to the altar of the initial location – quickly and easily. Also, since he is already dead, Cuchulainn cannot die again if he runs into the annoying Sidhe, beings that populate Tir Na Nog, but is forced to leave the object he is carrying and return to the starting location. Nothing like this had been seen on the Spectrum before, and even today *Tir Na Nog* is to be considered an essential title in that computer’s videogaming history.

GILSOFT
1982-1989

Gilsoft's impact on the Spectrum is due to its systems for creating text adventures, *The Quill* and *Professional Adventure Writer (PAW).* Until October 2022, the ZX-Database has 531 games composed with the first and 510 with the second.

Gilsoft was founded in 1982 by then 17-year-old Tim Gilberts, with financial support from his father, the owner of an electronics store. Gilberts had already written some programs for the ZX81, but following the launch of the Spectrum he came up with the idea of making money by creating games for the new platform. Initially, Gilsoft was a family business: Gilberts had the role of technical director, his father was the managing director, his mother was the secretary and his cousin the accountant. Some family friends and neighbors also worked there.

The first Gilsoft titles were simple arcade games, or were inspired by tabletop games, but with the arrival of Graeme Yeandle, who wished to create text adventures for the company, things came at their turning point. Yeandle wrote a program to facilitate the making of adventures, later released on the market as *The Quill,* which had a great success. Then *The Illustrator* followed, a program for drawing images to be added to adventures created with *The Quill,* and the *PAW.* After a mention in *Sinclair User* 77 in August 1988, where the launch of The Forge, a quarterly magazine published by the house and intended for *PAW* users, was announced, Gilsoft was disbanded, since its reference target, 8-bit home computers, was then approaching its extinction.

PROFESSIONAL ADVENTURE WRITER (1987)

The *PAW* system builds on the previous *The Quill*, but unlike that, it does not require *The Illustrator* expansion to add graphics to the locations, as it already includes a drawing utility. Other changes compared to *The Quill* are that *PAW* also provides for the use of complex commands – that is, not limited to a simple verb-object syntax –, custom character sets and the insertion of non-player characters.

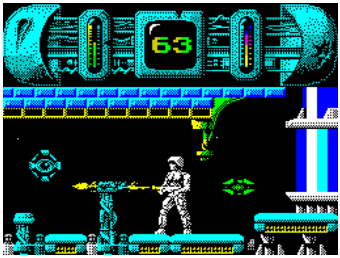
PAW is a powerful and flexible tool, and the fact that even today there are enthusiasts who use it, or that an unofficial version has been made for Windows, the *InPAWS,* testifies to the importance of this product.

GO!
1987-1993

Go! was a subsidiary of US Gold, established for the primary purpose of marketing licensed games, mainly conversions from Capcom coin-ops, under a specific agreement between it and the parent company. The most notable of them are, in the writer's opinion, *Black Tiger, Bionic Commando, LED Storm and Street Fighter.*

Go! also released original games. Among them, *Bedlam,* a vertical scrolling shoot-em-up programmed by Beam, similar to Faster Than Light's *Lightforce* and run-and-burn *Trantor The Last Stormtrooper* by Probe, as well as a compilation of two colourful and fast-paced horizontal scrolling shoot-em-ups, *The Fast And The Furious* and *Thunderceptor,* both made by Dutch development team Ernieware.

TRANTOR THE LAST STORMTROOPER (1987)



Trantor, the only surviving member of a special team on a mission to planet Nebulithone, must assemble the 8 characters of a keyword to be inserted into a central computer, thus allowing him to activate an emergency transport. The keyword changes with every game – there are a total of 16.

To defend himself from his many enemies, Trantor has an unusual weapon at his disposal: a flamethrower capable of incinerating everything that attacks him. One of the game's levels is infested with giant greenish aliens that can kill Trantor instantly if they touch him, while the others just make his energy level drop. This can be restored when he finds a burger (!). Fuel for the flamethrower is also not infinite; Trantor must therefore get more if he does not want to run out of it.

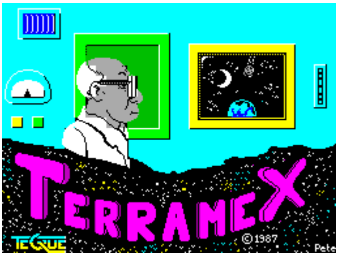
As if that were not enough, Trantor can also, in the search for him, run into a trap, a bomb that must be defused with a screwdriver within 30 seconds. Each level must then be completed within 90 seconds, which makes the action even more frantic than it could already be.

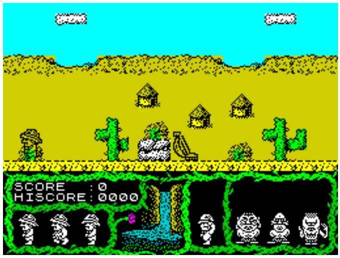
A run-and-burn game with large and detailed graphics, *Trantor The Last Stormtrooper* is pure action. Its difficulty will be a challenge for the most determined players.

GRANDSLAM ENTERTAINMENT
1987-1995

Grandslam arose in 1987 when Argus Press software house was bought by its own CEO Stephen Hall along with his friend David Dudman. Hall set up his own business by breaking away from the Argus publishing group, which no longer exists, and started a new company that gave the Spectrum some interesting titles. In particular, the strategy simulation *The Hunt For Red October,* based on Tom Clancy's novel of the same name, coin-op conversions *Pac-Mania* and *Scramble Spirits,* the collection of mini-games *The Flintstones,* licensed from the notorious Hanna-Barbera TV animated series and two dynamic adventures, *Terramex* and *Thunderbirds*. The latter, based upon the eponymous animated puppets series by Gerry Anderson, is divided into four parts, and in each one of them, the player controls two characters at a time.

TERRAMEX (1987)





Professor Eyestrain already discovered it twenty years ago: a stray asteroid is on a collision course with Earth. Disbelieved and ridiculed by the academic community, the professor retired to a distant and hostile territory. Now his prophecy is proving to be correct, so it is necessary to send an explorer to find him and convince him to devise a way to destroy the asteroid.

Our *alter ego* in the game can be chosen from five valiant characters, each one representing a humorous stereotype of a different nationality. *Terramex* is in fact an openly bizarre and rather zany dynamic adventure, and puzzles reflect this. For example, a party program is used as 'hot air' to make a balloon fly (!). It is therefore a refined game that requires the player to think quite outside the box.

GREMLIN GRAPHICS
1984-1994

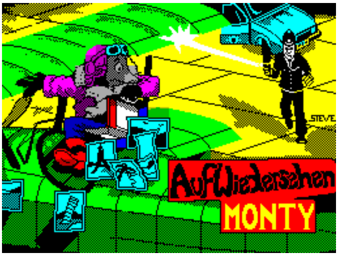
The software house from Sheffield created one the most notorious 1980s video game characters, Monty Mole, whose story unfolds through various episodes, the most important being *Wanted Monty Mole, Monty On The Run* and *Auf Wiedersehen Monty.*

Its catalogue includes a large number of Spectrum titles. Several are worth mentioning: *Bounder,* where you drive a tennis ball along ten paths full of pitfalls seen from above; a vaguely similar game, *Trailblazer,* but with a first-person view; arcade adventures *Grumpy Gumphrey Supersleuth, Future Knight, Jack The Nipper, Jack The Nipper II, The Final Matrix;* the trilogy of action games licensed from the *MASK* animated series; *Way Of The Tiger,* one of the best beat-em-ups for the Spectrum, and its sequel *Avenger,* a maze arcade adventure, both based on a series of adventure gamebooks by Mark Smith and Jamie Thomson; the dementedly violent *Death Wish 3,* tie-in of the eponymous film with Charles Bronson as the protagonist Paul Kersey; the football-themed virtual board games *Footballer Of The Year* and *Footballer Of The Year II;* the Spectrum version of the classic Amiga game *Shadow Of The Beast;* platform games *North Star* and *Switchblade; The Muncher,* clearly inspired by the *Godzilla* films; multi-stage shoot-em-up *Dark Fusion;* 'light' flight simulation *Night Raider; Skate Crazy,* a skill game on roller skates divided into two distinct sections; *Krakout,* a *Breakout* clone rotated 90 degrees; *Tour De Force,* a cycling-themed arcade game.

In its last years, excellent computer versions of Hero Quest and *Space Crusade,* two Games Workshop board games, appeared as well. Gremlin also programmed two very good conversions from the Atari *Gauntlet* and *Gauntlet II* coin-ops for US Gold.

The rights to Gremlin games are currently held by Urbanscan Ltd.

AUF WIEDERSEHEN MONTY (1987)



After a daring escape from prison in *Monty On The Run,* Monty landed in Gibraltar. From there, he has to start earning as much money as possible across Europe, both by collecting Euro Cheques scattered everywhere and by exchanging some items for money, taking them to the appropriate locations. In fact, he wants to buy the Greek island of Montos, where he can retire in good order, away from all the police.

To get around, Monty can walk as well as use plane tickets: each airport is connected to another, so memorizing routes, as well as drawing a map, becomes essential.

The game is visually very pleasing due to the colourful graphics and nice touches: among other things, the snow-capped Pyrenees and Alps, the Eiffel and Pisa towers, as well as the two Germanies still divided by the Berlin wall. But it is the gameplay that makes *Auf Wiedersehen Monty* the best episode of the series starring the mole with a monocle. The extreme precision and smoothness of the controls add up to a balanced difficulty that never gets frustrating, as it sometimes happened with the previous game instead.

HEWSON CONSULTANTS/RACK-IT
1982-1991

One of the most important software houses for Spectrum due to the quantity and quality of its products, Andrew Hewson's company produced some of the best known and most appreciated games for the four-colour-striped computer, counting among its authors highly skilled programmers like Steve Turner, Raffaele Cecco and Dominic Robinson.

In particular, the following should be mentioned: *Uridium* and *Uridium Plus,* two horizontal scrolling shoot-em-ups; arcade adventures *Avalon* and its sequel *Dragontorc*; *Astroclone,* a blend of exploration game and horizontal scrolling shoot-em-up; *Firelord,* a maze arcade adventure; colourful and challenging *Exolon, Cybernoid, Cybernoid II* and *Zynaps* shoot-em-ups; the equally colourful and even more challenging platformers *Technician Ted, Stormlord* and *Deliverance; Ranarama,* an exploration game with echoes of *Gauntlet;* unique titles such as *Quazatron, Impossaball, Nebulus* and *Netherworld* and two steam locomotive simulators, *Southern Belle* and *Evening Star*.

The budget Rack-it label also published some titles worthy of interest: the puzzle game *Anarchy; Draughts Genius,* a game of draughts with a virtual Albert Einstein as an opponent; the submarine combat simulator *Ocean Conqueror; Into Africa,* an adventure/strategy hybrid similar in both presentation and gameplay to Beyond's *Lords Of Midnight.*

QUAZATRON (1986)

Quazatron was originally simply intended to be the Spectrum version of Andrew Braybrook's C64 classic *Paradroid.* It actually went beyond the original, with a sumptuous isometric 3D perspective in place of the top view (and minimal graphics) of the other title, which greatly expanded the possible strategies for the player. Paradoxically, this was due precisely to the fact that Braybrook's game made excellent use of the C64 video hardware, compensating for the sketchy nature of the graphics with a very smooth and fast scrolling. This was impossible to fully recreate on the Spectrum, because it would have weighed excessively on the CPU. So, Steve Turner opted for a masterful solution: he changed the viewing angle and took advantage of high resolution.

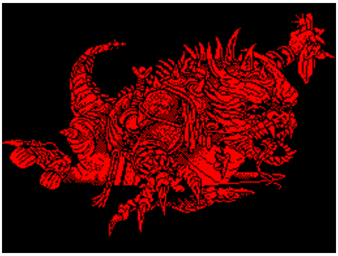
Everything else has remained, apart from a few cosmetic touches, as in *Paradroid:* by driving the KLP-2 droid you have to 'cleanse' the city of Quazatron from the alien droids that infest it. Enemies often have superior weapons, armour and motors, so you cannot hope to get rid of them just by shooting. When KLP-2 enters 'grapple' mode and touches an enemy droid, you move on to the sub-game, where you have to colour more than half of a chip by 'firing' charges of your colour (blue or yellow). If you win, KLP-2 can be fitted the undamaged parts of the old robot. If you lose, KLP-2's energy drops to zero; in the unfortunate event that you do not have any additional circuit, the robot blows up and it is 'Game Over'.

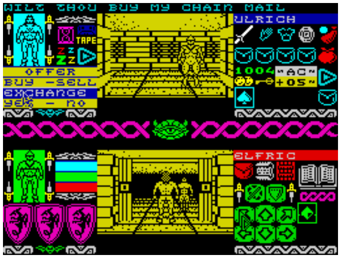
IMAGE WORKS
1988-1992

Label under which Mirrorsoft released their titles starting from 1988. Among them, the tie-ins of the *Back To The Future Part II, Back To The Future Part III* and *Predator 2* films, coin-op conversions *Blasteroids, Passing Shot* and *Teenage Mutant Hero Turtles The Coin-Op,* the official original *Teenage Mutant Hero Turtles* game, the humorous shoot-em-up *Foxx Fights Back* and the dungeon crawl role-playing game *Bloodwych.*

The Maxwell Communications group, owner of the software house, went bankrupt shortly after the death of its founder and chairman Robert Maxwell in November 1991. As a result, Image Works disappeared in February 1992.

BLOODWYCH (1990)





Bloodwych is clearly inspired by the famous *Dungeon Master,* released three years earlier for the Atari ST. As in that game, in *Bloodwych* four members of a party, each one with their own characteristics and skills, must be chosen, to explore a dungeon teeming with dangers.

A unique feature of *Bloodwych* is the possibility for simultaneous two-player mode: each one of them controls a character at a time, while the screen is divided into two halves that show the statistics and point of view of the active character.

IMAGINE

1982-1984 (until 1989 as an Ocean label)

The history of Imagine is emblematic as few others: a company that obtained a quick success folded equally fast, overwhelmed by debts due to the crazy expenses of its executives in luxury cars and advertising at full blast.

Founded in Liverpool by former Bug Byte employees, including young Eugene Evans (parodied by Matthew Smith in the bespectacled monster of 'Eugene's Lair' screen in *Manic Miner*), Imagine soon gained public attention for a series of games for various systems and rich in action, some of which met with particular favour by Spectrum owners: *Arcadia, Stonkers, Zzoom, Alchemist, Jumping Jack, BC Bill.* This gave way to a huge income and a half-hour BBC documentary, *Commercial Breaks,* that witnessed its heyday in early 1984. But on the 9th of July of the same year, Imagine went into liquidation, due to hundreds of thousands of pounds of debts accumulated towards advertising agencies and cassette duplication companies as well as the delay in the development of two major projects, *Bandersnatch* and *Psyclapse,* which never saw the light but consumed time and resources.

The software house was acquired by Ocean, that made it a label for publishing coin-op conversions, with the exception of the original *Movie* dynamic adventure and two Konami titles already released for the MSX, *Golf* and *Tennis.* Some of them are among the best ever seen on the Spectrum: *Mikie, Ping Pong, Hyper Sports, Green Beret, Terra Cresta* (all by the talented and prematurely deceased Jonathan 'Joffa' Smith), *Renegade, Arkanoid, Arkanoid II, Yie-Ar Kung Fu, Athena*. *Renegade* was the basis for an original sequel named *Target Renegade,* which achieved a notable success. Other conversions worth of mention are: *Dragon Ninja, Slap Fight, Rastan, Galivan, Typhoon, Victory Road, Mag Max, WEC Le Mans.*

ZZOOM (1983)

Zzoom is an action game that, like many of the same era, is disarming simple and at the same time requires a constant attention from the player. At the command of a flying vehicle, the Ground Skimmer, the player's task is to protect some refugees moving away from a war zone by shooting down planes, tanks, submarines and anything else that tries to make the mission fail. At the beginning, armament will be limited to two machine guns. After the first mission, missiles will also be available; they are particularly useful against ground targets.

Zzoom was one of the most important games of Imagine's 'golden age', to the point that Matthew Smith put a humourous reference to it into *Jet Set Willy,* imagining that one of the enemy planes got stuck in the roof of Willy's mansion (it can be seen, stylized and upside down, in the 'Nomen Luni' and 'Under The Roof' screens).

INCENTIVE
1982-1993

Incentive was, at first, known above all for its text adventures, in particular for the 'Ket trilogy' *(Mountains Of Ket, The Temple Of Vran, The Final Mission)* and the *Graphic Adventure Creator,* a more advanced graphic adventure creation system than Gilsoft's *Quill,* but that did not meet the same success. Other interesting games from this period are the fast-moving and frantic maze arcade *Splat!* and management simulator *1984.*

However, the real revolution from Incentive came in 1987, with the release of *Driller,* the first game based on the Freescape graphics engine. For the first time on an 8-bit computer it was possible to define worlds made with three-dimensional geometric structures rendered in full polygonal graphics, which could be recreated in real time following the player's movements. The impact of *Driller* started a successful series, consisting of *Dark Side, Total Eclipse* and *Castle Master.* In 1992, the Freescape engine provided the basis for a program to create similar games, *3D Construction Kit.* It was released by Domark.

In 1993, Incentive changed its name to Superscape and developed games for the PC and mobile devices until its acquisition by Glu Mobile Inc. in 2008.

DRILLER (1987)

The story behind *Driller* is narrated by a novella provided with the game. In the distant future, an Earth expedition founds a colony on a planet called Evath, and a new civilization is developed. After a few centuries of instability, order is restored, but the Ketar, individuals guilty of crimes, are sent into perpetual exile on Mitral, a satellite of Evath. They recklessly exploit Mitral's mineral resources to their advantage, but in doing so they end up making it unstable, due to strong accumulations of gas under the surface crust. The Ketar flee and occupy an uninhabited part of Evath, leaving the defenses of their cities operational. From Evath leaves Lesleigh Skerritt, the best technician on the planet, with the task of venting the gas from the bowels of Mitral, to avert the danger of a disastrous explosion.

Impersonating Skerritt, the player must then roam around the 18 sectors of Mitral, avoiding or attacking its defenses, looking for the gas vent points and installing drills to make it escape. The satellite's conformation requires a complex exploration, so that it will be essential to find a flying vehicle kept in a hangar. At this point, perspective changes to a bird's eye view and *Driller* unfolds in all its glory.

INFOGRAMES
1983-2009

The largest French software house for decades, Infogrames was a giant that, through an elaborate game of acquisitions, took over, among others, several Spectrum software producers (Ocean, Gremlin Graphics, Melbourne House) and then closed them all during the 2000s. Today, even its brand does not exist anymore, merged into the even older one of Atari, purchased since 2001, and currently known as Atari SA after various ups and downs, including a bankruptcy declared in 2013.

On the Spectrum, Infogrames stood out for often articulated and unusual games, both in their presentation and structure. In particular: two icon-controlled detective adventures, *The Vera Cruz Affair* and *The Sidney Affair;* two unusual arcade adventures with cartoon graphics, *The Inheritance* and *Sidewalk; Welltris,* a three-dimensional *Tetris* created by the latter's same author, the famous Aleksej Pazhitnov; the shoot-em-up *Prohibition,* a sort of unofficial conversion of Seibu Kaihatsu's *1931 Empire City* coin-op; *The Light Corridor,* a bat-and-ball game in first-person view; the excellent Spectrum conversions of three successful games for 16-bit systems, *North And South, Hostages* and *Sim City.*

SIDEWALK (1987)

In *Sidewalk* you play as a youngster trying to find two tickets to the Band Aid benefit concert (an evident parody of Live Aid), for himself and his closest friend. Unfortunately, his motorcycle was stolen and dismantled. Besides buying the tickets, he must therefore find every part of the vehicle and assemble them with a spanner, which he also has to obtain. In order to do this, he will often have to fight his way against some really shady figures. All by 7.30 pm, otherwise the girl will go to the concert with someone else.

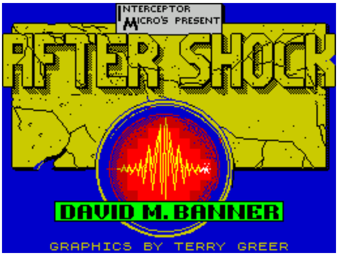
Sidewalk is an arcade adventure presented like a comic book: its cartoonish graphics and the screen partition echo the style of French and Belgian authors who published their works in the notorious *Spirou* magazine in the 1970s and 1980s. The result is a peculiar game, fun and pervaded by a light-hearted atmosphere.

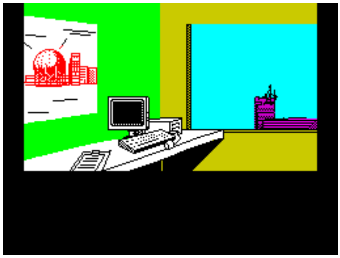
INTERCEPTOR/PANDORA
1983-1993

In its early years Interceptor, founded and managed by Julian Jones and his son Richard, created a series of titles for the Spectrum. The most interesting are text adventures, with some graphic illustrations, all by David Banner: *After Shock, The Forest At World's End, Heroes Of Karn, Jewels Of Babylon, Message From Andromeda, Sword Of Kings, Warlord.* Later it focused on the budget market with its Players label. Under it, many games were released, so that it is dealt with in an entry of its own here.

Interceptor also launched Pandora, a subsidiary for marketing full-price games, but the only Spectrum title launched under its label is the excellent maze arcade game *Into The Eagles Nest.*

AFTER SHOCK (1986)





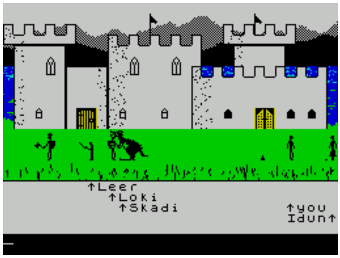
An earthquake struck a large city and the reactor of the local nuclear power plant began to heat up due to a failure in the cooling system. The player's task is therefore to find a way to cross the ruined city and reach the power plant, where the fault must be repaired before the reactor explodes.

A text adventure with a decidedly unusual setting, *After Shock* has an apocalyptic atmosphere due not only to its premises, but also to its descriptions – from collapsed buildings to panicked animals in the zoo – and graphic illustrations by Terry Greer, which, although few in number, are well-drawn and add an extra touch of class to a game already of great quality. The parser, as in David Banner's other games, is distinguished by the need to write in grammatically correct English, going beyond the simple verb-object scheme typical of less sophisticated adventures.

LEGEND
1983-1986

This company had the singular fate of publishing together, in its very short catalogue of only three titles, one of the most appreciated and one of the most loathed games ever produced for the Spectrum, respectively *Valhalla* and *The Great Space Race.* The third title, *Komplex,* is a mediocre shoot-em-up with vector graphics. After its release, Legend disappeared from the scene. The rights to *Valhalla* were acquired by Elite, which re-released it in its 2.99 Classics series of budget second editions.

VALHALLA (1983)



Very advanced for its era, *Valhalla* is a game that never ceases to captivate, despite its dated appearance. As it is easy to guess from the name, it is set in the world of the Viking gods. The player impersonates a character whose goal, once the necessary equipment – weapons, food, keys and more – has been obtained is to find, in a precise order, six special hidden objects.

Gameplay is complex and involves interaction with several non-player characters, each with their own individual stats, as well as exploration and combat. The particularity is that all the actions carried out in the current location are displayed in the graphic window occupying two thirds of the screen, so if for instance the game informs you that a character is leaving the scene, you will see him walking and go away.

The player's *alter ego* must also feed himself, if he does not want to starve, and can buy or sell items through the use of crowns, the game's currency.

LEVEL 9
1981-1991

Level 9 is synonymous with text adventure. During its history, the company produced about twenty titles, almost all of excellent quality, programmed by Pete Austin, founder of the house together with brothers Mike and Nick.

The first work for the Spectrum, *Colossal Cave Adventure,* is a faithful reproduction of Will Crowther's *Adventure* that started the genre in 1976. Together with *Adventure Quest* and *Dungeon Adventure* it forms the *Jewels Of Darkness* trilogy, openly inspired by the events of Middle-Earth narrated by John R. R. Tolkien. It was followed by *The Saga Of Eric The Viking,* then *Lords Of Time,* which will later be associated with *Red Moon* and its sequel *The Price Of Magik,* and the sci-fi trilogy *Silicon Dreams,* published by Rainbird, including *Snowball, Return To Eden* and *The Worm In Paradise.* This was also the time of *Emerald Isle,* set on an imaginary island in the Bermuda Triangle, and the curious *The Archers,* where the player acts as a script writer for the radio series of the same name, hugely popular in the United Kingdom, with the aim of creating new stories to find favour with the audience.

A new adventure creation system, with a greater emphasis on non-player characters, provided the basis the following games: *Knight Orc, Gnome Ranger* and his follow-up *Ingrid's Back, Lancelot* and *Scapeghost.*

LANCELOT (1988)

An extensive and articulated text adventure divided into three parts and based on Thomas Malory's *Le Morte d'Arthur* (1485), a reworking of stories from the Arthurian literary cycle. *Lancelot* follows the story of the famous knight Lancelot of the Lake, from his arrival at the court of King Arthur to the search for the Holy Grail.

The parser is very advanced and allows for many combinations of verbs, nouns and adjectives. Furthermore, the game presents various open situations. The player can sometimes not be pressed by tasks to perform and may wander around the play area at will, for example reading books held in magician Merlin's library, until deciding to continue the quest. Some other times, you are asked to decide your course of actions, even right at the beginning of the first part. Knowing how to choose in accordance to the virtues expected from a knight of the Round Table will be essential in order to proceed.

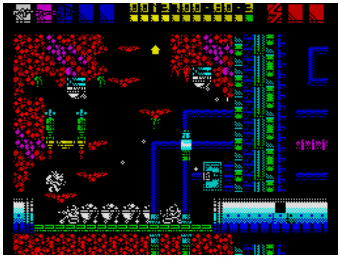
MARTECH/SCREEN 7
1982-1989

Martech was founded in 1982 by David Martin and John Barry, who met as students at the University of Surrey. It produced various games for the Spectrum, of uneven quality. The most noteworthy are characterized by a good degree of originality, sometimes even quirkiness, in their presentation and substance.

We mention here: *Geoff Capes Strong Man,* a multi-event sports game licensed by the eponymous British strength athlete; *Catch 23,* a complex arcade adventure with vector graphics; *Nemesis The Warlock,* a gory platform and fighting game based on the comic by Pat Mills and Kevin O'Neill published in *2000 AD* magazine; *Slaine,* an unusual arcade adventure based on another series by Mills appeared in the same magazine; *The Fury,* a racing and fighting game; *Uchi Mata,* the only existing judo simulation for the Spectrum; *The Armageddon Man,* where you play as a 'super-diplomat' whose task it is to prevent the Earth, divided into 16 superstates in a hypothetical 2032, from being engulfed in a nuclear war; *The Planets,* a mix of different genres where you explore the solar system looking for eight mysterious capsules of alien origin; the three-dimensional puzzle *Target;* licensed car racing game *Nigel Mansell's Grand Prix; Rex,* a platform/shoot-em-up game where the eponymous protagonist, an alien mercenary, must eliminate the terrestrial presence from the planet Zenith.

In 1989 Martech launched the Screen 7 label, that released only two titles, the puzzle *High Steel* and the *Jaws* exploration game, licensed from the film of the same name. After a short time, budget losses due to delays with the development of its following projects caused it to fold.

REX (1988)



Rex is not based on an articulated story or a particular setting: it is pure action. As the mercenary who looks halfway between a human and a rhino, the player must proceed from screen to screen, sweeping away everything that moves and some things that do not. Rex starts with a simple rifle, but can find new weapons in certain places – there are five in total. By collecting some sort of 'bubbles' left by destroyed enemies, Rex can upgrade his arsenal. He can also use an energy shield to defend himself, to be recharged by standing on special platforms, as well as some 'smart' bombs that destroy all enemies on the screen.

The game, with its detailed graphics and fast pace, is so large that it is divided into two parts. The second is accessed by entering a code displayed at the end of the first, which also contains information about the weapons owned by Rex at the time of completion.

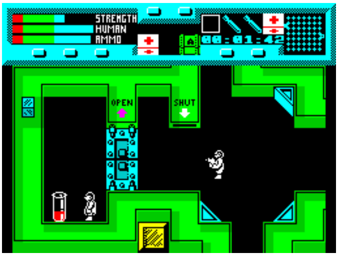
MASTERTRONIC/MASTERTRONIC PLUS
1983-1991

With its legions of low-cost titles, Mastertronic dominated the 8-bit computer game market for years, taking care of every aspect of production, from pre-evaluation to packaging and large-scale marketing. The pre-eminent position it gained led Mastertronic to launch two labels, MAD (Mastertronic Added Dimension) and Bulldog, and to acquire Melbourne House in 1988, only to be acquired by Virgin the following year and finally to be absorbed by Sega in 1991.

Mastertronic games costed £1.99 each. Several titles stand out from its extensive catalogue: *Agent X, Bosconian '87, Chronos, Finders Keepers, Jason's Gem, Kane, Kikstart II, Kobyashi Naru, Level 5, Milk Race, Mindtrap, Molecule Man, Nonterraqueous, Omega One, One Man And His Droid, Pippo, Planet 10, Pulse Warrior, Quest For The Golden Eggcup, Rasterscan, Rentakill Rita, Rescue, Reveal, Rockman, Rogue, SOS, Soul Of A Robot, Specventure, Star Farce, Universal Hero, Venom, Zzzz.*

MAD and Bulldog are dealt with in separate entries, while under the Mastertronic Plus label, active between 1989 and 1990, were released, among others: *Advanced Soccer Simulator, Canyon Warrior, Gregory Loses His Clock, Psycho Hopper, Raster Runner, Rugby Manager, Speedboat Assassins*. These titles were sold at £2.99 each.

RESCUE (1987)



In this elaborate and challenging arcade adventure, the player impersonates a special agent defending a research base orbiting Pluto. The base is under attack and the eight scientists on duty there have locked themselves up in their rooms with their respective experiments, or wander around the corridors in terror. One of the scientists, who changes with each game, devised a deadly weapon that must absolutely not fall into enemy hands. The aim of the game is to supply the rescue shuttle, where action begins, with eight barrels of fuel, guide each scientist to it with their own experiments and leave the base.

Three types of enemies stand in the way, and each one behaves differently. Tanks in particular are remarkably dangerous: they tend to chase the main character around the base and can only be destroyed by detonating an explosive in the place they are located in.

MASTERTRONIC ADDED DIMENSION
1986-1989

MAD was Mastertronic's premium label, aimed at distributing games considered to be of higher value and for this reason sold for £2.99, slightly more than those of the parent company, yet in the budget market segment.

MAD released the trilogy of Magic Knight, another Spectrum icon, whose adventures began with a slightly more arcade-flavoured title, *Finders Keepers.* The three games are, in order, *Spellbound, Knight Tyme and Stormbringer.* Enhanced versions of them have also been made for 128 KB Spectrums. All of them are dynamic adventures controlled by 'Windimation', an innovative drop-down menu system.

Other titles to remember: the darts simulator *180; Angle Ball,* a curious billiard game featuring a hexagonal table; the role-playing game *Master Of Magic*; *Flash Gordon,* a three-phase mixed arcade licensed from Alex Raymond's famous comic strip of the same name; *Motos,* an excellent conversion of a Namco coin-op; *Voidrunner,* the last Spectrum game by minimalist shoot-em-ups 'king' Jeff Minter; *Rockford,* a *Boulder Dash* clone; the text adventure *Play It Again Sam;* a colossal platform game, *Terminus,* a sequel to Quicksilva's *Tantalus; The Roads Of Plexar,* an arcade game similar to Gremlin Graphics's *Trailblazer; Amaurote,* a challenging game characterized by remarkable isometric 3D graphics, where you control a vehicle moving in a similar way to a spider, on a mission to liberate a metropolis invaded by gigantic and lethal insects.

STORMBRINGER (1987)

The last episode of Magic Knight's story, *Stormbringer* sees our hero looking for a way to reunite with his alter ego, the Off-White Knight, originated due to the dimensional rift occurred on his return from the future experienced in *Knight Tyme*. Magic Knight must therefore use various objects, interact with several non-player characters, some of whom are in possession of essential skills to help him in his quest, cast spells at the right time and also avoid lethal dangers scattered around the game's enviroment. Apart from moving, all actions are carried out through an original and functional drop-down menu system named 'Windimation' by the author, David Jones.

Stormbringer is the most complex and articulated of the Magic Knight adventures, as well as one of the best examples of this genre ever.

MELBOURNE HOUSE
1982-2006

The label under which games mainly developed by Melbourne-based Beam Software were published is one of the most important in the history of computer video games in general. Their debut is already legendary: *The Hobbit,* the first text adventure with graphics, an advanced parser in a custom language called INGLISH and non-player characters. INGLISH would have been implemented in the adventures based upon other works by John R. R. Tolkien, namely *Lord Of The Rings* and *Shadows Of Mordor,* and in *Sherlock,* inspired by Arthur Conan Doyle's novels. Other text adventures are often pervaded by a humorous vein: *Mordon's Quest, Terrormolinos, Hampstead* and *Dodgy Geezers. Redhawk, Kwah!* and *The Mystery Of Arkham Manor,* the latter inspired by Howard P. Lovecraft's works, show a peculiar mixture of verbal input and moving images instead. In the same period as *The Hobbit,* Melbourne House launched the first of the Spectrum's icon characters: Horace, a strange being with large eyes and no pupils, protagonist of three 16K titles, *Hungry Horace, Horace Goes Skiing* and *Horace And The Spiders,* marketed by Psion in the initial Sinclair software catalogue. Another milestone is *The Way Of The Exploding Fist,* a model for all martial arts simulation games in the years to come. It was followed by *Fist II Return Of The Legend*, a title combining action and exploration. Other titles: *Mugsy,* a gangster simulation in 1920s Chicago with spectacular graphics for the time, arcade games *Penetrator, Sir Lancelot, Marble Madness, Gyroscope, Fighting Warrior, Judge Dredd, Street Hassle, Xenon* and real-time strategy games *Throne Of Fire* and *War In Middle Earth,* both by Mike Singleton.

Melbourne House distributed Spectrum conversions of three Psygnosis games for 16-bit computers: *Barbarian, Terrorpods* and *Obliterator,* all made by Icon Design. Two popular applications also come from the Australian software house: *Melbourne Draw* for drawing and *Music Box* for musical composition.

