

**Memoright ST(R)-12 Series
Half Slim (Half 1.8") Form Factor
NAND Flash Solid State Drive**
Model Code: MRSAJ6J*****12I00

Product Specification

Version 1.0
May 2011

Overview

This document serves as reference basis for ST(R)-12 Series Solid State Drive's technical characteristics and help you choose Memoright industrial and commercial operating temperature range SLC NAND Flash solution.

Change History		
Rev.	Update	Updated
1.0	Initial release	2011/5/5

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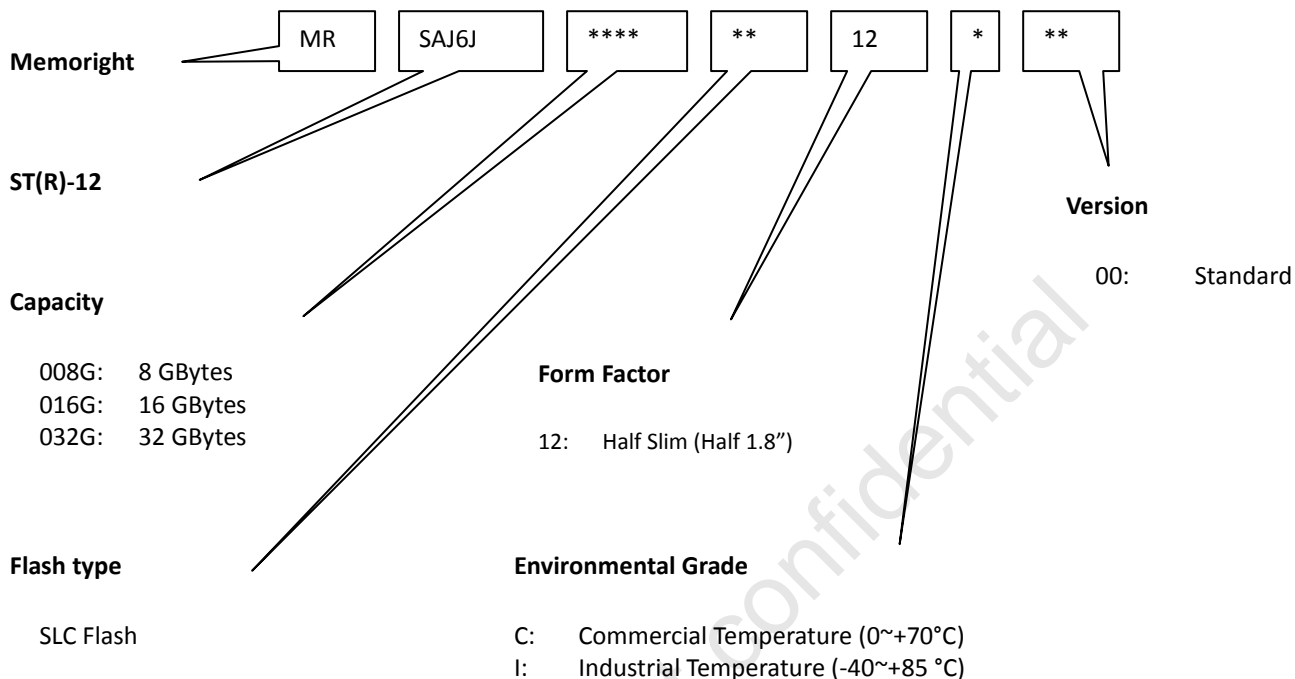
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Ordering information

Decoder



Product code

Memoright ST(R)-12 Series	
Part Number	Description
MRSAJ6J008GN112I00	8 GB SLC NAND Flash, SATA II, Half 1.8"SSD, Industrial Solution
MRSAJ6J016GN312I00	16 GB SLC NAND Flash, SATA II, Half 1.8"SSD, Industrial Solution
MRSAJ6J032GN412I00	32 GB SLC NAND Flash, SATA II, Half 1.8" SSD, Industrial Solution

For the latest ordering information, please consult Memoright's sales representatives or check on our website: <http://www.memoright.com>

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General Description

Memoright ST(R)-12 Series Solid State Drive consists solely of semiconductor devices, with high reliability and high compatibility MLC NAND Flash.

