USER GUIDE

4D SYSTEMS

TURNING TECHNOLOGY INTO ART

Workshop 4 - ViSi-Genie User Guide

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Contents

1. Introduction to ViSi-Genie

This user guide provides an introduction to ViSi-Genie, the codeless rapid development tool for designing and building graphic user interface on 4D Systems screens.

ViSi-Genie is a breakthrough in the way 4D Systems' graphic display modules are programmed, it provides an easy method for designing complex Graphics User Interface applications without any coding. It is an environment like no other, a code-less programming environment that provides the user with a rapid visual experience, enabling a simple GUI application to be 'designed' from scratch in literally seconds.

ViSi-Genie does all the background coding, no 4DGL to learn, it does it all for you.

Pick and choose the relevant objects to place on the display, much like the ViSi environment, yet without having to write a single line of code. The full animation of the objects is done under-the-hood, such as pressing a button or moving the thumb of the slider. Each object has parameters which can be set, and configurable events to animate and drive other objects or communicate with an external host.

Simply place an object on the screen, position and size it to suit, set the parameters such as colour, range, text, and finally select the event you wish the object to be associated with, it is that simple. Objects are classified in three different groups:

INPUT OJECTS, as a button or a keyboard, **OUTPUT OJECTS**, as a gauge or a meter, and **COMBINED OJECTS** or **INPUT/OUTPUT OBJECTS**, as a slider which acts as both an input and an output.

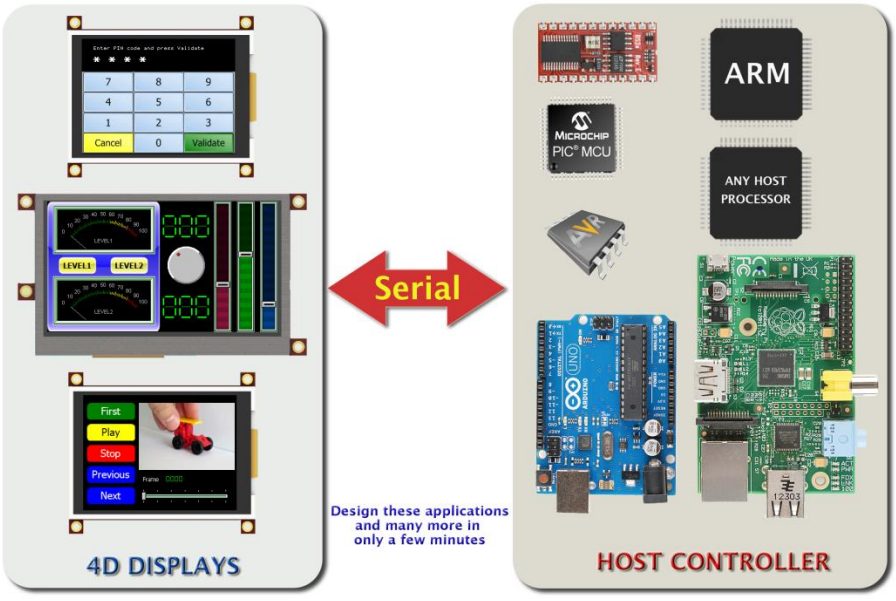
In seconds you can transform a blank display into a fully animated GUI with moving meters, animated press and release buttons, and much more. All without writing a single line of code!

ViSi-Genie provides the user with a feature rich rapid development environment, second to none.

This document should be used in conjunction with the ***ViSi-Genie Reference Manual***.

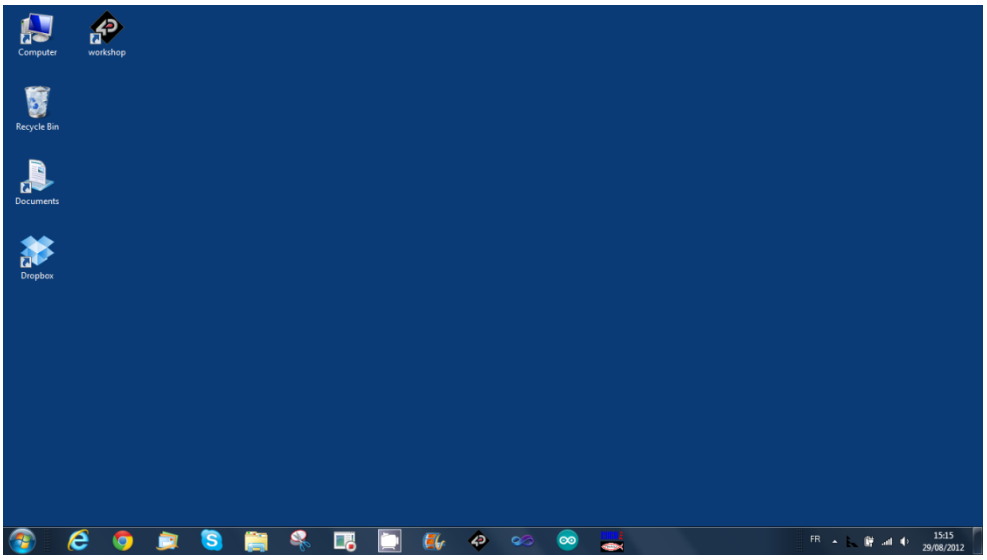
ViSi-Genie is included in the integrated development environment Workshop 4. To install Workshop 4, please refer to the document ***Workshop 4 Installation***.

ViSi-Genie is currently only available for the Picaso platform; attempting to build a ViSi-Genie program for Goldelox will fail.



2. Launch Workshop 4

There is an alias for Workshop 4 on the desktop:



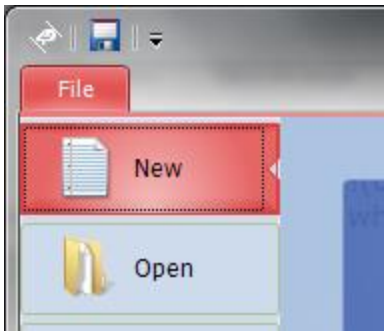
Launch 4D Workshop by double-clicking on the icon:

3. Create a New Project

Workshop 4 opens and displays the **Recent** page:

To create a new program, there are multiple options:

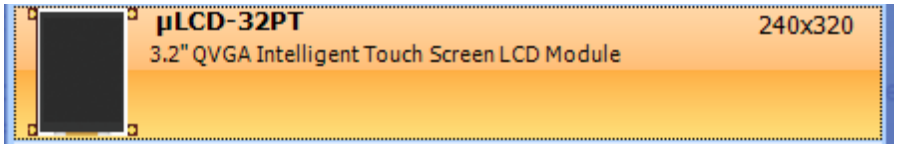
- Click on the top left-most icon **New**



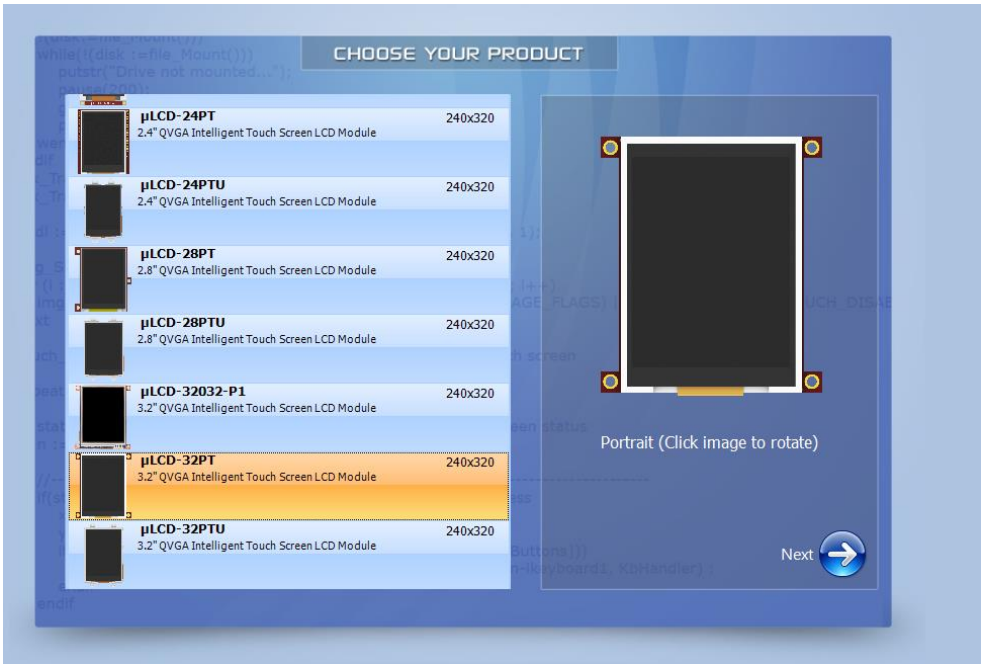
- Click on the icon close to **Create a New Project** on top or, if the settings have been already defined, click on the icon close to **Create a New Project** on bottom:

All those options update the main window with the selection of the screen:

Select the screen, here the µLCD-32PT:

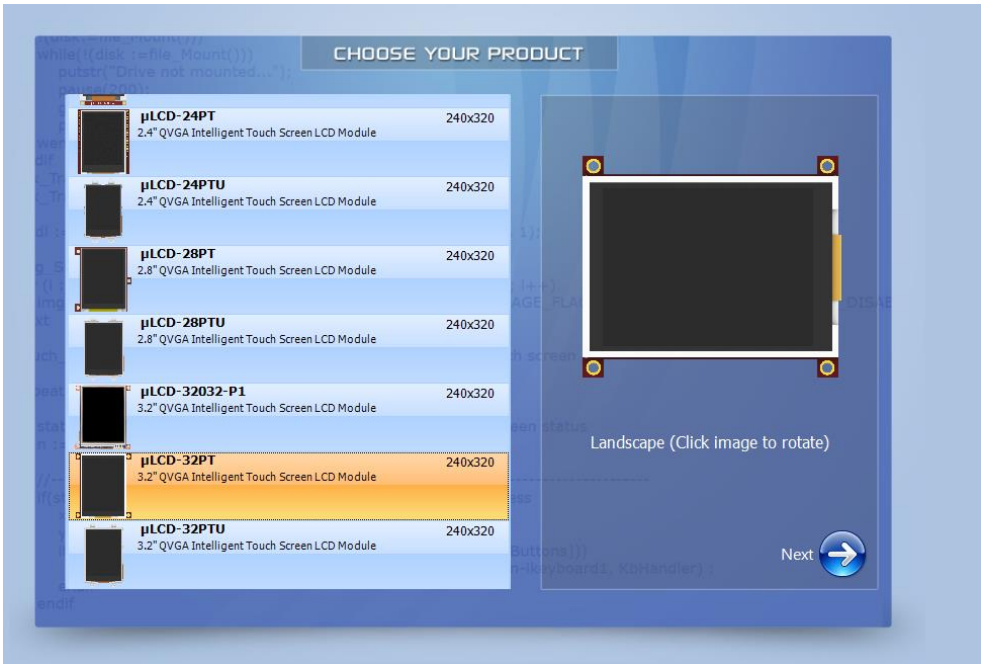


The selected screen is displayed:

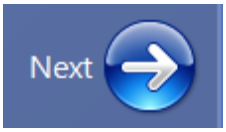


Orientation is portrait by default.

To set it to landscape, just click on the image of the screen to rotate it:



Press **Next** to proceed:

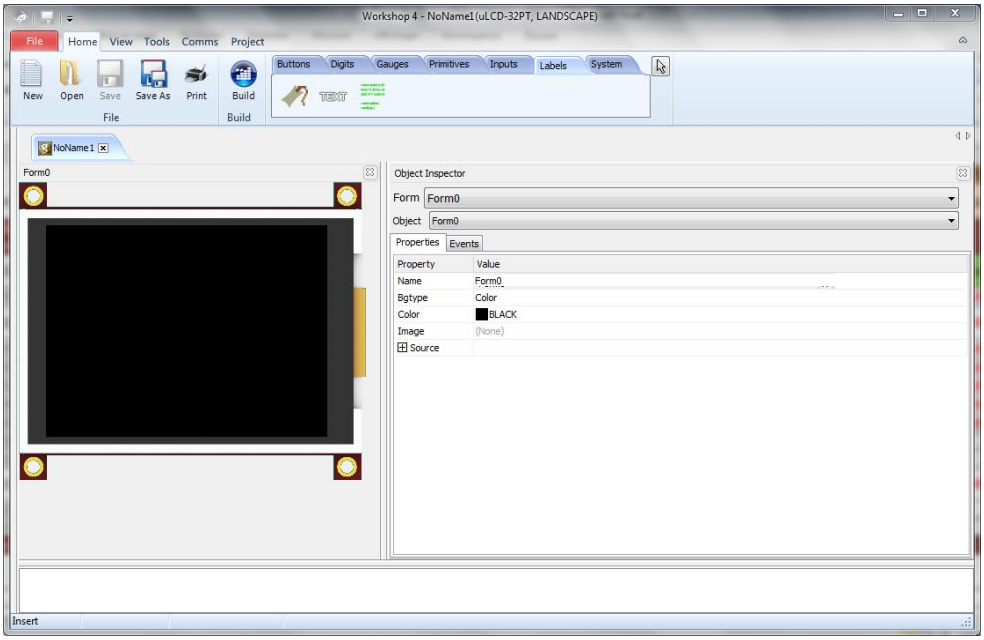


4. Select ViSi-Genie

The main window now asks for the kind of project:

