



4D SYSTEMS

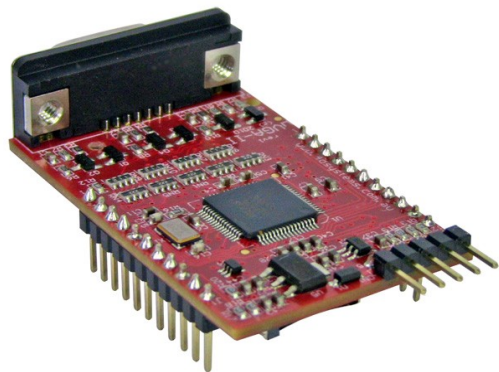
μVGA-II(SGC)

Serial VGA Graphics Engine

Data Sheet

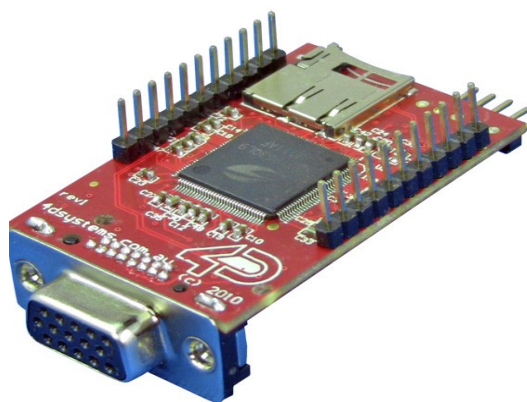
Document Date: 1st October 2010
Document Revision: 1.0

Description



The μVGA-II(SGC) module is a compact and cost effective Serial-to-VGA graphics engine powered by the PICASO-SGC graphics controller. It can provide QVGA/VGA/WVGA graphics solution to any embedded project with its powerful graphics, text, image, animation and countless more features built inside the module.

It offers a simple yet effective serial interface to any host micro-controller that can communicate via a serial port. All the serial commands are sent using a simple protocol via the serial interface. The serial platform allows users to develop their application using their favourite micro-controller and software development tools.



So next time your embedded application requires VGA graphics, the μVGA-II(SGC) might be the ideal solution.

Features

- Simple VGA interface to variety of monitors and LCD screens.
- Supports the following resolutions,
320 x 240 (QVGA)
640 x 480 (VGA)
800 x 480 (WVGA)
Custom Resolution $X*Y = 405K (414720)$
- Supports RGB 65K true to life colours.
- Easy 5 pin interface to any host device: **VCC, TX, RX, GND, RESET.**
- Asynchronous hardware serial port, TTL interface, with 300 baud to 256K baud.
- Powered by the 4D-Labs **PICASO-SGC** processor (also available as separate OEM IC for volume users).
- On-board micro-SD memory card adaptor for multimedia storage and data logging purposes. HC memory card support is also available for cards larger than 4Gb.
- DOS compatible file access (FAT16 format) as well as low level access to card memory.
- Dedicated PWM Audio pin supports FAT16 audio WAV files and complex sound generation.
- Comprehensive set of built in high level graphics functions and algorithms that can draw lines, circles, text, and much more.
- Display full colour images, animations, icons and video clips.
- Supports all available Windows fonts and characters (imported as external fonts).
- 16 x General Purpose I/O pins. Upper 8 bits can be used as an I/O Bus for fast 8-bit parallel data transfers.
- 2 x 11 pin male headers with 2.54mm (0.1") pitch to form a DIP mount package.

- 15 pin D-type standard VGA connector to interface to any external VGA monitor.
- 4.0V to 5.5V range operation (single supply).
- RoHS Compliant.

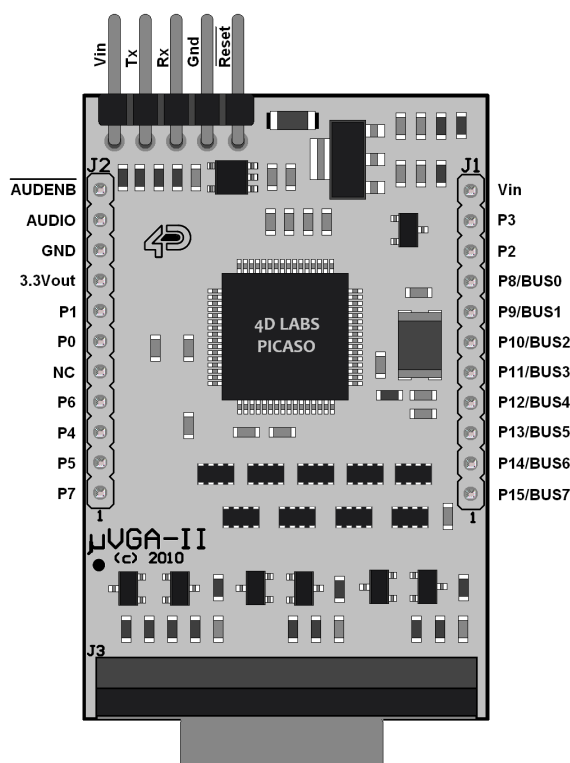
Applications

- General purposes embedded graphics.
- Elevator control systems.
- Point of sale terminals.
- Electronic gauges and metres.
- Test and measurement and general purpose instrumentation.
- Industrial control and Robotics.
- Automotive system displays.
- GPS navigation systems.
- Medical Instruments and applications.
- Home appliances.
- Smart Home Automation.
- Security and Access control systems.
- Gaming equipment..
- Aviation systems.
- HMIs.