As ST(R)-12 Series SSD doesn't have any mechanical part such as platter (disk), motor and suspension, it is a good solution in UMPC, Tablet PC, Server as storage device with high performance, low power consumption and small form factor.

For an easy adoption, the ST(R)-12 Series drive has the same device interface and physical dimension with HDD.

1.1 Raw capacity

8, 16, 32 GBytes,

1.2 Form Factor

Half Slim (Half 1.8") (39 x 54 x 4.7)mm

1.3 Host interface

Serial ATA 2.6 specification compliant

1.4 Performance

Host Interface: 3.0 Gbps

Sustained Read transfer: up to 130 MB/s

Sustained Write transfer: up to 120 MB/s

Access time: < 0.1ms

Random IOPS Read @4Kbytes: up to 10,000

Random IOPS Write @4Kbytes: up to 500

1.5 Reliability

1.5.1 Wear Leveling

Both dynamic and static wear leveling strategy, which ensure all blocks have nearly same wear level, reducing dependence of write endurance on access pattern.

1.5.2 Endurance

Write: >10 years @ 1TByte/day (64GB)

Read: unlimited

1.5.3 ECC

Enhanced ECC algorithm, which reduces error rate and enforces write endurance at same time. BCH-16 per sector(1K Bytes).

1.5.4 Bad block management algorithm

This drive has a certain number of reserved blocks. When a user data block fails, a reserved block will replace the failed block. The replacement of bad block is transparent to user.

1.5.5 Mean Time between Failures

More than 2,100,000 hours

1.5.6 Data Retention

Data retention :>10 years

Test under room temperature.

1.6 Power consumption

Input voltage: +5 VDC,

Input current : 1 A Max.(Transient)

Write : 1.8 W(Average)

Idle : 0.6 W(Average)

Test under room temperature @ 5V

1.7 Environmental

1.7.1 Temperature

Operating : 0°C ~ +70°C (C-Temp)

-40°C ~ +85°C (I-Temp)

Non-Operating : -40°C ~ +85°C (C-Temp)

-55°C ~ +95°C (I-Temp)

1.7.2 Shock

Operating: 11ms @50G, Half Sine Wave

Non-Operating: 0.5ms@1500G, Half Sine Wave

1.7.3 Vibration

Operating: 16.4G Peak, 10~2000Hz, x3 Axis

1.7.4 Humidity

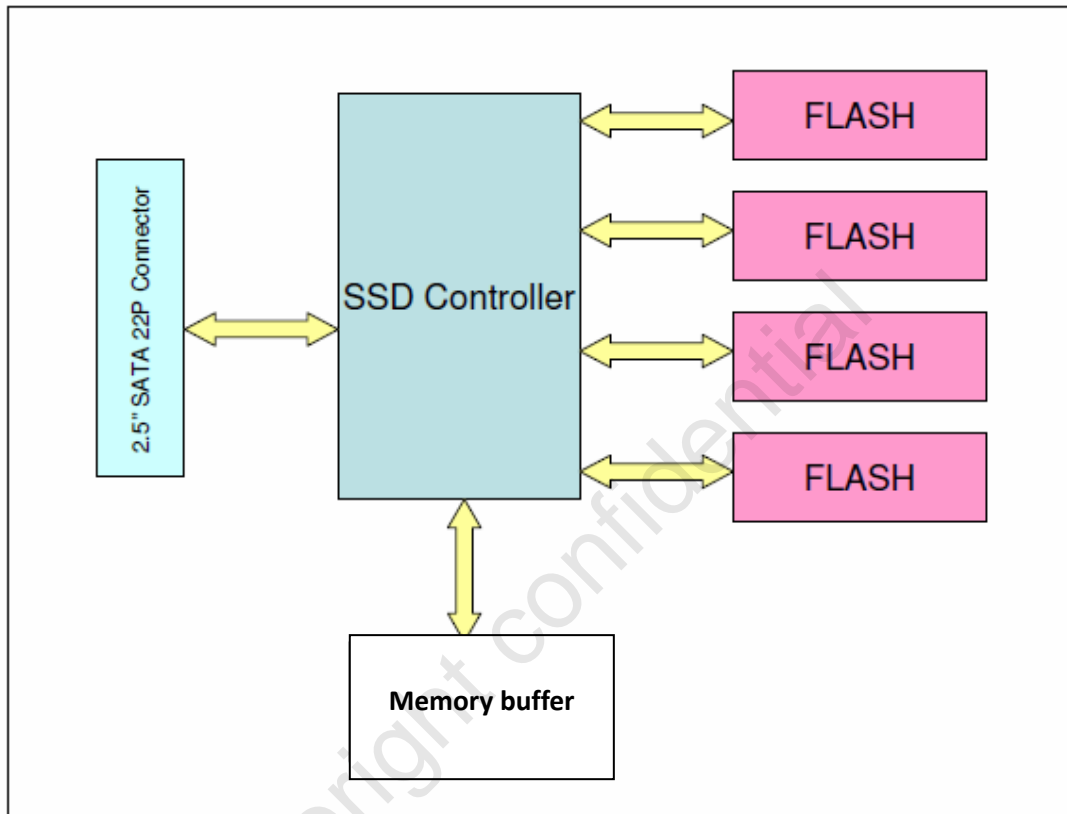
5~95% (Non-condensing)