To select ViSi Genie, just click on the blue arrow:

The development environment is now displayed:



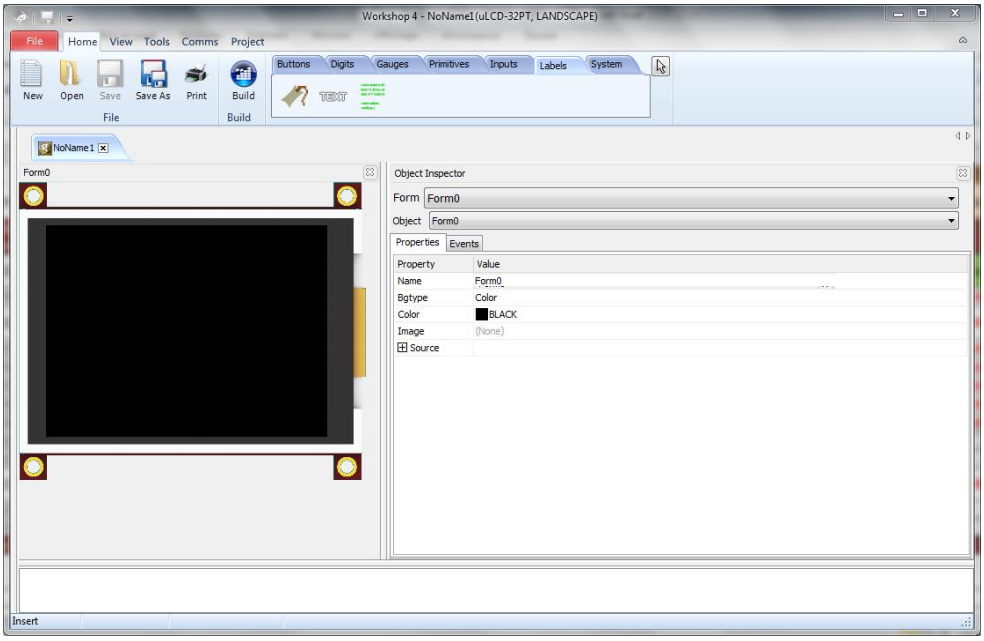
Workshop 4 displays an empty screen, called Form0.

- A **project** consists of one or more forms.
- A **form** is like a page on the screen.
- The form includes **objects**, like sliders, displays or keyboards.

You are ready to start.

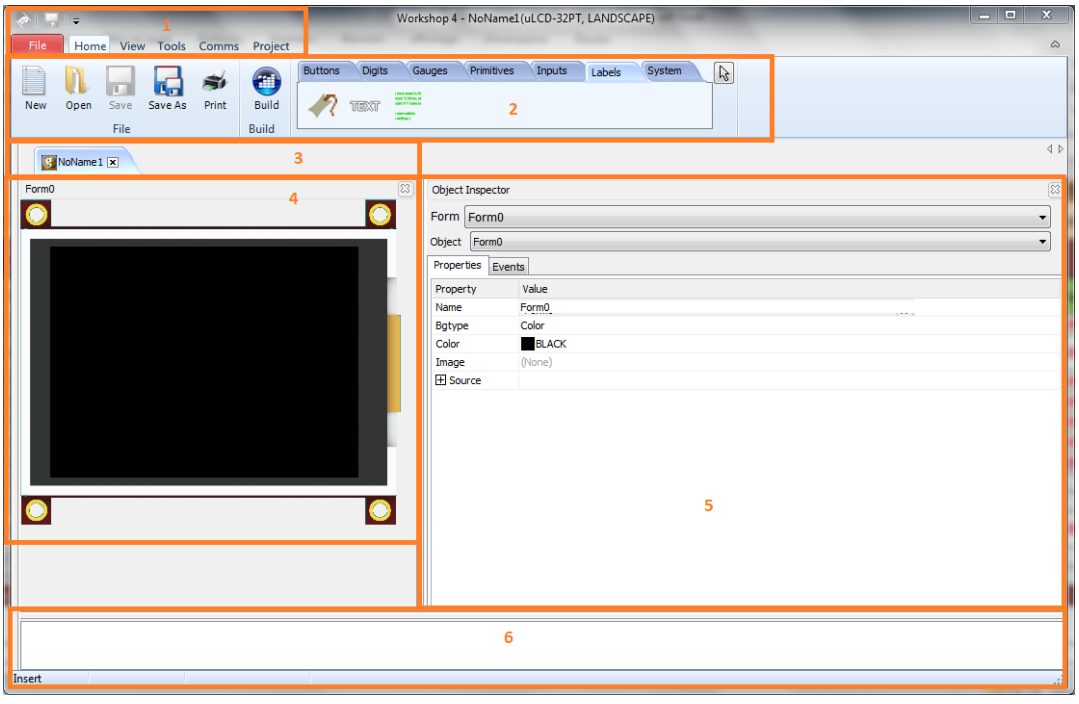
5. The Main Screen

The main screen appears:



Let's detail the different areas.

There are six different areas, from left to right, for top to bottom:

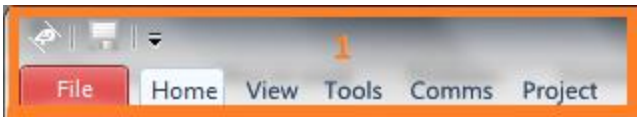


1. Menus;
2. Ribbon with icons;
3. List of open projects;
4. Form and WYSIWYG screen where to place the objects;
5. Object inspector, where properties and events are defined;
6. Messages about errors, warnings and notices.

5.1. Area 1: Menus

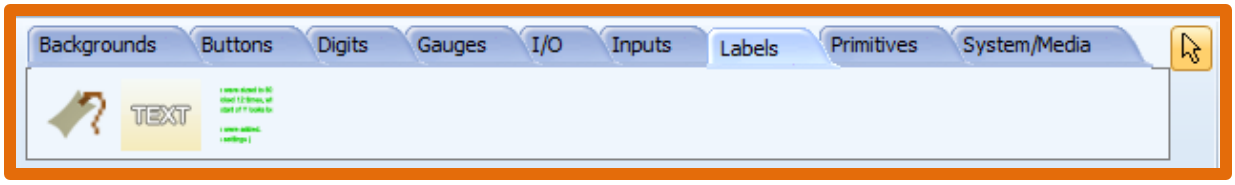
The menus include standard Windows options. Each menu displays a specific ribbon.

The debugger called **Genie Test Executor** is located under the Tool menu.



5.2. Area 2: Ribbon with Icons

For the Home menu, the ribbon includes the file related buttons and the objects grouped in panes:



The icons related to the files include **New** project, **Open** project, **Save** project, **Save as** project, **Print** project, and **Build** project.

The objects are grouped in seven panes, with input objects, output objects and composite objects.

Just click on an object to select it.

The **Build** button builds the project and uploads it to the screen.

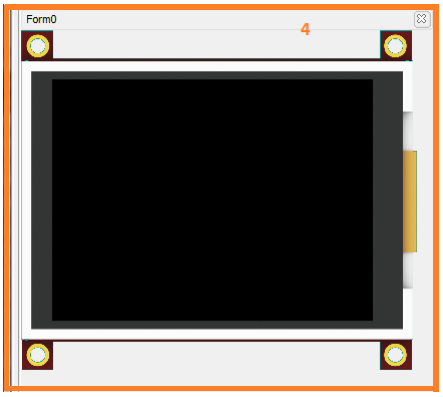
5.3. Area 3: List of Open Projects

On top of the What-You-See-Is-What-You-Get (WYSIWYG) screen, the open projects are displayed:

Click on the tab to open it or on the cross to close it.

5.4. Area 4: Form and WYSIWYG Screen

The form represents a WYSIWYG screen.



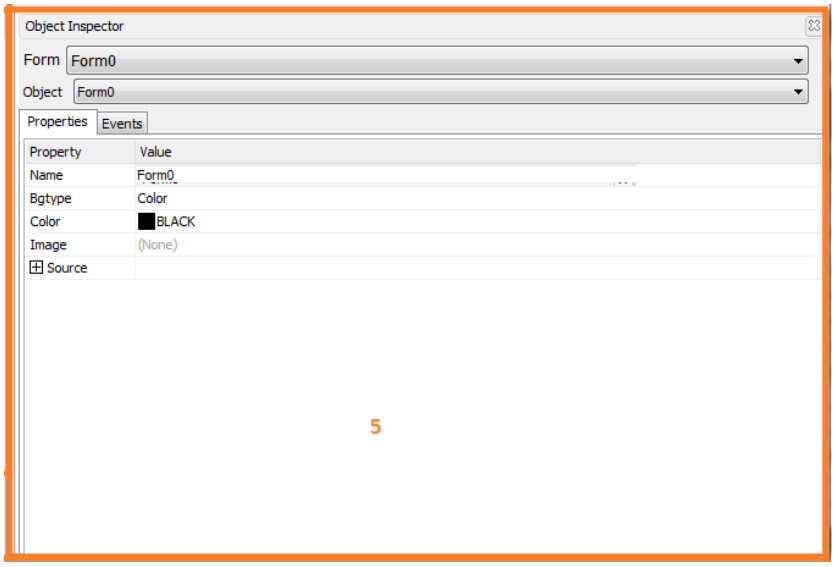
The active form is displayed there, with its objects. Objects are picked from the panes and can be resized and moved.

Click on an object to select it.

5.5. Area 5: Object Inspector

The object inspector provides all the information on the selected object:

- properties, as size and position;
- and events, where actions are defined.



5.6. Area 6: Message Window

The message window displays errors, warnings and notices after the project is built.

Before starting using the Workshop 4, we need to connect the screen and prepare a micro-SD card.

For more information about connecting the screen, please refer to the Workshop 4 User Guide.

The micro-SD card shall be FAT16-formatted. Partition can't exceed 2 GB.

For more information about formatting the micro-SD card, please check the details on chapter *Format the Micro-SD Card* described in the document Workshop 4 Installation.

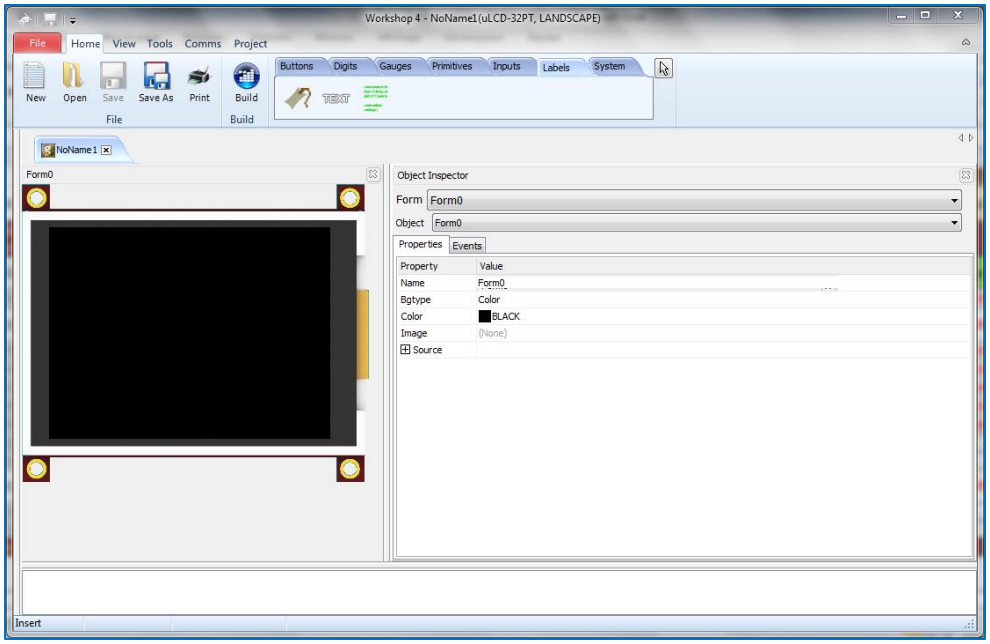
6. A First ViSi-Genie Project

Workshop 4 display an empty screen, called **Form0**.

A **form** is like a page on the screen.

The form includes **objects**, like sliders, displays or keyboards.

A **project** consists of one or more forms.



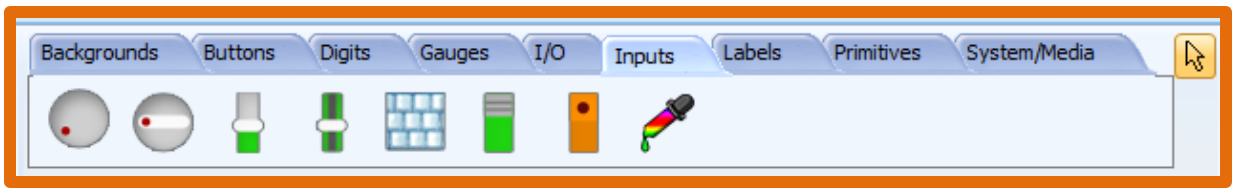
The form is empty.

We are going to build a form with two objets: a track bar that updates a meter.

