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Embedded - Microcontrollers - Application Specific: Tailored Solutions for Precision and Performance

Embedded - Microcontrollers - Application Specific represents a category of microcontrollers designed with unique features and capabilities tailored to specific application needs. Unlike general-purpose microcontrollers, application-specific microcontrollers are optimized for particular tasks, offering enhanced performance, efficiency, and functionality to meet the demands of specialized applications.

What Are Embedded - Microcontrollers - Application Specific?

Application-specific microcontrollers are engineered to

Details	
Product Status	Active
Applications	Graphics Processor
Core Processor	EVE
Program Memory Type	FLASH (10kB)
Controller Series	-
RAM Size	510 x 8
Interface	LCD, OLED, SD/SDHC, SPI, TFT, UART
Number of I/O	2
Voltage - Supply	3V ~ 3.6V
Operating Temperature	-40°C ~ 80°C
Mounting Type	Surface Mount
Package / Case	28-VQFN Exposed Pad
Supplier Device Package	28-QFN (6x6)
Purchase URL	https://www.e-xfl.com/product-detail/4d-systems/goldelox

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1. Description

The GOLDELOX is a custom embedded graphics controller designed to interface with many popular OLED and LCD display panels. Powerful graphics, text, image, animation and countless more features are built right inside the chip. It offers a simple plug-n-play interface to many 8bit 80-Series colour LCD and OLED displays.

The chip is designed to work with minimal design effort and all of the data and control signals are provided by the chip to interface directly to the display. Simply choose your display and interface it to the GOLDELOX on your application board. This offers enormous advantage to the designer in development time and cost saving and takes away all of the burden of low level design.

The GOLDELOX belongs to a family of processors powered by a highly optimised soft core virtual engine, EVE (Extensible Virtual Engine). EVE is a proprietary, high performance virtual processor with an extensive byte-code instruction set optimised to execute compiled 4DGL programs. 4DGL (4D Graphics Language) was specifically developed from ground up for the EVE engine core. It is a high level language which is easy to learn and simple to understand yet powerful enough to tackle many embedded graphics applications.

The device offers modest but comprehensive I/O features and can interface to SPI, serial, analogue, digital, buttons, joystick and Dallas 1-wire devices. Provision is also made for creating complex sound effects for audible user feedback with an extended RTTTL tone generator.

All of the display built-in driver libraries implement and share the same high-level function interface. This allows your GUI application to be portable to different display controller types.

4D Systems software development IDE called Workshop 4 is FREE and there are no licensing requirements.

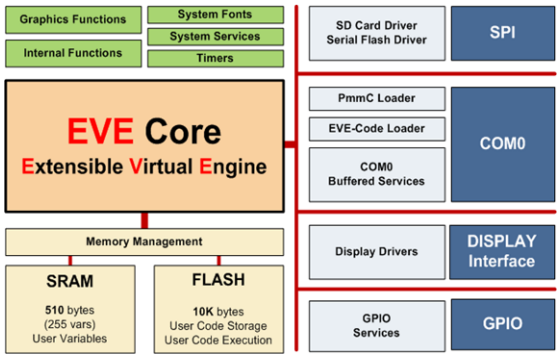
The GOLDELOX offers one of the most flexible embedded graphics solutions available.

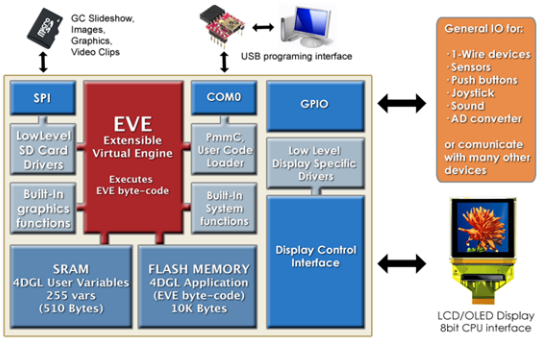
2. Features

- Low-cost OLED, LCD and TFT display graphics user interface solution.
- Ideal as a standalone embedded graphics processor or interface to any host controller as a graphics co-processor.
- Connect to any colour display that supports an 80-Series 8 bit wide CPU interface. All data and control signals are provided.
- Built in high performance virtual processor engine (EVE) with an extensive byte-code instruction set optimised for 4DGL, the high level 4D Graphics Language.
- 2 x GPIO ports supports:
  - Digital I/O
  - A/D converter with 8/10 bit resolution
  - Complex sound generation
  - Dedicated RTTTL tune engine
  - Multi-Switch Joystick
  - Dallas 1-Wire
- 10KB of Flash memory for user code storage and 510 bytes (255 x 16bit vars) of RAM for user variables.
- 1 x 32bit free running system timer with 1msec resolution.
- 4 x 16bit user timers with 1msec resolution
- Asynchronous hardware Serial port with auto-baud feature (300 to 256K baud).
- Hardware SPI port interface for micro-SD/micro-SDHC memory cards or Serial Flash memory chips for storing of icons, images, animations, etc.
- Comprehensive set of built in high level 4DGL graphics functions and algorithms that can draw lines, circles, text, and much more.
- Display full colour images, animations, icons and video clips.
- 8x8 built-in system font and support for unlimited user customisable fonts with fixed or proportional spacing with the aid of a freely provided Font-Tool.
- Single 3.3 Volt Supply @12mA typical.
- Available in a tiny 6mm x 6mm 28pin QFN.

