

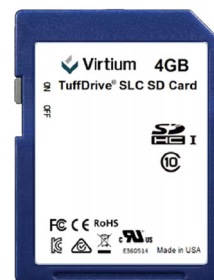


TuffDrive® S31 Series – SD Memory Card

Industrial SD 3.0, SLC

VTDS31PC004G-V11

Datasheet - Rev. 1.0



1. Description

Virtium TuffDrive® S31 Secure Digital (SD) cards provide highly reliable storage media in a very small space. The simplicity of the SD and SPI protocols allows easy host design and integration. The TuffDrive® S31 SD Cards support a high security level of copyright protection and an easy to implement interface.

Features

Capacity

- 4 GB

SLC NAND

Speed Class: Class 10

FAT32 format support

Sequential Performance

- Sustained Read: 35 MB/s
- Sustained Write: 35 MB/s

Power: 3.3V±10%

- Sequential Read: 0.20 W
- Sequential Write: 0.20 W
- Idle: 4 mW

Temperature Ranges

- Commercial: 0°C to 70°C
- Non-Operating: -40°C to 85°C

Reliability

- 40-Bit/1K Hardware BCH ECC
- Number of card insertions/removals up to 20,000
- MTBF: >3M hours

Optimized FW algorithms

- Wear Leveling technology
- Monitors device health
- Anticipates and predicts failures

Mechanical Dimensions

- 9-Pin SD Standard
- Length x Width x Height mm (inches)
32.00 (1.259) x 24.00 (0.945) x 2.1 (0.083)
- Weight: 2±0.1g

Compliance

- SD Memory Card Specifications
 - Physical Layer Specification Ver. 3.1 (Part 1)
 - File System Specification Ver. 3.0 (Part 2)
 - Security Specification Ver. 3.0 (Part 3)
- FCC, CE, UL, RoHS, WEEE

Environmental (Non-operating)

- Humidity (non-condensing): 5% to 95%
- Shock: 1500G, half-sine wave, 0.5ms duration
- Vibration: 20G, 20 Hz to 2000 Hz



Electrostatic Discharge (ESD) can damage this device. When handling the device, always wear a grounded wrist strap and use a static dissipative surface.



Any damage to the unit that occurs after its removal from the shipping package and ESD protective bag is the responsibility of the user.

Part Numbering System

V TD S31 P C 004G - V11

Where:	
V	= Virtium
TD	= TuffDrive
S31	= Form Factor / Interface: S31 = 9-Pin SD Standard / SD 3.0 Specification
P	= Product Class: P = PE
C	= Operating Temperature: C = Commercial (0°C to 70°C)
004G	= 4GB (1GB = 1,000,000,000 bytes)
V11	= Virtium Proprietary

Contents

TuffDrive® S31 Series – SD Memory Card	1
1. Description	1
Features	1
Part Numbering System	2
2. Revision History	4
3. Specifications	5
Capacity	5
Performance	5
Power Requirements	5
Temperature and Humidity	5
Shock and Vibration	5
Electrostatic Discharge (ESD)	5
4. Reliability	6
Mean Time Between Failures (MTBF)	6
5. Physical Specifications	6
Pin Layout / Assignments	6
Mechanical Dimensions	7
6. Electrical Specifications	8
DC Characteristic	8
7. SMART Attributes	10
Introduction	10
8. Registers	11
Card Identification Register (CID)	11
9. Certifications and Compliance	12
10. Contact Information	12

2. Revision History

Date	Revision	Page(s)	Description
09/28/2021	0.9	All	Preliminary
09/27/2022	1.0	All	Initial release

3. Specifications

Capacity

Unformatted Capacity (GB) ⁽¹⁾	User-Addressable LBA ⁽²⁾	User-Addressable Capacity Bytes
4	7,774,208	3,980,394,496
(1) 1GB = 1,000,000,000 bytes. LBA: Logical Block Address; Logical Block Size = 512 Bytes/1 Sector. (2) LBA: Logical Block Address; Logical Block Size = 512 Bytes/1 Sector.		