1.7.5 Altitude

-1000~80,000 ft

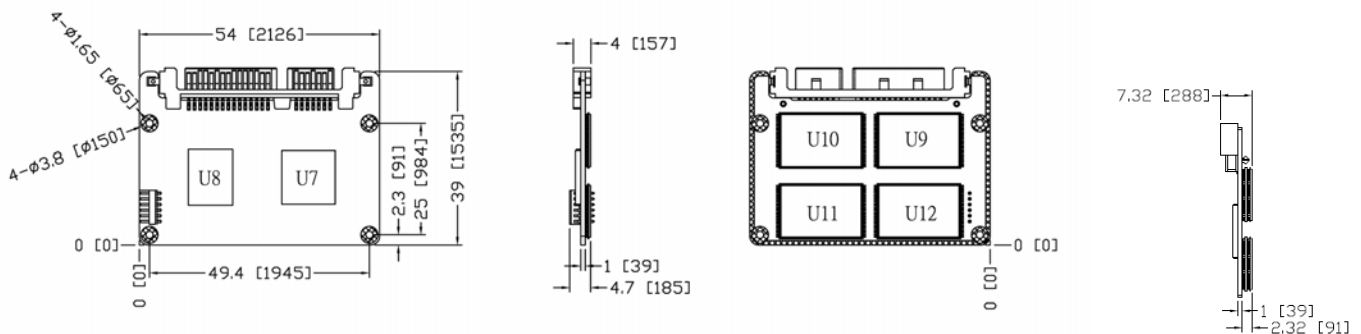
Functional Block Diagram

Figure 1: Block diagram



Physical specifications

Figure 2: Dimension (stacked flash on the right)



Drive Specifications

Unless otherwise noted, all specifications are measured under ambient conditions, at 25°C, and nominal power.

Specification Summary table

The specifications listed in the table below are for quick reference. For details on specification measurement or definition, see the appropriate section of this manual.

Table 1: Specifications Summary

Unformatted capacity	8 GB *	16 GB *	32 GB *
Sustained data transfer rate(read)	Up to 100 MB/s	Up to 120 MB/s	Up to 130 MB/s
Sustained data transfer rate(write)	Up to 60 MB/s	Up to 80 MB/s	Up to 120 MB/s
Channels	4		
Media type	Single Layer Cell (SLC) NAND Flash		
Random 4KBytes IOPS(read)	Up to 10,000		
Random 4KBytes IOPS(write)	Up to 500		
Interface	Serial ATA 2.0		
Height	4.7mm		
width	54 mm		
Length	39 mm		
Average latency(Typical)	< 0.1 msec		
Continue write power (Typical)* *	1.8 watts		
Idle mode power(Typical) * *	0.6 watts		
Humidity (non-condensing)	5%~95% (operating)		
Shock (Operating)	1000G (duration 0.5msec, Half Sine Wave)		
Shock (Non-Operating)	1500G (Duration 0.5msec, Half Sine Wave)		
Drive acoustics, sound power (dB)	0		
Non-recoverable read errors	< 10 ⁻¹⁴		
Mean Time Before Failure (MTBF)	> 2,100,000 hours (32GB)		
Altitude	-1000~60000(Ft)		

