

# ATP Industrial Grade SlimSATA Embedded Module

Version 2.0



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## Revision History

<b>Date</b>	<b>Version</b>	<b>Changes compared to previous issue</b>
Nov. 17 <sup>th</sup> , 2011	2.0	- First release

## Table of Contents

<b>1</b>	<b>INTRODUCTION</b>	<b>5</b>
1.1	Product Overview	5
1.2	Main Features	5
<b>2</b>	<b>PRODUCT SPECIFICATION</b>	<b>6</b>
2.1	Product Image	6
2.2	Product Capacities	6
2.3	Block Diagram	7
2.4	Performance	8
2.4.1	IOPS	8
2.4.2	Read/Write Performance	8
2.5	Electrical Characteristics	8
2.5.1	Supply Voltage	8
2.5.2	System Power Requirement	9
2.6	Environment Specifications	9
2.6.1	Temperature and Humidity	9
2.6.2	Vibration and Shock	9
2.6.3	Altitude	9
2.7	MTBF	10
2.8	Write/Erase Endurance	10
2.9	Certification	11
<b>3</b>	<b>SATA EMBEDDED MODULE PIN ASSIGNMENT</b>	<b>12</b>
3.1	Pin Location	12
3.2	Pin Assignments	13
<b>4</b>	<b>COMMAND SETS</b>	<b>14</b>
4.1	ATA Command Set	14
4.2	Identify Device Data	15
4.3	SMART Information	17
4.3.1	SMART subcommand sets	17
4.3.2	SMART Read Data (subcommand D0h)	17
4.3.3	ATP SMART Tool	19
<b>5</b>	<b>MECHANICAL INFORMATION</b>	<b>20</b>
5.1	Physical Dimension Specifications	20
5.2	Mechanical Form Factor	20

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# 1 Introduction

## 1.1 Product Overview

The ATP Industrial Grade SlimSATA Embedded Module is a high performance and high capacity mass storage solution in Slim form factor. Utilizing SLC (Single Level Cell) NAND flash components provides outstanding performance and proven reliability for products operating.

ATP Industrial Grade SlimSATA Embedded Module is perfect for in thin devices, especially networking, thin clients and embedded appliance and also suit for industrial applications such as transportation, industrial PC, healthcare, telecommunications, and other harsh environments where data integrity and consistent performance is mission critical.

## 1.2 Main Features

- Capacities: 2GB to 32GB
- SLC NAND flash memory
- Operating temperature: -40°C to 85°C
- Power consumption on idle mode is 0.4W/Operational mode is 1.3W
- Maximum performance: Sequential read up to 112MB/s, sequential write up to 91MB/s
- JEDEC standard: MO-297A (SlimSATA) compliant
- Slim form factor for design in thin devices, especially networking, thin clients and embedded appliance.
- Extensive application for storage
- Standard 7 + 15 pin SATA interface as the SSD I/O, can be a small density SSD replacement
- Compliant with Serial ATA Revision 2.6.
- Support PIO mode 0~4, MDMA mode 0~2,UDMA mode 0~6
- Compatible with SATA 1.5Gbps and SATA 3.0Gbps interface rates
- SMART function support by ATA CMD
- ATP SMART tool for Windows 2000/XP/Vista/7 and Linux.
- Support TRIM command, Off-line TRIM utility available for Windows XP/2000/2003/Vista/7
- Enhanced endurance by Global wear-leveling
- Power Protector, data integrity protection during abnormal power outage.
- Data integrity under power-cycling
- RoHS compliant
- CE, FCC certification

