SERDAVISION HDMI

8-bit ISA video card with HDMI output · VGA · SVGA · EGA · CGA · Hercules · MDA

User Manual



SerdaVision HDMI — User Manual

An 8-bit ISA video card with HDMI output: VGA, SVGA, EGA, CGA, Hercules and MDA, and the experimental ColorPlus, Olivetti PC1, Tandy and Hercules InColor, one at a time

Firmware 1.00 · SerdaVision HDMI · Serdaco BV

1. What SerdaVision HDMI is

SerdaVision HDMI is a video card for IBM PC compatibles with ISA slots, from the original PC and XT up to Pentium boards. It sends the picture to a modern screen over **HDMI**, and to an analog VGA monitor through an HDMI-to-VGA dongle.

It has no video chip. A Raspberry Pi RP2350 microcontroller does the card's work in firmware, and **the firmware decides which card it is**. The firmware holds thirteen cards, and the card runs as one of them at a time. Set to VGA, it is an IBM VGA with its own video BIOS. Set to Hercules, it is a Hercules Graphics Card, with no BIOS of its own, exactly like the original. You choose the card from DOS with one command, or with the on-screen button menu, in a few seconds (section 4).

A small DOS program, `SVSET.COM`, chooses the card and sets a few things an original card never had: scanlines for the look of a CRT, a green, amber or white monochrome screen or a portable's plasma or LCD panel, a stretched 4:3 picture, the refresh rate, and on the CGA, ColorPlus and Tandy cards the colours of a composite monitor. A change shows at once; `SVSET /W` saves it in the card, where it survives power-off. `SVKEY.COM` changes them with Ctrl+Alt keys while a program runs, and five more, `SVTEST.COM`, `SVMODES.COM`, `RASTER.COM`, `HICOL.COM` and `ZWSLOAD.COM`, test the card from DOS (section 8).

2. What you need

- **A PC with a free ISA slot.** 8-bit or 16-bit slot, either works: the card uses only the 8-bit part. The card is designed for 4.77 MHz to 8.33 MHz ISA buses, which covers every PC, XT and AT. It has been tested on 8088 and V20 XTs with GLaBIOS, a 386 and Pentium-class PCs; other PCs are expected to work. Some 386, 486 and Pentium boards can raise the ISA bus clock in their BIOS setup: the card has been used at 12 MHz, and is designed for up to 16 MHz, which has not been tested.
- **DOS** (any version) to run `SVSET.COM`, `SVKEY.COM`, `SVTEST.COM`, `SVMODES.COM`, `RASTER.COM`, `HICOL.COM` and `ZWSLOAD.COM`.
- **A screen**, one of:
- an **HDMI monitor or TV**, with an HDMI cable;
- a **DVI monitor**, with an HDMI-to-DVI cable (set the card to DVI, section 7);
- an **analog VGA monitor** (CRT or LCD), through the **HDMI2VGA dongle** from Serdashop. The card powers the dongle from its HDMI port; no extra power supply is needed.
- To copy the firmware (or the recovery file) onto the card, or to read the card's console: a **USB-C cable** and any PC with a USB port (Windows, Mac or Linux).

The software package holds: `firmware/` (the firmware `serdavision-all-v1.00.uf2`, the recovery file `serdavision-reset-to-vga-v1.00.uf2` and `CHECKSUMS-SHA256.txt`); `dos/` (`SVSET.COM`, `SVKEY.COM`, `SVTEST.COM`, `RASTER.COM`, `HICOL.COM`, `SVMODES.COM`, `ZWSLOAD.COM` and `SVCOMPAT.BAT`); this manual; `LICENSE.txt`, `THIRD-PARTY-NOTICES.txt`, `CHANGES.txt` and `README.txt`. The latest package, with new firmware as it comes out, is at **serdashop.com**.

3. The board

This manual describes the SerdaVision HDMI board as it is sold: **Rev B** (`SO-03182C` on its silk). The earlier **Rev A** board (`SO-03182`) differs only where this manual says so.

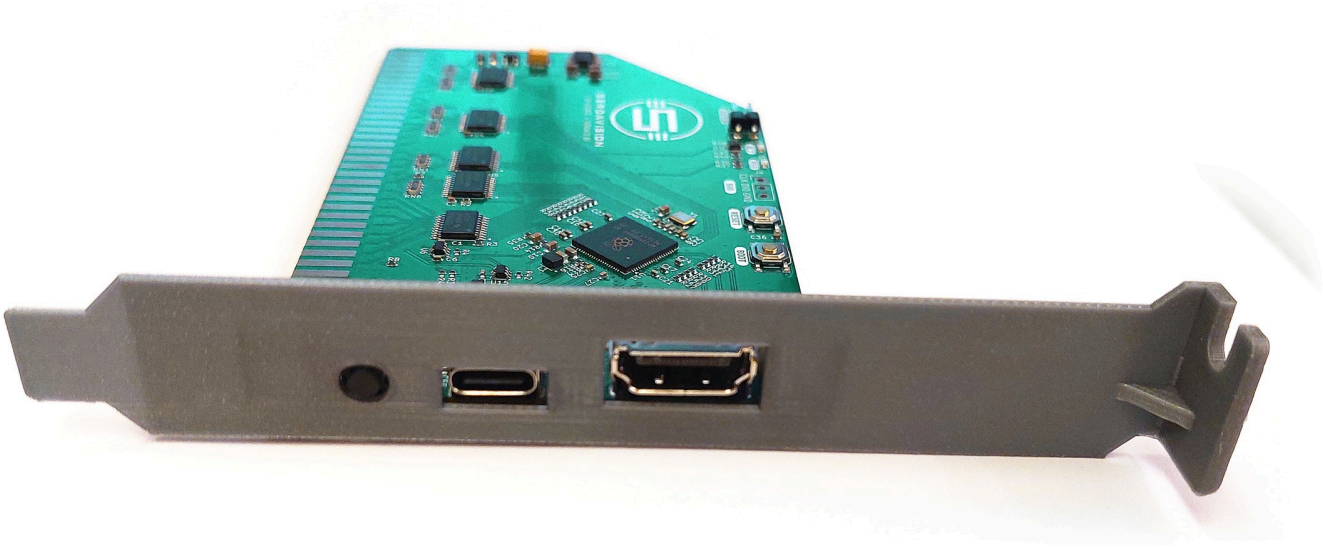


The SerdaVision HDMI board, Rev B, with its bracket

Part	Label	What it is for
ISA edge connector	—	Goes into the ISA slot. Only the 8-bit section is used
HDMI connector	J3	The picture. Also powers an HDMI2VGA dongle
USB-C connector	—	Firmware updates (section 9) and the console (section 10). Also powers the card on a desk
BOOT button	SW1	Held down while the card starts: the card waits for a file over USB — the firmware or the recovery file (section 9)
RESET button	SW2	Restarts the card
Menu button	SW3, on the bracket	Opens the on-screen button menu and moves through it (section 8, "The on-screen button menu")
Menu header	J5	For a front-panel switch on a cable; shorting its two pins is the same as pressing the menu button
Activity LED	D1	Blinks steadily, about once a second, while the card is producing a picture. After a start, and while the on-screen button menu is open, it blinks numbers (section 8)
Power LED	D2	On whenever the card has power, from the slot or from USB

The menu button on the card's bracket opens the on-screen button menu and is used to move through it (section 8, "The on-screen button menu"). If the card has no button on its bracket, the BOOT button on the

board can be used as the menu button instead: that is the case on a **Rev A** board, which has no SW3 and no J5. `SVSET` and `SVKEY` change the same settings from DOS (section 8).



The bracket, from the left: the menu button (behind the round hole), the USB-C connector and the HDMI connector

The card takes its power from the slot, from USB, or from both at once. Leaving the USB cable connected while the card is in a running PC is fine.

4. The firmware: one file, thirteen cards

The card's firmware is one file, **`serdavision-all-v1.00.uf2`**. It is on the card when you receive it, new versions are copied on over USB (section 9), and it holds thirteen cards. The card runs as one of them at a time, and you choose which — from DOS, or with the on-screen button menu — in a few seconds, without USB and without opening the PC. A new card starts as VGA. Choose the card your software expects. **If you are unsure, use VGA**: it runs everything written for VGA, EGA and CGA through the BIOS, and it is what a PC from 1990 onwards expects.

Card	The card becomes	Screen modes	Own video BIOS	Set the PC's video to
VGA	**IBM VGA**	text modes 0–3 and 7; CGA graphics 4–6; EGA 0Dh–10h; VGA 11h, 12h (640x480, 16 colours), 13h (320x200, 256 colours)	yes, 32 KB at C0000	EGA/VGA
SVGA	**VGA + VESA**	as VGA, plus VESA 100h (640x400, 256 colours), 101h (640x480, 256 colours) and 102h (800x600, 16 colours), and for 386 and later PCs 10Dh and 10Eh (320x200 in 32,768 and 65,536 colours); all 320 KB of video memory reachable	yes, VGA + VESA 1.2 (functions 00h–08h: also save/restore state, line length, display start and the palette width, which Windows 3.x VESA drivers can use)	EGA/VGA
EGA	**IBM EGA**, 256 KB	text 0–3 and 7; CGA graphics 4–6; EGA 0Dh, 0Eh, 0Fh, 10h (640x350, 16 colours)	yes, 16 KB at C0000	EGA/VGA

Card	The card becomes	Screen modes	Own video BIOS	Set the PC's video to
CGA	**IBM CGA**	40 and 80 column text; 320x200 in 4 colours (all three palettes); 640x200 in 2	no — uses the PC's own BIOS	CGA / Colour 80x25
Hercules	**Hercules Graphics Card**	monochrome text 80x25 (720x350); 720x348 graphics, two pages	no — uses the PC's own BIOS	Monochrome
MDA	**IBM MDA**	monochrome text only, 80x25 (720x350)	no — uses the PC's own BIOS	Monochrome
VGA-XT	**IBM VGA, for a PC or XT**	as VGA	yes, 32 KB at C0000	EGA/VGA
EGA-XT	**IBM EGA, for a PC or XT**	as EGA	yes, 16 KB at C0000	EGA/VGA
ColorPlus	**Plantronics ColorPlus** (experimental, below)	as CGA, plus 320x200 in 16 colours and 640x200 in 4	no	CGA / Colour 80x25
V6355D (PC1)	**Olivetti Prodest PC1** video (experimental, below)	as CGA, plus 160x200 in 16 colours and a programmable 512-colour palette	no	CGA / Colour 80x25
Tandy	**Tandy 1000 / IBM PCjr** video (experimental, below)	as CGA, plus 160x200 and 320x200 in 16 colours, 640x200 in 4	no	CGA / Colour 80x25
InColor	**Hercules InColor Card**, for an AT (experimental, below)	as Hercules, plus 720x348 in 16 of 64 colours, colour text and RamFont	no	Monochrome
InColor-XT	**Hercules InColor Card, for a PC or XT** (experimental, below)	as InColor	no	Monochrome

The names the card uses for itself. Wherever the card says which card it is running as — its BIOS line at start-up, the start-up and self-test screens, the on-screen button menu, SVSET and the other DOS tools, the USB console — it uses the names in the first column: **VGA**, **SVGA**, **EGA**, **CGA**, **Hercules**, **MDA**, **VGA-XT**, **EGA-XT**, **ColorPlus**, **V6355D (PC1)**, **Tandy**, **InColor** and **InColor-XT**. On the start-up and self-test screens and in the BIOS line they are in capitals after SERDAVISION, as in `SERDAVISION VGA-XT`; the menu's title reads `SerdaVision ISA - VGA-XT`.

