



4D SYSTEMS

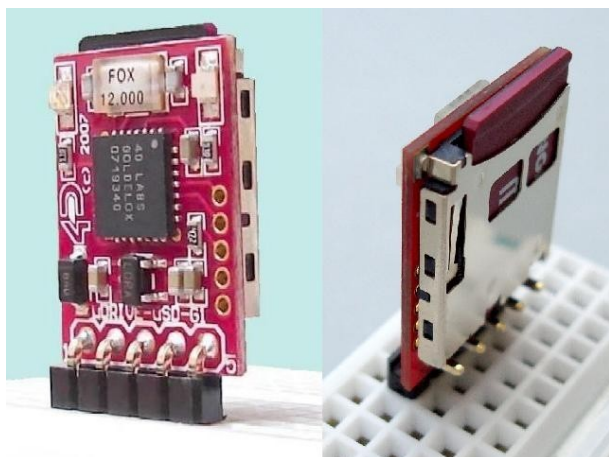
uDRIVE-uSD-G1 Embedded “DOS micro-Drive” Module Data Sheet

Document Date: 4th November 2011
Document Revision: 4.0

Note: This revision of the Document applies to uDrive PmmC Rev23 or above.

Description

The **micro-DRIVE** (uDRIVE-uSD-G1) is a compact high performance "Embedded Disk Drive" module that can be easily added to any micro-controller design that requires a DOS compatible file and data storage system. Most micro-controllers have small and limited on-chip memory. For those applications that require large volumes of data, the micro-DRIVE integrates the **GOLDELOX-DOS** chip onto a tiny 'drop-in- module'. A simple serial interface is all that is required to take away the burden of low level design that would otherwise be required for the host controller.



The micro-DRIVE module utilises off the shelf removable microSD memory cards of up to 4GB capacity and above as its medium. A handful of straightforward commands provide direct access to the on-board memory card for storing and retrieving any size or type of data. Access to the card can be at (FAT based) file levels or at raw disk byte levels. Applications can range from data logging, program storage, music files, image and video files or any type of general purpose data storage. So next time your host micro-controller application requires a file/data storage, the micro-DRIVE maybe the ideal solution.

Features

- General purpose data storage device with a simple serial interface that can be added to any design in a wide range of embedded applications.
- DOS compatible file access (FAT16 format) as well as low level access to card memory.
- On board microSD memory card interface and adaptor.
- Hardware and software interface for SD, microSD or MMC memory cards for multimedia storage and data logging purposes.
- HC memory card support is also available for HC cards larger than 4Gb.
- Simple serial commands provide full read-write access to the card.
- Easy 5 pin interface to any host device: VCC, TX, RX, GND, RESET.
- Serial interface (TTL levels) with auto-baud feature from 300 to 256K baud rates.
- On-board Status LEDs:
 - **GREEN:** Power and Memory Card detect indicator
 - **RED:** Drive data access indicator
- 3.6V to 5.5V range operation.
- Tiny footprint: 14.9 x 18.9 x 3.5mm.
- RoHS Compliant.

Applications

- General purpose embedded data logging.
- Embedded program, data or configuration storage for processors and FPGAs.
- Audio, Video and Image file storage.
- GPS type data base storage.
- Industrial, medical, automotive, security and gaming equipment.
- Test, measurement and general purpose instrumentation.

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1. Pin Configuration and Description