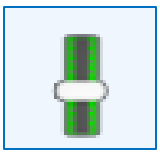
6.1. Adding Objects

The track-bar is an **input object** and the meter is an **output object**.

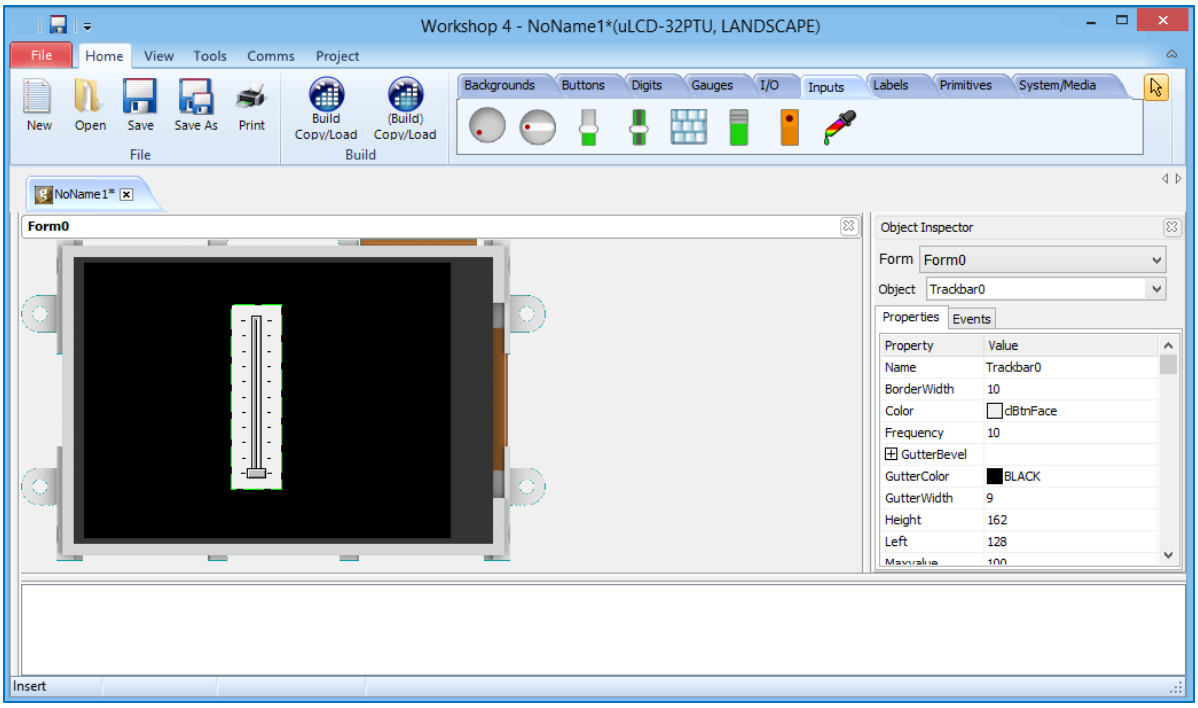
Select the **Inputs** pane...



...then the **Track-bar** object...

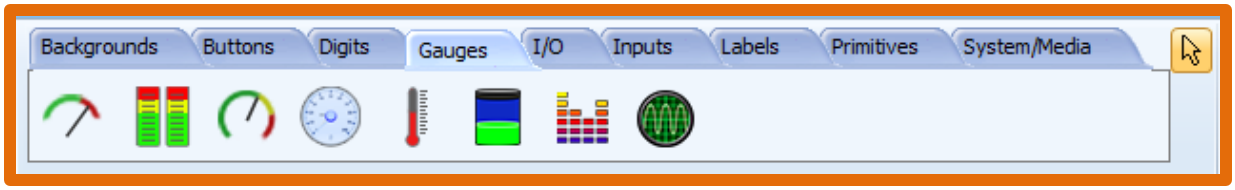


...and then click on the desired location on the form to place it:



Now, the same applies for the meter.

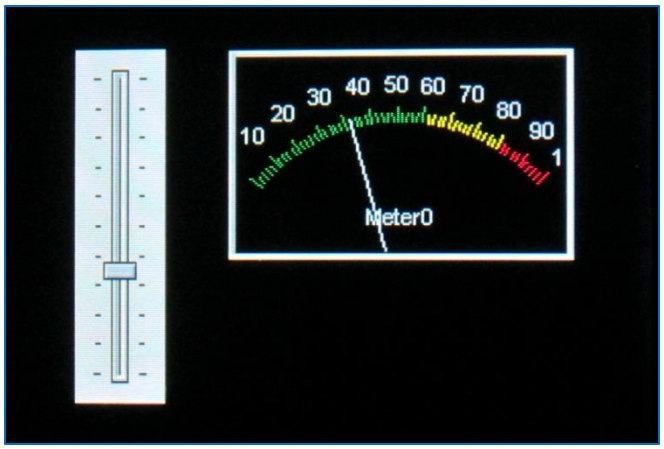
Select the **Gauges** pane...



...then the **Meter** object...

...and place it on the form.

The final form looks like:

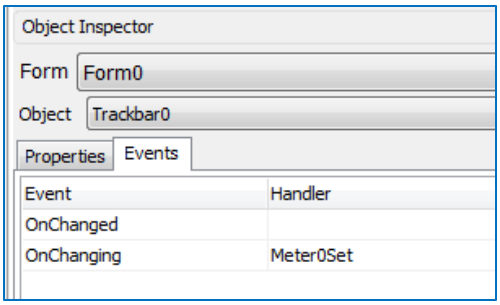


For a step-by-step example of a project, please refer to the application note 4D-AN-P4001 Getting Started — First Project with ViSi-Genie.

6.2. Linking Objects

Now, the objects need to be linked: moving the track-bar updates the meter.

Moving the track-bar raises an **event**, called **OnChanging**. When an **OnChanging** event arises, a message is sent to the meter with the value.



For the end-user, each time he moves the track-bar, the meter is updated accordingly.

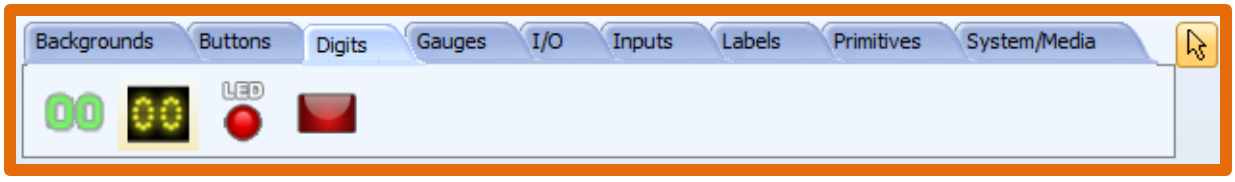
This example is detailed step-by-step on the application note 4D-AN-P4001 Getting Started – First Project with ViSi-Genie.

For a detailed presentation of the onChanging and onChanged events, please refer to the application note 4D-AN-P4002 ViSi-Genie – onChanging and onChanged Events.

6.3. Controlling Multiple Objects

As described in the previous section, an object sends a message to another single object.

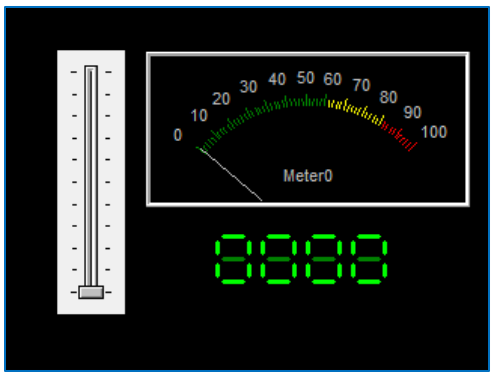
Select the **Digits** pane…



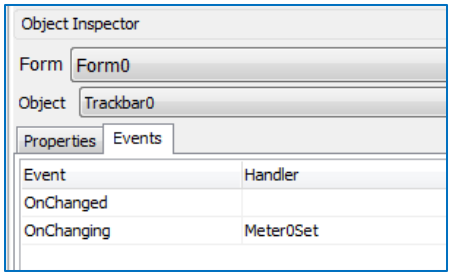
...then the **LedDigits** object...

...and place it on the form.

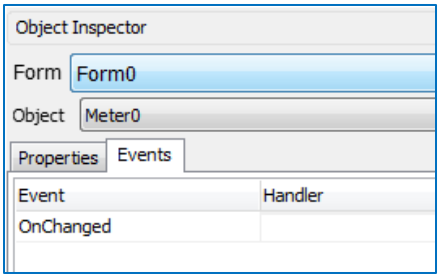
The final form looks like:



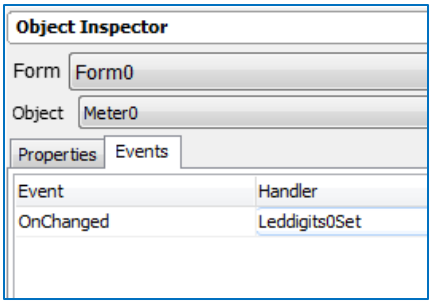
As previously, moving the track-bar raises the **OnChanging** event, which sends a message to **Meter0** with the value.



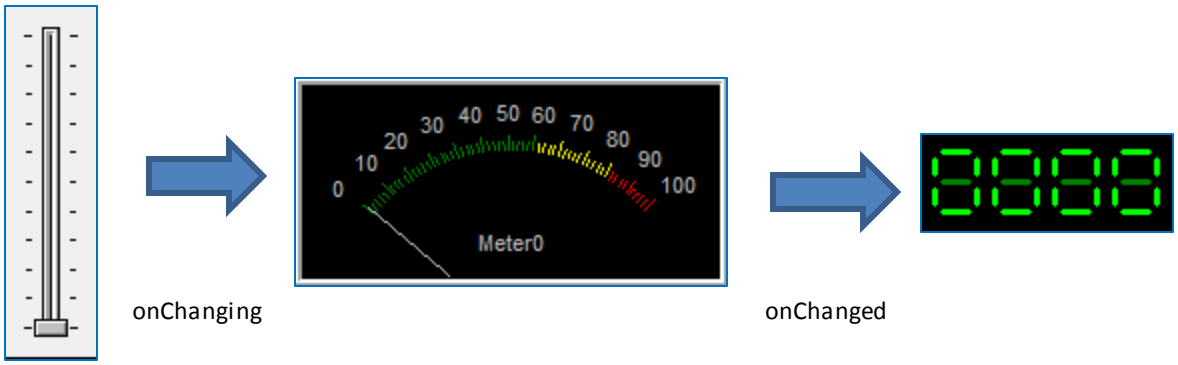
Now, the meter has the event **OnChanged** raised when the meter receives a new value.



An action can be associated to that event to send the value to the **LedDigits0** object:



Summarising:



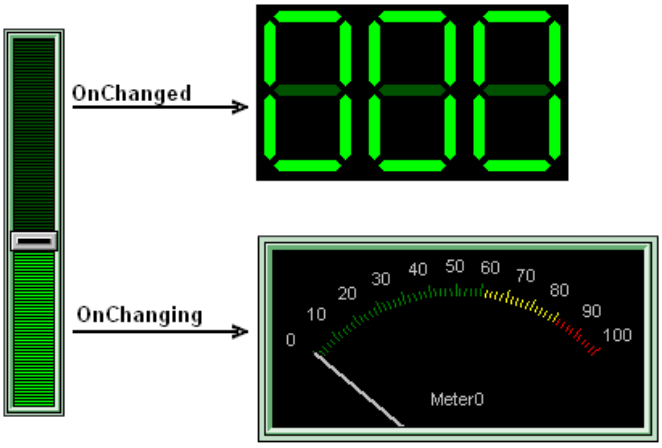
onChanging onChanged

- Moving the track-bar raises the **OnChanging** event, which sends a message to **Meter0** with the value;
- The meter **Meter0** displays the new value and raises the **OnChanged** event, which sends a message to **LefDigits0** with the value.

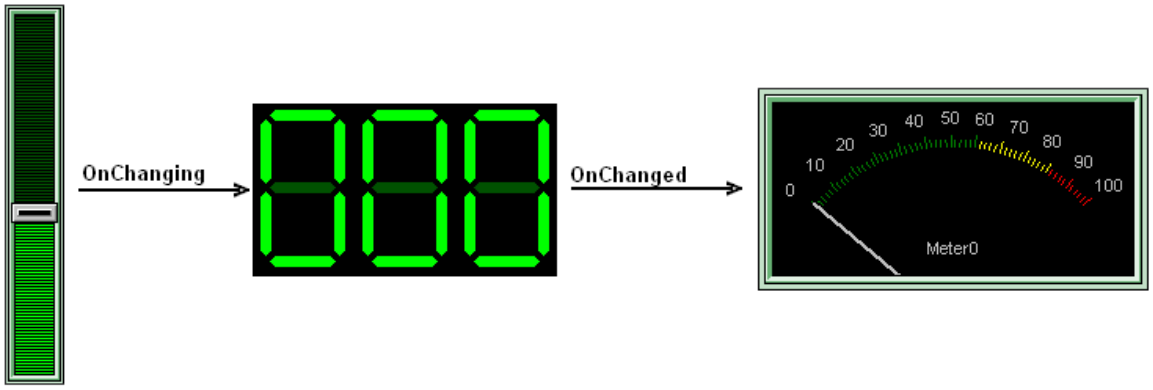
That way, multiple objects can be controlled.

