VIZIC TECHNOLOGIES

MINI SMART GPU

Datasheet----Rev 1.0

MINI SMART GPU – Intelligent Embedded Graphics Processor Unit

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VIZIC
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TX OUT
RX IN
3V3
GND
RST
MICRO SD CARD
PROCESSOR
Mini Smart GPU
LCD 160X128
Intelligent Embedded Graphics Processor Unit
Rev 1.0
Vizic Technologies 2012 Copyright

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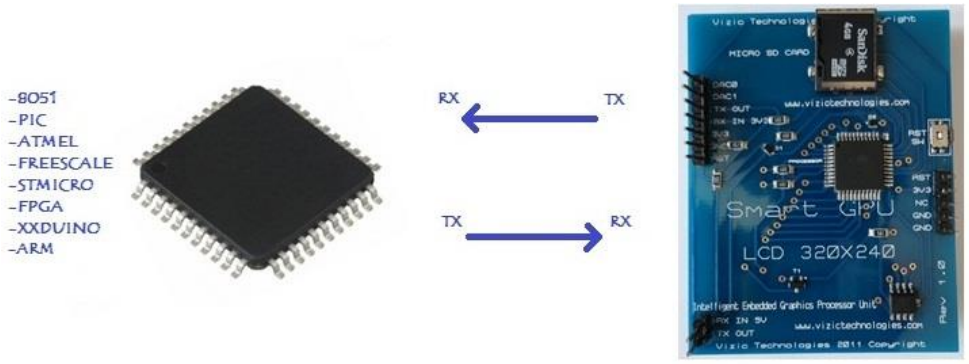
Introduction:

The MINI SMART GPU-Intelligent Graphics Processor Unit is a powerful easy to use embedded development/professional board with a full color LCD. It offers a simple yet effective serial interface to any host micro-controller that can communicate via a serial port. All screen/graphic related functions are sent using a simple protocol via the serial interface; it also features basic Data Logger functions. The MINI SMART GPU allows users to develop their application using their favorite micro-controller or FPGA and software development tools. In short it offers one of the most flexible embedded graphics solutions available

The MINI SMART GPU 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 on your favorite main processor (8051, PIC, ATMEL, FREESCALE, STMICRO, FPGA, XXDUINO, MBED, CORTEX, PC(serialport)) of your application.

The next image shows more clearly the roles played by the main processor of your application and the MINI SMARTGPU:



Main Processor:
-main application processing.
-math processing
-I/O processing

VS

SMART GPU Processor:
-Color processing
-Images processing
-SD memory card processing
-Geometry processing
-Text processing
-Touch processing
-Memory management
-And more...

Instead of loading all the Geometry, Images, SD memory access, etc. processing to your main processor, the MINI SMART GPU does all the job and stuff in parallel with your microcontroller or FPGA for you by simple orders or commands.

The main goal of the MINI SMART GPU it's to bring a very easy way to add colour, visual and touch human interfacing to any application or project, without the user having experience in handling LCDs and graphics algorithms. Although it's very easy to use, the SMART GPU it's a low power/very high performance graphics processor, with a microSD card slot supporting up to 32 GB of storage, and FAT/FAT12/FAT16 or FAT32 universal file System that is compatible with any PC, no special format is needed.

Features:

- 1.8“ LCD capable of displaying 262,144 colors.
- Easy 5 pin interface to any host device: **VCC, TX, RX, GND, RESET.**
- On-board uSD/uSDHC memory card adaptor compatible with FAT(windows PC), Support up to 32GB for storing images and text.
- Integrated File management/Data logger functions.
- PWM controlled display brightness.
- Sleep mode.
- Baud Rate speed up to 2000000 bps, 8 bits, no parity, 1 stop bit.
- 5V and 3V3 I/O compatible.
- 3V3 power supply.

MINI SMART GPU EXPLAINED

1.-Host Interface

The MINI SMART GPU is a slave peripheral device and it provides a bidirectional serial interface to a host controller via its UART(Universal Asynchronous Receiver - Transmitter).

Any microcontroller or processor (AVR, PIC, BASICstamp, XXDUINO, 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 2000000bps.

The MINI SMART GPU 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 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 MINI SMART GPU 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*. 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.

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

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

If the MINI SMART GPU 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 MINI SMART GPU is ready.

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

Remember:
The MINI SMART GPU 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 MINI SMART GPU retries to initialize a micro SD card, however if no micro SD card is detected after several tries, the MINI SMART GPU will send the ACK 'O' and the processor will function normally without the SD card functions.

1.3 Power-up and Reset

When the MINI SMART GPU 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 6 seconds, the MINI SMART GPU logo will automatically show up, host still can send the uppercase ascii character '**U**' (55hex) to initialize the MINI SMART GPU even if the logo has already appeared.

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

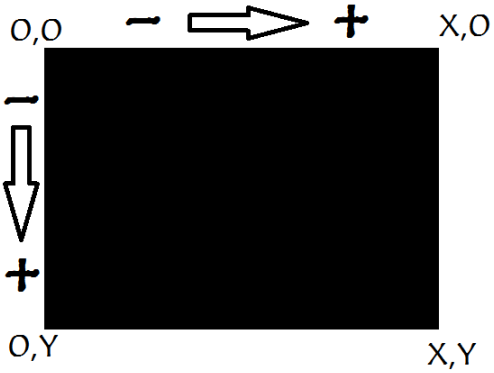
1.4 Splash Screen on Power Up

The MINI SMART GPU will wait up to 5 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 MINI SMART GPU before the welcome screen appears when it is undesired.

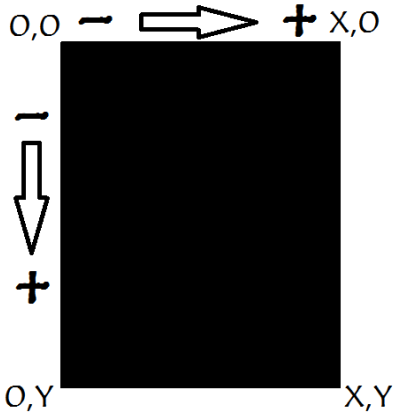
1.5 Understanding the Computer's graphic coordinate system

As well as a computer monitor's coordinate system, the MINI SMART GPU 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.

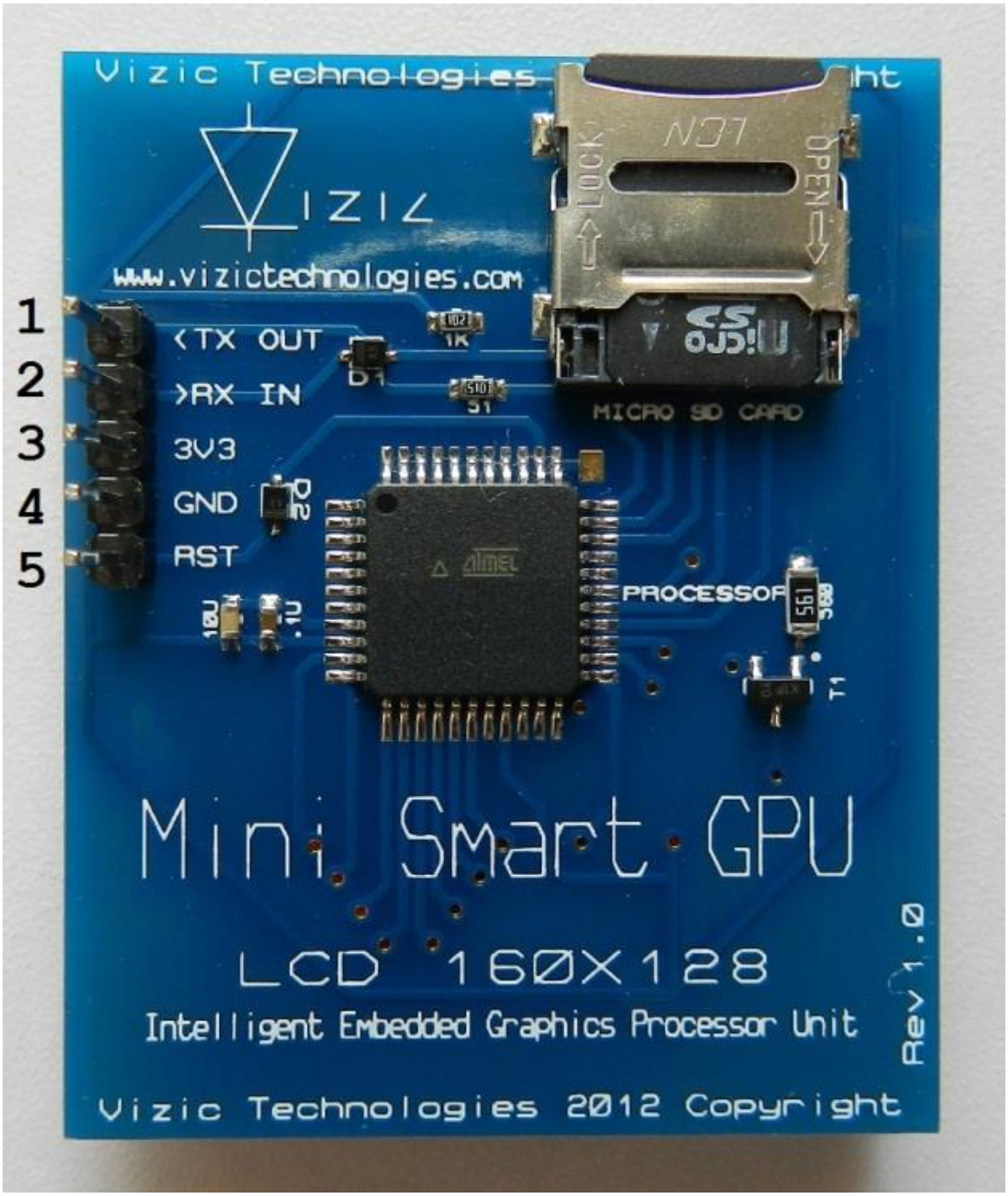


This image shows a LANDSCAPE orientation of the screen, the upper left corner is 0,0 (zero,zero). The maximum values of the MINI SMART GPU in LANDSCAPE mode are X:159,Y:127.