Performance

Capacity (GB)	Sequential Read ⁽¹⁾ MB/s	Sequential Write ⁽¹⁾ MB/s
4	35	35
(1) Product Performance is based on running CrystalDiskMark 8.00		

Power Requirements

Parameter	Min	Typ	Max
Voltage supply (3.3V)	2.7V	3.3V	3.6V

Parameter	Sequential Read	Sequential Write	Idle
Power Consumption ⁽¹⁾ (max)	0.20 W	0.10 W	0.4 W
(1) Measured at 3.3V			

Temperature and Humidity

Part Number	Operating Temperature	Non-Operating ⁽¹⁾ Temperature	Moisture Sensitivity (Non-Condensing)
VTDS31PC004G-V11	0°C to 70°C	-40°C to 85°C	5% to 95%
(1) Maximum non-operating temperature assumes data is stored on the SSD. Temperatures above 85°C are beyond NAND specification for data retention. Please see <i>Temperature Considerations for Industrial Embedded SSDs</i> whitepaper under the industrial SSD section of Virtium website (Virtium.com)			

Shock and Vibration

Reliability	Test Conditions	Reference Standards
Shock	1500G, half-sine wave, 0.5ms duration	JESD22-B110B.01
Vibration	20G, 20 Hz to 2000 Hz	JESD22-B103B.01

Electrostatic Discharge (ESD)

	Test Conditions
Non-operating	Contact discharge: ±4KV; 5 times/Pin Air discharge: ±15KV; 5 times/Position
Operating	Air discharge: ±8KV; 10 times/Position (EN55024-61000-4-2)

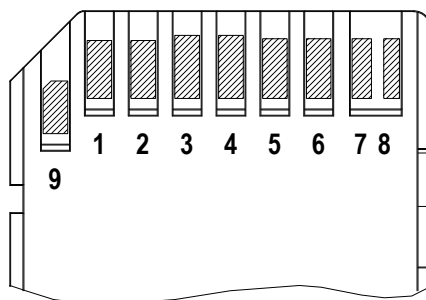
4. Reliability

Mean Time Between Failures (MTBF)

The SSD achieves a MTBF of greater than 3,000,000 hours predicted and is derived from the component reliability data using Telcordia SR-332 methods at 40°C and tested under standard environmental operating conditions.

5. Physical Specifications

Pin Layout / Assignments



SD Memory Card Pin assignment (Back View of the card)

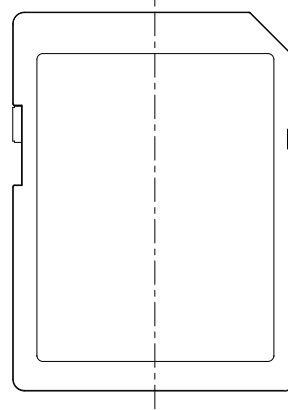
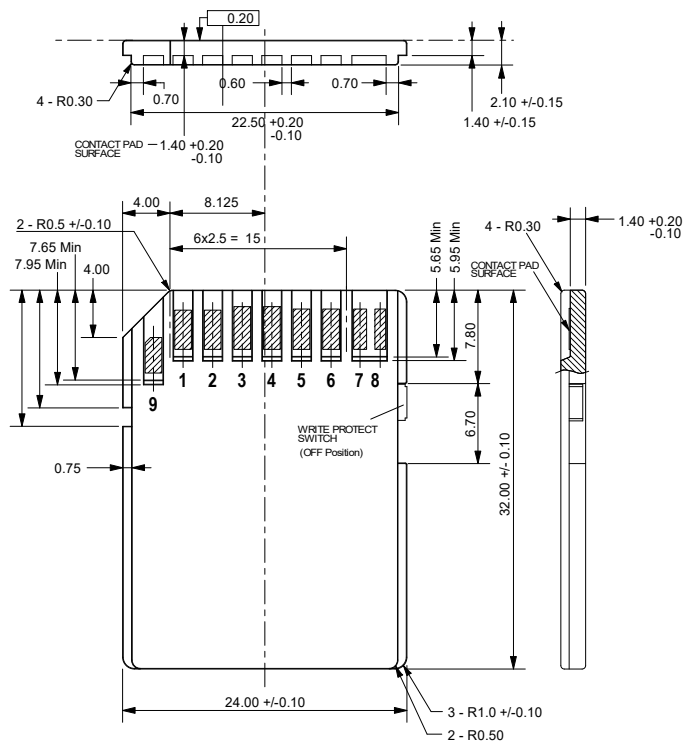
Pin	SD Mode			SPI Mode		
	Name	Type ⁽¹⁾	Description	Name	Type	Description
1	CD/DAT3 ⁽²⁾	I/O/PP ⁽³⁾	Card Detect/ Data Line [bit3]	CS	I ⁽³⁾	Chip Select (neg. true)
2	CMD	PP	Command/Response	DI	I	Data In
3	VSS	S	Supply voltage ground	VSS	S	Supply voltage ground
4	VDD	S	Supply voltage	VDD	S	Supply voltage
5	CLK	I	Clock	SCLK	I	Clock
6	VSS	S	Supply voltage ground	VSS	S	Supply voltage ground
7	DAT0	I/O/PP	Data Line [bit0]	DO	O/PP	Data Out
8	DAT1	I/O/PP	Data Line [bit1]	RSV		
9	DAT2	I/O/PP	Data Line [bit2]	RSV		

