Cactus® Technologies

Industrial Grade
USB DiskOnModule
(uDOM)
Product Manual

Corporate Headquarters
Suite C, 15/F, Capital Trade Center
62 Tsun Yip Street, Kwun Tong
Kowloon, Hong Kong

The information in this manual is believed to be accurate at the time of publication but is subject to change without notice. Cactus Technologies® Limited shall not be liable for technical or editorial errors or omissions contained herein; nor for incidental or consequential damages resulting from the furnishing, performance, or use of this material.

Cactus Technologies® makes no warranty, representation or guarantee regarding the suitability of its products for any particular purpose, nor does Cactus Technologies® assume any liability arising out of the application or use of its products, and specifically disclaims any and all liability, including without limitation consequential or incidental damages.

Cactus Technologies® products are not designed, intended or authorized for use as components in systems intended for surgical implant into the body or in other applications intended to support or sustain life or for any application where the failure of a Cactus Technologies® product can result in personal injury or death. Users of Cactus Technologies® products for such unintended and unauthorized applications shall assume all risk of such use and shall indemnify and hold Cactus Technologies® and its officers, employees, subsidiaries, affiliates and distributors harmless against all claims, costs, damages, expenses and attorney fees arising out of, directly or indirectly, any claim of personal injury or death associated with such unintended and unauthorized use, even if such claim alleges that Cactus Technologies® was negligent regarding the design or manufacture of the part.

All parts of the Cactus Technologies® documentation are protected by copyright law and all rights are reserved. This documentation may not, in whole or in part, be copied, photocopied, reproduced, translated, or reduced to any electronic medium or machine-readable form without prior consent, in writing, from Cactus Technologies® Limited.

Table of Contents

1.Introduction to Cactus Technologies Industrial Grade uDOM Products

Features:

- Solid state design with no moving parts

- Plugs into industry standard 10-pin USB headers

- Compliant with USB2.0 specifications

- Compliant with USB Mass Storage Class specifications v1.0

- Supports booting from USB device

- High reliability, MTTF > 6,500,000 hrs.

- Enhanced error correction with 8-bit BCH ECC

- Comes in standard or low profile configurations

Overview:

Cactus Technologies® USB DiskOnModule (uDOM) is a low capacity solid-state flash memory product that complies with the USB2.0 standard. Cactus Technologies® uDOMs provide up to 8GB of formatted storage capacity and is designed to plug in directly to 10-pin USB headers on industrial PC motherboards. Cactus Technologies® uDOMs are designed to be used in applications which requires a low capacity solid state disk that us compatible with USB interface.

Cactus Technologies® Industrial Grade uDOM products use high quality flash memory from well known vendors, such as Toshiba Corporation. In addition, they include an on-drive intelligent controller that manages interface protocols, data storage and retrieval as well as ECC, defect handling and diagnostics, power management, and clock control.

1.1. Supported Standards

Cactus Technologies® uDOM is fully electrically compatible with the following specification:

- USB2.0 Specification published by the USB Implementor's Forum

1.2. Product Features

Cactus Technologies® Industrial uDOM contains a high level, intelligent controller. This intelligent controller provides many capabilities including the following:

- USB command processing.
- Management of erasing and programming the flash memory independent of the host system

- Sophisticated defect managing capabilities (similar to magnetic disk drives).
- Sophisticated system for error recovery using powerful error correction code (ECC).
- Intelligent power management for low power operation.

1.2.1. Host and Technology Independence

Cactus Technologies® Industrial uDOM appears as a standard USB mass storage device to the host system. The host computer software simply issues USB commands to the drive as per the USB specifications. The host software then waits for the commands to complete. The host system does not get involved in the details of how the flash memory is erased, programmed or read as this is all managed by the built-in controller in the drive. Also, with the intelligent on-board controller, the host system software will not require changing as new flash memory evolves. Thus, systems that support the Cactus Technologies® Industrial uDOM products today will continue to work with future Cactus Technologies® Industrial uDOMs built with new flash technology without having to update or change host software.