This image shows a PORTRAIT orientation of the screen, the upper left corner is 0,0 (zero,zero). The maximum values of the MINI SMART GPU in PORTRAIT mode are X:127,Y:159.

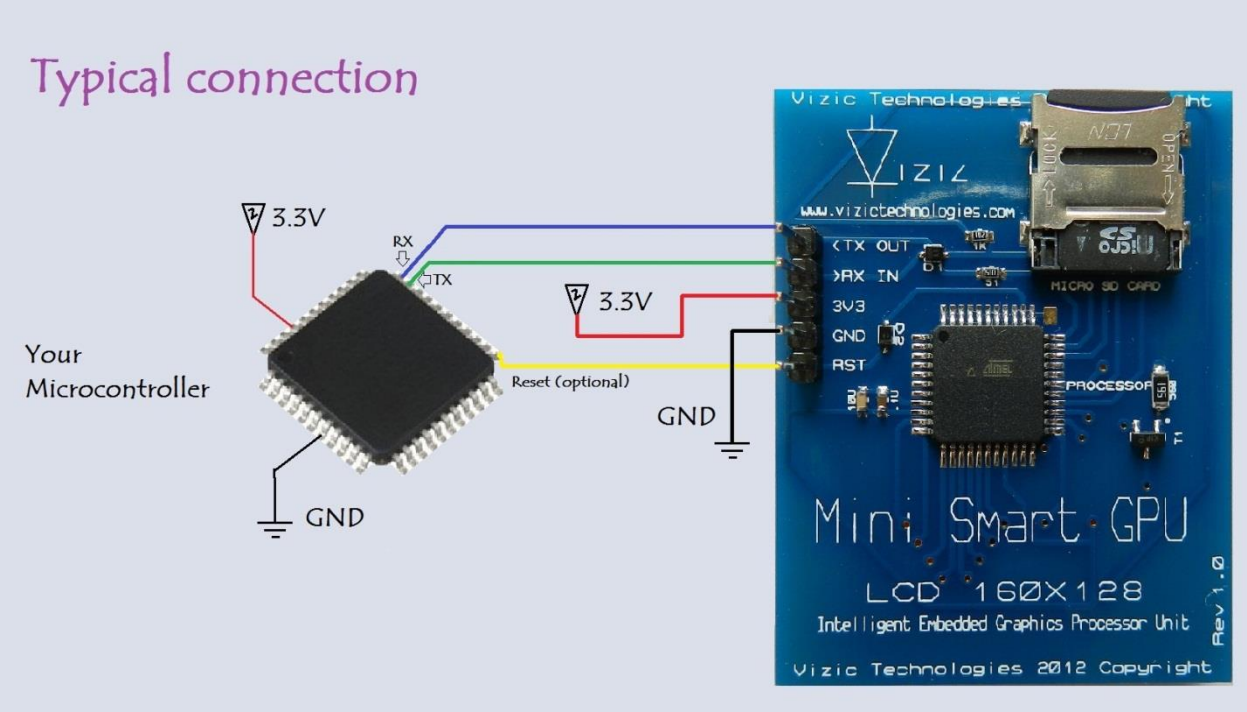
1.6 Pin configuration



Pin	Symbol	I/O	Description
1	**Transmitter Out 3.3V**	**Out**	Asynchronous serial transmit output pin, for 3.3V logic, 5V compatible.
2	**Receiver In 3.3V/5V**	**In**	Asynchronous serial receiver input pin for 3.3V logic, 5V-9V tolerant input.
3	**VCC 3.3V**	**In**	Main voltage supply, 2.8v-3.4v.
4	**Ground**	**In**	Supply Ground.
5	**Reset**	**In**	Master reset signal, Internally pulled up to 3.3V via a 20K resistor. An active low pulse greater than 100ns will reset the module. 5V-9V tolerant input.

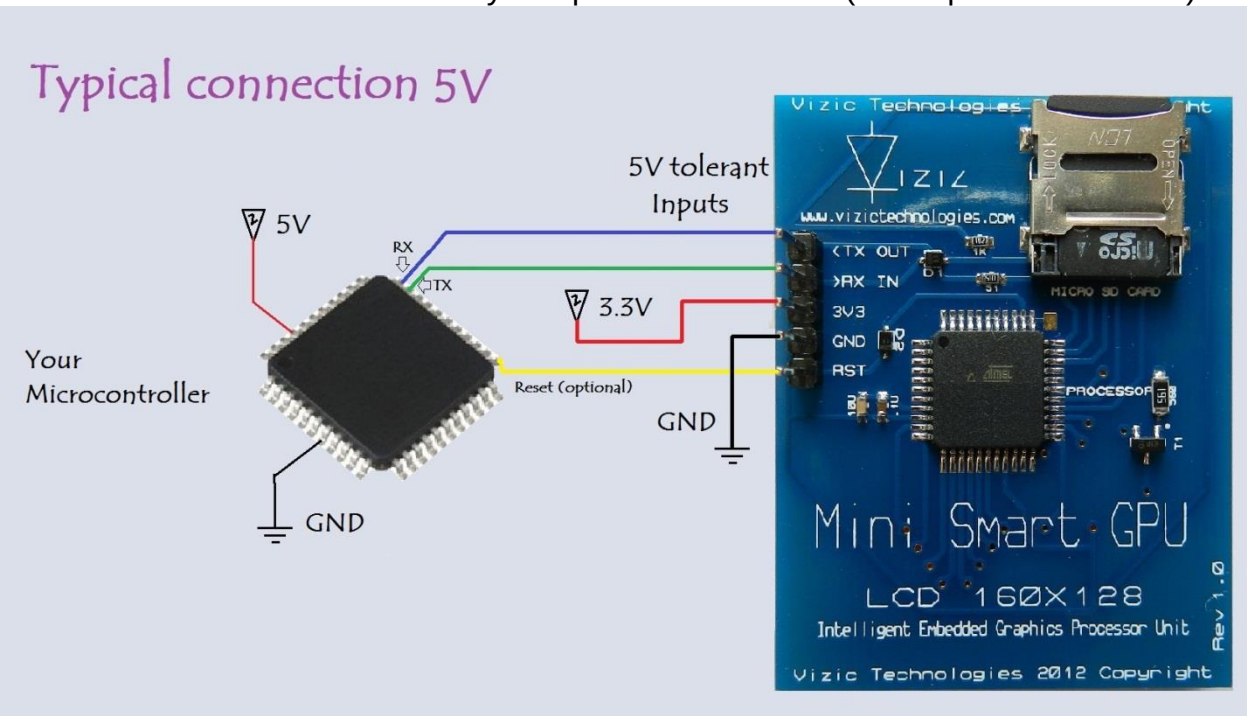
1.7 TYPICAL HOST CONNECTION: for 3.3V

*The MNI SMART GPU must always be powered with 3.3V (Reset pin is 5V tolerant)



1.8 TYPICAL HOST CONNECTION: for 5V inputs

*The MNI SMART GPU must always be powered with 3.3V (Reset pin is 5V tolerant)

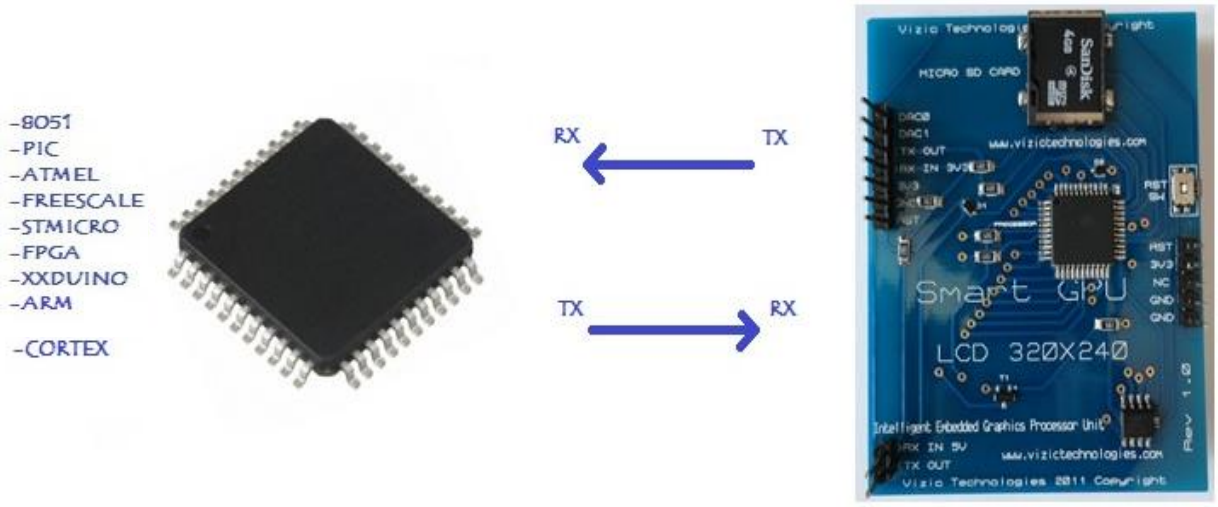


2. MINI SMART GPU Command Set - Software Interface Specification

As mentioned before the command interface between the MNI SMART GPU and the host is via the serial interface 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 an uppercase letter (ascii).