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1. Pin Configuration and Summary



uUSB Interface Pin Outs:

Pin	Symbol	I/O	Description
1	VCC	P	Main Voltage Supply +ve input pin. Reverse polarity protected. Range is 4.0V to 5.5V, nominal 5.0V.
2	TX	O	Asynchronous Serial Transmit pin. Connect this pin to host micro-controller Serial Receive (Rx) signal. The host receives data from the VGA Graphics Engine via this pin. This pin is tolerant up to 5.0V levels.
3	RX	I	Asynchronous Serial Receive pin. Connect this pin to host micro-controller Serial Transmit (Tx) signal. The host transmits commands and data to the VGA Graphics Engine via this pin. This pin is tolerant up to 5.0V levels.
4	GND	P	Supply Ground.
5	RESET	I	Master Reset signal. Internally pulled up to 3.3V via a 4.7K resistor. An active Low pulse greater than 2 micro-seconds will reset the module. If the module needs to be reset externally, only use open collector type circuits. This pin is not driven low by any internal conditions. The host should control this pin via one of its port pins using an open collector/drain arrangement.

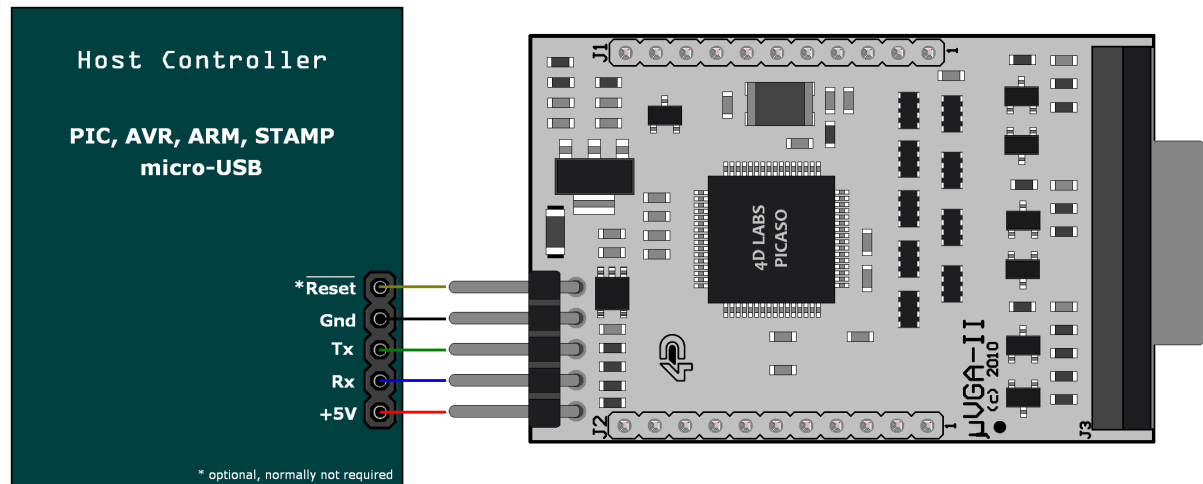
J2 Pin Outs (Expansion Port):

Pin	Symbol	I/O	Description
1	P7	I/O	PICASO-SGC General Purpose I/O Port, bit 7. This pin is 5.0V tolerant.
2	P5	I/O	PICASO-SGC General Purpose I/O Port, bit 5. This pin is 5.0V tolerant.
3	P4	I/O	PICASO-SGC General Purpose I/O Port, bit 4. This pin is 5.0V tolerant.
4	P6	I/O	PICASO-SGC General Purpose I/O Port, bit 6. This pin is 5.0V tolerant.
5	NC	–	Not Used
6	P0	I/O	PICASO-SGC General Purpose I/O Port, bit 0. This pin is 5.0V tolerant.
7	P1	I/O	PICASO-SGC General Purpose I/O Port, bit 1. This pin is 5.0V tolerant.
8	3.3V	P	Regulated 3.3 Volts output, available current max 400mA..
9	GND	P	Supply Ground.
10	AUDIO	O	PWM Audio Output
11	AUDENB	I	Audio Enable Output.

J1 Pin Outs (Expansion Port):

Pin	Symbol	I/O	Description
1	P15/BUS7	I/O	PICASO-SGC General Purpose I/O Port, bit 15. This pin is also the bit 7 of Parallel IO Bus (BUS0..7). This pin is 5.0V tolerant.
2	P14/BUS6	I/O	PICASO-SGC General Purpose I/O Port, bit 14. This pin is also the bit 6 of Parallel IO Bus (BUS0..7). This pin is 5.0V tolerant.
3	P13/BUS5	I/O	PICASO-SGC General Purpose I/O Port, bit 13. This pin is also the bit 5 of Parallel IO Bus (BUS0..7). This pin is 5.0V tolerant.
4	P12/BUS4	I/O	PICASO-SGC General Purpose I/O Port, bit 12. This pin is also the bit 4 of Parallel IO Bus (BUS0..7). This pin is 5.0V tolerant.
5	P11/BUS3	I/O	PICASO-SGC General Purpose I/O Port, bit 11. This pin is also the bit 3 of Parallel IO Bus (BUS0..7). This pin is 5.0V tolerant.
6	P10/BUS2	I/O	PICASO-SGC General Purpose I/O Port, bit 10. This pin is also the bit 2 of Parallel IO Bus (BUS0..7). This pin is 5.0V tolerant.
7	P9/BUS1	I/O	PICASO-SGC General Purpose I/O Port, bit 9. This pin is also the bit 1 of Parallel IO Bus (BUS0..7). This pin is 5.0V tolerant.
8	P8/BUS0	I/O	PICASO-SGC General Purpose I/O Port, bit 8. This pin is also the bit 0 of Parallel IO Bus (BUS0..7). This pin is 5.0V tolerant.
9	P2	I/O	PICASO-SGC General Purpose I/O Port, bit4. This pin is 5.0V tolerant.
10	P3	I/O	PICASO-SGC General Purpose I/O Port, bit6. This pin is 5.0V tolerant.
11	Vin	P	Main Voltage Supply +ve input pin. Same connection as uUSB Interface, pin 1.