THE WAY OF THE EXPLODING FIST (1985)

An extremely refined martial arts (Shotokan karate) simulation that allows the player to control the action with great precision. *The Way Of The Exploding Fist* represented, when it came out, the ‘state of the art’ of this genre of games. For years, at least until the appearance of System 3’s *International Karate Plus,* it was its indispensable touchstone.

MICROMEGA
1983-1985?

From this software house come two pioneering racing games, *Deathchase* and *Full Throttle,* both by Mervyn J. Estcourt.

Also to remember are *Codename MAT,* a space shoot-em-up in first-person view and the large text adventure *Kentilla.* The last Micromega game is *A Day In The Life,* an arcade adventure where the player plays none other than Clive Sinclair in an obstacle-ridden path towards Buckingham Palace, where he has to be knighted.

From 1985 onwards, traces of the company are lost. Some of its titles will be re-released in 1986 by Elite Systems' budget 2.99 Classics label and two years later by Zeppelin Games.

DEATHCHASE (1983)

Driving a motorcycle equipped with rocket launchers, the player has the objective of chasing and eliminating enemies fleeing among the trees of a forest. The game unfolds through eight levels of increasing difficulty, each one divided into daytime and nighttime action.

The formula behind so many successful games of those years – simplicity and speed – is evident in Deathchase. Action flows without pauses, and the convincing impression of speed leads to a strong identification with the game environment. It is no wonder, therefore, that this title, originally produced for the 'lesser' Spectrum with 16 KB of RAM, is still very popular today, so much so that in 2010 a remake for iPhone, *Dark Rider*, was released.

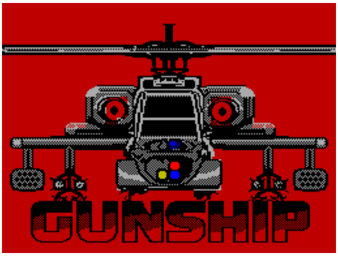
MICROPROSE
1982-1993

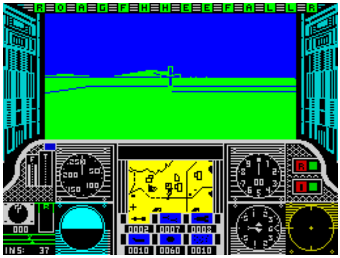
Founded by Sid Meier, the creator of *Civilization,* Microprose released a small number of military simulation games for the Spectrum, but of remarkable quality.

The two jet fighter simulations *F-15 Strike Eagle* and *Project Stealth Fighter* find place in Microprose's Spectrum catalogue together with the sophisticated combat helicopter simulation *Gunship* and *Silent Service,* an interesting reconstruction of submarine warfare in the Pacific by the United States Navy against Japan.

A separate mention goes to *Airborne Ranger,* a tactical combat game, where a paratrooper must perform various missions in different environments behind enemy lines. Actually, it is a hybrid between simulation and arcade, rather than a 'pure' simulation.

GUNSHIP (1987)





Like Digital Integration's *Tomahawk, Gunship* is a combat helicopter flight simulation. The two games also share the simulated aircraft, the Apache AH-64A. Compared to *Tomahawk,* two years earlier, *Gunship* has better graphics, a control system characterized by many options and a higher quantity of missions, which makes it one of the most advanced flight simulations for the Spectrum ever.

MICROSPHERE
1983-1986

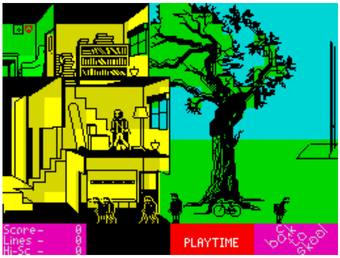
The name Microsphere is linked to Eric, one of the Spectrum's icon characters and the mischievous protagonist of two popular dynamic adventures set in an English school, *Skool Daze* and *Back To Skool.* Other games still well regarded today are *Wheelie,* where the player competes against the Ghost Rider in a mad dash through caverns full of dangers, and *Contact Sam Cruise,* a dynamic adventure similar to the two 'skool' games, inspired by hard-boiled detective novels in the style of Raymond Chandler.

Microsphere was founded by David Reidy, an electronic engineer, and Helen Reidy, a primary school teacher, both amateur programmers (they didn't even use an assembler, but wrote the code on paper and typed it in on the computer), while Keith Warrington, a childhood friend of Helen's, collaborated to graphics. At first, the Reidys programmed office applications like the *Omnicalc* spreadsheet, that saw a second version and later an expansion.

According to an interview published by *Crash!* in issue 25 (February 1986), *Back To Skool* was supposed to be the second chapter of a trilogy. The couple, however, found it increasingly difficult to keep up with the videogame software industry and decided to close Microsphere in 1986. In 1999, *Klass Of '99* was released, a third unofficial chapter for Windows and Gameboy Advance by Richard Jordan and Martin Eyre.[16] James McKay made in 2012 a version of it for 128 KB Spectrums, which however did not advance beyond a preliminary version, despite being fully playable.

[16] Available at: *retrospec.sgn.net/users/rjordan/klass/*

BACK TO SKOOL (1985)



It is the sequel to *Skool Daze,* a game where the protagonist Eric, anything but a model schoolby, had stolen his disastrous report card in order to forge signatures and grades to his advantage. In *Back To Skool,* Eric has the reverse problem: he has to break into the office of headmaster Mr Wacker (one who walks around in a black cloak and carries a wand for corporal punishment, just to be clear), open the safe and insert the 'retouched' report card.

To achieve his goal, Eric must accomplish several tasks, ranging from making stink bombs to get the windows open and pass through them, to 'fortifying' teachers' drinks with a little alcohol. At the same time, he has to avoid drawing attention to himself, otherwise, whenever his deeds are discovered, he will be punished by writing lines. Upon reaching 10,000 lines to write, the game ends.

As and more than *Skool Daze,* the qualities making *Back To Skool* still so popular today are the exuberant atmosphere and the feeling of being in a microcosm populated by different characters, with their unique individual personalities.

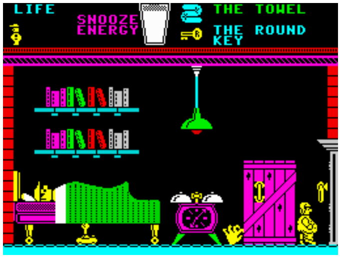
MIKRO-GEN
1983-1987

Mikro-Gen can boast the creation of another Spectrum icon character, worker Wally Week, whose adventures begin with *Automania* – the only arcade game in the Wally series, the others are all dynamic adventures – and continue with *Pyjamarama, Everyone's A Wally,* where other characters from his world appear, *Herbert's Dummy Run,* where the protagonist is Herbert, the son of Wally (who only appears at the end) and finally *Three Weeks In Paradise,* available in a standard version for the 48K Spectrum and an enhanced one for the 128 and later models. These games are marked by rich and colourful cartoonish graphics and a humourous setting.

Among other titles produced by Mikro-Gen: 3D vector space combat game *Battle Of The Planets,* licensed from the animated series of the same name, an adaptation of the *Gatchaman* anime by Hisayuki Toriyumi; the arcade adventure *Equinox; Frost Byte,* a weird platform game starring a strange tubular being; two shoot-em-ups, *Stainless Steel* and *Cop-Out;* an amusing text adventure, *The Witch's Cauldron.*

Mikro-Gen ceased to exist in December 1987 when it was taken over by Creative Sparks.

PYJAMARAMA (1984)



Wally works as an assembly worker in a factory where various car models are manufactured. He is often subject to terrible nightmares he finds very difficult to wake up from. This caused problems at work lately. If Wally arrives late at the factory again, he will be fired. Unfortunately, the present nightmare is particularly unsettling. Everything appears deformed, larger than reality. His home seems to expand and open up to spaces never seen before, unknown even to him. Strange, fearful beings roam around it, and even the old and familiar objects of everyday life seem to be completely out of place. But this time Wally realizes he is dreaming, it is what is called a lucid dream. His consciousness – or rather an astral projection, in an intermediate dimensional plane? – wanders around the house, looking for the only way to put an end to this torment: the key to charge the alarm clock that will allow him to wake up, free himself from the grotesque world generated by his own mind and get to work on time.

An excellent example of dynamic adventure, characterized by an instantly recognizable graphic style, *Pyjamarama* is one of the best known and most loved Spectrum games ever.

MIRRORSOFT
1983-1992

Mirrorsoft was the software division of the Mirror publishing group, now known, after a complex series of acquisitions and mergers, as Reach. Its flagship product is one of the United Kingdom's leading newspapers, the *Daily Mirror.* The software house was created by Jim Mackonochie, a former British naval officer with a passion for flight simulations.

Mirrorsoft gave the Spectrum two notable platform games, *Dynamite Dan* and *Dynamite Dan II,* as well as the official version of *Tetris,* the two excellent flight simulations *Strike Force Harrier* and *Spitfire '40* and two interesting licensed games: *Biggles,* a mixed arcade from the eponymous film by John Hough, and *Andy Capp,* a dynamic adventure based upon Reg Smythe's well-known comic strip. Also worth mentioning are two unusual shoot-em-ups, *Moon Strike* and *Mean Streak,* the martial arts game *Sai Combat* (*bō* stick fighting), *Action Reflex,* a mixture of arcade and puzzle, and the text adventure *Ashkeron.*

In 1988 the group no longer published under its own name, but as Image Works, a label covered in a separate entry.

DYNAMITE DAN (1985)

Agent Dynamite Dan broke into mad scientist Dr. Blitzen's home-laboratory-fortress. His mission is to find eight sticks of dynamite scattered throughout the building, each time in a different position, find the safe, blow it up, steal the plans of the Death Ray kept there and return to the base.

Dynamite Dan is an excellent platform game, standing out for the care in graphic design and the creative use of sound, with many effects and jingles, as well as for a truly challenging gameplay, which will only reward the most perseverant and determined player.

The sequel, *Dynamite Dan II,* largely followed the lines of its predecessor and obtained a very positive reception as well.

NEW GENERATION
1982-1986

It is the small but important software house of Malcolm Evans, author of one of the most innovative and original Spectrum games, *Trashman.* Other games in the Spectrum catalogue include the 'international' sequel to Trashman, *Travel With Trashman,* a sports simulation, *Jonah Barrington's Squash,* both also by Evans, and the unusual western-themed *Cliff Hanger* arcade adventure, the company's final act.

TRASHMAN (1984)

In this unique 'sanitation worker simulation', the player must collect garbage cans from several houses and empty them into the compactor slowly moving along the road in the centre of the screen, before the score, which decreases over time, reaches zero. It is necessary to pay attention to dogs trying to bite the character's leg, which causes him to limp, and bicycles. If a car hits the protagonist, the game will end immediately.

OCEAN
1984-1996

Starting rather quietly with a handful of games, including *Moon Alert, Hunchback* and *Pogo,* Ocean mostly made, from 1985 on, coin-op conversions and licensed games from various media, becoming one of the most important European producers of video games. Its catalogue for the Spectrum is huge and includes many notable titles. Among original games, besides the *Head Over Heels* masterpiece, the isometric 3D dynamic adventures *The Great Escape* and *Where Time Stood Still,* arcade adventures such as *Double Take* and *Phantom Club,* the two arcade football games *Match Day* and *Match Day II,* maze games *NOMAD* and *Gutz,* the dynamic puzzle game *Flashpoint,* the unusual shoot-em-ups *Cosmic Wartoad, Wizball* and *Firefly,* and the complex first-person tank battle game *Battle Command,* developed by Realtime.

Coin-op conversions to mention: *Cabal, Chase HQ, Combat School, Gryzor, Midnight Resistance, New Zealand Story, Operation Wolf, Operation Thunderbolt, Pang, Plotting, Puzznic, Rainbow Islands, Shadow Warriors, Sly Spy, Space Gun, Tank.* Licensed games include: *The Addams Family, Batman, Batman The Caped Crusader, Batman The Movie, Cobra, Daley Thompson's Decathlon* (the first multi-event sports game for the Spectrum), *Daley Thompson's Supertest, Daley Thompson's Olympic Challenge, Frankie Goes To Hollywood, Hudson Hawk, Navy SEALs, The Never Ending Story, Night Breed, Robocop, Short Circuit, The Simpsons: Bart Vs The Space Mutants, Tai-Pan* (one of the first titles specifically conceived to take advantage of the 128 KB RAM and one of the few examples of 'sandbox' games on the Spectrum), *Total Recall, The Untouchables, WWF Wrestle Mania.*

HEAD OVER HEELS (1987)

The story behind *Head Over Heels* sees the two protagonists, Head and Heels, two secret agents captured by the evil space emperor Blacktooth, trying to escape from the prison where they find themselves locked up. Once reunited, they must find the five crowns of the planets subdued by Blacktooth to return them to their legitimate owners, thus making them rebel against their oppressor.

Head Over Heels is the pinnacle of the isometric 3D arcade adventure genre pioneered by Ultimate's *Knight Lore,* with first class graphics, sound and gameplay. Controlling two characters with different abilities, who start as separate, but unite in a 'super-character' when they meet, is a great idea.

The effort required by the game to the player is also due to its size: there are more than 300 locations to explore, of different sizes, some of which require particularly tricky tactics to pass through. As a result, *Head Over Heels* is a truly compelling title, able to capture the player's attention for a long time.

ODIN COMPUTER GRAPHICS/THOR
1984-1987

The Thor and Odin brands were both used to market games produced by Odin Computer Graphics, based in Liverpool and headed by Paul McKenna. After a start marked by anything but memorable titles, the software house gained a considerable reputation with the release of *Nodes Of Yesod,* a large platform game with excellent graphics and remarkable playability, followed by the even better *The Arc Of Yesod.*

Other remarkable games: *Robin Of The Wood,* inspired by the deeds of the famous Sherwood Forest outlaw; the mixed arcade game *I.C.U.P.S.; Heartland,* an arcade adventure with many original touches; two horizontal scrolling shoot-em-ups, *Sidewize* and *Crosswize;* a platform game, *The Plot,* where the player leads Guy Fawkes in his attempt to blow up the House of Lords in the Gunpowder Plot. Both *Crosswize* and *The Plot* were released by Firebird in 1988, the former at full price and the latter at £1.99, as Odin had gone out of business the previous year.

THE ARC OF YESOD (1985)

After the events of *Nodes Of Yesod,* the intrepid space explorer Charlemagne Fotheringham-Grunes has to save the Earth once again. The Monolith at the centre of the previous game has teleported to Ariat, its planet of origin, bringing numerous data concerning the Earth with it. These data must not be collected by the Ariatians, since they intend to use them to plan an invasion of our planet.

'Charlie' must therefore explore the vast and insidious depths of Ariat in search of the Monolith, with the help of an Electronic Mole, a spherical device that will allow him to get rid of most of the enemies and discover hidden secret passages.

OPERA SOFT
1986-1992

Opera Soft derived from Indescomp, a company that distributed software for Spectrum and Amstrad CPC in Spain in the early 1980s. Some Indescomp developers, including Paco Suárez, author of the very first Spanish video game *La Pulga* (distributed in the United Kingdom by Quicksilva under the title *Bugaboo The Flea*), decided to set up on their own and established their first headquarters near the Madrid Opera House, from where the new software house got its name.

Opera Soft debuted with one of its most popular titles ever, *Livingstone Supongo,* a vast platform and exploration game with a humorous tone and considerable difficulty. It will have a sequel in 1989, *Livingstone Supongo II,* also noticeable, albeit without the impact of the first chapter.

Opera's production for the Spectrum includes several other titles. *La Abadia Del Crimen*, a complex dynamic adventure in isometric 3D and unofficial videogame version of Umberto Eco's notorious novel *The Name of the Rose,* is particularly remarkable. Also to mention are action games such as *The Last Mission, Soviet, Rescate En El Golfo, Sirwood, Mutan Zone* and *Sol Negro,* the platform game *Gonzzalezz,* the bizarre arcade adventure *Mot,* based on Alfonso Azpiri's comic book series of the same name, and sports games *Golden Basket, Poli Diaz Boxeo* and *Mundial De Fútbol.*

After a failed attempt to switch to the production of games for 16-bit computers, Opera Soft dissolved in 1992.

LIVINGSTONE SUPONGO (1987)

The player guides famous explorer Henry Morton Stanley in a parodic version of his search for Dr. David Livingstone, lost in Central Africa and found by him in 1871. Tradition has it that Stanley greeted Livingstone, with proverbial Victorian aplomb, by saying ‘Dr. Livingstone, I presume’, hence the game’s title.

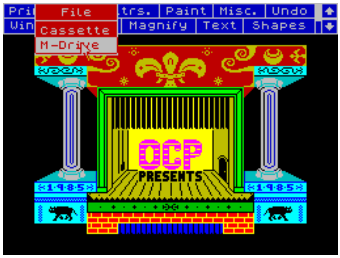
Livingstone Supongo’s Africa is populated by carnivorous plants, snakes, coconut-throwing monkeys, not quite friendly natives, mercenaries, traps, quicksands, mining carts running out of control and so on – it is not a quiet place by any means. In his defense, Stanley has at his disposal an infinite number of boomerangs, hand grenades, throwing knives, which travel further the longer the fire button is pressed, and a pole vault stick to overcome otherwise impassable obstacles. Stanley must also keep an eye on his food and water levels, that run out over time, so as not to die of hunger or thirst.

OXFORD COMPUTER PUBLISHING
1982-1986

OCP is the maker of *The Art Studio,* one of the most advanced drawing software for the Spectrum, as well as several other utility applications, like the *Plus 80* series, including a revised version of the popular *Full Screen Editor/Assembler* for machine code programming. Also worth mentioning are the *Word Manager* word processor and *Chess The Turk,* a chess game taking its name from the famous (and actually false) automaton, the Schachtürke ('Turkish chess player'), built by Hungarian inventor Wolfgang von Kempelen in 1770.

Both *The Art Studio* and its expanded version *Advanced Art Studio* were distributed by Rainbird.

THE ART STUDIO (1985)



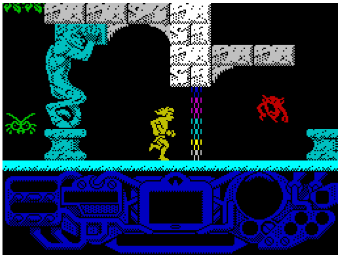
The Art Studio is one of the most advanced graphic editors for the Spectrum, provided with multiple features. You are able to draw straight and curved lines and geometric shapes, which can be filled with solid colours or pre-set textures. A unique possibility for that time is to the ability to copy or cut and paste portions of the drawing in other parts of the screen, through a special selection rectangle. The program includes a driver to send the drawings to the most popular printers of the time.

PALACE
1984-1991

The name derives from Palace Video, the company that owned the London video store where the two founders, Peter Stone and Richard Leinfellner, worked. The software house was absorbed by Titus in 1991, when the main group sold its side businesses to focus on film production.

Palace's Spectrum video game catalogue is of primary importance. Titles like *Cauldron, Cauldron II, The Sacred Armour Of Antiriad, Barbarian, Barbarian II The Dungeon Of Drax* are known to virtually anyone who owned a Spectrum in the second half of the 1980s. Less well known, but worthy of mention, are the icon-controlled dynamic adventure *Stifflip & Co.* and *International 3D Tennis,* a tennis simulation with vector graphics.

THE SACRED ARMOUR OF ANTIRIAD (1986)



After a nuclear war, mankind slowly emerges from chaos, and a new, peaceful society closely linked to nature is formed. Unfortunately, an alien invasion overwhelms it and enslaves it in order to exploit the Earth's resources. As Tal, a brave young warrior secretly trained by the Elders, you must explore the ruins of an ancient city in search of the Sacred Armour of Antiriad (actually a radiation suit developed immediately before the war as a means of defense and offense) and put an end to oppression. To make it work, you will have to find, one after the other, the anti-gravity boots, pulsar beam, particle negator and implosion mine. The Armour will be necessary to enter the alien base, located inside a nearby volcano, reach its energy core and blow it up with the mine, thus destroying the invaders' power source.

At the beginning of the game, Tal can only attack enemies by throwing stones at them. His energy is limited, but he can restore it by staying inside the Armour, once he finds and activates it. After assembling the entire Armour, Tal will be able to penetrate the alien defenses and complete his mission.

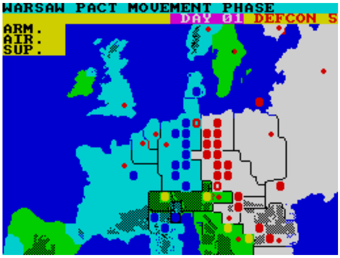
PERSONAL SOFTWARE SERVICES
1981-1988

Founded by Gary Mays and Richard Cockayne in Coventry in 1981, PSS began publishing games and utilities for the ZX81 before turning to the Spectrum. In 1984, the first strategy titles designed by Alan Steele were released. Almost all of the games produced by PSS are in fact of that kind; the most notable titles by this software house belong in fact to that genre. Scenarios are the Roman Empire in *Annals Of Rome,* World War II in *Pegasus Bridge* and *Tobruk,* a confrontation between NATO and the Warsaw Pact in *Theatre Europe* and even a fantasy setting in *Sorcerer Lord.* A separate mention for *Bismarck,* which combines elements of strategy and simulation in reconstructing the hunt for the notorious German battleship in August 1940, with the possibility of playing on the side of either the Third Reich or the British Empire.

Arcade games include *Frank N Stein,* a challenging platform/collect-em-up inspired by the famous novel of almost the same name by Mary Shelley. On 14 September 2011, exactly 27 years after its launch, *Frank N Stein Re-booted,* a revised version by the same author Colin Stewart with the assistance of Einar Saukas, was released.

In February 1987 PSS, no longer manageable by the founders due to excessive costs, was acquired by Mirrorsoft and moved its business towards 16-bit home computers, until the main company's shutdown in 1992.

THEATRE EUROPE (1985)



In the 1980s, with the resurgence of the Cold War, the fear of a conflict between the United States and the Soviet Union was more alive than ever. *Theatre Europe* presents a hypothetical clash on the European front between NATO and the Warsaw Pact. The player can control either of the two sides. The opponent can be either human or guided by an artificial intelligence; in this case, its skill can be selected from three increasing levels, of which the second and third unlock advanced modes not present in the first. There is also a demonstration mode where the computer plays against itself.

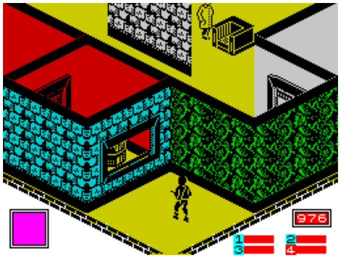
Action takes place in four phases: movement, ground attack, rebuild, air attack. There is an option to decide the outcome of the second phase through an arcade sub-game, but true strategy purists will definitely turn it off. You can also attack with chemical and – as a last resort – nuclear weapons. In the latter case, the code 'Midnight Sun' must be entered. It was originally communicated by calling (in the United Kingdom) a telephone number provided in the game instructions; a pre-recorded message gave the code. However, the ultimate goal would be winning without using weapons of mass destruction. This intention is confirmed by the fact that an atomic escalation easily leads to global nuclear war and the consequent destruction of human civilization, which in turn makes the game end immediately. *Theatre Europe* is therefore one of those games that reflect their own times all too well.

PIRANHA
1986-1987

The software division of British publishing group Macmillan, one of the largest and most important in the world, Piranha went bankrupt just 18 months after launch, leaving on paper several promising titles announced for the Spectrum. Among those that got an actual release there are three dynamic adventures by Don Priestley: *Flunky,* made famous by the caricatures of the then members of the British royal family, plus *The Trap Door* and *Through The Trap Door,* both under license from a claymation animated TV series.

Others worth mentioning are: *Strike Force Cobra,* a mix of action and exploration in isometric 3D; two humorous text adventures, *The Big Sleaze* and *The Colour Of Magic* (the latter taken from Terry Pratchett's book of the same name), both coded by Fergus McNeill's Delta 4; *Rogue Trooper,* based upon Alan Moore and Dave Gibbons' comic published on *2000 AD; Yogi Bear,* licensed from Hanna-Barbera's eponymous animated series; *Nosferatu The Vampyre,* a dynamic adventure in isometric 3D based upon Werner Herzog's film of the same name starring Klaus Kinski.

STRIKE FORCE COBRA (1986)



A supervillain simply known as the Enemy abducted some skilled scientists and forced them to work for him, tampering with computerized defense systems around the world. He threates to activate nuclear weapons worldwide if he is not given rule over the entire planet. World leaders then assemble a strike force called Cobra. The player must choose four among Cobra's eight members and guide them inside the Enemy's fortress. They must penetrate its defenses and locate the central computer to disable it, with the help of codes provided by the captured scientists, met along the way. All of this must be done before the Enemy's plan becomes reality.

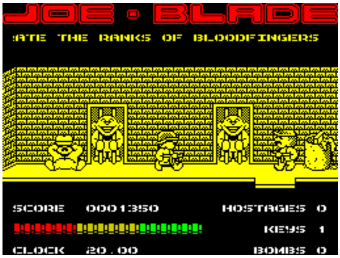
Cobra agents, armed with machine guns and electromagnetic bombs to disable or confuse the circuitry of the most powerful defenses, must coordinate their efforts, clearing each other's way to their goal. This makes *Strike Force Cobra* a game where reckless action leads to defeat. It is in fact necessary to avoid running head down into the fight and carefully plan every move.

PLAYERS/PLAYERS PREMIER
1986-1993

A subsidiary of Interceptor, Players released a good number of Spectrum titles for the modest price of £1.99. The best knows are the three episodes of the *Joe Blade* series. Others to mention are platform games *Anfractuous, Deviants, Lop Ears and Metal Army,* then *Denizen,* a clone of Gauntlet, the car racing game *Miami Cobra GT* and text adventures *Matt Lucas* and *Journey To The Centre Of Eddie Smith's Head*.

Under the Players Premiers label, whose games costed a pound more, several notable titles were released: *Cobra Force, Deadly Evil, Elven Warrior, Havoc, Hawk Storm, Iron Soldier, Lost Caves, Prison Riot, Solar Empire, Spooked, Steel Eagle, Task Force, War Machine*.

JOE BLADE (1987)



In this action game with a hint of puzzle, mustachioed Joe Blade has to carry out a double task. He must find and free six world leaders held captive by supervillain Crax Bloodfinger. Besides, he must blow up the place, activating six time bombs in a sub-game where, within a few seconds, six letters must be arranged in alphabetical order. Once the first bomb is activated, there will only be 20 minutes left to complete the rest of the mission.

To make things even more difficult, ammunition is limited, although it is possible to replenish it along the way, and some doors are locked, so it will be necessary to use the keys Joe will find from time to time wisely. If Joe finds and wears a uniform of Crax's henchmen he can, for a short time, walk around unnoticed.

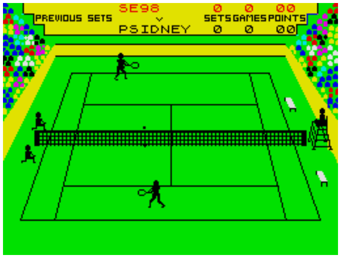
Joe Blade was the game that established Players on the Spectrum budget games market: simple and immediate, but certainly not easy to complete.

PSION
1980-in activity

Today Psion is a global company spread across 80 countries, involved in the production of cutting-edge solutions for mobile computing. In its early years, it was closely related to the Spectrum: it programmed the *Horizons* demonstrative compilation and produced and distributed the very first utilities and entertainment programs for that computer.

From Psion come a clone of *Asteroids, Planetoids* and one of *Space Invaders, Space Raiders,* as well as several Spectrum absolute 'premieres': the first flight simulation *(Flight Simulation),* car racing game in first-person view *(Chequered Flag),* tennis simulation *(Match Point)* and the first computerized versions of board games *(Backgammon, Chess, Scrabble).* Psion also made the VU series applications, i.e. *VU-File* (database), *VU-Calc* (spreadsheet) and *VU-3D* (three-dimensional drawing). Together with Melbourne House, Psion produced the Horace game series for the 16K, programmed by William Tang of Australian programming team Beam and published by Sinclair: *Hungry Horace, Horace Goes Skiing* and *Horace And The Spiders.*

MATCH POINT (1984)



Quite a few tennis simulations have appeared for the Spectrum, but none ever managed to outclass the pure and simple gameplay of *Match Point,* the first ever. Its minimalist graphics conceal an extremely precise game control – for example, hitting the ball while running against it can give greater strength to the shot – and a fast action. You can also increase the difficulty level (quarter finals, semifinals, final) when playing against the computer.

QUICKSILVA
1982-1989

Established as an independent developer, Quicksilva was acquired as a programming team by Argus Press and as such remained with Grandslam Entertainment until its dissolution in the late 1980s. Its name is known, above all, for the epic *Ant Attack,* the first isometric 3D title, the first example of 'survival horror' in the history of video games and the first game where it was possible to choose the sex of the protagonist. Its author Sandy White wrote a game based on the same graphics engine, *Zombie Zombie,* still for Quicksilva, but it did not enjoy as much success.

Other notable titles from Quicksilva include: *Fantastic Voyage,* licensed from Richard Fleischer's eponymous film; the English versions of the minimal but compelling *La Pulga* and the difficult platform maze arcade *Fred,* both from Spanish Indescomp; the Christmas-themed platform/collect-em-up *The Snowman,* from the children's book of the same name by Raymond Briggs; *Battlezone,* converted from the famous Atari coin-op; another coin-op conversion, from Taito's *Elevator Action;* the puzzle Gatecrasher; *Tantalus,* a huge and colourful platform and exploration game; shoot-em-ups *The Tube* and *Glass; Glider Rider,* an isometric 3D arcade adventure where you drive a motorbike that can turn into a hang glider; *Aquaplane,* a water ski arcade simulator; the arcade adventure *Max Headroom,* where you plays as the protagonist of the eponymous TV series, reporter Edison Carter.

Also from Quicksilva, the pioneering music and vocal synthesis program *Speakeasy.*

ANT ATTACK (1983)

The mythical city of Antescher. For millennia, its mighty buildings have remained almost completely intact, in the dry climate of the Great Desert, now populated only by gigantic and ferocious ants. Then one day they arrived: He and She, perhaps descending from a lineage of magicians, or from an ancient Nordic population. It doesn't matter: they came to try their hand at a game that gives the thrill of death, challenging the city's dwellers, the terrible insects moved only by their predatory instincts.

Ten times it will be up to him, or to her, to go beyond the walls of Antescher in order to find his/her companion hidden in the city and take him/her out within a set time, making their way through the ants by throwing bombs or jumping over them – this last step is sometimes essential to climb up to the higher places.

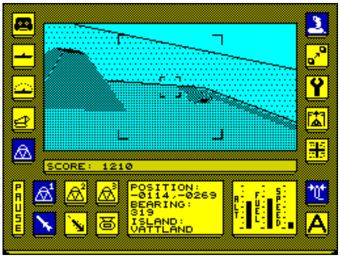
Ant Attack's originality, playability and arcane atmosphere – the latter inspired, as the name of the city indicates, by M.C. Escher's visions – do not cease to amaze even today. The game is still considered a milestone in the history of the Spectrum and of video games in general.

RAINBIRD
1987-1989

As Firebird and Silverbird, Rainbird was a label of Telecomsoft, the software division of telecommunications company British Telecom. Under Rainbird, high-end titles were released, namely Spectrum conversions of games already appeared for the Commodore Amiga and Atari ST. First of all, the famous adventures (in text-only format) by Magnetic Scrolls: *The Pawn, The Guild Of Thieves, Jinxter, Corruption, Fish!.* Then, it distributed three of the best combat games in first-person view with vector graphics ever produced for the Spectrum: *Starglider, Starglider II* and *Carrier Command,* all made by Realtime.

Rainbird released several Level 9 adventure games and OCP's *The Art Studio* drawing utility series too.

CARRIER COMMAND (1989)



Year 2166. Two very advanced aircraft carriers, ACC *Epsilon* and ACC *Omega,* are sailing in the waters of an archipelago made up of 32 islands rich in mineral resources. The *Omega* is assaulted and taken over by a mysterious terrorist organization called Stanza, with the intention of launching an attack on the islands to take possession of them. At the command of the *Epsilon,* it is necessary to prevent this from happening, by conquering the islands and destroying the *Omega.* The *Epsilon* is armed with Manta fighters and Walrus amphibious vehicles. The islands have different features – some host factories, others are sources of raw materials or used as warehouses. The whole game is controlled by specific icons.

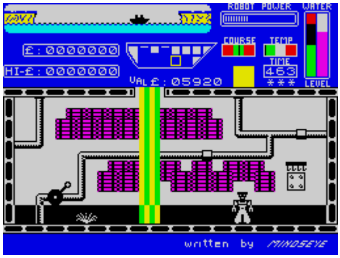
The strategic aspect, as well as the need to repel enemy attacks, make *Carrier Command* a successful mixture of different genres – simulation, strategy and management. Technical implementation is extraordinary by the standards of the Spectrum, especially due to its convincing graphics in solid 3D, but the size of the game itself means it is reserved to the Spectrum 128 and later models.

SILVERSOFT
1982-1986

Among the first software houses to publish games for the Spectrum, Silversoft has in its catalogue *Slippery Sid,* perhaps the best Spectrum version of the well-known 'snake game', *Sam Spade,* a clone of *Space Panic,* the fast maze game in two parts *Hyperaction*, and quite unconventional titles, such as *Robot Riot,* a sort of reverse *Pac-Man* (instead of eating pills, the main character must scatter them along a maze) and *Worse Things Happen At Sea.*

In June 1985, Silversoft became a subsidiary of CRL. It published two humorous text adventures by Delta 4, *Robin Of Sherlock* and *Bored Of The Rings,* and *Talos,* an arcade adventure where the player guides the hand of a mechanical giant in search of the other pieces of its body. In 1986 it ceased its operations.

WORSE THINGS HAPPEN AT SEA (1984)



At the command of a robot sailor, you have to make sure that an old and battered ship loaded with goods arrives to its port of call. The problem is that leaks immediately begin to appear in the hull. The incoming sea water damages the robot, deteriorates its cargo, makes engines explode if they overheat due to the increased load, and causes the ship to sink if too many compartments are flooded. The robot must therefore apply patches to cover the leaks and pump water from the flooded compartments, pour oil into the engine to lower the temperature, keep the ship on its course from time to time and recharge its own power. Three robots are available for each mission.

The situation is relatively easy to manage at the beginning, but as levels go by, difficulty increases, to the point that it becomes more and more arduous for the player to cope with all the tasks to perform in order to avoid disappearing under the waves.