6.4. Chaining Objects

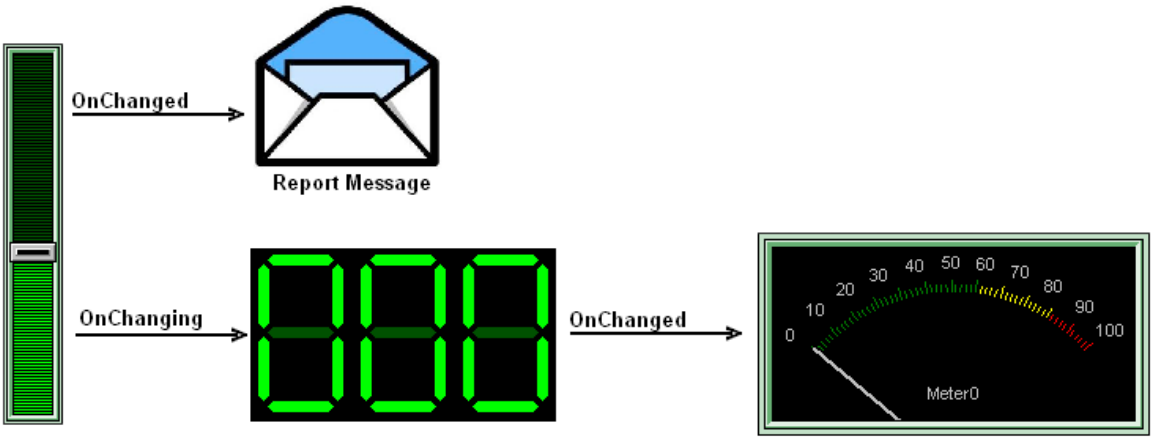
Combining the **OnChanged** and **OnChanging** events with sending messages from one object to another allows multiple configurations:



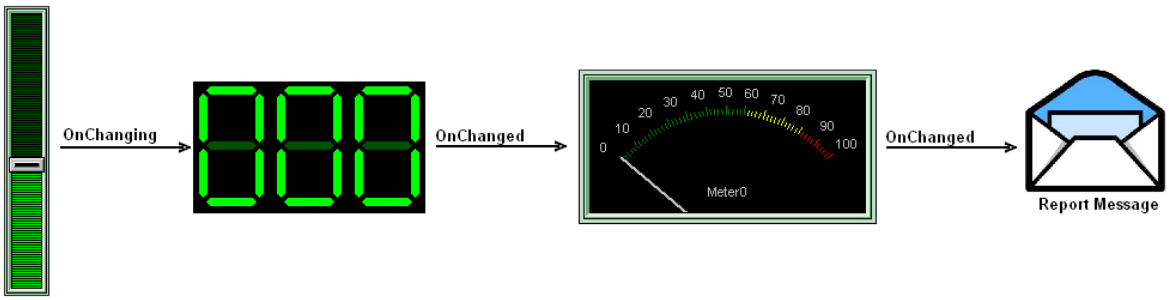
Another configuration with the same result:



A message is sent to the host controller once the track-bar has been released:



Another configuration with the same result:



For more information on the interfacing of ViSi-Genie with a host micro-controller, please refer to the application note 4D-AN-P4010 ViSi-Genie - Connection to a Host with Red-Green-Blue LED Control.

7. Objects

ViSi-Genie relies on three groups of objects:

- The **INPUT OBJECTS** produce stimuli data for INPUT type objects or directly to Serial output. The animation for these objects is done under the hood, for example the slider thumb movements, etc. A button press can launch a sub-form or can send out serial data or cause another event to occur.
  Example: a button.
- The **OUTPUT OBJECTS** only react to OUTPUT stimuli. The stimulus data can come from the Serial port or an INPUT object. They produce no input data or stimuli. The animation for these objects is performed under the hood, for example incoming serial data can move the needle of the meter, etc. OUTPUTs can be set regardless of whether they are displayed on the current form, when the form containing them is displayed, they are displayed with their current value.
  Example: a meter.
- Actually, most objects are **COMBINED OJECTS** or **INPUT/OUTPUT OBJECTS**. Most input objects can also function as outputs, with the notable exception of Keyboards. Certain objects need both an input stimuli as well as produce an output event. For example, a slider thumb position may need to be remotely controlled from incoming serial data. A button may need to be animated not only using the touch screen but via serial data.
  Example: a slider.

Here is the summary of the input, output and combined objects. A combined object is ticked both as input and output.

Pane	Object	Input	Output
Button	Win Button	✓	✓
	4D Button	✓	✓
	Ani Button	✓	✓
	User Button	✓	✓
Digits	Led Digits		✓
	Custom Digits		✓
	Led		✓
	User Led		✓
Gauges	Meter		✓
	Gauge		✓
	Angular Meter		✓
	Cool Gauge		✓
	Thermometer		✓
	Spectrum		✓
	Scope		✓
	Tank		✓

Pane	Object	Input	Output
Primitives	Circle		
	Rectangle		
	Triangle		
	Line		
	Ellipse		
	Panel		

Pane	Object	Input	Output
Inputs	Knob	✓	✓
	Rotary Switch	✓	✓
	Slider	✓	✓
	Track Bar	✓	✓
	Keyboard	✓	
	Dip Switch	✓	✓
	Rocker Switch	✓	✓
	Color Picker	✓	✓

Pane	Object	Input	Output
Labels	Label		
	Static Text		
	Strings		✓

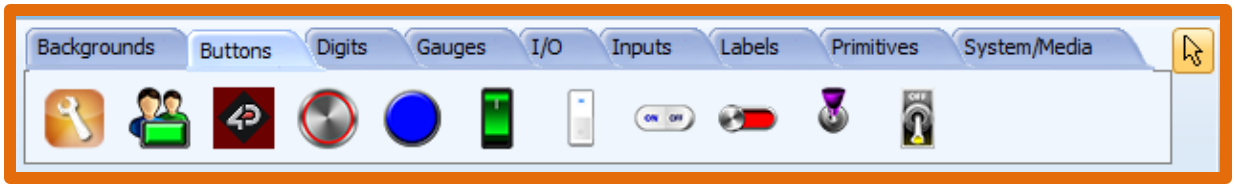
Pane	Object	Input	Output
System / Media	Image		
	Video		✓
	Form		✓
	Sound		✓
	Timer		✓
	User Images		✓

Pane	Object	Input	Output
I/O	Pin Input	✓	
	Pin Output		✓

Each object is presented with its button on the left and an example on the right when used on a form.

Objects are drawn on the display in the order they are created in the Workshop project. If Image objects are to be used for the background and other objects on top, then the image objects must be created and added first. Also note this only applies to non-active Image objects, other active objects should not be added on top of each other.

7.1. Buttons Object



The Buttons pane contains the WinButton, User Button, Animated Button, and the 4D Buttons. These objects have one single event, onChanged. Buttons can be linked together to form a group through a matrix. When one button of the matrix is pressed, the previous one is released. Buttons can also be momentary or toggle type.

For more information on the button objects, please refer to the application notes as they become available.

7.1.1. Win Button

This object has one single event, onChanged.

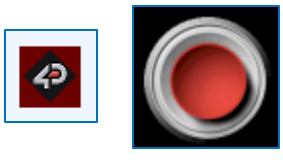
For more information on the win button object, please refer to the application note 4D-AN-P4004 ViSi-Genie – Advanced Buttons.

7.1.2. User Button

A generic button object for the users to create their own buttons with. The user button has four states – up, up pressed, down, and down pressed. The user provides the image for each of these states. The user button can be turned in to either a momentary, toggle, or matrix type.

For more information on the user button object, please refer to the application note 4D-AN-D4006 ViSi-Genie – User Button.

7.1.3. Animated Button



The animated button plays a sequence of images when touched. The user provides these images and sets the delay interval with which they are displayed. The animated button can be turned in to either a momentary, toggle, or matrix type.

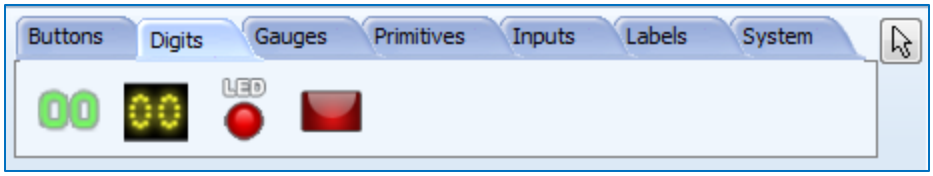
For more information on the animated button object, please refer to the application note 4D-AN-D4007 ViSi-Genie – Animated Button.

7.1.4. 4D Buttons

There are various 4D button types available in Workshop. The user can choose among the predefined sizes and styles. The 4D buttons can also be turned in to either a momentary, toggle, or matrix type.

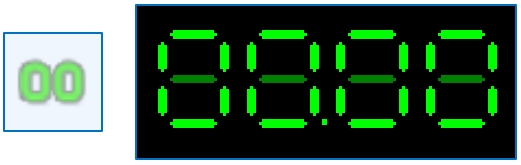
For more information on the 4D button objects, please refer to the application note 4D-AN-D4008 ViSi-Genie – 4D Buttons.

7.2. Digits Objects



The Digits pane contains 4 different displays.

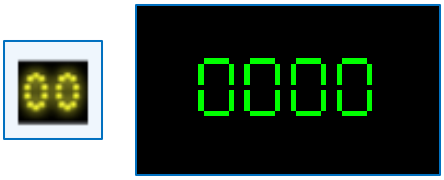
7.2.1. LED Digits



The number of digits, the decimal place, the size, the leading zeros can be customised.

This object has one single event, onChanged, very useful to send the value received.

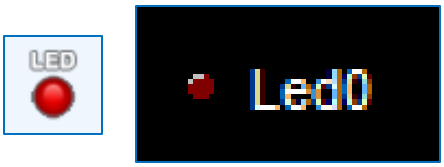
7.2.2. Custom Digits



This object offers no customisation.

This object has one single event, onChanged, very useful to send the value received.

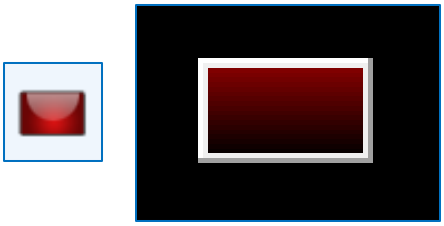
7.2.3. LED



The size, the label, the font and the colour can be customised.

This object has one single event, onChanged, very useful to send the value received.

7.2.4. User LED

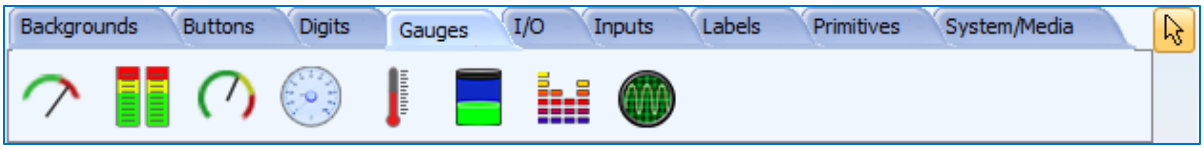


The size and the colour can be customised.

This object has one single event, onChanged, very useful to send the value received.

For more information on the Digits objects, please refer to the application note 4D-AN-P4012 ViSi-Genie - Digital Displays.

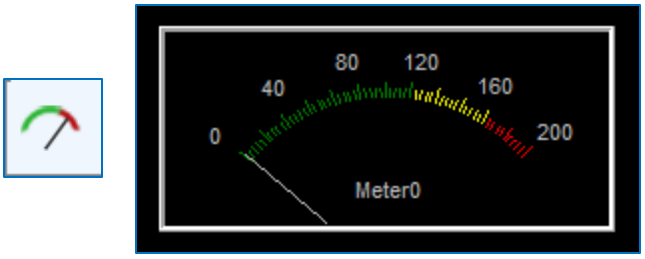
7.3. Gauges Objects



The Gauges pane contains 8 specialised displays.

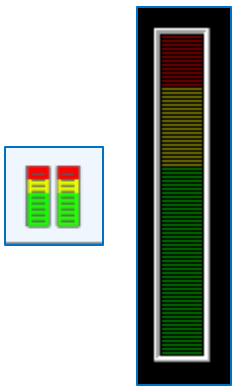
For more information on the Gauge objects, please refer to the application note 4D-AN-P4008 ViSi-Genie - Gauges. Dedicated application notes for some of the gauge objects are also available.

7.3.1. Meter



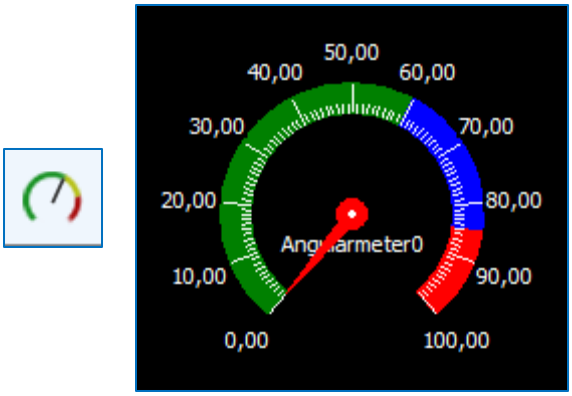
The meter displays a value in a dial. Minimum and maximum, number of intervals and scales, all colours are fully configurable, among other options. The meter is an output object and can send a message when changed. This object has one single event, onChanged, very useful to send the value received.