Choosing the card

- **From DOS:** `SVSET /M` lists the cards and shows which one runs. `SVSET /M:CGA` (or `VGA`, `SVGA`, `EGA`, `HGC`, `MDA`, `VGAXT`, `EGAXT`, `COLORPLUS`, `V6355D`, `TANDY`, `INCOLOR`, `INCOLORXT`) switches the card **at once, until**

the PC is switched off: SVSET shows the steps, Enter switches, and DOS goes on on the new card **without a restart**. Add `/W` — `SVSET /M:CGA /W`, or `SVSET /W` afterwards — to **keep** the card through every power-off. Details in section 9.

- **With the menu button**, without DOS (section 3): press it and the on-screen button menu appears; hold its **Card** line for a second and pick a card. A card chosen this way is kept at once. **Holding the menu button for five seconds** with the menu closed, then letting go, brings the card back to VGA, with the factory settings (section 8, "The on-screen button menu").
- **Automatically, between the XT and AT cards** (below): VGA and VGA-XT, SVGA and VGA-XT, EGA and EGA-XT.

Set the PC's video to match the card you choose (the last column, and section 5) — a PC set for EGA/VGA does not show a CGA or a monochrome card, and the other way round. If the PC shows nothing after a choice, section 9 has the ways back, among them the recovery file that puts the card back to VGA.

VGA or VGA-XT? Both are the same VGA to every program. The difference is how the card talks to the PC. An 8088 PC or XT (and an XT clone with a V20) does not always wait for the card when it reads the screen memory; in text and the CGA graphics modes (320x200 and 640x200) the VGA-XT answers those reads in hardware, in a fixed time, as the memory chips on an original card do, so CGA games that read the screen back — Alley Cat, for instance — show no stray dashes. (Both answer the card's own BIOS that way, so an XT keeps its full 640K with either.) Monochrome text (mode 7, `MODE MONO`) and the EGA/VGA graphics modes work too, answered the usual way, as on the VGA; for a monochrome monitor on an XT, choose the MDA or Hercules card instead. **Choose VGA-XT for a PC or XT with an 8088, 8086, V20 or V30; choose VGA for an AT, 386 or newer.** On the VGA-XT the CGA graphics modes (320x200 and 640x200, modes 4–6) are sent at 60 Hz, as a CGA sent them, because CGA games on an XT are timed to that (section 7).

The card makes this choice itself. Its BIOS tells the card at every start of the PC whether the processor is an 8088-class one (8088, 8086, V20, V30) or a 286 or newer. If you chose VGA and the PC is an XT, the card switches to the VGA-XT at the next reset — the PC's reset button, or switching it off and on (not Ctrl+Alt+Del) — and the start screen says so: "SerdaVision: the card's VGA-XT firmware starts at the next reset". Moved to an AT, it goes back to the VGA the same way ("the card's VGA firmware starts ..."). The SVGA does the same: in an XT it switches to the VGA-XT, which is the better card there, and moved back to an AT that VGA-XT returns to the SVGA, not the VGA — the card remembers which one it came from, also when you switch from the SVGA to the VGA-XT yourself. Choosing VGA yourself (the on-screen button menu, `SVSET /M:VGA /W`, or the five-second hold) makes the VGA the one it returns to; choosing SVGA makes it the SVGA. `SVSET /M` without `/W` (for now, until power-off) changes nothing of this. The same for EGA and EGA-XT. The card remembers what it found. `SVSET /B` and the menu's **Bus** line (section 8) can force one: `XT`, `AT`, or `AUTO` (the default, the card decides). Note that a 286 or 386 accelerator card in an XT counts as an AT.

EGA or EGA-XT? The same choice for the EGA: the EGA-XT is the same EGA to every program, and talks to an 8088-class PC the way the VGA-XT does — its BIOS and, in text and the CGA graphics modes (320x200 and 640x200), the screen memory answered in hardware; monochrome text (mode 7) and the EGA graphics modes the usual way. Choose EGA-XT for a PC or XT with an 8088, 8086, V20 or V30 that expects an EGA, EGA for an AT or newer. Both send every mode at 60 Hz. Like the EGA, the EGA-XT uses only C0000–C3FFF for its BIOS, so C4000–C7FFF stays free for another card's ROM or RAM (the VGA and VGA-XT use all of C0000–C7FFF).

Why both Hercules and MDA? Software can tell them apart, and some programs misbehave when they find a Hercules where they expected an MDA. The MDA card is a plain MDA and nothing more.

The three extra cards: ColorPlus, V6355D (PC1) and Tandy

Three more cards in the firmware, each a CGA underneath with more added, are **experimental**: fewer programs were written for them, and they have been tested with fewer programs than the cards above. All three: set the PC's video to **CGA / Colour 80x25**; no BIOS of their own, as the real cards had none; at power-on each is an IBM CGA until software asks for more; `SVSET /C` (composite colour) works on the ColorPlus and the Tandy as on the CGA, in the CGA's own modes.

Card	The card becomes	Adds to the CGA
ColorPlus	**Plantronics ColorPlus**	32 KB: 320x200 in 16 colours and 640x200 in 4, for software written for the card (Planet X3, Sierra's AGI ColorPlus driver)
V6355D (PC1)	**Olivetti Prodest PC1** video (Yamaha V6355D)	160x200 in 16 colours and a programmable 512-colour palette; with a program that loads an artifact-colour palette, CGA games drawn for a composite monitor show their colours over HDMI. Put no monochrome card in the same PC: this chip decodes B0000–BFFFF as one block
Tandy	**Tandy 1000 / IBM PCjr** video	32 KB, sixteen palette registers and the gate array: 160x200 and 320x200 in 16 colours (modes 8 and 9), 640x200 in 4 (mode 0Ah)

The ColorPlus in an XT and in an AT. Some XTs do not wait for a card when it reads its screen memory, so in an XT the ColorPlus answers its screen memory in hardware and makes the PC wait a moment at every `OUT` instruction — on an XT that costs nothing. An AT waits for the card, so there the ColorPlus works without that pause, which would hold up the PC's disk writes. The card picks the way when it starts, by the **Bus** setting (`SVSET /B`, section 8) and by the kind of PC it has found: `XT`, or `AUTO` in a PC it knows as an XT, the XT way; `AT`, or `AUTO` in a PC it knows as an AT, the AT way. The ColorPlus has no BIOS of its own to tell the card which PC it is in: the card goes by its last start as VGA, SVGA, EGA, VGA-XT or EGA-XT — so after moving the card to another PC while it is kept as ColorPlus, start it once as one of those (or set `SVSET /B`), then switch the PC off and on. Until then it takes the XT way, which works in every PC; in an AT its only effect is on the speed of disk writes (`SVSET /B:AT` avoids that). A changed Bus setting applies from the card's next start (switch the PC off and on).

The Tandy: what to know. The Tandy card draws what a program puts in its registers. On an ordinary PC, a few things decide whether a Tandy game uses it:

- **No video BIOS of its own.** The modes are set by the PC's own BIOS, as on the CGA. On anything but a Tandy 1000 or a PCjr that BIOS knows no modes 8, 9 or 0Ah: a program that asks the BIOS for them (INT 10h) gets nothing, or a CGA mode. Only programs that program the card's registers themselves get the Tandy modes.
- **Many Tandy games look for a Tandy PC, not a Tandy card.** They read the motherboard's BIOS — its model byte, or a signature in its ROM — and a video card cannot change that. On an ordinary PC they then offer CGA or EGA only, and no Tandy graphics at all. Many do this, among them Sierra's SCI games: the check is in Sierra's SCI interpreter, so it is the same in every game built on it (Space Quest III, King's Quest IV and the rest). Many also take "Tandy" to mean the Tandy's three-voice sound chip, which a video card does not have.
- **Three details are modelled, not measured on a real Tandy:** which register bit selects 640x200 in 4 colours (rather than the CGA's 640x200 in 2), how the work of the CGA's mode register is shared with the Tandy's own one, and the steps of the page register at 3DFh. A program written for the Tandy 1000 that sets its 16-colour modes another way gets a CGA picture or other colours.

- **Differences from IBM's PCjr reference.** The card's 640x200 in 4 colours stores the pixels in a different order from the PCjr, so a PCjr program in that mode shows a scrambled picture; the card shows the page a program writes to (3DFh) rather than the page it asked to display, so a game that draws on one page while showing the other can flicker or show the page being drawn; and the sixteen palette registers act only in the Tandy's own modes, not also in text and the CGA modes as on a real Tandy.
- **Video memory is the card's own.** A real Tandy keeps its video memory in the PC's RAM and pages it in through 3DFh; a card cannot. Programs that write the screen through B8000 work; the rare one that reaches it through its place in low memory does not.

So: a program that offers "Tandy" or "PCjr" graphics on your PC and then draws through the card is what this card is for. A game that offers no Tandy graphics on a non-Tandy PC is looking for the machine.

The Hercules InColor (experimental)

InColor and **InColor-XT** in the card list make the card a **Hercules InColor Card** (1987): a Hercules with 256 KB in four colour planes, 720x348 in 16 colours chosen from 64, colour text, RamFont (fonts loaded by the program, 80 or 90 columns, cells 4 to 16 lines high) and the InColor's own colour registers. Choose **InColor** on an AT (286 and newer) and **InColor-XT** on an 8088 PC or XT (`SVSET /M:INCOLOR`, `SVSET /M:INCOLORXT`, or Card in the on-screen button menu): the card does not pick between the two by itself, as it does for the VGA and the VGA-XT - neither has a BIOS that tells the card the PC's CPU. Set the PC's video to **Monochrome**; it has no BIOS of its own, as the real card had none. At power-on it is a Hercules - every Hercules and monochrome program runs as on the Hercules card, in white on black - until a program that knows the InColor programs its colours: Hercules' own utilities (TEST, PALETTE, SETCOLOR, RAMFONT, FONTMAN, LEARN222, the GB222 sample code), Write On!, and the InColor drivers for AutoCAD, Lotus 1-2-3, Symphony, Framework II, Word 3 and Windows 1.x. Like the real card it keeps its colour settings when you press Ctrl+Alt+Del; only the reset button or switching off resets them.