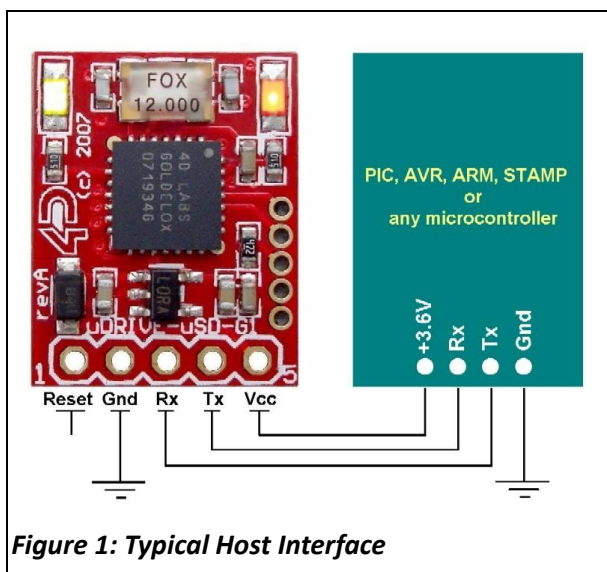


Figure 1: Typical Host Interface

Pin	Symbol	I/O	Description
1	RESET	I	Active Low pulse greater than 2 micro-seconds will reset the module. Only use open collector type circuits to reset the device if an external reset is required. This pin is not driven low by any internal conditions. The host should control this pin via one of its port pins using an open collector/drain arrangement. Internally pulled up to 3.3 Volts.
2	GND	P	Supply Ground.
3	RX	I	Asynchronous Serial Receive pin. Connect this pin to host micro-controller Serial Transmit (Tx) signal. The host transmits commands and data to the micro-DRIVE via this pin. This pin is tolerant up to 5.5V levels.
4	TX	O	Asynchronous Serial Transmit pin. Connect this pin to host micro-controller Serial Receive (Rx) signal. The host receives data from micro-DRIVE via this pin. This pin is tolerant up to 5.5V levels.
5	VCC	P	Supply input, 3.6V to 5.5V DC.

2. Host Interface

The micro-DRIVE (uDRIVE for short) provides both a physical and a software interface.

2.1 Physical Interface - UART

The physical or hardware interface is provided by the on-board UART and the host communicates to the micro-DRIVE via this serial link. The host uses this physical interface to send commands to the

module for data storage and retrieval. Only the serial TX, RX and GND signals are required for a minimal configuration (see Figure 1).

Serial Data Format: 8 Bits, No Parity, 1 Stop Bit.

2.2 Software Interface – Command Set

The software interface provided by the uDRIVE module is a set of easy to use serial commands. For a complete list of uDRIVE commands refer to

the separate document titled '**GOLDELOX-DOS Command Set - Software Interface Specification**'.

2.3 Auto-Baud Set-Up

The micro-DRIVE has an auto-baud feature which can automatically detect the host speed and can set its internal baud rate to operate from 300 to 256K baud. Prior to any commands being sent to the module, it must first be initialised by sending the auto-baud character 'U' (55hex) after any power-up or reset. This will allow the module to determine and lock on to the baud rate of the host automatically without needing any further set-up. Once the uDRIVE has locked onto the host baud rate it will respond with an **ACK** byte (06hex).

Auto-Bauding must be performed each time the uDRIVE is powered up or reset.

2.4 Command Protocol – Flow Control

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

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

No termination character is to be sent at the end of a command sequence, such as CR, Null, etc.

3. Power-Up and Reset

When the uDRIVE module comes out of a power up or external reset, a sequence of events must be observed before attempting to communicate with the module:

- Allow up to 500ms delay after power-up or reset for the uDRIVE to settle. Do not attempt to communicate with the module during this period. The module may send garbage on its TX Data line during this period, the host should disable its Rx Data reception.
- Within 100ms of powering up, the host should make sure it has its Tx line pulled HIGH. If the host Tx (uDRIVE RX) is LOW or floating after the 100ms period, the module may misinterpret this as the START bit of the auto-baud character and lock onto some undesired baud rate. If the host has a slow wake up time, i.e. less than 100ms, its Tx line maybe floating. This can be easily resolved by adding a pull up resistor on the host Tx line which will ensure the module does not encounter a false start bit. The pull up resistor can be any value within 10K to 100K.
- The host transmits the auto-baud character (capital **U**, 55hex) as the first command so the module can lock onto the host's baud rate.

Once the host receives the **ACK** the uDRIVE is now ready to accept Disk Drive commands from..