7.3.2. Gauge



The gauge displays a value in a dial. Minimun and maximum, number of intervals, scales and three palettes, all colours are fully configurable, among other options. The gauge is an output object and can send a message when changed. This object has one single event, onChanged, very useful to send the value received.

7.3.3. Angular Meter

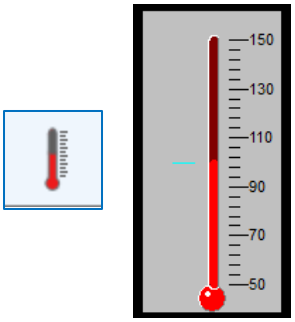


The angular meter displays a value in a dial. Minimun and maximum, number of intervals, scales and three zones, all colours are fully configurable, among other options. The angular meter is an output object and can send a message when changed. This object has one single event, onChanged, very useful to send the value received.

7.3.4. Cool Gauge

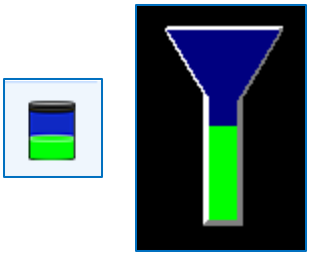
The cool gauge displays a value in a dial. Minimun and maximum, linear or logarithmic scales, all colours are fully configurable, among other options. The cool gauge is an output object and can send a message when changed. This object has one single event, onChanged, very useful to send the value received.

7.3.5. Thermometer



This object offers no customisation. This object has one single event, onChanged, very useful to send the value received.

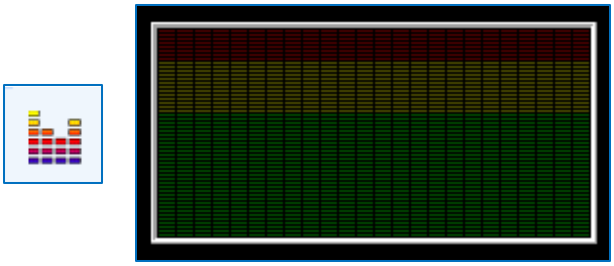
7.3.6. Tank



The tank object can be used to visually represent how much of an area is occupied. Minimun and maximum values and all colours are fully configurable, among other options. The tank is an output object and can send a message when changed. This object has one single event, onChanged, very useful to send the value received.

For more information on the tank object, please refer to the application note 4D-AN-D4002 ViSi-Genie - Tank.

7.3.7. Spectrum

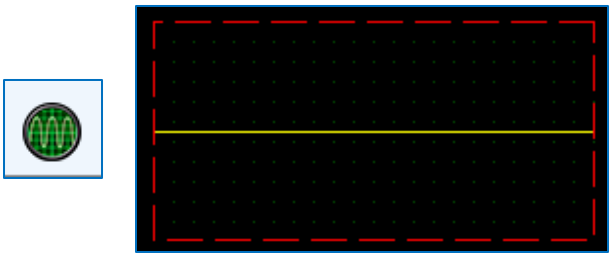


The spectrum can be used to visually indicate multiple quantity levels. It can be used as a bar graph or as an audio equalizer display, among other possible applications. The spectrum object is designed to be controlled or written to by an external host controller. Values can only be meaningfully be written to a Spectrum whilst its form is displayed. Each value written to a spectrum is comprised of two bytes, the first byte is the bar (0 to Columns-1), the second byte is the value (0 to maximum value). If the form on which the Spectrum appears is changed all displayed values should be considered lost and must be resent from the host when the form containing the spectrum is redisplayed.

The spacing between, number, and width of bars and area colours are all configurable, among other options. This object has no event.

For more information on the spectrum object, please refer to the application note 4D-AN-D4003 ViSi-Genie - Spectrum.

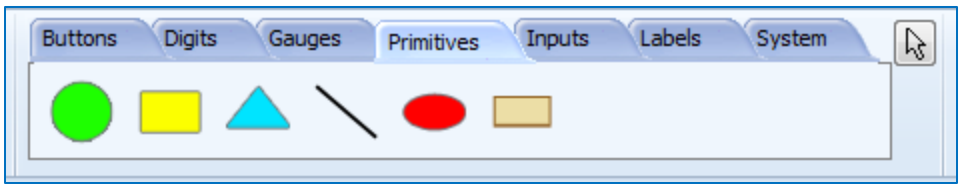
7.3.8. Scope



The scope can display a maximum of four signal traces on the screen. It is designed to be driven by an external host controller. The number and colour of the traces, the rate at which the scope is updated, the amplification/attenuation of the trace in the Y direction, the compression/expansion of the trace in the X direction, and the properties of the graticule are all configurable, among other options. This object has no event.

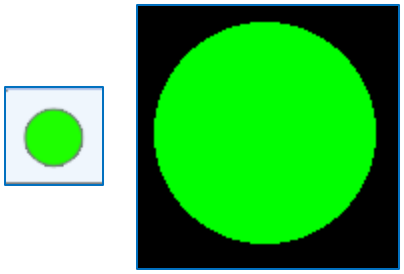
For more information on the scope object, please refer to the application note 4D-AN-D4004_ViSi-Genie_Single-Trace-Scope.

7.4. Primitives Objects



The Primitives pane offers standard static drawings.

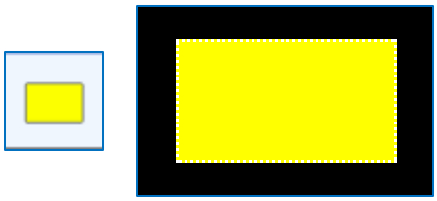
7.4.1. Circle



The colour and the option of empty or solid can be customised.

This object has no event.

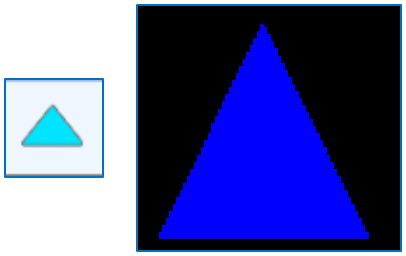
7.4.2. Rectangle



The colour, the outline and the option of empty or solid can be customised.

This object has no event.

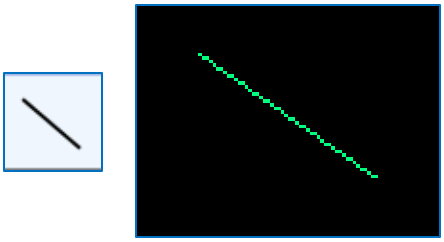
7.4.3. Triangle



The colour, the outline and the option of empty or solid can be customised.

This object has no event.

7.4.4. Line



The colour and the pattern can be customised.

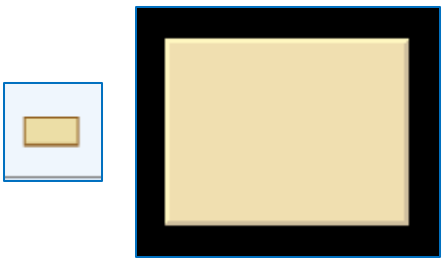
This object has no event.

7.4.5. Ellipse

The colour and the option of empty or solid can be customised.

This object has no event.

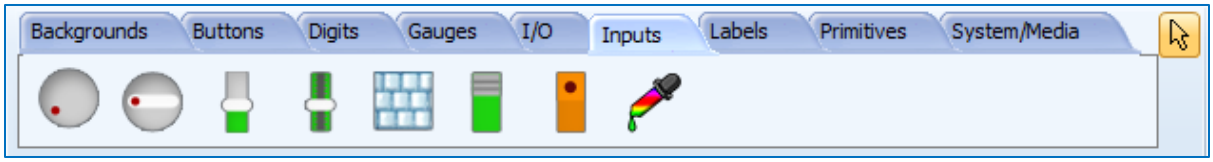
7.4.6. Panel



The colour, the outline, the state lowered or raised can be customised.

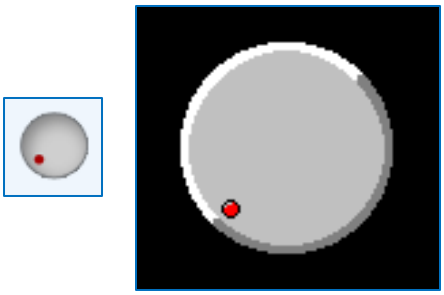
This object has no event.

7.5. Inputs Objects



The Inputs pane contains rotary selectors, linear selectors, keyboards, switches, and color picker.

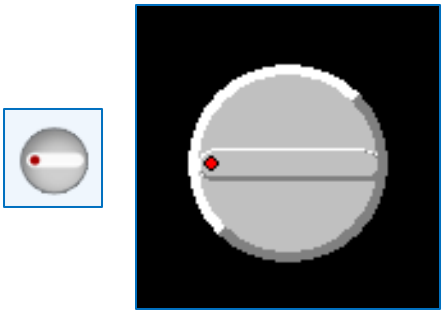
7.5.1. Knob



The minimum and maximum angles, the back and the handle can be customised.

This object has two events, **onChanged** and **onChanging**.

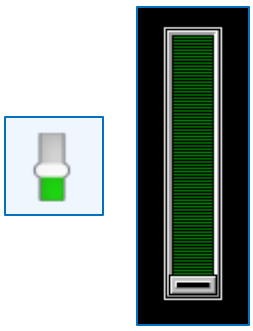
7.5.2. Rotary Switch



The minimum and maximum angles, the positions and labels, the switch and the winch colours can be customised.

This object has two events, **onChanged** and **onChanging**.

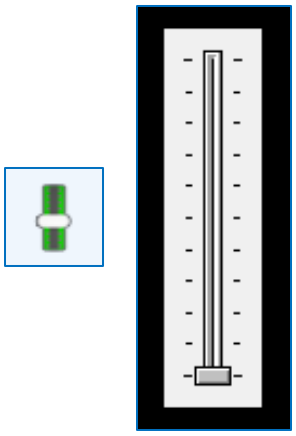
7.5.3. Slider



The minimum and maximum values, the vertical or horizontal orientations, the colours can be customised.

This object has two events, **onChanged** and **onChanging**.

7.5.4. Track-bar



The minimum and maximum values, the vertical or horizontal orientations, the frequency and ticks, the colours can be customised.

This object has two events, **onChanged** and **onChanging**.

7.5.5. Keyboard

ViSi-Genie comes with various defined keyboards:

- QWERTY keyboard, by default,

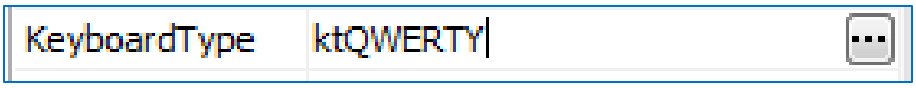
- Cell-phone keyboard

- Numeric keyboard

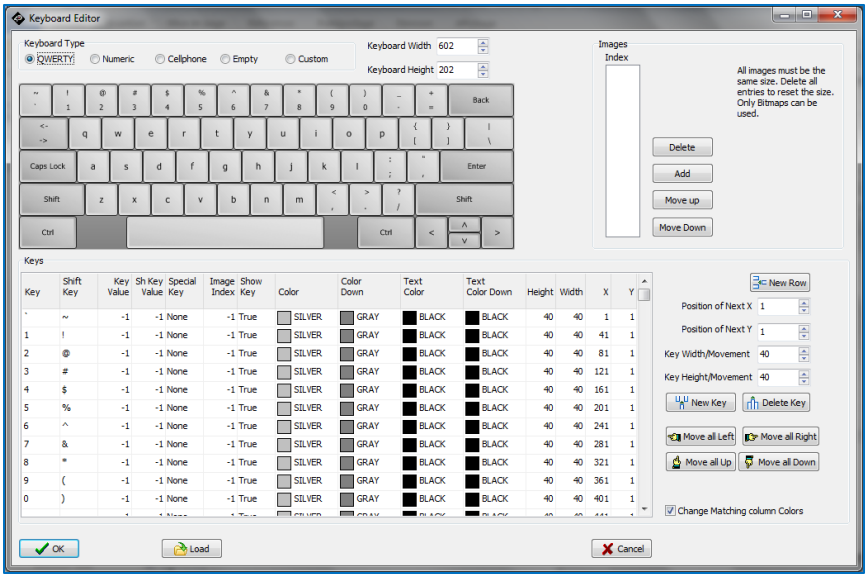
- And even a customised keyboard.

This object has one single event, onChanged, and sends the key pressed.

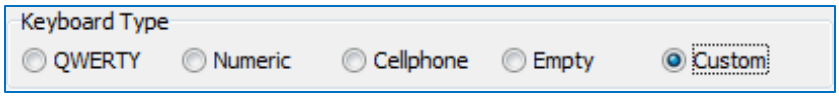
The different keyboards are selected by clicking on the **KeyboardType** property:



Click on the button  to launch the Keyboard Editor:

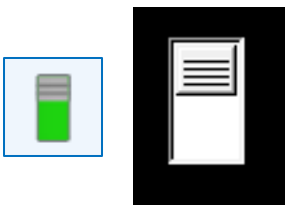


The Keyboard Editor allows you to select and customise the keyboard:



For more information on the Keyboard object, please refer to the application note 4D-AN-P4003 ViSi-Genie – Customised Keyboard.