SOFTWARE PROJECTS
1983-1988

The 'Penrose Triangle' software house is best known for its sequel to *Manic Miner, Jet Set Willy,* as well as for re-releasing the first game when Matthew Smith left Bug-Byte, taking the rights to it with him. The Software Projects version is recognizable not only by the different copyright message at the beginning, but also by the presence of the 'triangles' instead of the threshing machines on the seventeenth screen, 'The Warehouse', plus other less obvious graphic changes.

Software Projects should have released Smith's last work, *Attack of the Mutant Zombie Flesh Eating Chickens from Mars,* a description of which appeared in Sinclair User issue 63 (June 1987). Smith, unhappy with the result, left the project for good, dissolved Software Projects and left without a trace. He then began to wander until settling in a Dutch commune he returned from in 1998. The game was entirely rewritten by Software Creations and released in the budget range with the title *Star Paws.* Software Projects made a pseudo-sequel to Miner Willy's second game, *Jet Set Willy II,* actually a revised and expanded version of it. It was made for the Amstrad CPC 464 by Steve Wetherill and Derrick Rowson, then converted for the Spectrum by Rowson alone after Wetherill left Software Projects for Odin Computer Graphics.

Another well-known title is *Hysteria,* a run-and-jump arcade game by another historical Spectrum videogame author, Jonathan Smith. Other titles include *BC's Quest For Tires,* another run-and-jump arcade game, licensed from Johnny Hart's famous comic strip, arcade/puzzle hybrids *Astronut, Thrusta* and *Tribble Trubble,* the 'translation', rather than conversion, of the laser game *Dragon's Lair* as well as its original sequel *Dragon's Lair II* and the Spectrum version of the popular Brøderbund *Lode Runner* platform collect-em-up. The last game, *Anaconda,* a shoot-em-up divided into three distinct phases, was never released and was only recovered in 2010.

JET SET WILLY (1984)

Having amassed enormous wealth after surviving the perils of Surbiton Way mine in *Manic Miner,* Willy bought a huge mansion and threw a colossal housewarming party. His guests left everything in disarray, and his terrible housekeeper Maria won't let him go to sleep if he has not collected all the flashing objects scattered around the house and its surroundings before midnight. Action begins at 7.00am and takes place in real time, in an environment full of strange and lethal creatures, a legacy of the previous owner's unsettling experiments. In fact, Willy's entire residence is a huge single level, its exit being 'Master Bedroom', watched by Maria. *Jet Set Willy* then takes up, significantly expanding it, the *Manic Miner* formula, whilst introducing new features, like ropes which Willy can climb or use to reach other locations by jumping off them.

The game was plagued by a bug that occurred when the player reached 'The Attic'. This became known as 'The Attic Bug', and was humorously referred to as the giant insect in the attic of Clive Sinclair's house in the first screen of Micromega's *A Day In The Life*. Software Projects had four POKE instructions published on the pages of computer magazines: they had to be inserted into the game's BASIC loader, in order to solve this problem and other minor defects.

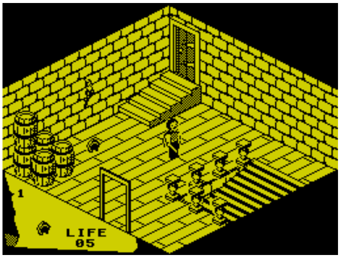
SOFTEK/THE EDGE/SOFTECHNICS/ACE
1980-1990

Softek was founded by Tim Langdell, one of the most controversial personalities in video game industry due to his aggressive stances on copyright, that led him to sue numerous other companies on the basis of the simple presence of the 'edge' term. It initially produced unofficial conversions of late 1970s arcade coin-ops for the 16K Spectrum.

The Edge label was born in 1984, under which the most successful titles were released. First of all, the two dynamic adventures in isometric 3D *Fairlight* and *Fairlight II,* then the arcade adventures, still in isometric 3D, *Bobby Bearing* and *Inside Outing,* the licensed games *Garfield Big Fat Hairy Deal* and *Snoopy,* arcade games *Starbike* and *Shadow Skimmer,* the coin-op conversions of the platform beat-em-up *Shao Lin's Road* and the horizontal scrolling shoot-em-up *Darius +,* the three-dimensional perspective chess game *Psi-Chess.* From The Edge also came two inusual arcade adventures: *Brian Bloodaxe,* with obvious references to the *Monty Python* TV show, and *That's The Spirit,* where you play as a 'ghost hunter' in an attempt to rid New York City of evil presences.

In 1985, Softechnics was established, producer of *The Artist* and *The Artist II,* two of the most appreciated drawing utilities for the Spectrum, and of a word processor, *The Writer.* The latest label launched by Langdell before dissolving and re-founding his company in California as Edge Games is ACE, that released a good conversion of Sega's *Alien Syndrome* coin-op as well as *Xecutor,* an interesting vertical scrolling shoot-em-up allowing for simultaneous two-player action.

FAIRLIGHT (1985)



Fairlight was once a prosperous kingdom. Now it is a poor and divided land, populated by hostile creatures. Of the ancient sovereigns' domain, only the castle of Avars remains. No one dares to enter it; it is rumoured that inside it a magician who knows the secret of immortality, as well as the only person capable of bringing light back to Fairlight, is imprisoned.

Isvar, an adventurous traveler, is lured into the castle against his will by the magician, who entrusts him with the task of finding the Book of Light and bringing it to him. Locked within the arcane walls, Isvar begins his story guided by the player, in an extremely detailed world, not only on the graphic side, but also in game mechanics. Objects have different uses as well as their own dimension and weight. Some locations are not accessible right from the start, so that Isvar must find a way to enter them, for example stacking barrels and using them as a ladder to reach a high place. It goes without saying that the castle is populated by enemies, which will make life very difficult for the hero.

SYSTEM 3
1982-in activity

More known for its activity on the Commodore 64 than on the Spectrum, Mark Cale's software house left however an important mark on the Sinclair home computer too. Of the most famous series, *The Last Ninja,* only the second chapter appeared on the Spectrum: some images of the first were published in a preview on *Sinclair User* 68 in November 1987. The magazine also stated that the delay in production was due to technical difficulties (problems with 'getting the little man to run around at a constant speed'). Meanwhile *The Last Ninja II* arrived and System 3 dropped the first chapter. The third was never even proposed for the Spectrum (and the Amstrad CPC), probably because, with regard to 8-bit platforms, the software house preferred to concentrate only on the C64 version, in addition to those for 16-bit platforms, namely the Amiga and Atari ST.

Other System 3 Spectrum games include: *International Karate Plus,* an ideal heir to Melbourne House's *The Way Of The Exploding Fist;* the original and challenging *Twister The Mother Of Charlotte* shoot-em-up (its earlier title, *The Mother Of Harlots,* was censored); *Tusker,* an arcade adventure whose main character searches for the legendary Elephant Graveyard; the epic *Myth.*

MYTH (1989)

Subtitled *History In The Making,* the game is a mixture of platform and adventure. In addition to jumping here and there and facing enemies through four levels inspired by as many mythical worlds, hence the name, the protagonist, to proceed in the game, must find and use some objects and trigger hidden mechanisms.

From a technical point of view, *Myth* is an excellent game. This contributes a lot to the creation of its tense and dark atmosphere. This can be seen from the first stage, where enemies consist of skeletons armed with swords and shields, in an underground environment aptly called 'The Road To Hell'. The action then moves on to the next one, set in the world of Greek mythology, where the Hydra of Lerna and the gorgon Medusa appear, then to Viking Scandinavia in the early Middle Ages, and finally to Egypt under the Pharaohs. The fifth level is the final battle with the demon who has been harassing the protagonist from the beginning.

TASMAN
1981-1993?

Tasman made an important contribution to the history of the Spectrum with its *Tasword* word processor, since the long history of this program was a testimony to its quality and professionality. *Tasword* in fact, after the initial version of 1982, underwent several revisions: *Tasword Two, Tasword Three, Tasword 128K, Tasword Plus Two, Tasword Plus Three,* following the transformations of the Spectrum itself.

In addition to its word processor, Tasman made a number of additional or complementary applications for it, such as *Tasmerge,* a mail merge program, *Tas-Sign,* a sign and advertisement creator, and the *Tascalc* spreadsheet.

In the end, Tasman was absorbed by a US company, Accusoft Imaging.

TASWORD (1982)

Initially appeared on the ZX81, *Tasword* found its ideal platform on the Spectrum, becoming the first, as well as the longest-running and most popular word processing program for that computer.

Tasword included, since its first edition, typical features of the most advanced (and expensive) text composition systems, like justification, left or right alignment, word wrap, insertion and deletion of single words or phrases and control via cursor. Later versions added other possibilities, for instance printing 64 characters per line, as opposed to the 32 of the standard Spectrum display, and were integrated with other Tasman software, up to *Tasword Plus Three,* designed for specific use with the +3 floppy drive.

THORN EMI VIDEO/CREATIVE SPARKS/ SPARKLERS
1983-1987

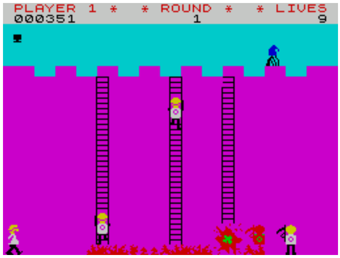
Thorn Emi Video, later Creative Sparks, arose as a subsidiary of British industrial conglomerate Thorn EMI, nowadays no longer existing as it was split up between different buyers.

Thorn Emi Video released a handful of titles – the only one worth mentioning is the fast and minimalistic arcade *River Rescue* – before taking the name of Creative Sparks in 1984. This one produced, among other things, some games under license from the British animated TV series *Danger Mouse,* as well as the classic *Orc Attack* arcade and a curious and original title, *Snodgits,* a sort of dynamic puzzle in isometric 3D where the player, in the role of a butler, has the task of retrieving some missing objects, bringing them back to their owners and finding out who took them.

Under the Sparklers budget label, several other games were released. Among them: *Quackshot,* a maze arcade very similar to the old Konami *Tuthankham* coin-op; *St Crippens,* an extravagant dynamic adventure where the player must escape from a scary hospital; another unusual game, *Bargain Basement,* whose main character, a pound symbol (£), wanders around a maze in search of objects to buy.

Creative Sparks bought Mikro-Gen in December 1986. In July 1987 it went bankrupt, crushed by debts estimated at between £750,000 and £1,500,000.

ORC ATTACK (1984)



The Spectrum version of the arcade classic where the player must defend a castle wall from the incessant enemy onslaught. As weapons, there are boulders, boiling oil – which sets off a lethal fire as soon as it hits the ground – and a sword for melee combat. For their part, enemies do not just use ladders to climb up the wall, but shoot arrows with their crossbows. When defeated, others come into play, even more lethal, such as the sorcerer, capable of casting skull-shaped spells, or the fearsome trolls.

Graphics and audio are simple, but gameplay is fast-paced and demanding, and exudes all the charm of 'old time' titles.

TOPO SOFT
1987-1994

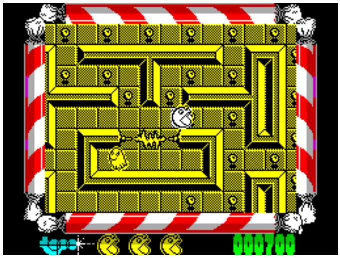
With Dinamic and Opera Soft, Topo Soft constitutes the 'trinity' of the so-called 'golden age' of the Spanish software industry. It was the creative arm of Erbe Software, distributor for Spain of the major British video game producers. Topo Soft was founded by Javier Cano Fuente and Emilio Martínez Tejedor: Erbe distributed their *Las Tres Luces De Glaurung,* later released in the rest of Europe by Melbourne House, translated into English and renamed *Conquestador.*

There are several Topo Soft games for the Spectrum, all arcade and sports, deserving a mention here. The software house's first major success, the football arcade game *Emilio Butragueño Fútbol,* sold (across all formats) more than 100,000 copies. Another well-known title is *Mad Mix,* an elaborate clone of *Pac-Man* which in its international version was marketed by US Gold as *The Pepsi Challenge,* one of the first cases of video game sponsorship. It had a sequel in isometric 3D, *Mad Mix 2.*

Also of interest are: *Coliseum,* a chariot racing game in ancient Rome; *Wells Fargo,* an arcade where you control a stagecoach in the Wild West; the pirate-themed *Gauntlet* clone *Black Beard;* the underwater exploration game Titanic; *Gremlins 2,* a platform/shoot-em-up licensed from Joe Dante's film of the same name; *Desperado,* the conversion of Capcom's *Gunsmoke* coin-op; cycling games *Perico Delgado* and *Tour 91;* the vertical scrolling shoot-em-up *Stardust; El Mundo Perdido,* Spanish version of US Gold's arcade adventure *People From Sirius;* the platform games with exploration elements *Spirits, Survivor* and *Viaje Al Centro De La Tierra;* the future racing games *Ice Breaker* and *Zone 0.*

The crisis in the 8-bit home computer software market between the end of the 1980s and the beginning of the 1990s was fatal to Topo Soft, which was closed by Erbe in 1994 after producing some PC-only titles.

MAD MIX (1988)

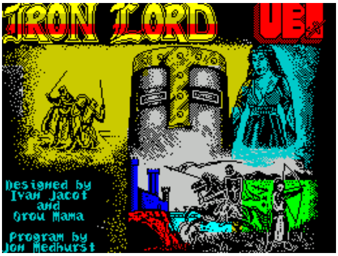
 

Can a video game classic be re-imagined without reinventing the wheel? *Mad Mix* proves that it is possible, when done with taste and creativity. The aim of the game is therefore to guide the protagonist Mad through fifteen different mazes, avoiding enemies, not limited to the usual ghosts, and eating pills scattered along the way, including trap doors and mandatory directions in addition to the normal tiles. Mad can also undergo five different transformations, necessary to counter the dangers and complete the levels.

UBI SOFT
1986-in activity

The French video game giant produced some interesting titles for the Spectrum: the platform game *Night Hunter,* featuring a vampire capable of transforming himself into a bat and a werewolf, who has to flee from humans chasing him; the tennis simulation *Pro Tennis Tour; Twin World,* a horizontal scrolling platform game divided into 23 levels; *Zombies,* an arcade adventure in first-person view ostensibly inspired by George A. Romero's *Dawn Of The Dead;* a dynamic adventure set in the Middle Ages, *Iron Lord.*

IRON LORD (1989)



A dynamic adventure with some arcade features characterized by a fascinating medieval atmosphere. The protagonist is a prince whose throne has been usurped by his evil uncle. He then has to go around competing in various tournaments – archery, arm wrestling and more – in order to win back the favour of his people and put together an army to battle against his unfaithful relative, by assaulting the family castle.

The game is divided into various subsections, joined together by a general map along which you move to reach the different game locations. In almost each one of them there are characters to meet or challenges to undergo in order to proceed with the adventure. Graphics and sound are first class, and together with the varied gameplay contribute to make *Iron Lord* an atmospheric and captivating experience for the player.

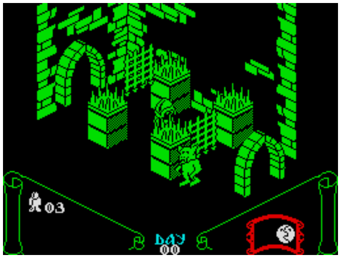
ULTIMATE PLAY THE GAME
1982-1988

The ‘Ultimate style’ is well known not only to Spectrum owners, but to anyone who owned an 8-bit computer in the 1980s. Arcade games with clean and detailed graphics and immediate and engaging gameplay, selling by the hundreds of thousands of copies, set a standard over the years. Behind this historical brand there was Ashby Computer Graphics, i.e. brothers Tim and Chris Stamper, whose elusiveness towards specialized press became proverbial, helping to fuel their fame in addition to the solid reputation obtained through their titles.

It all began in 1983 with a series of titles for the 16K Spectrum: *Cookie, Jetpac, Pssst, Tranz Am.* For the 48K arrived *Atic Atac* and *Lunar Jetman.* The following year began the Sabreman series, with *Sabre Wulf, Underwurlde* and the game with the greatest impact and influence, *Knight Lore.* This opened a real era of isometric 3D titles, static as in *Alien 8* or dynamic as in *Nightshade* and *Gunfright.*

In 1985, the Stamper brothers sold Ultimate to US Gold: it was the beginning of the decline. Only *Pentagram* was partially a work of their own, and not surprisingly it is the best of the four games released since then and until the dissolution of Ultimate in 1988. The others are produced internally by US Gold and maintain Ultimate’s brand, but certainly not the quality: fair *Cyberun,* disastrous *Martianoids* and passable *Bubbler.* The long-promised *Mire Mare* never came out: after years of never fully confirmed speculation and rumors, it now seems certain that it did not even reach pre-production status.

KNIGHT LORE (1984)



Knight Lore is one of the great classics in the history of video games, imitated countless times. It set the standards for the genre brought to its apex by Ocean's *Head Over Heels,* the isometric 3D arcade adventure.

The story follows the events of *Sabre Wulf.* The protagonist, poor Sabreman, was struck by a curse, thrown at him by the Wulf, that turned him into a werewolf. For this reason, Sabreman goes to the castle of the great wizard Melkhior looking for help. Melkhior orders him to find the ingredients of a potion that will set him free from his predicament, but he must do it within forty days, otherwise he will remain a werewolf forever. The ingredients he has to look for appear from time to time above the wizard's cauldron. Sabreman's transformation from man to wolf and vice versa occurs in the transition from day to night, and from night to day respectively, during game time. Some beings among those populating the castle, all lethal on contact, will attack Sabreman when he is in his wolf state.

The mission to accomplish in *Knight Lore* is not easy. Screens are often really difficult, and at times they can be frustrating. For the most determined player, however, saving Sabreman from doom will be a source of great satisfaction.

US GOLD
1984-1996

US Gold was founded in Birmingham by Geoff Brown with the aim of distributing in the United Kingdom games developed in the United States, hence the name, for machines like the Commodore 64 and the Atari XL. Spectrum conversions were carried out mainly by external programming teams. In fact, very few titles originated from anything other than Epyx or Access releases or coin-op arcade games. In its Spectrum catalogue there are: platform games such as *Impossible Mission, Impossible Mission II, Bruce Lee, Bounty Bob Strikes Back, Indiana Jones And The Last Crusade;* war-themed arcade games like *Beach Head, Beach Head II* and the controversial *Raid Over Moscow;* the puzzle game *Chip's Challenge; Killed Until Dead,* a humorous detective game; the crossing between arcade and simulation *Infiltrator;* two 'light' air combat simulations, *The Dam Busters* and *Ace Of Aces; Gunslinger,* a text adventure set in the Wild West; arcade adventures *Black Magic, People From Sirius* (released in Spain by Topo Soft as *El Mundo Perdido*) and *Indiana Jones And The Fate Of Atlantis;* less classifiable arcade games, like *Night Shift* and *E-Motion*; sports games like *Leader Board, Leader Board Tournament, World Class Leaderboard, Final Assault, 10th Frame, The Games Summer Edition, Winter Games, World Games.* Among coin-op conversions: *720°, Alien Storm, Crack Down, Express Raider, Forgotten Worlds, Gauntlet, Gauntlet II, Ghouls 'n' Ghosts, Indiana Jones And The Temple Of Doom, Last Duel, Last Mission, Metrocross, Out Run, Psycho Pigs UXB, Road Blasters, Road Runner, Rolling Thunder, Shadow Dancer, Solomon's Key, Spy Hunter, Strider, Super Monaco GP, Tapper, Thunder Blade, Strider, Turbo Out Run, UN Squadron.* US Gold released various Adventuresoft titles too.

After 1990, US Gold turned to the console market. The software house was acquired in 1996 by Eidos, which had incorporated Domark the previous year.

KILLED UNTIL DEAD (1987)

A rare example of an investigation game on the Spectrum, *Killed Until Dead* pits the player, in the role of detective Hercule Holmes, against the Red Herring Club, the elite association of the five greatest mystery writers. They gathered at the Gargoyle Hotel for a meeting which, in fact, is an opportunity to resolve some old issues. One of the members will be killed at midnight, and the player's task is to prevent this nefarious plan from happening. It is necessary to gather clues about the potential murderer, the intended victim, the place chosen for the attack, the weapon that will be used for the crime and the motive. Clues are gathered by breaking into the guests' rooms (obviously when they are not in), recording their conversations without their knowledge and finally questioning them. If clues found are strong enough to reconstruct the entire plan, an accusation can be launched, but in the event of a mistake, an unknown hand armed with a pistol will put an end to Holmes's career and life.

Killed Until Dead is a unique, well-crafted and humorous game requiring a constant use of intelligence on the part of the player in order to solve the many presented cases.

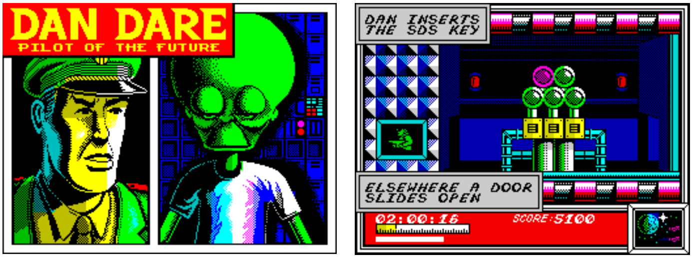
VIRGIN/LEISURE GENIUS
1981-1994

Virgin Games represented until 1994, when it changed its name to Virgin Interactive, the videogame sector, for 8 and 16-bit home computers, within the conglomerate of companies founded by Richard Branson. On the Spectrum, Virgin is best known for the series dedicated to comic book hero Dan Dare, created by Frank Hampson: *Dan Dare Pilot Of The Future, Dan Dare II The Mekon's Revenge* and *Dan Dare III The Escape*.

Also worth mentioning: the two arcade games licensed from Hasbro action figures *Action Force* and *Action Force II;* the platform game *Strangeloop; How To Be A Complete Bastard,* a satyrical dynamic adventure based on the book of the same name by comedian Adrian Edmondson; the shoot-em-up *Monty Python's Flying Circus,* based on Terry Gilliam's surreal animations for the eponymous TV show; *Rebel,* an arcade and puzzle hybrid; coin-op conversions *Golden Axe, Ivan 'Ironman' Stewart's Super Off Road, Shinobi, Silkworm*.

The official computer versions of some well-known board games were the field of activity of sister company Leisure Genius, which for the Spectrum published *Cluedo, Monopoly, A Question Of Scruples, Scalextric* and *Scrabble De Luxe*.

DAN DARE PILOT OF THE FUTURE (1986)



Hugely popular in the United Kingdom, Dan Dare is the protagonist of a science fiction comic strip launched in 1950 by its creator Frank Hampson on the pages of *Eagle* magazine. As a colonel in the Interplanetary Space Fleet, Dare is at the head of the Earth's defense forces against the threat of invasion by the Treen, Nazi-like aliens from Venus led by the very intelligent and evil Mekon. In the game, Dare arrives aboard an asteroid the Treen turned into a giant spaceship. The Mekon threatens to make it collide with Earth if the planet won't surrender to his forces. Dare is tasked with finding five parts of a self-destruct device and inserting them into a special control panel, before escaping. Of course, he also has to face the Treen hordes, and perhaps the Mekon himself.

Dan Dare is a platform game with shoot-em-up and exploration tones. Action is commented, in cartoon style, by bubbles appearing in certain circumstances. It is dedicated to the memory of Hampson, who passed away in 1985.

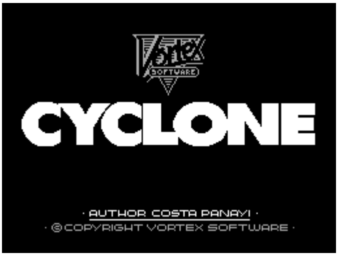
VORTEX
1981-1990

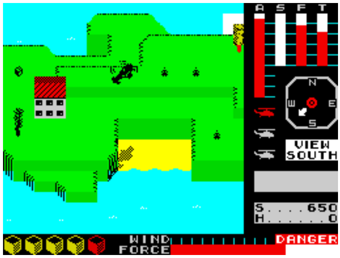
The software house founded by Costa Panayi has a great importance in the videogaming history of the Spectrum, since it produced several high quality and original games for that platform.

First of all, *Tornado Low Level,* where the player, guiding a Panavia Tornado aircraft, must pass over five targets at very low altitude, without crashing into buildings, trees and pylons in a pseudo-3D environment. The same type of setting returns in *Cyclone,* where you must pilot a helicopter to retrieve five precious supply crates scattered around the islands of an archipelago devastated by a cyclone. *Highway Encounter* and *Alien Highway* are two chapters of a series united by the same setting – a sort of 'highway' seen in semi-isometric 3D – and by the same protagonist, the robot Vorton.

Vortex's last games were released by other publishers: *Revolution* by US Gold, while *Deflektor* and *H.A.T.E. (Hostile All-Terrain Encounter)* by Gremlin Graphics.

CYCLONE (1985)





A game with an unusual setting: a tropical archipelago devastated by the arrival of a cyclone. The player is piloting a helicopter and must search the islands looking for five precious crates of supplies for the population. The task is obviously made difficult by the cyclone itself, that moves continuously around the archipelago. Being caught it in means risking to lose control of the aircraft, causing it to end up in the sea or against an obstacle. Fortunately, the position of the cyclone is visible on a map, while a bar at the bottom right of the screen indicates the wind force, warning you when it begins to become dangerous. You should also not forget to replenish your fuel as well as to steer clear of planes flying over the area.

ZEPPELIN GAMES
1987-1994

Nowadays known as Eutechnyx, Zeppelin was founded by the then seventeen-year-old Brian Jobling, attracting the attention of public and critics alike for a series of titles, mainly arcade and sports, in the budget range for all main 8-bit platforms. Among those for the Spectrum: *2088, Arcade Trivia Quiz, Blinky's Scary School, Draconus, F1 Tornado, Frontline, Arcade Fruit Machine, Grand Prix Championship, International Tennis, Jocky Wilson's Darts Challenge, Ninja Commando, Q10 Tank Buster, Rally Simulator, Sabotage, Sleepwalker, Spaghetti Western Simulator, Stack Up, Tai Chi Tortoise, Titanic Blinky, World Rugby, World Soccer, Zybex*.

ZYBEX (1989)

A shoot-em-up where the player does not have to shoot? It sounds absurd, but it is the great novelty of *Zybex,* a horizontal scrolling game where the player or players (the game allows for two-player action) take the role of two inmates of a space prison in their attempt to escape. Shooting is automatic – the fire button is used to switch between the four available weapons. However, not all of them will be in your possession from the beginning, as you will have to steal them from the destroyed enemies. Each weapon can be upgraded up to four levels, and when you are hit, you do not only lose a life, but also the level of the weapon you were using at the time. Furthermore, the game has a non-linear structure, that is to say, by collecting the appropriate tokens you can unlock the levels following the first, but each level 'costs' a certain number of tokens. Players could therefore not follow the same path on each game. Of course, levels become more and more challenging; there are 16 in total.

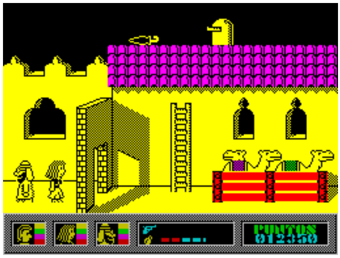
Due to all these features, *Zybex* proves that even an established genre like the horizontal scrolling shoot-em-up can be re-imagined in an original way.

ZIGURAT
1987-1993

Like Opera Soft, Zigurat was founded by some members of Indescomp's software development team. In 1986 Fernando Rada, Carlos Granados and Paco Menéndez, authors of the game *Fred* distributed in the United Kingdom by Quicksilva, created the Made In Spain group together with Jorge Granados and Camilo Cela. The Zigurat label was born the following year, to distribute games by Made In Spain and other developers. Menéndez, not being interested in the project, left the group to join Opera Soft, where he coded *La Abadía Del Crimen* together with Juan Delcán.

Zigurat's games were often characterized by original and unusual settings. *Sir Fred* is an elaborate arcade adventure game where the protagonist is searching for a princess held captive in a castle. Another complex arcade adventure, with three different playable characters, is *El Misterio Del Nilo,* inspired by Lewis Teague's film *The Jewel of the Nile.* In the *Comando Quatro* platform game, the player must guide four different characters back to their own worlds. *El Poder Oscuro* is an exploration title where you control the giant XR-2 robot, its pilot Johnny's capsule or the pilot himself on foot to save the Earth from an evil incoming threat. In *Humphrey,* the eponymous protagonist must complete in each level a walk on platforms suspended on an abyss. *Jump* features a likeable robot getting rid of annoying insects by dropping blocks of stone on them. In *Jungle Warrior,* explorer Keorg Kraken, lost in the Amazon rainforest, must find the pieces of an amulet to access a temple and find lost doctor Susan Vattan. More conventional titles are: *Paris-Dakar,* a top-down racing game inspired by the competition of the same name; the tennis simulation *Emilio Sanchez Vicario Grand Slam; Curro Jimenez,* a run-and-gun arcade game based on a Spanish TV series; the maze game/shoot-em-up *Afteroids,* a sort of modern version of *Asteroids; Star Bowls,* a platform game with some exploration features.

EL MISTERIO DEL NILO (1987)



Christine and Michael, two tourists on holiday in the Egyptian city of Luxor, try to save a young man, Muhammad al-Hasan, from an attempted abduction, but are captured and locked up in a palace. Al-Hasan explains them that Abu-Sahl, the evil governor of the Aswan region, is behind the fact. Abu-Sahl is also about to carry out a coup d'état. The three must then flee the city and reach the Jarga military base, where they can expose Abu-Sahl's plan. The long path separating the three characters from their goal is divided into several screen. Each one of them is a small puzzle in itself, to be solved by employing their individual skills: Michael can use a gun, Christine can throw hand grenades to hit enemies, even those placed on different levels, while al-Hasan, once he finds his umbrella, will use it as melee weapon. Abu-Sahl's henchmen won't give the three protagonists any quarter: they will have to jump, avoid bullets and bombs and return fire. All of this without exposing themselves to unnecessary risks, but carefully planning their every move.

El Misterio Del Nilo is a well-made, fun, challenging and original game, not easy to categorize as it includes elements of different genres: platform, shoot-em-up, puzzle. Firebird released it in English under the title *Mystery Of The Nile,* with a few small changes in the graphics.

WHERE THERE WAS NO SPECTRUM (ALMOST)

Even in some of the countries where the Spectrum was not officially imported, but available through the black market, or where local companies manufactured machines based on its architecture and more or less compatible with it, there were software houses that produced and marketed programs for the Spectrum or its clones. Here we recall the best known ones.

CIBERNE (Brasil, 1985-1987?)

Thanks to Einar Saukas it was possible to reconstruct the history of this software house. So far only one game from its production has been recovered, the text adventure *Amazônia,* released in 1985 and based on a similar title, *Aventuras Na Selva,* published in August 1983 on issue 23 of the *Micro Sistemas* magazine as a listing for the ZX81. *Amazônia* was developed through an application for programming text adventures published by Ciberne too, *Sistema Editor De Aventures* by Renato Degiovani, author of both *Amazônia* and *Aventuras Na Selva.* The ZX81 game was very well received, which prompted Degiovani to write a revised, expanded version of it in machine code rather than BASIC. This also prompted him to develop the *Sistema.*

Amazônia was very successful and was also converted for the TRS-80, MSX, MS-DOS (CGA, VGA and SVGA on CD-ROM, first game in Brazil on this medium) and Windows. However, the Spectrum version was undermined by an impressive amount of bugs, some of which prevented the game from being completed. In 2011 Saukas identified and corrected them all. The game's entry in the archives of the *World Of*

Spectrum and *Sinclair Computing* websites hosts both the original and the reworked version by him, along with a detailed list of bugs and fixes. A new expanded edition was released by Bitnamic in 2020 in digital and physical format, on cassette.

PROXIMA (Czechoslovakia-Czech Republic, 1990-1994)

The software house from Ústí nad Labem, Bohemia, released a wide range of programs for the Didaktik series, local clones of the Spectrum. Among its productos: *Peloponéská Válka,* a strategy-management game where the player leads Athens against Sparta in the Peloponnesian war; *Aven,* a maze arcade game with a sci-fi setting; the puzzles *Koky,* where some cubes with colourful faces must be arranged in the same order, *Magic Dice,* a sort of Tetris with dominoes, *Tango,* whose protagonist has to walk upon some tiles following a set path, and *Zlý Sen Františka Koudelky,* an elaborate *Sokoban* clone. Applications include the *Orfeus* music editor, *Desktop* word processor, *David* and *Goliath* copiers, *DevastAce* and *DevastAce II* assemblers, and *Edit Sampler* speech synthesis program.

STOP INFORMÁTICA (Brasil, 1987?)

Not much is known about this Rio de Janeiro company. Its only known product for the Spectrum, also recently recovered thanks to Einar Saukas, is the text adventure *A Lenda Da Gávea,* where the player impersonates a mountain guide in search of an alien spaceship thought to have crashed in prehistoric times on the hills of Tijuca, a northern district of Rio. The Spectrum version was entirely developed by Luiz Fernandez de Moraes with Gilsoft's *Graphic Adventure Creator,* while MSX one was programmed by Renato Degiovani; Moraes only contributed to illustrations. *A Lenda Da Gávea* was the first text adventure with graphics made in Brazil, and together with *Amazônia* it is still considered the most popular computer game produced in that country.

SUZY SOFT (Yugoslavia-Croatia, 1985-1988)

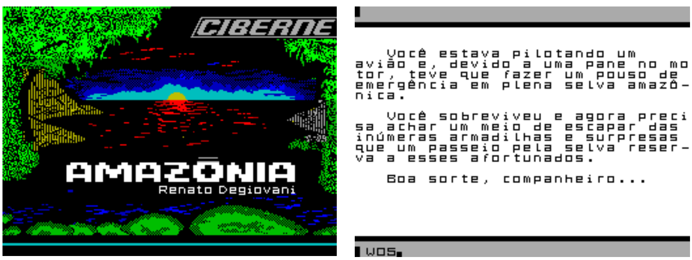
In Yugoslavia, a country that boasted a notable indigenous IT industry since the 1950s, interest in computers was strong. The Spectrum was sold on the 'grey market', tolerated by the authorities but formally illegal, and its popularity was considerable. Some programmers, such as Serbs Duško Dimitrijević, Damir Muraja and Davor Magdić, were able to make themselves known abroad, coding games for Imagine and Bug-Byte. On a national level, however, it was Croatian Suzy Soft that represented the commercial aspect. It was a subsidiary of Suzy Records of Zagreb, a record company founded in 1972 and still existing today. For the Spectrum it made a number of games, including *Ali Baba,* an unofficial conversion of the Sega *Ali Baba And 40 Thieves* coin-op, and *Pećinski Heroj* (also published in Slovenian under the title *Jamski Heroj*), a clone of *BC's Quest For Tires* by Software Projects.