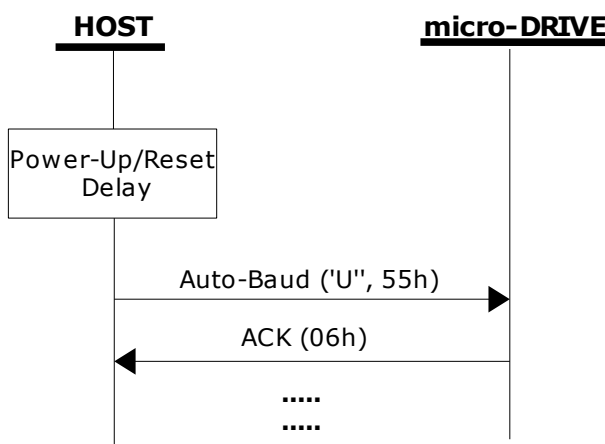


Figure 2: Reset Sequence of Events

4. Memory Cards – FAT16 Format

The uDrive uses off the shelf standard SD/microSD memory cards with up to 2Gb capacity. For any FAT file related operations, before the memory card can be used it must first be formatted with FAT16 option. The formatting of the card can be done on any PC system with a card reader. Select the appropriate drive and choose the FAT16 (or just FAT in some systems) option when formatting.



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

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

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

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

5. PmmC Programming - System Updates

The GOLDELOX-DOS controller on the uDRIVE module can be re-programmed with the latest PmmC configuration for updates and future proofing. The chip-level configuration is available as a PmmC (Personality-module-micro-Code) file and the programming must be performed over the serial interface. All of the high level software interface commands are part of the PmmC configuration file so please check regularly for the latest updates and enhancements.

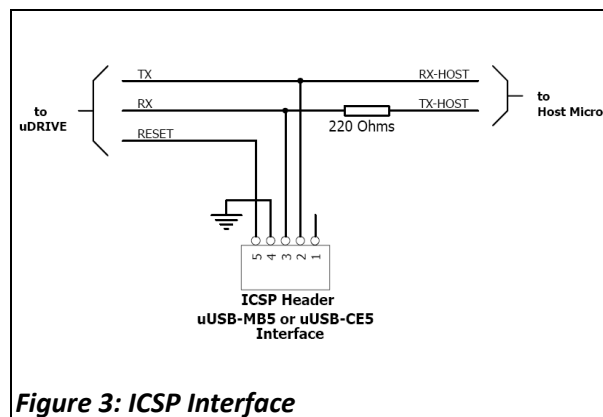
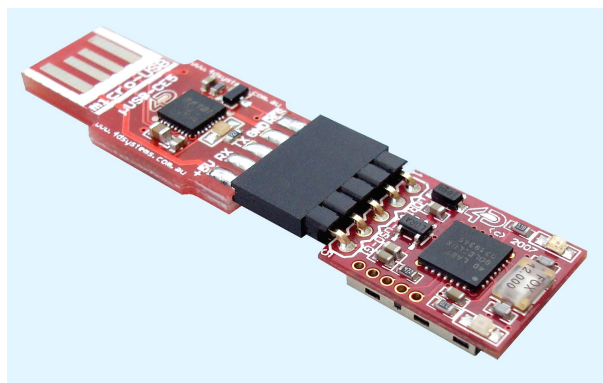


Figure 3: ICSP Interface

It is recommended that the uDRIVE module be socketed on the application board so that it can be easily removed for PmmC programming. If the module is to be permanently fixed and cannot be removed then access must be provided for PmmC programming on the application board. This is referred to as "In Circuit Serial Programming" (ICSP). Figure 3 provides a typical implementation for the ICSP interface.

The PmmC file is programmed into the device with the aid of "**PmmC Loader**", a PC based software tool. To provide a link between the PC and the ICSP interface a USB to Serial converter is required. A range of custom made micro-USB devices such as the uUSB-MB5 and the uUSB-CE5 are available from 4D Systems. For further details refer to '**Section 6: Development and Support Tools**'.

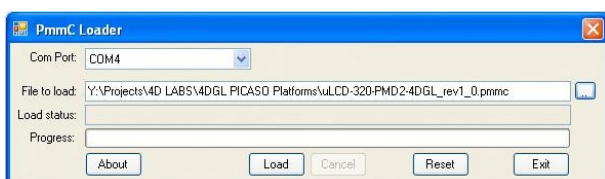


uDRIVE with uUSB-CE5 Interface

6. Development and Support Tools

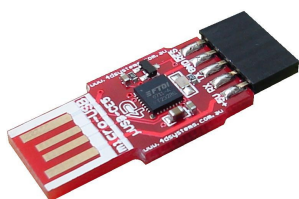
6.1 PmmC Loader–Software Programming Tool