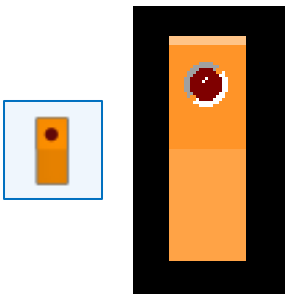
7.5.6. DIP Switch



The number of positions of the switch can be specified, 2 as shown or more.

This object has two events, onChanged and onChanging.

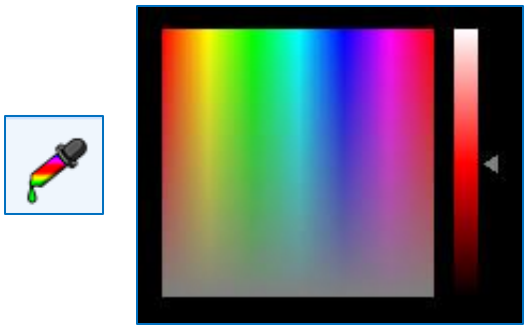
7.5.7. Rocker Switch



When on, the red LED is turned on. This object has two events, onChanged and onChanging.

For more information on the Inputs objects, please refer to the application note 4D-AN-P4009 ViSi-Genie - Inputs.

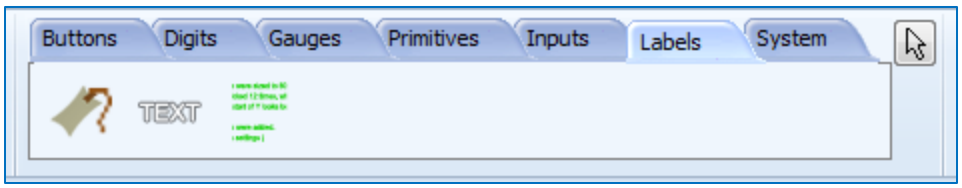
7.5.8. Color Picker



When touched at a certain point the color picker sends a corresponding message to the external host controller. The two-byte value contained by the message from a color picker represents the 16 bit color value in 565 format (5 bits of Red, 6 bits of Green, and 5 bits of Blue). On the other hand, if the host controller sends a message to the color picker, the colour contained by the message is indicated on the display. This object has one single event, onChanged, very useful to send the colour value.

For more information on the color picker, please refer to the application note 4D-AN-D4005 ViSi-Genie – Color Picker.

7.6. Labels Objects



The Labels pane offers three different objects to display text.

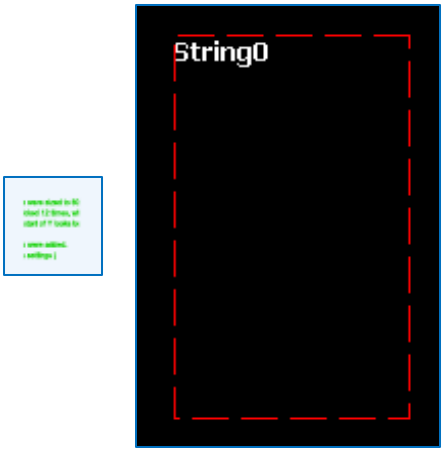
7.6.1. Label

This object has no event.

7.6.2. Static Text

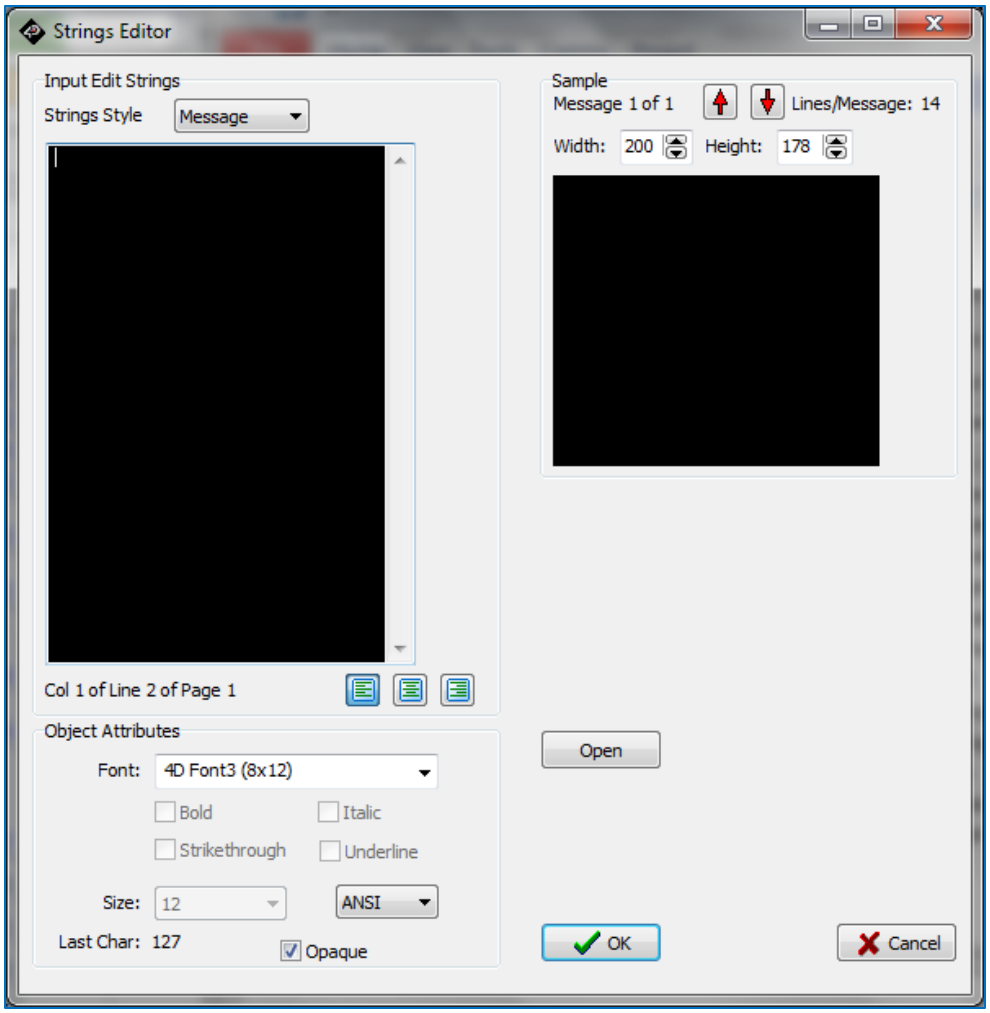
This object has no event.

7.6.3. Strings



This object displays a text.

The text is defined by:

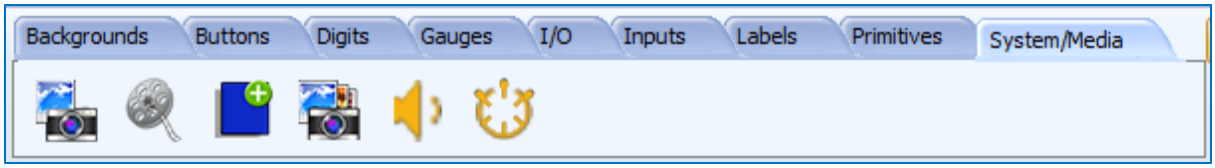


Font, size, ANSI or Unicode can be defined.

This object has no event.

For more information on the Labels objects, please refer to the application note 4D-AN-P4013 ViSi-Genie - Labels, Texts and Strings.

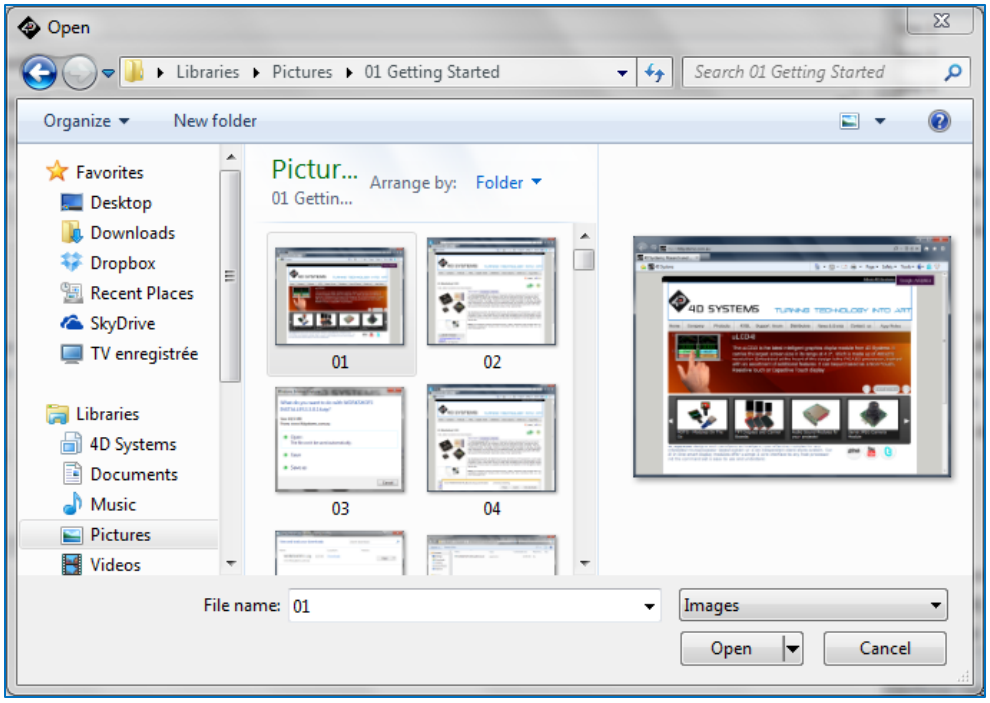
7.7. System/Media Objects



The System pane includes the form, image and video objects and two invisible objects, timer and sound.

7.7.1. Image

The image is selected through an Open window:

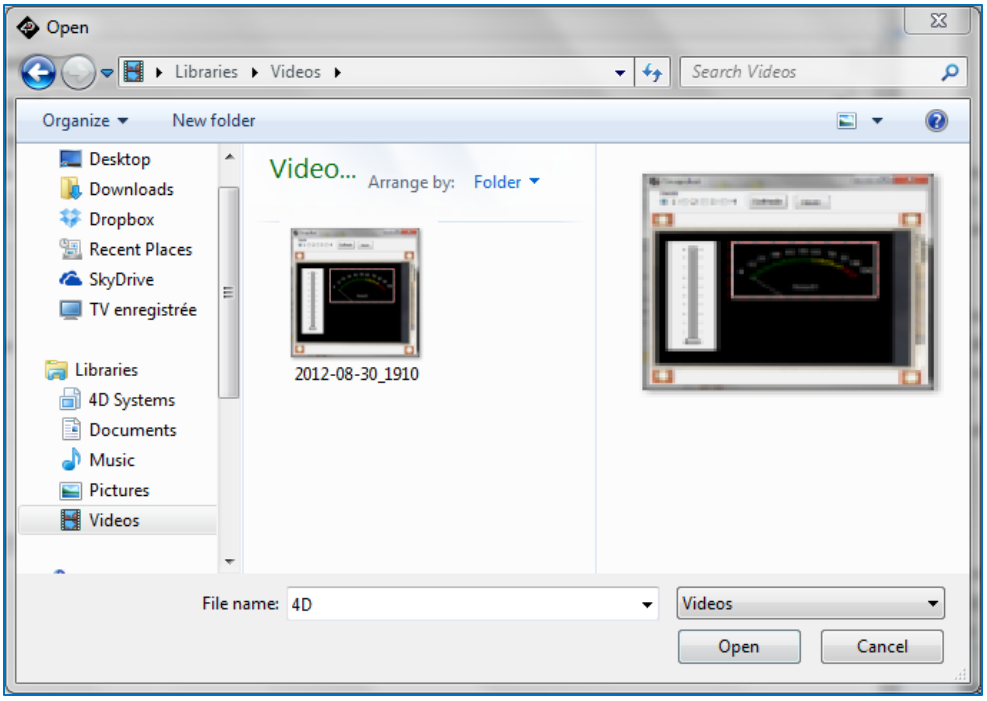


This object has no event.

For more information on the Image object, please refer to the application note 4D-AN-P4005 ViSi-Genie - Show Image.