## 2 Product Specification

### 2.1 Product Image



### 2.2 Product Capacities

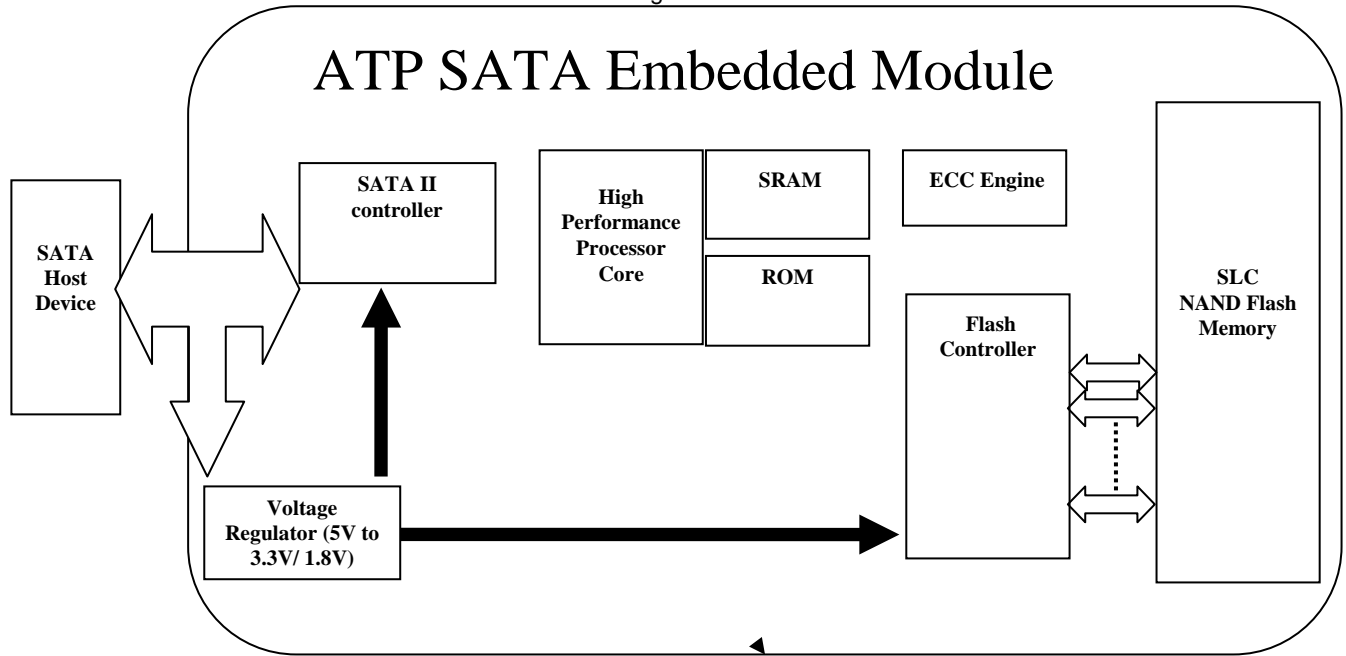
Table 2-1

ATP P/N	ATP EXTERNAL P/N	CAPACITY
AF2GSSEL-10P	AF2GSSEL-BABXP	2GB
AF4GSSEL-10P	AF4GSSEL-BABXP	4GB
AF8GSSEL-10P	AF8GSSEL-BABXP	8GB
AF16GSSEL-10P	AF16GSSEL-BABXP	16GB
AF32GSSEL-10P	AF32GSSEL-BAAXP	32GB

## 2.3 Block Diagram

ATP Industrial Grade SlimSATA Embedded Module consists of below functional blocks. The advanced architecture is optimized to provide highest data reliability and transfer performance.

Figure 2



## Performance

### 2.3.1 IOPS

Table 2-2

Type	Value
Random Read IOPS <sup>2</sup>	4KB Random Read: 2,250 IOPS

Notes: IOPS: Input/Output Operations per Second

### 2.3.2 Read/Write Performance

Table 2-3

Type	Value
Host Interface Speed	SATA 1.5Gb/s and SATA 3.0 Gb/s
Data Transfer Rate <sup>1</sup>	Sequential Read: up to 112MB/s
	Sequential Write: up to 91MB/s

Notes: The performance may vary according to different product capacity.

## 2.4 Electrical Characteristics

### 2.4.1 Supply Voltage

Table 2-4

Parameter	Symbol	Min	Typ	Max	Unit	Remark
Supply voltage	V <sub>CC</sub>	4.75	5.0	5.25	V	



## 2.4.2 System Power Requirement

Table 2-5

Parameter	Symbol	Min	Typ	Max	Unit	Remark
Sustained write power	$P_W$	-	1.30	-	W	RMS value
Sustained read power	$P_R$	-	1.00	-	W	RMS value
Idle power	$P_S$	-	0.40	-	W	RMS value

## 2.5 Environment Specifications

### 2.5.1 Temperature and Humidity

Table 2-6

Type		Value
Temperature	Operating	-40°C to 85°C
	Non-Operating	-45°C to 85°C
Humidity	Operating	25°C, 8% to 95%, noncondensing
	Non-Operating	40°C, 8% to 93%, noncondensing

### 2.5.2 Vibration and Shock

Table 2-7

Type		Value
Vibration	Operating	sine 16.4G, 10~2000Hz
Shock	Operating	Half sine 1500G/0.5ms

### 2.5.3 Altitude

Table 2-8

Type		Value
Altitude	Operating	80,000 feet Max.
	Non-Operating	80,000 feet Max.