The curious text adventure *Vruče Letovanje* (*Vroče Počitnice* in the Slovenian version) deserves a separate mention. Set between June and July 1985, it follows the protagonist Srećko in an attempt to organize a long-awaited beach holiday with his family. There are various references to life at the time in the Balkan country: lines at banks and post offices, the differences between the languages spoken in the various Republics of the Federation, a box of chocolates to give as a gift to solve a problem. A prize contest was associated with it: once the game had been completed, the user was asked to save some data on a cassette to be sent to Suzy Soft together with a coupon printed at the bottom of the game instructions by 30 July 1985. Prizes up for grabs were, in order, a set of records, a set of cassette tapes and a set of games. To this date, it is not known whether there have been any winners.

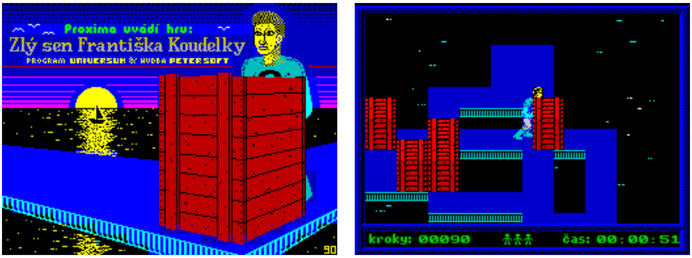
ULTRASOFT (Czechoslovakia -Slovakia, 1990-1996)

In terms of importance for the history of software produced for the Spectrum, or rather for its clones, what is Proxima for the Czech Republic is Ultrasoft for Slovakia, even if this software house, unlike the first, produced almost exclusively games. Utilities worth mentioning are the *ZX-7* music editor and the *Datalog 2 Turbo* database.

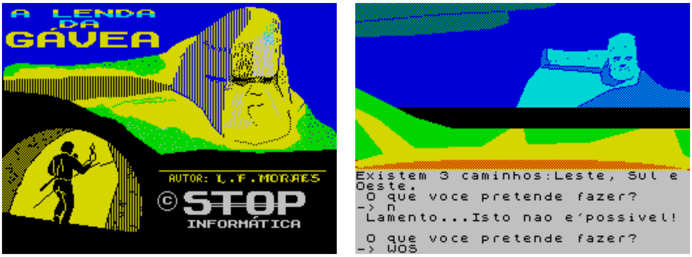
Regarding videogames, the most interesting titles are: *Komando II,* a *Commando* clone; arcade adventure *Kliatba Noci;* the *Quadrax* puzzle; *Towdie,* a dynamic adventure inspired by *Dizzy; Tetris 2,* an unofficial sequel to *Tetris* programmed by Czech František Fuka, now known in his country as a film critic, with an option for simultaneous two-player action; *Twilight: Krajina Tienov,* a unique example for the Spectrum of point-and-click adventure, presented by an extraordinary animated introductory sequence.



Amazônia

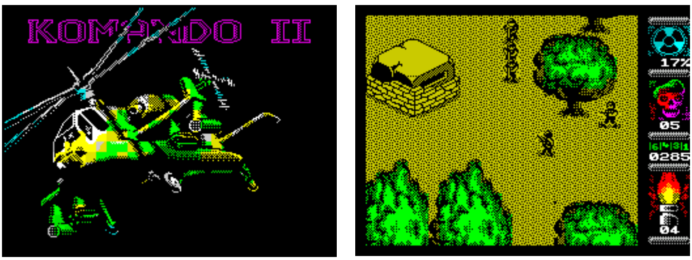


Zlý Sen Františka Koudelky



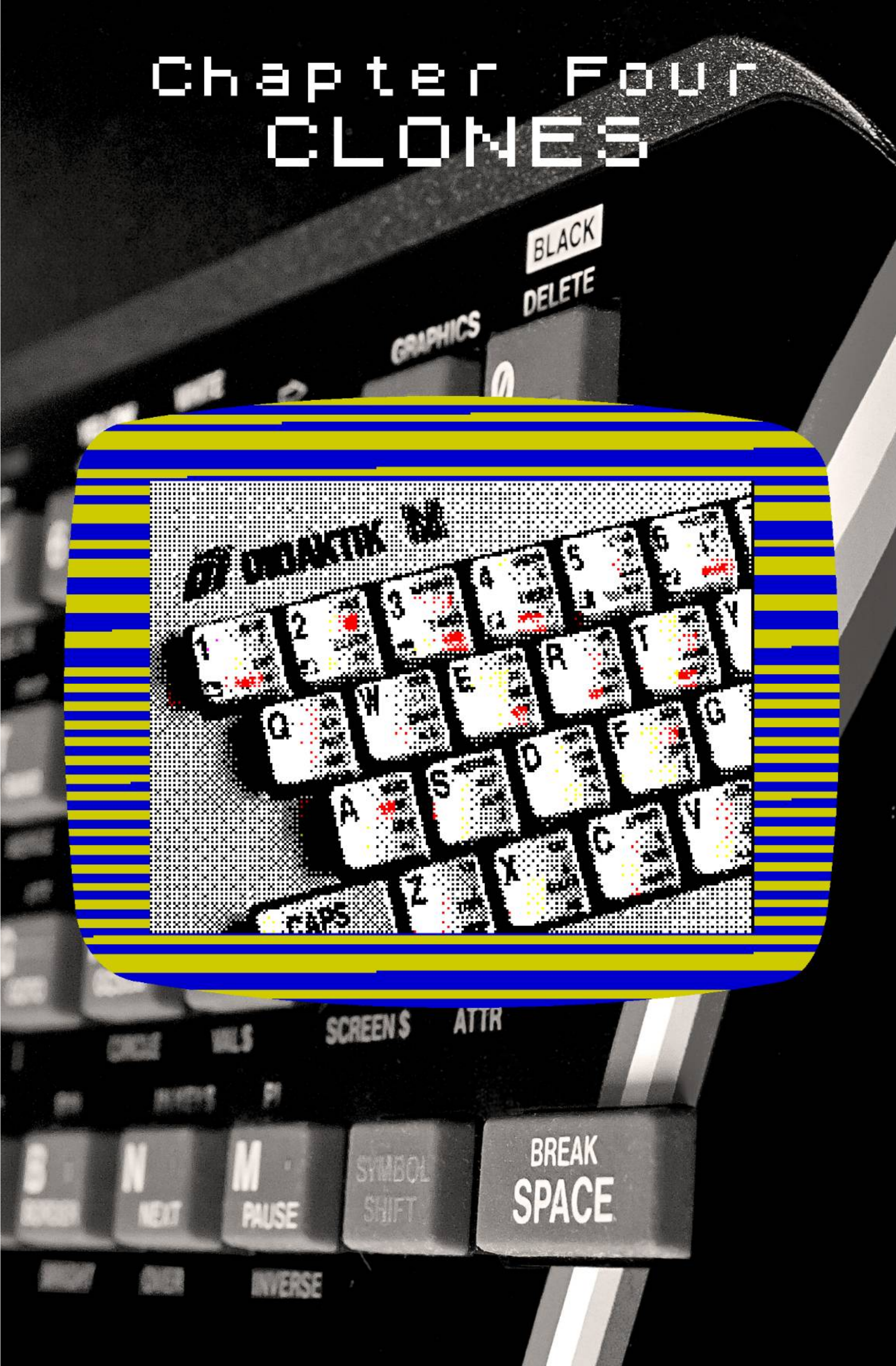
A Lenda Da Gávea

Vruče Letovanje



Komando II

Chapter Four
CLONES



The Spectrum, due to its relatively simple architecture, served as the basis for other machines called *clones*, only in a few cases directly authorized by Sinclair Research, like the Timex Sinclair TS 2068. The vast majority of them were either alternative versions created to circumvent copyright legislation (Inves Spectrum), or machines located in a 'grey zone', produced in contexts where such legislation was less strict, for example Brazil. In addition, there were clones designed and built in countries that recognized little or no copyright protection, especially the Soviet Union, and new architectures developed by small companies. The most recent clones, the work of individual authors or teams, are covered in the first chapter of Volume 2. Clones are presented by country of origin.

Most of the 'historical' and advanced clones come from the countries of Central-Eastern Europe and the former USSR. The extreme difficulty, if not the impossibility, of obtaining a genuine Western computer in the countries that were then part of the Warsaw Pact, due to the restrictions on the circulation of goods and technologies from the West in place until the beginning of the 1990s, caused a proliferation of machines more or less compatible with the Spectrum, for both educational and recreational purposes. In fact, especially in countries like Yugoslavia and Czechoslovakia, several local software houses produced games and applications, sometimes specifically targeted at clones, as in the case of Ultrasoft in Slovakia. While maintaining a partial or total compatibility with the Spectrum, depending on the degree of manipulation of the original ROM, these machines almost always added new hardware features, such such as interfaces for standard floppy disk drives – the Beta Disk in particular was very common – or joystick and printer ports.

ARGENTINA

Argentine clones of the Spectrum – and also of the ZX81 – were manufactured between 1985 and 1987 by Czerweny Electrónica S.A. of Paraná, in the state of Entre Rios. It was an independent company founded in 1982 as a subsidiary of Czerweny Motores, an electric motor factory in Galvez (Santa Fe) founded in 1941 by Tadeo Czerweny (1908-2000), an entrepreneur of Ukrainian origin.

A prototype of pocket calculator by Czerweny, with a design inspired by Sinclair Cambridge

Czerweny Electrónica (henceforth Czerweny for short) resumed the attempt to diversify Czerweny Motores's output, started in 1975 with the creation of an electronics division for the manufacture of calculators. The company worked closely with IBM Argentina through the latter's two employees Hugo Mazer and Oscar Crippa. Calculator prototypes were made using, among others, Sinclair models as an inspiration, but the project did not materialize to large-scale production, since the strong devaluation of the Argentine peso, decided at that time by Celestino Rodrigo, then Minister of Economy, caused a shortage of components supplied from abroad which led to the decision to stop manufacturing calculators.

It was on this basis that in 1983 Czerweny, refounded as a separate company, resumed contacts with Sinclair Research to produce home computers in Argentina. The historical moment was not the best: relations between the South American country and the United Kingdom were still tense due to the recent Falklands war. However, Czerweny could count on the infrastructure and supplies deriving from ties with IBM Argentina, so an agreement was reached for the manufacture of local versions of Sinclair computers. Due to the commercial ban on British products imposed by the Argentine government after the war, Czerweny clones could not assume the original names, so they were renamed with the initials CZ followed by a number.

Advertising for the CZ 2000. Note the connection to the two Microdrives and to the Seikosha GP 50S printer.

Around April 1985, three models were launched on the market, the *CZ 1000, CZ 1500* and *CZ 2000.* The first two were clones of the ZX81. The CZ 1000 had a case similar to the original, the second had the same of the Timex Sinclair TS 1500. Both machines were in fact clones produced under license in Portugal by Timex with the names *TS 1000* and *TS 1500* and rebranded with the Czerweny names. The CZ 2000 was instead a clone of the Spectrum assembled on Issue 4 and 6a motherboards also imported from Portuguese Timex, while its case was the same as the TS 1000/CZ 1500, but black instead of silver-grey.

After a short time, Czerweny switched to producing Sinclair clones by itself, as Timex Sinclair, after withdrawing from the US market, had begun to distribute their versions of these machines in Argentina, including the TS 2068, a clone of the Spectrum with more advanced features than the CZ 2000. The competition from Brazilian clones of the ZX81 and Spectrum from Microdigital, distributed in Argentina by Arvoc, was not to be underestimated. Thus, the *CZ 1000 Plus, CZ 1500 Plus* and *CZ Spectrum* were born; the latter was followed, in 1986, by the *CZ Spectrum Plus.* The new models featured a revised motherboard, plus one or two joystick ports, a reset button and a monitor video port, as well as cases other than Timex ones. Czerweny also produced a joystick for its CZ clones, while other Argentine companies made various peripherals, such as the Disciplus interface with attached 5” ¼ floppy drive, the EPI (Empresa Para Informática) optical pen or the Snapshot Valente, a device similar to the Multiface.

Left: CZ joystick.
Right: Disciplus interface with a 5” ¼ floppy disk drive.

Around 4000 CZ Spectrum per month were manufactured at the Czerweny plants. The history of Czerweny computers, however, was not meant to last long. In June 1986, the factory in Oro Verde near Paraná was completely destroyed by a fire generated by a short circuit. In September 1987, Czerweny, already in trouble for this event and pressed by competition from IBM and Commodore, permanently ceased the production of Sinclair-derived machines.

CZERWENY ELECTRÓNICA CZ 2000 (1985)

The CZ 2000 is a copy of the 48K ZX Spectrum. It mounts Issue 4 and 6a motherboards imported from Timex Portugal, while the case is a black version of the silver-grey one for the CZ 1500, itself a rebranded Timex TC 1500, a clone of the ZX81. The RF modulator has been modified to produce a PAL-N signal, in order to make the computer usable with local television sets.

For the rest, the CZ 2000 is identical to a common 48K Spectrum, and as such fully compatible with programs written for the British machine.

CZERWENY ELECTRÓNICA CZ SPECTRUM (1985)

Built on a motherboard redesigned by Czerweny, the CZ Spectrum was equipped with two standard joystick ports, a monitor port and a reset button, but came with a new and larger case.

CZERWENY ELECTRÓNICA CZ SPECTRUM PLUS (1986)

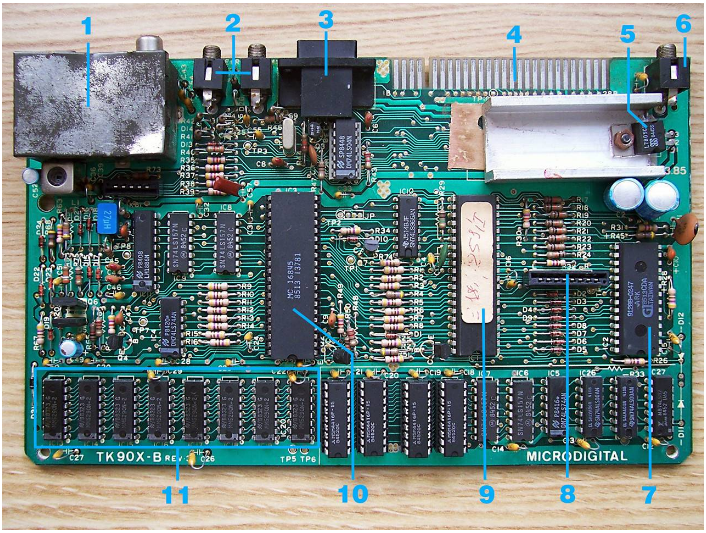
A copy of the ZX Spectrum +, with ROM messages translated into Spanish.

BRAZIL

MICRODIGITAL TK90X (1985)

Clone of the 16/48K ZX Spectrum from Microdigital of São Paulo, founded in 1981 by brothers George and Tomas Kovari (from the latter come the initials TK). The company also produced the TK82 and TK83, both clones of the ZX81, and the TK85, another clone of the ZX81, but with a case similar to that of the Spectrum and almost identical to that of the TK90X. It has a Sinclair joystick port and a partially modified ROM, as it includes a user-definable graphics editor and the new TRACE function. Also, all messages are translated into Portuguese. This, as well as some differences in the configuration and addresses of some I/O ports, limited its compatibility with Spectrum software, which, combined with the difficulty of obtaining original titles, originated a large piracy business that offered programs – especially games – adapted to run on the TK90X at reduced prices. The TV modulator tunes to UHF channel 3 and follows the PAL-M standard at 60 Hz, for compatibility with local TVs. The computer can send the audio signal directly to the TV speaker.

The TK90X experienced a wide diffusion in its country of origin as well as in Argentina. Here, it was distributed by Arvoc, a subsidiary of Microdigital, in competition with Czerweny clones. The TK90X was also exported in other South American countries such as Chile (where original Sinclair Spectrums were imported, adapted for the NTSC TV standard by means of a 6C011E-3 ULA), Uruguay or Ecuador. Exemplars marketed in all of these countries had their ROM messages translated into Spanish.



Internal view of the TK90X: 1-modulator and RF connector; 2-EAR and MIC connectors for the K7 tape recorder; 3-DB9 joystick port; 4-expansion port; 5-5V DC voltage regulator; 6-9V DC power connector; 7- I/O integrated circuit; 8-keyboard connector; 9-Zilog Z80A processor; 10-ULA MC16845 integrated circuit; 11-memory chips for a total of 48 KB, of which 16 in 8 chips and 32 in 4 chips.

MICRODIGITAL TK95 (1986)

Compared to the previous model, the TK95 has a s case similar to that of the Commodore Plus/4, a 57-element plastic keyboard, and a revised ROM for better compatibility with the Spectrum. It was available in the 48 KB RAM configuration only.

For both computers, Microdigital produced a light pen, a joystick and a parallel printer interface. Third parties manufactured other peripherals, for example the CBI-95, Arcade AR-20 or Cheyenne CAS disk interfaces, all derived from the Beta Disk.

Left: Microdigital light pen.
Right: Arcade AR-20 printer/floppy disk drive interface.

CZECHOSLOVAKIA/ SLOVAKIA


DIDAKTIK GAMA 87/88/89 (1987, 1988, 1989-1992)

The Gama was the first of the Spectrum-derived computers produced by Didaktik Elektronik in Skalica (then part of Czechoslovakia, now Slovakia), a still operating company, although it ceased manufacturing computers in 1994. It went through three revisions. The *Gama 87* is equipped with 80 KB of RAM, but since the Z80A does not allow to address more than 64 at a time, an OUT 127 command must be entered to toggle between the original 16 KB and two other 32 KB banks. A LED on the right side turns on when the additional banks are active. Unfortunately, when RAMTOP is set higher than 32768, a bug in memory paging causes the system to crash when the additional bank is activated. Changes to the original ROM resulted in software compatibility problems too.

To resolve these drawbacks, the *Gama 88* appeared. Its case was grey instead of black and was free from the defect that made it practically impossible to switch between memory banks. However, its ROM was still plagued by impefections which continued to limit compatibility with existing software.

These will only be solved by the third model, the *Gama 89*, externally identical to the 88, but with a further revised ROM and a character set extended to the Cyrilic alphabet. Its production continued until its definitive exit from the scene in 1992.

Common features to all Gamas are, in addition to the RAM configuration, the presence of a monochrome composite video output for monitors next to that for the TV, an 8255 parallel interface and a DIN input used for both the power supply unit and the tape recorder.

Internal view of the Didaktik Gama 87: 1-RF connector; 2-composite connector for monochrome monitors; 3-DIN input connector for the power supply unit and the tape recorder; 4-Ferranti ULA; 5- expansion port; 6- Zilog Z80A processor; 7-ROM; 8-8255 parallel port; 9-parallel port control chip; 10-Japanese-made 64 KB RAM bank; 11- Eastern European-made 16 KB RAM banks; 12-power LED (green), bank-switching activation LED (red) and reset button; 13-keyboard cable soldered on both sides, which makes it impossible to detach the keyboard from the motherboard; 14-RF TV modulator.

DIDAKTIK M 90/91/92/93 (1990-1993)

In 1990 Didaktik produced a new clone, simply called M, with a redesigned keyboard and four arrow keys at the bottom right. The RAM is lower than that of the Gama, 48 KB which is part of a chipset of overall 64 KB. The ULA is manufactured by the Soviet company Angstrem and produces a video image with an aspect ratio of 1:1, instead of 4:3 like that of the ordinary Spectrum and Gama. The CPU runs at a frequency of 4 MHz against the 3.5 of the Spectrum, in order to solve a phase shift problem with ULA timings. Other changes affect the character set and initial messages.

The M is also fitted with two Kempston and Sinclair (non-standard) joystick ports and can be connected to the optional D40 5” ¼ or D80 3” ½ floppy disk drives. It was affected by four revisions, named *90, 91, 92* and *93.* The first two are almost identical and differ for a slightly modified keyboard in the 91. The 92 has an extensively revised firmware. The 93 is a 92 with minor firmware changes.

Internal view of the Didaktik M: 1-RF modulator; 2-TV cable connector, 3-connector for monochrome monitors: 4-DIN input connector for the external power supply unit; 5-DIN input/output connector for the tape recorder; 6- Zilog Z80A processor; 7-expansion port; 8-16 KB ROM chips, 9-Soviet-made ULA chip; 10-Kempston--compatible (left) and Sinclair-compatible (right) joystick ports; 11-Soviet-made 64 KB RAM chips.

DIDAKTIK KOMPAKT (1992-1994)

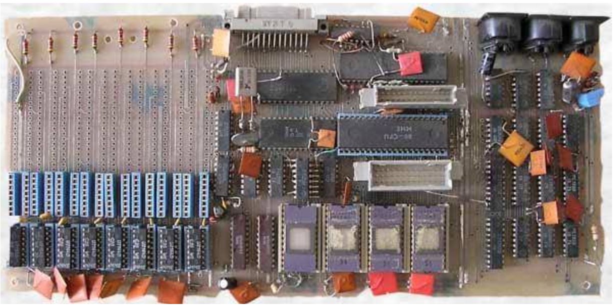
The Kompakt is an M with a built-in 3” ½ D80 floppy drive. This device uses 720 KB dual-density formatting, possibly expandable up to 840 KB, and is driven by the internal MDOS operating system, developed by Didaktik itself. The Kompakt also includes two standard Kempston and Sinclair compatible joystick ports, an 8255 parallel port like the Gama, and a SCART audio-video connector.

None of the Didaktiks had the ability to emit any other kind of sound than that of the traditional monophonic beeper. The optional Melodik module (left) compensated for this lack: at its centre there was the AY-3-8912 sound chip mounted on all Spectrums from the 128 onwards.

GERMAN DEMOCRATIC REPUBLIC

East German clones are mostly the result of experiments for study purposes conducted in certain Polytechnics and distributed through the press or in kits for enthusiasts, who enjoyed assembling them themselves. Their CPU is nearly always a locally built microprocessor, the U880, an unauthorized copy of the Zilog Z80. As the Z80, the U880 has known several variants: it provided the basis for the Soviet T34VM1 and KR1858VM1 and other, more advanced, CPUs.

GRAFIK-DISPLAY-COMPUTER 204 (1985)



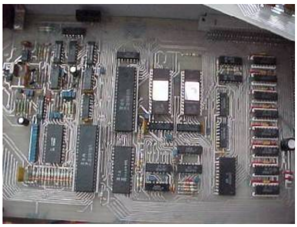
Produced at the Technische Hochschule (now Technische Universität) in Ilmenau, the GDC 204 was based on the U880 and partially compatible with the Spectrum: timings were different and video output only in black and white. Ralf Rathgeber received a copy of the clone at the end of 1988 and reworked it to make an improved, fully Spectrum-compatible version (left).

FGC87 (1987)

Also made in Ilmenau on the basis of the GDC 204, this computer was equipped with 8 U2164 ICs for a total of 64 KB of RAM, 16 of which hosted the ROM in use, copied there when the machine was turned on. This way, it was possible to make changes to the firmware and program in BASIC. The first versions were instead equipped with a 2 KB service ROM, so they had to load the operating system from tape. There are three video outputs: RGB for colour TVs, one for black and white TVs and one for green phosphor monitors.

The FGC87, like all East German Spectrum clones, did not come with a case or keyboard, which the user had to provide, sometimes reusing old electronic typewriters. About 250 were built. Unlike the GDC 204, it was fully compatible with software for the 48K Spectrum.

HCX (1987-1988)

HCX assembled by Viktor Cielepak, Magdeburg

Conceived in the laboratories of the Technische Universität of Magdeburg, incorporated into the Otto von Guericke Universität since 1993, the HCX – the origin of the name is unclear – was made up of a more elaborate motherboard than that of the GDC, with two iU885 and U887 ICs to 'simulate' the Spectrum ULA. This fact and the different structure of the

ROM meant that the HCX, like the GDC, was only partially compatible with the Spectrum. The motherboard production was entrusted to the local Schwermaschinenbau Kombinat 'Ernst Thälmann', in short SKET, one of the largest Kombinat (conglomerate companies) of the GDR, then dismembered and privatized after the reunification of 1990, but still existing. Only a few examples were produced, and the HCX remained confined to a small circle of enthusiasts.

SPECTRAL (1987-1988)

The continuation of an initial prototype called EPR01, the Spectral was developed by the IFAM (Ingenierbüro Für die Anwendung der Mikroelektronik) in Erfurt, still existing today. It was manufactured in the VEB Mikroelektronik 'Karl Marx' factory in the same city, one of the most advanced microelectronic production centres in the country: it produced the U880 and, since 1989, the U80701 32-bit processor, whose rights were acquired by Zilog in the 1990s when the company was privatized and restructured several times, until it assumed the current name of X-FAB Semiconductor Foundries. From 1st December 1988 and until the end of production, distribution was entrusted to Hübner-Elektronik, also in Erfurt, then the sales point for VEB Robotron-Vertrieb and nowadays an independent company.

The Spectral was sold as a 'ZX Spectrum compatible computer for amateurs' in kit form, including components, motherboard and instructions. It was equipped with a 4 MHz UA880D processor while clock frequency was 13.824 MHz. The RAM amounted to 48 or 128 KB; in the latter version, the memory was addressed by the CPU in pages of 16 KB each. The Spectral was also able to send the video signal through the common RF output or to an RGB monitor. It also had connections for matrix keyboard, tape recorder and Kempston joystick, as well as the usual expansion port. It was almost entirely compatible with the Spectrum.

A Spectral placed inside an old electronic typewriter case

KUB64K (1989)

A clone designed by the prestigious Berlin Academy of Sciences and built by the Liebenwalde Centre for the Construction of Scientific Equipment. Originally, the ROM was only 2 KB and the operating system had to be loaded from tape. The final version was equipped with a 16 KB ROM, thus eliminating this need. The KUB64k also fitted the U8272 floppy controller, compatible with the CP/M 2.2 standard, which relieved the CPU of the task of sorting the incoming data. Only four examples of the KUB64k remain today.

HUNGARY

HÍRADÁSTECHNIKA SZÖVETKEZET HT 3080C (1986)

The only known Hungarian clone of the Spectrum is also one of the most mysterious. It was designed as part of the computer education program *Iskolaszámítógép* ('computer for schools'), planned by the local Ministry of Education in 1981. The program was aimed at establishing computing laboratories in primary and secondary schools for the learning of basic computer science and programming languages such as BASIC, as well as training teachers for this purpose. Activities began in April and May 1983. The first machines adopted as 'computer for schools' were two clones of a first issue Tandy TRS-80 made by Híradástechnika Szövetkezet in Budapest. However, over time they proved inadequate and in 1985 another competition was launched in this regard, which in March 1986 saw another product from the same enterprise, the HT 3080C, among the selected machines.

Externally, this computer was no different from its predecessors, including the built-in recorder on the right side, but the inside was deeply changed: a clone of the Spectrum was born. Its technical specifications were:

- 64 KB RAM;
- ROM up to 48 KB;
- expanded 74-element keyboard with keys for Hungarian and 8 keys for function recalling;
- RGB and TV colour video output;
- AY-3-8910 sound chip, connected to the CPU with a different scheme from the Sinclair one;
- Z80 bus connector;
- two 8-bit I/O Centronics interfaces, light pen, joystick, Commodore (V24) serial port for the 1541 floppy disk drive;
- extended BASIC;
- an auxiliary program able to understand and run software written for the 48K Spectrum.

In order to ensure compatibility with the Spectrum, the HT 3080C had to load its ROM from tape. Since only a few schools chose it among the machines selected by the Ministry, mass production was not started and the computer remained in the prototype stage.

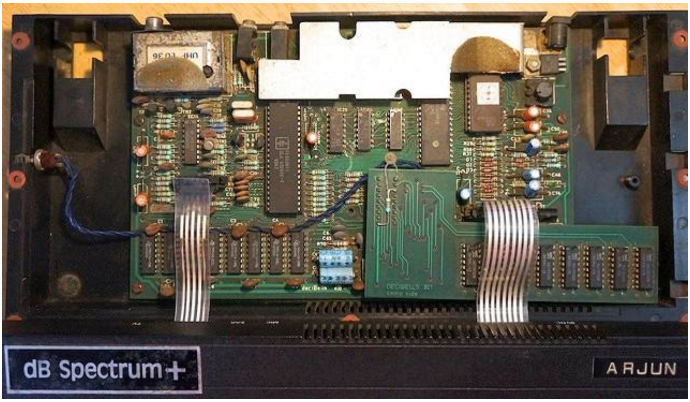
Advertising for the HT 3080C, 'the new computer for schools'

INDIA

DECIBELLS DB SPECTRUM + (1986)

This Spectrum + clone was manufactured in Pune under license from Sinclair Research. Compared to the original computer, it is identical in both appearance and technical specifications. No changes were made to the ROM. The dB Spectrum + was one of the first home computers to be sold in India at a competitive price, around 6,000 rupees. At that time (1986) it was a quite substantial sum for the middle class, but by 1988 the computer could be found in the most popular large retail chain shops.

Besides the official channels, an unofficial 'grey' market arose, where it was possible to find (often badly duplicated) software, peripherals and books at reduced prices. In fact, while the 'canonical' distribution offered various types of programs (all with the same generic inlays) for about 50 rupees per cassette, on the unofficial market duplicate cassettes were sold for about 30 rupees each, including games impossible to find through official channels. Books could also be found officially, but the small number of those available often made it mandatory to look for them on street stalls, where good deals could be made.



The dB Spectrum + had some success in India, evidenced by the fact that it was one of the few home computers to be advertised on state television at the time.

[Thanks to Arjun Nair for the information and images pertaining to the db Spectrum +.]

POLAND

UNIPOLBRIT KOMPUTER 2086 (1986)

A semi-official clone, a rare case for countries of the then Warsaw Pact. It was the result of an agreement between two companies, Unimor in Gdansk and Polbrit International – a subsidiary of Timex whose name, according to various sources, derives from ‘Pol’ for ‘Poland’ and ‘Brit’ for ‘Britain’ –, hence the name. The Unipolbrit Komputer 2086 was a localized version of the Timex Computer TC 2068, itself a Portuguese reworking of the Timex Sinclair TS 2068 produced in the United States (the TC 2048 was already sold in Poland with documentation translated into the local language). An optional external floppy drive was also available. It differed from the TC 2068 by the presence of a DB15 printer port in place of the

right joystick port and of an audio/video connector on the rear. For the rest, it kept all of its characteristics, including the need to use a cartridge to be inserted in the built-in reader, in order to ensure full compatibility with software originally written for the Spectrum.

ELWRO 700 SOLUM/800 JUNIOR/ 804 JUNIOR PC (1986-1990)

In 1985, the Polish Ministry of Education entrusted the Instytutu Automatyki Politechniki of Poznań with the task of developing a computer for school use. It had to be inexpensive and compatible with the ZX Spectrum, for which a large amount of software, mostly locally produced, was available. A computer was then designed; it began to be manufactured the following year by Mera-Elwro in Wroclaw. Mera-Elwro already produced computer systems based on the 8080 processor and its derivatives. Two systems emerged: the *700 Solum,* not adopted due to compatibility problems, and the *800 Junior,* which was chosen instead.

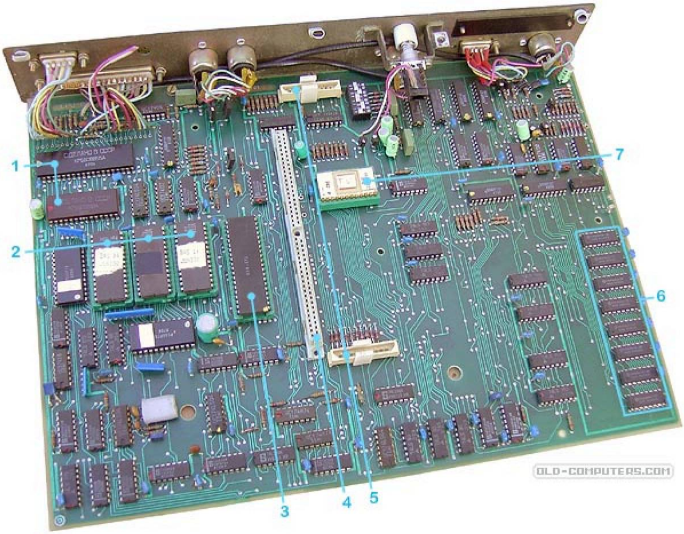
The Elwro 800 Junior is a machine designed for use in school laboratories. Consequently, it comes in three different versions: ‘student’, simply called 800 Junior, without a floppy drive controller and connector; ‘teacher’, called 800-2 Junior, equipped with a floppy drive controller and connector; and one for home use, called 800-3 Junior. All of them share the same case, also used for the small Elwirka electric organ; the latter's stand placed on the top was kept. Compared to the Spectrum, the other changes were:

- 64 KB RAM and 24 KB ROM;
- 76-element professional Hall-effect keyboard with letters and diacritics used in the Polish language;
- optional text mode with 64 characters per line through an alternative font with 4×8 pixel characters;
- compatibility with the CP/J operating system, a modified version of the CP/M for use with the Junet proprietary local network system; it was enabled by disabling the ROM, while maintaining compatibility with CP/M 2.2;
- connectivity: DIN output connector for monochrome monitors; RGB output for colour monitors; DIN I/O connector for tape recorders; reset button; double DIN I/O connectors for the Junet local network; joystick port; parallel printer port.

The presence of the Junet local network allowed computers, once connected, to share 5" ¼ floppy disk drives and printers.

Back of an Elwro 800 Junior with its various connectors

In 1990 an advanced version appeared, the *Junior 804 PC,* with a new case and a built-in 3" ½ floppy drive. Never produced on a large scale, it remained little more than a prototype. Mera-Elwro was absorbed by Siemens in September 1993.

