

# VIZIC TECHNOLOGIES

## SMART GPU 2 3.5" TOUCH

Datasheet----Rev 1.1



## SMART GPU 2– Intelligent Embedded Graphics, Audio and Touch Processor.





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## Smart GPU 2:

Intelligent Embedded Graphics, Audio and Touchscreen Processor.

## **Description:**



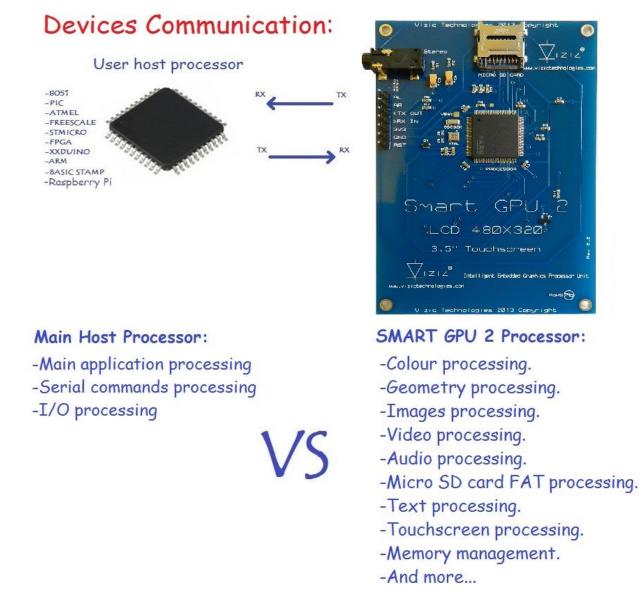
The Smart GPU 2 is a powerful easy to use, intellectual property, embedded graphics, audio and touchscreen processor in a state-ofthe-art ARM Cortex-M3 chip; this is mounted on a board with a touchscreen color LCD. It's aimed to help developers to create advanced Graphical User Interfaces (GUIs) in a very easy way. It features high end FAT format data management functions (Data Logger) to create even more advanced applications in just minutes, not days. The Smart GPU 2 processor doesn't need any configuration or programming on itself, it's a slave device that only receives orders, reducing and facilitating dramatically the code size, complexity and processing load in the master host processor.

The Smart GPU 2 offers a simple yet effective serial interface UART to any host micro-controller/microprocessor that can communicate via a serial port(8051, PIC, ATMEL, FREESCALE, STMICRO, ARM, CORTEX, ARDUINO, raspberry PI, FPGA MBED, etc. even PCs(RS232)). All graphics, audio and touchscreen related functions are sent using simple commands via the serial interface.

The main goal of the Smart GPU 2 processor it's to bring a very easy way to add colour, audio and touch interfacing to any application or project without the need of having experience in handling LCDs and graphics algorithms. The Smart GPU 2 it's a low power/very high performance processor, it integrates the FAT/FAT12/FAT16 or FAT32 universal PCs file System for data storage (read/write), supporting up to 32 GB of storage with a microSD/HC card, NO special format is required.

SmartGPU2 chip is also sold as "bare chip" for high end applications and can be adapted to drive any LCD with parallel 8080 interface.

The next image clearly explains the roles played by the user host main processor and the Smart GPU 2 processor:



Instead of loading all the Geometry, Images, audio, video, SD FAT memory access, etc. processing to the main host processor, the Smart GPU 2 does the entire job and stuff in parallel with the user microcontroller/microprocessor by receiving simple orders or commands.

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## **Board Features:**

- 3.5", 480x320 pixels resistive touchscreen LCD, capable of displaying 262,144 colours.
- Easy 5 pin interface to any host device: VCC, TX, RX, GND, RESET.
- On-board uSD/uSDHC card adaptor, FAT(windows PC) Support up to 32GB for storing images and text, Data Logger functions (read-write) and LFN(long File Names).
- BMP and JPG images support.
- Video and Audio(CD quality) capable.
- Integrated 2 channel DACs outputs can play **stereo** audio.
- Integrated Touch screen driver, 12 bit accuracy touch.
- 5 general purpose Icons on touchscreen panel.
- Integrated RTC Real Time Clock with battery back-up.
- PWM controlled display brightness.
- Sleep mode.
- UART/USART Baud Rate speeds from 9600bps up to 200000bps, 8 bits, no parity, 1 stop bit.
- 5V and 3V3 I/O compatible, 3V3 power supply.

## Smart GPU 2 Board – EXPLAINED

Technolo 3.5mm Stereo Quality **Audio Outputs** izicte croSD card Socket C2 32GB storage AL or up O 3.3V and 5V Inputs-AR KTX OUT **Outputs compatible** >RX IN Graphics, Audio, SVB R10 GND touch and datalogger RST Processor PROCESSOR Smar LCD 480X<u>320</u> Full Colour 3.5" Touch 3.5" Touchscreen Screen of 480x320 pixels **PWM Backlight** (same type, resolution, and size as iphone 3GS) 71 Intelligent Embedded Graphics Processor Unit ROHS Vizic Technologies 2013 Copyright

SmartGPU2 LCD480x320 3.5" Touch Xplained

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## 1.-Host Interface

The Smart GPU 2 is a slave peripheral device and it provides a bidirectional serial interface to a host controller via its USART(Universal Serial Asynchronous Receiver - Transmitter).

Any microcontroller or processor (AVR, PIC, BASICstamp, XXDUINO, raspberry PI, 8051, MBED, FPGA, ARM, STmicro, etc) or PC(by serial interface RS232) as host, can communicate to the device over this serial interface from 9600bps up to 4000000bps.

The Smart GPU 2 doesn't need to be configured in any way; it's a plug-and-play device, could be used by students, up to industrial and professional applications, its compatible with any device and existing development board with a USART/UART.

The serial protocol is universal and very easy to implement. Serial Data Format: 8 Bits, No Parity, 1 Stop Bit. BaudRate: 9600 bps (default; could be changed). Serial data is true and not inverted.

## 1.1 Command Protocol : Flow Control

The Smart GPU 2 Intelligent Graphics Processor Unit is a slave device and all communication and events must be initiated first by the host. Commands consist of a sequence of data bytes beginning with the command/function byte.

When a command is sent from host to the device, this process the command and when the operation is completed, it will always return a response<sup>\*</sup>. The device will send back a single acknowledge byte called the ACK (4Fhex, 'O' ascii), in the case of success, or NAK (46hex, 'F' ascii), in the case of failure or not recognized command.

<sup>\*</sup> Commands having specific responses may send back varying numbers of bytes, depending upon the command and response. It will take the device a certain amount of time to respond, depending on the command type and the operation that has to be performed.

## 1.2 Serial Set-up

The Smart GPU 2 is configured to be always initialized at a standard **baud rate** of 9600 bps. So the first command that the host sends to the Smart GPU 2 must be at that speed.

Always after any power-up or reset, the Smart GPU 2 must be initialized by sending the uppercase ascii character '**U**' (55hex) at 9600bps. This will initialize all the processor, and when done it will respond with an ACK byte (4Fhex, 'O'ascii).

If the Smart GPU 2 respond with a NAK(46hex, 'F'ascii), Host must try to send the uppercase ascii character '**U**' (55hex) again until a valid ACK is received, meaning this that Smart GPU 2 is ready and running.

Once the chip is initialized, user can change the baud rate speed to a total of 8 different speeds up to 2Mbps.