I: Input, O: Output, A: Analogue, P: Power



Typical Host Interface

2. Hardware Interface - Pins

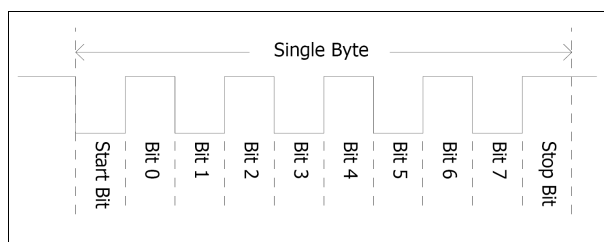
The uVGA-II(SGC) VGA Graphics Engine provides both a hardware and a software interface to its host. This section describes in detail the hardware interface pins.

2.1 Serial Interface - UART

The uVGA-II(SGC) modules have a dedicated hardware UART that can communicate with a host micro-controller via its serial port. This is the main interface used by the host micro-controller to communicate with the module to send commands and receive back data. The primary features are:

- Full-Duplex 8 bit data transmission and reception through the TX and RX pins.
- Data format: 8 bits, No Parity, 1 Stop bit.
- Baud rates from 300 baud up to 256K baud (default 9600 baud).

A single byte serial transmission consists of the start bit, 8-bits of data followed by the stop bit. The start bit is always 0, while a stop bit is always 1. The LSB (Least Significant Bit, Bit 0) is sent out first following the start bit. Figure below shows a single byte transmission timing diagram.



The Serial port is also the primary interface for updating and programming the on board PICASO-SGC processor with PmmC files for future serial command upgrades and enhancements. Please refer to **Section 6. Programming-System Updates** for more details.

TX (Serial Transmit), uUSB Interface pin 2:

Asynchronous Serial port Transmit pin, TX. Connect this pin to host micro-controller Serial Receive (Rx) signal. The host receives data from the uVGA-II(SGC) module via this pin. This pin is

5.0V tolerant.

RX (Serial Receive), uUSB Interface pin 3:

Asynchronous Serial port Receive pin, RX. Connect this pin to host micro-controller Serial Transmit (Tx) signal. The host transmits data to the uVGA-II(SGC) module via this pin. This pin is 5.0V tolerant.

2.2 GPIO - General Purpose IO Interface

There are 16 general purpose Input/Output (GPIO) pins available to the host controller via the J1 and J2 connectors. These are grouped as P0..P15. Each individual GPIO pin can be set as an INPUT or an OUTPUT. The upper 8 bits (P8..P15) are also labelled as BUS0..BUS7 and these 8-bits provide a fast parallel data transfer to and from external devices. For detailed usage refer to the separate document titled:

'*PICASO-SGC-COMMANDS-SIS.pdf*'.

P0-P15 (16 x GPIO pins), J1/J2:

General purpose I/O pins. Each pin can be individually set for INPUT or an OUTPUT. Power-Up Reset default is all INPUTS.

BUS0-BUS7 (8bit GPIO Bus), J1/J2:

8-bit parallel general purpose I/O Bus.

Note: All GPIO pins are 5.0V tolerant.

2.3 System Pins

Vin (Module Voltage Input)

uUSB Interface pin 1, J1 pin 11:

Module supply voltage input pin. This pin must be connected to a regulated supply voltage in the range of 4.0 Volts to 5.5 Volts DC. Nominal operating voltage is 5.0 Volts.

3.3Vout (3.3V Regulated Output)

J2 pin 8:

External circuitry that requires a regulated 3.3V

supply can be powered up via this pin. Maximum available current is 400ma.

GND (Module Ground)**uUSB Interface pin 4, J2 pin 9:**

Device ground pins. These pins must be connected to ground.

RESET (Module Master Reset)**uUSB Interface pin 5:**

Module Master Reset pin. An active low pulse of greater than 2 micro-seconds will reset the module. Internally pulled up to 3.3V via 4.7K resistor. Only use open collector type circuits to reset the device if an external reset is required.

3. Software Interface - Commands

The software interface provided by the uVGA-II(SGC) module is a set of easy to use serial commands. The command set is grouped into following sections:

General Commands:

- AutoBaud
- Set new Baud-Rate
- Version-Device Info Request
- Replace Background Colour
- Clear Screen
- Display Control Functions
- Set Volume
- Sleep (Low Power Mode)
- Read GPIO Pin
- Write GPIO Pin
- Read GPIO Bus
- Write GPIO Bus

Graphics Commands:

- Add User Bitmap Character
- Draw User Bitmap Character
- Draw Circle
- Draw ellipse
- Draw Triangle
- Draw Rectangle
- Draw Image-Icon
- Set Background colour
- Draw Line
- Draw Pixel
- Draw Polygon
- Read Pixel
- Screen Copy-Paste
- Replace colour
- Set Pen Size

Text Commands:

- Set Font
- Set Transparent-Opaque Text
- Draw "String" Text (graphics format)
- Draw ASCII Char (text format)
- Draw "String" Text (text format)
- Draw ASCII Char (graphics format)
- Draw Text Button

Touch Commands:

- Get Touch Coordinates
- Wait Until Touch
- Detect Touch Region

uSD Memory Card Commands (Low-Level/RAW)

- Initialise Memory Card
- Set Address Pointer of Card
- Read Byte Data from Card
- Write Byte Data to Card
- Read Sector Block from Card
- Write Sector Block to Card
- Screen Copy-Save to Card
- Display Image-Icon from Card
- Display Object from Card
- Display Video-Animation Clip from Card
- Run Script (4DSL) Program from Card

uSD Memory Card Commands (FAT-Level/DOS)