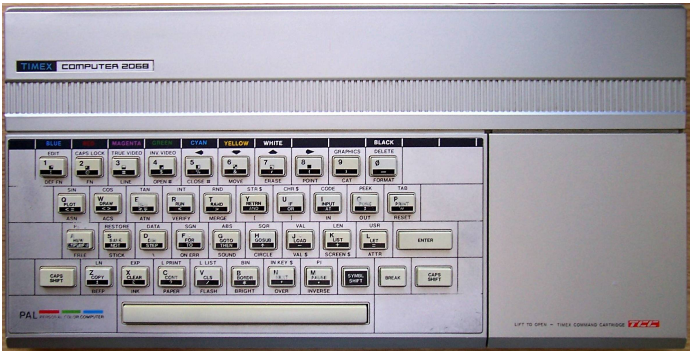


Internal view of the Elwro 800-2 Junior: 1-8055 and 8035 I/O chips for the joystick, parallel and local network ports; 2-the three 2764 EPROM chips containing Sinclair BASIC and the operating system; 3-processor; 4-connector for the floppy drive controller board; 5-keyboard connectors; 6-eight 4164 RAM chips of 8 KB each; 7-EPROM for the character generator.

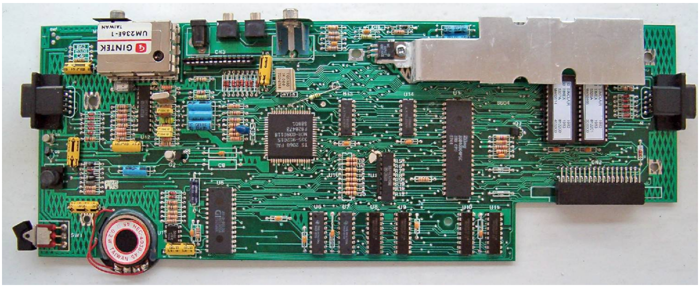
An Elwro Junior 804 PC.
Very few units of this computer still exist.

PORTUGAL

TIMEX COMPUTER TC 2068 (1984)



The Timex Computer TC 2068, abbreviated to TC 2068, is the Portuguese version of the Timex Sinclair TS 2068, the 'enhanced' Spectrum produced in the United States. The TC 2068 differs from its American counterpart for some modifications made in order to solve compatibility problems. The TV modulator and SCLD chip have been modified to make the computer compatible with the PAL television standard. The buffer amplifiers placed between the Z80 bus and the SCLD bus have been removed and replaced with resistors as in the Spectrum. Power supply is 9V DC. The expansion port is compatible with those of the Spectrum and TC 2048, thus making it unnecessary to use the additional Zebra Systems Twister card to operate Sinclair interfaces, as well as external 3” FDD floppy drives (160 or 640 KB capacity, 16 KB RAM, RS232 port) and FDD 3000 (like the previous ones, but with 64 KB of RAM). To the latter, Timex added a CP/M keyboard and terminal, the Timex Terminal 3000.



TC 2068 motherboard

Other prominent features of the TC 2068 are the sending of sound produced by the SCLD chip to the TV speaker and an extension of Sinclair BASIC called BASIC 64, which made it possible to use the 512×192 two-colour mode even in BASIC programs.

The TC 2068 came in a silver-grey and a black version; the latter formed the basis of the Polish clone Unipolbrit Komputer 2086. It was also fully compatible with software for the Timex Sinclair TS 2068, including cartridges.

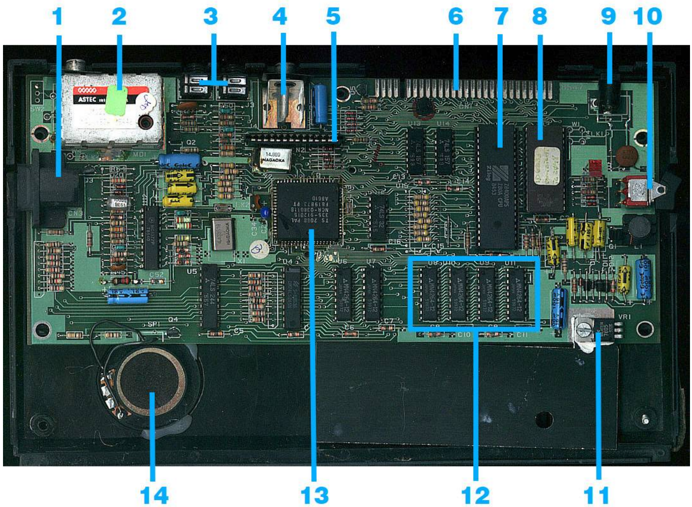
TIMEX COMPUTER TC 2048 (1984)

Contrarily to the TC 2068, this computer is not a European version of an American Timex machine, but a product entirely developed and manufactured in Portugal by Timex Computer, the local subsidiary of Timex Corporation.

It is based upon the TC 2068, but some features have been eliminated: the cartridge reader, the AY-3-8912 sound chip and one of the two joystick ports, reworking the other in accordance with the Kempston standard. The ULA is the same as the TC 2068, thus the characteristic 8×1 and 512×192 pixels in two colours graphic modes are still present. The ROM has been further modified to make it even more compatible with that of the Spectrum, but some differences remain, as per the following table.

Address	ROM TC 2048	ROM ZX Spectrum
4762	CALL 14446	CALL 3082
14446	OUT (255), A	RST 56
14448	CALL 3082	RST 56
14451	RET	RST 56

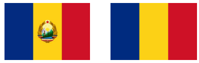
The expansion port is fully compatible with that of the Spectrum instead, to the point where the ZX Interface 1 and 2 can be connected to the TC 2048 without problems.



Internal view of the TC 2048: 1-joystick connector; 2-RF/TV modulator; 3-tape recorder I/O jacks; 4-composite video output; 5-keyboard connector; 6-Spectrum compatible expansion port; 7-Z80A processor, here an original Zilog chip (other units could have a NEC D780C instead); 8-16 KB ROM chip holding the BASIC interpreter; 9-external AC power supply connector; 10-on/off switch; 11-internal 5V DC regulator and heat sink; 12-4 4264 RAM chips of 16 KB each; 13-custom ULA chip made by NCR; 14-loudspeaker.

The TC 2048 would have been the basis for a prototype, called *TC 3256,* equipped with two motherboards and Tenet local network connectors. News about this are extremely scarce, also because towards the end of the 1980s the Portuguese branch of Timex stopped manufacturing these computers. The only certainty is that it never went into production.

ROMANIA



TIM-S/MICROTIM/MICROTIM+ (1986-1990)

The first series of Romanian Spectrum clones came from the Timişoara Polytechnic (hence the TIM letters), and in particular the Territorial Electronic Computing Centre in the same city, the first computer development institute in the Balkan country, founded in 1968 with assistance from France. The Centre converted into a commercial company in 1993 under the name of Infotim S.A. and today it is part of the Eta2U conglomerate, mainly dealing with high-level technical training. The production was instead the work of the local FMETC, i.e. Fabrica de Memorii, associated with the Polytechnic. The main designer of the TIM series was engineer Dumitru Panescu. The TIM series computers were mostly used in schools, provided with monitors and tape recorders.

TIM-S (external view and motherboard)

Preceded by a prototype called *Spec-TIM,* the TIM-S was the first computer industrially produced in Timişoara. Almost entirely compatible with the Spectrum, it was equipped with a Z80B CPU, capable of changing its frequency from 3.5 to 6 MHz through a special ‘Turbo’ switch, 80 KB RAM – of which

16 (on an IC4116) for the video buffer, so as to leave the other 64 entirely to the CPU – on eight IC 4164 chips, 16 KB ROM (on four IC2716 EPROMs), one 96-pin male expansion connector, RS232 port, Centronics parallel port, DIN connector for the tape recorder and three video output connectors (monochrome monitor, RGB and RF-TV).

The *MicroTIM,* a simplified and less expensive version of the TIM-S, was the second computer in the series. It did not include the 7 MHz processor mode and only had 64 KB of RAM, while still retaining the 16 KB for the video buffer. On the other hand, it mounted about 50 ICs against the about 80 of the TIM-S. It was followed by a revised version, the MicroTIM+, initially quite similar in its appearance to the MicroTIM, then reworked into a model where the keyboard was separated from the case, which included an internal power supply unit and a Sinclair joystick port.

All TIM series computers had the ability to copy the ROM into the RAM at address 0, or load a ROM from tape into the RAM at the same location. This allowed to overcome the compatibility problems with Spectrum software, that however, as far as is known, were infrequent and mainly affected some games.

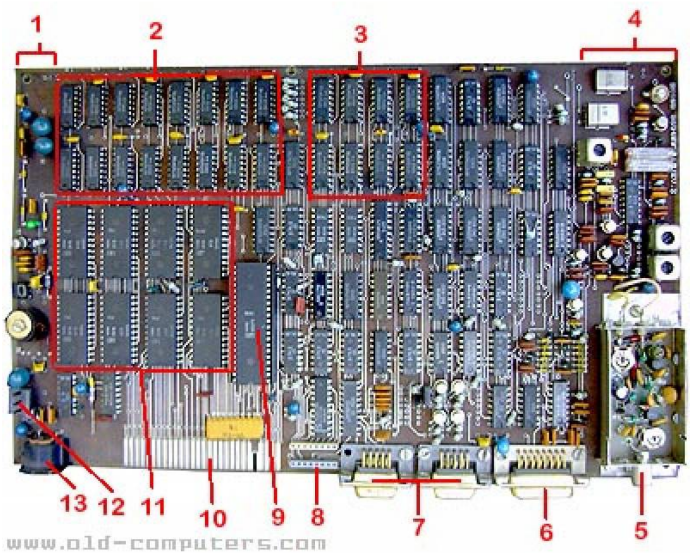
MicroTIM+ (external view and motherboard)

ICE FELIX HC85/HC88/HC90 (1985, 1988, 1990)

PICTURE FROM HTTP://POCKET.FREE.FR/

The HC computer family was created by Inteprinderea de Calculatoare Electronice Felix in Bucharest as a development of the experiments conducted at the Polytechnic of the Romanian capital by Professor Adrian Petrescu since the early 1980s. The HC85 was the first and longest-lived: it remained virtually unchanged, except for some marginal revisions of the keyboard and case, until the early 1990s, when its successor, the HC91, appeared. Main features are: Z80A CPU or locally produced equivalent MMN-80; 16 KB ROM (on an EPROM) and 64 KB RAM; two Sinclair joystick ports; a DIN I/O connector for the tape recorder; an expansion port, very similar to that of the Spectrum; video output connectors for PAL monitors (both monochromatic and RGB) and RF- TV (UHF 10 channel); reset button; +9V DC power input.

The initial model had to load BASIC from tape; a later revision (informally called *HC85+*) had BASIC installed in the ROM and three more connectors: one for an external 5 "¼ floppy disk drive, one for a standard RS-232/CCITT V24 serial line, to connect another machine or a printer, and finally a port to connect other HC85s in a local network, up to a maximum of 64 units. The computer saw two further revisions, the *HC88* and *HC90.* The first mounted 80 KB of RAM instead of 64, while the second had a different keyboard.



The HC85's motherboard mounts a total of 78 chips, of Eastern European manufacture. 1-filter for the tape recorder audio signal; 2-32 KB RAM; 3-16 KB RAM; 4-video signal management circuitry; 5-RF modulator; 6-RGB video connector; 7-joystick ports; 8-16-pin keyboard connector; 9- Z80A processor; 10-expansion port; 11-16 KB ROM; 12-connector for the power supply unit; 13-DIN connector for the tape recorder.

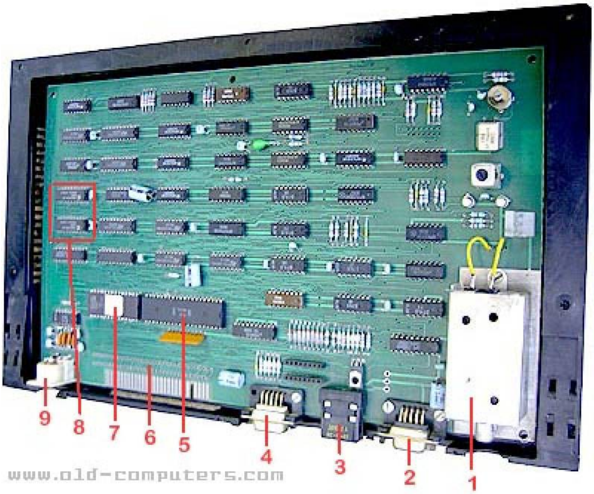
ICE FELIX HC91/91+ (1991, 1992)

For the most part, the HC91 is a revision of the HC85, but with some interesting new features. First of all, the quantity and quality of the ICs changed considerably: 46 chips against 78 of the previous model, not only of Eastern European, but also Japanese, American and even Brazilian origin.

The ROM is divided into 32 KB on EPROM chips, 16 KB for BASIC (derived from the Sinclair one) and 16 KB for the CP/M BIOS. Only 8 KB of the CP/M EPROM are actually mapped, while the other 8 KB are used in the event of a configuration change. The ROM also includes 16 KB of extended BASIC for the floppy disk drive and local network interface controls, modified from the original 8 KB of the Sinclair ROM intended for the Microdrive. The RAM is hosted in two 44C64 ICs, 64 KB×4 bit each. Only 48 are used in BASIC, but CP/M uses the full capacity of 64 (56 KB RAM + 8 KB EPROM). The 8 KB for the video area are paged between addresses 49152 and 57344, and as a consequence the total accessible RAM is 64 KB.

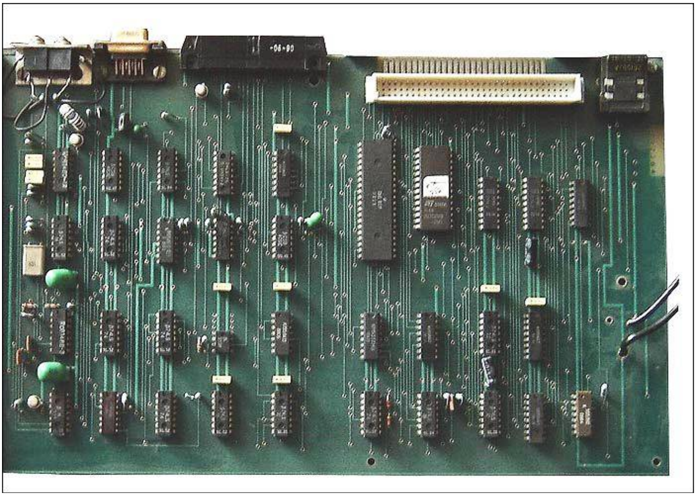
The computer was produced in two versions. The first was inserted in a case with a 40-element keyboard, of the same type as that of the last revision of the HC85, called the HC90. The second is equipped with a 50-element keyboard of improved construction.

Comparison between the HC91's 40-element keyboard (left) and the 50-element one (right)



The HC-91's motherboard. 1-RF modulator; 2-RGB video connector; 3-connector for the power supply unit; 4- standard DB9 joystick port; 5- MMN-80 processor; 6-holes for installing the extension card; 7-16 KB ROM chip for the Spectrum BASIC interpreter; 8-two 4464 RAM chips (64 KB×4 bit); 9-DIN connector for the tape recorder.

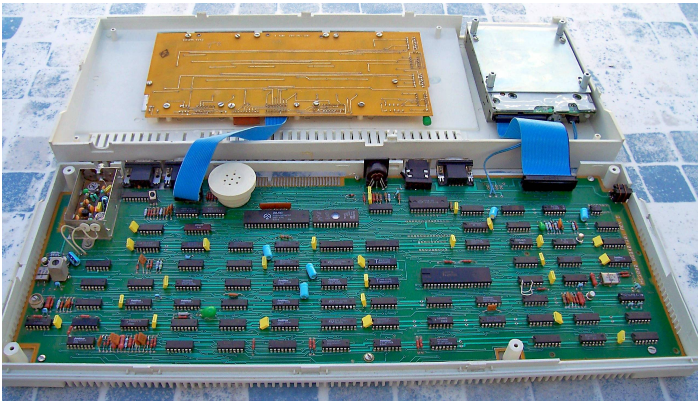
The revised 91+ version included an extension card equipped with three interfaces: 5" ¼ floppy drive, RS232 and local network, mapped in the extended BASIC on channels 'd', 't'/'b' (text/binary) and 'n' respectively. They use the same commands as the Microdrive, with some changes in the syntax.



HC extension board, optional for the HC91, already present in the HC91+

ICE FELIX HC2000 (1992)

The HC2000 is essentially a HC91+ with a built-in 3” ½ floppy drive and internal 8272 controller capable of formatting disks from both sides, single or double density (80 tracks, 720 KB), as well as managing a second external drive through a specific interface. The ROM is contained in two chips of 32 KB each, of which the first houses the internal operating system and the second the CP/M, accessed by entering RANDOMIZE USR 14446, and the instructions for the IF1 disk interface.



Internal view of an ICE Felix HC2000

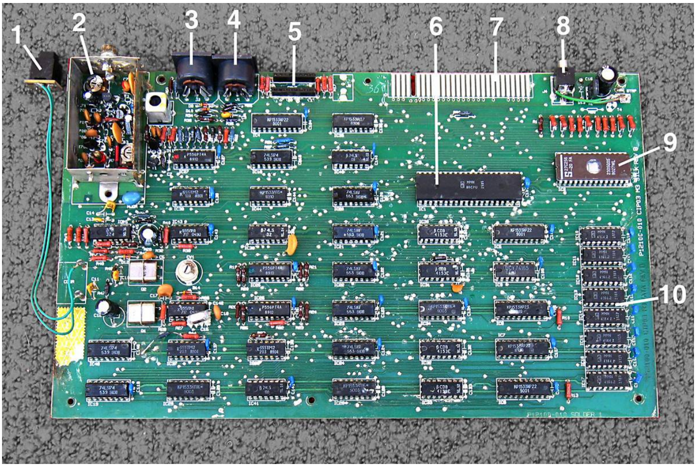
SAGES V1

This small, almost unknown clone of the 48K Spectrum has a keyboard very similar to that of the HC-91's first version. The audio output connector and the two standard 9-pin Atari joystick ports are on the front rather than on the back. The power supply is internal.

ELECTRONICA CIP-01/CIP-02/CIP-03 (1988, 1989, 1990)

CIP is the acronym for *Calculator de Instruire Programabil,* ‘programmable calculator for education’. This series comes from Bucharest too, produced by Intreprindera Electronica. Very little is known about the first two: the *CIP-01* only had 2 KB ROM, containing a copy program, thus the BASIC interpreter had to be loaded in the first 16 KB of the total 64 KB of available RAM. The *CIP-02* was a transition model.

On the other hand, much more is known about the *CIP-03.* It was engineer Calin Popescu’s brainchild – he led the project from design to manufacture. The computer came in two versions, with a red or blue keyboard overlay. It was primarily aimed at computer laboratories in schools as well, and only from 1991 on it was made available to the general public. Its processor was the locally produced MMN-80 chip common to the entire series, 64 KB RAM a mechanical keyboard with 40 elements, arranged in the same way as the 16/48K Spectrum, the usual connectivity – TV and composite video output, tape recorder input/output, expansion port – and a reset button.



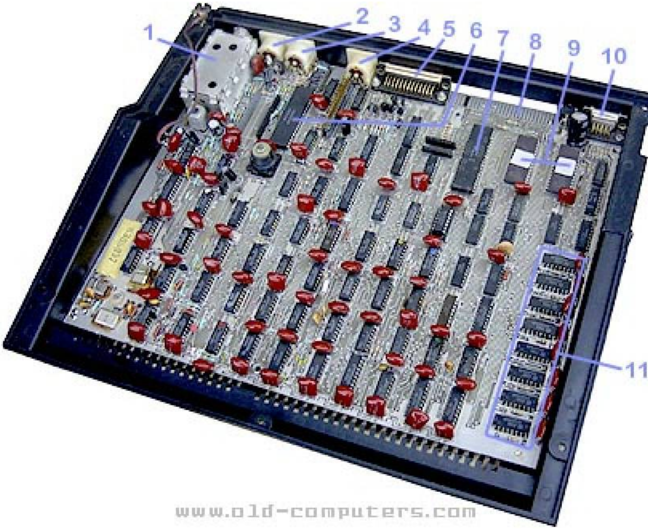
CIP-03 motherboard: 1-reset button; 2-RF modulator; 3-DIN composite connector for the monitor; 4-DIN connector for the tape recorder; 5-keyboard connector; 6- MMN-80 processor; 7-expansion port; 8-jack connector for the power supply; 9-16 KB EPROM containing the Sinclair BASIC interpreter; 10-eight MMN-4164 RAM chips for a total of 64 KB. The approximately 20 standard chips (mostly from the 74xx series) simulate the original Spectrum ULA.

It is not known when the production of the CIP-03 ceased. Popescu reports that, until he left Romania in 1993, the CIP-03 was still in production and that about 15,000 had been built up to that point. Its production is believed to have been halted in 1994, when that of the *CIP-04* successor model also ended.

ELECTRONICA CIP-04 (1992)

This computer is clearly modeled on the ZX Spectrum +3. The menu is identical, with the same options, even if the reference to Amstrad has been removed from the initial message. The processor is still the MMN-80, and as in the +3, its frequency is set at 3.5469 MHz. The ROM is hosted on two M27C256B chips, of 32 KB each, which, like in the +3, contain the 48 BASIC, +3 BASIC and the +3DOS operating system. This suggests it kept the compatibility with CP/M.

On the right side there is a built-in 3" ½ floppy drive for single-sided and double-density (40 tracks) disks, so only 180 KB of these media can be used out of a total of 720; this is likely due to the need to comply with the +3 file system. The controller is a CM-609-P, a Russian-made clone of the better known 8272. The computer is equipped with a unidirectional parallel port without PIO mode – for this reason, it is presumably software-controlled – and a serial port without a UART controller, therefore it would be software-controlled too. There are also the AY-3-8912 sound chip and a Sinclair joystick port. The video connector is used for audio output as well. The most curious aspect, however, is the RAM: there are 256 KB of it, even if the +3 BASIC interpreter can only access 128 of them.



CIP-04 motherboard: 1-RF modulator; 2-DIN composite connector for the monitor; 3-DIN connector for the tape recorder; 4-DIN connector for the serial port; 5-DB25 parallel port; 6-floppy drive controller chip; 7-MMN-80 processor; 8-expansion port; 9-two 27C256 ROM chips of 32 KB each; 10-DB9 joystick connector; 11-eight K565RU7G RAM chips for a total of 256 KB, of Eastern European production.

ITCI COBRA (1988)

The Cobra ('*Co*mputer *Bra*șov') prototype was built in 1986 at the Institutul de Tehnica de Calcul si Informatica in Brașov after about a year of work by eight researchers, coordinated by Professor Gheorghe Toacșe, to answer the government's request of an internally produced computer, for various uses. The hardware part was handled by Vasile Prodan, Wagner Bernd Hansgeorg and Mircea Ungur, while Marcel Arefta, Sorin Finichiu, Mircea Pop and Sorin Cismaș took care of the software. The initial prototype featured a different logo than the final one, a very simple case, and a touch keyboard similar to that of the ZX80 and ZX81. It was only in 1988 that production of the definitive version began. It was assembled in the SIACT-CFR workshops in Brașov from components produced in various other parts of the country as well as in that city. Motherboards, for example, came from ICE Felix in Bucharest, the same that manufactured, among other things, the HC series of Spectrum clones, while the keyboard from IUS, also in Brașov.

Cobra prototype, 1986

The Cobra mounts either the usual Romanian Z80A clone, the MMN-80, or the U880 of East German manufacture as its CPU. Later Cobras could also be equipped with genuine Z80As. Clock frequency is still 3.5 MHz, as in the 16/48K Spectrum. The ROM (initially on an EPROM 92716 chip, then on 27128, 27256 or 27512 chips) is divided into 2 KB for the boot sequence, 16 KB for the standard Sinclair BASIC, 16 KB for the OPUS (‘*Op*erating *U*ser *S*ystem’) and possibly 16 KB for CP/M 2.2+. OPUS was an internal system that included an assembler/disassembler, a memory monitor and a software copying program.

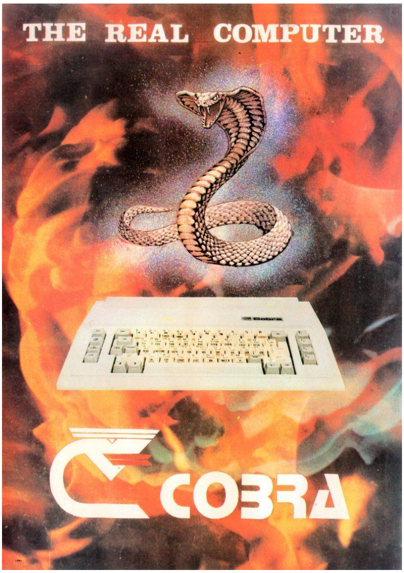
The RAM (initially on 4116 chips, then 4516 and finally 4164) is 64 KB (80 for some versions), of which 16 are intended for the video controller. The user always has 40 or 48 KB available at a time, depending on the operating system used. The case could be black or white with a 54-element keyboard (6×8 matrix) and the following connections: standard i8272 for 8”, 5” ¼ or 3” ½ external floppy disk drives of 720, 360 or 180 KB (up to 4 can be connected); tape recorder connector; auxiliary connector; colour/black and white video connector; RS232 interface; expansion port; Kempston joystick port.

At start-up, the computer shows a logo, a stylized cobra, that after a few moments moves from right to left; the relevant code can be found in the 2 KB EPROM. The Cobra works mainly in two ways: BASIC (automatically) and CP/M (loaded from a floppy disk). If a boot floppy disk is connected, the computer automatically enters BASIC. Otherwise, the user must press B, W, D or C, for each possible system – BASIC, OPUS, CP/M from disk or load another operating system from tape, for example Forth. In this case, the computer waits to load two headerless files each 8192 bytes long, after which it jumps to location 0.

The Cobra start-up screen, with the computer's logo and a multicolour bar at the bottom

The Cobra was used in many fields: technological processes (ovens, machine tools), accounting, freight management, monitoring systems (cameras) and entertainment. The strong demand for the Cobra by microelectronics enthusiasts, denied by the government which opposed any unofficial use, meant that on the black market, or through the 'right' acquaintances, it was possible to illegally obtain the components to be able to assemble the computer by oneself, or an already assembled unit. Most of the time, motherboard and components were inserted in cases that were either self-produced or taken from other machines, especially the HC85, since the original one was very difficult to find. Particularly active in this sense were the students of the University of Bucharest itself, to the point where a common joke was that more Cobras were assembled in the student dormitory than in the factory.[17] Only in 1990 the system was briefly available on the market at very high prices for the time, ranging from 27,000 lei for the basic set to 35,000 lei when supplied with programs for the customer's specific needs.

Since the Cobra came with BASIC and CP/M as its operating systems, it was advertised under the slogan *Două computere într-unul singur* ('two computers in one'). That same year, however, production ceased, due to competition from other systems, less expensive but also of lower build quality and reliability than the Cobra, such as the HC90 and JET, or more advanced like the CIP-04.



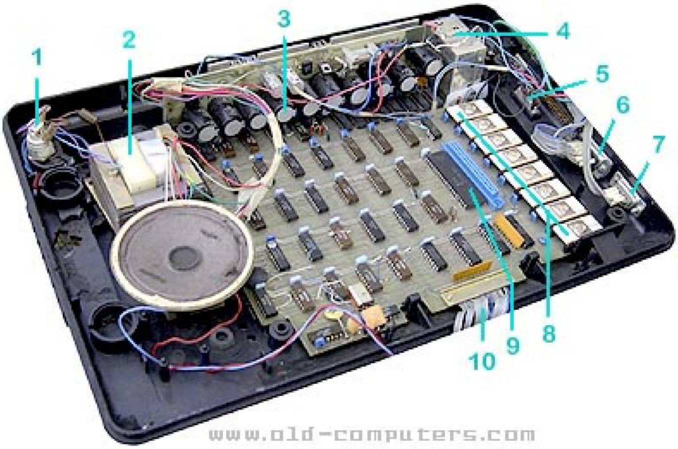
Promotional poster for the Cobra, by Alexandru Antal

[17] Account by Bogdan Bordea, in: *www.homecomputer.de/images/infos/ /east-europe/Cobra_de.txt*

ELECTROMAGNETICA JET (1990)

As its name implies (*Jocuri Electronice pe Televizor,* 'electronic game for television'; sometimes also presented as JET-EM *Aparat pentru jocuri pe ecran TV,* 'gaming device for TV screen'), the JET is designed especially for electronic entertainment. The peculiarity that immediately catches the eye is the case, 'recycled' from a push-button telephone. There are known examples of it in at least three colours: white, yellow and blue.

Internally, it is a derivative of the HC85 plus an additional card, placed above the motherboard, whose function is unclear. Keys are made of transparent plastic with words printed on small pieces of paper inserted inside. The CPU is an East German Z80 clone, the UB-880, with a lower clock frequency than the original (2.5 MHz versus 3.5). Strangely, given its intended use, the JET did not have a joystick port, although it contained the appropriate internal control circuitry, so it was up to the user to modify the computer in order to add it.



Inside the JET: 1-power fuse; 2-transformer; 3-voltage regulator; 4-RF modulator; 5-reset button; 6-joystick port (probably added by the user); 7-RGB connector; 8- ROM chip for the BASIC interpreter and the operating system; 9-UB-880 processor; 10-keyboard cable.

The JET with the upper card in position

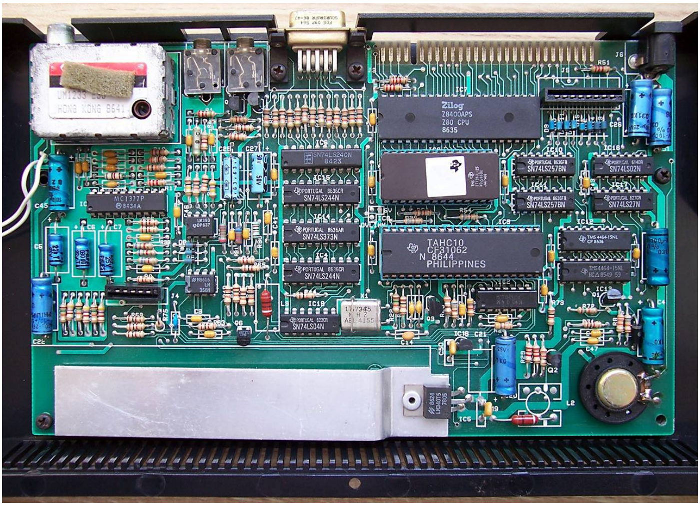
SPAIN

INVESTRONICA INVES SPECTRUM + (1986)

A few months after Amstrad's acquisition of Sinclair Research, Investronica replaced the 'Hispanicized' ZX Spectrum + with a computer entirely made by it, the Inves Spectrum +. The launch took place towards the end of 1986 at a price of 19,900 pesetas. Differences with the + are as follows:

- the four-colour strip and the 'ZX' prefix have disappeared;
- the Sinclair logo has been replaced by the Inves one;
- the initial message is replaced by <*Sistema preparado*>;
- the motherboard is an original Investronica design, totally renewed;
- various auxiliary circuits have been improved (power supply, colour generation, etc.);
- the processor is an original Zilog Z80A, unlike the compatible CPUs of other brands mounted on many Sinclair models;
- the ULA is not produced by Ferranti, but is a new chip developed by Texas Instruments;

- the RAM consists of only two ICs, against 16 of the original model;
- the operating system is contained in an EPROM;
- the clock frequency is slightly higher;
- there are no video signals or any of the power supply voltages in the expansion port connector;
- different behaviour of some I/O ports.



Inves Spectrum + motherboard. Note the differences with the Issue 3 Spectrum motherboard

While some of these changes are caused by the new features of the machine, many were made only to avoid copyright issues with Amstrad, which had acquired the rights to all Sinclair computers. The modified ROM, as well as some of the hardware peculiarities, generates incompatibilities with part of the extensive software catalogue and with some peripherals.

The Inves Spectrum + was also the protagonist of a curious urban legend, originated on the pages of the popular Iberian

MicroHobby weekly magazine, precisely on page 32 of issue 156 (8-14 December 1987). It was claimed that by typing the sequence of commands:

```
BORDER 5
RANDOMIZE USR 4665
```

the computer would have failed, thus revealing itself as the first one ever to be damaged by entering instructions from the keyboard. In reality, that sequence of commands caused the appearance of the start-up message, then a *C NO EXISTE EN BASIC, 0:1* error message and some meaningless characters. To bring back the machine to its initial state, it was enough to reset it. This was a peculiarity of the ROM, already present in the original Sinclair one, which did not cause any damage to the hardware, but the 'hoax' resisted at least until July 2008, when it was definitively debunked by Miguel Angel Rodriguez Jodar on his *zxprojects.com* website.

Both the 'Spanish' ZX Spectrum + and the Inves Spectrum + were manufactured in limited numbers and are now rare machines, highly sought after by collectors.

UNITED STATES

TIMEX SINCLAIR TS 2068 (1983)

The “stars and stripes” Spectrum was designed and manufactured as part of a joint venture between Timex Computer Corporation (hereafter TCC), the computer technology arm of the American wristwatch giant, and Sinclair Research. Under this agreement, the Timex Sinclair TS 1000 and 1500, the local versions of the ZX81, had already been produced. The TS 1000 had been received pretty well, while the TS 1500, with a case similar to the Spectrum 16/48K, the same type of keyboard, and the 16KB RAM expansion already installed, was intended as a transitional model.

In fact, not a few within the TCC staff believed that their version of the Spectrum needed to be modified if it was to beat the competition, as the North American home computer market was much busier and more aggressive than that of the United Kingdom and of Europe in general. Some changes were thus made which, although seeming providential on paper, caused serious compatibility problems instead. The real cause of its untimely demise, however, was the US company’s short-sighted management of its own computer sector.

According to Bill Skyrme,[18] then head of research and development at TCC, Timex and Sinclair first came together when the ZX80 had to go into production. Clive Sinclair was seeking a manufacturer for the computer, so he contacted Timex in order to take advantage of their plant in Dundee, Scotland. Skyrme had heard of the ZX80 and started manufacturing since he thought the machine provided good human interfacing. Then, marketing surveys indicated that there was a demand in the States for home computers, and this led to an agreement between Timex and Sinclair at the beginning of 1982, at a time when about 500,000 ZX81s had already been sold.

Therefore, the Timex Sinclair TS 1000, a clone of the ZX81 with 2 KB of RAM, double the amount of the original machine, and an NTSC RF modulator to fit the American TV system, was announced in April 1982 and launched the following July at $99.95, thus being dubbed the "world's cheapest computer" by the press. The new computer was manufactured by the Timex subsidiary in Portugal, while the Dundee plant kept producing the Spectrum. The market's initial reaction was enthusiastic: a Timex spokesman declared that one TS 1000 was being made every ten seconds, while Dan Ross, Timex's vice president and head of TCC, stated that operators providing information through a toll-free telephone number were receiving at a point 5,200 calls per hour.[19] By the end of 1982, about 550,000 TS 1000s were sold.[20]

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[18] Steven Kaye, *The guy from Timex,* in *LISTing Newsletter,* February-March 1988, pp. 5-8.