Remember:

The SMART GPU 2 always initializes the micro SD card after a valid 'U' character is received. If a micro SD card is detected the ACK 'O' will be response almost immediately, however if no micro SD card is detected, the ACK 'O' could be delayed while the SMART GPU 2 retries to initialize a micro SD card, however if no micro SD card is detected after several tries, the SMART GPU 2 will send the ACK 'O' and the processor will function normally without the SD card functions.

#### 1.3 Power-up and Reset

When the Smart GPU 2 device comes out of a power up or external reset, a 200ms delay before sending any command must be met, do not attempt to communicate with the module before this period.

If no valid uppercase ascii character '**U**' (55hex) is sent before 3 seconds, the Smart GPU 2 logo will automatically show up, host still can send the uppercase ascii character '**U**' (55hex) to initialize the processor even if the logo has already appeared.

Remember:

The host transmits the upper case character ('U', 55hex) as the first command so the device to start communication.

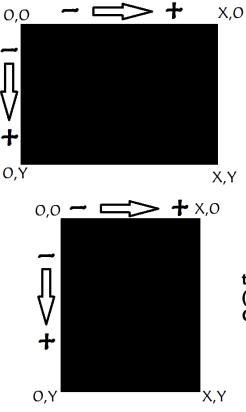
## 1.4 Splash Screen on Power Up

The Smart GPU 2 will wait up to 3 seconds with its screen in black, for the host to transmit the Initial command ('U', 55hex). If the host has not transmitted this initial command the module will display its splash screen. If the host has transmitted only the initial command and has received a valid ACK, the screen will remain in black. This wait period of the splash screen to appear, is to allow the user initialize the Smart GPU 2 before the welcome screen appears when it is undesired.

## 1.5 Understanding the Computer's graphic coordinate system

As well as a computer monitor's coordinate system, the Smart GPU 2 uses the same universal coordinate system, on computer's there's only one positive coordinate quadrant, and there's no negative numbers or points. This quadrant is represented as follows:

The upper left corner is 0,0 if we go right the X values increases, as we go down the Y values increase.



This image shows a LANDSCAPE orientation of the screen, the upper left corner is 0,0 (zero,zero). The maximum values of the SMART GPU 2 in LANDSCAPE mode are X:479,Y:319.

This image shows a PORTRAIT orientation of the screen, the upper left corner is 0,0 (zero,zero). The maximum values of the SMART GPU 2 in PORTRAIT mode are X:319,Y:479.

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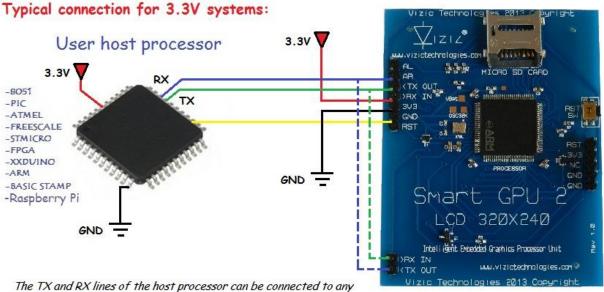
## **1.6 Board Pin configuration**



Pin	Symbol	I/O	Description
1	AL(DAC)	Out	Audio Left Channel Output analog pin, always use a >=100uF capacitor to decouple output.
2	AR(DAC)	Out	Audio Right Channel Output analog pin, always use a >=100uF capacitor to decouple output.
3	Transmitter Out 5V / 3.3V	Out	Asynchronous serial transmit output pin, for 5V and 3.3V logic.
4	Receiver In 5V / 3.3V	In	Asynchronous serial receiver input pin for 5V and 3.3V logic.
5	VCC 3.3V	In	Main voltage supply, 2.8v-3.3v.
6	Ground	In	Supply Ground.
7	Reset	In	Master reset signal, Internally pulled up to 3.3V via a 40K resistor. An active low pulse greater than 100ns will reset the module. 5V tolerant input.

## 1.7 TYPICAL HOST CONNECTION: for 3.3V Systems

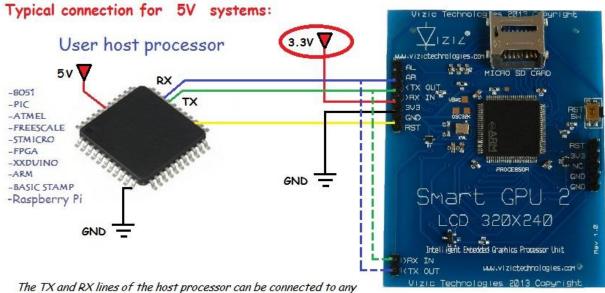
The SmartGPU2 must always be powered with 3.3V (TX, RX, and Reset pins are 5V tolerant).



The TX and RX lines of the host processor can be connected to any of the 2 pair of lines TX,RX of the SmartGPU 2 board as they're bridged/Internally connected inside the board.

## 1.8 TYPICAL HOST CONNECTION: for 5V Systems

\*The SmartGPU2 must always be powered with 3.3V (TX, RX, and Reset pins are 5V tolerant).



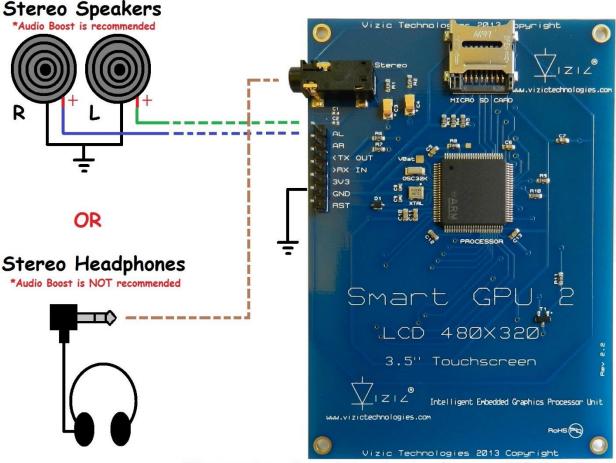
The TX and RX lines of the host processor can be connected to any of the 2 pair of lines TX,RX of the SmartGPU 2 board as they're bridged/Internally connected inside the board.

## 1.9 Typical Audio headphones/speakers connections:

The Smart GPU 2 supports stereo audio output, the pins labeled AL(Audio Left Channel) and AR(Audio Right Channel) are the audio DACs outputs. The processor can manage any Audio file, so files with **.wav** extension will be easily opened and played.

The following circuit connections are recommended to achieve a good CLEAN headphones or speaker's connection, no LPF or HPF Filter is applied to outputs.

**Recommended Audio Connections:** 



\*Never connect more than one load per channel, as the processor DACs can be damaged.

The SMART GPU 2 can play any RIFF-WAVE format sound files known as Microsoft wave file in LPCM: 8/16 bits, Mono or Stereo sound, and up to 48KHz sampling rate (CD Quality). Any other format of sound files (mp3,acc,wma,etc) must be converted to the .wav format.

A complete tutorial on how to load Audio Files to the SD card is explained on this PDF file at the SD card file management section.

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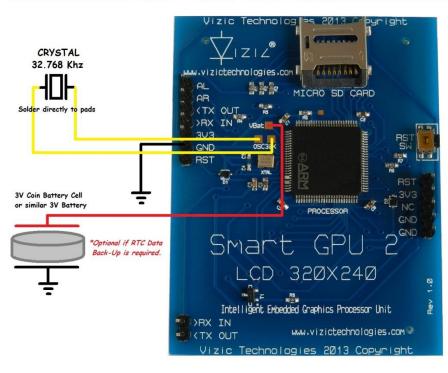
## 1.10 Typical RTC Real Time Clock connections:

The Smart GPU 2 processor has an embedded RTC Real Time Clock to support full Time-Date calendar functions, also Data Logger applications that require a precise timestamp.