- Initialise Memory Card
- Read File from Card (FAT)
- Write File to Card (FAT)
- Erase file from Card (FAT)
- List Directory from Card (FAT)
- Screen Copy-Save to Card (FAT)
- Display Image-Icon from Card (FAT)
- Play Audio WAV file from Card (FAT)
- Run Script (4DSL) Program from Card (FAT)

4DSL - Scripting Language Commands

- Delay
- Set Counter
- Decrement Counter
- Jump to Address If Counter Not Zero
- Jump to Address
- Exit-Terminate Script Program

For a complete detailed list of commands refer to the separate document titled:

“PICASO-SGC-COMMANDS-SIS.pdf”

Each command is made up of a sequence of data bytes. When a command is sent to the module and the operation is completed, the module will always return a response. For a command that has no specific response the module will send back a single acknowledge byte called the ACK (06hex), in the case of success, or NAK (15hex), in the case of failure.

Commands having specific responses may send

back varying numbers of bytes, depending upon the command and response. It will take the module a certain amount of time to respond, depending on the command type and the operation that has to be performed. If the VGA Graphics Engine receives a command that it does not understand it will reply back with a negative acknowledge called the **NAK** (15hex). Since a command is only identified by its *position* in the sequence of data bytes sending incorrect data can result in wildly incorrect operation.

4. Module Features

The uVGA-II(SGC) module is equipped to accommodate most applications. Some of the main features of the module are listed below.

4.1 The VGA – Interface

The uVGA-II(SGC) module can be interfaced with a VGA Monitor or a screen with VGA interface. It supports certain range of resolutions. The VGA interface consists of primarily R, G, B, Vsync, Hsync and Clock. Some displays have fixed resolutions while others support multiple resolution setting which you can set to Auto or manually to a particular setting that suits the module. Following VGA resolutions are supported,

- 320 x 240
- 640 x 480
- 800 x 480
- Custom Resolution X*Y = 405K (414720)

4.2 The PICASO-SGC Processor

The module is designed around the PICASO-SGC Serial Graphics Controller from 4D-Labs.

The **PICASO-SGC** is an intelligent Serial Graphics Controller which drives an RGB engine to eventually generate RGB signal for the VGA screen.



Powerful graphics, text, image, animation and countless more features are built right inside the chip. It offers a simple yet effective serial interface to any host micro-controller that can communicate via a serial port.

The data sheet for the chip is available from the www.4dsystems.com.au website:

"PICASO-SGC-DS-revx.pdf"

4.3 The uSD Memory Card

The module supports micro-SD memory cards via the on-board uSD connector. The memory card is used for all multimedia file retrieval such as images, animations and movie clips. The memory card can also be used as general purpose storage for data logging applications. Support is available for off the shelf micro-SD and high capacity HC memory cards (4Gb and above).

Note: The module also supports FAT file formats.

4.4 The Audio

Audio is available via the dedicated PWM signal from the PICASO-SGC. Volume is adjustable (range of 8 to 127) via serial commands. A simple instruction empowers the user to execute the audio WAV files. Audio operation can be carried out simultaneously with the execution of other necessary instructions.

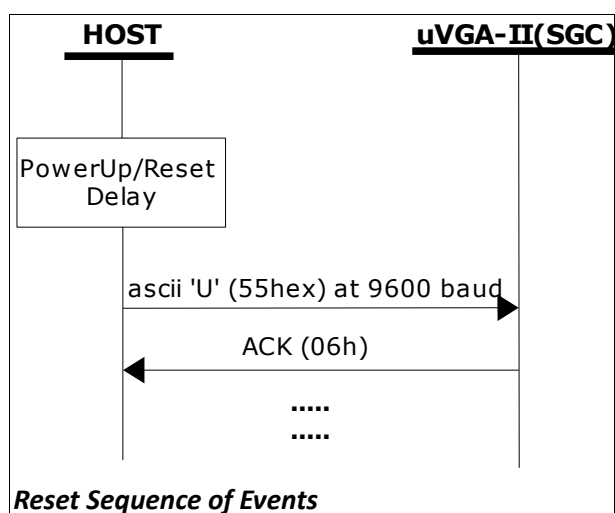
For a complete list of audio commands please refer to the separate document titled '**PICASO-SGC-COMMANDS-SIS.pdf**'.

Note: There is no on board speaker. User can access the Audio Output pin via connector. The Pin description is provided on Pg. 6.

5. Power-Up and Reset

When the uVGA-II(SGC) comes out of a power up or external reset, a sequence of events must be observed before attempting to communicate with the module:

- Allow up to 500ms delay after power-up or reset for the module to settle. Do not attempt to communicate with the module during this period. The device may send garbage on its TX Data line during this period, the host should disable its Rx Data reception.
Note: For applications that utilise memory cards with large capacity, allow up to 3 seconds for the card initialisation.
- The host must send the ascii 'U' (55hex) command at 9600 baud and wait for an ACK (06hex). The default baud rate of the module is 9600 bps and the host must communicate initially with the module at this speed. The **"Set new Baud-Rate"** command can then be used to change to a different baud-rate if desired.



5.1 Splash Screen on Power Up

The uVGA-II(SGC) will wait up to 5 seconds with its screen blank for the host to transmit the Auto-Baud command ('U', 55hex). If the host has not

transmitted the Auto-Baud command by the end of this period the module will display a built-in splash screen. If the host has transmitted the Auto-Baud command, the screen will remain blank. This wait period is for those customer specific applications where the splash screen is undesired.

