



SMART Storage Products

Product Specification

SMART Modular Rugged Xcel-10 Solid State Drive



2.5" Data Storage

August 2009, Rev A
PN: 810100021-1N



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www.adtron.com

REVISION HISTORY

Date	Revision	Section(s)	Description
Aug 2009	A	All	Prepared for release.



ESD Caution – Handling

Static electricity may be discharged through this disk subsystem. In extreme cases, this may temporarily interrupt the operation or damage components. To prevent this, make sure you are working in an ESD-safe environment. For example, before handling the disk subsystem, touch a grounded device, such as a computer case, prior to handling.

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1.0 INTRODUCTION

This product specification defines the architecture, attributes, performance, technologies, and compliance and regulatory requirements for the Xcel-10 SATA solid state drive.

1.1 Product Description

The SMART Modular rugged Xcel-10 SATA solid state drives (SSDs) are designed to meet the needs of mission-critical applications in the defense, aerospace, and industrial markets where high shock, vibration, and temperature tolerances are as important as high performance and reliability. The rugged version also supports Normal and Enhanced Security Erase modes as defined by the ATA-7 Specification.

1.2 Key Features

- High capacity in a 2.5" form factor; up to 128 GBytes in 9.5 mm
- High performance
 - ◆ **Burst:** 300 MBytes/sec
 - ◆ **Sustained Read:** Up to 110 MBytes/sec
 - ◆ **Sustained Write:** Up to 110 MBytes/sec
 - ◆ **Random Read:** 6100 Input/Output Operations Per Second (IOPS) ¹
 - ◆ **Random Write:** 290 IOPS
 - ◆ **Random 67% Read, 33% Write:** 800 IOPS
 - ◆ **Access Time:** < 0.1 msec
- ATA-7, SATA 2.6-compliant with speeds of 3.0 Gbits/sec and support for 1.5 Gbits/sec
- High reliability with single-level cell (SLC) flash
 - ◆ **Mean Time Between Failure:** 1,100,000 hours ²
 - ◆ **Non-Operating Shock:** 1500 g, half-sine, 0.5 ms
 - ◆ **Operating Shock:** 50 g half-sine, 11 ms, 3 shocks along each axis: X, Y, and Z
 - ◆ **Operating Vibration:** 16.4 g rms
 - ◆ **Industrial Operating Temperature:** -40°C to 85°C
 - ◆ **Data Retention:** 10 years at 25°C

¹ Random performance values are based on 4 KByte transfers on an A25FD-32GI32N.

² Calculated using an A25FD-32GI32N. Based on Telcordia, SR-332 Issue 1 at 25°C.