The InColor and InColor-XT are **experimental**: they have been tested with Hercules software and with SVMODES's colour text and 16-colour modes, and have not been tested against a real InColor card or with all of its software. Their limits:

- **The InColor-XT** works as the Hercules card for as long as the card is a Hercules - Hercules and monochrome programs run on it the same way, and so do palette changes and RamFont - and switches to its colour logic when a program sets the InColor's write mode or colour-compare registers (its start-up screen says `SERDAVISION INCOLOR-XT`). Once a program has drawn through the colour logic, until the reset button or switching off, an XT that does not wait for the card on every read can occasionally read a wrong byte back in a colour program, which shows as a stray dot. In an XT, use the InColor-XT rather than the InColor. One difference from a real InColor: a colour picture left on the screen when you press reset shows in white on black until something redraws it.
- A few details of colour text and RamFont are not specified in the InColor's documentation; the card implements them as that documentation implies.
- `SVSET`, `SVTEST` and `RASTER` name it ("InColor", "InColor-XT"), and `SVKEY` works on it; SVTEST tests its text memory and its colour logic (the six `IC` lines, section 8). `SVMODES` tests the Hercules's three modes and three of the InColor's own: `ICT` (colour text), `IRF` (RamFont) and `IC16` (sixteen colours through the palette). After start-up the D1 light blinks **12** (InColor-XT: **13**).

Only one video card in the PC. Set to VGA, SVGA, EGA, VGA-XT or EGA-XT, the card brings its own video BIOS at address C0000, and so does any other EGA or VGA card or on-board VGA chip: two of them conflict. Remove the other card, or disable the on-board video in the BIOS setup. (The CGA, Hercules, MDA, InColor, ColorPlus,

V6355D and Tandy cards carry no BIOS. A monochrome card beside a colour SerdaVision HDMI works, with the limits given under SVKEY and 0WS in section 8.)

5. Installing the card

1. **Switch the PC off and unplug it.** Never insert or remove an ISA card with the power on. Touch the PC's metal case before handling the card, and hold it by its edges and bracket.
2. Remove the old video card, or disable the on-board video.
3. Put the SerdaVision HDMI in a free ISA slot, press it down evenly, and screw the bracket down.
4. Connect the screen to the HDMI connector (or the HDMI2VGA dongle, then the VGA monitor to the dongle).
5. **Tell the PC which kind of card it has**, to match the card it is set to (table in section 4; a new card starts as VGA):
6. **AT, 386, 486, Pentium:** in the BIOS setup, set the primary display to *EGA/VGA*, *CGA 80x25* or *Monochrome*.
7. **PC and XT:** the video switches on the motherboard. On an IBM 5160 (XT) these are switches 5 and 6 of SW1: both ON for EGA/VGA, 5 ON / 6 OFF for colour 80x25 (CGA), both OFF for monochrome. Clones differ: check the motherboard manual.
8. Switch the PC on.

Which card is it set to? As VGA, SVGA, EGA, VGA-XT or EGA-XT the start-up line says so (section 6); `SVSET` names the card under DOS (section 8). To choose another, see section 4.

6. The first start

Within a second of power-on the PC's start-up screen appears. With the card set to VGA, SVGA, EGA, VGA-XT or EGA-XT, its own BIOS announces itself first, by the card's name (`SERDAVISION VGA BIOS 1.00 - RP2350 ISA VGA card` , `(c) 2026 Serdaco BV` ; on the VGA-XT `SERDAVISION VGA-XT BIOS 1.00 - RP2350 ISA VGA-XT card` , and so on), then the PC continues with its memory count and the rest of its start-up. DOS then boots as usual. As CGA, Hercules, MDA, ColorPlus, V6355D, Tandy, InColor or InColor-XT there is no card BIOS line: the PC's own BIOS drives the card, as it did the originals.

The screen stays black? Look at the activity LED D1:

- **D1 blinks:** the card is running and sending a picture. The problem is the screen or the cable: see section 7 and section 12.
- **D1 is dark, D2 is on:** the card has no firmware, or is waiting for a file over USB (BOOT held at power-on). Copy the firmware file onto it (section 9).
- **D2 is dark too:** no power reaches the card. Check that it is fully seated in the slot.

7. Screens and refresh rates

The card always sends a standard PC signal that practically every HDMI screen accepts. The picture of the PC's screen mode is placed inside it, unscaled and centred, with a border where the mode is smaller.

Screen mode	The card sends	Note
640x480 modes (11h, 12h), and all modes of the CGA, EGA, EGA-XT, Hercules, MDA and InColor cards and of the three extra cards	640x480 at 60 Hz	Hercules, MDA and InColor send 720x480 at the same line rate, as the originals are 720 wide; so does 9-dot text on the EGA, VGA and SVGA cards (`SVSET /T:9`), and the screen may re-sync between text and graphics
200-, 350- and 400-line modes on the VGA and SVGA cards (DOS text, 13h games, ...)	640x480-class at **70 Hz**	what a real VGA sends. Switch to 60 Hz with `SVSET /R:60`
The same on the VGA-XT	640x480-class at **70 Hz**, but the CGA graphics modes 4–6 at **60 Hz**	a CGA game on an XT is timed to a CGA's 60 Hz; at 70 some draw wrong (Alley Cat's fish level flickers). `SVSET /R:VGA` sends those at 70 too, `SVSET /R:60` every mode at 60
VESA 100h (SVGA)	640x480-class at **70 Hz**, 400 lines	as the 400-line modes above; `SVSET /R:60` for 60 Hz
VESA 101h (SVGA)	640x480 at 60 Hz	
VESA 102h (SVGA)	800x600 at **56 Hz**	the VESA standard for this mode; some screens refuse it
VESA 10Dh / 10Eh (SVGA)	640x480-class at **70 Hz**, 400 lines, each picture line twice	as mode 13h; `SVSET /R:60` for 60 Hz
ET4000 2Eh / 2Fh / 29h (SVGA with `SVSET /E:ON`)	as VESA 101h / 100h / 102h	the same pictures under the Tseng chip's mode numbers

VESA hi-colour, 10Dh and 10Eh (SVGA card): 320x200 in 32,768 colours (10Dh) or 65,536 (10Eh), two bytes a pixel, for image viewers, demos and games that ask the VESA BIOS for them on a 386 or later PC. The card's memory holds two such pictures, and programs that switch between them (VESA display start) work. On an 8088 or 8086 PC they would work, but a picture is 128,000 bytes and drawing one over the 8-bit bus takes such a PC a long while; for those PCs the VGA-XT is the card to use (section 4), and it has no VESA modes.

DOS text on the VGA and SVGA cards is 400 lines of 16-line characters, as on a VGA. A program can ask for 350 lines (the EGA's shape, 14-line characters) or 200 before it sets a text mode, as some BIOS start-up screens do for their logo; the card follows, exactly as an IBM VGA does.

The screen shows "out of range" or nothing, in DOS, on the VGA or SVGA card: the screen does not accept 70 Hz. The DOS prompt itself is a 70 Hz mode, so you cannot read what you type. Type `SVSET /R:60` and press Enter blind; the picture appears once the card switches.

HDMI or DVI. The card sends HDMI, and tells the screen the picture is 4:3. A **DVI** monitor, or an HDMI-to-DVI adapter, may show two stray columns at the left edge or no picture: switch to DVI with `SVSET /H:DVI` . An HDMI screen given DVI shows the picture too, but may stretch it to full width.

The HDMI2VGA dongle plugs straight into the card and gives an analog VGA signal for a CRT or VGA LCD. Your old VGA monitor then sees the signal it always saw from a VGA card: 640x480 at 60 Hz; the 70 Hz modes are sent to it as well (if the monitor shows nothing in them, use `SVSET /R:60`).

8. The DOS tools: SVSET, SVKEY, SVTEST, SVMODES, RASTER, HICOL and ZWSLOAD

All seven run under DOS on any PC, including an 8088. Copy them to the PC (to `C:\DOS` or your path, for instance). Each starts with a line naming its version - all but ZWSLOAD also name the build, such as `SVSET v1.00 abdc89e, built 2026-10-31` - and SVSET, SVTEST, SVMODES and RASTER also show the **card's firmware** version and commit (`firmware 1.00 abdc89e`): quote both when you contact Serdaco about a problem.

SVSET — the card's settings

`SVSET` on its own shows the card and its settings:

```
SVSET v1.00 abdc89e, built 2026-10-31
(c) 2026 Serdaco BV
SerdaVision VGA card, settings interface 14
  firmware:  1.00 abdc89e
  scanlines: off
  stream:    AUTO
  phosphor:  colour
  vertical:  lines (centred, as they are)
  aspect:    4:3
  refresh:   70 Hz for 200/350/400-line modes, as a VGA
  BIOS:      AUTO (a copy only if the card cannot answer its ROM itself)
  0WS:       off
  text:      8 dots wide
  card mode: VGA
  bus:       AUTO, host AT (286 or later, this boot)
```

The `0WS:` line (`/Z` below) is shown on a Rev B board by the EGA, VGA and SVGA cards; a Rev A board has no 0WS, and no such line. The EGA, VGA and SVGA cards (and the EGA-XT and VGA-XT) also show a `text:` line (`/T`).

Change a setting by giving a switch; several can go on one line, for instance `SVSET /S:4 /V:FILL` . A switch starts with `/` or `-` , the value follows a `:` or `=` , and upper or lower case does not matter. **A change takes effect at once and is not saved**: add `/W` to keep it (section "Saving" below).