5.2 4DSL Memory Card Script Program

The complete command summary for the PICASO-SGC is listed in the previous section 3 of this document. The command execution is not only limited to the host sending these via the serial interface. The majority of them can be composed as a script and written into memory card. A 4DSL script program is a sequence of those commands that reside and can be executed from inside the memory card and these can be a combination of graphics, text, image, video and audio commands. Complete list of commands available for the scripting program is listed in a separate document titled:

"PICASO-SGC-COMMANDS-SIS.pdf"

5.3 Auto-Run Card Script Program

The uVGA-II(SGC) module has a feature that will auto run a preloaded script program on power-up. The module device is equipped to accept memory cards and when using the FAT file system, upon power-up, if a 4DSL script program file called **'autoexec.4ds'** exists on the memory card, the PICASO-SGC will automatically run this script program. This is a useful feature for those stand alone applications where the device does not require a host controller to send commands to the module to play a slide show of images, video clips, etc.

The user will have to create and upload a slide show composition to the card to benefit from this auto play feature.

Refer to **'Section 4: Appendix B'** at the end of the separate document titled: **"PICASO-SGC-COMMANDS-SIS.pdf"** for a quick guide to creating scripting files using the FAT-Controller software tool available from 4D Systems.

6. Programming - System Updates

The PICASO-SGC, used in the uVGA-II(SGC) module, is a custom graphics controller. All functionality including the high level commands are built into the chip. This chip level configuration is available as a PmmC (Personality-module-micro-Code) file.

A PmmC file also contains all of the low level micro-code information (analogy of that of a soft silicon) which define the characteristics and functionality of the device. The ability of programming the device with a PmmC file provides an extremely flexible method of customising as well as upgrading it with future enhancements.

A PmmC file can only be programmed into the module via the serial port and an access to this should be provided for on the target application.

The PmmC file is programmed into the device with the aid of "**PmmC Loader**", a PC based software tool. To provide a link between the PC and the ICSP interface a USB to Serial converter is required. A range of custom made micro-USB devices such as the uUSB-MB5 and the uUSB-CE5 are available from 4D Systems.

For further details refer to:

'Section 9: Development and Support Tools'.

7. Memory Cards – FAT16 Format

The uVGA-II(SGC) module uses off the shelf standard microSD memory cards.

For any FAT file related operations, before the memory card can be used it must first be formatted with FAT16 option. The formatting of the card can be done on any PC system with a card reader. Select the appropriate drive and choose the FAT16 (or just FAT in some systems) option when formatting. The card is now ready for use.



The module also support high capacity HC memory cards (4Gb and above). The available capacity of SD-HC cards varies according to the way the card is partitioned and the commands used to access it.

The FAT partition is always first (if it exists) and can be up to the maximum size permitted by FAT16. Windows will format FAT16 up to 2Gb and the Windows command prompt will format FAT16 up to 4Gb.

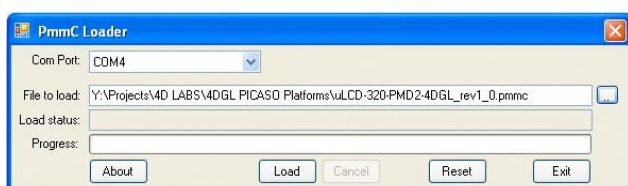
For the RAW partition, byte reads and writes can access 2^{32} (i.e. 4gb) of the card, Sector reads and writes can access 2^{24} sectors (of 512 bytes, i.e. 8gb).

The total amount of the card usable is the sum of the FAT and RAW partitions.

8. Development and Support Tools

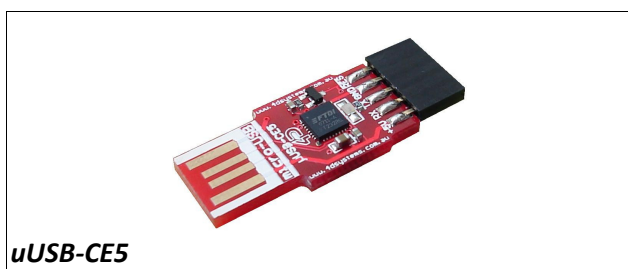
8.1 PmmC Loader – PmmC Programming Software Tool

The 'PmmC Loader' is a free software tool for Windows based PC platforms. Use this tool to program the latest PmmC file into the PICASO-SGC chip embedded in the uVGA-II(SGC) module. It is available for download from the 4D Systems website, www.4dsystems.com.au



8.2 microUSB – PmmC Programming Hardware Tool

The micro-USB module is a USB to Serial bridge adaptor that provides a convenient physical link between the PC and the module. A range of custom made micro-USB devices such as the uUSB-MB5 and the uUSB-CE5 are available from 4D Systems www.4dsystems.com.au. The micro-USB module is an essential hardware tool for all the relevant software support tools to program, customise and test the uVGA-II(SGC) module.

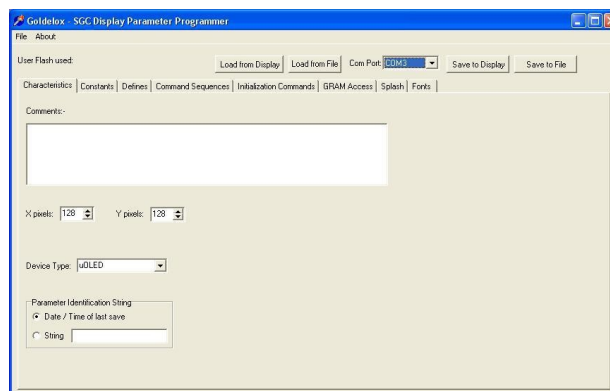


8.3 Display Initialisation Setup Personality (DISP) – Software Tool

DISP is a free software tool for Windows based PC platforms. Use this tool to:-

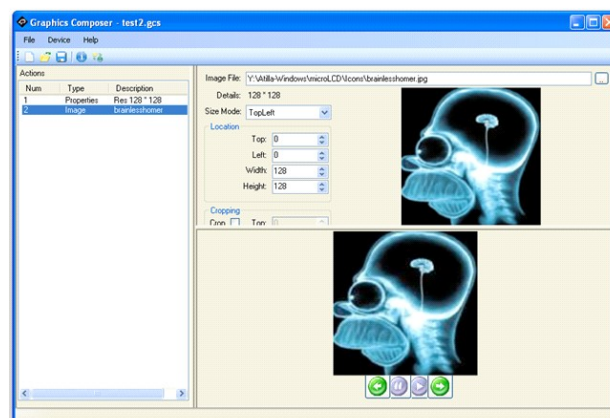
- Configure the PICASO-SGC chip to work with a specific display.
- Add custom fonts through the files generated by the Font Tool.
- Construct the splash screens.
- Replace or modify the embedded fonts.