2.0 PRODUCT SPECIFICATIONS

2.1 Physical Characteristics

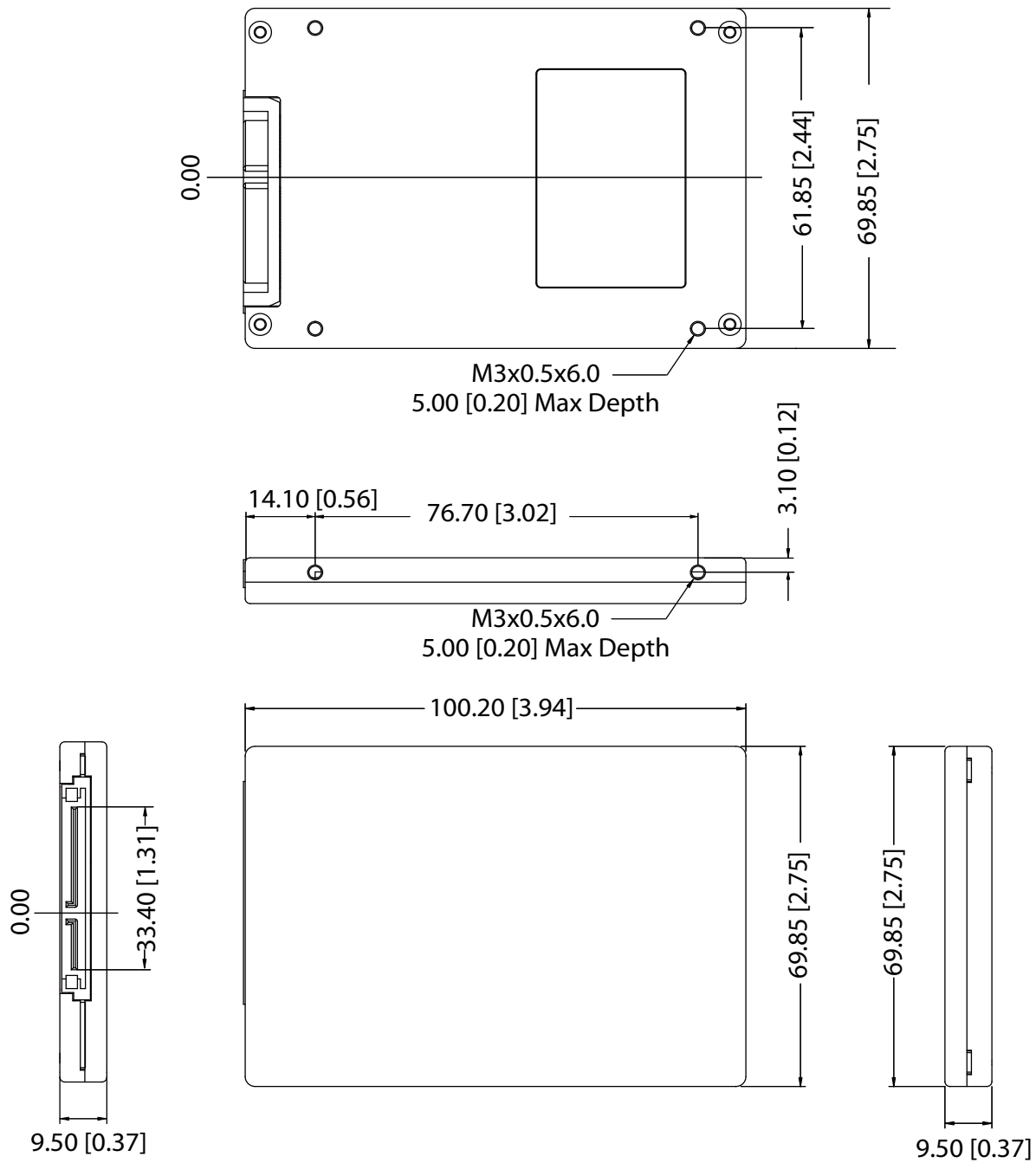
The following table describes the Xcel-10 SATA SSD dimensions, with the maximum weight. For detailed mounting configurations, see [Figure 2](#).

Table 1: Physical Dimensions

Parameter	Model	Value (Max)	Capacities
Weight	A25FD-128GI32N	115.0 g [4.1 oz]	128 GBytes
Height	All	9.5 mm [0.4"]	32, 64, 128 GBytes
Depth	All	100.2 mm [3.9"]	
Width	All	69.9 mm [2.8"]	



Figure 2: Xcel-10 SATA 2.5" SSD Physical Dimensions (in mm [inches])



Complies with Serial ATA Revision 1.0 Specification available from the Serial ATA International Organization.



2.2 Interface

The Xcel-10 SATA 2.5" SSD supports ATA modes of operation, as shown in Table 2, and complies with the ATA/ATAPI-7; ANSI INCITS 397-2005, AT Attachment with Packet Interface-7 standard.

Table 2: ATA Modes of Operation

Mode	Support
PIO	0, 1, 2, 3, 4
Ultra DMA	0, 1, 2, 3, 4, 5, 6

2.3 Performance

Tables 3 and 4 show the performance specifications, which are based on the A25FD-64GI32N.