(1) S: power supply, I: input, O: output using push-pull drivers; PP: I/O using push-pull drivers.

(2) The extended DAT lines (DAT1-DAT3) are input on power up. They start to operate as DAT lines after SET_BUS_WIDTH command. The Host shall keep its own DAT1-DAT3 lines in input mode as well while they are not used. It is defined so in order to keep compatibility to MultiMedia Cards.

(3) At power up, this line has a 50KOhm pull up enabled in the card. This resistor serves two functions: Card detection and Mode Selection. For Mode Selection, the host can drive the line high or let it be pulled high to select SD mode. If the host wants to select SPI mode, it should drive the line low. For Card detection, the host detects that the line is pulled high. This pull-up should be disconnected by the user during regular data transfer with SET_CLR_CARD_DETECT (ACMD42) command.

Mechanical Dimensions



Note:

1. All dimensions are in millimeters
2. The dimensional diagram is for reference only

6. Electrical Specifications

DC Characteristic

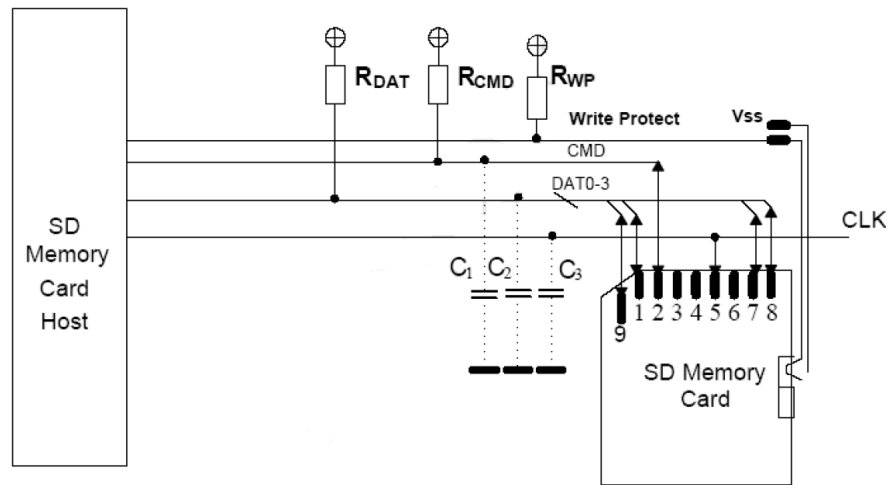
Bus Operation Conditions for 3.3V Signaling

Parameter	Symbol	Min	Max	Unit	Condition
Supply Voltage	VDD	2.7	3.6	V	
Output High Voltage	VOH	0.75*VDD		V	IOH=-2mA VDD Min
Output Low Voltage	VOL		0.125*VDD	V	IOL=2mA VDD Min
Input High Voltage	VIH	0.625*VDD	VDD+0.3	V	
Input Low Voltage	VIL	VSS-0.3	0.25*VDD	V	
Power Up Time			250	ms	From 0V to VDD min
Peak voltage on all lines		-0.3	VDD+0.3	V	
Input Leakage Current – All Input		-10	10	uA	
Output Leakage Current – All Input		-10	10	uA	

Bus Operation Conditions for 1.8V Signaling

Parameter	Symbol	Min	Max	Unit	Condition
Supply Voltage	VDD	2.7	3.6	V	
Regulator Voltage	VDDIO	1.7	1.95	V	Generated by VDD
Output High Voltage	VOH	1.4	-	V	IOH=-2mA
Output Low Voltage	VOL	-	0.45	V	IOL=2mA
Input High Voltage	VIH	1.27	2.00	V	
Input Low Voltage	VIL	Vss-0.3	0.58	V	
Input Leakage Current – All Input		-2	2	uA	