It is available for download from the 4D Systems website, www.4dsystems.com.au.



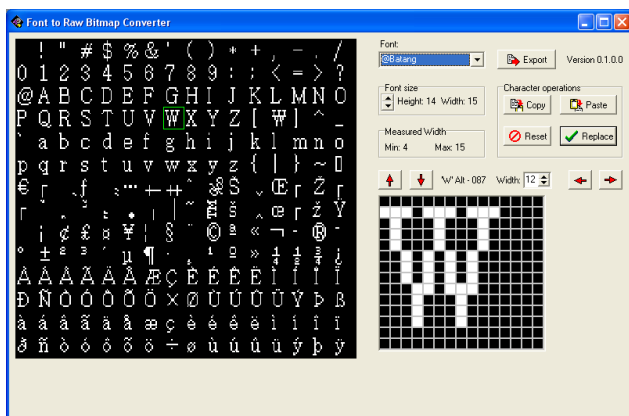
8.4 Graphics Composer – Software Tool

The Graphics Composer is a free software tool for Windows. This software tool is an aid to composing a slide show of images/animations/movie-clips (multi-media objects) which can then be downloaded into the uSD memory card. The host simply sends serial commands to the module to display the multimedia objects.



8.5 FONT Tool – Software Tool

Font-Tool is a free software utility for Windows based PC platforms. This tool can be used to assist in the conversion of standard Windows fonts (including True Type) into the bitmap fonts used by the PICASO-SGC chip.

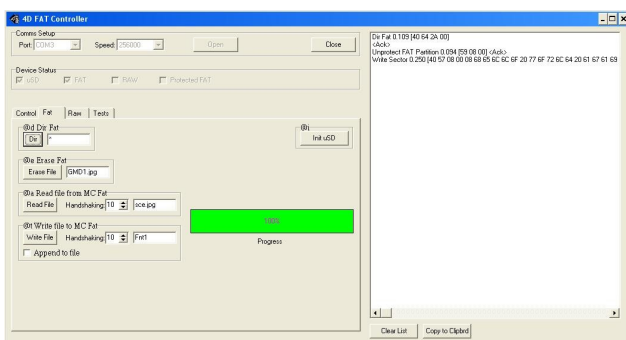


It is available for download from the 4D Systems website, www.4dsystems.com.au.

Disclaimer: Windows fonts may be protected by copyright laws. This software is provided for experimental purposes only.

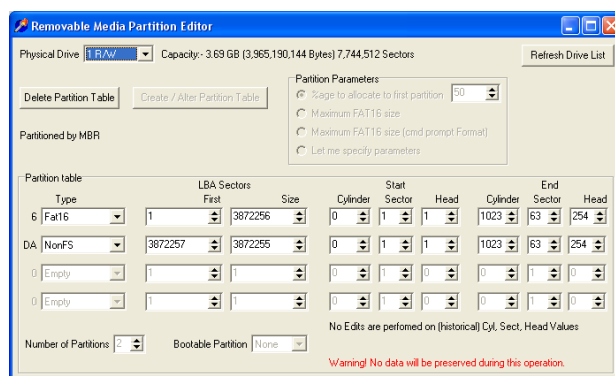
8.6 FAT Controller – Software Test Tool

The 4D FAT Controller is a free software tool to test all of the functionality of the GOLDELOX-DOS, GOLDELOX-SGC and the PICASO-SGC devices and their respective modules. It is useful in learning about how to communicate with the chips and the modules. For the GOLDELOX-SGC and the PICASO-SGC it can also simulate most of the operation of the device and assist in the creation of simple scripts, either simulating the execution of those scripts and / or downloading them into a uSD/uSDHC card for execution on the display.