The real-time clock is an independent timer that counts every second and keeps information about Date(day, month, year) and Time(hours, minutes, seconds). The next RTC Timer Functions enable full possibilities with the Smart GPU 2. User can create full real time Graphic User Interfaces and Data-logger applications with clock-calendar functions with the accuracy that only a RTC provides.

The RTC is internal and ready to run, an external crystal has been soldered to the **OSC32** external pads to enable full RTC support. To avoid the RTC lose time and date data each time main VCC power is removed or shut down from the chip, a Standard 3V coin backup battery or similar can be connected between the pads noted as **VBat** and **GND** pin on the board, this way the RTC will continuously running conserving Time and Date data even the Smart GPU 2 chip is power off.

The following circuit connections are recommended to achieve a good RTC Crystal and Back-Up Battery connection.



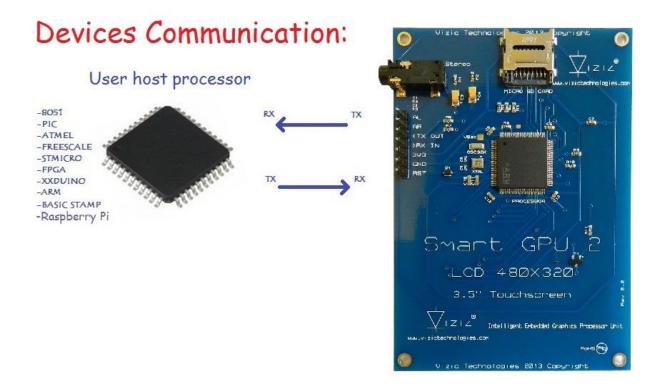
#### Recommended RTC - Real Time Clock Connections:

## 2. SMART GPU 2 Command Set - Software Interface Specification

As mentioned before the command interface between the Smart GPU 2 and the host processor is via the serial interface USART/UART.

A list of very easy to learn commands provide complete access to all the available functions. Commands and responses can be a single byte or a byte package. All commands always return a response, either a single ACK, or data followed by an ACK.

Remember all commands start with a uppercase letter (ascii).



## 2.1 Command summary

For detailed information, be sure to check the SmartGPU 2 COMMAND SET Sheet.

#### **General Commands:**

• Initialize SMART GPU –	55hex 'U'
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#### **Master Commands:**

Erase Screen	– 45hex 'E'
Set Erase Background Colour	– 43hex 'C'
<ul> <li>Display Orientation</li> </ul>	– 4Fhex 'O'
<ul> <li>Display Brightness</li> </ul>	– 42hex 'B'
<ul> <li>BaudRate Change</li> </ul>	– 58hex 'X'
• Sleep	– 5Ahex 'Z'
Calibrate Touch	– 54hex 'T'
<ul> <li>Software Reset</li> </ul>	– 52hex 'R'

#### **Geometry Commands:**

Ocometry Commanus.	
Put Pixel	– 50hex 'P'
• Draw Line	– 4Chex 'L'
<ul> <li>Draw Rectangle</li> </ul>	– 52hex 'R'
<ul> <li>Draw Round Rectangle</li> </ul>	– 4Fhex 'O'
• Draw Gradient Rectangle	– 47hex 'G'
Draw Arc	– 41hex 'A'
Draw Circle	– 43hex 'C'
<ul> <li>Draw Ellipse</li> </ul>	– 45hex 'E'
Draw Triangle	– 54hex 'T'

#### String/Text Commands:

- Put Letter – 4Chex 'L'
- Print Number 4Ehex 'N'
  Display String 53hex 'S'
- Display String SD 46hex 'F'
- Strings Configuration 43hex 'C'

#### Image Commands:

- Draw Image/Icon 49hex 'l'
- Image BMP SD 42hex 'B'
- Image JPG SD 4Ahex 'J'
- Memory Read 4Dhex 'M'
- Screenshot BMP 53hex 'S'

#### Video Commands:

- Allocate Video SD 41hex 'A'
- Play Video SD **50hex 'P'**
- Set Frame Video SD 46hex 'F'
- De-allocate Video SD 44hex 'D'

#### Audio Commands:

- Initialize/De-initialize DACs/Audio 49hex 'l'
- Play WAV File 50hex 'P'
  Pause WAV File 57hex 'W'
  Advance WAV File 41hex 'A'
  Stop WAV File 53hex 'S'
  Set Volume WAV 56hex 'V'
  Get Playing State 47hex 'G'
  Audio Boost 42hex 'B'

#### **Touch Commands:**

- Get Touchscreen 53hex 'S'
- Get Touch icons 49hex 'l'

#### FAT Data Management/ Data Logger:

	- 33
<ul> <li>List Dirs and Files</li> </ul>	–4Chex 'L'
<ul> <li>Get name Item#</li> </ul>	–47hex 'G'
Get Dir Path	–48hex 'H'
New Dir/File	–4Ehex 'N'
• Open Dir	–44hex 'D'
Open File	–4Fhex 'O'
• Read File	–52hex 'R'
Write File	–57hex 'W'
<ul> <li>Set/Get Pointer</li> </ul>	–50hex 'P'
Sync File	–53hex 'S'
Test Error-EOF	–51hex 'Q'
Close File	–43hex 'C'
Truncate File	–56hex 'V'
Erase Dir/File	–45hex 'E'
Dir/File Rename/move	–4Dhex 'M'
• Set/Get Time and Date Dir/File	–54hex 'T'
Get Dir/File Info	–49hex 'l'
<ul> <li>Get Free and Total Space</li> </ul>	–46hex 'F'
·	

#### **RTC Real Time Clock Commands:**

- RTC Setup 53hex 'S'
- RTC Set/Get Time and Date 50hex 'P'

- 57hex 'W'

- 45hex 'E'

– 43hex 'C'

#### **EEPROM-FLASH Commands:**

- Read from EEPROM Buffer 52hex 'R'
- Write to EEPROM Buffer
- Fill Buffer with EEPROM Page# 46hex 'F'
- Save Buffer to EEPROM Page# 53hex 'S'
- Erase EEPROM Page#
- Compare Buffer to EEPROM Page#
- Init/Clear EEPROM Buffer 49hex 'l'

#### **Objects Commands:**

- Object Button 42hex 'B'
- Object Checkbox 43hex 'C'
- Object Switch 54hex 'T'
- Object Progress Bar 50hex 'P'
- Object Scroll Bar 53hex 'S'
- Object Slider 4Chex 'L'
- Object Window 57hex 'W'

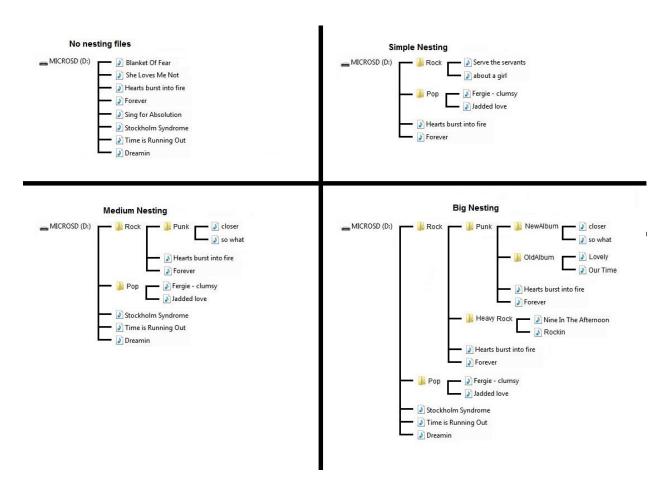
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## 3 Micro SD File/Folder organization

The Smart GPU 2 is capable of managing nested folders, so a complete files and folder organization could be achieved inside the micro SD card. Also the Smart GPU 2 could directly access nested folders for example: "0:/rock/punk/oldies/song.wav".