3. Applications

- Industrial (general).
- Test, measurement and general purpose instrumentation
- Elevator Control Systems.
- Point of Sale Terminals.
- Home Appliances (general).
- Security Systems.
- Access Control Systems.
- Air-conditioning Control Systems.
- Universal Remote Control.
- Automotive (general).
- Electronic Gauges and Meters.
- Portable ECG Systems.
- Portable Blood Pressure Monitors.
- Aviation (general).
- Gaming and Slot Machines.
- And much more..



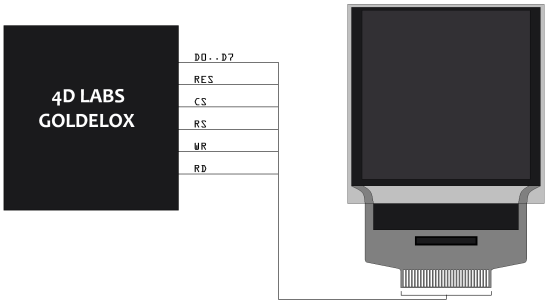


5. Hardware Interface - Pins

The GOLDELOX provides both a hardware and software interface. This section describes in detail the hardware interface.

5.1. Display Interface

The GOLDELOX supports LCD and OLED displays with an 80-Series 8 bit wide CPU data interface. The connectivity to the display is easy and straight forward. The chip generates all of the necessary timing to drive the display.



CS	RS	RD	WR	Operation
0	0	0	1	Read Display Status Register
0	0	1	0	Write Display Index Register
0	1	0	1	Read Display GRAM Data
0	1	1	0	Write Register or GRAM Data
1	X	X	X	No Operation

Display Operation Table

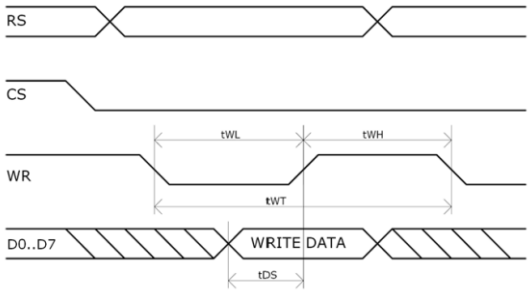
D0-D7 pins (Display Data Bus):
The Display Data Bus (D0-D7) is an 8 bit bidirectional port and all data writes and reads occur over this bus. Other control signals such as RW, RD CS, and RS synchronise the data transfer to and from the display.

CS pin (Display Chip Select):
The access to the display is only possible when the Display Chip Select (CS) is asserted LOW. Connect this pin to the Chip Select (CS) signal of the display.

RS pin (Display Register Select):
The RS signal determines whether a register command or data is sent to the display.
LOW: Display index or status register is selected.
HIGH: Display GRAM or register data is selected.
Connect this pin to the Register Select (RS) signal of the display. Different displays utilise various naming conventions such as RS, A0, C/D or similar. Be sure to check with your display manufacturer for the correct name and function.

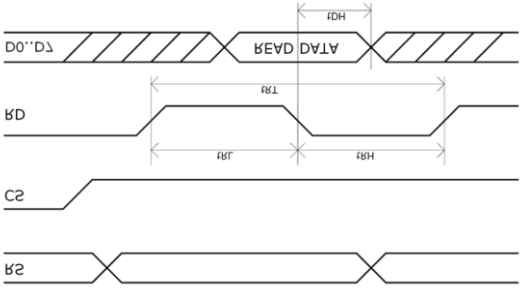
RES pin (Display Reset):
Display RESET. GOLDELOX initialises the display by strobing this pin LOW. Connect this pin to the Reset (RES) signal of the display. This signal can also be used to control the back-light of the LCD or as the DC/DC converter enable. Refer to the reference design in Section 7 in this document for an example.

WR pin (Display Write):
This is the display write strobe signal. The GOLDELOX asserts this signal LOW when writing data to the display in conjunction with the display data bus (D0-D7). Connect this pin to the Write (WR) signal of the display.