1.2.2. Defect and Error Management

Cactus Technologies® Industrial uDOM contains a sophisticated defect and error management system similar to those found in magnetic disk drives. The defect management is completely transparent to the host and does not consume any user data space.

The soft error rate for Cactus Technologies® Industrial uDOMs is much lower than that of magnetic disk drives. In the extremely rare case where a read error does occur, the drive has sophisticated ECC to recover the data.

These defect and error management systems, coupled with the solid-state construction, give Cactus Technologies® Industrial uDOMs unparalleled reliability.

1.2.3. Intelligent Wear Leveling

Cactus Technologies® Industrial uDOM employs sophisticated static, dynamic and global wear leveling algorithms and intelligent bad block management to ensure high data reliability and to maximize product life.

2. Power Supply Requirements

Cactus Technologies® Industrial uDOM operates off the standard USB bus power supply of 5.00 volts ± 10%.

For all the following specifications, values are defined at ambient temperature and nominal supply voltage unless otherwise stated.

2.1. System Environmental Specifications

Table 2-2.1. Environmental Specifications

		Cactus Technologies® uDOM
Temperature	Operating:	0° C to +70° C (Standard) -45° C to +90° C (Extended)
Humidity	Operating & Non-Operating:	8% to 95%, non-condensing
Acoustic Noise		0 dB
Vibration	Operating & Non-Operating:	20 G MIL-STD-883G Method 2005.2 condition A
Shock	Operating & Non-Operating:	3000G MIL-STD-883G Method 2002.3 condition C
Altitude (relative to sea level)	Operating & Non-Operating:	100,000 feet maximum

2.2. System Power Requirements

Table 2-2.2. Power Requirements

		Cactus Technologies® Industrial uDOM
DC Input Voltage (VCC) 100 mV max. ripple (p-p)		5V ±10%
(Maximum Average Value) See Notes.	Standby: Reading: Writing:	58mA 130 mA 130 mA

NOTES: All values quoted are worst case at low temperature and high supply voltage unless otherwise stated.

Sleep mode is specified under the condition that all drive inputs are static CMOS levels and in a "Not Busy" operating state.

2.3. System Performance

All performance timings are typical values under normal operating conditions and assuming the drive controller is in the default (i.e., fastest) mode.

Table 2-2.3. Performance

Read Transfer Rate		up to 33 MBytes/sec
Write Transfer Rate		up to 26 MBytes/sec

.

2.4. System Reliability

Table 2-2.4. Reliability

|	
MTTF (@ 25°C)	> 6,500,000 hours
Data Reliability	< 1 non-recoverable error in 10^{14} bits READ
Endurance:	> 2,000,000 erase/program cycles

2.5. Physical Specifications

The following sections provide the physical specifications for Cactus Technologies® Industrial uDOM products.
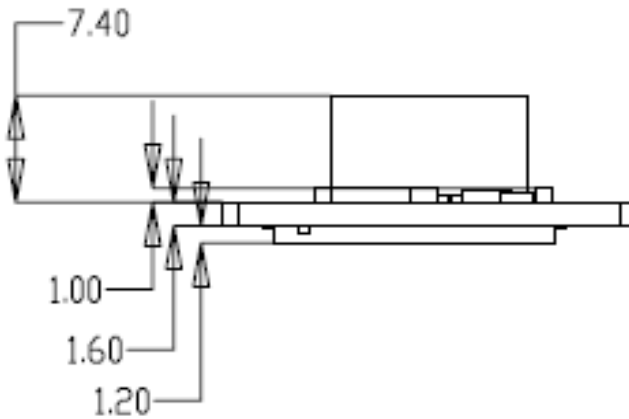
2.5.1. uDOM Connector