The next image gives some examples of files/folders organization/nesting that can be achieved and accessed with the Smart GPU 2 processor:



For a detailed information about how to access nest folders please refer to the "SmartGPU2LCD320x240 - Command Set.pdf" file.

## 4 Micro SD card file management

The Smart GPU 2 is capable of managing files directly in FAT/FAT12/FAT16 or FAT32 file systems without any special program/interface or micro SD rare formats.

A maximum of 32GBs micro SD memory card is supported, allowing storing thousands of full screen images, videos, audio files/songs, and thousands of text files.

The files are fully compatible format with any PC. This section explains how to load and create images (.bmp/.jpg), audio files (.wav) and text (.txt) files to be read with the Smart GPU 2 processor.

Note that FAT file system could be faster than FAT32 on some micro SD cards.

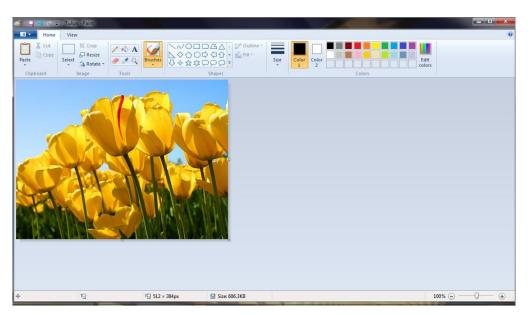
#### 4.1 Storing Images on the micro SD card

Any image could be prepared to be stored and loaded by the Smart GPU 2, the only requirement is the .bmp extension and desired size.

Any image processing software could convert or "Save As" images as .bmp or .jpg. To keep it simple, in this section the universal and easiest to use: Microsoft Paint software is used.

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Home Home	View								0
Paste Clipboard	Select ↓ Crop ↓ Resize ↓ Rotate ↓ Image	Tools	0-0-0-0-0	C C C C C C C C C C C C C C C C C C C	Size	Color 1 2	Colors	t rs	
						0			
		0							
÷	1 <u>C</u>	†⊒ 679 :	× 491px					100% 😑	

#### 1.- Open the Paint software.

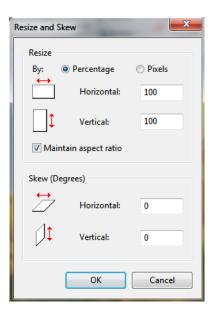


2.- Go to File->Open, and select the desired image, or draw your own creation.

3.-Press on the resize button on the main bar

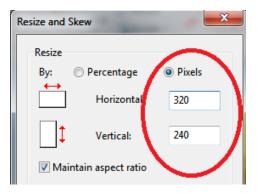


3.1- A new window will pop-up:



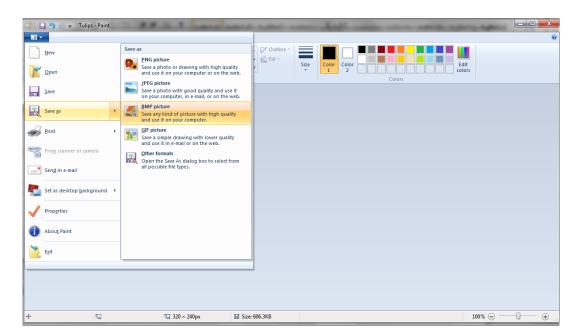
3.2- We only care on the resize section of this new window, now select PIXELS, and then write the size of the image, in this case we create a full screen image (landscape) on the SMART GPU 2, that is 480x320

**pixels.** (Any size under 480x320 could also be chosen if we desire a non-full screen image. In portrait mode we chose 320x480 for a full screen image).



#### 3.3- Press OK button and the image it's now resized.

Clipboard	Crop	Tools	つ つ つ つ つ つ つ つ つ つ つ つ つ	Size	Colors	it ors
+	1 <u>0</u>	1 <u>교</u> 320 × 240px	믒 Size: 606.3KB			100% @



4.- Now go again to File->Save As->BMP or JPG picture, and click.

5.- A new window pop-up, select any path of the micro SD, give it a name to the image in the File Name field, and click SAVE. (Remember that the file name must be up to 250 CHARACTERS, special characters may not work, it's recommended to use only alphanumeric characters).

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Home View				0
Paste V Resize Select V Resize Save As	Computer + SDCARD (D:)	✓ 4y Search SDCARD (D)		
	New folder			
Music Pictures Videos Computer Local Disk SDCARD (C Network ECL-VAID TORO-PC	<ul> <li>Name</li> <li>Date modified</li> <li>No items match your sea</li> <li>(Ci)</li> </ul>	Type Siz		
File nan	re: Tulips		-	
Save as typ	pe: 24-bit Bitmap (*.bmp;*.dib)		-	
Hide Folders		Save	Cancel	
+ 1⊡ 1⊡ 320 × 240	ox 🖼 Size: 606.3KB		100% 😑 👘	• •

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6.- Finally check the contents on the microSD card. Safely remove the micro SD card, then insert it on the SMART GPU and call the image!

Computer > SDCARD (D:)		- 45 Search SDCARD (D-)
Organize 👻 🔄 Preview 👻 Print Burn New fol	ler	
	maximage	
Tulips Date modified 5/12/2011 1:17 AM	Size: 225 KB	
Bitmap image Oimensions: 320 x 240	Date created: 8/26/2011 4:39 PM	
🚳 📺 🕢 🔽		EN 🔺 📴nl 🔹 4:39 PM 8/26/2011

7.- Follow always the same procedure to load images onto the microSD card!

#### 4.2 Storing Songs/Audio files on the micro SD card

Any Song/Audio file could be stored and played by the Smart GPU 2 processor, the only requirement is the .wav extension and WAVE format.

From a music CD, just extract the files/songs in .wav format and place them into the microSD card to be played (see **SmartGPU2-Audio Player-CD Tutorial.pdf**).

For PC stored files with any other extension than .wav, use any Audio processing software to convert .mp3, .wma, .atrac, .mp4, etc. to **.wav** supported format. To keep it simple, in this section it's explained how to convert any file to .wav using the popular apple's iTunes software.