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

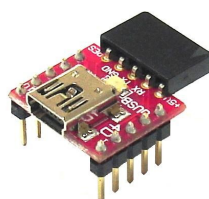


6.2 microUSB – Hardware Programming Tool

The micro-USB module is a USB to Serial bridge adaptor that provides a convenient physical link between the PC and the uDRIVE module. A range of custom made micro-USB devices such as the uUSB-MB5 and the uUSB-CE5 are available from 4D Systems (must be purchased separately). The micro-USB module is an essential tool for PmmC programming as well as for using the 4D Fat Controller software tool.



uUSB-CE5

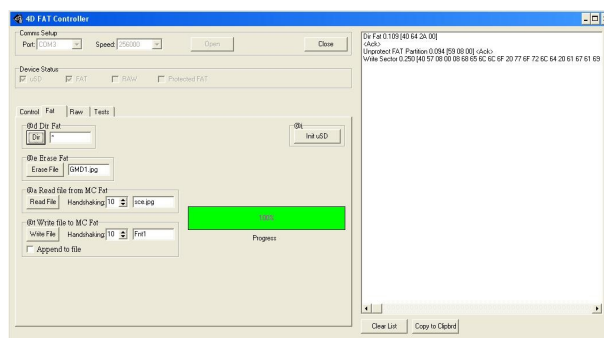


uUSB-MB5

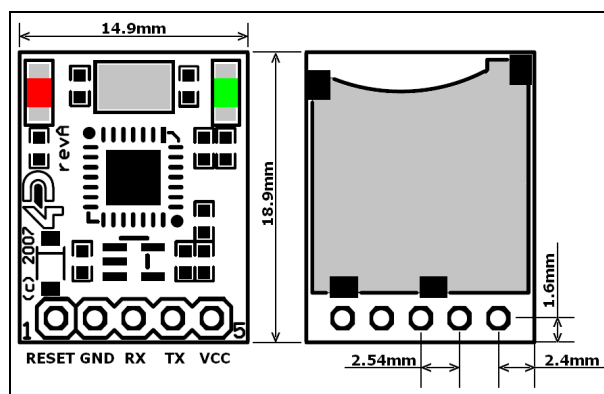
6.3 4D FAT Controller – Software Test Tool

The 4D Fat Controller is a free software tool to test all of the functionality of the uDRIVE module. Files can be removed, read and written directly to the memory card on the module. The software tool not only tests all of the high level file handling capability, it also allows the user to test the raw byte level read/write options. For raw read/write, the 'Protected FAT' check box needs to be unchecked. The user can also do random tests, available under the 'Test' tab.

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



7. Mechanical Details



8. Specifications and Ratings

Absolute Maximum Ratings

Operating ambient temperature	-40°C to +100°C
Storage temperature	-65°C +150°C
Voltage on any digital input pin with respect to GND	-0.3V to 6.0V
Voltage on VCC with respect to GND	-0.3V to 6.0V
Maximum current out of GND pin	300mA
Maximum current into VCC pin	250mA
Total power dissipation	1.0W

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

Recommended Operating Conditions

Parameter	Conditions	Min	Typ	Max	Units
Supply Voltage (VCC)		3.6	5.0	5.5	V
Operating Temperature		-10	--	+70	°C
Input Low Voltage	RX pin	GND	--	0.8	V
Input High Voltage	RX pin	2.0	3.3	5.0	V
Reset Pulse	External Open Collector	2.0	--	--	µs
Operational Delay	Power-Up or external reset	500	--	--	ms

Global Characteristics based on Operating Conditions

Parameter	Conditions	Min	Typ	Max	Units
Supply Current (ICC)	VCC = 5V, no memory card	--	15	26	mA
Output Low Voltage	TX pin, IOL = 3.4mA	--	--	0.4	V
Output High Voltage	TX pin, IOL = -2.0mA	2.4	--	3.3	V
Flash Memory Endurance	GOLDELOX-DOS chip PmmC programming.	--	1000	--	E/W

Ordering Information

Order Code: uDRIVE-uSD-G1

Package: 14.9mm x 18.9mm Module.

Packaging: Module sealed in bubble bag inside a ZIF bag, both Antistatic.

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