Switch	Values	Default	What it does
`/S:n`	`0` to `6`	`0`	**Scanlines.** 200-line modes (most games before 1990) are sent with every line twice; this darkens the second copy, for the look of a CRT: `0` off, `1` a sixteenth darker (the lightest), `2` an eighth, `3` a quarter, `4` half, `5` three quarters, `6` black
`/P:x`	`COLOR` , `WHITE` , `GREEN` , `AMBER` , `PLASMA` , `LCD`	`COLOR`	**Phosphor.** Shows the picture as a monochrome monitor would, in white, green or amber, or as the orange-red gas plasma screen of a portable such as a Toshiba T3100 or Compaq Portable III. `LCD` looks like a Toshiba T1000's screen: dark blue-grey on pale grey-green, so black becomes the background and the brightest colours the darkest. Works on every card (but not in the SVGA's VESA 10Dh and 10Eh, section 13): an amber Hercules or a green CGA is one switch
`/V:x`	`LINES` , `FILL`	`LINES`	**Vertical.** `LINES` shows the lines as they are, centred. `FILL` stretches every mode over the whole screen height, the way the original monitors filled their 4:3 tubes — a 320x200 game gets its 4:3 shape back

Switch	Values	Default	What it does
`/A:x`	`4:3`, `16:9`	`4:3`	**Aspect** the card declares to an HDMI screen. Some TVs follow it; most monitors use their own setting
`/H:x`	`AUTO`, `HDMI`, `DVI`	`AUTO`	**Stream.** `DVI` for DVI monitors and adapters (section 7). On this board `AUTO` means HDMI
`/R:x`	`70`, `60`, `VGA`	`70`	**Refresh**, VGA, VGA-XT and SVGA cards only: `70` sends the 200-, 350- and 400-line modes at 70 Hz as a VGA does, `60` sends every mode at 60 Hz. On the VGA-XT, `70` keeps the CGA graphics modes 4–6 at 60 Hz, as a CGA (section 7), and `VGA` sends those at 70 as well; on the other cards `VGA` is the same as `70`
`/C:x`	`OFF`, `NEW`, `OLD`	`OFF`	**Composite colour**, CGA card (and the ColorPlus and Tandy, CGAs underneath) only: shows what a CGA put on an NTSC composite monitor or TV, where fine dot patterns become the extra colours many CGA games were drawn for. `NEW` models a later IBM CGA board, `OLD` the first one (less saturated colours, and softer text). It applies only while a program switches the composite colour on, so DOS and RGB-only games look as before. On these three cards SVSET shows it as a `composite:` line
`/X:x`	`AUTO`, `SMALL`, `FULL`, `OFF`	`AUTO`	**BIOS in RAM**, EGA, VGA, SVGA, EGA-XT and VGA-XT cards: whether the card's BIOS copies itself into the PC's memory at start-up and runs from there. Takes effect at the **next start** of the PC, once saved with `/W`. See "BIOS in RAM" below
`/E:x`	`ON`, `OFF`	`OFF`	**ET4000**, SVGA card only: the card also answers as a Tseng ET4000 chip, for Windows 3.1's "ET4000 640x480 256 colors" driver and DOS programs with Tseng drivers. Takes effect at the **next reset or power-on**, and saves on its own. See "ET4000" below
`/Z:x`	`ON`, `OFF`	`OFF`	**0WS on memory writes and reads**, Rev B boards only, EGA, VGA and SVGA cards in an AT (286 and newer): the card tells the PC it has taken each memory write at once, and that the byte of a screen-memory or card BIOS read is ready, so the PC skips its wait states - faster writes and reads on chipsets that honour it. Refused in a PC or XT (8088, 8086, V20): there pin B8 is not a 0WS line. An XT with a 286 or 386 accelerator card counts as an AT: set `SVSET /B:XT` there, and 0WS stays off. Not with a second display card. If the PC does not run correctly with it, `SVSET /Z:OFF /W`. Saving the settings while the card runs as a card without 0WS (CGA, Hercules, MDA, the XT cards and the other cards) turns it off again. See "Bus speed" below
`/D`	—	—	Back to the defaults, and saved
`/W`	—	—	**Write**: save the settings as they are now to the card's memory. With other switches (`SVSET /S:4 /W`) or alone — it also keeps what SVKEY changed. It also **keeps the card**: a card started with `/M:` alone runs only until the PC is switched off, and `SVSET /W` keeps it for good (section 9)

Switch	Values	Default	What it does
`/M`	card name	—	**Card mode** (sections 4 and 9): `/M` alone lists the cards, `/M:CGA` starts the CGA **until the PC is switched off**, `/M:CGA /W` starts it and **keeps** it. Names: `VGA`, `SVGA`, `EGA`, `CGA`, `HGC` (or `HERCULES`), `MDA`, `COLORPLUS`, `V6355D` (or `PC1`), `TANDY`, `VGAXT` (or `VGA-XT`), `EGAXT` (or `EGA-XT`), `INCOLOR`, `INCOLORXT` (or `INCOLOR-XT`; section 4)
`/B:x`	`AUTO`, `XT`, `AT`	`AUTO`	**Bus**: which of the VGAs (VGA or SVGA, VGA-XT) and the two EGAs (EGA, EGA-XT) runs, and how the ColorPlus works (section 4, "The ColorPlus in an XT and in an AT"). `AUTO` lets the card decide from the processor its BIOS finds at start-up (section 4); `XT` and `AT` force one. Takes effect at the **next reset or power-on** (not Ctrl+Alt+Del; on the ColorPlus at the next power-on), and saves on its own. `SVSET` shows it as a `bus:` line, with what the card found and, when the next reset will change the card, which one starts
`/T:x`	`8`, `9`	`8`	**Text**, EGA, VGA and SVGA cards (and the EGA-XT and VGA-XT): `8` draws text characters 8 dots wide, 640 across, as the card always has. `9` draws them 9 dots wide where the mode asks for it, 720 across, as a real IBM VGA does in modes 0–3 and 7 at 400 lines, its normal text (and an EGA in mode 7) - 43-line text, which uses 350 lines, stays 8 dots as on a real VGA: letters stand a little apart and box and line characters join up across the gap. A program that sets 8-dot text itself (90-column modes, some demos) still gets 8. With `9` many HDMI screens **go black for a second or two** when a program switches between text and graphics (starting or leaving a game), because the picture's width changes - as a CRT re-syncs on a real VGA. That is why `8` is the default. `SVSET` shows it as a `text:` line. Saving settings while the card is set to a card without it (CGA, Tandy, ColorPlus, V6355D, Hercules, MDA, InColor) sets it back to `8`, as for `/Z`
`/?`	—	—	Shows the list of switches

Saving. A change takes effect at once and is **not saved**: the saved settings come back at the next power-on or reset. To keep what you see, run `SVSET /W` (or put `/W` on the line). The card then writes its memory, only when something actually changed, and the screen **blinks once** while it does; saved settings survive power-off and a firmware update. Three switches save on their own: `/R`, because `SVSET /R:60` is typed blind at a screen that shows nothing and has to stick; `/E`, because the card only takes it at the next reset, and a reset brings back the saved settings; and `/D`, the defaults. `/B` is kept by the card itself, apart from the other settings, as soon as it is given. The card choice works the same way (section 9): `SVSET /M:CGA` is for now — until the PC is switched off — and `/W` keeps it.

Because a change is not saved, a batch file can set things for one program and put them back without writing the card's memory, however often it runs:

```
SVSET /V:FILL /S:4
GAME.EXE
SVSET /V:LINES /S:0
```

BIOS in RAM (`/X`, EGA, VGA, SVGA, EGA-XT and VGA-XT cards). Whether the card's BIOS copies itself into the top of the PC's conventional memory at start-up and runs from there. Some XT clones do not wait for the card on every read of its BIOS; the card answers those reads in hardware, in a fixed time, as a BIOS chip would, so no copy is needed and the PC keeps its full 640K. That is `AUTO`, the default: the card decides, and copies nothing.

(Should the card be unable to answer its BIOS that way, `AUTO` copies it on an 8088, 8086, V20 or V30 PC.) On an AT (a 286) or newer, "Video BIOS Shadow" in the PC's own BIOS setup is the setting for speed. The other values:

- `OFF` — never copy.
- `SMALL` — copy on every PC, without the character fonts (they stay on the card): 10 KB on the VGA, 12 KB on the SVGA, 7 KB on the EGA, so `MEM` shows for instance 630K instead of 640K.
- `FULL` — copy on every PC, fonts included: 19 KB on the VGA, 21 KB on the SVGA, 13 KB on the EGA. The character fonts are then read from the PC's memory too. A few tables still come from the card itself: the colour tables a VGA or SVGA screen mode loads when it is set, and what a program reads when it asks the BIOS for its mode tables or the SVGA's mode details - read once each time, never run.

The card's BIOS reads this setting once, when the PC starts, so a change shows at the next start — and only once it is saved: `SVSET /X:OFF /W`, or with the on-screen button menu (which saves when it closes).

ET4000 (`/E`, SVGA card). With `SVSET /E:ON` the SVGA card answers, from the next reset or power-on, as a Tseng ET4000 graphics chip as well as the VGA and VESA card it is. Windows 3.1's Super VGA driver package from Microsoft (SVGA256.DRV: "ET4000 640x480 256 colors" or "Super VGA 640x480 256 colors" in Windows Setup) and DOS programs with their own ET4000 drivers then find it. It adds the ET4000's BIOS modes **2Eh** (640x480, 256 colours), **2Fh** (640x400, 256 colours) and **29h** (800x600, 16 colours), and the chip's registers those programs use. VESA keeps working beside it. `SVSET` shows the setting as an `ET4000:` line; until the card has been reset it adds `, from the next reset`. `SVSET /E:OFF` (or `/D`) goes back to the plain VGA and VESA card, again from the next reset. The on-screen button menu has the same switch as **ET4000**.

It works with Windows 3.1 and with Windows 98's own Tseng driver too:

Windows 98 in 256 colours:

1. The card set to SVGA, `SVSET /E:ON`, restart the PC; `SVSET` must show "ET4000: on".
2. Display Properties - Settings - Advanced - Adapter - Change - "Display a list of all the drivers" - "Show all hardware" - **Tseng Labs** - **Tseng Labs ET4000**. Windows may ask for its CD or setup files.
3. Restart, then Settings: **256 Colors** and **640 by 480 pixels**.

Windows lists larger screen areas and more colours as well; the card does not have the memory for them, and Windows says "There is a problem with your display settings" and comes back in 16 colours - choose 640 by 480 and 256 colours again. Windows 95 has not been tested (section 13).

What it is not: an ET4000 with 1 MB. The card has 320 KB, and tells programs that ask that it has 256 KB, as the smallest ET4000 boards did — so they offer what the card can show. 800x600 and 1024x768 in 256 colours do not exist on this card: in Windows Setup choose a **640x480** entry (the 800x600 and 1024x768 ones stop with an error when Windows starts; choose again with Setup from DOS).