2.3.1 Sustained and Random Performance

Table 3: Sustained and Random Read/Write Performance

Parameter	Value
Burst Read	300 MBytes/sec ⁴
Burst Write	300 MBytes/sec
Sustained Read	Up to 110 MBytes/sec
Sustained Write	Up to 110 MBytes/sec
Random Read ⁵	6100 Input/Output Operations Per Second (IOPS)
Random Write	290 IOPS
Random 67% Read, 33% Write	800 IOPS

2.3.2 Access/Startup Times

Table 4: Access/Startup Performance

Parameter	Value (Typ)
Start Up Time (Reset to Busy)	100 msec
Start Up Time (Reset to Not Busy)	1 sec
Access Time	< 0.1 msec
Seek Time and Latency	0

⁴ One megabyte, or MByte, equals 1,048,576 bytes.

⁵ Random performance values are based on 4 KByte transfers.



2.4 Capacity

Table 5 describes the available memory capacities for the Xcel-10 SATA 2.5" SSD.

Table 5: Xcel-10 SATA Capacities

Unformatted Disk Capacity (GBytes)	User Addressable Sectors in LBA Mode	Cylinder Heads Sectors (CHS)			
		Number of Logical Cylinders	Number of Logical Heads	Logical Sectors Per Track	Current Capacity (CHS)
9.5 mm SSD					
32	62914560	16383 ⁶	16	63	16514064
64	125829120	16383 ⁶	16	63	16514064
128	251658240	16383 ⁶	16	63	16514064

2.5 Supply Voltage

Table 6: Xcel-10 SATA SSD Supply Voltage

Parameter	Min	Typ	Max	Units
Supply Voltage (V _{CC})	4.75	5	5.25	V

⁶ The ATA specification defines a limited number of bits for the cylinders, heads, and sectors (CHS). When using CHS-mode commands, the host can only access the first 16 GBytes, not the full drive capacity. In addition, because the Xcel-10 drives do not allow users to change the geometry, the CHS values listed in the table cannot change.



2.6 Power Consumption

The A25FD-32N houses an array of capacitors, which are designed to store enough power to flush the drive cache in the event of a power interruption. Because the drive charges these capacitors on power up, the initial power spike is much higher than typical power consumption. See [Table 7](#) for more information.

Table 7: A25FD-32N SSD Power Consumption ⁷

Parameter	Maximum		Average	
	mA	W	mA	W
Sustained Read	460	2.3	250	1.3
Sustained Write	460	2.3	250	1.3
Idle	440	2.2	240	1.2
Startup	620	3.1	240	1.2
Hot Swap	620	3.1	350	1.8
Fast Clear Secure Erase	660	3.3	390	2.0

⁷ All measurements are recorded based on the voltmeter (Fluke 189 Meter) with a fast minimum/maximum capture rate of 250 μ s. Because the capture rate is very fast, the voltmeter records current spikes in the drive.



3.0 RELIABILITY CHARACTERISTICS

Table 8: Reliability Parameters

Parameter	Value
Bit Error Rate	< 1 non-recoverable in 10 ¹⁴ bits read
Data Retention	10 years at 25°C
ECC/EDC (BCH)	Up to 4 bits in a 512-byte sector
Write Endurance	> 50 years @ 200 GBytes/day write/erase cycles or > 10 years @ 1 TByte/day write/erase cycles for 64 GBytes ⁸

4.0 ENVIRONMENTAL SPECIFICATIONS

4.1 Temperature

Table 9: Reliability Temperatures

Parameter	Min	Typ	Max
Industrial Operating Temperature	-40°C	---	85°C
Storage Temperature	-50°C	---	90°C

4.2 Operating Environment

Table 10: Operating Environment

Parameter	Value
Relative Humidity ⁹	5% to 95% non-condensing
Altitude ⁹	24,384 m [80,000 ft]

⁸ Based on 128 KByte block transfers and continuous, sequential writes to the drive. The number does not include file system overhead, which may vary depending on the file system. The total life span of the drive depends on both the write endurance numbers and MTBF. One kilobyte, or KByte, equals 1024 bytes.