Bus Operation Conditions – Signal Line's Load

$$\text{Total Bus Capacitance} = \text{CHOST} + \text{CBUS} + \text{N CCARD}$$


Parameter	Symbol	Min	Max	Unit	Condition
Pull-up resistance	R_{CMD}	10	100	k Ω	to prevent bus floating
Total bus capacitance for each signal line	R_{DAT}		40	pF	1 card CHOST+CBUS shall not exceed 30 pF
Card Capacitance for each signal pin	CL		10	pF	
Maximum signal line inductance	CCARD		16	nH	
Pull-up resistance inside card (pin1)	R_{DAT3}	10	90	k Ω	May be used for card detection
Capacity Connected to Power Line	CC		5	μ F	

7. SMART Attributes

Introduction

The following table defines the current SMART data attributes that are supported.

Attribute ID (Hex)	Attribute ID (Dec)	Attribute Name	Description
0x0C	12	Power Cycle Count	Number of Power On Cycles
0xC2	194	Temperature	Not used.
0xC4	196	Spare Block Count	The amount of available spare blocks. The attribute value returned is the percentage of remaining spare blocks summed over all flash chips, i.e., $(100 \times \text{Current Spare Blocks} / \text{Initial Spare Blocks})$.
0xC7	199	UDMA CRC Error Rate	Not used but included for compatibility.
0xCB	203	ECC Error Count	Total number of ECC errors correctable and uncorrectable for the NAND data.
0xCC	204	Number of Corrected ECC Errors	The total number of correctable ECC errors that have occurred on flash read commands.
0xD5	213	Reserved	Reserved
0xD6	214	Reserved	Reserved
0xE5	229	Erase Count	The value returned is an estimation of the remaining card life, expressed as a percentage according to the number of flash block erases compared to the target number of erase cycles per block.
0xE8	232	Number of Reads	The total number of flash read commands.
0xF1	241	Total LBAs Written	Total number of LBAs written to the disk, divided by 65536.
0xF2	242	Total LBAs Read	Total number of LBAs read from the disk, divided by 65536.

8. Registers

Card Identification Register (CID)

The Card Identification (CID) register is 128 bits wide. It contains the card identification information used during the card identification phase. Every individual flash card shall have a unique identification number. The structure of the CID register is defined in the following table.

CID bit	Width	Name	Field
[127:120]	8	Manufacturer ID	MID
[119:104]	16	OEM/Application ID	OID
[103:64]	40	Product Name	PNM
[63:56]	8	Product Revision	PRV
[55:24]	32	Product Serial Number	PSN
[23:20]	4	Reserved	-
[19:8]	12	Manufacturing Date	MDT
[7:1]	7	CRC7 check sum	CRC
[0]	1	Not used, always '1'	-

9. Certifications and Compliance

Compliance / Certification	Description
CE and FCC Compliant	Class: FCC Part 15 Subpart B Class B:2011 Declaration of Conformity registration No. STE120607699
RoHS Compliant	Restriction of Hazardous Substance Directive
UL Certified	Underwriters Laboratories, Inc. 94V-0
WEEE Certified	Waste, Electrical and Electronic Equipment Directive

10. Contact Information

Corporate Headquarters and Manufacturing Location:

30052 Tomas, Rancho Santa Margarita, CA 92688 USA

Main Website:	www.virtium.com
Contacts / Sales:	http://www.virtium.com/contacts-sales/
Toll Free:	(888) VIRTUUM / (888) 847.8486
Telephone:	+1 (949) 888.2444
Fax:	+1 (949) 888.2445
Customer Support	custserv@virtium.com



Virtium manufactures storage and memory and solutions for the world's foremost industrial embedded OEMs. For over two decades, we have designed, manufactured and supported our products in the USA – fortified by a network of global locations. Our world-class technology and unsurpassed support provide a superior customer experience that continuously results in better industrial embedded products for an increasingly interconnected world.

© Copyright 2022. All rights reserved. Virtium®, StorFly®, TuffDrive®, StorKit®, vtView®, vtGuard® are registered trademarks and, vtSecure™ and vtTools™ are trademarks of Virtium LLC. All other non-Virtium product names are trademarks of their respective companies.