7.7.2. Video

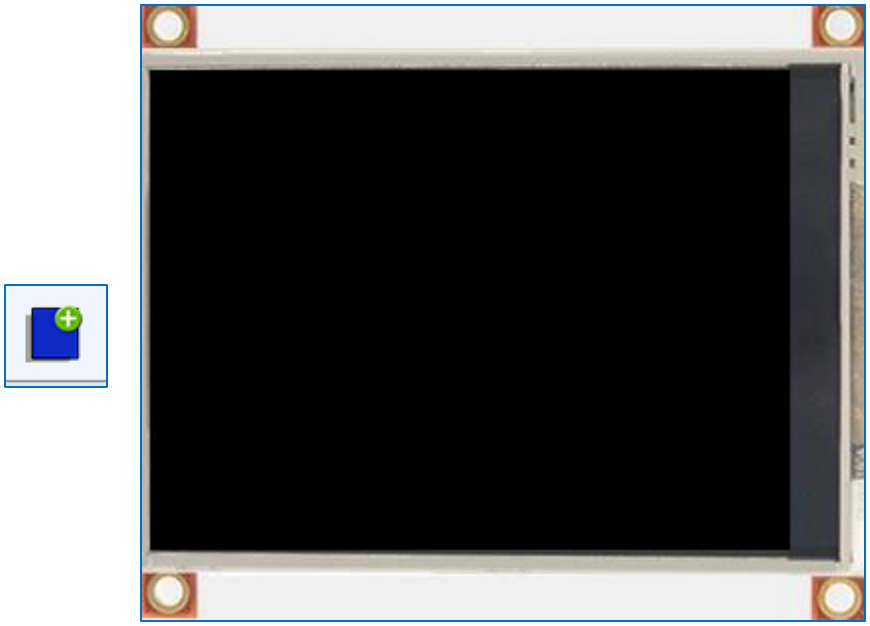
The video is selected through an Open window:



This object has one single event, onChanged.

For more information on the Video object, please refer to the application note 4D-AN-P4007 ViSi-Genie - Play Video.

7.7.3. Form



The Form creates a new empty form and adds it to the project.

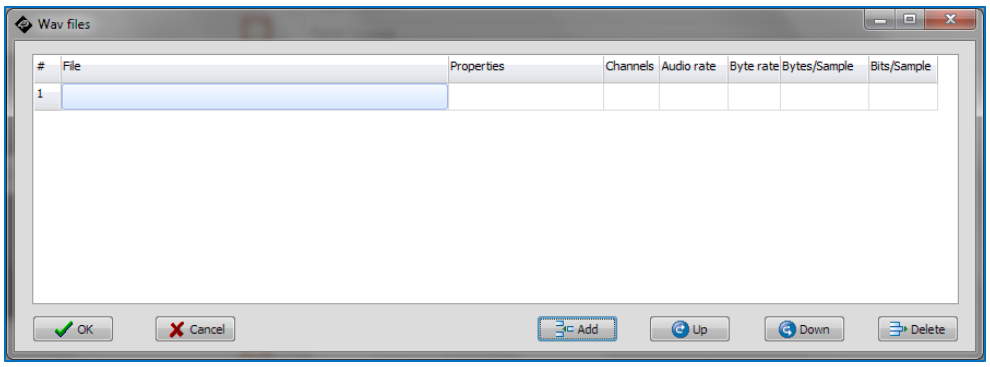
This object has one single event, onActivate.

7.7.4. Sounds

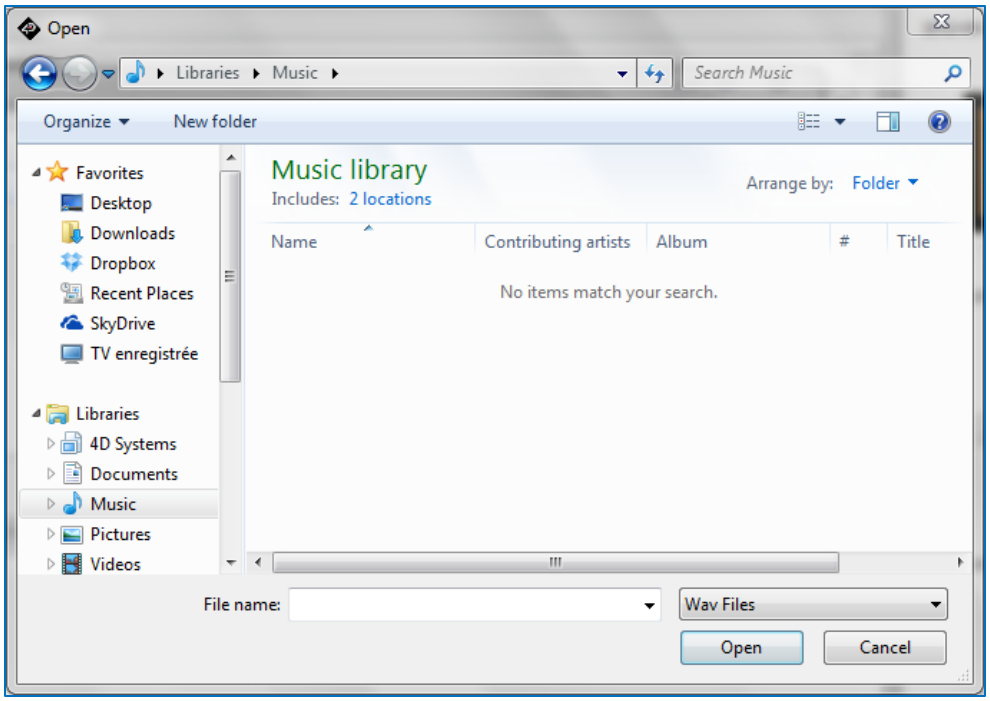
Sound is an invisible object.

This object has two events, onPlayingChanged and onVolumeChanged.

The Sound object contains a list of sound files:

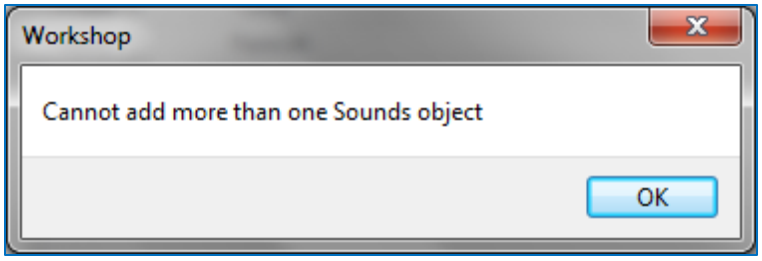


To add a sound file, click on **Add**: the sound file is selected through an Open window:



Files can be sorted by clicking on **Up** or **Down** and removed by clicking on **Delete**.

Only one Sound object can be added per project, but this sound object can contain multiple sound files.



For more information on the Sound object, please refer to the application note 4D-AN-P4006 ViSi-Genie - Play Sound.

7.7.5. Timer

Timer is an invisible object. It raises an event, here every *1000 ms*.

This object has one single event, onTimer.

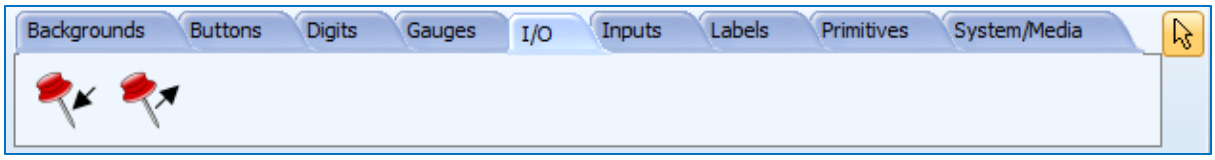
7.7.6. User Images

The user images object represents an easy way to build a slideshow by joining together a sequence of images in one place. The user provides the images and can use an input type object, such as a button or a slider, to make the user images object display the next or previous frame.

The user images object can also be made to behave as a video player with the use of a timer object. Each click of the timer will increment to the next frame. The user images object has one single event, onChanged, which is useful for sending the value of the current frame.

For more information on the user images object, please refer to the application note 4D-AN-D4010 ViSi-Genie – User Images.

7.8. I/O



The I/O pane includes the pin input and the pin output.

For more information on the I/O objects, please refer to the application note 4D-AN-D4009 ViSi-Genie – Pin Input and Output.

7.8.1. Pin Input

The user can read the status of a specific pin when it's configured as a **PinInput** object. Multiple PinInputs can use the same pin. It is the users' responsibility to manage such usage in a reasonable way. This object has one single event, onChanged, which can cause either another output to be changed or a message to be sent to the host.

Do not set a pin to both input and output as undesirable results may occur. If you need to read an output pin from your host then use the normal read command for the PinOutput.

The PinInput object (like the PinOutput) will always reside in Form0.

7.8.2. Pin Output

When a specific pin is configured as a **PinOutput** object, the user can control or pulse its output. Multiple PinOutputs can use the same pin. It is the users' responsibility to manage such usage in a reasonable way.

An input object such as a button can be linked to a PinOutput object. Logically, it makes sense to only connect a momentary button to a pulsed output pin and a toggled button to a non-pulsed output. Of course, it occasionally come in handy to be able to do the non-apparent, so you can set these options any way you like.

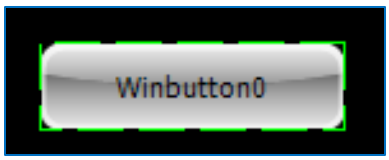
This object has one single event, onChanged, which can trigger another output to be changed or a message to be sent to the host. PinOutputs can be read by the host.

The PinOutput object (like the PinInput) will always reside in Form0.

7.9. Selection Tool

The arrow is used to deselect an object.

To select an object, just click on it: green or red dotted lines appear.



To deselect an object, just click again: the dotted lines disappear.

8. ViSi-Genie Communications Protocols

The ViSi-Genie display platform offers a serial communications protocol called the **Genie Standard Protocol**. The protocol provides access to a majority of the display's features and gives the host detailed information on the current state of all the objects used in the display application.

The **Genie Standard Protocol** provides a simple yet effective interface between the display and the host controller and all communications are reported over this bidirectional link. The protocol utilises only a handful of commands and is simple and easy to implement.

Serial data settings are:

8 Bits, No Parity, 1 Stop Bit.

The baud rate for the display is selected from the Workshop Genie project. The user should match the same baud rate on the host side.

Note: RS-232 handshaking signals (i.e., RTS, CTS, DTR, and DSR) are not supported by the ViSi-Genie protocols. Instead, only the RxD (received data), TxD (transmitted data), and signal ground are used.

Objects are drawn on the display in the order they are created in the Workshop project. If Image objects are to be used for the background and other objects on top, then the image objects must be created and added first. Also note this only applies to non-active Image objects, other active objects should not be added on top of each other.

8.1. Genie Standard Protocol

This section describes the Genie Standard Protocol in detail.

8.1.1. Protocol Definitions

The commands and parameters are sent and received using a very simple messaging structure. The message consists of a command byte, command parameters, and a checksum byte. The checksum ensures some the integrity of the message. The following figure shows the organisation of the message.

CMD	PARAM (1 to N bytes)	CHKSUM

- **CMD:** This byte indicates the command code. Some commands will have more parameters than others. The table below outlines the available commands and their relevant parameters.
- **PARAM:** Parameter bytes (variable); a variable number of parameter bytes (between 1 to N) that contains information pertaining to the command. Refer to the command table below.
- **CHKSUM:** Checksum byte; this byte is calculated by taking each byte and XOR'ing all bytes in the message from (and including) the CMD byte to the last parameter byte. Then, the result is appended to the end to yield the checksum byte.

Note: If is correct, check byte plus the sum of all the other bytes in the message will give a result of 0.

8.1.2. Command and Parameters Table

Command	Code	Parameter 1	Parameter 2	Parameter 3	Parameter 4	Parameter N	Checksum
READ_OBJ	**0x00**	Object ID	Object Index	-	-	-	Checksum
WRITE_OBJ	**0x01**	Object ID	Object Index	Value (msb)	Value(lsb)	-	Checksum
WRITE_STR	**0x02**	String Index	String Length	String (1 byte chars)			Checksum
WRITE_ STRU	**0x03**	String Index	String Length	String (2 byte chars)			Checksum
WRITE_ CONTRAST	**0x04**	Value	-	-	-	-	Checksum
REPORT_OBJ	**0x05**	Object ID	Object Index	Value (msb)	Value(lsb)	-	Checksum
REPORT_EVENT	**0x07**	Object ID	Object Index	Value (msb)	Value(lsb)	-	Checksum

8.1.3. Command Set Messages

The ViSi-Genie Reference Manual provides detailed information intended for programmers of the Host Controller. It contains the message formats of the commands that comprise the ViSi-Genie protocol. New commands may be added in future to expand the protocol.

8.1.4. Acknowledgement Bytes Table

ACK	Acknowledge byte (06hex); this byte is issued by the Display to the Host when the Display has correctly received the last message frame from the Host. The transmission message for this is a single byte: 06hex
NAK	Not Acknowledge byte (15hex); this byte is issued by the receiver (Display or Host) to the sender (Host or Display) when the receiver has not correctly received the last message frame from the sender. The transmission message for this is a single byte: 15hex

8.2. Genie Advanced Protocol

Genie advanced protocol allows managing multiple screens will be released soon.