Item	Sym	Min	Typ	Max	Unit
Write Low Pulse	tWL	170	-	-	ns
Write High Pulse	tWH	85	-	-	ns
Write Bus Cycle Total	tWT	255	-	-	ns
Write Data Setup	tDS	85	-	-	ns

RD pin (Display Read):
This is the display read strobe signal. The GOLDELOX asserts this signal LOW when reading data from the display in conjunction with the display data bus (D0-D7). Connect this pin to the Read (RD) signal of the display.



Item	Sym	Min	Typ	Max	Unit
Read Low Pulse	tRL	300	-	-	ns
Read High Pulse	tRH	300	-	-	ns
Read Bus Cycle Tot	tRT	600	-	-	ns
Read Data Hold	tDH	150	-	-	ns

5.2. SPI Interface – Master Mode Only

The GOLDELOX supports micro-SD/micro-SDHC memory cards as well as Serial Flash memory chips via its hardware SPI interface. These storage devices are used for all multimedia file storage such as images, animations and movie clips. The memory card can also be used as general purpose storage for data logging applications. Support is available for micro-SD with up to 2GB capacity and for high capacity HC memory cards starting from 4GB and above. The GOLDELOX also supports any other general purpose SPI serial device.

SDI pin (SPI Serial Data In):
The SPI Serial Data Input (SDI). It connects to the Serial Data Out (SDO) pin of external SPI device.

SDO pin (SPI Serial Data Out):
The SPI Serial Data Output (SDO). This pin connects to the Serial Data In (SDI) signal of the external SPI device.

SCK pin (SPI Serial Clock):
The SPI Serial Clock output (SCK). This pin connects to the Serial Clock (SCK) signal of the external SPI device.

SDCS pin (SPI Chip Select):
SPI device Chip Select (SDCS). Connect this pin to the Chip Enable (CE or CS) signal of the external SPI device.
Also refer to "Section 13.3 SPI Timing Diagram"

5.3. Serial Port - UART

The GOLDELOX has a dedicated hardware UART that can communicate with external serial devices.

This is referred to as the COM0 module. The primary features are:

- Full-Duplex 8 bit data transmission and reception through the TX and RX pins.
- Data format: 8 bits, No Parity, 1 Stop bit.
- Auto Baud feature.
- Baud rates from 300 baud up to 256K baud.
- Single byte transmits and receives or a fully buffered service. The buffered service feature runs in the background capturing and buffering serial data without the user application having to constantly poll the serial port. This frees up the application to service other tasks.

The Serial port is also the primary interface for downloading user application code (compiled 4DGL byte-code) into the GOLDELOX Flash program memory. Once the download is complete the serial port is available for user application.

Note: Low level PmmC chip programming and updates also take place via the serial port.

Refer to "Section 4. In-Circuit-Serial-Programming (ICSP)" for further details.

TX pin (Serial Transmit):
Asynchronous Serial port Transmit pin, TX. Connect this pin to external serial device Serial Receive (Rx) signal.

RX pin (Serial Receive):
Asynchronous Serial port Receive pin, RX. Connect this pin to external serial device Serial Transmit (Tx) signal.

5.4. General Purpose I/O Interface

There are 2 GPIO pins available, IO1 and IO2. Each GPIO has a multitude of high level functions associated with it and these can be selected within 4DGL user application code.
Refer to the separate document titled "GOLDELOX-Internal-Functions.pdf" for a complete set of built in 4DGL library functions.

IO1, IO2 pins (General Purpose Input Output):
General purpose IO1, IO2 pins. The table below lists the available GPIO functions and features.

10. Hardware Tools

The following hardware tools are required for full control of the GOLDELOX Processor.

10.1. 4D Programming Cable

The 4D Programming Cable is an essential hardware tool to program, customise and test the GOLDELOX Processor.

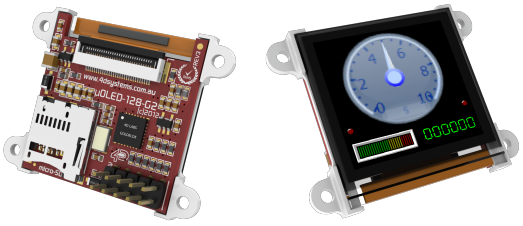
The 4D Programming Cable is used to program a new Firmware/PmmC and downloading compiled 4DGL code into the module. It even serves as an interface for communicating serial data to the PC.

The 4D Programming Cable is available from 4D Systems, www.4dsystems.com.au

4D Programming Cable

10.2. Evaluation Display Modules

The following modules, available from 4D Systems, can be used for evaluation purposes to discover what the GOLDELOX processor has to offer.



