# MicroVGA - Device Overview

MicroVGA is low-cost Microcontroller to VGA interface providing 80x25 16 color text mode (physical resolution is 800x600 at 60 Hz). MicroVGA is connected to a MCU via 2 or 4 wire RS-232 TTL or LVCMOS compatible interface. Display is controlled using ANSI terminal codes (such as cursor movement, colors, etc).

In addition to VGA output the interface provides also NTSC/PAL signal output for television viewing and PS/2 keyboard input. This makes the MicroVGA an ideal solution for user interface in embedded applications. The MicroVGA is a complete user interface module, 3-in-1 functions.
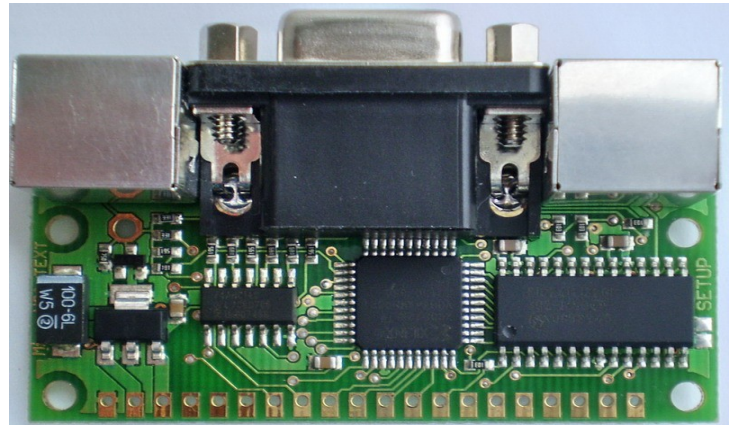
MicroVGA can be connected to any MCU with UART, such as Microchip PIC (including PICmicro, PIC16 and dsPIC33), Atmel ATmega, 8051, ARM, MIPS, or even PowerPC.

Key features

- Provides 80x25 color text mode
- SVGA output 800x600@60Hz resolution (font 22x10)
- S-Video television output – PAL (font 11x10)
- S-Video television output – NTSC (font 9x10)
- Automatic selection of TV or VGA output
- PS/2 keyboard input (MiniDIN-6)
- Easy connection to almost every microcontroller using only 2 wires (minimum, 4 recommended for handshaking)
- Very easy to use: works like standard ANSI (or VT100) terminal
- 6 supported character sets (US-ASCII and ISO8859-1 through ISO8859-5) with full internationalization support!

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MADE IN THE EU

RoHS Compliant

System description

MicroVGA reads data from UART (serial port) or SPI interface and displays them on a VGA/TV. All keyboard activity is sent via UART or SPI.

TV/VGA output selection

MicroVGA displays on VGA port by default, however MicroVGA automatically detects the presence of connection to a television or other S-Video/S-VHS device. Presence is detected by checking cable termination at television side (75Ohm). When a television is connected, VGA port is disabled and only S-Video signal is generated. Please note that television is detected even if turned off.

TV output may be disabled in MicroVGA setup. PAL or NTSC mode selection is configurable using MicroVGA setup. The TV output configuration is stored in a non-volatile memory.

UART Bypass mode

The UART interface for MicroVGA while the module is de-asserted (CS#=1) is directly wired to secondary UART. This will allow the user to connect other devices onto the physical UART bus.

MicroVGA Communication

MicroVGA reads data from UART port when CS#=0 and displays them on a VGA/TV. All keyboard activity is sent via UART when CS#=0 and CTS#=0.

Communication speed depends on MicroVGA settings. Default value is 1 000 000 bits/s (1Mbit). UART is always using 1 start bit, 8 data bits, **no** parity bit, 1 stop bit (8N1).

Available baud rates are: 9600, 19 200, 38 400, 57 600, 115 200, 500 000, 1 000 000, 1 250 000. The baud rate configuration is stored in a non-volatile memory and is configurable using built-in setup program (see MicroVGA-TEXT user manual for more information).

ANSI Commands

MicroVGA is controlled using VT100-compatible ANSI escape sequences. More information can be found in MicroVGA-TEXT User's Manual or MicroVGA conio library and demo projects.