⁹ Based on MIL-STD-810F



4.3 Shock and Vibration

Table 11: Shock and Vibration

Parameter	Value
Non-Operating Shock ¹⁰	1500 g half-sine, 0.5ms, 1 shock along each axis, X, Y, Z, in each direction
Operating Shock ¹⁰	50 g half-sine, 11 ms, 3 shocks along each axis, X, Y, Z, in each direction
Operating Vibration ¹⁰	16.4 g rms, 15-2000 Hz random, 3 axes

4.4 Regulations

Table 12: Regulation Compliances

Regulation	Compliance
EMC/Emissions	EN 55022:2006; FCC CFR 47 Part 15 Subpart B:2003
EMC/Immunity	EN 55024:1998+A2:2003
Safety	UL IEC 60950-1:2003; CSA C22.2 No. 60950-1; EN 60950-1:2006
RoHS	Directive of the European Parliament and of the Council on Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment, 2002/95/EC, January 2003 (RoHS Directive)



¹⁰Based on MIL-STD-810F, Method 516.5-10 Procedure I (modified).

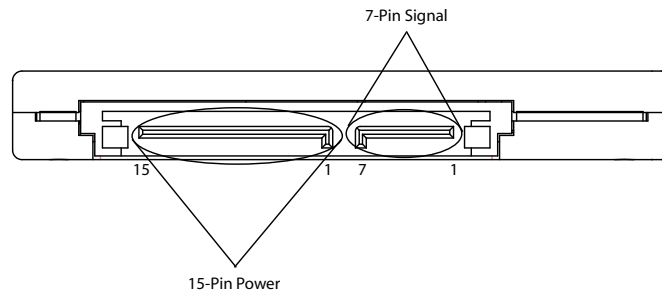


5.0 DRIVE CONFIGURATION

5.1 Pin Configuration

The Xcel-10 SATA 2.5" data storage interface connector pinout is shown in Figure 3. Connector pinout descriptions are detailed in Table 13 and Table 14.

Figure 3: Xcel-10 SATA Connection View



5.2 Power Pinout Descriptions

Table 13: Power Pinout Descriptions

Pin	Signal	Description	Cable Use	Backplane Use
P1	3.3 V (Reserved)	Reserved		
P2				
P3				
P4	GND	Ground	1 st mate	1 st mate
P5			1 st mate	2 nd mate
P6				
P7	5 V	5 V power, pre-charged	1 st mate	2 nd mate
P8	5 V	5 V power	2 nd mate	3 rd mate
P9				
P10	GND	Ground	1 st mate	2 nd mate
P11	Reserved	Reserved		
P12	GND	Ground	1 st mate	1 st mate
P13	Not Used	N/A		
P14				
P15				



5.3 Signal Pinout Descriptions

Table 14: Signal Pinout Descriptions

Pin	Signal	Description	Cable Use	Backplane Use
S1	GND	Ground	1 st mate	2 nd mate
S2	Dev Rx+	Differential signal pair A from Phy	2 nd mate	3 rd mate
S3	Dev Rx-			
S4	GND	Ground	1 st mate	2 nd mate
S5	Dev Tx-	Differential signal pair B from Phy	2 nd mate	3 rd mate
S6	Dev Tx+			
S7	GND	Ground	1 st mate	2 nd mate

6.0 SUPPORTED ATA COMMANDS

The Xcel-10 SATA 2.5" SSD supports the commands listed in the following table. For a complete description of these commands, see the ATA-7 Standard Specification.

Table 15: Supported ATA Commands

Command Name	Op Code (Hex)	Command Set (Category)
Check Power Mode	E5	PwrMgmt
Execute Device Diagnostic	90	General
Flush Cache	E7	General
Flush Cache Extended	EA	ExtLBA
Identify Device	EC	General
Idle	E3	PwrMgmt
Idle Immediate	E1	PwrMgmt
Initialize Device Parameters	91	General
Read Buffer	E4	General
Read DMA	C8	General
Read DMA Ext	25	ExtLBA
Read Multiple	C4	General
Read Multiple Ext	29	ExtLBA
Read Sectors	20	General
Read Sectors Ext	24	ExtLBA
Read Sectors w/o Retries	21	General
Read Verify Sectors	40	General
Read Verify Ext	42	ExtLBA
Recalibrate	10	General
Security Disable Password	F6	Security
Security Erase Prepare	F3	Security
Security Erase Unit	F4	Security
Security Freeze Lock	F5	Security

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Table 15: Supported ATA Commands (Continued)