SVSET's messages:

Message	Meaning
`Settings saved to the card's flash.`	Done
`Settings unchanged; nothing to save.`	The card already had these settings

Message	Meaning
`SVSET: no SerdaVision card found …`	No SerdaVision HDMI in this PC, or it is not answering — or the tool runs in a DOS box inside Windows, which answers the video card's ports itself (SVTEST then tests "as VGA"): run the SerdaVision tools in plain DOS (Windows 95/98: F8 at start-up, "Command prompt only", or "Restart in MS-DOS mode")
`SVSET: bad option.`	A switch or value SVSET does not know; the list of switches follows
`SVSET: /x needs settings interface n or newer …`	The card's firmware is older than this SVSET: update the firmware (section 9)
`SVSET: /T:8 and /T:9 (text cells) are for the EGA, VGA and SVGA cards, with firmware 1.00 or later.` (two lines)	`/T` on a card without 9-dot text, or on older firmware
`SVSET: note: /C is set, but this card does not use it.` (also /R, /X, /E, /B)	The setting belongs to another card (the table above says which). It is stored all the same, because the cards share their settings: it acts once that card runs
`SVSET: the card could not write its flash.` or `… did not confirm the save.`	The setting is active now, but will be lost when the PC is switched off. Try again; if it repeats, contact Serdaco
`Live now, not saved: SVSET /W saves. …`	The change is active; add `/W` to keep it
`card mode: CGA, kept (confirmed by this SVSET)`	`SVSET /W` has kept the card chosen with `/M`: it stays (section 9)
`card mode: CGA (until power-off; SVSET /W keeps it)`	The card was chosen with `/M` without `/W`: it runs until the PC is switched off, then the card before it starts again. `SVSET /W` keeps it (section 9)
`card mode: VGA-XT (on trial; SVSET /W keeps it)`	The card has just switched between VGA (or SVGA) and VGA-XT (or EGA and EGA-XT) by itself and will keep it once its BIOS has run (section 9)
`The card will restart as CGA until the PC is switched off. …` or `… as CGA and keep it. …`	`/M`, without or with `/W`: read the steps, then Enter switches, Esc cancels (section 9)
`Note: this firmware keeps a new card only after SVSET is run from it.`	The card's firmware is older than this SVSET: there `/M` starts a card on trial, and `SVSET` on its own, typed in the new card, keeps it; three power-ons without that go back (section 9)
`bus: AUTO, host XT (8086-class CPU, this boot)` and `VGA-XT starts at the next reset`	`/B`: what the card found, and that the next reset (reset button or power) changes the card
`SVSET: /Z:ON refused: 0WS needs a Rev B board, read as one at power-on.`	`/Z:ON` on a Rev A board, which has no 0WS line (or a Rev B board the card could not read as one at power-on, which can happen when it restarts after a USB update: switch the PC and the card off and on)

Message	Meaning
`SVSET: /Z (0WS) is not available on this card: …`	The card runs as a card without 0WS: only the EGA, VGA and SVGA have it
`SVSET: /Z:ON refused: 0WS is for AT (286 and later) buses.`	`/Z:ON` in a PC or XT (an 8088, 8086 or V20): on that bus pin B8 is not a 0WS line, so the card never uses it there
`SVSET: /Z:ON refused: the bus is set to XT (SVSET /B); 0WS is for AT buses.`	`/Z:ON` with the bus set to XT (`/B:XT`): the card treats the PC as an XT. `SVSET /B:AUTO` first, if the PC really is an AT
`0WS: on, not in force`	Shown right after `SVSET /Z:ON` : the card turns it on a moment later, and the next `SVSET` shows `0WS: on (zero wait state memory reads and writes)`
`0WS: on, not in force until the card's BIOS reports a 286 or later`	The card uses 0WS only once its BIOS has told it, at this start of the PC, that the PC is an AT. After a restart of the PC it is in force again
`0WS: on, not in force: 0WS is for AT (286 and later) buses`	The setting is on, but the card is in a PC or XT: it never uses 0WS there. Harmless; `SVSET /Z:OFF /W` clears the setting
`0WS: on, not in force: the bus is set to XT (/B)`	The setting is on, but the bus is set to XT: the card treats the PC as an XT and does not use 0WS

SVTEST — test the card

`SVTEST` writes the card's video memory and registers through the ISA slot, reads them back, and reports what came back wrong. It takes a few seconds on a Pentium, longer on an XT, and the screen shows patterns and changes mode while it runs; that is normal. It tests any video card, not only the SerdaVision HDMI.

```
SVTEST v1.00 abdc89e, built 2026-10-31
(c) 2026 Serdaco BV
SerdaVision VGA card, firmware 1.00 abdc89e
test              result
text memory       pass
four planes       pass
latch copy        pass
write modes       pass
write order       pass
bursts            pass
DAC               pass
registers         pass
speed: write nnn KB/s by bytes, nnn KB/s by words; read nnn KB/s by bytes
SVTEST: all passed.
```

On a 386 or newer a second speed line follows the first, for the 32-bit instructions: `speed: write nnn KB/s by dwords; read nnn KB/s by words, nnn by dwords` . An 8088, V20 or 286 prints the first line only.

The speeds depend on the PC and its ISA bus. The tests depend on the card: all eight on VGA and SVGA; the first six on EGA; text memory and bursts on CGA, Tandy, ColorPlus, V6355D, Hercules and MDA; on the InColor (and on a real Hercules InColor) text memory, bursts and the six `IC` tests of its colour logic.

Test	What it checks
text memory	Every byte of the text screen's memory, with fixed, address and random patterns. On the CGA, ColorPlus, V6355D and MDA cards also the copy of the memory higher up that the original cards show
four planes	EGA/VGA: each of the four 64 KB memory planes on its own
latch copy	EGA/VGA: the fast screen-to-screen copy many games use (write mode 1)
write modes	EGA/VGA: thousands of random settings of the graphics controller, each result checked bit for bit
write order	EGA/VGA: port writes mixed with memory writes at full speed; a byte in the wrong place means the card took a port write too late or too early
bursts	Whole-screen fills and copies with the fastest instructions the CPU has
DAC	VGA: the 256-colour palette, written and read back
registers	VGA: the registers a program can read back
IC write modes	InColor: its four write modes, from the foreground and background colours and the latch, random settings checked plane by plane (read back through the card's own colour compare) - and that a write leaves the latch alone
IC write protect	InColor: planes protected from writes (register 18h) keep what they had
IC compare reads	InColor: a read compares each pixel with the background colour, leaving out the "don't care" planes, either way round (register 19h)
IC latch protect	InColor: protected pixels keep the latch they had (register 1Bh)
IC display planes	InColor: the planes switched off on the screen (18h) still read and write as before
IC palette port	InColor: palette writes (1Ch) change nothing but the palette; the palette itself only shows on the screen, which SVTEST cannot see

On the InColor the screen is blank while the `IC` tests run. SVTEST puts the registers that decide how the card reads and writes (18h-1Bh) back to their power-on values before and after; the palette ends as the fixed colours of a card that has none loaded, so run `PALETTE` again if you had loaded one. On the **InColor-XT** the `IC` tests switch the card to its colour logic, which it keeps until the reset button: SVTEST then says so, and on an XT that does not wait for the card on every read an `IC` FAIL can come from that XT's bus timing (see the InColor section above) - press the PC's reset button after SVTEST.

`SVTEST /L` repeats until you press a key, and then reports over all passes: leave it running for an hour to look for a fault that comes and goes. `SVTEST /Q` is a shorter pass.

A line with **FAIL** gives the number of errors and the first one: where (`A000:E061 plane 1`), what was written and what came back. **Photograph the screen and send it to Serdaco**, with the PC's make and CPU. Exit code 0 means all passed, 1 errors found, 2 a bad option.

Bus speed, 0WS and ZWSLOAD

How fast a program writes to and reads from the card's screen memory is set by the ISA bus, the PC's chipset and the card. On a Pentium 75 (Intel 430HX chipset) `SVTEST` and `ZWSLOAD` measured, in KB/s:

	by bytes	by words	by dwords
writes	847	1013	1137
writes with 0WS on (Rev B, `SVSET /Z:ON`)	1261	1654	1964
reads	771	951	1096
reads with 0WS on (Rev B, `SVSET /Z:ON`)	951	1240	1509

Without 0WS (and always on a Rev A board) these are that Pentium 75's own limits for any 8-bit ISA card. In short: **up to 1.1 MB/s writes and 1.1 MB/s reads without 0WS, the full speed of the 8-bit ISA bus; up to 1.9 MB/s writes and 1.5 MB/s reads with zero-wait-state (0WS, `SVSET /Z:ON`, Rev B board) on supported chipsets such as the Intel 430HX/PIIX3.** Measured with 32-bit transfers on a Pentium; the actual speed depends on the PC and its chipset (1 MB = 1024 KB).

Every PC has a limit of its own, whatever the card: a Pentium 133 with a VIA VXPro+ chipset, for instance, stops at 754 / 942 / 1077 KB/s for writes and 660 / 868 / 1013 for reads (bytes / words / dwords), with 0WS or without. Writes and reads by words and dwords are faster than by bytes because the PC itself splits them into bytes for an 8-bit card, with less time between them. On an XT the XT's own bus speed is the limit.

0WS (Rev B boards, `SVSET /Z`). An ISA card can pull the bus's 0WS line (pin B8) to tell the PC that it has taken a memory write at once, and the PC then skips the wait states it otherwise adds to every 8-bit write. The card does the same for the reads it can answer at once - most reads of the screen memory in the graphics modes, and the card's BIOS - so reads get faster too; reads that have to wait for the card (right after a write, text modes, the colour-compare read mode) and every I/O read run as before. The Rev B board has this line wired; a Rev A board does not, and there `/Z:ON` is refused. `SVSET /Z:ON` turns it on for the EGA, VGA and SVGA cards in an AT (286 and newer). Only an AT bus has a 0WS line: in a PC or XT pin B8 means something else (on the IBM XT's slot 8 it is the "card selected" line), so there `/Z:ON` is refused, and the card itself never uses 0WS in a PC or XT, even with the setting on - it waits each time the PC starts until its BIOS has reported a 286 or later. An XT with a 286 or 386 accelerator card looks like an AT to the card: use `SVSET /B:XT` in such a PC. It is **off by default**; `SVSET /Z:ON /W` keeps it. Not every chipset honours 0WS: an Intel 430HX with its PIIX3 (the Pentium 75 above) does, a VIA VXPro+ ignores it - nothing gets faster there, and everything works as without it. It is an optional speed-up: **if a PC does not run correctly with `/Z:ON` - a wrong picture or a hang - turn it off with `SVSET /Z:OFF /W`** (or the five-second hold of the menu button, which restores the factory settings). Do not use it with a second display card in the PC (a monochrome card beside the SerdaVision HDMI): the card's 0WS covers all of A0000-BFFFF. `SVSET` shows the setting as a `0WS:` line on a Rev B board.

ZWSLOAD (`ZWSLOAD.COM`) measures the bus more steadily than SVTEST's short speed test: it runs thirteen loads one after the other, ten seconds each - mode 13h writes by bytes, words and dwords, copies from memory to the screen, mode 12h writes to all four planes, reads by bytes, words and dwords into memory, and reads of the card's BIOS - and at the end lists the KB/s of each (the dword loads only on a 386 or newer). It takes about two and a half minutes; `ZWSLOAD /Q` runs three seconds a load, about one minute; `ZWSLOAD /?` lists its options. A key stops it. Run it with the card as VGA or SVGA (or on another VGA card, to compare); on a Rev B board, run it once with `SVSET /Z:OFF` and once with `SVSET /Z:ON` to see what 0WS gains in that PC.