Internal watchdog

In case of internal error, communication error, or voltage drop, MicroVGA contains internal watchdog which automatically resets MicroVGA. The internal state (cursor position, color, etc) is retained.

SPI Signal Pin Description

The SPI module is compatible with Motorola's SPI and SIOP interfaces.

Signal Data Output (SO)

SO is used to transfer data serially out of the SPI device. Data is shifted out on the falling edge of the serial clock.

Signal Data Input (SI)

SI is used to transfer data serially into the SPI device. Data, instructions and addresses to be programmed are latched on the rising edge of the serial clock.

Serial Clock (SCK)

SCLK is an input signal that provides the necessary timing for the serial interface. Data are latched on the rising edge of SCLK, while data present on the SO changes after the falling edge of SCLK.

Chip Select (CS#)

When CS# is high, the SPI device is deselected and SO is at high impedance. When CS# is low, the SPI device is enabled and in the active power mode.

Chip ready (RDY#)

When RDY# is low, MicroVGA is ready for SPI communication.

Pinouts

In addition to connectors specified below, MicroVGA also has "system setup" pad. When this pad is short-circuited, the built-in setup tool is invoked.

System connector

Pin	Signal	Direction	Description
1	GND	-	Ground
2	+5V	-	5V input
3	+3V3	-	3.3V regulated output
4	CS#	IN	Chip select
5	RXD SCK	IN	UART Receive, data to be displayed on monitor (SPI mode: clock)
6	TXD RDY#	OUT	UART Transmit, keyboard output (SPI mode: MicroVGA ready signal, active low)
7	RTS# SO	OUT	UART Request to send signal (active-low) (SPI mode: master-in, slave-out)
8	CTS# SI	IN	UART Clear to send signal (active-low) (SPI mode: master-out, slave-in)
9	INT	OUT	Reserved for future use, do not connect
10	SYSRQ	OUT *	System-Request output (SysRq key), open-drain
11	RXD2	OUT	UART-bypass mode RxD PIN
12	TXD2	IN	UART-bypass mode TxD PIN
13	RESET#	IN	Reset signal
14	NC		Not connected, reserved for future use
15	NC		Not connected, reserved for future use
16	NC		Not connected, reserved for future use
17	NC		Not connected, reserved for future use
18	NC		Not connected, reserved for future use
19	NC		Not connected, reserved for future use
20	NC		Not connected, reserved for future use

* SYSRQ is open-drain output, pull-up resistor is required

VGA

Pin	Symbol	Name
1	RED	Red video component
2	GREEN	Green video component
3	BLUE	Blue video component
4	N/C	
5	GND	Ground (HSync)
6	RED_RTN	Ground (Red)
7	GREEN_RTN	Ground (Green)
8	BLUE_RTN	Ground (Blue)
9	+5V VDC	+5V DC
10	GND	Ground (VSync)
11	N/C	
12	SDA	I^2C Data
13	HSYNC	Horizontal Sync
14	VSYNC	Horizontal Sync
15	SCL	I^2C Clock
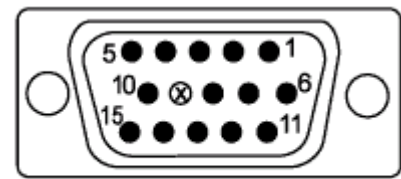
Female

PS/2 Keyboard – MiniDIN6

Pin	Symbol	Name
1	DATA	Data
2	N/C	
3	GND	Ground
4	VCC	+5V DC
5	CLK	Clock
6	N/C	
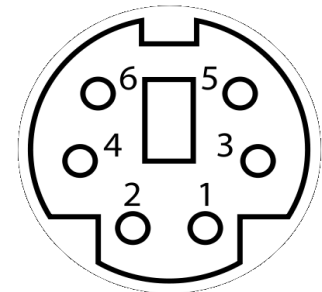
TV Output (S-Video) – MiniDIN 4

Pin	Symbol	Name
1	GND	Ground (Y)
2	GND	Ground (C)
3	Y	Intensity (Luminance)
4	C	Color (Chrominance)
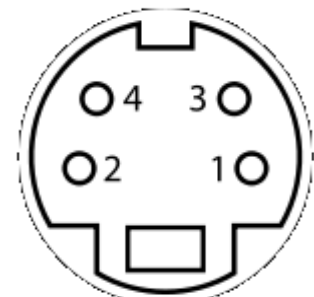
Note: C signal is connected to GND in MicroVGA-TEXT, only Y is provided.