µOLED-128-G2 - 1.5" Intelligent GOLDELOX Display

Other modules, such as the 0.96" and 1.7" OLED, or 1.44" LCD versions are also available. Please contact 4D Systems for more information, or visit the 4D Systems website, www.4dsystems.com.au

11. 4D Systems - Workshop 4 IDE

Workshop 4 is a comprehensive software IDE that provides an integrated software development platform for all of the 4D family of processors and modules. The IDE combines the Editor, Compiler, Linker and Downloader to develop complete 4DGL application code. All user application code is developed within the Workshop 4 IDE.

The Workshop 4 IDE supports multiple development environments for the user, to cater for different user requirements and skill level.

- The **Designer** environment enables the user to write 4DGL code in its natural form.
- A visual programming experience, suitably called **ViSi**, enables drag-and-drop type placement of objects to assist with 4DGL code generation and allows the user to visualise how the display will look while being developed.
- A **Serial** environment is also provided to transform the GOLDELOX Processor into a slave serial module, allowing the user to control the display from any host microcontroller or device with a serial port.

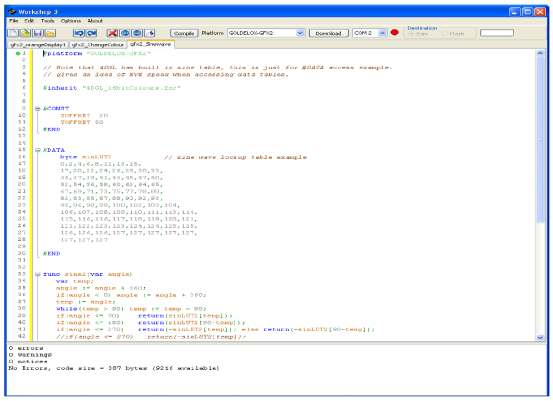
The Workshop 4 IDE is available from the 4D Systems website. www.4dsystems.com.au

For a comprehensive manual on the Workshop 4 IDE Software, refer to its documentation from the 4D Systems website.
"Workshop-4-IDE-User-Manual.pdf"

11.1. Workshop 4 – Designer Environment

Choose the Designer environment to write 4DGL code in its raw form.

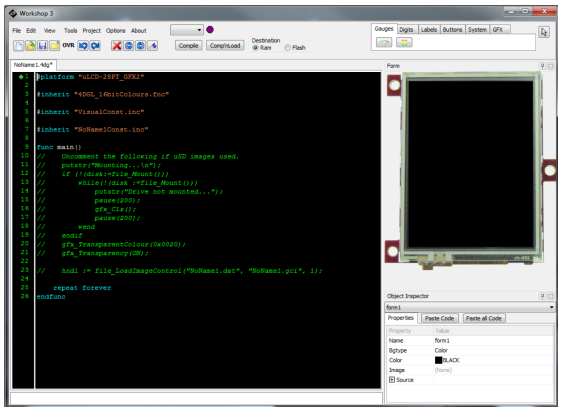
The Designer environment provides the user with a simple yet effective programming environment where pure 4DGL code can be written, compiled and downloaded to the GOLDELOX.



11.2. Workshop 4 – ViSi Environment

ViSi was designed to make the creation of graphical displays a more visual experience.

ViSi is a great software tool that allows the user to see the instant results of their desired graphical layout. Additionally, there is a selection of inbuilt dials, gauges and meters that can simply be placed onto the simulated module display. From here each object can have its properties edited, and at the click of a button all relevant 4DGL code associated with that object is produced in the user program. The user can then write 4DGL code around these objects to utilise them in the way they choose.



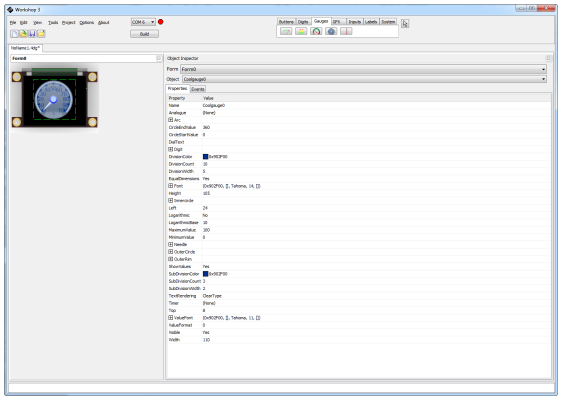
11.3. Workshop 4 – Serial Environment

The Serial environment in the Workshop 4 IDE provides the user the ability to transform the GOLDELOX Processor into a slave serial graphics controller.