Cactus Technologies® uDOM utilizes the standard 10-pin USB header found on many PC motherboards. The pinout for this connector is as shown below:

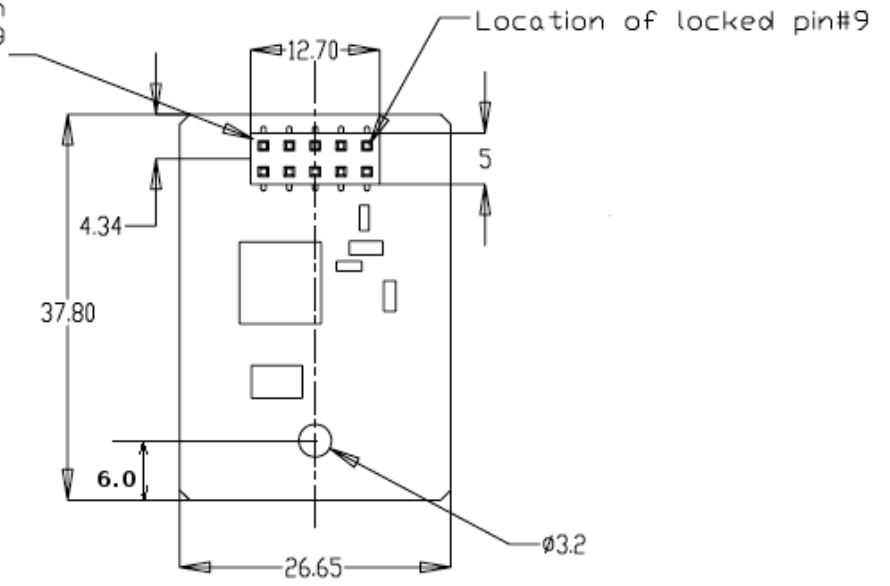|	
NC 2	1 +5VDC input
NC 4	3 USB1 Data(-)
NC 6	5 USB1 Data(+)
NC 8	7 GND
NC 10	9 KEY (blocked)
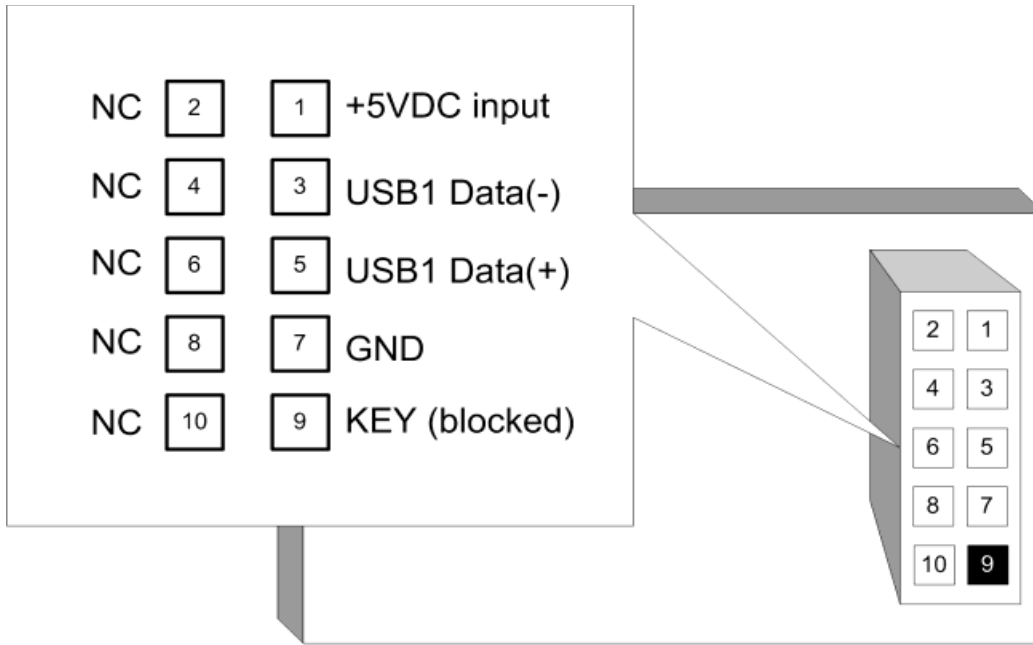
2.5.2.   uDOM Physical Specifications