TV Output (S-Video) – Cinch

Pin	Symbol	Name
1	VIDEO	Video Signal
2	GND	Ground (VIDEO)

Note: Video signal contains only intensity (Luminance) information.

Part Numbers

Product Ordering Codes:

Code	Description
UVGA-TEXT1-S	MicroVGA Module with VGA HDF-15, S-Video Mini-DIN4 and keyboard connector

Other variants are possible for high volume orders.

Typical applications

Typical setup
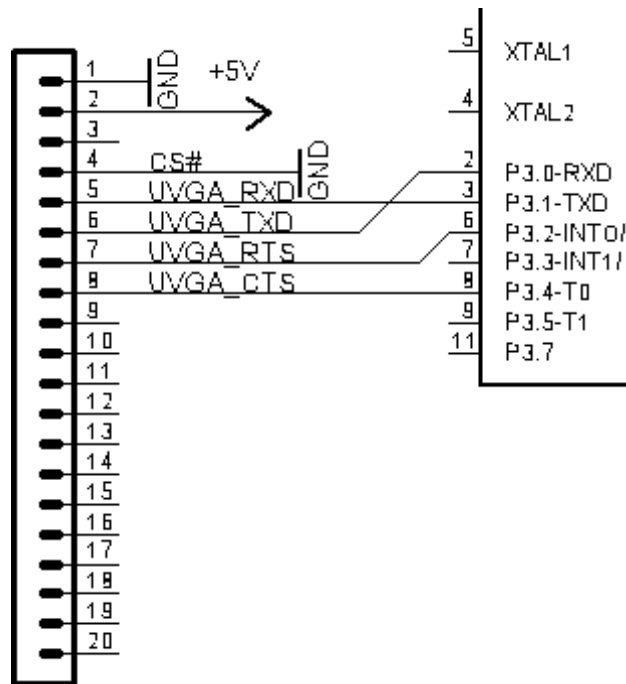
The above diagram shows typical connection to a microcontroller. Please note that MicroVGA TXD pin has to be connected to RXD of the microcontroller, RXD to MCU TXD, CTS to MCU RTS and RTS to MCU CTS. Handshaking signals (CTS#/RTS#) can be software-emulated if no silicon support for UART handshaking is provided.

Test setup

Micro-VGA-TEXT can be tested very easily. It should start working immediately after connecting power supply to pins 1 and 2 of system connector (GND, +5V). When power supply is applied and other pins are left unconnected, MicroVGA header is displayed on TV or VGA port.

VGA Timing

VGA Mode is SVGA standard 800x600 @ 60 Hz, 37kHz, horizontal and vertical synchronization is positive.

General timing

Screen refresh rate	60 Hz
Vertical refresh	37.8 kHz
Pixel freq.	40.0 MHz

Horizontal timing (line)

Scanline part	Pixels	Time [µs]
Visible area	800	20
Front porch	40	1
Sync pulse	128	3.2
Back porch	88	2.2
Whole line	1056	26.4

Vertical timing (frame)

Frame part	Lines	Time [ms]
Visible area	600	15.84
Front porch	1	0.0264
Sync pulse	4	0.1056
Back porch	23	0.6072
Whole frame	628	16.5792

TV/PAL Timing

PAL TV output signal is non-interlaced (progressive) B/G PAL. One of the advantages of a non-interlaced mode is that it is flicker-free. Since all fields (and their scan lines) get drawn on the same location, there is no interlace flicker. The image is very stable and clear compared to standard interlaced mode.