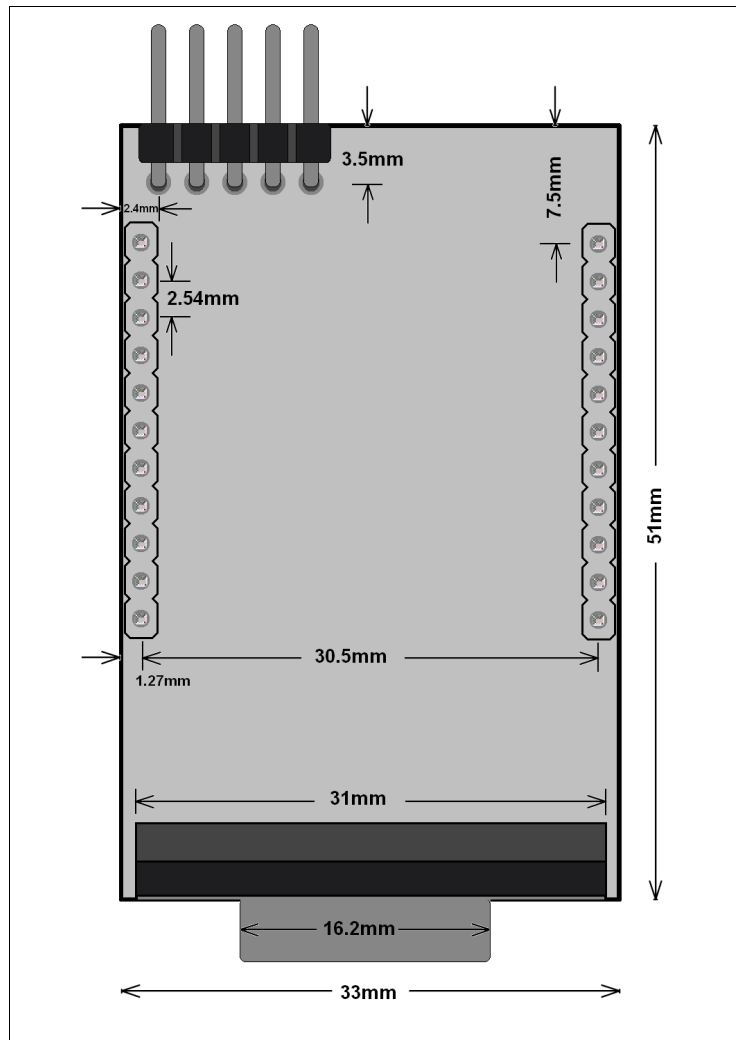
8.7 RMPET – Software Tool

uSD/SD/SDHC memory cards nearly always come pre-partitioned with a single partition. Windows only accesses the first partition on the card and ignores any other partitions. Removable Media Partition Edit Tool (RMPET) can split a large card into two partitions, the first partition for use as a FAT16 partition and the second partition for use as a RAW partition. RMPET allows setting of the first partition to a percentage of the card, the 2Gb maximum of the FAT16 Windows format program, or the 4Gb maximum of FAT16 when the command prompt format command is used.