Refer to Figure 2-1 for Cactus Technologies® standard profile uDOM physical specifications and dimensions and Figure 2-2 for Cactus Technologies® low profile uDOM physical specifications.
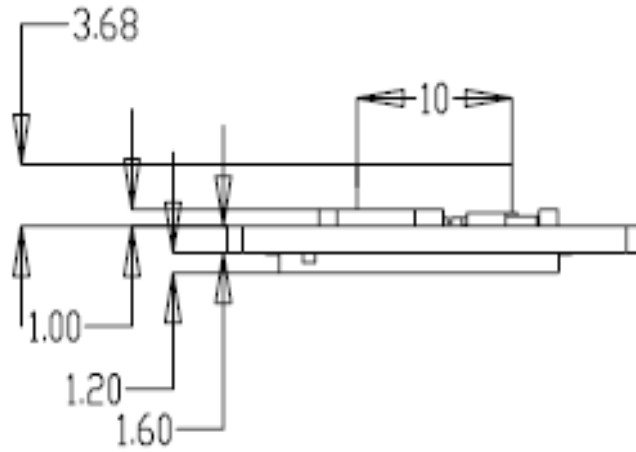
Figure 2-2.1. Standard Profile uDOM physical specifications

Female connector 2x5 2mm pitch
with locked pin #9

Location of locked pin#9

4.34

37.80

4

6.0

26.65

⌀3.2
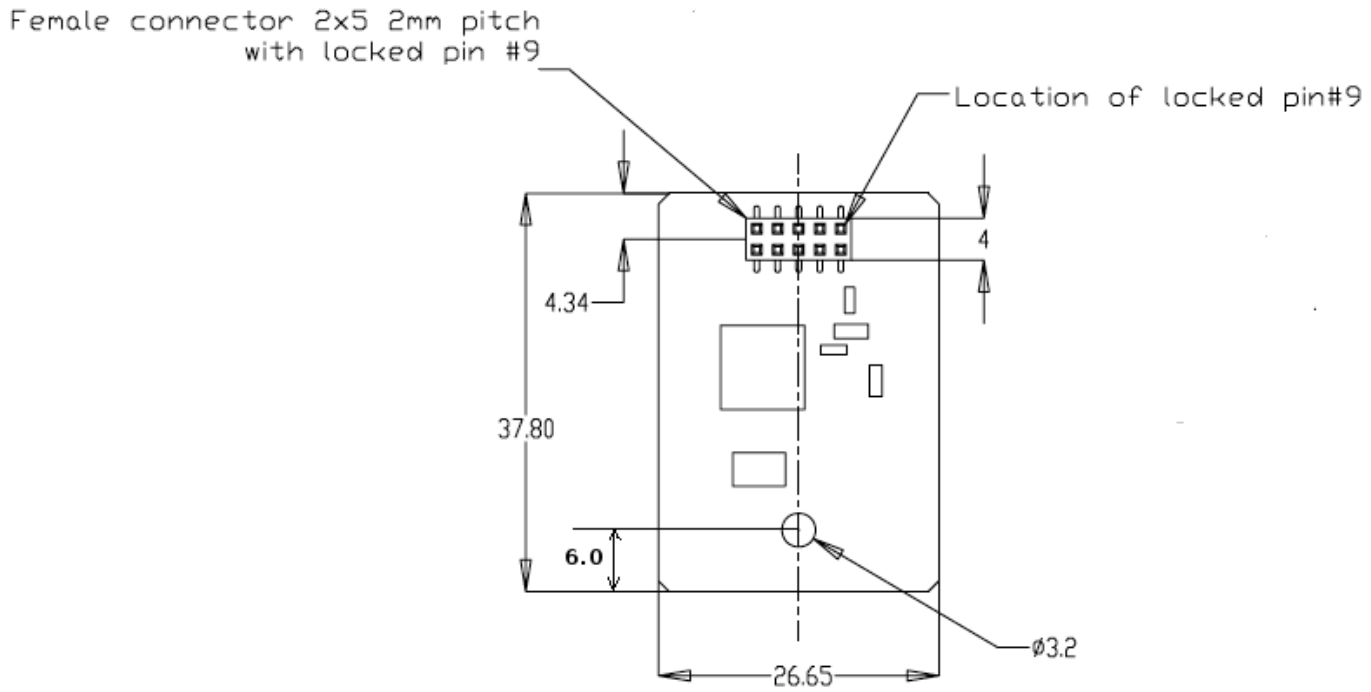
Figure 2-2.2 Low Profile uDOM physical specifications