8.3. Object Types Table

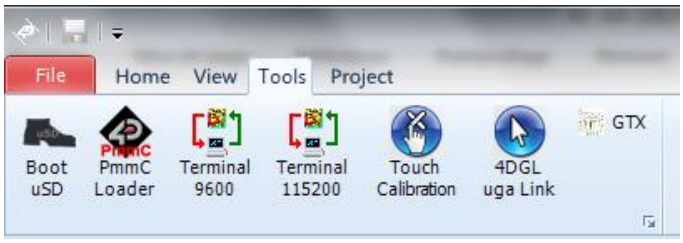
Object	ID	Input	Output	Notes
Dipswitch	0 (0x00)	✓	✓	
Knob	1 (0x01)	✓	✓	
Rockerswitch	2 (0x02)	✓	✓	
Rotaryswitch	3 (0x03)	✓	✓	
Slider	4 (0x04)	✓	✓	
Trackbar	5 (0x05)	✓	✓	
Winbutton	6 (0x06)	✓	✓	
Angularmeter	7 (0x07)		✓	
Coolgauge	8 (0x08)		✓	
Customdigits	9 (0x09)		✓	
Form	10 (0x0A)		✓	Used to set the current form
Gauge	11 (0x0B)		✓	
Image	12 (0x0C)			Displayed as part of form, no method to alter
Keyboard	13 (0x0D)	✓		Keyboard inputs are always single bytes and are unsolicited
Led	14 (0x0E)		✓	
Leddigits	15 (0x0F)		✓	
Meter	16 (0x10)		✓	
Strings	17 (0x11)		✓	
Thermometer	18 (0x12)		✓	
Userled	19 (0x13)		✓	
Video	20 (0x14)		✓	
Statictext	21 (0x15)			Displayed as part of form, no method to alter
Sound	22 (0x16)		✓	
Timer	23 (0x17)		✓	
Spectrum	24 (0x18)		✓	
Scope	25 (0x19)		✓	
Tank	26 (0x1A)		✓	
UserImages	27 (0x1B)		✓	
PinOutput	28 (0x1C)		✓	
PinInput	29 (0x1D)	✓		
4Dbutton	30 (0x1E)	✓	✓	
AniButton	31 (0x1F)	✓	✓	

ColorPicker	32 (0x20)	✓	✓	
UserButton	33 (0x21)	✓	✓	

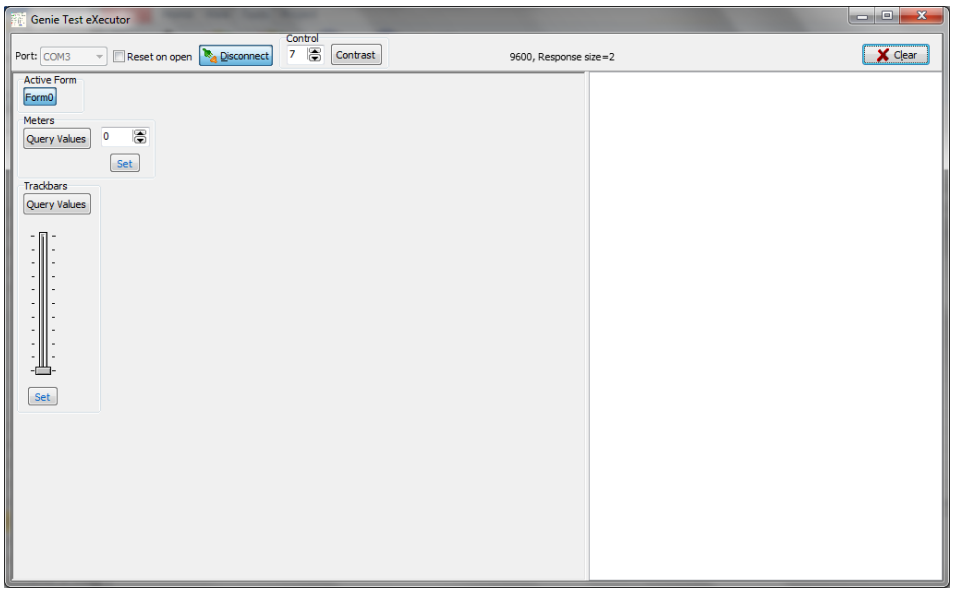
9. Integrated Debugger

The integrated debugger of Workshop 4 is called **Genie Test Executor** or GTX.

To launch the debugger, click on the **GTX** button available on the menu **Tools**.

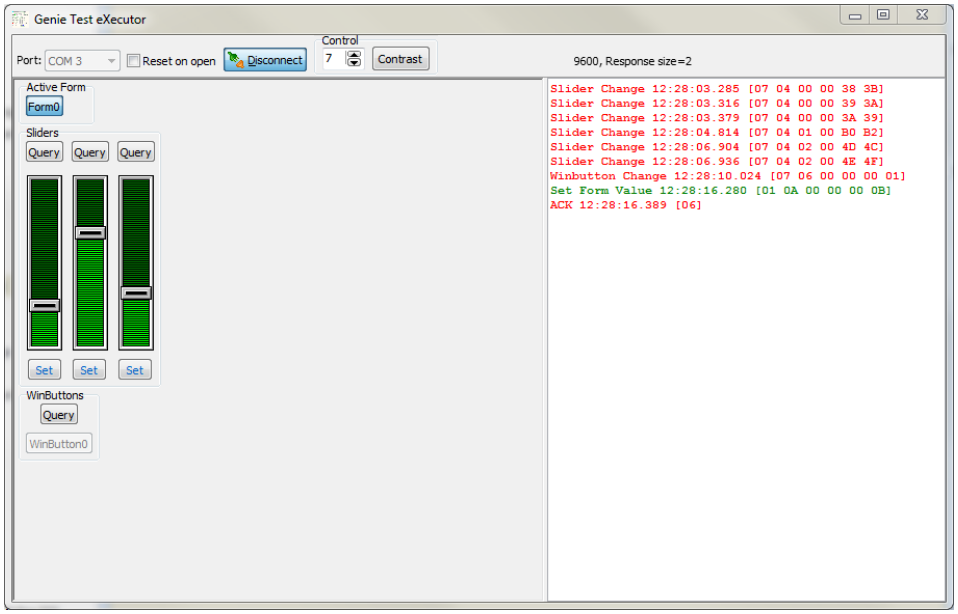


A new screen appears, with the form and objects we have defined previously:



Just try to move the track-bar and press Set: the value is sent to the screen.

Pressing **Query Values** reads the value from the screen's track-bar.



The white area on the right displays:

- In **green** the messages sent to the screen;
- And in **red** the messages received from the screen:

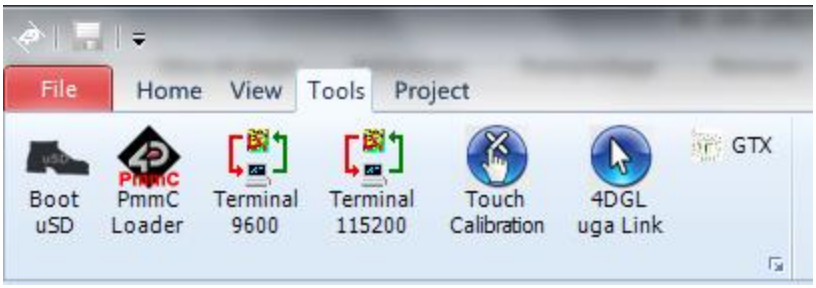
```
Slider Change 12:28:03.285 [07 04 00 00 38 3B]
Slider Change 12:28:03.316 [07 04 00 00 39 3A]
Slider Change 12:28:03.379 [07 04 00 00 3A 39]
Slider Change 12:28:04.814 [07 04 01 00 B0 B2]
Slider Change 12:28:06.904 [07 04 02 00 4D 4C]
Slider Change 12:28:06.936 [07 04 02 00 4E 4F]
Winbutton Change 12:28:10.024 [07 06 00 00 00 01]
Set Form Value 12:28:16.280 [01 0A 00 00 00 0B]
ACK 12:28:16.389 [06]
```

All values are in hexadecimal.

10. Communication Terminal

An alternative to the debugger is the Terminal.

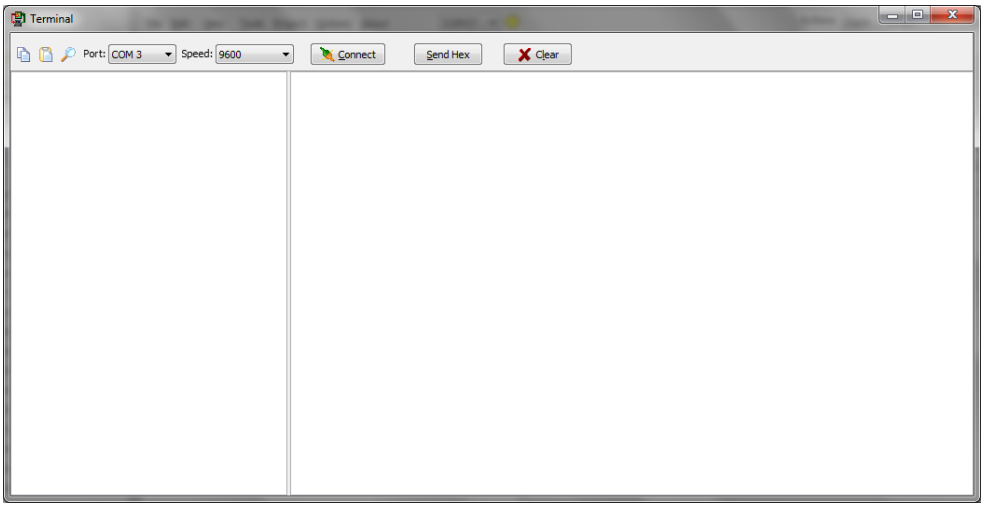
To launch the Terminal, select the **Tools** menu…



…and

- Click '**Terminal connect 9600**' to open the currently selected com port at 9600 baud in the Terminal program.
- Click '**Terminal connect 115200**' to open the currently selected com port at 115200 baud in the Terminal program.

A new screen appears:



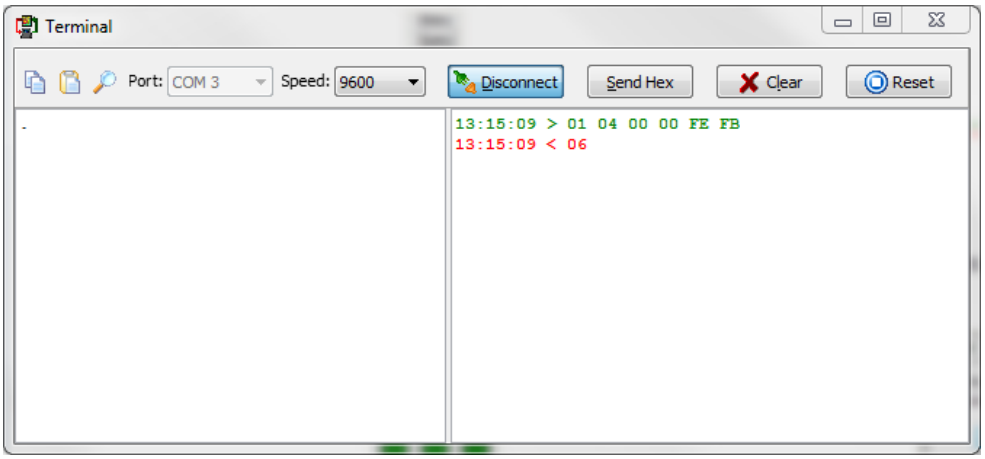
To send the commands on hexadecimal format, press

The commands sent by the host and the messages sent by the screen are the same as with the **Genie Test Executor** debugger.

The white area on the right displays

- In **green** the messages sent to the screen;
- And in **red** the messages received from the screen:

Here, the command *Set Slider0 to value 0x17* is sent, or **04 00 17** displayed in green on the terminal window.



And the screen answers with the **0x06** successful acknowledgement, displayed on red on the terminal window.

11. Application Notes

For a more detailed presentation of the objects with examples, please refer to the corresponding application notes:

Reference	Content
4D-AN-P4001	Getting Started - First Project with ViSi-Genie
4D-AN-P4002	ViSi-Genie - onChanging and onChanged Events
4D-AN-P4003	ViSi-Genie - Customised Keyboard
4D-AN-P4004	ViSi-Genie - Advanced Buttons
4D-AN-P4005	ViSi-Genie - Show Image
4D-AN-P4006	ViSi-Genie - Play Sound
4D-AN-P4007	ViSi-Genie - Play Video
4D-AN-P4008	ViSi-Genie - Gauges
4D-AN-P4009	ViSi-Genie - Inputs
4D-AN-P4010	ViSi-Genie - Connection to an Arduino Host with Red-Green-Blue LED Control
4D-AN-P4011	ViSi-Genie - Using Combined Objects
4D-AN-P4012	ViSi-Genie - Digital Displays
4D-AN-P4013	ViSi-Genie - Labels, Texts and Strings
4D-AN-D4002	ViSi-Genie - Tank
4D-AN-D4003	ViSi-Genie - Spectrum
4D-AN-D4004	ViSi-Genie - Single Trace Scope
4D-AN-D4005	ViSi-Genie - Color Picker
4D-AN-D4006	ViSi-Genie - User Button
4D-AN-D4007	ViSi-Genie - Animated Button
4D-AN-D4008	ViSi-Genie - 4D Buttons
4D-AN-D4009	ViSi-Genie - Pin Input and Output

For an exhaustive reference on ViSi-Genie objects, please refer to the ViSi-Genie Reference Manual.

12. Revision History

Revision	Revision Content	Revision Date
1.0	First Release	Nov 19, 2012
1.1	Fixed protocol information which was incorrect	Mar 21, 2013
1.2	Added new widgets	Sept 23, 2013

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For Technical Support: support@4dsystems.com.au

For Sales Support: sales@4dsystems.com.au

Website: www.4dsystems.com.au