SVMODES — every screen mode of the card, tested

`SVMODES` goes through every screen mode the card has as it is set — on the VGA the text modes, 80x50, CGA 320x200 and 640x200, EGA 0Dh–10h, VGA 11h–13h and Mode X; on SVGA also the VESA modes (and the ET4000 modes when the card started with that setting on); on CGA, Tandy, Hercules, MDA, InColor, ColorPlus and V6355D their own (the InColor: the Hercules's three, colour text ICT, RamFont IRF and 16-colour IC16; the Tandy's 16-colour and 640x200x4 modes marked `(model)`: they are checked against the card's own model of the Tandy) — and in each one writes text, draws a rectangle, lines, a circle and a colour bar, scrolls, and reads every pixel back to check it. Each mode stays on the screen two seconds with its result at the top left (`/D:5` for five), then the next one comes; at the end a table and **ALL PASS** in large letters, or the modes that failed. `SVMODES /L` repeats until a key, `SVMODES /M:12h` tests one mode. It writes `SVMODES.LOG` in the current directory and a report for the PC (its name is shown at the end) next to `SVMODES.COM`; `/N` writes neither. With the card's USB console open on a computer (a logger or a terminal), every step also appears there (`mark: svmodes MODE 12h TEXT PASS ...`; section 10), so a test can be watched from another room - and the card sends a **capture of each mode's picture** there too (5 to 11 seconds a mode at the least, longer when the computer takes the text more slowly; `/NC` skips them), for diagnosis of the picture the card sends. A capture that stops moving for 30 seconds is given up (`CAPTURE=TIMEOUT`) and the rest of the run takes none (`SKIP`); a key stops a capture and the run. Exit code 0 means all passed, 1 a mode failed (or a key stopped the first pass), 2 a bad option (or a `/M` mode this card does not have), 3 no SerdaVision card found (or not enough memory). To test every card of the firmware in a PC with one command, use `SVCOMPAT.BAT`, run from the directory that holds `SVTEST.COM`, `SVMODES.COM` and `SVSET.COM`: it runs SVTEST and then `SVMODES /ALL` (below) and writes a report for the PC there (`SVCOMPAT /P:NAME` names it `NAME.TXT`); where /ALL cannot run it goes card by card with a restart for each (or at once with `SVCOMPAT /C`).

`SVMODES /ALL` — every card of the firmware in one run. `SVMODES /ALL` tests the card it runs as, then switches the card to each other card this PC can use — on an XT the XT ones (VGA-XT, EGA-XT), on an AT the AT ones (VGA, SVGA, EGA), and on both CGA, Tandy, ColorPlus, V6355D, Hercules and MDA (and the InColor-XT on an XT, the InColor on an AT) — tests that one's modes, and at the end switches the card back and puts the screen back as DOS had it. The PC is **not** restarted, and you change nothing in the BIOS setup or on the motherboard: the card's screen goes dark for a second or so at each switch, then the next card's modes follow. `/D`, `/Q`, `/M:id`, `/N`, `/NC` and `/P` work as above (`/M:03h` tests mode 3 on every card that has it); `/T:n` is SVTEST's exit code from `SVCOMPAT.BAT`, recorded in the first card's section; not with `/L` or `/C`. The report gets one section a card and a summary (`ALLVERDICT PASS`); the end screen lists each card with PASS, FAIL or why it was skipped (another display where that card would sit, for instance). A card that does not come back ends the run with exit code 4 and a message: **switch the PC off and on** — every switch `/ALL` makes lasts only until the power goes off, so the card then starts as the card it began with (with the USB cable in, the card keeps its power: unplug it too). On a PC whose setup shadows the video BIOS ("Video BIOS Shadow") SVMODES reads each card's own BIOS from the card and runs it from memory. Exit code 3 with /ALL: it cannot run here (firmware older than SVMODES, which it reports as `SVMODES /ALL: the card needs newer firmware (settings interface 13 or later):`; less than 160 KB of free memory; the card on trial; or a program's vector into the card's video BIOS - on a 286 or later, a program loaded high into memory a memory manager made there, as COMMAND.COM with EMM386 after a start on the 16 KB EGA BIOS, does not count) — `SVCOMPAT.BAT` then goes card by card instead. The DOS screen at a switch uses the PC's own BIOS for a moment, and a program that was resident with its own video handling (a mouse driver, a screen saver) does not see the cards in between.

HICOL — the VESA hi-colour modes

`HICOL` shows the SVGA card's VESA hi-colour modes, 10Eh (65,536 colours) and then 10Dh (32,768 colours), each on two screens: eight colour bars and a red, a green, a blue and a grey ramp in a white frame; then a second picture, shown by moving the display start, so the first must vanish at once. A key moves on after each screen; Esc stops. `HICOL /E` shows 10Eh only, `HICOL /D` 10Dh only. At the end it lists what each VESA call answered. Exit code 0 means every call answered as VESA says, 1 one did not (or Esc was pressed), 2 no VESA BIOS or a bad option.

RASTER — measure the picture timing

`RASTER` measures the picture the card really sends, from DOS, for each of the card's standard modes: frames per second, lines, line rate, and the blank intervals between lines and between frames. It shows whether the card keeps VGA timing, and gives numbers to compare with a real VGA card in the same PC.

```
mode   refresh lines     total   line rate   hblank front  sync  back    poll
 03h  70.18 Hz   400       449   31.51 kHz   4.3 us  12.1   2.0  35.0  0.9 us
 13h  70.18 Hz   400       449   31.51 kHz   4.3 us  12.1   2.0  35.0  0.9 us
 12h  60.02 Hz   480       525   31.51 kHz   4.3 us  10.1   2.0  33.0  0.9 us
 10h  70.18 Hz   350       449   31.51 kHz   4.3 us  37.1   2.0  60.0  1.0 us
```

These are the card's nominal numbers; on a real PC the `poll` column is that PC's, and the front and back porches can read up to a line different. The `hblank` is shorter than a VGA's (about 6 us) on purpose: some games, Commander Keen among them, mistake a long horizontal blank for the vertical one. `poll` is how long one read of the card's status takes on this PC. When it is longer than `hblank` the row ends in `!`: the PC cannot poll fast enough to count lines, and only the refresh column is reliable (an 8088 always gets this). `RASTER /M:13` measures one mode (in hex; up to four `/M`).

`RASTER /B` (VGA and SVGA cards) is a visual line test in mode 13h. A ruler runs down the left edge, and a yellow marker sits at line T; the arrow keys move T by 2 lines, PgUp and PgDn by 20. Keys 1 to 3 choose what the program does when the picture reaches line T: **1** changes the background colour (red, then blue 40 lines lower), **2** draws a red block, 80 lines tall, just ahead of the picture, **3** splits the screen there (the CRTC's line compare). On a real VGA all three start exactly at the marker. On the SerdaVision HDMI the split does too; the background colour does not change at all, because the card takes the palette once per frame, and the block's top edge appears about 30 lines lower (its bottom edge is in place), because the card draws that far ahead of the picture. Esc leaves.

SVKEY — settings from the keyboard

`SVKEY` stays in memory (752 bytes) and changes settings with a key combination while a program runs:

Keys	Setting
Ctrl+Alt+S	Scanlines: off, 1/16, 1/8, 1/4, 1/2, 3/4, black, off, ...
Ctrl+Alt+P	Phosphor: colour, white, green, amber, plasma, LCD, colour, ...
Ctrl+Alt+V	Vertical: lines / fill
Ctrl+Alt+R	Refresh: 70 / 60 Hz (VGA, VGA-XT and SVGA cards only; on the VGA-XT three steps: 70 with the CGA graphics modes at 60, 70 for every mode (`SVSET /R:VGA`), 60)
Ctrl+Alt+C	Composite colour: off, new CGA, old CGA (CGA, ColorPlus and Tandy cards)

Keys	Setting
Ctrl+Alt+W	Write the settings to the card's flash (the screen blinks once)

The change shows at once; there is no menu on the screen. Each press is one step; holding the keys down does not repeat. A change made this way is **not saved** until Ctrl+Alt+W, or `SVSET /W`: the saved settings come back at the next power-on or reset. The key is not passed on to the program underneath. Load `SVKEY` from `AUTOEXEC.BAT` to have it always; `SVKEY /U` removes it again (not possible when another resident program took over the keyboard after it: remove that one first).

Where the keys work: at the DOS prompt and in programs that read the keyboard through the BIOS (most applications, and many games). Most action games — Commander Keen, Wolfenstein 3D, Doom — take the keyboard over themselves and pass nothing on, so the keys do nothing while they run. For those, set things before starting them, or put `SVSET …` in the batch file that starts them (section 8, SVSET).

Two screens: with a monochrome card (MDA or Hercules) in the same PC beside a colour SerdaVision HDMI, SVKEY finds it when it loads, says "(A mono card answers at 3B4h: SVKEY uses this card's own CRTC port.)", and leaves that card alone. On the EGA and the CGA family (CGA, Tandy, ColorPlus, V6355D) a key pressed at exactly the wrong moment can then cost the program underneath one write to a display register; on the VGA and SVGA nothing is lost.

With a keyboard layout where Ctrl+Alt is AltGr (for instance Hungarian or Polish on an old 84-key keyboard), SVKEY takes AltGr+S, P, V, R, C and W, so the characters those give cannot be typed while it is loaded.

On the Hercules and MDA cards, a key press that lands in the very microseconds a program is setting a CRTC register can make that one register write go missing — typically the cursor position, put right by the program's next write. On the other cards the program's write lands where it should — except on the EGA, CGA, Tandy, ColorPlus and V6355D with a monochrome card beside them (see "Two screens" above).

The on-screen button menu — settings without DOS

The menu button (section 3) opens a menu of the card's own and is used to move through it. The card draws the menu over the picture itself, so it works whatever the PC is doing — in a game, in the BIOS setup, or when the PC shows nothing at all because it is set up for another card.

- **Press the menu button:** the menu opens, in a box in the middle of the screen.
- **Press briefly:** the next line. After the last line it starts at the top again.
- **Hold for one second:** choose the line. A yellow bar fills along it while you hold; when it is full, the choice is made, and you can let go.
- **Leave it alone for ten seconds:** the menu closes. Settings you changed are then saved to the card's flash (the screen blinks once).