Symbol	Parameter	Typ. value	Units
T_{FRAME}	Frame time	19.9	ms
T_{LINE}	Nominal line period	64	µs
$T_{LONGSYNC}$	Long sync time	30	µs
$T_{SHORTSYNC}$	Short sync time	2	µs
T_{SYNC}	Normal sync time	4	µs
$T_{BACKPORCH}$	Back Porch time	8	µs
N_{LINES}	Number of lines per frame	625	lines
N_{VLINES}	Video lines	6 - 309	lines

PAL mode is configured by default and is preferred over NTSC if possible.
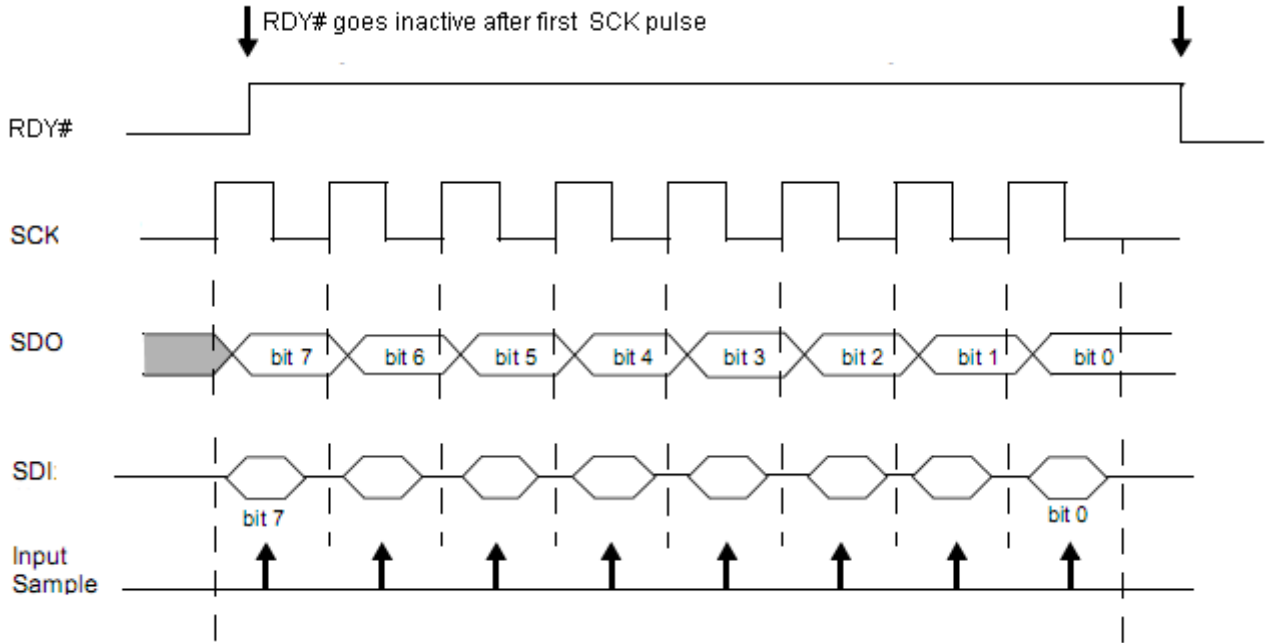
TV/NTSC Timing

NTSC TV output signal is non-interlaced (progressive) NTSC. Like in PAL mode, one of the advantages of a non-interlaced mode is that it is flicker-free. Please note that NTSC mode has limited number of visible scan lines, so quality of image is worse compared to PAL. Most of the modern American televisions are capable of displaying "European" PAL signal so it's recommended to use PAL mode whenever possible.

Symbol	Parameter	Typ. value	Units
T_{FRAME}	Frame time	16.6833	ms
T_{LINE}	Nominal line period	63.5	µs
$T_{LONGSYNC}$	Long sync time	-	µs
$T_{SHORTSYNC}$	Short sync time	-	µs
T_{SYNC}	Normal sync time	-	µs
$T_{BACKPORCH}$	Back Porch time	-	µs
N_{LINES}	Number of lines per frame	262	lines
N_{VLINES}	Video lines	4 - 229	lines

PS/2 Keyboard Timing

Symbol	Parameter	Typ. value	Units
T_{CLK}	Clock	1-17	kHz

SPI Communication Diagram

RDY# goes inactive after first SCK pulse

RDY#	
SCK	
SDO	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
SDI:	bit 7							bit 0
Input Sample	