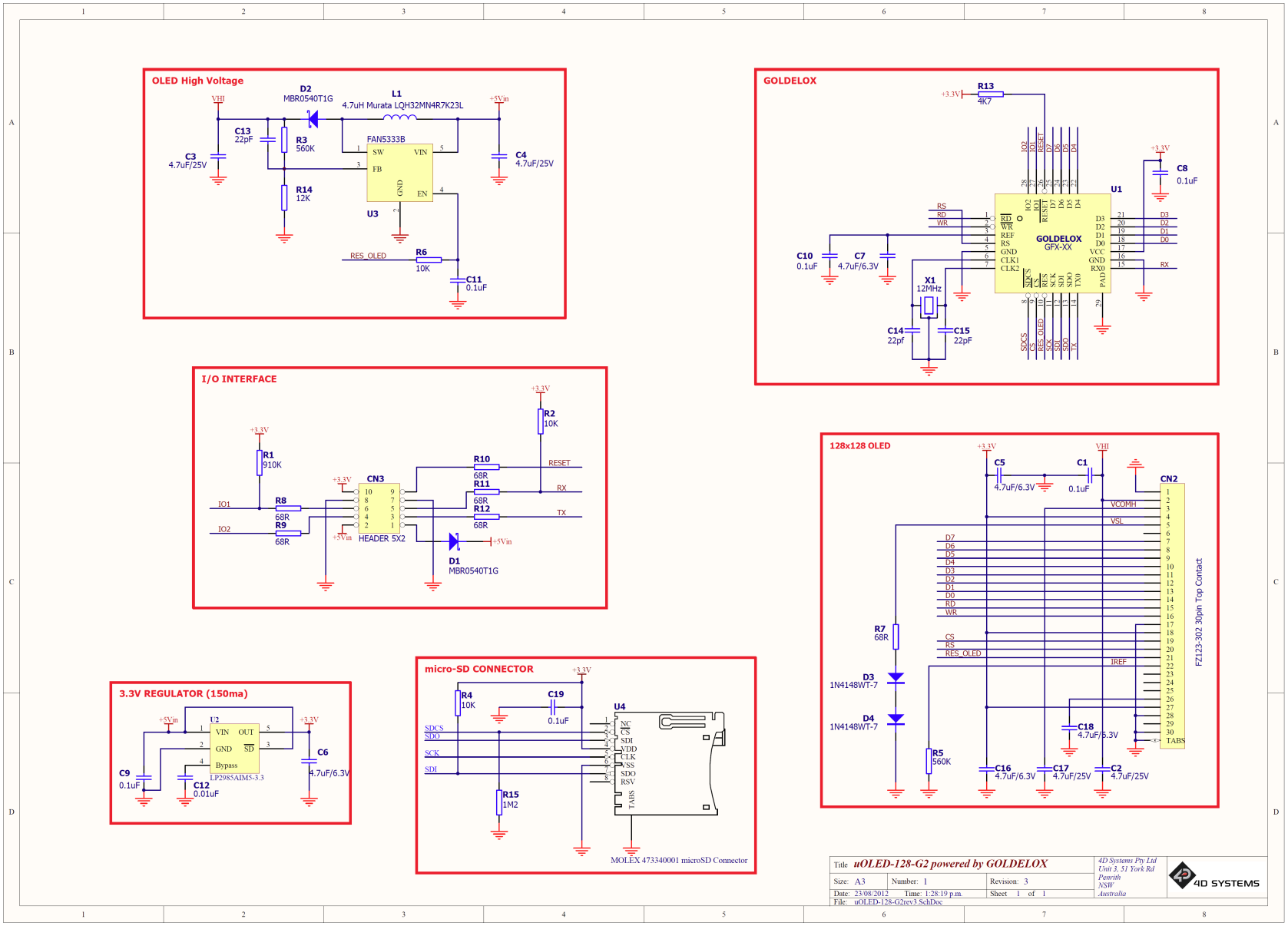
This enables the user to use their favourite microcontroller or serial device as the Host, without having to learn 4DGL or program in a separate IDE. Once the module is configured and downloaded to from the Serial Environment, simple graphic commands can be sent from the users host microcontroller to display primitives, images, sound or even video.

Refer to the Serial Environment section in the Workshop 4 user manual, for a complete listing of all the supported serial commands
"Workshop-4-IDE-User-Manual.pdf"

By default, each module shipped from the 4D Systems factory will come pre-programmed ready for use in the Serial mode.