* 1GB = 1,000,000,000 Bytes

* * typical value under room temperature

1.8 Unformatted capacity

Table 2: Products capacity

Unformatted capacity	Guaranteed sectors	Bytes per sector
8 GBytes	15,728,640	512
16 GBytes	31,457,280	512
32 GBytes	62,914,560	512

1.9 default logic geometry

Table 3: Default logic geometry

Unformatted capacity	Cylinders	Read/write heads	Sectors per track
8 GB	974	255	63
16 GB	1,946	255	63
32 GB	62,037	16	63

LBA mode

When addressing these drives in LBA mode, all blocks (sectors) are consecutively numbered from 0 to n-1, where n is the number of guaranteed sectors as defined above.

1.10 Physical organization

Table 4: Physical organization

Channels
4

The number of channels means the maximum NAND flash units parallel involved in each host command execution.

1.11 Recording and interface technology

Table 5: Recording and interface

Technology	Specification
Interface	Serial ATA 2.0
Interface data transfer rate	3.0Gbps
Recording media	Single Layer Cell (SLC) NAND flash

1.12 Physical characteristics

Table 6: Physical characteristics

Height	(mm)	4.7
Width	(mm)	54
Length	(mm)	39

1.13 Access time

The time accessing to data in HDD equals to that the seek time plus the latency time, not including controller time overhead. But for SSD, the latency time is 0, and the seek time is very small. Most of the time is consumed by controller overhead.

The access time definition here is measured from the last byte of host command received by drive to the first data byte sent to host by drive in read operation.

1.14 Power specifications

The drive receives DC power (+5V) through the interface connector.

1.14.1 Power consumption

Power requirement for the drive is listed in the table. Typical power measurements are based on an average of drive testing, under nominal conditions, using 5.0V input voltage at room temperature.

- **Write power**

The write power is measured with three 63 sectors write operations every 100msecs.

The consecutive write power is measured with consecutive 128Kbytes write operations.

- **Idle mode power**

The idle power is measured with no read/wrote operation.

Table 7: Power Consumption

Power mode	Power consumption (W) @+5V, Room Temp
Consecutive write	1.8
Idle	0.6

1.14.2 Voltage tolerance

Voltage tolerance (including noise): $5V \pm 5\%$

1.15 Environmental specifications

1.15.1 Operating temperature

Ambient temperature is defined as the temperature of the environment immediately surrounding the drive. Actual drives usual temperature should not exceed 70°C within the operating ambient conditions.

Above 1,000 feet (305 meters), the maximum temperature is decreased linearly by 1°C every 1000 feet.

Table 8: Ambient temperature

Operating	Commercial	0°C to +70°C
	Industrial	-40°C to +85°C
Non-operating	Commercial	-40° to +85°C
	Industrial	-55° to 95°C

1.16 Reliability

It's well known that the reliability of a chip configuration is better than a mechanical configuration. Because the mechanical configuration is affected by too many factors, it influences the reliability of HDD very much. While the chip configuration is opposite, it makes that ST(R)-12 Series SSD has a nice reliability.

1.17 Agency certification

FCC	Federal Communications Commission
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CE	European Community Directive
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RoHS	Restriction of Hazardous Substance Directive
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1.18 Environmental protection

ST(R)-12 Series SSD produces almost no quantity of heat and the noise is 0 dB when it is working. At the same time, the ST(R)-12 Series SSD products and the enclosed components/devices and/or assemblies are lead-free. It has no influence on environment.

2 Configuring and mounting the drive

This section contains the specifications and the instructions for configuring and mounting the drive.