2.1 Commands summary

For detailed information on those commands, be sure to check the **COMMAND SET** sheet. Available on our website.

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

Master Commands:
• Erase Screen – **45hex 'E'**
• Set Erase Background Colour – **43hex 'C'**
• Display Orientation – **4Fhex 'O'**
• Display Brightness – **42hex 'B'**
• BaudRate Change – **58hex 'X'**
• Sleep – **5Ahex 'Z'**

Geometry Commands:
• Put Pixel – **50hex 'P'**
• Draw Line – **4Chex 'L'**
• Draw Rectangle – **52hex 'R'**
• Draw Circle – **43hex 'C'**
• Draw Triangle – **54hex 'T'**

Image Commands:
• Draw Image/Icon – **49hex 'I'**
• Image BMP SD – **42hex 'B'**
• Memory Read – **4Dhex 'M'**

Text/String Commands:
• Put Letter – **4Chex 'L'**
• Display String – **53hex 'S'**
• Display String SD – **46hex 'F'**
• Strings Configuration – **43hex 'C'**

FAT Data Management/ Data Logger:
• List Files –**4Chex 'L'**
• Get name Item# –**47hex 'G'**
• New File –**4Ehex 'N'**
• Open File –**4Fhex 'O'**
• Read File –**52hex 'R'**
• Write File –**57hex 'W'**
• Set/Get Pointer –**50hex 'P'**
• Sync File –**53hex 'S'**
• Close File –**43hex 'C'**
• Truncate File –**56hex 'V'**
• Erase File –**45hex 'E'**

3 Micro SD card file management (PC)

The MINI SMART GPU 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 or thousands of text files.

The files are fully compatible format with any PC. This section explains how to load and create images (.bmp) and text (.txt) files to be opened with the MINI SMART GPU.

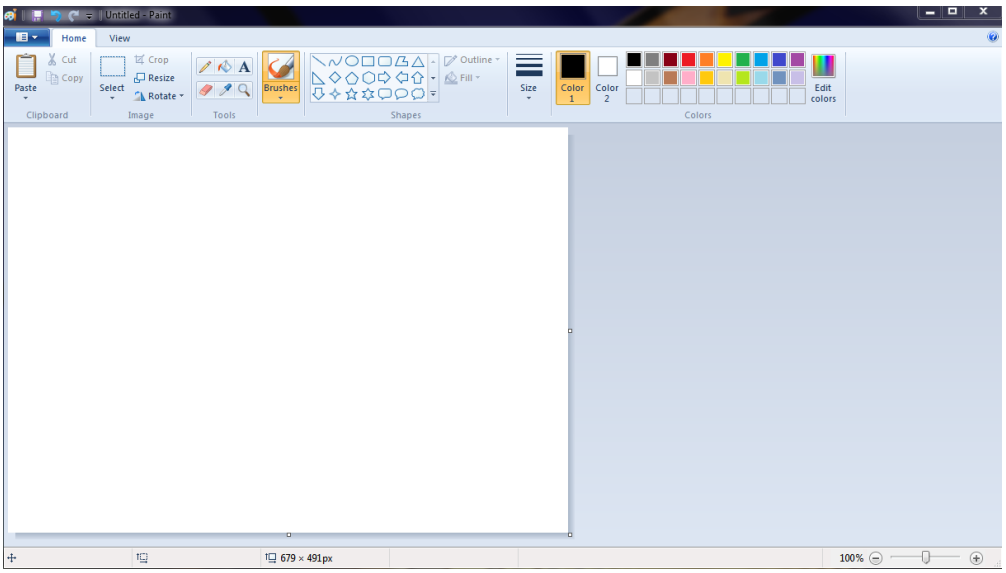
**Note that FAT file system could be faster than FAT32 on some micro SD cards.*

3.1 Storing Images on the micro SD card (PC)

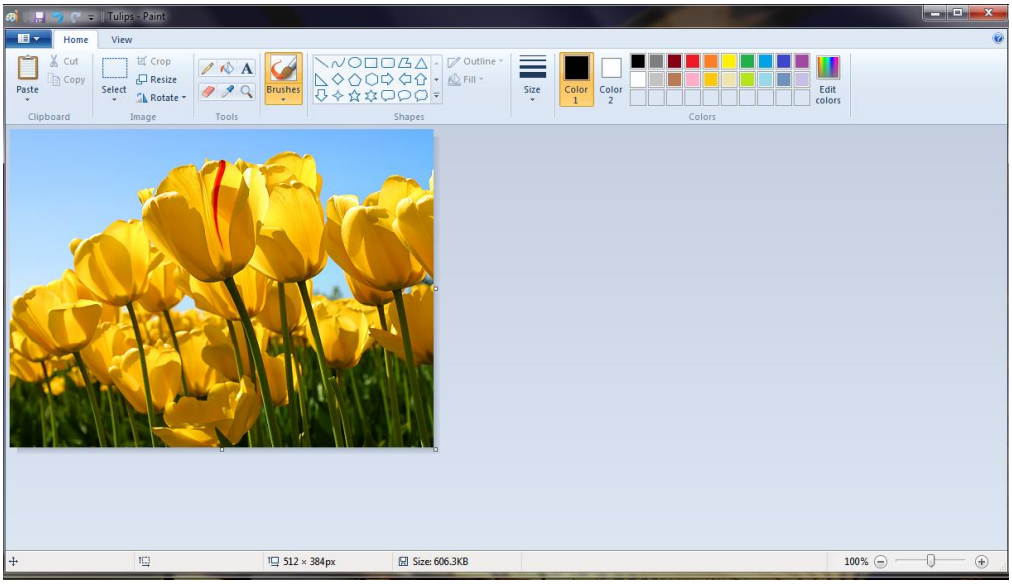
Any image could be prepared to be stored and loaded by the MINI SMART GPU, the only requirement is the .bmp extension and desired size.

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

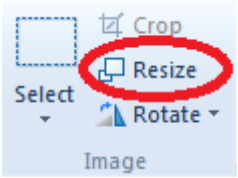
1.- Open the Paint software.



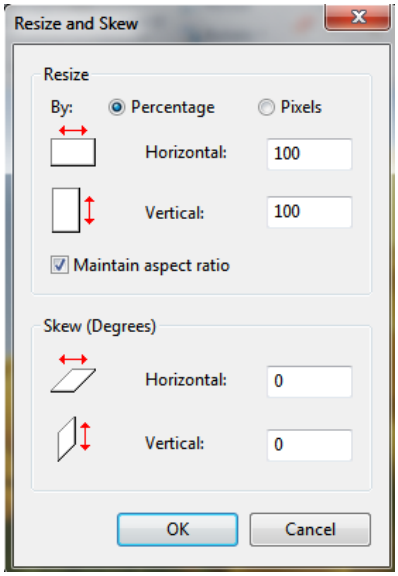
2.- Go to File->Open, and select the desired image, or draw your own creation!



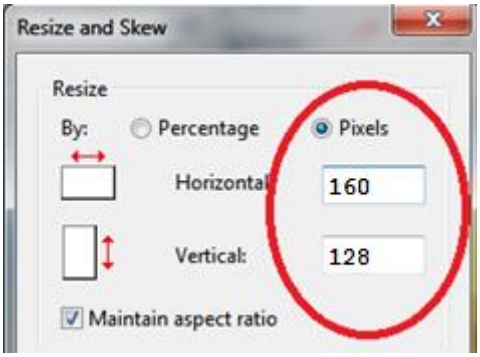
3.-Press on the resize button on the main bar