2.6. Capacity Specifications

The following sections provide capacity specifications for Cactus Technologies® uDOM products.

2.6.1.   uDOM Capacity Specifications

Cactus Technologies® uDOM product is offered in capacities of 1,2,4 or 8 GB.

3.Interface Description

The following sections provide detailed information on the Cactus Technologies® Industrial uDOM interface.

3.1. uDOM Pin Assignments and Pin Type

The signal/pin assignments are listed in Table 3-3.1. Low active signals have a "-" prefix. Pin types are Input, Output or Input/Output. Sections 3.3.1 to 3.3.4 define the DC characteristics for all input and output type structures.

Table 3-3.1. uDOM Pin Assignments and Pin Type

Pin #	Signal Name	Pin Type		Pin #	Signal Name	Pin Type
1	5V Vcc	power		2	NC	
3	USB1 D-	I/O		4	NC	
5	USB1 D+	I/O		6	NC	
7	GND	power		8	NC	
9	Key (no pin)			10	NC	

3.2. Electrical Specification

The following table defines all D.C. Characteristics for the uDOM. Unless otherwise stated, conditions are:

Vcc = 5V ± 10%
Ta = -45°C to 90°C

3.2.1. Absolute Maximum Ratings

Parameter	Symbol	MIN	MAX	Units
Storage Temperature	Ts	-65	+150	°C
Operating Temperature	T_A	-45	+90	°C
Vcc with respect to GND	Vcc	-0.3	6.5	V

3.2.2. DC Characteristics

Parameter	Symbol	MIN	MAX	Units
Input Levels USB D+,D-, Full Speed Mode Low High	V_{IL} V_{IH}	- 2.0	0.8 -	V
Output Levels USB D+, D-, Full Speed Mode Low High	V_{OL} V_{OH}	0 2.8	0.3 3.6	V
Output Signal Crossover Voltage USB D+, D-, Full Speed Mode	V_{CRS}	1.3	2	V

Parameter	Symbol	MIN	MAX	Units
Input Levels USB D+, High Speed Mode Low High	V_{IL} VIH	-10 360	10 440	mV
Input Levels USB D-, High Speed Mode Low High	V_{IL} VIH	360 -10	440 10	mV
Output Levels USB D+, D-, High Speed Mode Low High	V_{OL} V_{OH}	-10 360	10 440	mV
Operating Current Suspend Active	I_{CC}		2.5 200	mA

Appendix A.Ordering Information
A.1. uDOM

Model KUXRY-100Z

    Where X is drive capacities:
     1G ---------------- 1GB
     2G ---------------- 2GB
     4G ---------------- 4GB
     8G ----------------- 8GB

    Where Y is temperature
     Blank --------------- Standard temperature (0° C to +70° C)
     I --------------------- Extended temperature (-45° C to +90° C)