2.1 Static discharge and handling precautions

After unpacking and before installation, the drive may be exposed to potential handling and electrostatic discharge (ESD) hazards. Observe the following standard handling and static-discharge precautions:

Caution:

- Keep the drive in the electrostatic discharge (ESD) bag until you are ready to installation to limit the drive's exposure to ESD.
- Before handling the drive, put on a grounded wrist strap, or ground yourself frequently by touching the metal chassis of a computer that is plugged into a grounded outlet. Wear a grounded wrist strap throughout the entire installation procedure.
- Handle the drive only by its edges or frame.
- The drive is fragile, and handles it with care. Do not press down on the drive top cover.
- Always rest the drive on a padded, antistatic surface until you mount it in the computer.
- Do not touch the connector pins or the printed circuit board.
- Do not remove the factory-installed labels from the drive or cover them with additional labels. Removal voids the warranty. Some factory-installed labels contain information needed to service the drive. Other labels are used to seal out dirt and contamination.

2.2 Drive mounting

You can mount the drive using four screws in the side-mounting holes or four screws in the bottom-mounting holes. See Figure 2 for drive mounting dimensions (dimensions in inches with mm in parentheses). Follow these important mounting precautions when mounting the drive:

- Allow a minimum clearance of 0.030 inches (0.76 mm) around the entire perimeter of the drive for cooling.
- Use only M1.4 x 5 mm mounting screws.
- Do not over tighten the mounting screws (maximum torque: 1.5kg).
- Four (4) threads minimum screw engagement recommended.

2.3 Installation considerations

The advantages of ST(R)-12 Series SSD are obvious comparing to HDD. More and more users of computers replace the hard drive with ST(R)-12 Series SSD, or planning to do so. Refer to your system's user manual for the location of the hard drive compartment and the specific instructions regarding replacement. Refer to your system manufacturer's support website for the most up-to-date information. Read and follow all instructions regarding the proper steps to be taken when replacing the system hard drive. Some mobile systems are sealed and require specialized tools to gain access to the hard drive. Special training or tools may be needed to service some mobile computers. In some cases, opening the case may void your warranty. Consult your system documentation. MemoRight recommends taking your system to an authorized service technician to replace your hard drive.

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- Unpack the drive and keep it away from any potential ESD (Electrostatic Discharge) hazard area.
- Mount the drive with 4 screws either through the two sides of the drive or at the bottom of the drive.
- Use M1.4 x 5 mm screws which you may find in the packing box.
- Connect the 15-Pin power cable to the power connector of the drive and connect the 7-Pin signal cable to the signal connector of the drive properly.
- Power on your host and then format the SSD or initiate the SSD through the RAID card with the standard drive format procedure.
- Please install the windows XP first then Vista if coexisted systems required.

3 SATA interface

The drive uses the industry-standard Serial ATA interface that supports 16-bit data transfers. It supports programmed input/output (PIO) modes 0–4; Ultra DMA modes 0–6. The drive also supports the use of the IORDY signal to provide reliable high-speed data transfers.

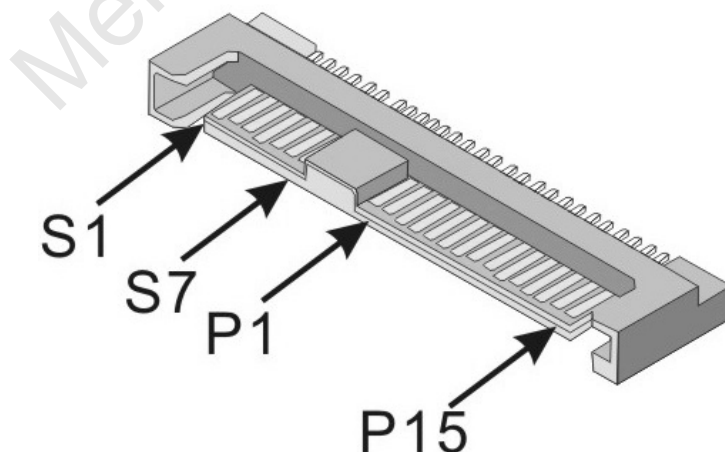
For detailed information about the Serial ATA interface, refer to the draft of AT Attachment with Packet Interface Extension (ATA/ATAPI-7), NCITS T13 1410D, subsequently referred to as the Draft ATA-7 Standard.

3.1 SATA interface signals and connector pins

The SATA connector on Memoright ST(R)-12 Series SSD is divided into a signal Segment and a power Segment. The following tables summarizes the signals on the SATA interface connector. For a detailed description of these signals, refer to the Draft ATA-7 Standard.