Command Name	Op Code (Hex)	Command Set (Category)
Security Set Password	F1	Security
Security Unlock	F2	Security
Seek	70	General
Set Features	EF	General
Set Multiple Mode	C6	General
Sleep	E6	PwrMgmt
S.M.A.R.T. Operations	B0	S.M.A.R.T.
Standby	E2	PwrMgmt
Standby Immediate	E0	PwrMgmt
Write Buffer	E8	General
Write DMA	CA	General
Write DMA Ext	35	ExtLBA
Write Multiple	C5	General
Write Multiple Ext	39	ExtLBA
Write Sectors	30	General
Write Sectors Ext	34	ExtLBA
Write Sectors w/o Retries	31	General

7.0 SUPPORTED S.M.A.R.T. OPERATIONS

Self-monitoring analysis and reporting technology (S.M.A.R.T.) commands provide diagnostic information regarding drive operation and, in certain cases, can assist in predicting drive degradation. Because S.M.A.R.T. alerts the host of possible drive problems, you can assess the situation and back up data prior to an operational failure.

Each S.M.A.R.T. attribute monitors a specific drive condition, such as temperature. Host systems initiate commands, generated manually or with a third-party diagnostic tool, to monitor S.M.A.R.T. attributes.

Although SMART Modular drives support several S.M.A.R.T. operations, which are subcommands of the S.M.A.R.T. Operations command (see [Table 16](#)), the S.M.A.R.T. Return Status and S.M.A.R.T. Read Data subcommands are used for monitoring the drive.

Initiating a S.M.A.R.T. Return Status command returns the current state of the drive, specifying “passed” or “failed.” A failed status indicates the drive has experienced an “actual” or “predictive” failure. Actual failures are returned when the drive is no longer usable, whereas a predictive failure means the drive has exceeded a reasonable level and should be monitored more closely.

NOTE:

The S.M.A.R.T. Return Status command does not indicate the attribute that caused the failure. To determine which attribute exceeded the threshold, issue the S.M.A.R.T. Read Data command. For more details, ask your representative for the *S.M.A.R.T. Attributes Technical Reference* for Xcel-10 drives.



Table 16: Supported S.M.A.R.T. Subcommands

Subcommand Name	Feature Code (Hex)
S.M.A.R.T. Read Data	D0
S.M.A.R.T. Read Attribute Thresholds	D1
S.M.A.R.T. Read Log	D5
S.M.A.R.T. Write Log	D6
S.M.A.R.T. Enable Operations	D8
S.M.A.R.T. Disable Operations	D9
S.M.A.R.T. Return Status	DA

Table 17: Supported S.M.A.R.T. Attributes

Attribute ID	Name	Description
9	Power-On Hours	Specifies the total number of hours the drive has been powered-on since the drive was first manufactured.
12	Power Cycle Count	Indicates the total number of power-on events.
192	Power-Off Retract Count	Specifies the number of times the drive has been powered down.
194	Temperature	Returns the drive temperature in degrees Celsius, which is located in the first byte of the raw data.
197	Current Pending Sector Count	Indicates the number of data correction activities the controller performed.
198	Offline Scan Uncorrectable Count	Specifies the number of ECC errors detected but not resolved.
199	UDMA CRC Error Count	Returns the number of sectors that encountered a CRC error while in UDMA mode.
251	Minimum Spare Blocks Remaining	Specifies the number of spare blocks remaining as a percentage of the total number of spare blocks.
252	Newly Added Bad Flash Blocks	Indicates the number of bad flash blocks detected since the last time the drive was initialized.
254	Total Erase Block	Indicates the total number of erase blocks that the drive has erased.

8.0 SUPPORTED SECURE ERASE OPERATIONS

The Xcel-10 SATA SSDs support the ATA-7 standard security erase operations, including Normal and Enhanced modes. See [Table 15](#) for a list of the supported secure erase commands. The secure erase operations erase all blocks that currently contain or previously contained data, including spare blocks. When the operation completes, the drive automatically re-initializes and is usable. For more information about the secure erase operations, see the *Secure Erase Programmer's Guide* or the *ATA-7 Specification*.



11.0 CONTACT INFORMATION

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