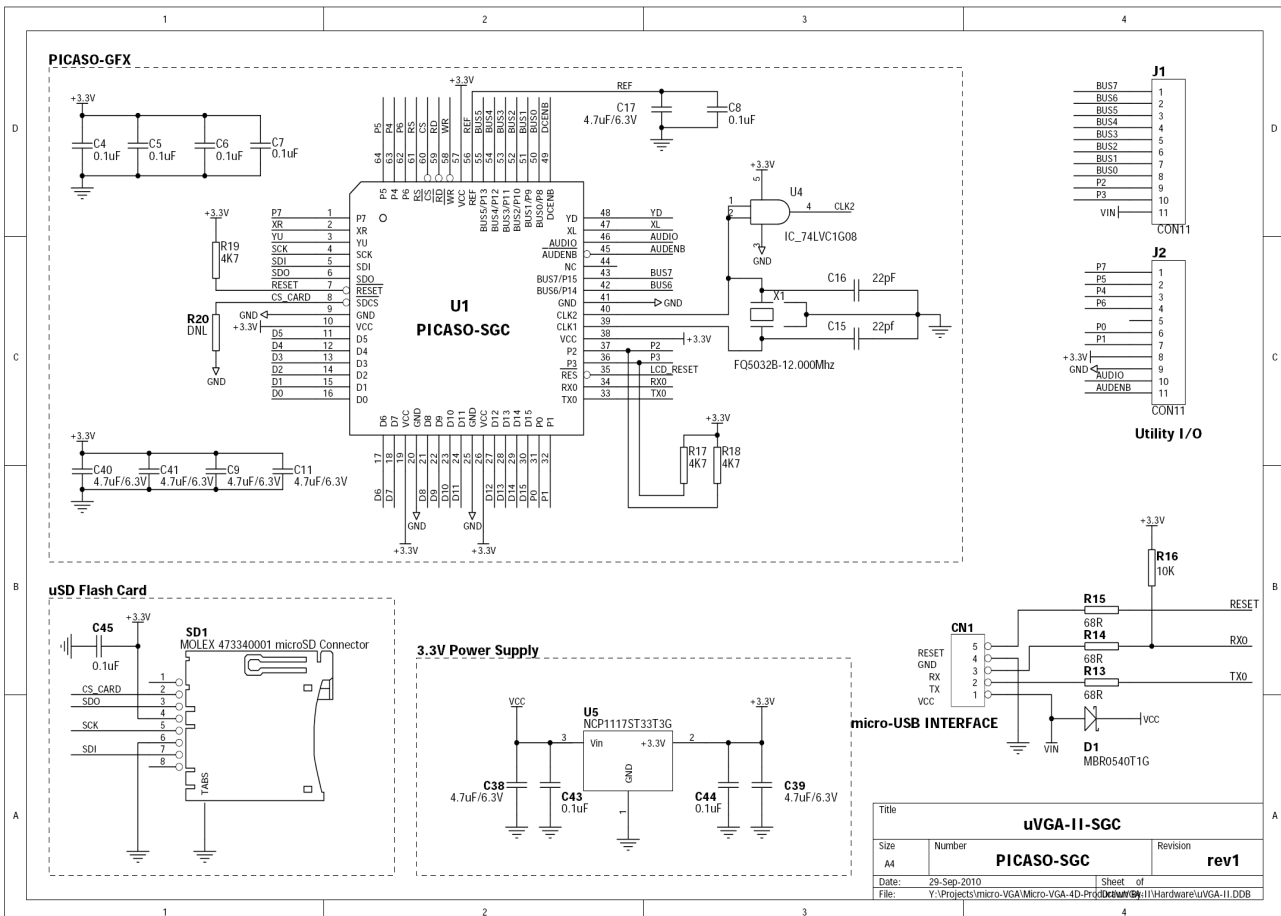


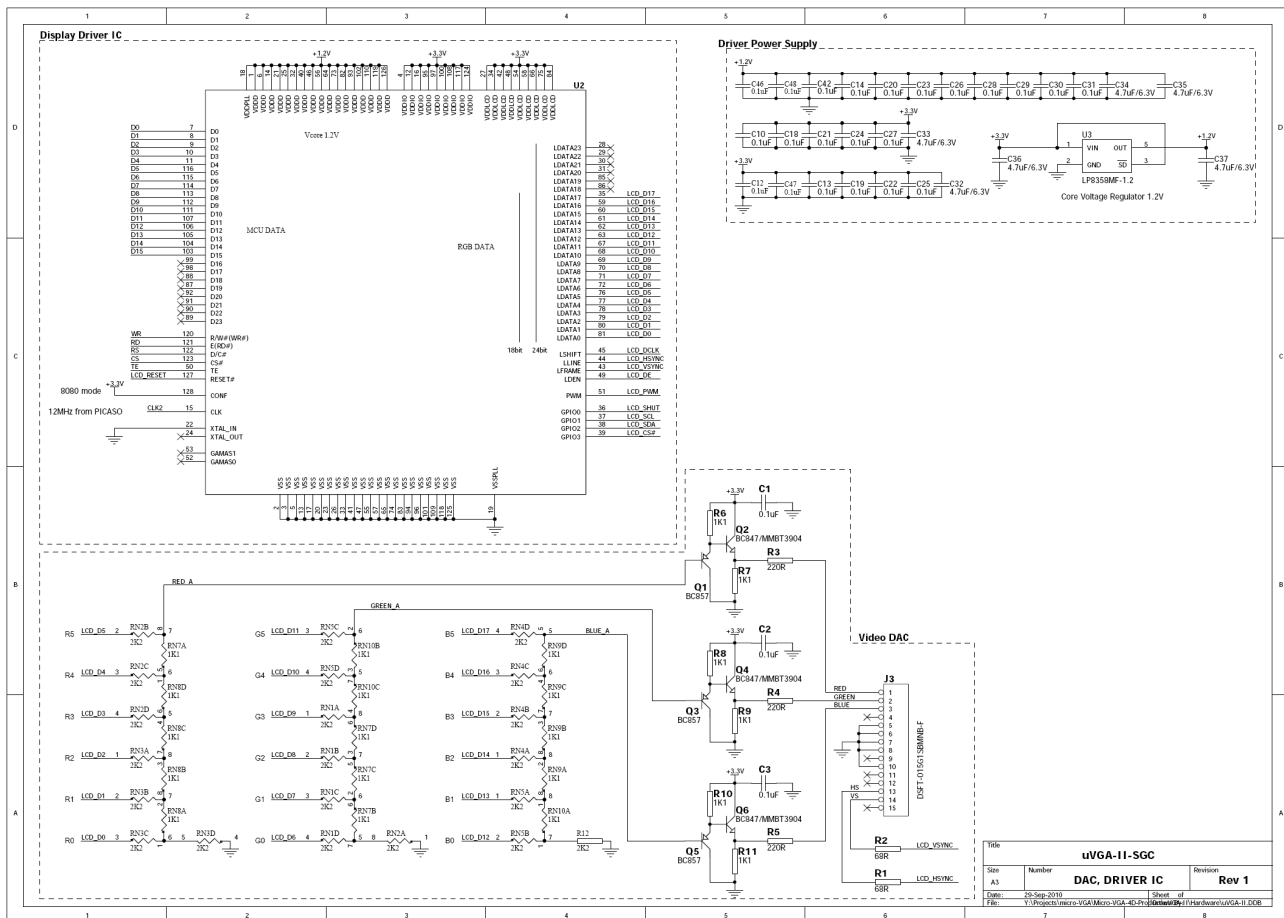
It is available for download from the 4D Systems website, www.4dsystems.com.au.

9. Mechanical Details



10. Reference Design





11. Specifications and Ratings

Absolute Maximum Ratings

Operating ambient temperature	-15°C to +65°C
Storage temperature	-30°C to +70°C
Voltage on any digital input pin with respect to GND	-0.3V to 6.0V
Voltage on SWITCH pin with respect to GND	-0.3V to 6.0V
Voltage on VCC with respect to GND	-0.3V to 6.0V

NOTE: Stresses above those listed here may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the recommended operation listings of this specification is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

Recommended Operating Conditions

Parameter	Conditions	Min	Typ	Max	Units
Supply Voltage (VCC)		4.0	5.0	5.5	V
Operating Temperature		-10	--	+60	°C
Input Low Voltage (VIL)	VCC = 3.3V, all pins	VGND	--	0.2VCC	V
Input High Voltage (VIH)	VCC = 3.3V, non 5V tolerant pins	0.8VCC	--	VCC	V
Input High Voltage (VIH)	All GPIO pins, RX0 and TX0 pins	0.8VCC	--	5.5	V
Reset Pulse	External Open Collector	2.0	--	--	μs
Operational Delay	Power-Up or External Reset	500	--	3000	ms

Global Characteristics based on Operating Conditions

Parameter	Conditions	Min	Typ	Max	Units
Supply Current (ICC)	VCC = 5.0V, heavily depends on screen usage conditions, sleep mode	4	150	170	mA
Output Low Voltage (VOL)	VCC = 5.0V, IOL = 3.4mA	--	--	0.4	V
Output High Voltage (VOH)	VCC = 5.0V, IOL = -2.0mA	2.4	--	--	V
Capacitive Loading	All pins	--	--	50	pF
Flash Memory Endurance	PICASO-SGC PmmC Programming	--	1000	--	E/W

Ordering Information

Order Code: uVGA-II(SGC)

Package: 150mm x 95mm (ZIF Bag dimensions).

Packaging: Module sealed in antistatic padded ZIF bag.

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