Mechanical Dimensions
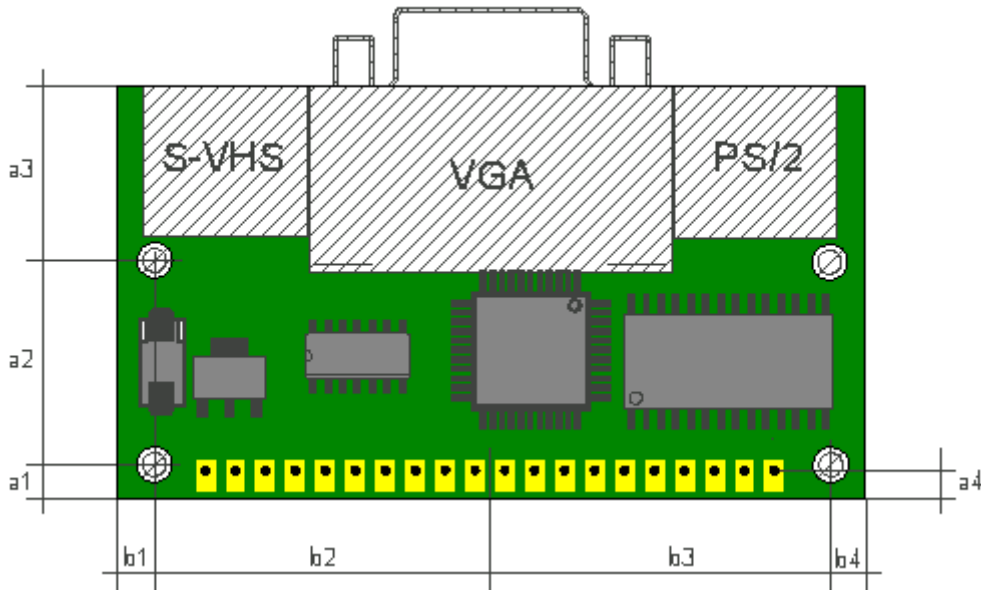
Dimension	Description	Value [in]	Value [mm]
A	Module height	1.380	35.052
B	Module width	2.500	63.500
a1	Mounting hole distance	0.115	2.921
a2	Mounting holes	0.680	17.270
a3	Mounting hole distance	0.585	14.859
a4	System connector drill position	0.095	2.413
b1,b4	Mounting hole distance	0.125	3.175
b2,b3	Mounting hole-to mid of connector	1.437	36.437
R1	Mounting hole diameter	0.118	3.000
R2	System conn. drill diameter	0.0138	0.350
--	System connector pitch	0.100	2.54

A = a1+a2+a3, B = b1+b2+b3+b4

Electrical Characteristics

Symbol	Parameter	Min	Max	Typ.	Units
VCC	Supply voltage	4.5	5.5	5.0	V
VCC$_{33}$	3.3V Output	3.2	3.4	-	V
I$_{MAX33}$	3.3V Ouput max. current output	-	400	-	mA
Vih	Low-level input voltage	2.0	5.5	-	V
Vil	High-level input voltage	0	0.80	-	V
Voh*	Output high voltage	2.4	-	-	V
Vol*	Output low voltage	-	0.4	-	V
I$_{KBD}$	Keyboard current (VCCKBD = VCC, unfused)	-	200	-	mA
V$_{ESD}$	Electrostatic Discharge (ESD)	2000	-	-	V
Tdr	Data retention	20	-	-	Years
V$_{TVBLANKING}$	TV signal output blanking voltage	-	-	0.3	V
V$_{TVCOLOR}$	TV signal output color voltage	0.3	1.0	-	V
V$_{VGA}$	VGA signal output voltage (R, G, B)	0	0.7	-	V

* Applies both to I/O pins and VGA synchronization signals (HSYNC, VSYNC)

On-Line Support

Documentation is available at http://www.microvga.com/docs (datasheets, user manual, application notes).

MicroVGA conio library and reference projects are available from http://www.microvga.com/conio-lib .