Line	Holding it does
Card (section 4)	Opens the list of cards. Press to move to one, hold to start it: when you let go, the card restarts as that card, and keeps it — no `SVSET` needed. Set the PC's video to match (section 5). **Back** returns to the menu
Scanlines	off, 1/16, 1/8, 1/4, 1/2, 3/4, black, off, … (as `SVSET /S`)
Monitor	colour, white, green, amber, plasma, LCD (as `SVSET /P`)

Line	Holding it does
Refresh (VGA, VGA-XT and SVGA)	60 Hz / 70 Hz (as `SVSET /R`). On the VGA-XT: 60 Hz / 70 Hz, CGA 60 Hz / 70 Hz, CGA too (as `SVSET /R:60`, `/R:70`, `/R:VGA`)
Composite (CGA, ColorPlus and Tandy)	off, new CGA, old CGA (as `SVSET /C`)
Vertical	as is / fill (as `SVSET /V`)
Text (EGA, VGA, SVGA, EGA-XT and VGA-XT)	8 dots / 9 dots (as `SVSET /T`)
BIOS in RAM (EGA, VGA, SVGA, EGA-XT and VGA-XT)	auto, small, full, off (as `SVSET /X`; at the next start of the PC)
ET4000 (SVGA)	off / on (as `SVSET /E`; from the next reset or power-on, once the menu has saved it)
Bus (EGA, VGA, SVGA, EGA-XT, VGA-XT and ColorPlus)	auto, XT, AT (as `SVSET /B`; from the next reset or power-on, once the menu has closed — on the ColorPlus from the next power-on). "auto: XT" means the card decides and has found an XT
Factory settings	Every setting back to how the card came (Bus: auto)
Exit	Closes the menu (and saves what you changed)

The changes show at once. The top of the box names the card and its firmware version.

Without a screen. The activity LED D1 follows the menu, so it can be used blind:

D1	Means
Lit steadily	Your finger is on the button
Blinks *n* times, then a pause, over and over	The menu is open, on line *n*
Three quick flashes	Done: the choice was made
After the card starts: a pause, *n* blinks, then the usual steady blinking	The card that started: 1 VGA, 2 SVGA, 3 EGA, 4 CGA, 5 ColorPlus, 6 V6355D (PC1), 7 Hercules, 8 MDA, 9 Tandy, 10 VGA-XT, 11 EGA-XT, 12 InColor, 13 InColor-XT

The way back to VGA: with the menu closed (if unsure, leave the button alone for ten seconds first), press the menu button and **keep holding it for five seconds**, until the bar is full (the box says "Keep holding" after one second), **then let go**: the card goes back to VGA with the factory settings (Bus: auto) and restarts as VGA. With the button on the bracket, let go within the next five seconds — the box says "Let go now" and D1 flickers; held longer than ten seconds, nothing happens ("Held too long", D1 dark). (In an XT the card then switches to the VGA-XT again at the next reset, as section 4 describes; set **Bus** to AT to keep the VGA there.) (The recovery file of section 9 does the same without touching the settings.)

9. Choosing the card, and the firmware file

Choosing the card from DOS

The firmware carries all thirteen cards (section 4). A new card starts as VGA; you change it from DOS, without USB:

1. `SVSET /M` shows the cards and which one is running.
2. `SVSET /M:CGA` (or `VGA`, `SVGA`, `EGA`, `HGC`, `MDA`, `COLORPLUS`, `V6355D`, `TANDY`, `VGAXT`, `EGAXT`, `INCOLOR`, `INCOLORXT`) first shows the steps, with the PC setting the new card needs; read them, then press **Enter** to switch (**Esc** cancels). The card restarts as the new one and the screen goes dark for a few seconds.
3. `SVSET` waits for the new card and **sets it up itself**, as the PC does at start-up, and DOS goes on on it: the screen comes back with `SVSET: the card runs as CGA now, …` and the DOS prompt. **No restart is needed.**

How it sets the new card up: a card with its own BIOS (EGA, VGA, SVGA, VGA-XT, EGA-XT) gets that BIOS started, as the PC's start-up does. On an XT (8088, V20) it follows the card's "BIOS in RAM" setting (`/X`, section 8) exactly as the start-up does: with `AUTO` the card answers its BIOS itself and it runs from the card (`…with its BIOS from its ROM.`), with `SMALL` or `FULL` it is copied into memory first; on a PC whose setup copies the video BIOS ("Video BIOS Shadow") the old card's BIOS is still in that copy, so `SVSET` reads the new card's BIOS from the card and runs it from memory - as it does when EMM386's upper memory, placed at C400-C7FF while a 16 KB EGA BIOS was there, now covers the upper half of a 32 KB VGA BIOS. On an XT, upper memory there (a PicoMEM's) is memory on the bus itself, which the card's BIOS would answer over: `SVSET` then refuses the switch before anything happens and says where (`SVSET: C000:4000 answers (read 5A A5), where the VGA-XT's BIOS would sit: …`) — keep C000-C7FF out of upper memory to use the 32 KB cards. Should the card start another card than the one asked for (the one it last kept), `SVSET` says so, sets that one up, and ends with exit code 2. Such a copy takes 16 KB (EGA) or 32 KB (VGA, SVGA) of DOS memory until the PC restarts — the next `SVSET /M` gives it back first, so it is never more than one (`MEM` lists it as SVBIOS). A card without one (CGA, Tandy, ColorPlus, V6355D, Hercules, MDA) gets its screen mode set by the PC's own BIOS before DOS writes anything. Leaving a card with its own BIOS, `SVSET` first hands DOS's screen to the PC's own BIOS — the card's BIOS goes with the switch, and a PC that does not copy it to RAM (an XT never does) would otherwise stop at the next character. If the new card does not answer within ten seconds, `SVSET` says so and DOS stays on the PC's own BIOS: restart the PC (with the PC's video set for the new card). Should the PC's BIOS lack the usual entries for this (very rare), `SVSET` warns before you press Enter: either DOS's text simply does not show until the restart (the PC runs, Ctrl+Alt+Del works), or the PC may stop at the switch — then switching it off and on restarts it (with the old card, after `/M` without `/W`). If an XT stops at a switch, switch it off and on in the same way; on such a PC, choose the card with the on-screen button menu or with `SVSET /M:… /W`, then switch the PC off and on with its video set for the new card.

As with the settings, **`/W` means for good, and without it means for now**:

- **`SVSET /M:CGA` — for now.** The card runs as the CGA **until the PC is switched off**, at once (above). Resets keep it — the PC's reset button and Ctrl+Alt+Del — so before restarting the PC while it runs, set the PC's video to match (section 4's last column: EGA/VGA, CGA or Monochrome). Type **`SVSET /W`** to keep the CGA for good. If the PC shows nothing, just switch it off and on: the card starts as the card it was before. (`SVSET` on its own keeps nothing: it shows `card mode: CGA (until power-off; SVSET /W keeps it)`.) **An `SVSET … /W` in AUTOEXEC.BAT keeps the card too** — even when the screen shows nothing — so take `/W` out of AUTOEXEC.BAT before trying a card this way.

- `SVSET /M:CGA /W` **— for good.** The card restarts as the CGA and keeps it, through every power-off; DOS goes on on it at once, as above. Before the PC is next switched on, set its video to match — the switches on an XT's motherboard need the PC off. **If the PC then shows nothing, switching it off and on does not bring the old card back**: use the menu button or the recovery file, below.

With the USB cable in, the card keeps its power when the PC is switched off: a card chosen for now then lasts until the cable is out and the PC is off too, or until the card's RESET button (SW2) is pressed, which counts as switching off.

If the PC shows nothing with the new card

A PC set up for one kind of card does not show another: a CGA, Hercules or MDA card chosen on a PC set to EGA/VGA, for instance, or a card kept with `/W` that the PC cannot show. Any of these brings the card back:

- **Switch the PC off and on** — after `SVSET /M` without `/W`. The card starts as the card it was before.
- **The menu button** (section 3). The on-screen button menu shows even when the PC shows nothing: press the button, hold **Card** for a second, and pick a card (section 8, "The on-screen button menu"). Or, with no picture at all: leave the button alone for ten seconds so the menu is closed, then **hold the menu button for five seconds and let go** — the card goes back to VGA with the factory settings and restarts as VGA. A card chosen with the button is kept at once.
- **The recovery file**, `serdavision-reset-to-vga-v1.00.uf2`, when the menu button cannot be reached or does not help: copy it onto the card over USB as below. It is not a firmware of its own: it sets the firmware already on the card back to the VGA card (below).

VGA or VGA-XT by itself. With Bus on auto (the default, section 8) the card moves between the VGA or the SVGA and the VGA-XT (and the EGA and the EGA-XT) by itself, at a reset or power-on, after its BIOS has told it which processor the PC has (section 4). Such a switch is a trial: the new card keeps itself ten seconds after its BIOS has run, with no `SVSET` needed; if it never gets that far, three power-ons bring the old one back, and the card does not try that switch again until it finds another kind of PC or you choose a card yourself (with Bus set otherwise it does not apply).

Copying a file onto the card over USB

The firmware file, `serdavision-all-v1.00.uf2` (section 4), goes onto the card this way for every new version, and so does the recovery file. BOOT (SW1) and RESET (SW2) are on the board itself: with the card in the PC, open the case to reach them, or take the card out. You need the SerdaVision HDMI card, a USB-C cable, and a computer with a USB port. The card can stay in the PC — **with the PC switched off** — or lie on a desk; USB powers it either way.

1. Connect the card to the computer with the USB-C cable.
2. **Hold BOOT (SW1), press and release RESET (SW2), then release BOOT.** (Or: hold BOOT while plugging the cable in.)
3. A drive named **RP2350** appears on the computer, like a USB stick.
4. Copy the file (`.uf2`) onto that drive.
5. The drive disappears by itself when the copy is done, and the card restarts. That takes a few seconds for the recovery file and longer for the firmware, which holds every card; **do not unplug before the drive has gone.**

A new firmware version keeps the card's settings (section 8). The card then starts as the card it was set to before; with a card that has never had this firmware, as VGA. Set the PC's video to match (section 5).

The recovery file, `serdavision-reset-to-vga-v1.00.uf2` (512 bytes). It changes only the card's record of which card to start, and sets it to **VGA**. The firmware and its thirteen cards stay as they are, and so do the settings (scanlines, refresh and the rest) — unlike the five-second hold of the menu button, which also restores the factory settings. It also forgets the kind of PC the card found and sets **Bus** back to auto, so in an XT the card switches from the VGA to the VGA-XT again at the next reset, as section 4 describes. The card starts as VGA as soon as the copy is done: set the PC's video to EGA/VGA. It does its job only on a card that has the firmware on it — it changes which card starts, it does not put the firmware on.

10. The card on a desk: self-test and console

The self-test screen. Powered from USB with no running PC behind it — on a desk, or in a PC that is switched off — the card shows its self-test screen on the HDMI output: a grid, a square of 100 x 100 pixels, colour bars, the firmware version, and these checks:

Line	Good result
`bus 34 nets 0 shorts 0 bridges`	0 shorts and 0 bridges (green)
`cont 26 of 26 nets follow the bus pull`	26 of 26
`loop not fitted - needs the ISA jig`	always shown; not a fault
`slot absent: no strobe in 200 ms`	always shown on a desk; not a fault

Red text in the `bus` or `cont` line is a fault: photograph it and send the photo to Serdaco. As soon as a running PC talks to the card, the self-test screen gives way to the PC's picture.