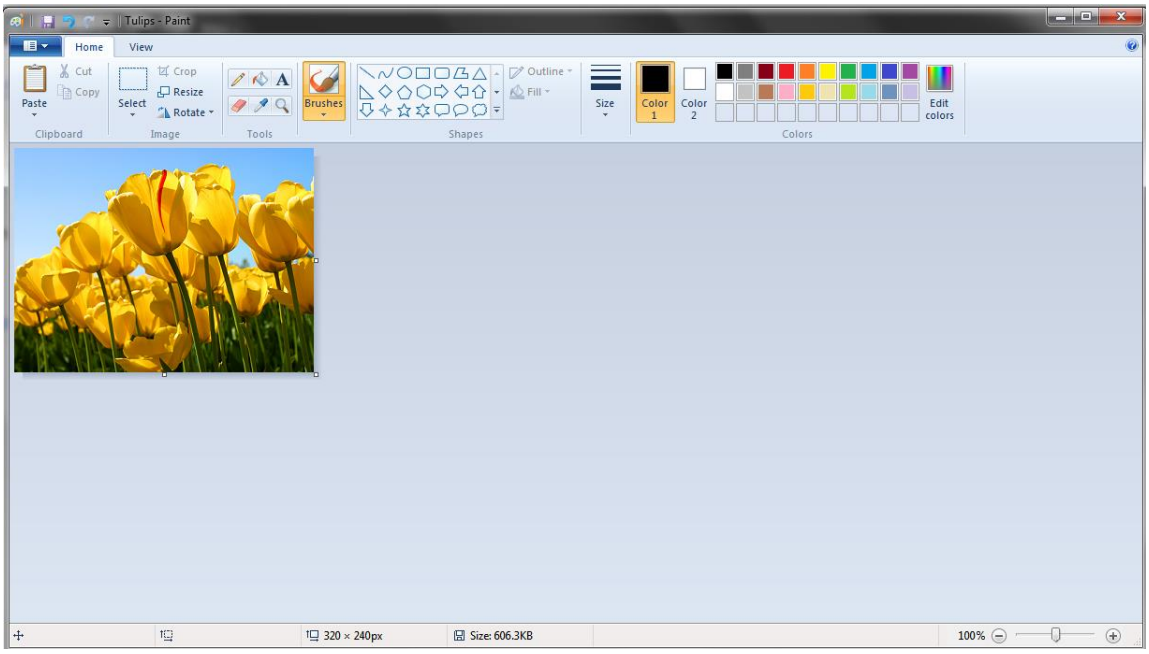
3.1- A new window will pop-up:



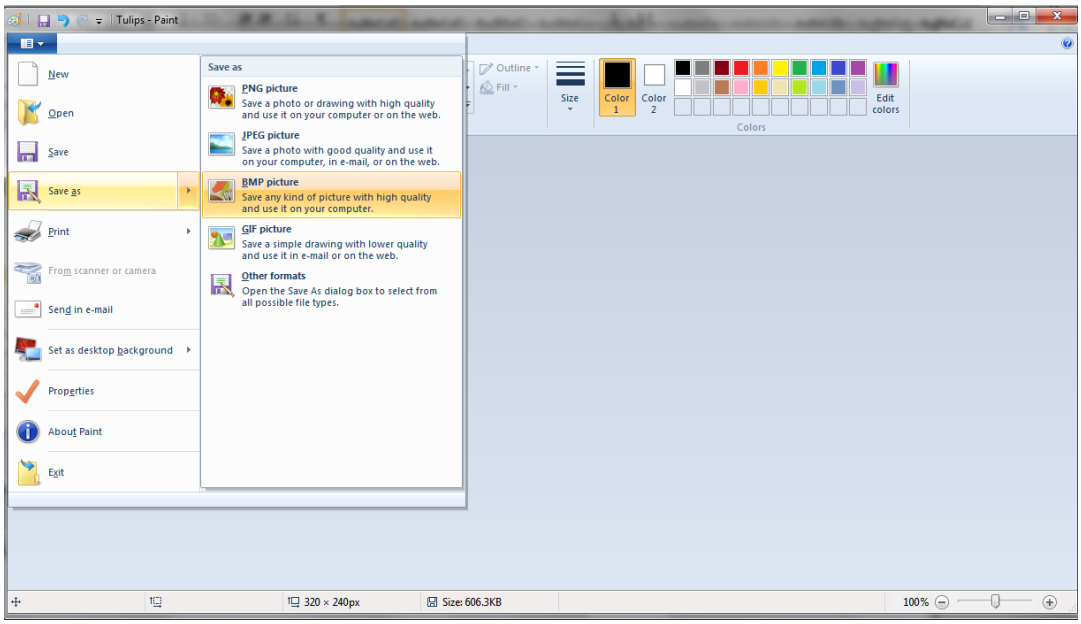
3.2- We only care on the resize section of this new window, now we select PIXELS, and then we write the size of the image, in this case we create a full screen image (landscape) on the MINI SMART GPU : 160X128 pixels. ***(Any size under 160X128 could also be chosen if we desire a non-full screen image. In portrait mode we chose 128X160 for a full screen image).***



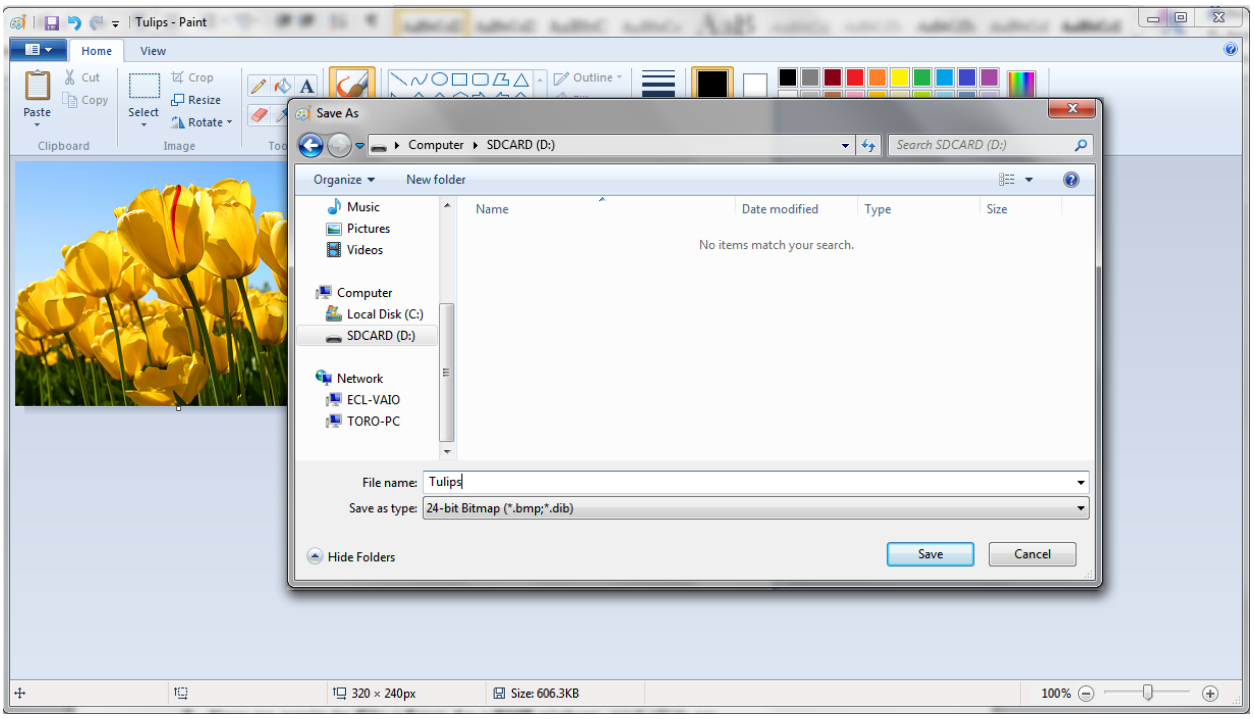
3.3- Press OK button and then the image it's now resized.



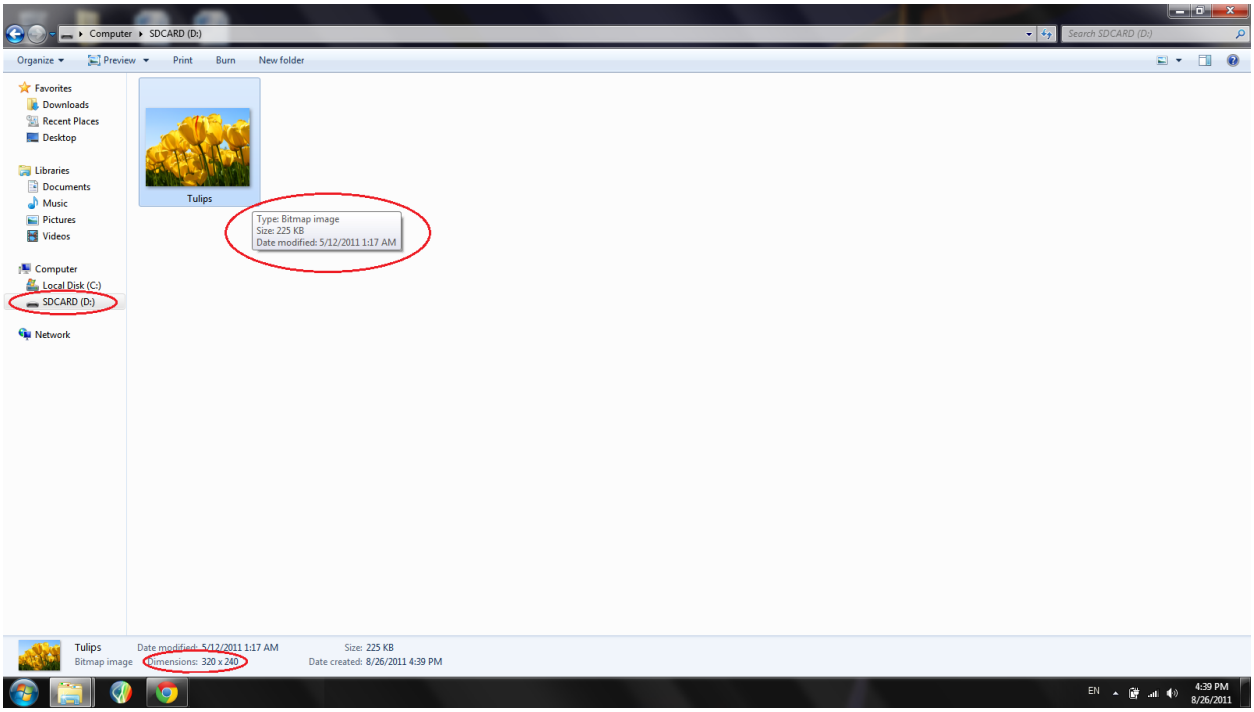
4.- Now go again to File->Save As->BMP picture, and click on.