## 2.6 MTBF

Table 2-9

Type	Value
MTBF (@ 25°C) <sup>1</sup>	2GB: 1,090,000 hours 4GB: 1,080,000 hours 8GB: 1,060,000 hours 16GB: 1,030,000 hours 32GB: 1,000,000 hours

Notes:

The Mean Time Between Failures (MTBF) is calculated using a prediction methodology, Telcordia SR-332, which based on reliability data of the individual components in the SlimSATA embedded module. It assumes nominal voltage, with all other parameters within specified range.

## 2.7 Write/Erase Endurance

Table 2-10




Type	Value
Endurance Technology	Enhanced Global Wear Leveling algorithm SLC flash block: 100,000 program/erase cycles
SlimSATA Endurance	2GB: 80 terabyte random write 4GB: 160 terabyte random write 8GB: 320 terabyte random write 16GB: 640 terabyte random write 32GB: 1,280 terabyte random write

Note:

Endurance for the SlimSATA can be predicted based on the usage conditions applied to the device, the internal NAND component cycles, the write amplification factor, and the wear leveling efficiency of the drive.

## 2.8 Certification

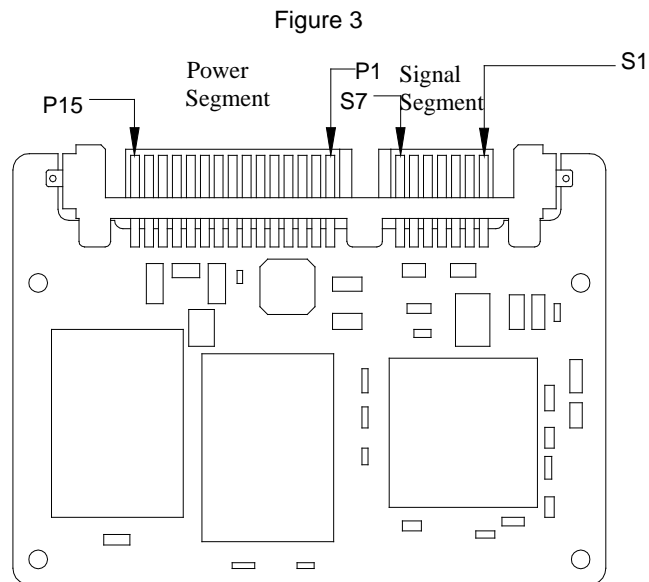
Table 2-11

Mark/Approval	Documentation	Compliant
	<p>The CE marking (also known as CE mark) is a mandatory <a href="#">conformance mark</a> on many products placed on the single market in the <a href="#">European Economic Area</a> (EEA). The CE marking certifies that a product has met EU consumer safety, health or environmental requirements. CE stands for Conformité Européenne, "European conformity" in French.</p>	Yes
	<p>FCC Part 15 Class B was used for Evolution of United States (US) Emission Standards for Commercial Electronic Products, The United States (US) covers all types of unintentional radiators under Subparts A and B (Sections 15.1 through 15.199) of FCC 47 CFR Part 15, usually called just <a href="#">FCC Part 15</a></p>	Yes
	<p>RoHS is the acronym for Restriction of Hazardous Substances. RoHS, also known as Directive 2002/95/EC, originated in the European Union and restricts the use of specific hazardous materials found in electrical and electronic products. All applicable products in the EU market after July 1, 2006 must pass RoHS compliance. For the complete directive, see Directive 2002/95/EC of the European Parliament.</p>	Yes

### 3 SATA Embedded Module Pin Assignment

#### 3.1 Pin Location

The following figure shows the pin location of the SlimSATA embedded module, the connector is with both signal and power segments



## 3.2 Pin Assignments

There are total of 7 pins in the signal segment and 15 pins in the power segment. The pin definitions are shown in Table 3-1

Table 3-1

Group	Pin No. <sup>1</sup>	Function	Description
Signal Segment	S1	GND	Ground
	S2	A+	Differential signal pair A
	S3	A-	
	S4	GND	Ground
	S5	B-	Differential signal pair B
	S6	B+	
	S7	GND	Ground
Key & Spacing			
Power Segment	P1	NC/V <sub>33</sub>	3.3V power (Not used)
	P2	NC/V <sub>33</sub>	3.3V power (Not used)
	P3	NC/V <sub>33</sub>	3.3V power (Not used)
	P4	GND	Ground
	P5	GND	Ground
	P6	GND	Ground
	P7	V <sub>5</sub>	5V power, pre-charge
	P8	V <sub>5</sub>	5V power
	P9	V <sub>5</sub>	5V power
	P10	GND	Ground
	P11	DAS	Device Activity Signal
	P12	GND	Ground
	P13	NC/V <sub>12</sub>	12V power (Not used)
	P14	NC/V <sub>12</sub>	12V power (Not used)
	P15	NC/V <sub>12</sub>	12V power (Not used)