[19] Tom Shea, *Big ad campaign spurs sales of world's cheapest computer,* in *InfoWorld,* 1 November 1982, p. 6.

[20] *Timex clocks out of home-computer industry,* in *The Financial Post,* 3 March 1984, p. 34.

The affirmation of the TS 1000 led TCC to consider the idea of developing a colour computer modeled after the ZX Spectrum, which had been launched on the market just as the TS 1000 was being announced. This sparked a "holy war" in Timex. A faction thought that the Spectrum was "a very dirty" machine when compared with the standards set by the FCC, i.e. the Federal Communication Commission, the independent agency of the United States federal government that regulates communications by radio, television, wire, satellite and cable across the country. The Spectrum should then have been redesigned to "clean it up" and also to prove that Timex could do a better design job than Sinclair did.

While this debate was going on, sales of the TS 1000 were beginning to drop and other manufacturers were pushing their products at aggressive prices, especially Commodore with its VIC-20. A "stop-gap" product, the Timex Sinclair TS 1500, was then released to take time and keep consumers interested in Timex computers until the launch of the new colour machine. Announced on 17 May 1983, the TS 1500 was a redesigned TS 1000 with 16 KB RAM and a case and keyboard very similar to those of the Spectrum, plus the correction of a small bug in its ROM which was not present in the ZX81's one.[21] Timex expected to launch the TS 1500 in July of that year, but manufacturing delays pushed the actual launch back to September. The machine was sold at an initial retail price of $79.95. At the same time, the price of the TS 1000 was lowered to $49.95.

Meanwhile, Skyrme was trying to rush a colour machine onto the market as soon as possible. The Spectrum was quickly redesigned, in order to make it comply with FCC standard, as the experimental model TS 2000, announced at the 1983

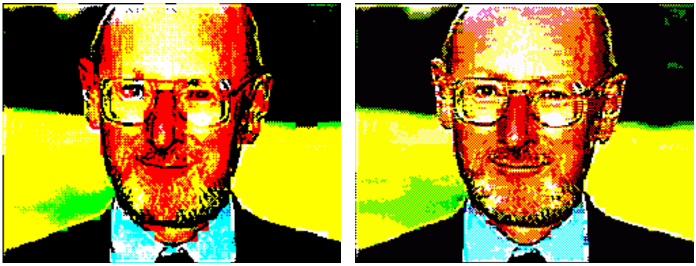
[21] *news.ycombinator.com/item?id=21363892*

Winter Consumer Electronic Show in Las Vegas.[22] The actually produced machine, the Timex Sinclair TS 2068, arrived in November 1983 at a price of $199.95. It has a large silver plastic case and a keyboard similar in its construction to that of the Spectrum but with a plastic, rather than rubber, main element, not unlike pocket calculators or portable typewriters. Its technical specifications are:

- Z80A microprocessor at a frequency of 3.58 MHz;
- ability to use cartridges thanks to a slot located on the front right side of the machine;
- total memory of 72 KB divided into blocks of 8 KB each and structured as follows: HOME bank (16 KB ROM and 48 KB RAM as in the Spectrum), EXROM bank (*Ex*tension *ROM,* 8 KB), containing the I/O addresses for tape management and video mode switching, and DOCK bank, reserved for cartridges;
- a redesigned ULA providing three different video modes: the standard Sinclair one of 256×192 pixels and 32×24 attribute blocks; an 'extended' or '8×1' colour mode, again at 256×192 pixels but allowing for 32×192 pixels of attributes (each row of pixels of each 8×8 block can have specific attributes); a two-colour mode at 512×192 pixels. All of them can be set with the OUT function;
- AY-3-8912 sound chip; it cannot be employed by programs originally written for the Spectrum 128 and later models, as it communicates with the CPU through I/O ports other than those of the original;
- extended BASIC (see below);
- two standard DB9 Atari joystick ports (therefore not compatible with Sinclair joysticks);
- RF and composite video outputs;

[22] *InfoWorld*, 31 January 1983, pp. 14-16.

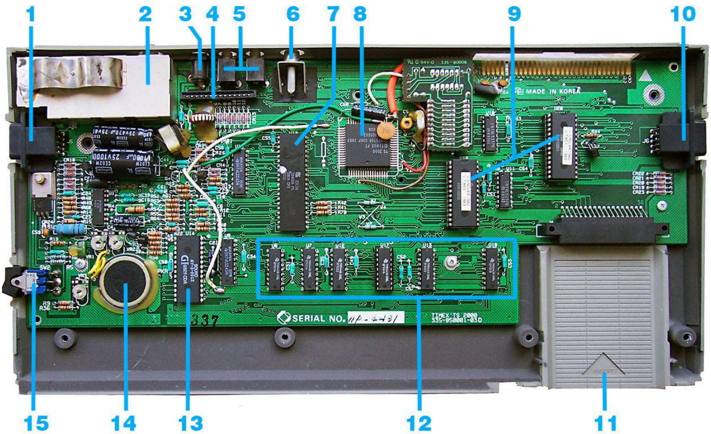
- RGB video output on the expansion port, which has been enhanced compared to the Spectrum's one.



Comparison of the traditional Spectrum graphic mode (left) and the 8×1 mode of the TS 2068 (right)

The TS 2068's extended BASIC provides some new keywords, illustrated in the following table:

Keyword	Argument	Meaning
DELETE	x,y	Deletes program lines *x* to *y*. If only line *x* is specified, all lines from it until the end of the program are deleted. If only *y* line is specified, all lines from the start of the program up to it are deleted.
FREE	none	Shows the number of available bytes for BASIC programs and variables.
ON ERR	GO TO line, CONTINUE, RESET	Allows the programmer to disable the automatic stop of the program in case of an error and establish some directives to follow.
RESET	none	Used with peripherals.
STICK	(x,y)	Indicates the numbers resulting from reading the input provided by the device connected to the joystick port. *x=1* is the joystick; *x=2* is the button; *y=1* is the left device; *y=2* is the right device.
SOUND	x,y; x,y;… x,y	Controls the 3-channel audio synthesizer: *x* is any of the 15 registers, and *y* is a value entered in the register.

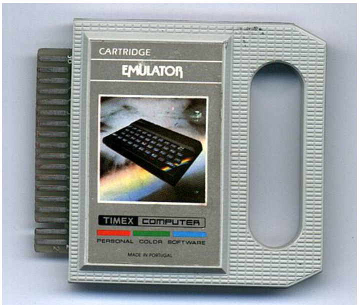


Internal view of the TS 2068: 1-left joystick port; 2-RF modulator; 3-external power supply unit connector; 4-keyboard flat cable connector; 5-tape recorder EAR and MIC sockets; 6-RCA composite video output; 7-Zilog Z80A processor; 8-ULA chip made in USA by NCR; 9-BASIC and operating system ROM chips; 10-right joystick port; 11-slot for ROM cartridges; 12-six 4416 RAM chips of 8 KB each; 13-AY-3-8912 sound chip; 14-loudspeaker; 15-power switch.

Several peripherals were also announced. The main one was the TS 2060 Bus Expansion Unit, that would provide the TS 2068 with 16 MB of RAM, serial and Centronics ports, RGB video output and an interface for external 3.5" floppy disk drives. Others were the TS 2080 80-columns, 9-pins dot matrix printer (actually a rebranded Mannesmann Tally Spirit 80), TS 2065 Microdrives (only existing as prototypes, they never went into production), TS 2050 300-baud modem, built by Westridge Communications and later released as the Westridge 2050, and TS 2020 tape recorder.

The deep differences between the Spectrum's ROM and that of the TS 2068 mean that the vast library of software written in machine code available for the original computer is not

Timex Sinclair TS 2060 Bus Expansion Unit and peripherals



The* Emulator *cartridge. It has to be inserted in the TS 2068 to ensure (almost) total compatibility with the Spectrum. The inscription 'Made in Portugal' indicates that it was manufactured by the local subsidiary. The TS 2068 was made in South Korea instead.

compatible with the American clone. An estimate by Bob Johnson[23] puts the percentage of Spectrum programs able to run on the TS 2068 without any modification at 7% of the total. Aware of this, Timex made an *Emulator* cartridge alongside the computer, containing an exact copy of the Spectrum ROM, in order to allow greater compatibility with machine code software. When used, the percentage of Spectrum programs capable of running on the TS 2068 rises to around 97%; the rare inconveniences are due to the different

[23] *worldofspectrum.net/pub/sinclair/technical-docs/SinclairHardwareFactSheet.txt*

mapping of some I/O ports between the two machines. However, these difficulties had not prevented the sale of approximately 500,000 units at the date of 22 February 1984, when Timex decided to close its home computing branch. C. M. Jacobi, vice president of the company's marketing and sales department, stated in this regard:

> We believe instability in the (home computer) market will cause the value of inventories to decline, making it difficult to make a reasonable profit. Further, we are concerned that those conditions will strain trade relations between manufacturers and retailers, a relationship which Timex Corporation values very highly. These factors, coupled with strong demand in our other product lines, have indicated that Timex can now better utilize it's [sic] resources in those areas. […] Consequently Timex has decided to withdraw from the retail portion of the home computer business.

Another spokesman of the company added that

> while we believe that our 1500 and 2068 computers represent fine value for both the consumer and the retailer, our overall analysis of the business led us to the conclusion that 1984 would be another year of turmoil in the market-place […] making it difficult to make a reasonable profit.[24]

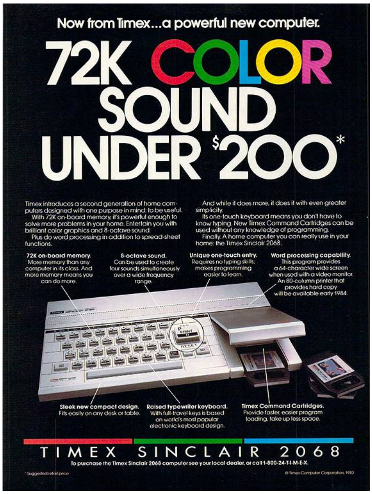
Things would actually have gone differently in 1984, a year that would not have seen a dramatic price cut, but on the contrary a stabilization of the market, after the strong increase in sales and the ruthless competition policies implemented by American home computer manufacturers during the previous year. Nonetheless, Timex was a fairly conservative company that had made its fortune selling watches for decades, and did not want to take the risk of maintaining a business sector that

[24] Taken from: T. Woods, *The Rise and Fall of the Timex Computer Corporation,* in *Time Designs Magazine,* Vol. 1 No. 1, n.d.

seemed to no longer offer the same certainties as it did in early 1983. Timex's withdrawal sealed the fate of Sinclair computers in the United States: they were no longer able to withstand the supremacy exerted there, above all, by Commodore and Atari.

The end of TCC also prevented the TS 2060 Bus Expansion Unit from entering production, and meant that the computer's successor, the *Timex Sinclair TS 3068,* never went beyond the design stage. In 1988, Skyrme revealed that this computer would have been in the same league as the Commodore Amiga: it would have featured 1 MB RAM, virtual memory, 256 colours, hi-res graphics and an advanced Motorola 16-bit CPU. The TS3068 would have retailed for $199.95.[25]

Notwithstanding the decision of pulling out of the home computer market, Timex published a technical manual of the TS 2068 out of good will to customers Its Portuguese subsidiary and Unipolbrit, a Polish-British company, would continue making machines derived from the TS 2068 – the Timex Computer TC 2068 and TC 2048 and the Unipolbrit Komputer 2086 respectively – for a few more years.



Advertising for the Timex TS 2068

[25] *Ever heard of the T/S 3068? (And other matters),* in *Time Designs Magazine,* Vol. 4 No. 3, March/April 1988, p. 10.

U.S.S.R/FORMER U.S.S.R.

The largest quantity of Spectrum clones comes from the Soviet Union and some states that took its place it after its dissolution in 1991: first of all, Russia, then Ukraine, Belarus and Moldova.

Starting in the late 1980s, the progressive opening of the USSR to the West made it possible for Spectrum-related schemes, projects, drawings and so on to circulate. These came to integrate the exemplars already illegally imported there. This led, especially in the years between 1988 and 1993, to an extraordinary proliferation of computers independently developed in various parts of the country (or post-Soviet countries), made by companies either being converted from the military industry, or with a previous experience in microelectronics. The Spectrum, due to its simple architecture and its large software base, also received through 'unofficial' ways, proved to be by far the most popular system. Even nowadays, after Peters Plus ceased manufacturing the Sprinter in 2000, several enthusiast groups continue to create increasingly refined clones with extraordinary specifications.

This discussion focuses on those clones of which an effective production and a certain diffusion are known, leaving out projects of which only a name has been recorded or known as schemes and components lists, but without any sure information about actual realizations. It must be said that variations between clones of the 1988-1993 period are often minimal and mainly concern the use of different components and connectivity. The latter usually includes the TV, monitor and DIN tape recorder connectors, the expansion port and at least one joystick port, in most cases conforming to the Kempston standard. The diffusion of the Beta 128 Disk interface, adopted by the most advanced clones such as the Pentagon and its derivatives, is evidenced from 1989 onwards.

ARUS

Made by Iset' in Kamensk-Uralsky (Sverdlovsk oblast, Russia) in the early 1990s, it is based on the Pentagon 48. It mounts a KR1818VG93 controller chip for floppy drive management and TR-DOS support. The BASIC interpreter supports the Russian language. On one side there is a 'magic button' for memory snapshots, as well as a volume control for the built-in speaker.

ATM TURBO/TURBO 2/TURBO 2+

One of the most advanced Russian clones, built starting from 1991 by ATM in Moscow in collaboration with the MicroART development team, already responsible for the third version of the Pentagon. Like the latter, the ATM is actually a motherboard to be mounted in an external case, although a 40 or 64-key keyboard and a 2×1-watt stereo amplifier were supplied upon request. The initial model, informally called *ATM Turbo 1,* has these specifications:

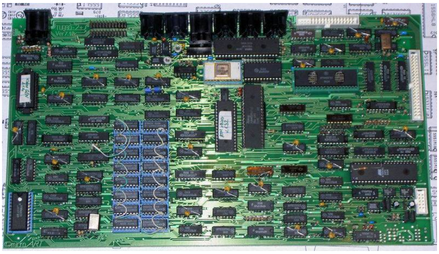
- Zilog Z80 processor at 3.5 and 7 MHz ('turbo' mode);
- 128 to 512 KB RAM and 64 to 128 KB ROM;
- AY-3-8910 sound chip plus standard beeper;
- 8-bit digital-to-analog converter;
- single-channel analog-to-digital converter;
- Centronics, Beta Disk interfaces and integrated modem;
- TR-DOS and CP/M support;
- graphic modes: 256×192 with 15 colours and 32×24 for attributes (the original Spectrum mode); 'Pseudo-EGA',

i.e. 320×200 with 16 colours, in groups of two pixels, not planar like 'real' EGA; 640×200 with 2 colours for each line of 8 pixels from a total of 64.

The first ATM went through various revisions, from 4.10 to 5.20, but failed to outclass the Pentagon for several reasons, including the lack of a joystick port – almost all Russian Spectrum clones have at least one – and the fact that the correction of some bugs of the Pentagon ROM, from which the ATM one derives, caused incompatibilities with a non-negligible part of software developed for that machine. Consequently, in 1993 a new version, the *ATM Turbo 2,* was released. Changes included the presence of an RS232C port and a connector for XT keyboard, an IDE interface for floppy drive, hard disk and CD-ROM, and a text-only graphic mode at 80×25 pixels with 16 colours. The SECAM TV modulator was removed.

Failure to renew the agreement between ATM and MicroART meant that the latter remained the owner of the rights to the computer, until, in 1996, it withdrew from amateur computer systems manufacturing. The documentation relating to the ATM Turbo 2 entered public domain: work was continued by the NedoPC independent developers' network, which aims to spread technologies related to these machines to enthusiasts through the web, following the dictates of open source. They are responsible for the latest ATM revision, 7.10, as well as the updated version of the Pentagon. NedoPC also developed the TASiS operating system for the ATM and other advanced clones such as the KAY, Scorpion or Profi, based on the iS-DOS produced by Iskra Soft of St. Petersburg between 1990 and 1992. iS-DOS resolved some of the main shortcomings of TR-DOS, like the absence of folders, limitation to a maximum of 128 files per disk, maximum file size of 64 KB and so on.

However, it was not compatible with TR-DOS. A subsequent revision took the name of iS-DOS Chic.



ATM Turbo 2+ 7.10 motherboard made by NedoPC

The Turbo 2 was followed by the *Turbo 2+,* with some changes like a 1024 KB RAM and the removal of the internal modem, but without the radical changes resulting from the transition from the first to the second. At present research on the ATM, as well as on the Pentagon and other projects such as the ZX-Evolution, is progressing thanks to the community of enthusiasts, with NedoPC members in the forefront.

BAYT/BAYT-01

From Russian *bayt* ('byte'). Built at the Electrotechnical Plant in Brest, Belarus, it began to be sold from the end of 1989, at a price of 1,000 rubles. The Bayt, like various other clones, has a keyboard including both traditional letters and symbols, as well as Cyrillic characters. It mounts a service bus connector to which the Beta Disk floppy drive controller, 64 KB RAM and 16 KB of standard ROM, plus another 8 KB of extended ROM, can be soldered. A button allows to alternate the extended mode with the standard ROM copied from the Spectrum, in order to increase the compatibility with software written for the original machine.

The *Bayt-01* version allows the use of CP/M and TR-DOS in version 5.01; to work in such environments it is necessary to connect the computer to a floppy drive with a special boot disk inserted. However, the internal controller is not compatible with the standard Beta Disk interface, so the Bayt needs additional disk interfaces to use TR-DOS. The CP/M environment is displayed in a 512×192 pixels monochrome mode. Until 1995, Brest produced an average of 234 units per month (the peak of production was reached in 1992, with an average of 1705 units per month), and in the spring of 1996 people were still queuing to buy one.[26]

BALTIK/ASTRA

It seems that this clone of the Spectrum was made in one of the Baltic republics from 1985-1986 on, probably in Kaunas, Lithuania, due to the connections with the team responsible for the development of the L'vov, some time before. It is more certain that it was also manufactured in Minsk, the capital of Belarus, by the Sonet co-operative, starting from 1988. It appears in different versions: the first houses a power supply unit in the upper part of the case. The ULA is made up of 4 K155RE3 and KR556RT4 chips, while the CPU runs at 4 MHz of frequency. Other differences regard ROM versions.

[26] Account by Sergey Bagan: *zxbyte.ru/byte19_en.htm*

Sonet's Baltiks, in addition to the traditional one, have an auxilary ROM that can be inserted by pressing a special button. This ROM includes a start menu with four options: *Disk CP/M, Copy Turbo, Format/92, Tape Test.* CP/M is present in version 2.2, shows the start-up message *Sinclair version by SONETSOFT © 1990* and is displayed in a 512×192 pixels monochrome mode.

Up: Baltik, Sonet variant.
Right: Astra.

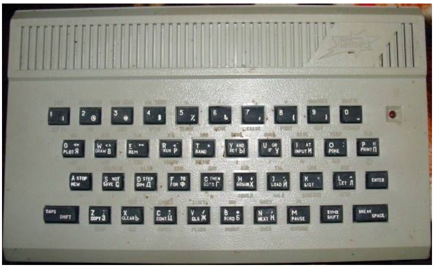
Another variant, known as *Astra,* was also produced in Minsk by Granat.

BEJSIC (BASIC)/BRIZ (BREEZE)

The Bejsic (Russian transliteration of 'BASIC') is based on the Leningrad. It was manufactured in Vladivostok (Russia) by former military Radiopribor factory from about 1990 to 1994, together with the *Briz* ('Breeze'), a computer of identical appearance, but a clone of the Spectrum 128, equipped with the AY-3-8910 sound chip. Keys are made of hard plastic and characters are laser engraved, very resistant to abrasion. The processor is South Korean (Goldstar).

The computer, in addition to the usual connections, has controls to adjust colour and brightness levels, as well as a colour/black and white switch to optimize video output when using a monochrome monitor. Compatibility with the Spectrum is almost total.

BLITZ



A clone of the 48K Spectrum developed from the Leningrad, with an original Zilog CPU. The firmware has been modified in order to include Cyrillic characters, which can be alternated with Latin ones by entering a POKE 23607,56 command. The keyboard is made of rubber, similar in layout and size to that of the Spectrum, and shows both alphabets.

BYTE/ELEKTRONIKA VI-201 'PARUS'/VI-202

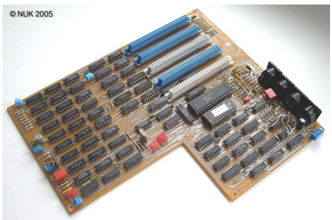
Not to be confused with the Bayt, this clone was a product of the Dnestr factory, located in the city of Bender (Moldova) and appeared around 1991 in two successive versions. The first is very similar to the Spectrum, also due to the presence of a rubber keyboard, while the second, besides the plastic keys and the case of a different type and colour, has far fewer components, as the numerous ICs necessary to emulate the original ULA have been replaced by a single Russian-made Angstrem T34VG1 chip. It keeps the East German processor U880 as its CPU.

Technical specifications are identical to those of the 48K Spectrum, with the addition of a joystick port. It mounts a KR1013RE1-020 ROM with Didaktik Skalica firmware and was manufactured at least until 1995.

A variant of this computer, equipped with a SECAM RF modulator and a different case, was made in Sevastopol (Ukraine) under the name of *Elektronika VI-201,* also known as *Parus* (Russian for ‘sail’). It was followed by a version called *VI-202* manufactured in Chişinău, Moldova.

CONTACT 64/CONTACT 128/CONTACT CPS-128

A series of clones built by Peters (later Peters Plus) of St. Petersburg. The *Contact 64* and *128* had four versions, marked with the letters D or S or DS, or without any of them. The D indicated the presence of a floppy drive controller, the S of an AY-3-8910 sound chip. Numbers most likely indicated the amount of RAM installed in KB.



The *CPS-128* appeared around 1993 and was housed inside a solid steel sheet case, to which the keyboard was connected. It contained the motherboard with an 80-MME CPU, the 64 KB M27C512 ROM, and five slots. These were used for the KR1818VG93 Beta Disk floppy drive controller, a sound card with the YM2149F chip, a SECAM encoder with composite video output. If necessary, a video card could be mounted for other standards (PAL, NTSC) and other types of connections, for example S-Video. It could equip from 128 to 256 KB of

RAM. The firmware included a test mode that could be recalled through the 'magic button' usually employed by the Beta Disk for storing a snapshot of the computer's state.

DELTA-S/SA/SB/S-128

This 'family' of clones brings together machines with similar features but coming from different places, appeared in the early 1990s. The *Delta-S* comes from the Pribor company in Kursk, while the *SA* and *SB* from Elara in Cheboksary, both in Russia. The Delta-S and its derivatives were also manufactured in a former military factory converted for civilian production located near Zelenograd, a suburb of Moscow.

The Delta-S is a clone of the Spectrum + with a separate RAM: 16 KB on the KR565RU6 chip, 32 on the KR565RU5. Also known are a version equipped with a floppy drive controller and SECAM TV modulator *(Delta-SECAM-Disk),* and one called *Delta Micro.*

The *Delta-SA,* like various other Soviet clones produced both industrially and by hand, has a transparent plastic keyboard with words printed on small pieces of paper placed inside the keys. It differs from the previous model for the constant presence of a key at the bottom right to exchange the Latin character set with the Cyrillic one (sending the BASIC code #209) and vice versa (#210). These changes to the ROM caused compatibility problems with various programs; the user manual itself warned that about 30% of Spectrum software would not work.

There are some Delta-S examples with a Russian ROM. The Cheboksary version kept the © *1982 Sinclair Research Ltd* start-up message, while the others showed the words © *1990 Delta* (© *1989 Delta* for the non-Russified Delta-S).

The *Delta-SB* is recognized by the presence of four buttons numbered from 1 to 4 located on the left side. Pressing one would cause a reset and immediately load a game from the ROM. Configurations could vary, but usually the games were *Commando, Astro Marine Corps, Dan Dare III The Escape* and *Star Raiders II*.

A clone of the Spectrum 128 was produced in Cheboksary as well, the *Delta-S 128,* equipped with the KB01VG1 chip, manufactured in the Micron factory, as its ULA.

The existence of another machine called 'Delta' has been reported from various sources. It seems to be unrelated to this series, but rather to be part of a batch of original Spectrum +'s, perhaps bought below maket value in Western Europe, then rebranded and redistributed in Yugoslavia, Czechoslovakia and other countries. The confusion probably derives from the coincidence of the name.

DUBNA 48K

The clone takes its name from Dubna, a city located in the Moscow oblast, where it was manufactured by the Tensor factory. It features a CPU with a clock frequency of 1.85 MHz, almost half of the Spectrum, for which underwent changes in the firmware, as well as in I/O management for reading and writing data to tape, all in order to improve software compatibility. However, its slow speed made it difficult to use some programs, especially racing games, that ran much slower than on the original hardware, or to load others from the cassette. Otherwise it had, like the 48K Spectrum, 16 KB ROM and 48 KB RAM. The case could be black (as in the photo), grey or yellow.

DUET

48K Spectrum clone. Manufactured by Liazonovo electro-mechanical construction factory (LEMZ), near Moscow, between 1992 and 1994.

DYNAELEKTRONIKA DYNAEL M48A/M48B

Clone of the 48K Spectrum produced from 1991 to 1995. Includes Latin and Cyrillic characters. Differences between its two A and B versions are not known.

ELARA

Manufactured in Cheboksary (Russia) by the same 'Elara' factory that produced some machines of the Delta-S series. Two models are known: *Elara-48,* with 48 KB RAM, and *Elara-Disk-128,* with 128 KB RAM, AY-3-8910 sound chip and floppy drive controller. The keyboard has 58 elements. The computer is erroneously referred to as 'Ella Ra' by some sources.

ELBRUS

Clone of the 48K Spectrum produced by the tele-mechanical equipment factory, IZTA, in Nalchik, in Caucasian Russia, from which, presumably, the name (Mount Elbrus is the highest peak in the Caucasus). There are two versions, an initial one equipped with a SECAM RF modulator and one without. It was sold together with a joystick and could use an optional 5" ¼ floppy disk drive manufactured by IZTA itself.

EL'F

Also known as *ALF TV Game,* it is a game console derived from the 48K Spectrum, designed by Zapad and produced by

Tsvetotron, both in Brest (Belarus), in the early 1990s. Two versions are known, depending on the amount of internal memory: one with 128 KB, the other with 32. It works with 256 KB RAM cartridges, which can accommodate from 4 to 6 games, translated into Russian from the originals with fictitious names. The 128 KB version ha three built-in games: 'Spasatel' *(Tujad),* 'Bertolyot' *(Airwolf II)* and 'Gonki' *(Enduro).* The 10 compilations on cartridges available include, among others: *Knight Lore, Boulder Dash, Cyclone, Dizzy, Saboteur, West Bank, Bomb Jack, Zynaps, Cauldron, Into The Eagles Nest, Commando, Ant Attack, Dynamite Dan,* the inevitable *Manic Miner* and even *Raid Over Moscow.*

Its ULA is the widespread Angstrem T34VG1. As a control system, the console uses two simple button pads.

ETON

A clone of the 48K Spectrum. Internally it is identical to the Inter, and also shows the same message at the start. It appeared in 1990 and was sold as a 'TV game console'. The package included a joystick.

FORUM BK-09 TURBO/BK-10 TURBO/ BK-11 TURBO/128 TURBO

Clones designed by Mikhail Dmitrevich Potsukov and produced by the Forum co-operative in Berdsk, near Novosibirsk (Russia). The word 'Turbo' in the name indicates the use of a modified Sinclair BASIC with accelerated tape loading capability. As their ULA, they mount a T34VG1 chip.

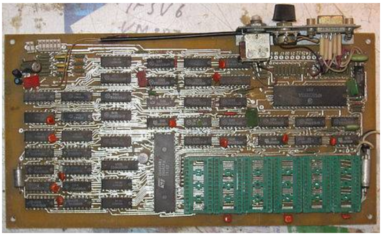
The *BK-09* is the basic model, devoid of particular features. The *BK-10* has a sound chip; the *BK-11,* in addition to this, has a floppy drive controller. The *BK-128* is a BK-11 with 128 KB of RAM instead of the previous models' 64. All BKs consist of about 30 ICs and include a SECAM RF modulator, as well as some internal menus called up by the function keys.

FOTON-IK02

A quite unusual clone, given that the basic architecture of the Spectrum is used in this case to manage a coin-op board, programmable by mounting up to six ROMs on it. It was created in the early 1990s by the Foton co-operative in Penza (Russia), which already produced motherboards for coin-operated video games.

Games were translated into Russian, adding a screen with instructions and game time restrictions, as by inserting a coin each game could last from a maximum of six minutes (default) to a minimum of one, adjustable through a dedicated dip switch. Controls were also modified to adapt them to the joysticks inserted in the cabinet. A switching circuitry between the ROM banks including some specifically programmed I/O ports allowed for changing between the various available titles (the original title is reported in brackets): 'Brodyaga' *(Inspector*

Gadget And The Circus Of Fear), 'Chyorny Korabl' *(Black Beard),* 'Povar' *(Cookie)*/'Sobrat Buran' *(Jetpac)*/'Agronom' *(Pssst)* (multi-game configuration). These games are all emulated by *MAME* from version 0.140 on.



Foton-IK02 motherboard

Povar (Cookie)

GAMMA

Clone of the 48K Spectrum produced by the Processor experimental design bureau in Voronezh, Russia, in the late 1980s. The ROM has been modified to replace lowercase Latin characters with Cyrillic ones. The start-up message has also been translated into Russian. An unusual feature is that instead of the usual DIN I/O connector for the tape recorder there are two separate ones, one for incoming and one for outgoing data. On the motherboard, there is a space reserved for soldering the floppy drive controller chip.

GRAND ROM MAX/GRM+/GRANDBOARD 2+

Variations of the Pentagon developed starting from 1993 at the laboratory of scientific and industrial equipment in Fryazino, a town not far from Moscow. The Grandboard 2+ in particular is equipped with a 3.45 MHz NEC Z80 CPU and 128 KB RAM.

HIMAC 48/128

Clones manufactured by the Khimak plant in Novosibirsk (Russia), which also produced external cards for floppy drive controllers. The 48 and 128 are distinguished by the chips used to emulate the original ULA of the Spectrum, respectively I185 and 1515HM1-6004, not found in any other clone.

HOBBIT

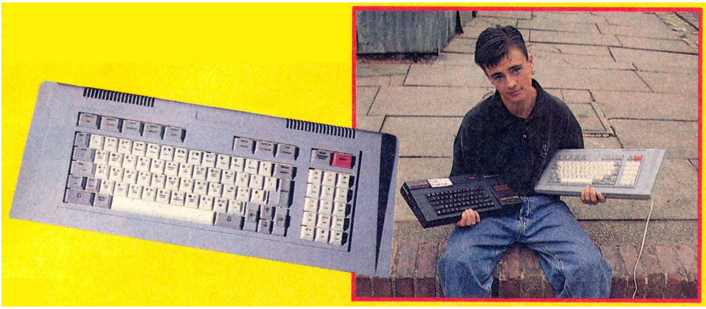
The Hobbit was one of the first Soviet clones to be known in the West: it was the subject of two articles published by *Your Sinclair* 57 (September 1990) and 61 (January 1991) in the *Rage Hard!* hardware review column, and then only mentioned in *Crash!* 98 (April 1992). However, the most exhaustive articles about it published outside its country of origin were those that appeared in *Sinclair User* 126 and 127 (August and September 1992).

The Hobbit is a computer based on the 48K Spectrum, even if it has 64 KB RAM and as many of ROM. It comes in two different versions, the 8030 and the 8060, of which the second, intended for export, is the one known through British magazines. Compared to the 8030, the 8060 is larger and has 10 function keys, a numeric keypad on the side and a built-in 3” ½ floppy disk drive, with the slot on the right side of the machine. At the same time, it lacks the name of the clone engraved in large letters at the top right. The article on *Sinclair User* 127 affirms that the Hobbit was fully compatible with the 48K Spectrum.

The Hobbit takes its name from the friendly characters invented by John R.R. Tolkien, as shown by this drawing reproduced on the cover of the user manual distributed with the computer.

The Hobbit was the first clone exported from Russia, precisely to the United Kingdom, in 1992, by London-based InterCompex-ADB Russian Services. It was sold at an introductory price of just £79, with the option of purchasing an optional IBM PC-compatible floppy drive, for 5” ¼ and 640 KB capacity disks, costing £59. However, this only happened for a short time, presumably for copyright issues concerning the Spectrum’s original ROM.

The computer was developed in Leningrad (now St. Petersburg) in the late 1980s and manufactured by InterCompex. In addition to the Sinclair BASIC environment extended with additional commands for disk and network management, key combinations, renumbering etc., the Hobbit can be used under CP/M (adapted for the Beta), Forth and LOGO. This plurality of available programming environments – encoded within special EEPROM chips mounted on the motherboard – is explained by the fact that the Hobbit was intended both for learning computer science and programming languages in schools, and for use in offices and companies as low-cost data management systems, given the prohibitively expensive prices of IBM PCs and compatibles, which were beginning to be officially imported in the USSR at the time.



Pictures of the Hobbit from* Sinclair User *126

The Hobbit development team was made up as follows:

- Dmitry Mikhilov: hardware, most system software, except CP/M mode – Forth, FFS, Forth Assembler etc.;
- Mikhail Ossetinsky: LOGO operating environment, on extended EEPROM, marketed as an alternative to Forth, especially for educational institutions;
- Slava Trubinov: shadow routine, CP/M;
- Peter Trubinov: CP/M;
- Oleg Kozlov: applications for the Forth/FFS system, especially the database and disk repair programs; co-author of the textbook about the Forth system;

- Elena A. Leibson: head of the Heuristica research and development team; marketing;
- Valery Vainer: repairs;
- Victor Krym: modem driver and BBS software;
- Vassily Khachaturov: graphics; Forth-LOGO; Forth-LISP; Forth/FFS drivers, games and demos; hacking of the Forth and FFS EEPROM;
- Sergey Stepanov: file management interface (modeled on Norton Commander); co-author of the textbook about the Forth system;
- Mark Frenkel: *Pravda* utility for TR-DOS; hybrid TR-DOS/Forth environment;
- Dima Lebedev: graphic editor for the Forth system;
- Sasha Agranov: Heuristica financial application; applications for the Forth/FFS system.