5.- A new window pops-up, select the ROOT path of the formatted micro SD, give it a name to the image in the File Name field, and click SAVE. ***(Remember that the file name must be 8 CHARACTERS or less, special characters may not work, it's recommended to use only alphanumeric characters).***



6.- Finally we check the contents on the microSD root. We safely remove the micro SD card, then insert it on the MINI SMART GPU and call the image!



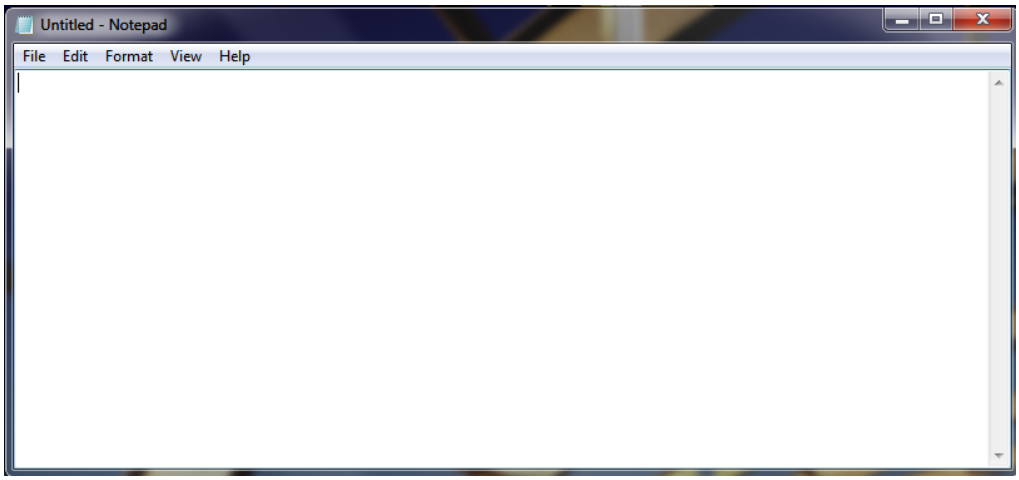
7.- Follow always the same procedure to load images onto the micro SDcard!

3.2 Storing text files on the micro SD card (PC)

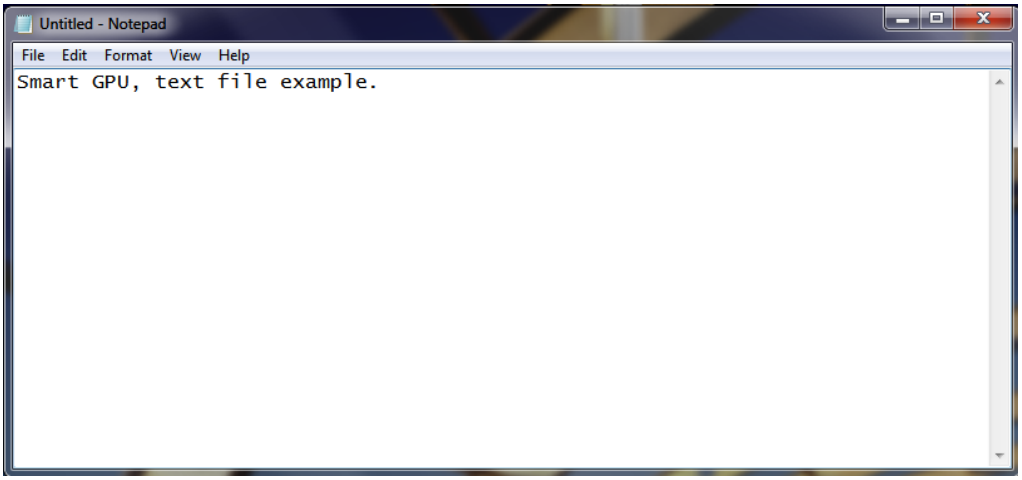
Any text could be prepared to be stored and loaded by the MINI SMART GPU, the only requirement is the .txt extension and desired size.

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

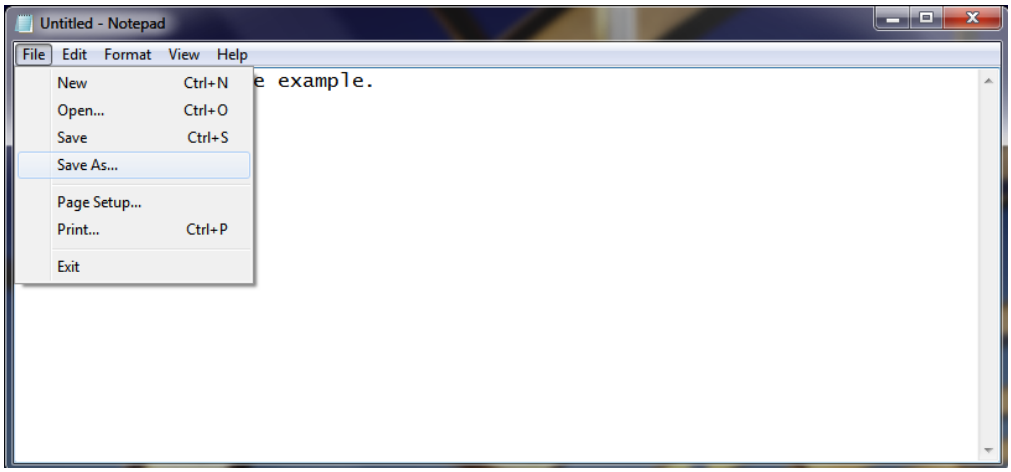
1.- Open the Note Pad software.



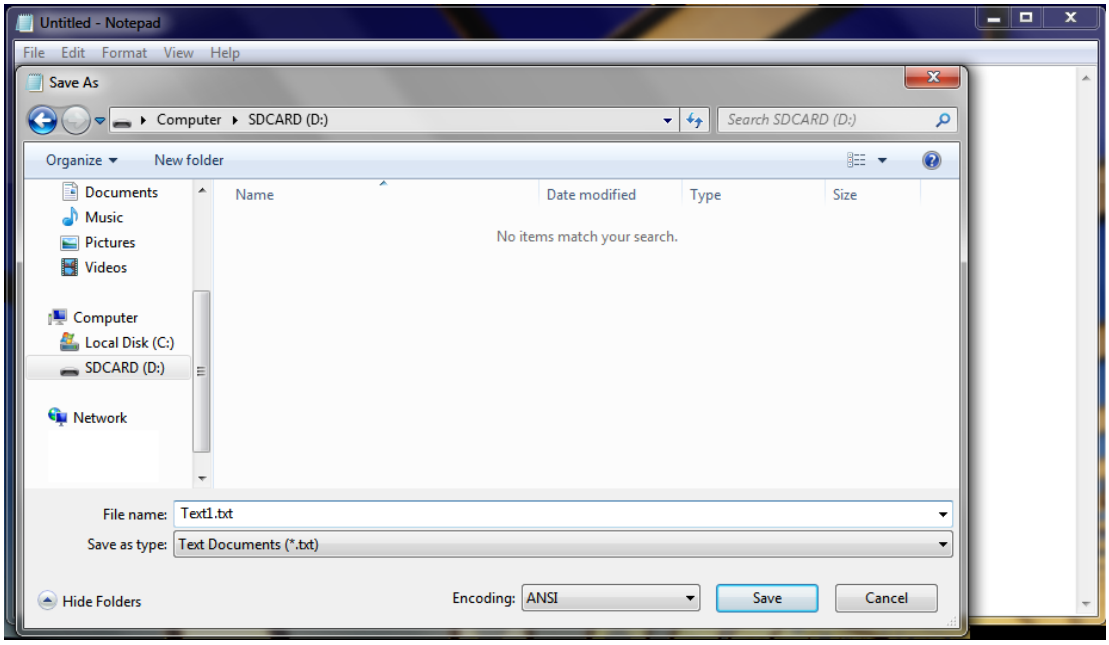
2.- Go to File->Open, and select the desired text file, or write your own text!