Notes:

1. All pins are in a single row, with a 1.27 mm (0.050") pitch.

## 4 Command Sets

### 4.1 ATA Command Set

ATP SlimSATA Embedded module support the commands show in the following table

Table 4-1

Command	Code	Protocol
<b>General Feature Set</b>		
Execute Drive Diagnostic	90h	Device diagnostic
Flush Cache	E7h	Non-data
Identify Device	ECh	PIO data-in
Read DMA	C8h	DMA
Read Multiple	C4h	PIO data-in
Read Sector(s)	20h	PIO data-in
Read Verify Sector(s)	40h or 41h	Non-data
Set Feature	EFh	Non-data
Set Multiple Mode	C6h	Non-data
Write DMA	CAh	DMA
Write Multiple	C5h	PIO data-out
Write Sector(s)	30h	PIO data-out
NOP	00h	Non-data
Read Buffer	E4h	PIO data-in
Write Buffer	E8h	PIO data-out
<b>Power Management Feature Set</b>		
Check Power Mode	E5h or 98h	Non-data
Idle	E3h or 97h	Non-data
Idle Immediate	E1h or 95h	Non-data
Sleep	E6h or 99h	Non-data
Standby	E2h or 96h	Non-data
Standby Immediate	E0h or 94h	Non-data
<b>Security Mode Feature Set</b>		
Security Set Password	F1h	PIO data-out
Security Unlock	F2h	PIO data-out
Security Erase Prepare	F3h	Non-data
Security Erase Unit	F4h	PIO data-out
Security Freeze Lock	F5h	Non-data
Security Disable Password	F6h	PIO data-out
<b>SMART Feature Set</b>		
SMART Disable Operation	B0h	Non-data
SMART Enable/Disable Autosave	B0h	Non-data
SMART Enable Operations	B0h	Non-data
SMART Return Status	B0h	Non-data
SMART Execute Off-Line Immediate	B0h	Non-data

Command	Code	Protocol
SMART Read Data	B0h	PIO data-in
<b>Host Protected Area Feature Set</b>		
Read Native Max Address	F8h	Non-data
Set Max Address	F9h	Non-data
Set Max Set Password	F9h	PIO data-out
Set Max Lock	F9h	Non-data
Set Max Freeze Lock	F9h	Non-data
Set Max Unlock	F9h	PIO data-out

## 4.2 Identify Device Data

Table 4-2

Word Address	Default Value	Total Bytes	Data Field Type Information
0	044Ah	2	General Configuration
1	XXXXh	2	Default number of cylinders
2	0000h	2	Reserved
3	00XXh	2	Default number of heads
4	0000h	2	Obsolete
5	0240h	2	Obsolete
6	XXXXh	2	Default number of sectors per track
7-8	XXXXh	4	Number of sectors per card (Word 7 = MSW, Word 8 = LSW)
9	0000h	2	Obsolete
10-19	XXXXh	20	Serial number in ASCII (Right justified)
20	0002h	2	Obsolete
21	0002h	2	Obsolete
22	0000h	2	Obsolete
23-26	XXXXh	8	Firmware revision in ASCII. Big Endian Byte Order in Word
27-46	XXXXh	40	Model number in ASCII (Left justified) Big Endian Byte Order in Word
47	8001h	2	Maximum number of sectors on Read/Write Multiple command
48	0000h	2	Reserved
49	0F00h	2	Capabilities
50	4000h	2	Capabilities
51	0200h	2	PIO data transfer cycle timing mode
52	0000h	2	Obsolete
53	0007h	2	Field validity
54	XXXXh	2	Current numbers of cylinders
55	XXXXh	2	Current numbers of heads
56	XXXXh	2	Current sectors per track
57-58	XXXXh	4	Current capacity in sectors (LBAs) (Word57=LSW, Word58=MSW)
59	0100h	2	Multiple sector setting