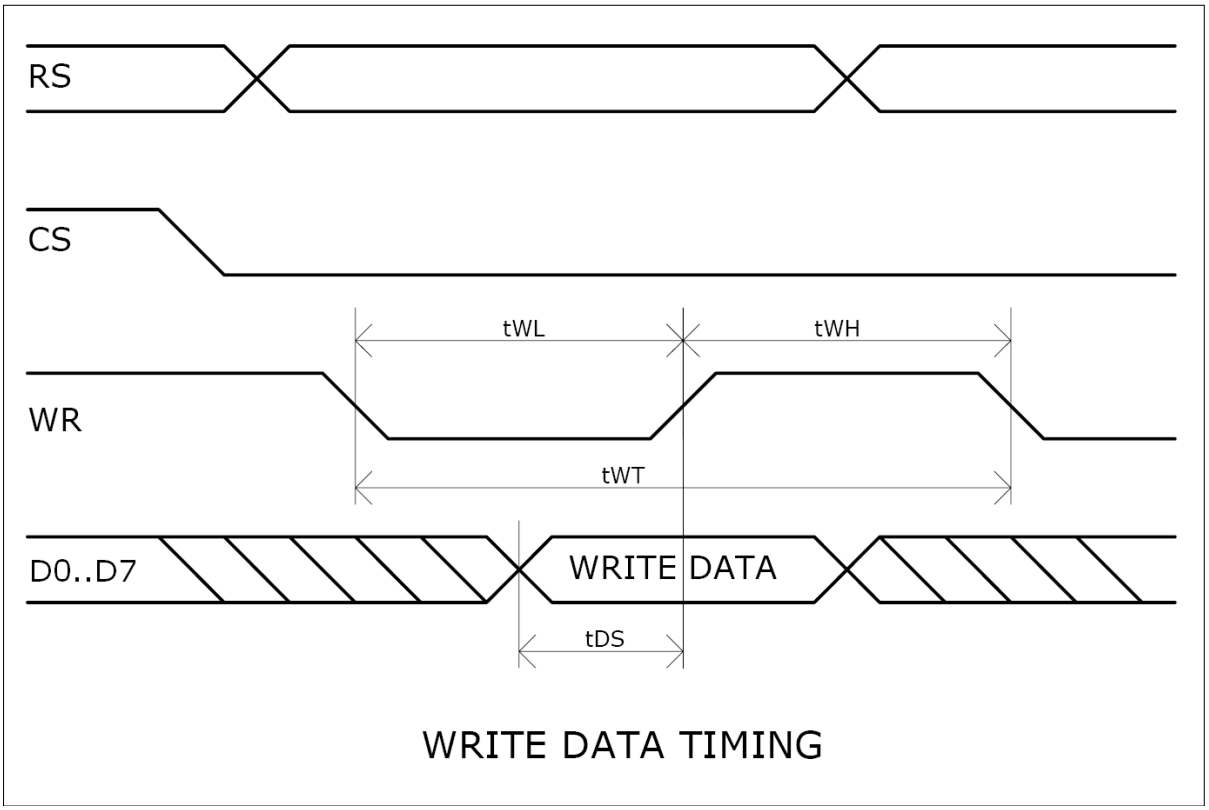


12. Reference Design



13. Timing Diagrams

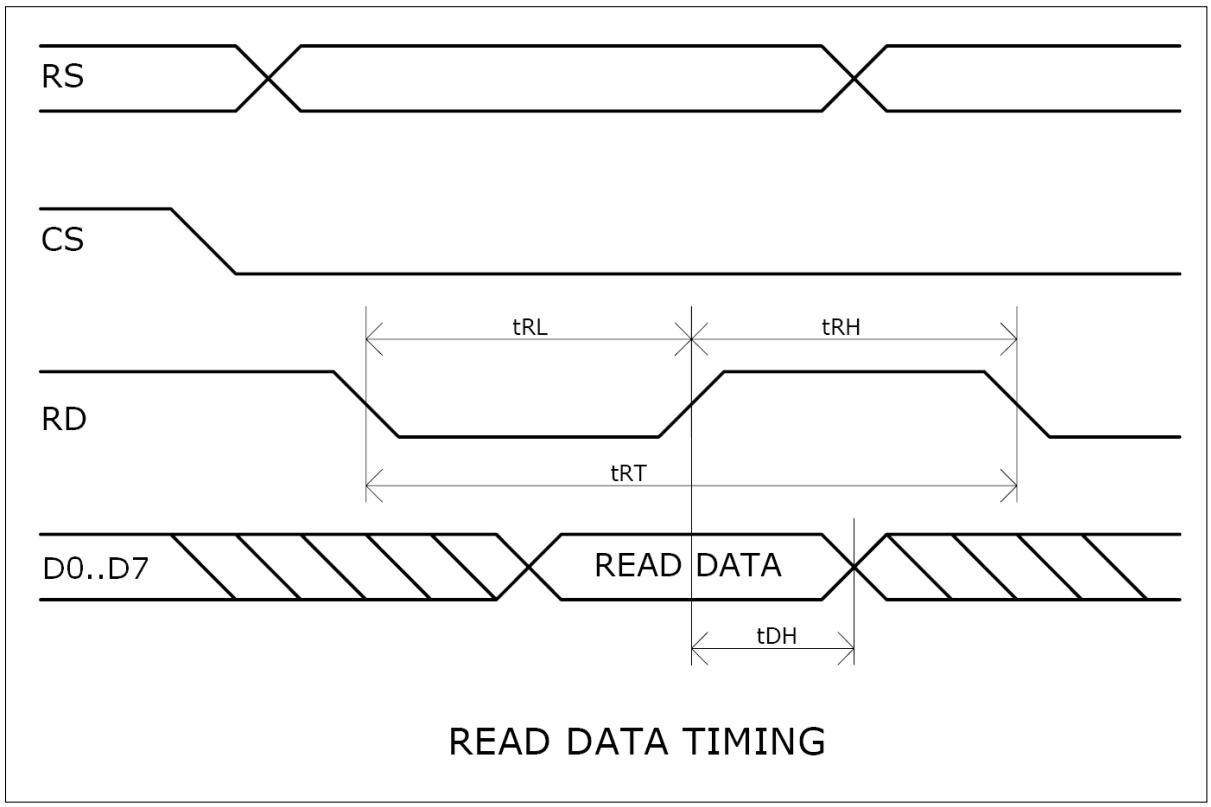
13.1. Display Write Data Timing



WRITE DATA TIMING

Item	Symbol	Min.	Typ.	Max.	Unit
Write Low level pulse width	tWL	170	-	-	ns
Write High level pulse width	tWH	85	-	-	ns
Write Bus Cycle Total	tWT	255	-	-	ns
Write Data Setup	tDS	85	-	-	ns

13.2. Display Read Data Timing



READ DATA TIMING

Item	Symbol	Min.	Typ.	Max.	Unit
Read Low level pulse width	tRL	300	-	-	ns
Read High level pulse width	tRH	300	-	-	ns
Read Bus Cycle Total	tRT	600	-	-	ns
Read Data Hold	tDH	150	-	-	ns