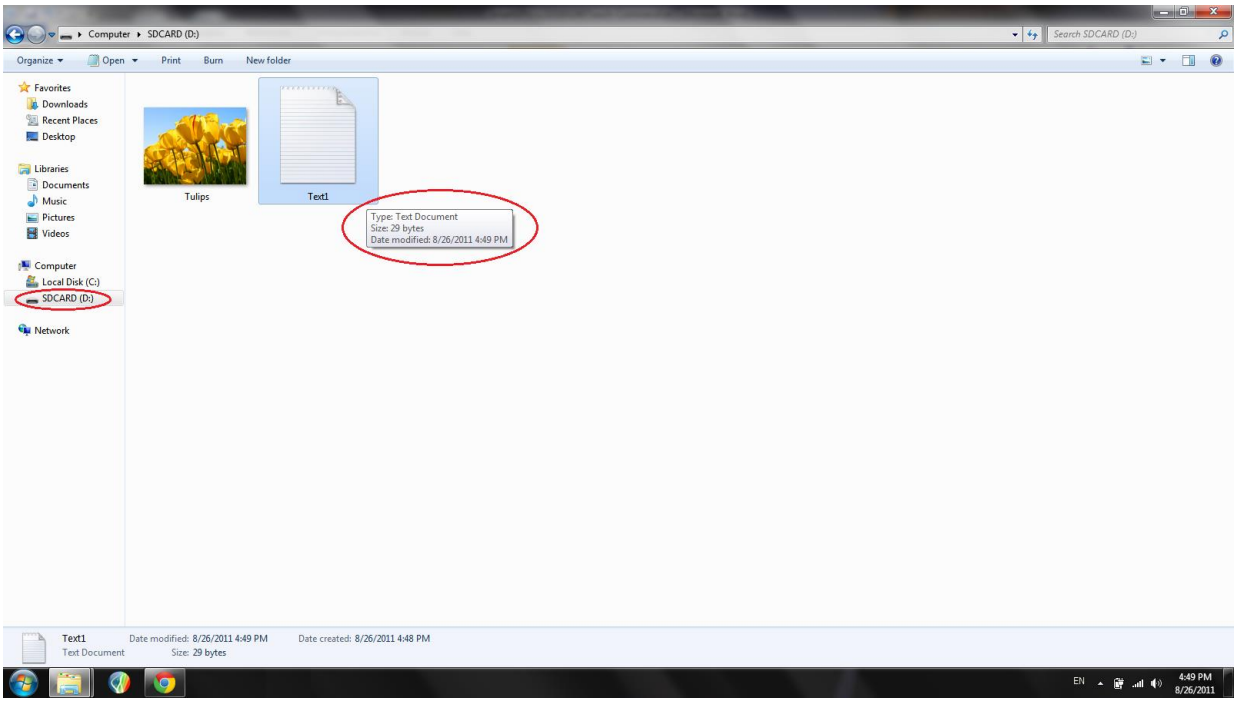
3.- Now go again to File->Save As, and click on.



4.- A new window pops-up, select the ROOT path of the formatted micro SD, give it a name to the text file in the File Name field, be sure that the ".txt" extension is selected, and click SAVE. ***(Remember that the file name must be 8 CHARACTERS or less, special characters may not work, it's recommended to use only alphanumeric characters).***



5.- Finally we check the contents on the microSD root. We safely remove the micro SD card, then insert it on the MINI SMART GPU and call the text file!

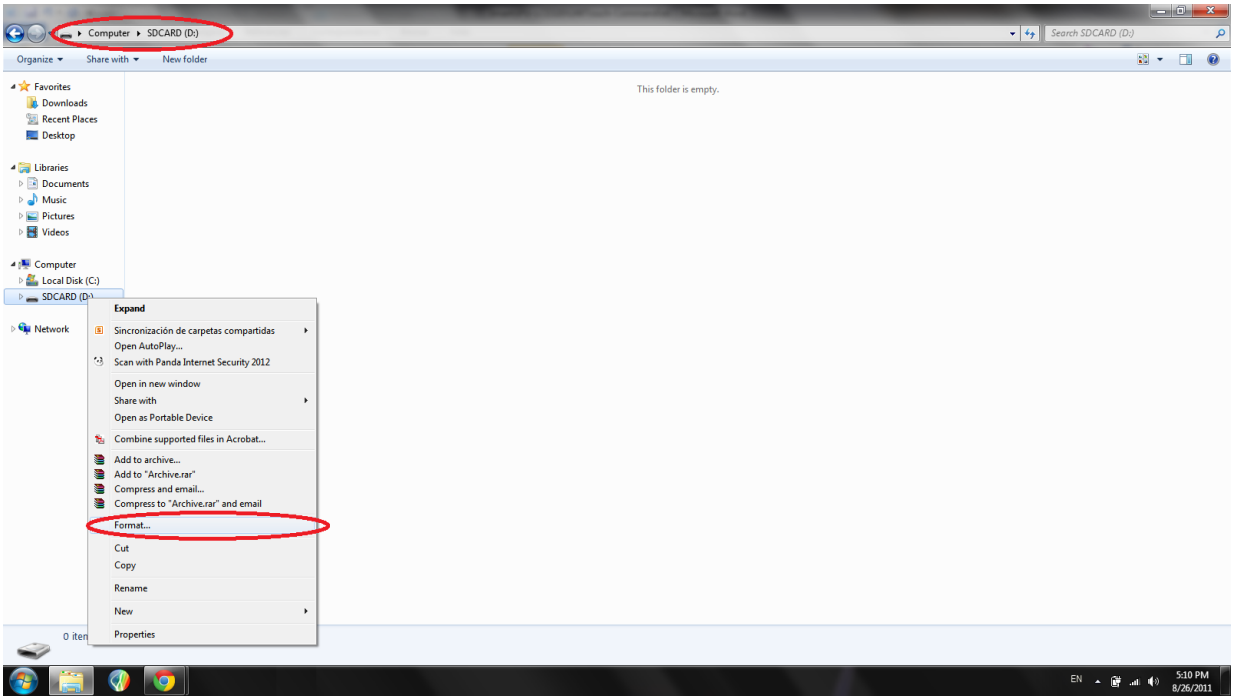


6.- Follow always the same procedure to load text files onto the micro SDcard!

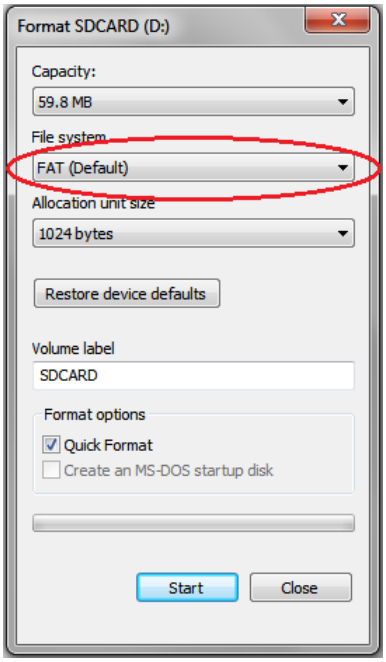
3.3 Formatting the micro SD card for first use

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.

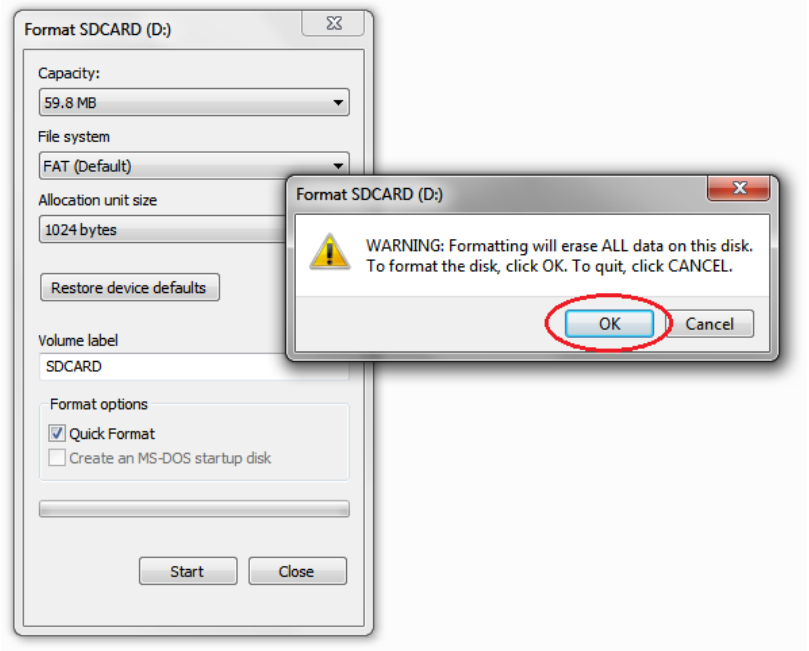
1.- Open a new windows explorer right click on the microSD card and a menu appears, select the "FORMAT…" and click on it. ***(Note that formatting a micro SD card will erase all the contents of it).***



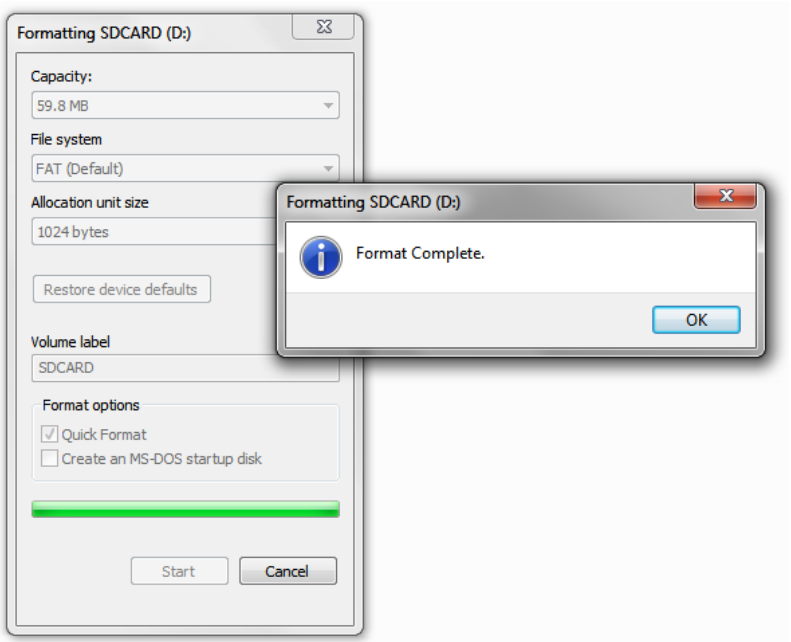
2.- A new window will pop-up, chose FAT(default) on the File System menu, and click start.