#### 1.- Open the iTunes software.

e Edit View Controls St					4						Q- Search Music
	φ								Ē		Ce Search Music
BRARY	Album by Artist			✓ Name	Time	Artist 🔺	Genre	Rating	Plays		Barra lateral de iTunes
Music		Jai Ho! (You Are My	1	✓ Jai Ho!	3:42	A.R. Rahman & The P	Рор			A	
Movies		Almost Here	10	✓ Almost Here	3:07	The Academy Is	Alternative		1		
TV Shows		The Academy Is	10	✓ Almost Here	3:07	The Academy Is	Alternative		1		
Podcasts 10		Fast Times At Barrin	1	✓ About A Girl	3:38	The Academy Is	Rock		1		
🛣 Radio		Silent Hill 3 ~ Limite	1	✓ You're Not Here	3:46	Akira Yamaoka	Game Music				
ORE		Silent Hill 4	21	✓ Room of Angel	7:11	Akira Yamaoka	Other				
📋 iTunes Store		``°´´fineZtblackvibeZ	2	✓ Over The Edge	4:21	Akon	Soul and R				
Q Ping		Freedom	1	✓ Beautiful	3:58	Akon	Other				
IARED		Konvicted	12	✓ Don't Matter	4:52	Akon	Soul And R				Dind
Home Sharing		Unknown Album	1	✓ I Wanna love You Clean	4:18	Akon feat Snoop					
		Unknown Album		✓ Hey Guera	3:47	Alejandra Guzman					
NIUS		A Corazon Abierto		✓ Que Voy A Hacer Con Mi Amor	4:09	Alejandro Fernandez	Latin				
🍀 Genius		Aleks Syntek	1	✓ Intocable	3:38	Aleks Syntek	Unclassifiable				Una red social dedicad
AYLISTS		Leccion De Vuelo	5	✓ Hasta el fin del mundo	3:58	Aleks Syntek	Latin				a la música.
📎 iTunes DJ		Hot Party Winter 20	1	✓ Destination Calabria	3:02	Alex Gaudino	<unknown></unknown>				Únete a la
🕸 90's Music		Hot Party Winter 20	8	✓ I Love Rock n' Roll	3:25	Alex Gaudino & Jaso	Dance				conversación.
🔅 Classical Music		Guitar Hero III		✓ Schools Out For Summer	3:35	Alice Cooper	Other				
🕸 Music Videos		Facelift	11	✓ Man In The Box (1990)	4:47	Alice In Chains	Rock				Sigue a tus artistas favoritos amigos y descubre la músic
🕸 My Top Rated		Alice in Chains	11	✓ Man In The Box (1990)	4:47	Alice In Chains	Rock				de la que están hablando,
Recently Added		Unknown Album		✓ No One (2007)	4:10	Alicia Keys					escuchando y descargando Encuentra la actividad recien
Recently Played		J'en ai marre	1	✓ J'en ai marre	4:17	Alizee	Inconnu				de artistas en tu biblioteca y
🕸 Top 25 Most Played		Psychedelices	1	✓ Mademoiselle Juliette	3:21	Alizee	Pop				quien sea que sigues en la
		Alizée	2	✓ Fifty Sixty	3:44	Alizée	Other				barra lateral de iTunes.
		The All-American Re	4	✓ Time Stands Still	3:30	The All-American Rej	Alternative				
		The All-American Reje	11	✓ The Last Song	5:00	The All-American Rej	Alternative				
		When the World Co	4	✓ Gives You Hell	3:32	The All-American Rej	Rock				Más
		The All-American Reje	32	✓ Time Stands Still	3:30	The All-American Rej	Рор				
		Unknown Album		✓ Swing Swing	3:50	The All-American Rej					Ocultar barra lateral 🕨
		Memorama	2	✓ Memorama	3:07	Allison	Other				
		Allison	2	✓ Memorama	3:07	Allison	Other				
		Girados Disc 2	7	✓ Hijo de la Luna	4:27	Amante Bandido	Latin				
		Freaky Friday Sound	11	✓ She Is Beautiful	3:36	American Pie Band c	AlternRock				
		Angels & Airwaves	1	✓ The Adventure Final	5:41	Angels & Airwaves	Rock				
		Sexy Lounge	18	✓ Bells Of Babylon	5:53	Anthony Grant	Downtemp				
			8	✓ Basement Ghost Singing	4:38	Armor for sleep	Other				

File Ed	lit View Controls	Store Advanced	d Help		
	Undo	Ctrl+Z			
	Redo	Ctrl+Shift+Z			
LIBR	Cut	Ctrl+X	ist		✓ Name
5	Сору	Ctrl+C	Jai Ho! (You Are My	1	✓ Jai Ho!
	Paste	Ctrl+V	Almost Here	10	✓ Almost Her
		Cui+v	The Academy Is	10	✓ Almost Her
P	Delete		Fast Times At Barrin	1	✓ About A G
<sup>(D</sup> A <sup>()</sup>	Select All	Ctrl+A	Silent Hill 3 ~ Limite	1	✓ You're Not
STOR	Select None	Ctrl+Shift+A	Silent Hill 4	21	✓ Room of A
Ê	Preferences	Ctrl+,	```´fineZtblackvibeZ	2	✓ Over The E
çQ Pir	ng		Freedom	1	✓ Beautiful
SHARED			Konvicted	12	✓ Don't Matt
	ome Sharing		Unknown Album	1	✓ I Wanna Io
ar nu	and sharing		Unknown Album		✓ Hey Guera
GENIUS			A Corazon Abierto		✓ Que Voy A

#### 2.- Go to Edit->Preferences, and click.

3.-A new Window pops up, then click on the "Import Settings..." box:

General Preferences	-	-	×
General Playback	Sharing Store	Parental Devices	Advanced
Library Name: User(s Sources: V Mo V TV	vies 🔲 F	lingtones Iadio	
<ul> <li>✓ Poc</li> <li>□ iTui</li> <li>□ Boc</li> <li>□ App</li> </ul>	nes U 📝 i 1 oks 📝 G	ing Funes DJ ienius hared Libraries	
Source Text: Small List Text: Small Grid View: Light		how source icons how list checkboxes	
	Ask to Import CD omatically retrieve CD to omatically download m	rack names from Inter	Settings
Che Language: Englis	ck for new software up h (United States)	odates automatically	
?		ОК	Cancel

3.1- A new window pops-up, now select "WAV Encoder" and change setting "Automatic" to "Custom", then click OK:

Import Settings	3
Import Using: WAV Encoder	
Setting Automatic	
Details	
All automatic.	
Use error correction when reading Audio CDs	
Use this option if you experience problems with the audio quality from Audio CDs. This may reduce the speed of importing.	
Note: These settings do not apply to songs downloaded from the iTunes Store.	
? OK Cancel	

#### -Select the desired Sample Rate, 8/16 bit Sample Size and MONO or

**STEREO Audio and click OK.** *The best audio quality is achieved with the 44.100Khz, 16bit, Stereo parameter).* 

Import Settings	23
Import Using: WAV Encoder WAV Encoder Σ	3
Sample Rate: 44.100 kHz Sample Size: 16-bit Channels: Stereo Use Default Settings OK Cancel	
importing. Note: These settings do not apply to songs downloaded from the iTunes Store. OK Cance	

3.2- Now select the "Advanced" tab to visualize the path where converted files/songs will be stored, finally click OK to close the window:

Advanced Preferences
General Playback Sharing Store Parental Devices Advanced
Tunes Media folder location C:\Users\Music\Tunes\Tunes Media Reset
<ul> <li>Keep iTunes Media folder organized</li> <li>Places files into album and artist folders, and names the files based on the disc number, track number, and the song title.</li> <li>Copy files to iTunes Media folder when adding to library</li> </ul>
Reset all dialog warnings: Reset warnings
Reset iTunes Store cache: Reset cache
Warn me if iTunes is not the default player for audio files
Keep Mini Player on top of all other windows           Keep movie window on top of all other windows
Show iTunes icon in system tray
Minimize iTunes window to system tray
Tenable full keyboard navigation
? OK Cancel

4.- Once again in the main window, select the desired songs to be converted:

	+			<b>á</b>			= = = = ==	Q- Search Music
000			✓ Name		6	Dellar		
IBRARY	Album by Artist Baila Morena (EP)	1	✓ Name ✓ Baila Morena	Time Artist 4:10 Maná/Zucchero	Genre Latin	Rating	Plays	Barra lateral de iTunes
Music	What To Do When Y		Basement Ghost Singing	4:38 Armor for sleep	Other			
Movies TV Shows	Battlefield (Deluxe E	0	Battlefield	4:04 Jordin Sparks	otilei			
Podcasts (1)	Unknown Album		✓ Baya Baya	5:27 Safri Duo				
Radio					Indie			
	No More Stories Are	3	✓ Beach ✓ Beautiful	2:46 Mew	Other			
FORE	Freedom	1		3:58 Akon				
📋 iTunes Store	Human Clay [Austra			4:20 Creed	Pop			-
çQ Ping	The Best of 1990-20	3	✓ Beautiful Day	4:04 U2	Alternative			
ARED	The Beautiful Letdo	7	✓ The Beautiful Letdown	5:21 Switchfoot	Рор			Pind
Home Sharing	A Little More Person	12	<ul> <li>A Beautiful Life (La Bella Vita)</li> </ul>	3:26 Lindsay Lohan	Рор			
ENIUS	Dancing Shoes	5	Because I Love You	3:17 September	Dance			
& Genius	The Long Road	6	✓ Because of You	3:30 Nickelback	Metal			
	Becoming Insane EP	1	<ul> <li>Becoming Insane (Radio Mix)</li> </ul>	3:12 Infected Mushroom	Psychedelic			Una red social dedicad
AYLISTS	The Pick Of Destiny	13	Beezleboss (The Final Showdown)	5:36 Tenacious D				a la música.
🔮 iTunes DJ	Minutes To Midnight	2	Behind Your Lies (Minutes To Midni	3:21 Linkin Park	Metal			Únete a la
章 90's Music	Unknown Album		Belanova-Moemia- Me equivoqué	3:35 Moenia & Belanova	Other			conversación.
Classical Music	belanova - Toma mi		🖌 belanova - Toma mi mano	2:33				Sigue a tus artistas favoritos
Music Videos	Twilight		✓ Bella's Lullaby	2:43 Carter Burwell	Other			amigos y descubre la músic
My Top Rated	Utopía	4	✓ Bella Traición	3:43 Belinda	Other			de la que están hablando,
Recently Added	Sexy Lounge	18	<ul> <li>Bells Of Babylon</li> </ul>	5:53 Anthony Grant	Downtemp			escuchando y descargando Encuentra la actividad recien
Recently Played	The Bends	2	🗹 The Bends 📀	4:06 Radiohead	Rock			de artistas en tu biblioteca y
Top 25 Most Played	06-2005 Mainstrea	2	✓ Best Of You	4:14 Foo Fighters	Miscellaneo			quien sea que sigues en la barra lateral de iTunes.
	Infest	5	Between Angels and Insects	3:58 Papa Roach	Rock			Darra lateral de ri unes.
	Beyonce ft Jay-Z - C		Beyonce ft Jay-Z - Crazy In Love	4:08				
	1996	3	Bibo No Aozora - Babel Soundt	6:37 03	Other			Más
	Untitled	3	✓ Bitch We Got a Problem	3:23 Korn	Metal			Wids
	Unknown Album		✓ Bittersweet Symphony	5:58 Radiohead	Other			
	Urban Hymns	23	✓ Bittersweet Symphony (1997)	5:59 The Verve	Rock			Ocultar barra lateral 🕨
	Bjork & Thom Yorke		✓ Bjork & Thom Yorke - Chopin - Fun	9:13				
	Bjork & Thom Yorke		✓ Bjork & Thom Yorke - Chopin - Fun	9:13				
	Ten	5	✓ Black	5:44 Pearl Jam	Rock			
	Black Eved Peas feat		Black Eved Peas feat Jack Jonhson	3:14				
	A Little More Person	2	Black Hole	4:02 Lindsay Lohan	Рор			
	Superunknown	13	✓ Black Hole Sun (1994)	5:20 Soundgarden	Rock			
	Superunknown	13	Black Magic Magaz	5:20 Soundgarden	Classic Deck		, in the second s	

## 4.1- Once the desired songs are selected, perform right click on the mouse and a new menu will pop-up, click on "create WAV version":

Dancing Shoes	5	V	Because I	Love You	3:17	September	Dance
The Long Road	6	$\checkmark$	Because o	f You	3:30	Nickelback	Metal
Becoming Insane EP	1	V	Becoming	Insane (Radio Mix)	3:12	Infected Mushroom	Psychedelic
The Pick Of Destiny	13	$\checkmark$	Beezlebos	s (The Final Showdown)	5:36	Tenacious D	
Minutes To Midnight	2	V	Behind Yo	ur Lies (Minutes To Midni	3:21	Linkin Park	Metal
Unknown Album		V	Belanova-	Moemia- Me equivoqué	3:35	Moenia & Belanova	Other
belanova - Toma mi		V	belanova	- Toma mi mano	2:33		
Twilight		V	Bella's Lul	laby	2:43	Carter Burwell	Other
Utopía	4	$\overline{\mathbf{V}}$	Bella Traic	ión 🕤	3.43	Belinda	Other
Sexy Lounge	18	V	Bells	Get Info		Anthony Grant	Downtemp
The Bends	2	$\overline{\mathbf{v}}$	The E	Rating	- <b>F</b>	Radiohead	Rock
06-2005 Mainstrea	2	V	Best	Get Album Artwork Clear Downloaded Artwork		Foo Fighters	Miscellaneo
Infest	5	V	Betw			Papa Roach	Rock
Beyonce ft Jay-Z - C		V	Beyo	Get Track Names	o		
1996	3	V	Bibo	Convert ID3 Tags		03	Other
Untitled	з	$\checkmark$	Bitch	Reset Plays		Korn	Metal
Unknown Album		V	Bitter	Create WAV Version	-	Radiohead	Other
Urban Hymns	23	$\checkmark$	Bitter	Consolidate Files	2	The Verve	Rock
Bjork & Thom Yorke		V	Bjork	Consolidate Files			
Bjork & Thom Yorke		$\checkmark$	Bjork	Сору			
Ten	5	$\checkmark$	Black	Delete		Pearl Jam	Rock
Black Eyed Peas feat		$\checkmark$	Black	Uncheck Selection			
A Little More Person	2	V	Black	Analy Cast Field		Lindsay Lohan	Pop
			Black	Apply Sort Field		Soundgarden	Rock

5.- Wait for the files to be converted, then search for them in the iTunes Media Folder previously visualized with the Advanced Preferences Tab. User could copy all

the files with the folders directly to the microSD card to be sorted by artist/album/year, etc.

Cor Libraries	Music → iTunes → iTunes Med	ia ▶ Music ▶	✓ 4 Sear	ch Music 🔎
Organize 🔻 🚺 Play	Play selection Share with 🔻	Burn New folder		iii 🗸 🗍 🔞
▲ ★ Favorites 월 Recent Places	Music library			Arrange by: Folder 🔻
💻 Desktop 👔 Downloads	Name	Contributing artists Album	# Title	
4 词 Libraries	鷆 Radiohead			
Documents				
Music				
Pictures				
Videos				
4 🜉 Computer				
Disk (C:)				
E MICROSD (D:)				
Network				
*				
27 items select Show more deta				

Datasheet

6.- Finally, copy the files to microSD card and check the contents. Safely remove the micro SD card, then insert it on the SmartGPU 2 and play the files!



7.- Steps 1-4 must be done only for the first time to setup WAV conversion, once iTunes is configured, user could repeat process from step 4. Follow always the same procedure to load song/audio files onto the microSD card!