Main technical specifications:

- Zilog Z80A processor at 3.5 MHz;
- as mentioned, 64 KB both RAM and ROM: 6.5 KB of RAM are reserved for the video memory, while the ROM includes the various operating systems (Sinclair BASIC, Beta CP/M, Forth and LOGO) as well as Cyrillic and Latin character sets, which can be alternated by pressing a specific function key;
- embedded applications: assembler/disassembler, system monitor, tape-to-disk copier;
- standard video mode at 256×192 pixels and text-only mode at 80×24 (for CP/M);
- 74-key professional keyboard with double Latin and Cyrillic nomenclature;
- expansion port, RS232 port, Centronics printer port, RF connectors for an EGA monitor and tape recorder and

three joystick ports, one Kempston-compatible and the other two Sinclair-compatible;

- controller for connecting up to four 5" ¼ floppy disk drives;
- local network connection at 56 kilobits per second; another Hobbit or an IBM PC can be used as the main computer on the network, the latter via a network adapter also supplied by InterCompex;
- AY-3-8910 sound chip.

The 8030 was a simplified version for the internal market. Besides the already mentioned differences, the Forth programming language was absent from the relevant EEPROM and had to be loaded from disk. It also lacked the AY-3-8910 chip (available on optional add-on cards) and the RF modulator.

IKAR-64

A clone of the 48K Spectrum, but with 64 KB RAM. Built by Khartron in Kharkiv, Ukraine, starting from 1990. It is made with a total of 48 ICs. Has a 50-element membrane keyboard: some of them only include Cyrillic characters. The metal case is a distinctive and very rare feature.

INFOTON-030

Spectrum 128 clone, with a floppy disk drive controller and an RF modulator at an unusual vertical frequency of 60 Hz. The ULA is composed by two ICs, a KA1515HM1-433 and a KA1515HM1-458. Some examples feature an AY-3-8912 sound chip, like the Spectrum, in place of the much more popular original 8910 version.

ISKRA 1085

Clone of the Spectrum +, produced by Shyotmash in Kursk, Russia, still in business. The motherboard mounts two KS573RF4A ICs as the ROM and is

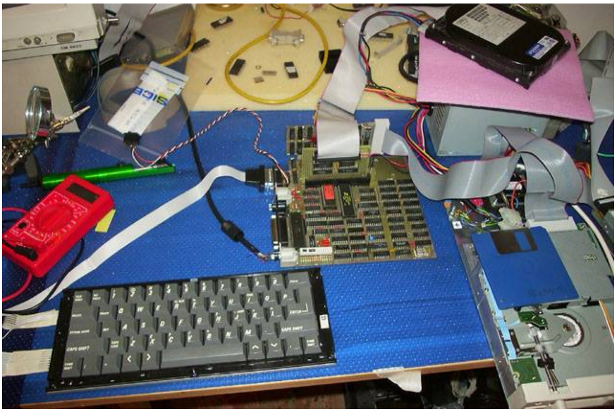
inserted in a case derived – without function keys and with a power LED – from that of another computer produced by the same company, the Iskra 1080 Tartu, dating back to 1988. An internal transformer is housed in the upper right corner.

KARAT

Clone of the 48K Spectrum, produced by Tochnost scientific production association in Tula, Russia. It has a membrane keyboard. There are no precise indications about its time of production: a known model dates from February 1991.

KAY-128/256 TURBO/1024

The KAY was born in the second half of the 1990s as an alternative to the popular Scorpion. It was produced by Nemo, a St. Petersburg microelectronics company founded by Vyacheslav Georgevich Skutin, known under the pseudonym of 'Nemo' and also active as a collaborator of local fanzines in electronic format such as *ZX Format, Abzats* and others. After a first, preliminary model, the *KAY-128,* the *KAY-256* appeared in 1998. It was the official debut of the clone, which in this phase was essentially a cheaper, totally compatible version of the Scorpion ZS 256. Version 1.0 does not have the 'turbo' mode and includes only two expansion slots, brought to three in subsequent revisions.



A KAY-1024 tested by Davide Barlotti with keyboard and floppy disk drive

The real new deal, however, came in 2001, with the *KAY-1024,* built on the basis of a motherboard called KAY-1024/3SL/Turbo. It includes 1 MB of RAM, three slots for additional cards, one of which is always occupied by the Beta Turbo floppy disk drive interface, and a CPU 'turbo' mode at 7 MHz, that can be activated by pressing a special key, next to the usual 3.5 MHz frequency. The RAM can be configured as 256 KB for direct access and the rest as a RAM disk. The expansion bus is based on a new proprietary design called *ZX-Bus* or *Nemo-Bus,* which assigns a different order of priority to the three slots: the highest to the first, the lowest to the third.

Technical features of the KAY-1024 include a Z84C0010PEC or Z84006PEC processor and compatibility with the AT/XT PC keyboard and Kempston mouse. The computer was sold with several components not assembled, but offered in various combinations and prices: the customer could specify whether to add an XTR modem or a General Sound audio module to the motherboard. Other optional components were the Dallas and AY-3-8910 chips or an IDE controller, still of the ZX-Bus type, together with a 40 MB hard disk.

The KAY's diffusion was hindered by Skutin's idiosyncracies. He was critical of the Internet to the point of not setting up a website, let alone an email address, for his company, dealing with orders, payments and distribution of the KAY only by mail. In August 2003 he declared that the company would remain closed until the following January, if orders for at least 50 units would not have been received; at the time, a unit costed 7,000 rubles. The following year, Skutin officially left the KAY, which has been taken up by enthusiast developers ever since, like it already happened with the ATM Turbo.

In the following years, new and improved versions of the KAY appeared. In 2006 a development called *KAY 2006 NB* (North Bridge) was carried out, on an Altera EPM7064 MAX FPGA. It offers three additional video modes: 8×1, 512×192 pixels at two colours (both initially seen on the Timex Sinclair TS 2068) and Gigascreen. 2010 saw the release of an update of the original KAY 1024 developed by the Nemo group, called *KAY-2010* or *KAY 1024/SL4* and produced in Chelyabinsk by ZST. Among the new features:

- integrated keyboard controller;
- 30-pin SIMM memory slot;
- four ZX-Bus type slots;
- support for PROF-ROM, a system monitor with various functions designed by Andrey Anatolyevich Larchenko for the Scorpion;
- two Sinclair joystick ports;
- control module for an ATX power supply unit;
- NemoIDE controller for hard disks, CD-ROM drives and Compact Flash cards;
- Nemo FDC Beta Turbo controller for faster access to TR-DOS floppy disks.

KIS

Clone of the Spectrum 128, with a case similar to that of the Hobbit 8060 and other clones, but devoid of the numeric keypad.

KOLIBRI

Designed by Aleksandr Babaylov on the Pentagon 48 scheme, the Kolibri clones the 48K Spectrum and integrates the power supply unit into the case. 2000 of them were manufactured.

KOMPAN’ON (COMPANION)

Spectrum clone produced from 1989 to 1995 by the Arsenal company, operating within the mechanical construction factory of Izhevsk, Russia. Various models are known, marked by the absence of other words, or by the M, 2 or 3 characters. The first is practically a copy of the Baltik in a different case. The *M, 2* and *3* models are distinguished by the presence of the Angstrem T34VG1 ULA and have a total of 19 ICs. The *Kompan’on 2* has the same case as the Kvorum BK04, with the RUS and LAT keys for alternating between Cyrillic and Latin characters, but this feature does not seem to have been activated. All models up to 2 have original Zilog or equivalent 4 MHz frequency processors, 48 KB RAM and 16 KB ROM. The *Kompan’on 3* was supposed to be a clone of the Spectrum 128, but remained in the prototype stage.

KONTACT (KONTAKT)

The Kontact is a Leningrad with a built-in 5” ¼ floppy drive, located on the right side of the case.

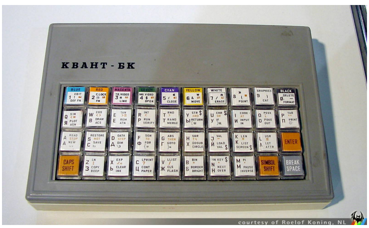
KRASNOGORSK

Clone of the 48K Spectrum manufactured starting from 1990, perhaps in the town of the same name near Moscow. Video circuitry consists of five K573RF2 ICs.

KVANT (QUANTUM)/INTER

Clone of the 48K Spectrum produced by the automatic control equipment factory in Orsha, Belarus. It was not very successful, due to overheating issues and the fragility of the plastic key pins, as well as being about 10-15% slower than the Spectrum on average. It was also distributed under the name of *Inter:* the only difference is in the initial message, *Orsha * Computer KVANT* for the Kvant, © *1989 Cooperative INBEL Ltd* for the Inter.

KVANT (QUANTUM) BK/BK MS0530 ZX-ATAS/ATAS 128/ATAS 256/CONSTRUCTOR



Not to be confused with the previous clone, it is a series of computers produced by Kvant in Zelenograd (Russia) in the early 1990s, at least until 1993. All that is known of the *BK* is that it is a clone of the 48K Spectrum. The *MS0530* model features a Soviet T34VM1 or East German UB880A CPU, while the ULA is a T34VG1 chip, plus an internal Beta Disk floppy disk drive controller. Similar to the MS0530 is the *Atas,* or *ZX-Atas,* which features the same motherboard. Version 1.5 has 48 KB of RAM and houses a transformer in the case. Later versions offer 128 or 256 KB RAM configurations and an AY-3-8910 sound chip, but require an external power supply unit. A construction kit version of the BK, equipped with the original Zilog CPU, was sold as the *Constructor.*

KVARTS (QUARTZ)

'Gaming computer' made by Kvarts in Kaliningrad (Russia). It has 85 ICs: eight of them, 2 KB each, compose its ROM. RAM amounts to 48K, while the processor is an 80A-MME9212. The keyboard is made up with 40 elements, just like the 16/48K Spectrum.

KVORUM (QUORUM)/KVORUM 64/128/128+/ BK04

This computer 'family' comes from Urals Production Association Vektor. The first model is a clone of the 48K Spectrum. The *64* is a modification of the Magic-05 and integrates 16 KB of shadow RAM alongside the canonical 48. The *128* is inserted in a larger case with an 88-element keyboard. Its ULA is made up of KB01VG1-2 chips, while the ROM includes diagnostic and software copy programs and system monitors. A TR-DOS and CP/M compatible floppy

disk drive controller is also present. The *128+* adds a built-in 3” ½ floppy disk drive and is equipped with an AY-3-8910 sound chip. The *BK04* is similar to the first Kvorum, but with an additional SECAM RF modulator.

LENINGRAD/KOMPOZIT/LENINGRAD 2

The Leningrad was the first Spectrum clone produced in the Soviet Union on a large scale. Designed in Leningrad (hence the name; St. Petersburg today) by Sergey Yurevich Zonov, the future creator of the Scorpion, and in circulation since 1987, it was a simple and cheap clone, sold both in kit form and already assembled. The Leningrad, which had a total of 64 KB of RAM but used only 48, proved to be very popular with the public and formed the basis for many other clones: Spektr 48, Ural-48K, Vesta IK-30, Elektronika KR-005, Kontact, SICH-48, Sunkar. A small revision from 1988 was known as *Leningrad+*

or *Kompozit.* A later version was dubbed *Leningrad-2*: it added an expansion port and connectors for other peripherals installed directly on the motherboard. The Leningrad-2 was also very popular.

LILIYA

This 48K Spectrum clone features four arrow keys on the right side, similar to a PC keyboard, but only three connectors. The CPU is an original Zilog Z80. It has a total of 42 ICs.

LVOV

The Lvov, built in 1985 at the Lviv (*L'vov* in Russian; now part of the Republic of Ukraine) Polytechnic Institute, was in all likelihood the first Soviet clone of the Spectrum. The development team was coordinated by Yuri Dmitrevich Dobush; Yevgeny Evgenevich Natopta took care of the firmware and Oleg Vasilevich Starostenko of the printed circuit.

The computer was planned to satisfy the need for a clone of a simple machine with good graphics capabilities and a lot of available software. At that time in Kiev an indigenous clone of the IBM PC was already under development, therefore the Spectrum was chosen as the cloning object. The British computer had been seen by the authors in mid-1984 thanks to some foreign students from Hungary, the German Democratic Republic, Syria and other countries, who were in the Soviet Union for their education and stayed in a hostel of the Institute. In particular, the original Spectrum's circuit diagram arrived in the USSR through the GDR. Other information about its ROM was taken from photocopies of a West German magazine, also received from foreign students, some of whom had programming experience on the Spectrum and collected many documents on its hardware.

First prototype of the Lvov

At the end of 1984, a possible commercial release of the computer was discussed with colleagues in Kaunas (Lithuania), where there was another research team trying to clone the Spectrum. It is likely that the Kaunas team was at the origin of the other Baltik clone, since news of it came shortly after the advent of the Lvov. In August 1985, the original Spectrum was examined by foreign students for two hours to study its circuitry. On the basis of the information received, and on the observed Spectrum's scheme, development began. It took about a month and was not carried out on paper, but directly 'in-vivo', in the form of a work schedule, and with a reduced availability of components. The scheme of the new machine was therefore drawn up only after development. The first prototype had 16 RF2 chips as its ROM, the second 4 RF4 chips. The Lvov kept all of the synchronization parameters and the current consumption of the original computer.

The first version of the clone was officially released in October 1985. To test it, the developers loaded three games for the 16K Spectrum, namely *Jumping Jack, Harrier Attack* and *Firebirds,* on the Lvov, with positive results. After the completion of the computer, the authors began working on a clone of the IBM PC. The Kaunas developers made a working prototype before the Lviv team, but the final version, in all likelihood what would later be known as Baltik, was finished after the Lvov. Previously, they had provided their Ukrainian colleagues with a memory card, developed by them, which accelerated work on the Lvov. In March 1986, schematics for the Lvov were sent to the Polaron production association, where motherboards were manufactured; they can be recognized by the '1400HH' inscription. Brought to Moscow and St. Petersburg by Starostenko, the Lvov was the starting point for the design of the Moskva 48K and the Leningrad, as well as for other more advanced clones such as the Pentagon 48, that shares several components with it. The Lvov should not be confused with the PK-01 Lvov, based on the 8080 architecture.

MAGIC-04/05/06/07

A series of models developed by a team co-ordinated by Anatoly Khomben and including Sergey Zhavoronkov, Andrej Vychegzhanin and Yuri Seryogin. Manufactured at the Integral scientific production association.

The *Magic-04* is a clone of the 48K Spectrum. It consists of 52 ICs and has 41 keys arranged in a similar way to the +, a SECAM RF modulator and two joystick ports (Kempston and Sinclair).

The *Magic-05* is inserted in a case identical to that of the Kompan'on 2 and the Kvorum BK-04. Its ROM was modified to manage the printer port, added in this model, and the new keyboard.

The *Magic-06* has a further modified firmware, dated 1993. The ULA was developed by Seryogin and is unmarked. It also has an RGB video socket.

A final model, the *Magic-07,* with 128 KB of RAM, a new custom ULA, an AY-3-8910 sound chip and a floppy drive controller, remained just a prototype, of which some examples exist.

MAGISTR-128

Clone of the Spectrum 128, very similar to the Kvorum 128+. The reset button and the various connectors are located on the right, below the built-in floppy drive. Its power supply unit is internal.

MASTER/ANBELO-S/MASTER-2

The Master, appeared around 1990, is the result of the co-operation between three companies: Komponent (case, assembly and sale), Angstrem (components) and Prokom (documentation and maintenance). The system is based on a set of 15 Angstrem T34 chips (T34VM1, T34VG1, T34RE1). The keyboard has 52 keys, of very poor quality. The ROM comes from Didaktik Skalica, with a slightly modified font (in bold). It was sold assembled or in kit form.

The motherboard of the first Master is found in another clone, the *Anbelo-S,* produced by MGP Anbelo in Belozersk, Russia, also sold as a kit or already assembled.

A later version, known as *Master-2,* is distinguished by a different chipset (two T34RE1 and RF2 ROMs). The case and keyboard stayed unchanged. Both models come in white, black or brown.

MIKO-BEST

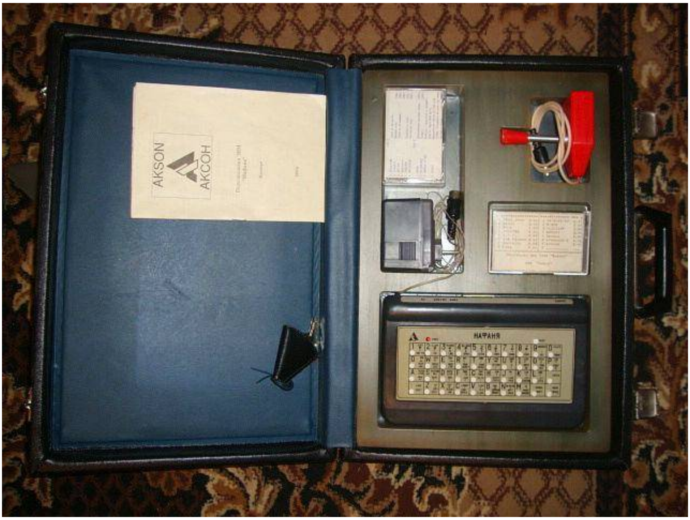
Clone produced by Miko in Ternopil (Ukraine), also popular in Lviv. It has 256 KB RAM controlled by port 220 (DCh) and a flash ROM with a memory monitor that can be launched at system start.

MOSKVA 48K/KRASNODAR/MOSKVA 128K

Together with the Leningrad, it was the first Soviet Spectrum clone to be mass produced. The Moskva 48K appears in 1988 and is an evolution of the Lvov. The RAM consists of 16 ICs, divided into eight 565RU5s and eight 565RU6s. In Rostov-on-Don, Russia, a variant called *Krasnodar* was developed, revised and corrected by Vladimir Kyashko. The *Moskva 128K* came the following year and was the first local clone with 128 KB of RAM. It has a LX-PRINT serial port for printer, a Sinclair joystick interface and can send an RGB video signal. However, it was not very successful due to memory faults.

NAFANYA

'Travel' clone manufactured by Akson in Moscow and based on the Dubna 48K. It has a smaller case and a membrane keyboard with diminutive elements and without symbols. Mainly aimed at diplomats and their families, it was sold to the public at a price of 650 rubles. It is designed to fit in a briefcase; the package includes a joystick, red for the black variant, green for the white one. Its scheme includes 17 ICs.



A black Nafanya in its full configuration

NEIS

Clone of the 48K Spectrum created by the Electrotechnical Communications Institute of Novosibirsk (Russia), the current SibSUTI (Siberian State University of Telecommunications and Informatics).

OLYMPIK-S

A clone made in the 1990s by Olimp in Svitlovodsk, Ukraine,. There have been versions with 48 and 128 KB of RAM.

OREL BK-08

The *kompjuter videoigrovoj* (videogaming computer) Orel BK-08 is a product of the mechanical engineering factory of Dnepropetrovsk (now Dnipro, Ukraine). The name would suggest a machine conceived exclusively for videogaming, but this hides the fact that the Orel, when analyzed more thoroughly, turns out not to be the 'usual' clone, but a much more interesting computer.

The CPU is a UA880A of East German origin or an original Z80A, running at a frequency of 3.5 MHz. The 64 KB RAM is made up of eight KR565RU5V chips. Video output is RGB, in accordance with the Soviet GOST 24838-47 standard. The processor addressing area (0-16383), normally reserved for ROM, can be allocated in a shadow RAM. The project involved the installation of two ROM chips of 16 KB each, but in practice only one is used, since the configuration of the components on the board does not allow this. This problem can be solved by means of a shadow RAM.

It is possible to select the source of data reading, while recording is always done in RAM. This organization, on the one hand, allows the loading of data from the shadow RAM through BASIC, but on the other hand its contents can be corrupted by those programs that do not take its presence into account. Data contained therein is not lost after pressing the reset button.

The 67-element keyboard includes a special key (RUS), located at the bottom left, to switch between the Latin and Cyrillic character sets. At the top, next to the reset button, there is a key to generate a non-maskable interrupt (NMI), which, combined with the MZ80 system debugger-monitor inserted in the shadow RAM, makes Assembly programming easier.

The ROM differs from the original Spectrum one for the presence of all these features. A 7-bit KOI-7 encoding was adopted to Russificate the character set. Although the Sinclair BASIC keywords are not shown on the keyboard, the traditional Spectrum way of typing the has been implemented anyway, even if variations in the code table due to Russification mean that keywords are not always in the same positions of the original. As for the MZ80, it is activated when the NMI key is pressed. It is a true low-level operating system, designed for running and debugging machine language programs. It offers the following functions: input-output system management, loading, running and copying of programs and other service utilities. However, important features such as a disassembler or step-by-step execution are missing. Sometimes, returning from the NMI can be problematic due to errors in the management of the R register.

A diagnostic program is supplied with the Orel; it performs keyboard tests and controls colour and brightness, audio, RAM, ROM and tape recorder input and output signals. The modifications to the original ROM cause problems with all those programs, especially games, involving the interaction between the I register and memory addresses 14847 (39FFh) and 15103 (3AFFh): it is the same problem found in the +2A/+3. A possible solution is to load a copy of the original Spectrum ROM into the shadow RAM.

In the Orel, the number of clock cycles between interrupts is 69,888, as in the original Spectrum. The address signals are sent through the K155LP9 keyboard buffer and not through the diodes, as in many other Spectrum clones. This eliminates any interference between the system bus and the keyboard. Signals generated by the video controller (K155RE3 and K556RT4 chips) are synchronized as in the original Spectrum.

ORIZON-MICRO

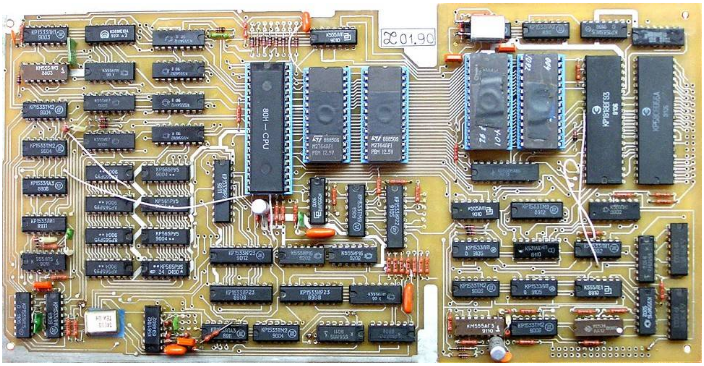
Clone of the 48K Spectrum manufactured by the radio-electronic construction factory of Smela, in the Cherkasy oblast (Ukraine). It is made up with 67 ICs.

PATISONIC 48/48ST

Patisonic started its activity in in Omsk (Russia) in 1991. The following year it produced the *Patisonic 48,* a clone of the 48K Spectrum derived from a substantial modification of the Leningrad and inserted in the case of another computer, the Korvet, based on the 8080 architecture. The following *48ST* version can use ROM cartridges in 'hot swap', i.e. without the need to turn the computer off before inserting them, and for this reason a special loader has been added to Sinclair BASIC. Cartridges had a variable capacity, from 2 to 4 Mbits, and on them there was space for 5-20 games. There are reports about a local shop that sold them. About 1,000 machines were sold.

PENTAGON

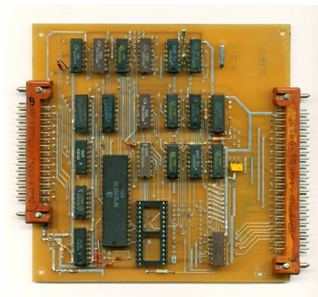
The Pentagon was the first of the Spectrum clones to go far beyond the limits of the original computer's basic architecture, paving the way for machines that revolutionized the very idea of 'cloning'. The Pentagon spread among enthusiasts since it presented itself from the beginning as an open and freely shareable design, so that anyone with the necessary skills to build it could do it themselves.



The first version of the Pentagon was made in Moscow in 1989 by Vladimir Drozdov, author in 1983 of another successful open project, the RA3AO amateur radio transceiver. It was a clone of the 48K Spectrum with something more: the ability to connect to a standard floppy drive through the Beta 128 Disk interface, the specific version for the Spectrum 128 of the well-known Beta Disk, via a KR1818VG93 controller mounted on the board. The reason for choosing this type of controller over others is not entirely clear. As far as is known,[27] the Beta 128 Disk was imported into the USSR around 1987 to try to copy its code and structure. In mid-1988, the interface controller was cloned on Soviet-made chips such as the aforementioned KR1818VG93 and its scheme was publicly disclosed in the country. Hence the custom of informally calling both the Beta 128 Disk and its internal operating system 'TR-DOS', including unofficial versions developed in the USSR to improve the original 5.03. Be that as it may, the diffusion of this data storage system became very wide, also thanks to the popularity of the Pentagon, to the point of even supplanting cassettes, which elsewhere were the main medium used for the Spectrum and its local derivatives.

The origin of the clone's name is also rather obscure. According to an article by Konstantin Sviridov appeared in August 1992 on *Radiolyubitel,* a magazine for radio amateurs, the Pentagon owes its name to the fact that the bottom face of its circuit board has a cut corner, so that its shape has not four, but five sides.

Soviet-made clone of the Beta 128 Disk interface. The big chip on the bottom left is the KR1818VG93 controller.



In 1990, the second version of the Pentagon was released. Compared to the first, changes and additions are significant:

[27] Aleksandr Samsonov ('MacBuster'), *Pentagon FAQ v1.0.2.*

- 3.5 MHz CPU;
- 128 KB of non-contended RAM;
- 2 KB ROM for the ZX-LPRINT III type printer interface, originally produced in the United Kingdom by Euroelectronics in 1984 and like the Beta Disk, cloned in the USSR as well;
- same behaviour of the +2A/+3 with regard to suppressed I/O ports of previous Spectrums, like port 255 (FFh), which never gives the screen attributes present at that moment;
- however, the address decoding scheme is the same as in the 48K and 128 Spectrum;
- the Pentagon does not have an expansion port, but since it also lacks a real ULA (emulated by about twenty ICs) what is needed can be connected to a cable to be soldered directly on the motherboard.

A year later, a third version of the clone appears, this time developed by the consortium MikroART and ATM, later the creator of the ATM Turbo. The computer is now equipped with a sound chip, most of the time a Yamaha YM2149F – a licensed copy, with some marginal differences, of the General Instrument AY-3-8910, whose reduced but fully compatible version, the AY-3-8912, was fitted to the Spectrum 128 and later models. Initially the chip was on an additional board attached to the main one: a revision of the third version, sometimes referred to as the Pentagon 128+, has the chip mounted directly on the motherboard. This add-on card also has a Kempston joystick port, while the second revision already includes it on the motherboard. However, there is the possibility of connecting a General Sound or Covox card. A third revision of the second version of the Pentagon was made by the Solon company in 1993.

In the following years, the Pentagon had to face competition from other advanced Spectrum clones, in particular the Scorpion ZS 256, ATM Turbo, KAY and Profi. Nonetheless, it remained one of the most popular machines among Spectrum fans in the former USSR, and as such underwent several revisions. Alexey Sergeyevich Zhabin ('King Of Evil'), member of the Russian NedoPC developers community, created one between 2005 (first version) and 2006 (second version), the *Pentagon 1024 SL,* based on an FPGA with Altera MAX chipset. It has 1 MB RAM, two ZX-Bus expansion slots, a 7 MHz 'turbo' mode and a '16col' graphic mode, with 384×304 pixels at 16 colours per pixel.

On 11 and 12 July 2009, the sixth edition of 'DiHalt' was held in Nizhny Novgorod. 'DiHalt' is a microelectronics fair where advanced Spectrum clones, as well as graphics and music created with them, are among the main attractions. On that occasion, the latest model of the Pentagon was presented, the *Pentagon v2.666,* built on the basis of the EP2C8Q208C8N Cyclone II Altera FPGA. It has 2 MB of static RAM, CPU at 3.5/14/28 MHz, Multicolor 8×1 and 16col at 320×200 pixels additional video modes, VGA output at 50/60 Hz, Turbo Sound circuit with two YM2149F chips, compatibility with PS/2 keyboard and mouse, three ZX-Bus slots, IDE connectivity and SD card reader. This clone, of which there is a 'Light Edition' (LE), is developed by NedoPC too.

PETERS MC64/MP64/WS128/256

Peters, later Peters Plus, was a microelectronics and information technology company founded in 1990 in St. Petersburg, best known for the advanced Sprinter clone. Its first Spectrum clones bear its name as well:

- *MC64:* 48K Spectrum clone with 64 KB RAM and virtual disk on a flash ROM; the ROM also includes some utilities (machine code assembler, system monitor, video test, copier); two revisions, the second of which has a game *(Tetris),* besides the utilities, embedded in the ROM and a Centronics parallel printer port;
- *MP64:* like the previous one, except that the ULA is made up of only one IC;

- *WS128* (above): Spectrum 128 clone;
- *256:* based on the Scorpion; can use the iS-DOS disk management firmware as an alternative to TR-DOS.

PIK/PICK-MASTER

Manufactured in Vinnitsya, Ukraine, by Terminal, the Pik is a clone of the 48K Spectrum that stands out from the rest for more than one reason.

The case is very large, since components are not located under the keyboard, but to the right and at the bottom. The keyboard itself seems to have been adapted by a different machine: among other things, the reset button is located in the position of the ‘ESC’ key on a PC keyboard, which can sometimes cause it to be accidentally pressed. It has a South Korean-made Goldstar Z80400A PS processor mounted on a socket. The KR563RE2 ROM chip is identical to the KR1013RE1, but with firmware number 20, indicating the presence of the Didaktik Skalica operating system, whereas 165 refers to the classic 48K Spectrum ROM. On the back there are four identical RSH-2N type connectors for the tape recorder (incorrectly indicated as ‘TYPE’ instead of ‘TAPE’), RGB video output, joystick (identified as Kempston) and the power supply unit.

An export version of this clone, called *PiCK-MASTER,* is also known. Writings on the case have been translated into English and components are slightly different: it has a Soviet-made 80A-MME9212 CPU and a small daughter card at the top right, the function of which is not clear.

PLM AVTOMATIKA/PLM EXPRESS/ NOVOSIBIRSK 54

Spectrum 128 clone. It was developed between 1986 and 1987 at the Research Institute of Automation and Electrometry in

Novosibirsk, Russia. Also known as *PLM Express* and *Novosibirsk 54,* from its city of origin and the number of chips. It has a constant ‘turbo’ mode and shadow RAM, controlled through port 15 (0Fh). A subsequent revision, carried out between 1988 and 1989, includes the KR1818VG93 floppy disk controller, an AY chip (it is not known whether 8910 or 8912) and an RF modulator for use with the TV.

POLIGON

Spectrum 128 clone, possibly developed by Ekspopribor in Obninsk, Russia (the start-up message reads *Obninsk, 1992*). It has an extended memory (up to 512 KB) and can operate under CP/M. It can display 25 lines, with 40 and 80 characters per line, in CGA and EGA video modes.

PROFI

One of the other ‘super-clones’ of the early 1990s, the Profi was built in 1991 by Kondor’ in Moscow. It is composed of two superimposed and connected printed circuits and has the following specifications:

- 512 or 1024 KB RAM and 64 KB ROM;
- Z80 processor at a constant frequency of 7 MHz;
- Centronics parallel printer port;
- AY-3-8910 sound chip;
- Beta 128 Disk and (on later models) IDE interfaces;
- compatibility with CP/M environment;
- 512×240 multicolour graphic mode (2 colours for each line of 8 pixels, 16 colours displayed from a palette of 256) under CP/M, with 80 characters per line;
- compatibility with 8-bit DAC modules;

- compatibility with AT/XT keyboards;
- can be connected to a modem.

PULSAR/PULSAR 128

Clones of the 48K and 128 Spectrum produced by Mezon in Chişinău (Moldova). Both had a slot for NETI-compatible ROM cartridges.

RADUGA-001

The Raduga-001 is a Spectrum+ clone derived from the Lvov. It is not known for sure where and when it was produced, but several clues point to the UVM 'K.N. Rudnev' factory in Oryol (Russia), during the first half of the 1990s. The computer's case is very similar to that of another machine produced there, the Spektr-001, a clone of the popular build-it-yourself Radio-86RK home computer, whose schemes were published on the *Radio* magazine in 1986.

The Raduga-001 was produced by reusing some of the pre-existing components of the Spektr-001, like the mould for the case and the internal power supply unit, located in the upper left part.

RATON-9003

Clone of the 48K Spectrum produced in the early 1990s by Raton in Gomel, Belarus. It comprises a total of 19 ICs, including the T34 chipset series: KA1515HM1-216 (ULA), KR1858VM1 (CPU, reworking of the Angstrem T34VM1) and KR1013RE1 (ROM). There are also examples with original Zilog Z80 CPUs and without a single-chip ULA. It was manufactured at least until 1995.

ROBI

Alternative version of the Hobbit 8030, the one intended for the domestic market. The InterCompex logo in the top left is missing and the name engraved on the case is 'ROBI'.

ROBIK

Clone of the 48K Spectrum produced since 1989 in Cherkasy (Ukraine) by the Selto-Rotor scientific production association, a former military factory converted to civilian production. It has a keyboard for Cyrillic and Latin characters, switchable through the C and L keys located in the lower right corner. The four arrows on the right also emulate a Kempston joystick through port 31.

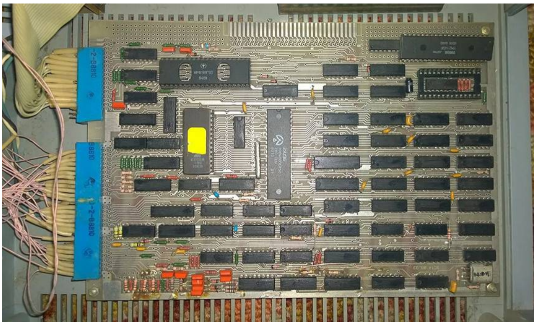
Internally the Robik consists of 53 ICs, of which two 2764s and two PT2s form the ROM. The computer has in fact a 16 KB shadow RAM where the original ROM of the Spectrum can be loaded, since due to the heavy modifications to the ROM for the Russification of characters, native compatibility with Spectrum software is around 40%. This way, compatibility improves, but the double alphabet capability is lost. To reset the on-board ROM, it is necessary to press the reset button. The exemplar in the photo is equipped with an ST Z80A CPU.