The console. Over USB the card also appears as a serial port (COM port on Windows). Open it with a terminal program (PuTTY, Tera Term; 115200 baud) and the card prints a status report every two seconds. It is for diagnosis; you never need it to use the card. The useful lines:

Line	What it tells you
`measured: 60.02 frames/s …`	The picture rate really being sent (about 60.02, 70.18 in the VGA's 70 Hz modes, 56.27 in VESA 800x600)
`vo: … restarts=0 … retimes=`	How often the video output had to restart itself (should stay 0), and how often a screen mode changed the picture's timing, which is normal (VESA 800x600 and back, or 9-dot text to graphics)
`video: raster now 800x600 at 56.27 Hz … (retimed for the mode, not a fault)`	A program set a mode with another picture timing; the monitor re-syncs
`bus: iow= memw= ior= memr= … drops=`	How much work the PC gives the card. `drops` counts picture lines the output had to fill with border; it should stop climbing after start-up
`tags: … dropped at overflow iow= memw=`	Writes from the PC the card had to drop. Should stay 0
`output: HDMI mode …` / `DVI mode …`	Which stream is being sent

The console only reports, with one exception: type `CAP` and Enter and the card sends a capture of the picture on the screen as text lines (`cap: …` , about 8 seconds), for diagnosis (section 8, SVMODES). Do not open it at 1200 baud: that is the signal that puts the card into firmware-update mode (the RP2350 drive of section 9).

11. Specifications

Bus	ISA, 8-bit; fits 8-bit and 16-bit slots; 4.77–8.33 MHz (used at 12 MHz; designed for up to 16 MHz, not tested)
Screen memory speed	Up to 1.1 MB/s writes and 1.1 MB/s reads without 0WS, the full speed of the 8-bit ISA bus; up to 1.9 MB/s writes and 1.5 MB/s reads with zero-wait-state (0WS, `SVSET /Z:ON` , Rev B board) on supported chipsets such as the Intel 430HX/PIIX3. Measured with 32-bit transfers on a Pentium; the actual speed depends on the PC and its chipset (section 8, "Bus speed, 0WS and ZWSLOAD")
Video memory	256 KB (VGA, VGA-XT, SVGA, EGA, EGA-XT, InColor); 320 KB with the VESA modes (SVGA); 16 KB (CGA, V6355D); 32 KB (ColorPlus, Tandy); 64 KB (Hercules); 4 KB (MDA)
Video BIOS	own, at C0000: 32 KB for VGA, VGA-XT and SVGA, 16 KB for EGA and EGA-XT; none for CGA, Hercules, MDA, InColor and the three extra cards, as the originals (the Tandy's lives in a Tandy's motherboard BIOS, section 4)
Output	HDMI connector: HDMI or DVI signal, 640x480 (720x480 for monochrome and 9-dot text) at 60/70 Hz, 800x600 at 56 Hz (VESA 102h)
Analog VGA	through the HDMI2VGA dongle, powered by the card
Settings	scanlines, phosphor, vertical fill, aspect, stream, refresh, composite colour (CGA, ColorPlus, Tandy), BIOS in RAM (EGA/VGA/SVGA and the XT cards), ET4000 (SVGA), 0WS (Rev B; EGA/VGA/SVGA), text 8 or 9 dots (EGA/VGA/SVGA and the XT cards), bus (AUTO/XT/AT); kept in the card's flash
Firmware	one file with all thirteen cards, chosen with `SVSET /M` or the on-screen button menu; updated over USB-C, drag-and-drop `.uf2`
Power	from the ISA slot (+5 V), or USB-C

12. Troubleshooting

For anything this table does not solve, contact Serdaco through **serdashop.com**.

Problem	What to do
DOS text, scrolling or Ctrl+Alt+Del slow on a 286 or newer (EGA, VGA, SVGA)	"Video BIOS Shadow" is off in the PC's BIOS setup, so every BIOS call reads the card's BIOS over the 8-bit ISA bus, as any video card's BIOS chip is read when nothing copies it into RAM. Shadowing is many times faster: enable it (C000-C7FF); the card's own `/X` setting is not the one for speed
No picture at all, D1 blinks	Try another cable or screen input. On the VGA or SVGA card in DOS: type `SVSET /R:60` blind (section 7). On a DVI screen: `SVSET /H:DVI` blind
A CGA game on an XT flickers or draws stripes on the VGA card	Use the VGA-XT (`SVSET /M:VGAXT` , section 4): it sends the CGA modes at a CGA's 60 Hz. On the VGA, `SVSET /R:60` does the same for every mode

Problem	What to do
No picture, D1 dark	The card has no firmware or waits for a file over USB: copy the firmware file on (section 9). If D1 stays dark with the firmware on it, contact Serdaco
The PC beeps at start-up, or stops before DOS	Check that there is no second video card or on-board video, and that the PC's video setting matches the card it is set to (section 5)
At start-up the PC reports a display-switch or video-type error (press F1)	The PC's video setting does not match the card: press F1 to go on, then set the PC's video to match the card (section 5)
Two stray columns at the left edge	DVI screen or adapter: `SVSET /H:DVI`
Picture too wide on a 16:9 screen	Set the screen's own aspect to 4:3 or "original"; some TVs also follow `SVSET /A:4:3`
320x200 games look flat and wide	`SVSET /V:FILL` for the 4:3 shape, `SVSET /S:4` for scanlines (`/S:1` or `/S:2` for very light ones)
A setting is gone after switching off	It was not saved: use `SVSET /W`, Ctrl+Alt+W (SVKEY), or let the on-screen button menu close by itself. If SVSET says the card could not write its flash, see the SVSET messages in section 8
Monochrome software shows nothing	Is the card set to Hercules or MDA (`SVSET /M:HGC`, `/M:MDA`), and the PC set to Monochrome?
The PC stops (Ctrl+Alt+Del does nothing) right after `SVSET /M`, or at the first key after it	Switch the PC off and on: after `/M` without `/W` the card before it starts again. On such a PC, choose the card with the on-screen button menu or with `SVSET /M:… /W`, then switch the PC off and on with its video set for the new card (section 9)
After choosing a card (`SVSET /M`, `/W`, the on-screen button menu) the PC shows nothing	Set the PC's video to match the card (section 5). Or: switch the PC off and on (after `/M` without `/W`), or use the Card line of the on-screen button menu, or hold the menu button five seconds (menu closed) for VGA, or copy the recovery file `serdavision-reset-to-vga-v1.00.uf2` onto the card over USB (section 9, "If the PC shows nothing with the new card")
A setting has made the picture unusable	`SVSET /D` (typed blind if need be), or open the on-screen button menu and choose **Factory settings**, or hold the menu button five seconds with the menu closed (section 8, "The on-screen button menu")
A Tandy game offers no Tandy graphics (Tandy card)	It is looking for a Tandy PC, not a Tandy card — Sierra's SCI games among them: on an ordinary PC they offer CGA or EGA only (section 4, "The Tandy: what to know")
Colour software complains about a monochrome card	The other way round: the card set to VGA, EGA or CGA, and the PC set to match

13. Known limitations

- **Mode 7 and VGA text are 8 dots wide** on the VGA, SVGA and EGA cards (640 pixels across instead of 720) unless `SVSET /T:9` is set (section 8); the Hercules and MDA cards always use the true 720. With 9 dots,

IBM's handful of reshaped 9-dot characters (an M and W a little wider, for example) are not there: every character keeps its 8-dot shape.

- **Colour changes in the middle of the picture are not shown.** A program that changes a palette colour while the picture is being drawn (the "raster bars" of some demos and games) gets one colour for the whole frame: the card takes the palette once per frame. Screen memory changed while the picture is being drawn shows from about 30 lines further down than on a CRT card. `RASTER /B` shows both (section 8).
- **No light pen.** (The CGA cards report one that is not pressed.)
- **Composite colour is a model.** HDMI has no composite signal, so CGA games that relied on the colour fringes of a composite TV show their RGB colours — unless `SVSET /C:NEW` or `/C:OLD` is set (CGA, ColorPlus and Tandy cards), which shows a model of the composite picture. It is built from the IBM CGA's circuit, with its timings matched to measurements of real IBM boards. The 80-column text modes stay RGB, as a real CGA sends them without colour on a composite monitor.
- **VESA 102h is 56 Hz**, which some screens do not accept. So is the ET4000's 800x600 mode, 29h.
- **The phosphor setting does not reach VESA 10Dh and 10Eh.** Their pixels are colours, not palette entries, and the white, green, amber, plasma and LCD looks are made in the palette.
- **The ET4000 setting (`SVSET /E:ON`) is 640x480 and 640x400 in 256 colours**, not the 800x600 and 1024x768 a 1 MB ET4000 board gives.
- **Windows 98: 256 colours at 640x480 only**, with the ET4000 setting and the "Tseng Labs ET4000" driver (section 8, ET4000). Without them Windows 98 finds a "Standard Display Adapter (VGA)": 16 colours. Larger screen areas in 256 colours, and High/True Color, need more memory than the card has. **Windows 95** has not been tested.
- **The MDA card sends 60 Hz**, not the original's 50 Hz. The screen cannot tell.
- **8-bit only.** The card never uses the 16-bit part of an AT slot.
- **Early vertical blanking.** A program that ends its picture with the VGA's blanking a few lines before the end it programs - up to an eighth of the picture, as Turrican II does - has the picture cut there, in the border colour (a real VGA shows black); a larger cut is ignored and the whole picture is shown.
- A game that expects a Hercules **graphics driver it did not ship with** can show a sheared picture (Total Eclipse is known to do this).
- **Experimental cards.** The ColorPlus, V6355D (PC1), Tandy, InColor and InColor-XT cards are experimental: they have been tested with fewer programs than the other cards, and the Tandy and the InColor have limits of their own (section 4).
- **Tested PCs.** The card has been tested on 8088 and V20 XTs with GLaBIOS, a 386 and Pentium-class PCs; other PCs are expected to work. ISA bus clocks above 8.33 MHz: used at 12 MHz; 16 MHz has not been tested.
- **Changing cards live on an XT.** If an XT stops at a card switch with `SVSET /M`, switch it off and on; on such a PC, choose the card with the on-screen button menu or `SVSET /M:… /W`, then switch the PC off and on (section 9).

14. Third-party software

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The build tools (GCC, NASM, CMake) put none of their own code into the product apart from the C runtime listed below; the compiler's `libgcc` falls under the GCC Runtime Library Exception and needs no notice.

Component	Used for	Licence
Raspberry Pi Pico SDK 2.3.0	chip start-up, PIO, DMA, clocks, flash, both cores	BSD 3-Clause
TinyUSB (in the Pico SDK)	the USB serial console	MIT
printf by Marco Paland (in the Pico SDK)	the console's text formatting	MIT
newlib (the ARM GCC toolchain's C library)	memcpy, memset and similar	BSD-style

Raspberry Pi Pico SDK

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TinyUSB

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printf (Marco Paland)

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newlib

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