Datasheet

#### 4.3 Storing text files on the micro SD card

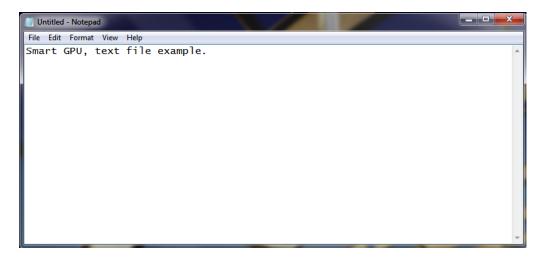
Any text could be prepared to be stored and loaded by the SmartGPU 2, the only requirement is the .txt extension and desired size.

Any text processing software could convert or "Save As" text as .txt. To keep it simple, in this section the universal and easiest to use: Microsoft Notepad software is used.

#### 1.- Open the Note Pad software.

ĺ	🧾 U	ntitled	- Notepa	đ					×
I	File	Edit	Format	View	Help				
									*
1	1								

2.- Go to File->Open, and select the desired text file, or write your own text.



#### 3.- Go to File->Save As, and click on.

<u> </u>	ntitled - Notepa	d		_ <b>D</b> X
File	Edit Format	View Help	)	
	New	Ctrl+N	e example.	*
	Open	Ctrl+O		
	Save	Ctrl+S		
	Save As			
	Page Setup			
	tritled - Notepa Edit Format New Open Save Save As Page Setup Print Exit	Ctrl+P		
	Exit			
				-

4.- A new window pop-up, select any path of the microSD card, give it a name to the text file, be sure that the ".txt" extension is selected and click SAVE. (Remember that the file name must be up to 250 CHARACTERS, special characters may not work, it's recommended to use only alphanumeric characters).

Untitled - Notepad				
File Edit Format V	iew Help			
Save As			×	^ ^
	omputer 🕨 SDCARD (D:)	✓ 49 Sea	rch SDCARD (D:)	
Organize 👻 Ne	w folder		:= • 🔞	
<ul> <li>Documents</li> <li>Music</li> <li>Pictures</li> <li>Videos</li> </ul>	^ Name	Date modified Type	Size	
P Computer Local Disk (C:) SDCARD (D:) Network				
	Text1.txt Text Documents (*.txt)		•	
A Hide Folders		Encoding: ANSI	Save Cancel	-

Datasheet

5.- Finally check the contents in the microSD card. Safely remove the micro SD card, then insert it on the SMART GPU 2 and call the text file!

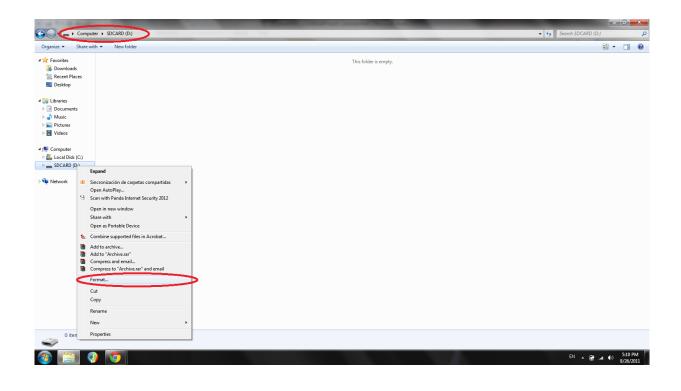
🕞 🕞 🗢 🚘 🕨 Computer 🔸 SDCARD (D:)		<ul> <li>✓ 47</li> <li>Search SDCARD (D:)</li> </ul>
Organize 🕶 🎒 Open 👻 Print Burn New fo	der	L • 1 0
Favorites     Destropter     Protures     Protures	Text Text Exc: 29 bytes Date modified 8/25/2011 4-49 PM	
Text1 Date modified: 8/26/2011 4:49 PM Text Document Size: 29 bytes	Date created: 8/26/2011 4:48 PM	
		EN ▲ ☞ 내네 (*) 4-49 PM 8/26/2011

6.- Follow always the same procedure to load text files onto the microSD card!

#### 4.4 Formatting the micro SD card for first use

It is recommended but not necessarily to format the micro SD card for first use, in this section a format to new micro SD card to FAT format is explained.

1.- Open a new explorer window, right click on the microSD card and a menu appears, select "FORMAT..." and click. (Note that formatting a micro SD card will erase all the contents of it).

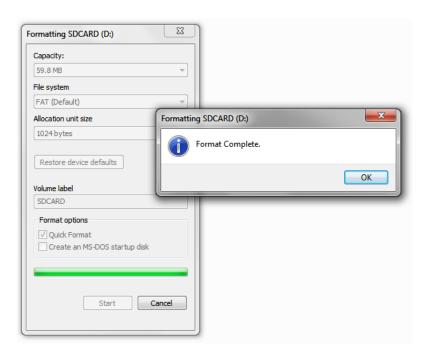


2.- A new window will pop-up, choose FAT(default) or FAT32 on the File System menu, and click start.

Format SDCARD (D:)
Capacity:
59.8 MB 🗸
File system
FAT (Default)
Allocation unit size
1024 bytes 🔹
Restore device defaults
SDCARD
Format options
✓ Quick Format
Create an MS-DOS startup disk
Start Close

3.- Click OK on the new window and wait to the PC to perform the format.

Format SDCARD (D:)	23	
Capacity:		
59.8 MB	-	
File system		
FAT (Default)	-	
Allocation unit size	Format SD	CARD (D:)
1024 bytes		WARNING: Formatting will erase ALL data on this disk.
Restore device defaults		To format the disk, click OK. To quit, click CANCEL.
SDCARD		
Format options		
Quick Format Create an MS-DOS startup disk		
Start	lose	



#### 4.- Now the microSD card is ready to load images, songs and text!

## 5 Development software tools

In order to make even easier the learning about how to communicate with the Smart GPU 2 processor, FREE software could be downloaded and used in any PC.

This software simulates most of the functions of the Smart GPU 2 chip by connecting it to the PC through the USB-UART SX Bridge, this connection enables real live graphics processing.

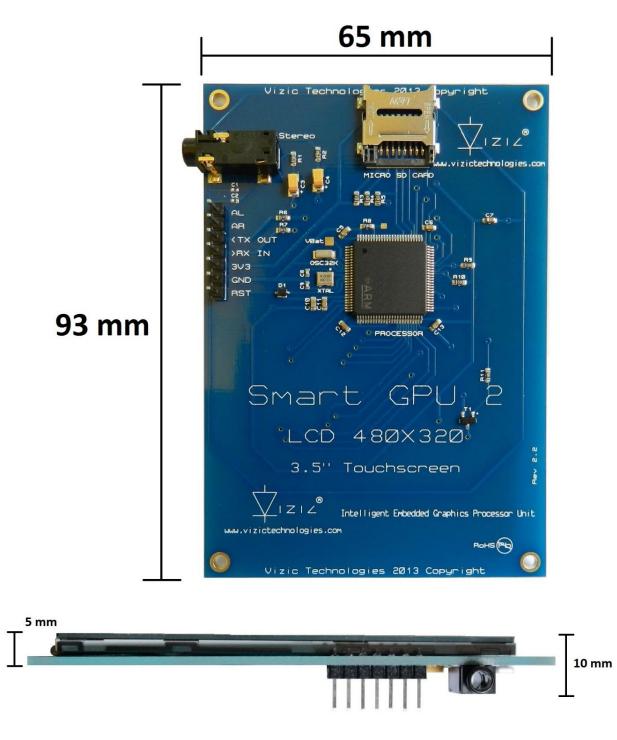
This software greatly reduces the time of learning the commands, and helps the user to understand how commands are created as it shows the sent and received commands by the PC<->Smart GPU 2 processor.