13.3. SPI Timing Diagram

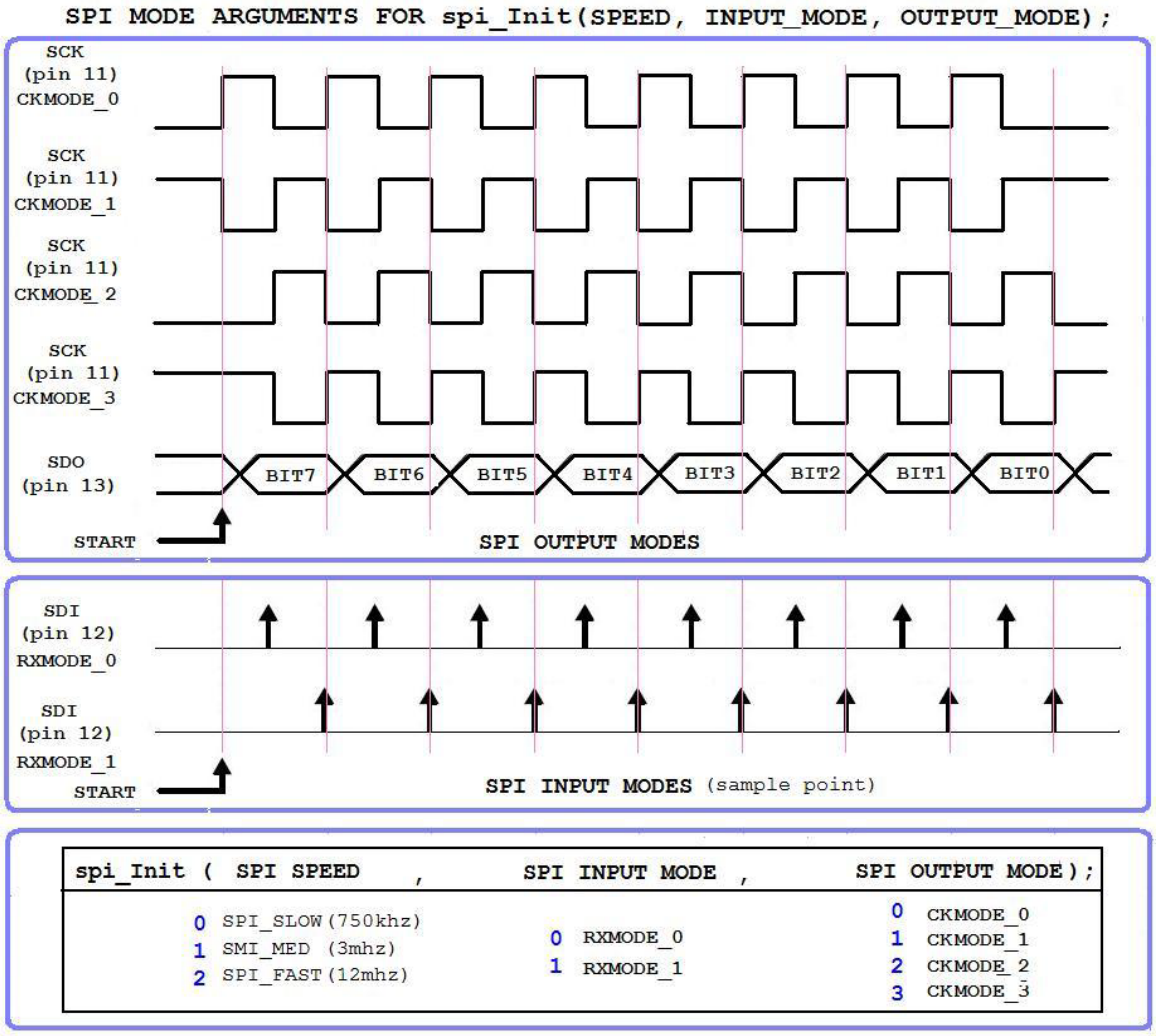
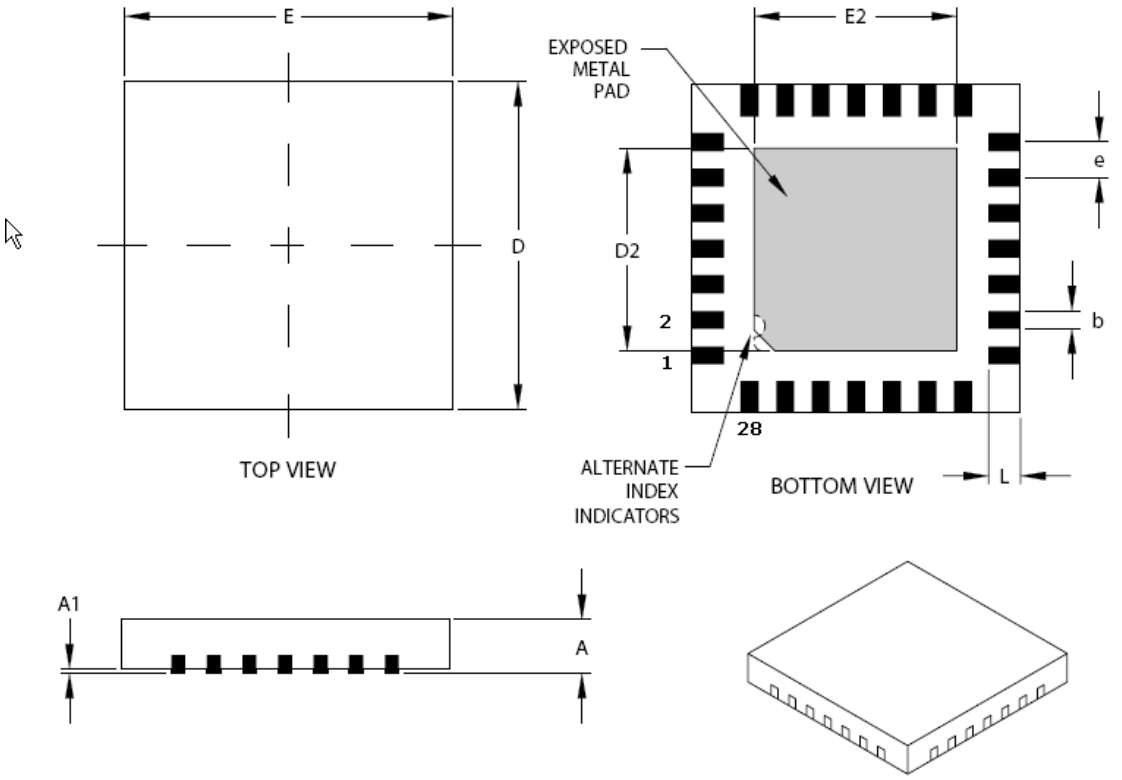


Figure 8.1: SPI Timing Diagram and spi_Init() usage

14. Package Details

28 Pin QFN28 JEDEC MO-220



Units		INCHES			MILLIMETERS		
Dimension Limits		MIN	NOM	MAX	MIN	NOM	MAX
Pitch	e		.026 BSC			0.65 BSC	
Overall Height	A	.031	.035	.039	0.80	0.90	1.00
Standoff	A1	.000	.001	.002	0.00	0.02	0.05
Contact Thickness	A3		.008 REF			0.20 REF	
Overall Width	E	.232	.236	.240	5.90	6.00	6.10
Exposed Pad Width	E2	.140	.146	.152	3.55	3.70	3.85
Overall Length	D	.232	.236	.240	5.90	6.00	6.10
Exposed Pad Length	D2	.140	.146	.152	3.55	3.70	3.85
Contact Width	b	.009	.011	.013	0.23	0.28	0.33
Contact Length	L	.018	.022	.024	0.45	0.55	0.65