SANTAKA-002/IMPULS/IMPULS-M

Spectrum + clone. It was designed in 1986 at the Information Technology department of Kaunas University, Lithuania, and

manufactured in the Lenin factory in Minsk (Belarus) in the early 1990s. A variant called *Impuls* was produced by the radio sets factory in Krasnodar (Russia). The *Impuls-M* model is equipped with a SECAM decoder for use with the TV. The exemplar in the photo above has an original Zilog Z80A CPU.

SCORPION ZS 256/TURBO/TURBO +



Since its first appearance in 1991, the Scorpion was for years the main competitor of the Pentagon for the 'title' of most popular Spectrum clone among microelectronics and computer science enthusiasts in the former USSR. The two factions 'battled' against each other like supporters of rival sport teams. While the Pentagon was 'born' in Moscow, the Scorpion originated in the other main city of European Russia, namely

St. Petersburg, on the initiative of Sergey Yurevich Zonov, already responsible for the creation of another successful clone, the Leningrad. The first model, the *ZS 256* (the letters are in fact Zonov's initials), had the following specifications:

- 256 KB RAM and 64 KB ROM;
- 3.5 MHz CPU like the original Spectrum;
- CP/M development environment;
- simplified Beta Disk controller for connection to two 5" ¼ floppy disk drives;
- SMUC (Scorpion and Moa Universal Controller) interface for connecting two IDE peripherals, especially hard disks, under TR-DOS, iS-DOS and CP/M;
- PC/AT keyboard controller.

The subsequent revisions of the Scorpion, known as *Turbo* and *Turbo* +, added new features:

- expandable RAM, up to 2 MB through an additional GMX card (2 SIMM30 slots), which also offers a graphic mode at 640×200 pixels and 16 colours with hardware scrolling;
- ROM from 64 to 512 KB;
- two processor frequencies, normal at 3.5 MHz and 'turbo' at 7 MHz, alternated either by pressing a specific button or by software, and indicated by an LED;
- PROF-ROM, firmware extension consisting of a system monitoring program with several functions, developed by Andrey Anatolyevich Larchenko ('Andrew Moa') and residing in a shadow ROM;
- AY-3-8910/8912 sound chip;
- MIDI peripheral management through optional MIDI-SC interface;

- compatibility with General Sound and Covox sound cards;
- compatibility with the PROSCO programming card for EPROMs;
- RS232 serial port;
- Centronics parallel printer port;
- one or two ZX-Bus connectors.

Zonov's company stopped developing computers based on the Spectrum after 1997 and went bankrupt in January 2020. Unlike what happened with the Pentagon, the Scorpion's schematics were not made public. There are therefore no new versions of it developed by enthusiasts, with the partial exception of the Profi Interface, an additional module for the Spectrum 128 and +2 (only compatible with Series 3 motherboards so far), which replicates at hardware level the Scorpion as well as the Pentagon 128 and the Profi. This module was created by Czech developer Jiří Veleba ('Velesoft') from a previous project of his own, limited to hardware emulation of the Pentagon, and can mount from 512 to 1024 KB RAM. The Scorpion's ROM has been integrated into various emulators of the Spectrum and its clones.

SELEN

Clone of the 48K Spectrum manufactured by Kiberlen in St. Petersburg since 1991. The power supply unit, RF modulator and SECAM encoder are integrated. One of the keys bears no symbol.

SEVER/SEVER 48/002

The Sever is a Spectrum clone manufactured by the eponymous Production Association in Novosibirsk (Russia). It was likely produced in the first half of the 1990s. There are versions with 48 KB RAM almost identical to the Magic-05, except for a revised ROM dated 1995 from the start-up message, and one with 128 KB. The *Sever 48/002* is a different version of the 48K model.

SIBSTAR-48/48S/128/128S

Clones produced by Sibstar, a computer and peripheral development company based in Novosibirsk, Russia, founded in 1990. From then until about 1995 it produced a series of Spectrum clones, where the ULA is emulated via two PT2 chips so that it possible to render the multicolour graphics of certain programs almost entirely. There are two basic variants: *Sibstar-48* with a KR1858VM1 CPU at 3.5 MHz, 48 KB RAM, 16 KB ROM, RGB monitor output; *Sibstar-128* with 128 KB RAM, 32 KB ROM, YM2149F sound chip, and the rest like the previous model. Variants with the 'S' suffix also have an RF modulator and a SECAM encoder for TV connection.

Sibstars could also use ROM cartridges containing up to 5 games to plug into the expansion port. They were quite expensive: in 1993 a cartridge costed 23,000 rubles, while the

Sibstar-48 55,000 and the 128 65,000. The manufacturer also provided optional cards such as a Beta Disk floppy drive controller and some DAC (Digital Audio Converter) devices to improve sound quality.

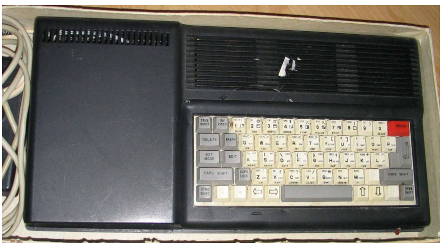
SIMVOL

Another 'gaming computer' *(igrovoj kompjuter),* clone of the 48K Spectrum, the Simvol, manufactured by the radio factory of Penza, Russia, in the first half of the 1990s, shows some particularities even from its appearance. Even its package catches the eye – simplified versions of the inlay illustrations of five well-known games (from left to right and top to bottom, *Commando, Show Jumping, Renegade, Match Point* and *The Way Of The Exploding Fist* can be recognized) appear on it. These games are provided on cassette with other programs and a guide to BASIC.

The keyboard hosts, under the usual 40 elements, five additional keys, ordered according to the standard AGF cursor/joystick left-down-up-right key sequence, strangely interrupted in the middle by a fire key. The CPU is a KR1858VM1 at a frequency of 4.75 MHz, while the ULA is the equally widespread T34VG1. It has 48 KB RAM and 16 KB ROM. The firmware comes from Didaktik, with the base font in bold. Despite the different processor frequency and

ROM, no compatibility issues with 48K Spectrum games are reported. The motherboard can be modified by adding the KR580VV55 controller to enable connection to a printer or floppy disk drive.

An expanded version of the Simvol is also known. It clones the Spectrum 128, has 128 KB RAM, the standard Spectrum ROM (the classic menu with the words © *1986 Sinclair Research Ltd* appears at start-up), an extended keyboard, a 5” ¼ floppy disk drive integrated on the left side and managed by TR-DOS, the AY-3-8910 sound chip and a Centronics interface with a non-standard connector. The RF modulator, present in the 48 KB model, is replaced by an RGB connector.



SINKO-BEST

Clone of the Spectrum 128 produced by the company of the same name in Krasnoyarsk (Russia). It has the usual T34VG1

ULA and an in-built Beta Disk interface managed by the KR1818VG93 chip. It also features a YM2149F sound chip and a transformer inserted in the right side of the case. The flash ROM houses a Russified BASIC: two RUS and LAT keys placed on the left side of the keyboard allow for switching between the Cyrillic and Latin alphabets. There is a 'FIRE' key between CAPS SHIFT and the spacebar. The start-up menu has the following items: *128K TR-DOS; Test; Information; Tape Loader; 48 BASIC.*

SINTEZ/SINTEZ 2/SINTEZ 3

There is not much information about this series of Moldovan Spectrum clones. Sigma was a company located in the capital Chişinău and in the Soviet period it mostly made computer systems for military applications. After the dissolution of the USSR in 1991, like many other companies mentioned here, a process of reconversion began, leading it to the production of consumer electronics.

Among the first products of the new course was the Sintez. The case was either white or light grey, with a professional-grade keyboard. This computer, however, was little more than a prototype, as it was soon set aside to make way for the *Sintez 2,* very similar externally to the Spectrum + but equipped with various additional features.

Compared to the +, the Sintez 2 added: Kempston and Sinclair-compatible joystick ports, a DIN I/O connector for tape recorder, RGB video monitor output instead of TV. It was also possible to adjust colours, by intervening on the individual red, green and blue channels, and volume, using the controls on the side.

A later model, the *Sintez 3* (*31* according to other sources), had 128 KB RAM and included TR-DOS, while logic consisted of a single Application Specific Integrated Circuit (ASIC) chip plus other port management components. It was also equipped with an RF TV output and no longer provided for manual colour and audio adjustment.

SPARK

A common name for some Spectrum clones, most likely related to each other. One was manufactured in Rostov-on-Don (Russia) in the early 1990s by Spark-Jug, based on components supplied from Moscow. It was produced in two versions: a normal one with 48 KB RAM and an upgraded one with 128 KB RAM and a floppy disk drive controller.

A clone of the Spectrum 128 is also known with the name of *Spark-128,* produced by the Spark scientific production association in Moscow. It too has a disk drive controller. It was sold both assembled and in a construction kit: instructions and diagrams are dated 1990-1991.

SPECTRUM ITC

48K Spectrum clone with an internal power supply unit and made up with 41 ICs.

SPEKTR

Clone of the 48K Spectrum built around 1990 by Popov in Nizhny Novgorod (Russia), with an unusual metal case. The Spektr consists of 46 ICs; two 8 KB chips, connected together, hold the ROM. A peculiarity is the presence of a volume control on the back. It shows the message *N. Novgorod 1990 Basic 48K* at start-up.

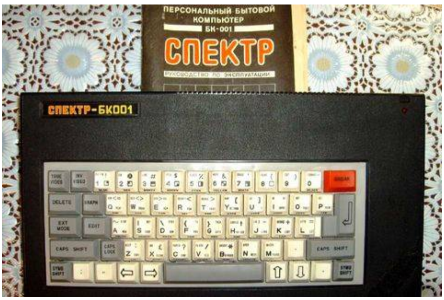
SPEKTR-48

Clone of the 48K Spectrum manufactured by the Oryol plant in St. Petersburg (Russia) in 1991. It has a membrane keyboard with mixed characters, but it is not clear how to toggle between them. The ROM includes a monitor/debugger program.

SPEKTR B-IK

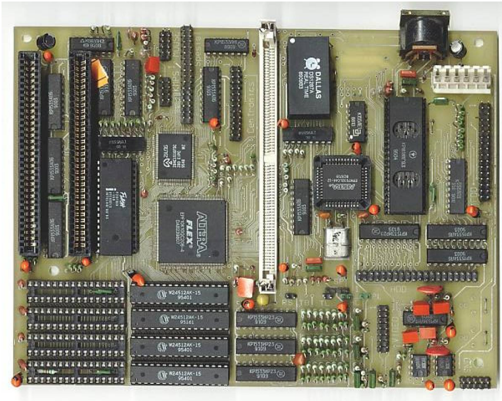
Spectrum + clone. Its ULA is a KA1515HM1-216. 14 ICs. The case, as for other clones, derives from that of the BK, a computer designed by the Zelenograd Research Centre near Moscow.

SPEKTR BK-001



Clone of the 48K Spectrum from Tver (Russia). It has a membrane keyboard with double alphabet and a modified ROM. It shows various defects: low compatibility with Spectrum software, uncomfortable keyboard, tendency to overheat and lack of protection from interference generated by static electricity. Other examples, such as the one shown in the photo above, are housed in a BK-type case, common to other clones. Some cassettes with games were bundled with it.

SPRINTER



The Sprinter, made by Peters Plus of St. Petersburg, also behind the Contact and Peters clones series, was the last Spectrum clone to be manufactured on an industrial scale, and is also one of the most sophisticated and rich of remarkable features. The presence of programmable ICs stands out: it allows for changing the configuration software. This started a practice that was to be followed by various independent clone developers. It made it possible to derive several computers from a single hardware and to alternate between different configurations. Its creator is Ivan Pavlovich Makarchenko, also known under the pseudonyms of 'Ivan Mak' and 'WingLion', a hardware engineer and designer as well as a science fiction writer. In 1996, employing an Altera programmable chipset as a basis, Makarchenko produced the first version of the machine, commonly known as Sprinter 97, previewed at the Enlight '96 show in Moscow and marketed the following year. Its technical specifications are:

- FPGA Altera Flex EPF10K10QC208 chipset;
- Zilog Z84C15 processor at 14 MHz in the native

configuration and 3.5 in the Spectrum one;
- from 1 to 4 MB RAM in SIMM-72 modules, configurable as various virtual disks with drive letters from E to T;
- separate 192 KB video RAM;
- KR1818VG93 chip for managing 3” ½ (720 KB, 1.44 MB) and 5” ¼ (720 KB) floppy disk drives;
- IDE controller for hard disk (FAT16) and CD-ROM drive;
- PC/AT keyboard controller;
- 2 COM ports and 1 Centronics parallel printer port;
- two ISA-8 slots for add-on cards;
- AY-3-8910 sound chip emulation and compatibility with Covox sound module;
- TV or RGB monitor video output.

In 2000 a new version of the Sprinter came out, informally called *Sprinter 2000.* Compared to the previous one, changes are:

- maximum theoretical processor frequency at 21 MHz and real at 16 MHz (due to the ULA);
- total RAM expandable up to 64 MB;
- separate 256 KB video RAM, expandable up to 512 KB;
- possibility of 16-bit stereo sound;
- TV or CGA monitor video output.

In 2004, after having sold 110 units, some even outside of Russia, Peters Plus stopped manufacturing the Sprinter, without however making its schematics, firmware and source codes public. In 2005 the NedoPC development team tried to negotiate with Peters Plus the access to the necessary documentation for resuming the production of the Sprinter on an amateur scale (similarly to what had been done with the ATM Turbo), but the company demanded 10,000 US dollars in exchange. Faced with such a request, NedoPC abandoned their resolve, hoping for better times to come.

On 1 February 2007, Makarchenko published an official announcement on behalf of Peters Plus on the the Russian Spectrum enthusiast website *zx.pk.ru.* It stated that, since the company had sold all the rights to the Sprinter, all related information would soon become public. However, for another year and a half, this announcement would not be followed by the facts, as only previously available information would be released, on a purposely created web page. It was only in the autumn of 2009 that the entire information concerning the Sprinter, including the firmware with its source code, was disclosed.

ST SIRIUS

Clone of the 48K Spectrum produced by Sistemotekhnik in Obninsk (Russia). 58 ICs, including an ST Z80A CPU. The power supply unit is internal. It was manufactured at least until 1993.

SUNKAR

Clone of the 48K Spectrum, derived from the Leningrad. It is made up with 42 ICs.

SURA-S

48K Spectrum clone made by VEM in Penza (Russia), inserted in the same case of the Sura PK8000, a computer by the same company based on a processor derived from the Intel 8080.

The Sura-S has 20 ICs, including the KR1858VM1 CPU, the Angstrem T34VG1 ULA and a KR580VV55 controller. The power supply unit is hosted inside the case. The *© 1991 KOMPAN'ON V2.2* start-up message suggests that the firmware was obtained from the Kompan'on 2.

TAGANROG-128

Produced by design bureau Mius in Taganrog, Russia, in the 1990s. Derived from the Scorpion, it has a 64-pin expansion port to connect add-on cards with EPROM-based virtual disks, where frequently used programs can be stored, and supplementary sound cards with AY-3-8910 or YM2149F chips. There are a floppy drive controller and RS232 and Centronics ports as well. Later versions are compatible with the Kempston mouse and can mount up to 512 KB ROM and up to 1 MB RAM.

TOKK PC-48G

48K Spectrum clone. At start-up, it displays the *TOKK Computer © 1990* message. It is possible to alternate between Latin and Cyrillic characters by pressing a specific key. Known versions mount 128 KB RAM with the same case as the Kvant BK, while others are non-Russified and some also lack the AY-3-8910 sound chip and floppy disk drive controller.

URAL-48K

Another clone based on the Leningrad, with an internal transformer. A known example mounts an original Zilog Z80 CPU.

VESTA IK30/IK31

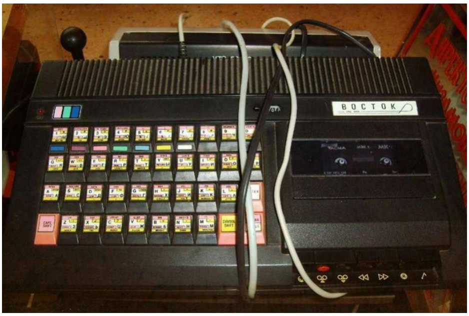
Clones of the 48K Spectrum made by Signal in Stavropol, Russia. The IK30 derives from the Leningrad, while the IK31 has a similar composition to the Anbelo-S, in turn a derivative of the Master, and is equipped with the same Didaktik ROM of Slovak origin, with the only difference of the bold font.

Contrarily to the IK30, the IK 31 has a single-chip ULA, the widespread Soviet T34VG1.

VOLNA

Clone of the 48K Spectrum made by the Volna research and production enterprise in Moscow in the early 1990s. The main ROM is housed on two 2764 chips of 8 KB each, while the processor can be a KR1858VM1 or a U880AD. It is made up with a total of 57 ICs. The mainboard has room for additional chips in order to expand the RAM up to 128 KB.

VOSTOK

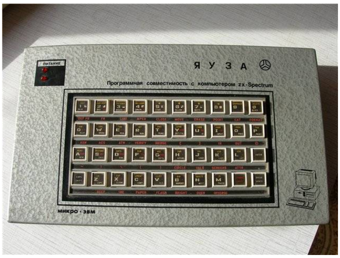


Together with the Hungarian HT 3080C, it is the only known clone of the Spectrum (in this case the 48K) to integrate a tape recorder, although this computer actually went into production. It was manufactured by Vostok-Informatika in Ufa (Russia) around 1990. The recorder is an Agidel model.

YAC

Clone of the 48K Spectrum produced in 1994 by an unknown manufacturer. It has a small square motherboard that takes up only half of the case. There are only 14 ICs on it. The CPU is unmarked, while the ULA is made up of a KA1515HM1216 chip. Externally, it looks a lot like another clone with a unique appearance, the Radon Plus, to the point of suggesting that it is the same machine distributed with two different names.

YAUZA



Clone of the 48K Spectrum. It features a 16 KB ROM on a T34RE1 chip with the Didaktik M firmware. The case is made of metal.

YULDUZ

School computer for local network use. Its motherboard is housed in a case including a 5” ¼ floppy drive and a Beta 128 Disk interface with a KR1818VG93 controller chip. It features 64 KB RAM and an original Zilog Z80 processor. The keyboard is separate and shows both Latin and Cyrillic characters. The back of the main unit has five connectors for the network, plus two more for the tape recorder and video output, and a printer port. On the front, keys numbered from 1 to 5 allow for controlling the secondary terminals.

ZVEZDA

A 48K Spectrum clone manufactured from 1991 to 1993 by ZEMZ in Sergiev Posad, in the Moscow oblast. ZEMZ actually manufactured the case, printed circuit and power supply unit, while the flash ROM was provided by other sources. On the back there are the audio and RGB/black and white video outputs, plus the connectors for tape recorder, Kempston joystick and floppy disk drive. Four series are known. Some exemplars have an original Zilog Z80 CPU, others a KR1858VM1.

Like other clones, the Zvezda hosts in its ROM a modified firmware in order to support the Russian language. Cyrillic characters are recalled by a routine at address 15299, while Latin ones by a similar one at address 15284.

ZX-NEXT

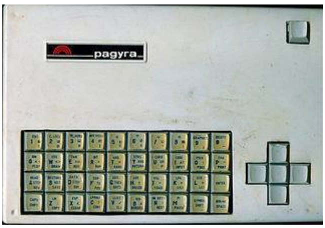
Not to be confused with the ZX Spectrum Next. Development started in 1989, but the final version appeared in 1993. The authors of the project are Konstantin Smiridov and Leonid Ermakov. On the main board there are the CPU, the RAM modules (128 KB, expandable up to 512) and slots for other boards, e.g. video controller, Beta Disk interface, IDE hard disk controller, local network controller, additional RAM modules. In particular, the video controller card hosts another Z80, in addition to the main CPU. Its task is to adjust the video signal's timing, so to offer a resolution of 640×200 pixels next to that of 256×192. It was distributed both as a construction kit and already assembled; about 700 units were sold.

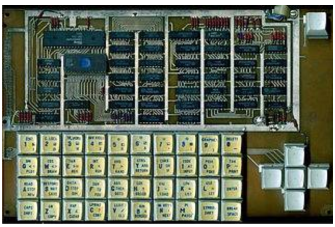
OTHER CLONES

There is no information about the following computers from the former USSR, except that, judging by the appearance of the keyboards, they are clones of the 48K Spectrum or of the +.

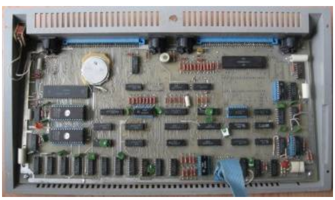
Fanny

Dik





Raduga (different)



Šaulys-1

Pavlodar/Vidicon

Rita

On some websites, computers unrelated to the Spectrum, or that do not seem to be based upon it at all (e.g. the aforementioned PK-01 Lvov, Pioneer, Lik etc.), are indicated as Spectrum clones.

In addition to that, quite a few machines autonomously built by individual enthusiasts on the basis of the most popular clones, especially the Leningrad and the Pentagon, may be found on the web.

NEITHER A CLONE, NOR A SUPER-SPECTRUM: THE SAM COUPÉ

At the end of 1987, the first rumours of a ‘superclone’ of the Spectrum being under development appeared in the British magazine *Crash* (issue 48, January 1988). This ‘phantom’ machine would have been equipped with a Z80B processor at 6 MHz of frequency, 32 KB ROM, 128 KB RAM in 8 blocks of 16 KB each, freely mappable and uncontended. It would also feature the same multicolour graphic mode as the Timex Sinclair TS 2068, as well as a monochrome mode with 80×25 characters besides the traditional Spectrum one. A final cost of £99.95 was also assumed. However, there was no mention at all of whoever should have made it.

More substantial news arrived a couple of months later, when Crash (issue 51, March 1988) and Sinclair User (issue 72, same date) reported that the ‘superclone’ or ‘super-Spectrum’ had the provisional name SAM and would have been built by Miles Gordon Technology, a British company founded in 1986 by Alan Miles and Bruce Gordon, two former employees of Sinclair Research who went on their own after the Amstrad takeover. MGT had established a solid reputation with well-known and acclaimed products, such as the DISCiPLE and Plus D interfaces.

A year later, a working prototype appeared. Meanwhile, expectations had been fueled by the specialized press, that with excessive, in hindsight, enthusiasm saw the computer developed by MGT as the dawn of a new era for Spectrum users, after the disappointment caused by the +3 and at a time when 8-bit computers were inexorably about to give way to the new 16-bit generation.

The new computer was officially announced on 20 November 1989 as the *SAM Coupé* and launched on the market the following December at a price of £169.95. The origin of the first word – acronym of *Some Amazing Micro* for some, of *Spectrum Advanced Machine* for others – is unclear, while the 'Coupé' attribute derives from the peculiar trapezoidal profile of the case, designed by Nick Holland Design in Cardiff and equipped with a palm rest below the keyboard, which was reminiscent of that of a sports car.

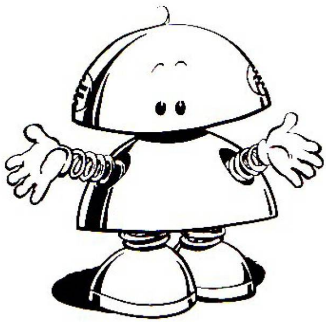
Alan Miles and Bruce Gordon present the SAM Coupé (from* Sinclair User *94, January 1990)

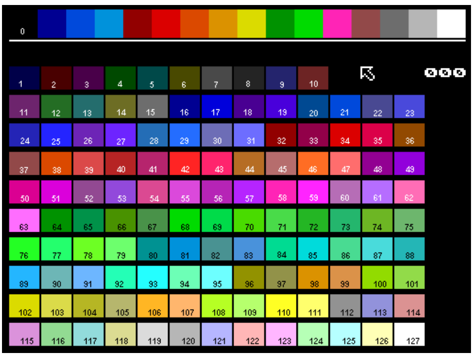
The SAM Coupé aims at a hybrid market segment: performance must approach that of 16-bit machines, but the price must fall within the 8-bit range, while leaving the possibility of taking advantage of the vast software library available for the Spectrum. The initial technical specifications seem, at first glance, to satisfy expectations:

- Zilog Z80B CPU at 6 MHz frequency;
- Motorola MC1377P video chip for PAL decoding;
- a specific integrated ASIC chip designed by Gordon, in VLSI scale and equipped with 10,000 logic gates, for video signal generation;
- RAM: 256 KB, internally expandable to 512 KB or up to 4.5 MB with an external card;
- ROM: 32 KB, featuring a complex BASIC interpreter developed by Andrew Wright on the basis of *BetaBASIC,* an advanced programming language for the Spectrum, also his work;
- a display of 32×24 (as in the Spectrum) or 85×24 characters;
- four different graphic modes: Mode 1, 32×24 blocks with 2 colours per block (similar to the Spectrum's low resolution); Mode 2, 32×192 blocks with two colours per block (8×1 extended colour mode of the Timex Sinclair TS 2068); Mode 3, 512×192 pixels (85-character columns) with four colours; Mode 4, 256×192 pixels with 16 colours;
- 16 colours simultaneously displayed in Mode 4 and four in Mode 3 from a palette of 128;
- Philips SAA1099 sound chip with 6 frequency generators of 8 octaves each and 256 notes per octave, 2 noise and 2 envelope generators, 4-bit digital-analog output;
- one or two Citizen 3" ½ floppy disk drives;
- connectivity: Atari joystick port; 5-pin DIN for audio output; 3.5 mm mono audio input for the tape recorder; 5-pin DIN for light pen input; a SCART connector,

> slightly different from the standard one, with composite and RGB video output, both digital and linear; standard 64-pin Euro Connector; 8-pin DIN for mouse input; 7-pin DIN MIDI input and output ports and through (via software), also able to connect up to 16 machines in a local network.

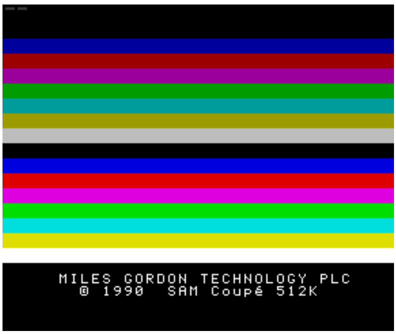
The computer's user manual was written by none other than Mel Croucher, the versatile founder of Automata UK. Croucher composed it in a humorous and familiar style, in a deliberate contrast with the aseptic descriptiveness of many of these publications. Robin Evans drew the artwork, featuring the SAM robot (right) that soon became MGT's mascot. At the time of its launch, this 8-bit computer, capable of challenging the Amiga and Atari ST on their own ground whilst retaining compatibility with the Spectrum and its peripherals already produced by MGT, looked like it was bound to achieve a good success. Sadly, events would have taken a very different turn.





The SAM Coupé colour palette. It should have included 256 colours, but insufficient space on the ASIC chip caused it to be halved.

Serious problems emerged from the very beginning of the SAM Coupé's distribution. First of all, the computer had been supplied with a ROM affected by some bugs, although it had gone through quite a few revisions before being marketed. Even worse, *SamDOS,* the operating system that managed the floppy disk drives, was not only plagued by programming errors, but also devoid of essential features like the use of folders or file dates. It was therefore replaced by *MasterDOS,* which also added the possibility of reserving some RAM areas to create a virtual disk (already present in all Spectrums from the Sinclair/Investronica 128 on). *MasterDOS* was the base environment for a third-party operating system, *Pro-DOS,* developed in 1991 by Chris Pile of Digital Reality in order to provide the SAM Coupé with CP/M 2.2 support. The BASIC interpreter, despite being already rich in features, received an extension called *MasterBASIC.*



The SAM Coupé start-up screen, with the typical colour stripes at normal and high brightness placed all over it.

Other hardware problems were: the persistence of sounds generated by the sound chip even after pressing the reset button; possible data corruption for floppy disks left in drives at the time of reset; random blocks of the mouse pointer due to a defect in the internal power supply for its input connector. Furthermore, the SAM Coupé was not directly connected to the television, but by means of a connector placed in the external power supply unit, that caused interferences with the video signal due to the magnetic field generated by the unit's circuitry. A modification was therefore required for those users who wanted to avoid purchasing a monitor.

All these difficulties certainly did not facilitate the impact of the SAM Coupé, but another hindrance for its success was the fact that the much hyped compatibility with the Spectrum remained for the most part just wishful thinking. The software industry did not believe in the machine's potential and did not support it adequately, despite notable licenses like *Prince Of Persia* and *Lemmings.* In order to run programs written for the Spectrum, the SAM Coupé needed to load the Sinclair computer's ROM, or rather its emulation, in Mode 1, the graphic mode identical to that of the Spectrum. Programs saved with the ROM scheme could be loaded, but custom and/or copy-protected loaders were not recognized. The remedy was found in the *Messenger* (left), a device to be inserted into the Spectrum's expansion port on one side, and the SAM Coupé's MIDI input port on the other. Thanks to its 'magic button' for generating non-maskable interrupts, the Messenger saved the contents of the Spectrum's video memory, or of its whole RAM, as a 'snapshot' file in the SAM Coupé's RAM. This trick did not work with software designed for the Spectrum 128, which required a direct manipulation of their code in order to run on the SAM Coupé.

However, when the Messenger was released, MGT had already ceased to exist. On 11 June 1990, after just seven months from the market launch of the SAM Coupé, the company went into liquidation. The drawbacks surfaced until then certainly had their weight, but the real causes of the computer's failure were elsewhere.

On the eve of the launch, the company that manufactured the ASIC chips was unable to deliver a sufficient number of them to produce enough machines to take advantage of the traditional Christmas shopping period Miles and Gordon relied upon to boost the SAM Coupé's debut sales. As a result, only 200 units were delivered before Christmas 1989. This meant the loss of a good opportunity to quickly regain at least part of the £500,000 capital acquired six months earlier from the Johnson Fry financial agency (now Moneyextra).

Problems with the ROM and SamDOS, combined with the lack of software specifically developed for the machine, did the rest. Potential buyers had been heavily exposed for a year to the expectations of journalists and MGT propaganda presenting the SAM Coupé, first of all, as a sort of advanced Spectrum, so it was very difficult for them, if not impossible, to understand the computer's authentic potential. Moreover, all of this took place in a historical moment when software houses were slowly deserting the 8-bit range. In the end, those who had a Spectrum kept it, and those who wanted more bought an Amiga or an ST. The few who purchased a SAM Coupé – total sales are estimated at 12,000 units – were satisfied enough to create a small but active community that continues to play its role in the retrocomputing galaxy to this day.

Miles and Gordon did not transfer the rights to the SAM Coupé and continued to produce it under a new company name, SAM Computers Ltd, that lasted from 6 August 1990 to 15 July 1992. A music synthesis peripheral *(SAM Midi Sequencer),* a RAM expansion *(OneMeg),* the Messenger and a hardware development kit for hobbyists were also released. After the folding of SAM Computers, its shares were acquired by West Coast Computers, which renamed the machine as the *SAM Élite* and made the following changes:

- 512 KB RAM;
- the floppy drive was moved to the right (for single-drive models);
- a SIPI printer parallel port was placed on the left side;
- the ROM was updated from version 3.0 to version 3.5;
- feet were black instead of blue;
- the MGT logo on the case was covered with a sticker bearing the WCC one.

This machine was produced in very small numbers. WCC disappeared for good in 2005.

SAM Élite

The SAM Coupé advertising campaign

Readers of *Crash, Sinclair User* and *Your Sinclair,* the main British magazines dedicated to the Spectrum, found in the December 1989 issue of each one of them an advertisement spread over four whole pages. Among other things, it explained why a user of that computer should have been interested in the SAM Coupé. The attempt to take advantage of the favourable moment represented by the Christmas sales season was however unsuccessful, for the reasons seen before. In addition to that, insisting on the continuity – moreover existing more on paper than in reality – between the Spectrum and the SAM Coupé did not produce the desired results. It ended up driving away a large part of users eager to switch to a system they considered superior in all respects, like the Commodore Amiga or the Atari ST.

The opposite page shows a reproduction of the part with the title: *So why do Speccy*[28] *owners need the SAM Coupé?*. The answer, furtherly developed in the text, is already given in the very first lines:

You've been building up your Spectrum software collection for years. You want a computer with better sound, graphics, more power – but you don't want to lose your software.

The Coupé is the computer for you. Four screen modes with a choice from 128 colours, a six-channel stereo sound chip, 256K RAM (expandable to 512K) – yet by actually slowing the Coupé down, we allow most of your 48K Spectrum software to run in the Coupé's level 1 mode.

[28] Colloquial nickname of the Spectrum.

SO WHY DO SPECCY OWNERS NEED THE SAM coupé?

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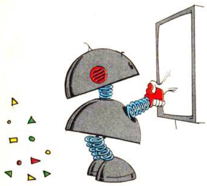
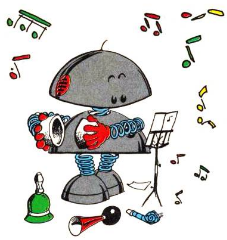


Growth

You never stand still with a computer. You're always learning, always growing, always wanting to do more. With the Coupé, your computer can grow with you.
Memory can be expanded from 256K to 512K. One or two 1 MB disk drives can be added. There are output ports for almost everything we can think of, and an expansion connector for things that other people develop later. And all of it simply slots in - no screws, no soldering, no hardware expertise.

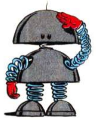
Graphics

See the full range of 128 colours on an ordinary TV set. Or better still, use a video monitor for really high definition. Best of all, use a modern TV with SCART to get the quality of a monitor on an ordinary TV set.
The Coupé has four graphics modes. Even at the lowest level - Spectrum emulation - you can change the colours in the the software to take full advantage of the palette. In modes 3 and 4, you can display up to 16 colours per line, a different colour for every pixel in a 256 x 192 pixel display; or have an 80-column 512 x 192 display for word processing and spreadsheets.
And free with the Coupé comes FLASH!, a software package by ace Swedish programmer, Bo Jangeborg, designed to give you total control over these powerful graphics.



Music

There won't be a better buy for all you aspiring electronic musicians. The Coupé features a full implementation of MIDI - MIDI In, Out and Through - with 16 channel capability, and MGT is promoting a full range of MIDI support software. Better still, the Coupé features an 8 octave, 6 channel stereo sound chip. For sensational sound effects, just plug in your headphones.
Play it again SAM!



SAM No, the computer's not called SAM, it's called the Coupé. This is SAM - he's the character who will guide you through the manual.