Smart GPU-LCD320X240-Touch-FAT-HXVIZIC TECHNOLOGIES© 2	011		×
Display Simulation	Geometry Text SD Card Extra Tou	Baud Rate 9600 Set Selected Baud ch Calibration	Open/Close COM Open Com Select S
Commands TX/RX	Put Pixel X 120 Y 120	Draw Line           X 0 Y 0 Colour           X 2 0 239 Y2 0 239	Draw Rectangle           × 550         Y 550         Colour           ×2 5150         Y2 5150         Colour
	Draw Circle X 120 Y 120 Colour Radius 80	Draw Iriangle           × ⊕ 50         Y ⊕ 60         Colour           ×2 ⊕ 100         Y2 ⊕ 200         Image: Colour	Colour
• Clear Commands Save To File		X3 (230) Y3 (120)	Fill/No Fill Geometry

For detailed information about this software please download it from the website in the smartGPU2 LCD480x320 page.

For detailed information about the USB-UART SX Bridge, please visit our web site.

## 6 Mechanical dimensions



## 7 Specifications and ratings

Item	Contents	Unit/Note
LCDtype	TFT/Transmissive/Normal white	/
Size	3.5	Inch
Viewing direction	12:00	O'Clock
Module area $(W \times H \times T)$	54.66×82.90x3.25	mm <sup>3</sup>
Active area (W×H)	48.96×73.44	mm <sup>2</sup>
Number of Dots	320(RGB)×480	/
Pixel arrangement	RGB vertical stripe	/
Colors	65K/262K	/
Backlight Type	6LED	/
With/Without TSP	With T/P	/

Parameter	Symbol	Min	Max	Unit
Power supply voltage	VCC	3.0	3.5	V
Logic input signal voltage	VIN	-0.5	VCC+0.3	V
forward current	I	300	-	mA
Operatingtemperature	Тор	-20	70	°C
Storagetemperature	TST	-30	80	°C
Humidity	RH	-	90%(Max60 °C)	RH

#### **CHIP** processor:

## Absolute maximum ratings

Stresses above the absolute maximum ratings listed in *Table 7: Voltage characteristics*, *Table 8: Current characteristics*, may cause permanent damage to the device. These are stress ratings only and functional operation of the device at these conditions is not implied. Exposure to maximum rating conditions for extended

periods may affect device reliability.

Table 7. Voltage characteristics

Symbol	Ratings	Min	Max	Unit
V <sub>DD</sub> -V <sub>SS</sub>	External main supply voltage	-0.3	3.4	
V <sub>IN</sub> <sup>(2)</sup>	Input voltage on five volt tolerant pin	V <sub>SS</sub> – 0.3	V <sub>DD</sub> + 4.0	V
VIN' /	Input voltage on any other pin	V <sub>SS</sub> – 0.3	3.4	

2. V<sub>IN</sub> maximum must always be respected. Refer to *Table 8: Current characteristics* for the maximum allowed injected current values.

Symbol	Ratings	Max.	Unit
	Output current sunk by any I/O and control pin	25	
	Output current source by any I/Os and control pin	- 25	mA
I <sub>INJ(PIN)</sub> <sup>(2)</sup>	Injected current on five volt tolerant pins <sup>(3)</sup>	-5/+0	
	Injected current on any other pin <sup>(4)</sup>	± 5	

#### Table 8. Current characteristics

- 2. Negative injection disturbs the analog performance of the device.
- Positive injection is not possible on these I/Os. A negative injection is induced by V<sub>IN</sub><V<sub>SS</sub>. I<sub>INJ(PIN)</sub> must never be exceeded. Refer to *Table 7: Voltage characteristics* for the maximum allowed input voltage values.
- A positive injection is induced by V<sub>IN</sub>>V<sub>DD</sub> while a negative injection is induced by V<sub>IN</sub><V<sub>SS</sub>. I<sub>INJ(PIN)</sub> must never be exceeded. Refer to *Table 7: Voltage characteristics* for the maximum allowed input voltage values.

Item	Symbol	Condition	Min	Тур	Max	Unit	Remark
<b>Response time</b>	Tr +Tf		-	50	70	ms	Fig.1
Contrastratio	Cr	$\theta = 0^{\circ}$	150	250	-	—	<b>FIG 2.</b>
Luminance uniformity	<b>δ WHITE</b>	Ø=0° Ta=25℃	80	85	-	%	<b>FIG 2.</b>
Surface Luminance	Lv	1 a-25 C	-	160	-	cd/m <sup>2</sup>	<b>FIG 2.</b>
		$\emptyset = 90^{\circ}$	40	60	-	deg	<b>FIG 3.</b>
Viewing angle range	θ	$\emptyset = 270^{\circ}$	60	70	-	deg	FIG 3.
viewing angle l'ange	0		60	70	-	deg	FIG 3.
			60	70	-	deg	FIG 3.
	Red x	θ=0° Ø=0°	-	0.633	-		
	Red y		-	0.329	-		
	Green x		-	0.297	-		
CIE (x, y) chromaticity	Green y		-	0.577	-		<b>FIG 2.</b>
	Blue x		-	0.133	-		FIG 2.
	Blue y	Ta=25℃	-	0.129	-		
	White x		-	0.294	-		
	White y		-	0.334	-		
NTSC Ratio	S		-	50	-	%	

#### **ELECTRO-OPTICAL CHARACTERISTICS**

#### PRECAUTION RELATING PRODUCT HANDLING SAFETY

If the LCD panel breaks , be careful not to get the liquid crystal to touch your skin. If the liquid crystal touches your skin or clothes , please wash it off immediately by using soap and water.

#### HANDLING

Avoid any strong mechanical shock which can break the glass.

Avoid static electricity which can damage the CMOS LSI—When working with the module , be sure to ground your body and any electrical equipment you may be using. Do not remove the panel or frame from the module.

The polarizing plate of the display is very fragile. So , please handle it very carefully, do not touch , push or rub the exposed polarizing with anything harder than an HB pencil lead (glass , tweezers , etc.)

Do not wipe the polarizing plate with a dry cloth , as it may easily scratch the surface of plate.

Do not touch the display area with bare hands , this will stain the display area. Do not use ketonics solvent & aromatic solvent. Use with a soft cloth soaked with a cleaning naphtha solvent.

To control temperature and time of soldering is  $320 \pm 10^{\circ}$ C and 3-5 sec.

To avoid liquid (include organic solvent) stained on LCM

#### STORAGE

Store the panel or module in a dark place where the temperature is  $25^{\circ}C \pm 5^{\circ}C$  and the humidity is below 65% RH.

Do not place the module near organics solvents or corrosive gases. Do not crush , shake , or jolt the module. VIZIC TECHNOLOGIES COPYRIGHT 2016.

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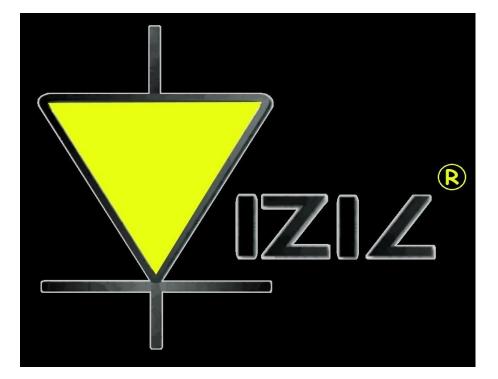
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