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



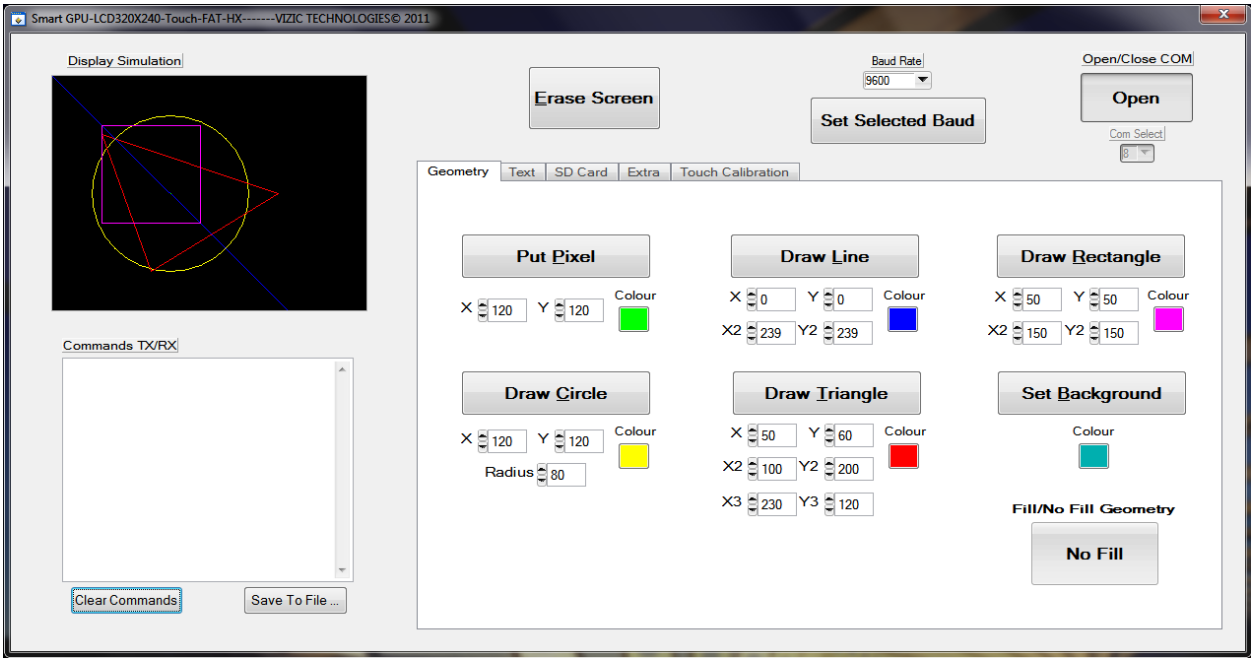
4.- Now the microSD card is ready to load images and text!



4 Development software tools

In order to make easier the learning about how to communicate with the MINI SMART GPU, free software could be downloaded and used in any PC. This software simulates most of the functions of the MINI SMART GPU by connecting it with the USB-UART SX Bridge to enable real graphics processing on the MINI SMART GPU.

This software greatly reduces the time of learning the commands, and helps the user to understand how commands are created.

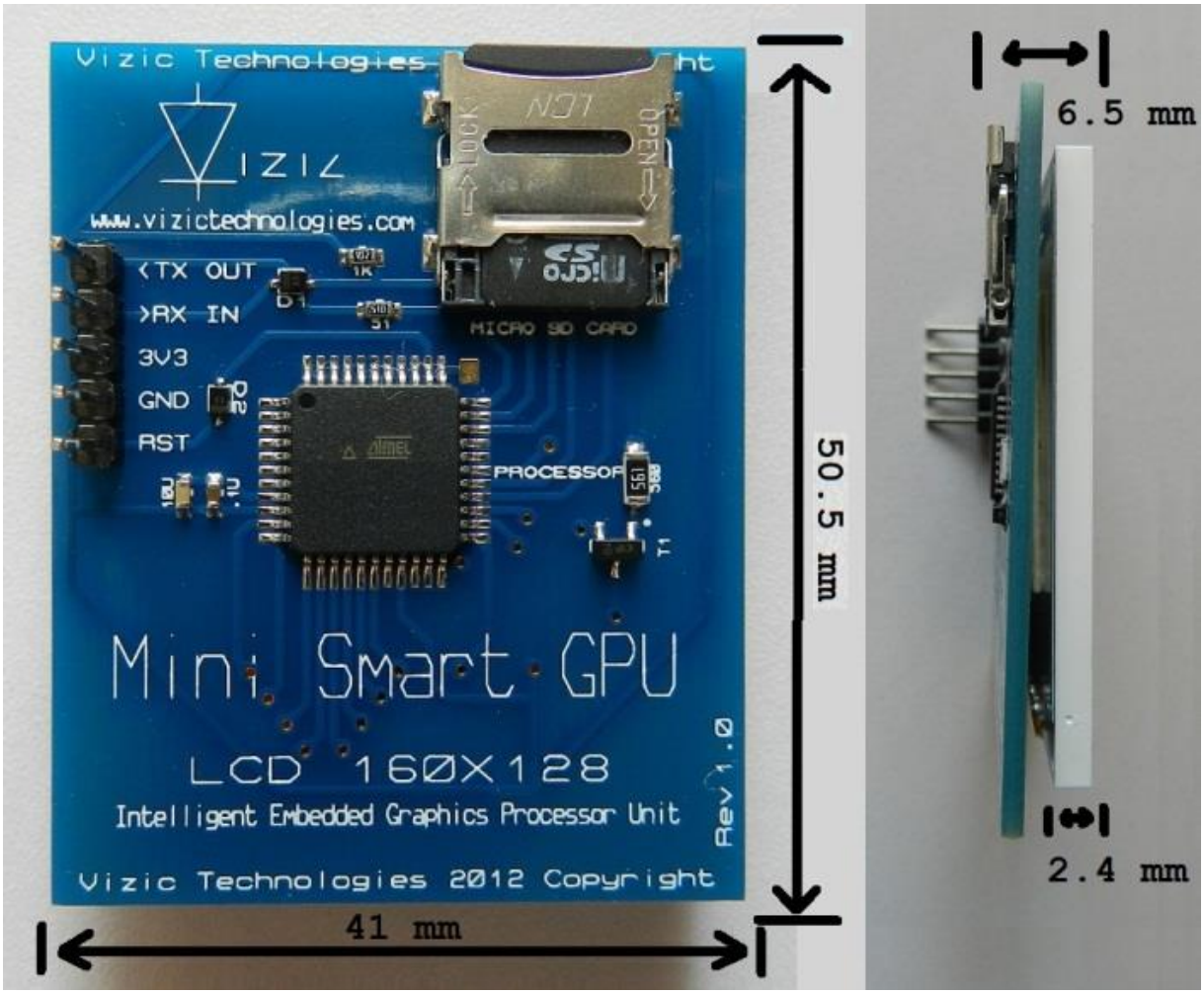


For detailed information about this software and how to use it, please refer to the "MINISMARTGPU-PCsimulation.pdf" sheet that could be downloaded in the web site.

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

5 Mechanical dimensions

All units in mm.