Word Address	Default Value	Total Bytes	Data Field Type Information
60-61	XXXXh	4	Total number of sectors addressable in LBA Mode (Word60=LSW, Word61=MSW)
62	0000h	2	Reserved
63	0007h	2	Multiword DMA transfer
64	0003h	2	Advanced PIO modes supported
65	0078h	2	Minimum Multiword DMA transfer cycle time per word
66	0078h	2	Recommended Multiword DMA transfer cycle time
67	0078h	2	Minimum PIO transfer cycle time without flow control
68	0078h	2	Minimum PIO transfer cycle time with IORDY flow control
69~75	0000h	20	Reserved
76	0060h	2	Serial ATA capabilities Support Serial ATA Gen1 Support Serial ATA Gen2
77~79	0000h	6	Reserved
80	0080h	2	Major version number (ATAPI-7)
81	0000h	2	Minor version number
82	742Bh	2	Command sets supported 0
83	5500h	2	Command sets supported 1
84	4002h	2	Command sets supported 2
85~87	XXXXh	6	Command set/feature enabled
88	007Fh	2	Ultra DMA supported and selected
89	0003h	2	Time required for Security erase unit completion
90	0000h	2	Time required for Enhanced security erase unit completion
91	0000h	2	Current Advanced power management value
92	FFFEh	2	Master Password Revision Code
93~127	0000h	70	Reserved
128	0001h	2	Security status
129~159	0000h	62	Vendor unique bytes
160	0000h	2	Power requirement description
161	0000h	2	Reserved
162	0000h	2	Key management schemes supported
163	0000h	2	CFA True IDE Timing Mode Capability and Setting
164	0000h	2	Reserved
165~175	0000h	22	Reserved
176~216	0000h	82	Reserved
217	0100h	2	Non-rotating media(SSD)
218~255	0000h	76	Reserved



## 4.3 SMART Information

ATP Industrial Grade SlimSATA Embedded Module Support S.M.A.R.T. ATA feature set in IDE mode, not support in RAID mode and AHCI mode.

### 4.3.1 SMART subcommand sets

In order to select a subcommand the host must write the subcommand code to the device's Features Register before issuing the SMART Function Set command. The subcommands are listed below.

Table 4-3

Command	Command Code
SMART READ DATA	D0h
SMART SAVE ATTRIBUTE THRESHOLD	D1h
SMART ENABLE/DISABLE AUTOSAVE	D2h
SMART SAVE ATTRIBUTE VALUES	D3h
SMART EXECUTE OFF-LINE IMMEDIATE	D4h
RESERVED	D5h
RESERVED	D6h
SMART ENABLE OPERATIONS	D8h
SMART DISABLE OPERATIONS	D9h
SMART RETURN STATUS	DAh

Note:

If the reserved size is below a threshold, status can be read from the Cylinder Register using the Return Status command (DAh)

### 4.3.2 SMART Read Data (subcommand D0h)

The following 512 bytes make up the device SMART data structure. Users can obtain the data using the “Read Data” command (D0h).

Table 4-4

Byte	F/V	Description
0~1	X	Revision code
2~361	X	Vendor Specific

362	V	Off-line data collection status
Byte	F/V	Description
363	X	Self-test execution status byte
364~365	V	Total time in seconds to complete off-line data collection activity
366	X	Vendor Specific
367	F	Off-line data collection capability
368~369	F	SMART capability
370	F	Error logging capability: 7-1 Reserved 0-1 = Device error logging supported
371	X	Vendor Specific
372	F	Short self-test routine recommended polling time(in minutes)
373	F	Extended self-test routine recommended polling time(in minutes)
374	F	Conveyance self-test routine recommended polling time(in minutes)
375~385	R	Reserved
386~395	F	Firmware Version/Date Code
396~397	F	Number of initial invalid block (396=MSB, 397=LSB)
398~399	V	Number of run time bad block (398=MSB, 399=LSB)
400~406	F	SMI2242
407~415	X	Vendor specific
416	F	Reserved
417	F	Program/write the strong page only
418~419	V	Number of spare block
420	F	Reserved
421~423	V	Average erase count
424~425	V	Number of child pair
426~428	V	Maximum erase count
429~431	V	Minimum erase count
432~445	F	Reserved
446~510	X	Vendor specific
511	V	Data structure checksum

## Notes:

F=content (byte) is fixed and does not change

V=content (byte) is variable and maybe change depending on the state of the device or the command executed by the device

X= content (byte) is vendor specific and maybe fixed or variable

R=content (byte) is reserved and shall be zero

### 4.3.3 ATP SMART Tool

ATP provides SMART Tool for Windows 2000/XP/Vista/7 and Linux, it can monitor the state of SlimSATA Embedded Module, the following picture shows SMART tool operation. This tool supports that users read spare and bad block information. Users can thus evaluate drive health at run time and receive an early warning before the drive life ends.

Figure 4



## 5 Mechanical Information

### 5.1 Physical Dimension Specifications

Table 5-1

Type		Value
Embedded module (Without housing)	Length	54.0 mm +/- 0.15mm
	Width	39.0 mm +/- 0.15mm
	Thickness	4.0 mm +/- 0.15mm

### 5.2 Mechanical Form Factor (Units in mm)

Figure 5