    Where Z is form factor
     M1 ----------------- Standard Profile

     M2 ----------------- Low Profile

    Example:

    (1) 2GB Standard Profile uDOM --------------------------------- KU2GR-100M1
    (2) 1GB Low Profile uDOM Extended Temp ------------------- KU1GRI-100M2

Appendix B.Technical Support Services

B.1.Direct Cactus Technical Support

Cactus Technologies Limited

Suite C, 15/F, Capital Trade Center

62 Tsun Yip Street, Kwun Tong

Kowloon, Hong Kong

Tel: +852-27972261

Fax: +852-27973777

Email: tech@cactus-tech.com

Appendix C.Cactus Worldwide Sales Offices

Cactus Technologies Limited

Suite C, 15/F, Capital Trade Center

62 Tsun Yip Street, Kwun Tong

Kowloon, Hong Kong

Tel: +852-27972277

Fax: +852-27973777

Email: sales@cactus-tech.com

US Office:

Cactus USA
3112 Windsor Road , Suite A356
Austin, Texas 78703
Tel: (512) 775 0746
Email: americas@cactus-tech.com

Appendix D.Limited Warranty

I. WARRANTY STATEMENT

Cactus Technologies® warrants its Industrial Grade products only to be free of any defects in materials or workmanship that would prevent them from functioning properly for five years from the date of purchase. This express warranty is extended by Cactus Technologies®, Limited

II. GENERAL PROVISIONS

This warranty sets forth the full extent of Cactus Technologies® responsibilities regarding the Cactus Technologies® Industrial Grade Flash Storage Products. Cactus Technologies®, at its sole option, will repair, replace or refund the purchase price of the defective product. Cactus Technologies® guarantees our products meet all specifications detailed in our product manuals. Although Cactus Technologies® products are designed to withstand harsh environments and have the highest specifications in the industry, they are not warranted to never have failure and Cactus Technologies® does not warranty against incidental or consequential damages. Accordingly, in any use of products in life support systems or other applications where failure could cause injury or loss of life, the products should only be incorporated in systems designed with appropriate redundancy, fault tolerant or backup features.

III. WHAT THIS WARRANTY COVERS

For products found to be defective within five years of purchase, Cactus Technologies® will have the option of repairing or replacing the defective product, if the following conditions are met:

A. The defective product is returned to Cactus Technologies® for failure analysis as soon as possible after the failure occurs.

B. An incident drive filled out by the user, explaining the conditions of usage and the nature of the failure, accompanies each returned defective product.

C. No evidence is found of abuse or operation of products not in accordance with the published specifications, or of exceeding storage or maximum ratings or operating conditions.

All failing products returned to Cactus Technologies® under the provisions of this limited warranty shall be tested to the product's functional and performance specifications. Upon confirmation of failure, each product will be analyzed, by whatever means necessary, to determine the root cause of failure. If the root cause of failure is found to be not covered by the above provisions, then the product will be returned to the customer with a report indicating why the failure was not covered under the warranty.

This warranty does not cover defects, malfunctions, performance failures or damages to the unit resulting from use in other than its normal and customary manner, misuse, accident or neglect; or improper alterations or repairs.

Cactus Technologies® reserves the right to repair or replace, at its discretion, any product returned by its customers, even if such product is not covered under warranty, but is under no obligation to do so.

IV. RECEIVING WARRANTY SERVICE

According to Cactus Technologies® warranty procedure, defective product should be returned only with prior authorization from Cactus Technologies® Limited Please contact Cactus Technologies® Customer Service department with the following information: product model number and description, nature of defect, conditions of use, proof of purchase and purchase date. If approved, Cactus Technologies® will issue a Return Material Authorization or Product Repair Authorization number. Ship the defective product to:

Cactus Technologies Limited

Suite C, 15/F, Capital Trade Center

62 Tsun Yip Street, Kwun Tong

Kowloon, Hong Kong