6 Specifications and ratings

Main LCD panel

Item	Standard Value
Display Type	128*(R、G、B)*160 Dots
LCD Type	a-si TFT，Positive，Transmissive type
Screen size(inch)	1.77" (Diagonal)
Viewing Direction	12:00 O'clock
Color configuration	R.G.B. vertical stripe
Backlight Type	White LED B/L

Mechanical Specifications

Item	Standard Value	Unit
Outline Dimension	34 (W) *45.83(L) *2.65(H)	mm

LCD panel

Item	Standard Value	Unit
Active Area	28.03（W）*35.04（L）	mm

Absolute Maximum Ratings

Module

Item	Symbol	Condition	Min.	Max.	Unit
System Power Supply Voltage	VCC	-	-0.3	3.3	V
Input Voltage	V_{IN}	-	-0.3	VCC+0.3	V
Operating Temperature	T_{OP}	-	-20	+70	°C
Storage Temperature	T_{ST}	-	-30	+80	°C
Storage Humidity	H_D	Ta < 40°C	20	90	%RH

Absolute Maximum Ratings*

Voltage on any Pin with respect to Ground..-0.5V to V_{CC}+0.5V
Maximum Operating Voltage 3.3V
DC Current per I/O Pin ..... 20.0 mA

*NOTICE: Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or other conditions beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

(Reset pin and RX pin are 5V-9V tolerant)

DC Characteristics

Current Consumption

Symbol	Parameter	Condition		Min.	Typ.	Max.	Units
I_{CC}	Power Supply Current	Active	V_{CC} = 3.0V		50	60	mA
		Idle	V_{CC} = 3.0V		11.4	13	mA

LCD Module with LED Backlight

Maximum Ratings

Item	Symbol	Conditions	Min.	Max.	Unit
Forward Current	IF	Ta =25°C	-	30	mA
Forward Voltage	VF	Ta =25°C	-	3.4	V
Power Dissipation	PD	Ta =25°C	-	102	mW

Electrical / Optical Characteristics

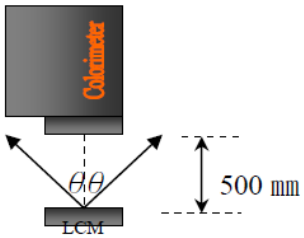
Item	Symbol	Conditions	Min.	Typ.	Max.	Unit
Forward Voltage	VF	IF=30mA VF=3.2 V 4 white leds Ta =25°C	2.9	3.2	3.4	V
Average Brightness (Without LCD)	IV		3000	-	-	cd/m^2
Color of CIE Coordinate (without LCD)	X		-	-	-	-
	Y		-	-	-	
Color	White					

Optical Characteristics

TFT LCD panel VCC=2.8V, Ta=25°C

Item		Symbol	Condition	Min.	Typ.	Max.	unit	
Response time		Tr+Tf	Ta = 25°C θX, θY = 0°	-	8	16	ms	Note2
Contrast ratio		CR	Ta = 25°C θX , θY = 0°		500	-	-	Note3
Color of CIE Coordinate （With B/L）	White	X		-	0.310	-	-	Note1
		Y		-	0.327	-		
	Red	X		-	0.657	-		
		Y		-	0.320	-		
	Green	X		-	0.287	-		
		Y		-	0.591	-		
	Blue	X		-	0.140	-		
		Y		-	0.080	-		
Average Brightness Pattern=white display （main）		IV	-	-	-	-	cd/m^2	Note1
Uniformity		△B	-	-	-	-	%	Note1

Note1:
1：△B=B(min) / B(max) ×100%
2：Measurement Condition for Optical Characteristics:
a：Environment: 25℃±5℃ / 60±20%R.H，no wind，dark room below 10 Lux at typical lamp current and typical operating frequency.
b：Measurement Distance: 500 ± 50 ㎜ ，(θ= 0°)
c：Equipment: TOPCON BM-7 fast，(field 1°)，after 10 minutes operation.
d：The uncertainty of the C.I.E coordinate measurement ±0.01，Average Brightness ± 4%

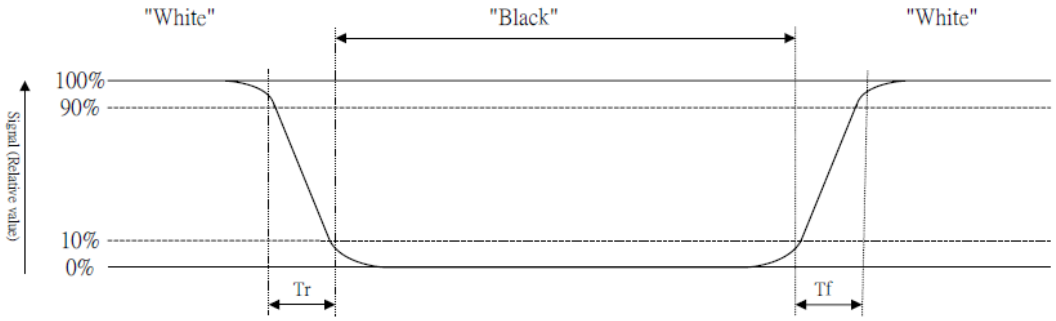


Colorimeter=BM-7 fast

Note2: Definition of response time:

The output signals of photo detector are measured when the input signals are changed from “black” to “white”(falling time) and from “white” to “black”(rising time), respectively. The response time is defined as the time interval between the 10% and 90% of Amplitudes.

Refer to figure as below:



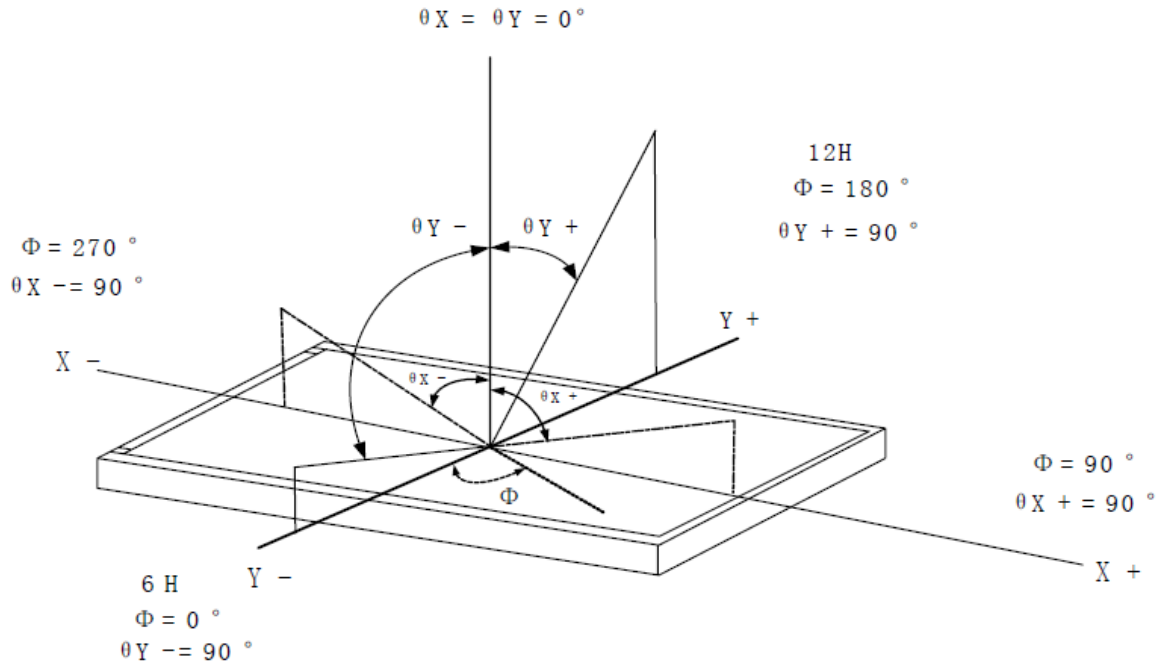
Note3: Definition of contrast ratio:

Contrast ratio is calculated with the following formula

$$\text{Contrast ratio (CR)} = \frac{\text{Photo detector output when LCD is at “White” state}}{\text{Photo detector output when LCD is at “Black” state}}$$

Note4: Definition of viewing angle:

Refer to figure as below:



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 ± 10℃ 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℃ ± 5℃ 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.

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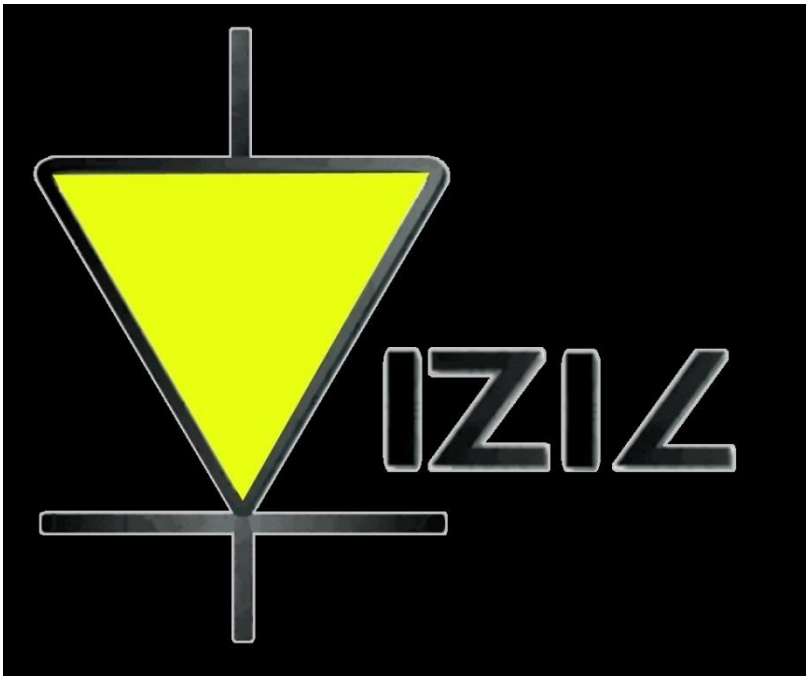

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