3.1.1 Signal Segment Pin-out Configuration

Figure 3: SATA Pin



The SATA signal cable uses a protocol transmitted over a 7-pin cable. The following table lists the signal definitions of the 7-pin segment.

Table 9: SATA Connector Signal Definitions

Pin	Signal Name	Signal Definitions
S1	Ground	Second Mate
S2	R+	+Differential Receive Signal
S3	R-	-Differential Receive Signal
S4	Ground	Second Mate
S5	T-	-Differential Transmit Signal
S6	T+	+Differential Transmit Signal
S7	Ground	Second Mate

3.1.2 Power Segment Pin-out Configuration

The SATA power connector consists of 15 pins. The following table lists the signal definitions of the 15-pin segment.

Table 10: SATA Connector Power segment Definitions

Pin	Signal Name	Signal Definitions
P1	V3.3	3.3V Power(Not used)
P2	V3.3	3.3V Power(Not used)
P3	V3.3	3.3V Power(Not used)
P4	Ground	First Mate
P5	Ground	Second Mate
P6	Ground	Second Mate
P7	V5	5V Power, pre-charge, Second Mate
P8	V5	5V Power
P9	V5	5V Power
P10	Ground	Second Mate
P11	Reserved	Reserved
P12	Ground	First Mate
P13	V12	12V Power(Not used)
P14	V12	12V Power(Not used)
P15	V12	12V Power(Not used)

3.2 Supported ATA commands

For a detailed description of the ATA commands, refer to the Draft ATA-7 Standard. Below reference table of ATA standard command set.

Table 11: ATA command set

Command Name	Code	PARAMETERS USED					
		SC	SN	CY	DR	HD	FT
CHECK POWER MODE	E5h	X	X	X	O	X	X
EXECUTE DIAGNOSTICS	90h	X	X	X	O	X	X
FLUSH CACHE	E7h	X	X	X	O	O	X
IDENTIFY DEVICE	ECh	X	X	X	O	X	X
IDLE	E3h	O	X	X	O	X	X
IDLE IMMEDIATE	E1h	X	X	X	O	X	X
INITIALIZE DEVICE PARAMETERS	91h	O	X	X	O	O	X
READ DMA	C8h or C9h	O	O	O	O	O	X
READ MULTIPLE	C4h	O	O	O	O	O	X
READ SECTOR(S)	20h or 21h	O	O	O	O	O	X
READ VERIFY SECTOR(S)	40h or 41h	O	O	O	O	O	X
RECALIBRATE	10h	X	X	X	O	X	X
SEEK	7xh	X	X	O	O	O	X
SET FEATURES	EFh	O	X	X	O	X	O
SET MULTIPLE MODE	C6h	O	X	X	O	X	X
SLEEP	E6h	X	X	X	O	X	X
S.M.A.R.T.	B0h	X	X	O	O	X	O
STANDBY	E2h	X	X	X	O	X	X
STANDBY IMMEDIATE	E0h	X	X	X	O	X	X
WRITE DMA	CAh or CBh	O	O	O	O	O	X
WRITE MULTIPLE	C5h	O	O	O	O	O	X
WRITE SECTOR(S)	30h or 31h	O	O	O	O	O	X

Note:

- O = Valid, X = Don't care
- SC = Sector Count Register
- SN = Sector Number Register
- CY = Cylinder Low/High Register
- DR = DEVICE SELECT Bit (DEVICE/HEAD Register Bit 4)
- HD = HEAD SELECT Bit (DEVICE/HEAD Register Bit 3-0)
- FT = Features Register

3.3 ATA COMMAND SPECIFICATIONS

3.3.1 CHECK POWER MODE (E5h)

The host can use this command to determine the current power management mode.

3.3.2 EXECUTE DIAGNOSTICS (90h)

This command performs the internal diagnostic tests implemented by the drive. See ERROR register for diagnostic codes.

3.3.3 FLUSH CACHE (E7h)

This command is used by the host to request the device to flush the write cache. If there is data in the write cache, that data shall be written to the media. The BSY bit shall remain set to one until all data has been successfully written or an error occurs.

3.3.4 IDENTIFY DEVICE (ECh)

This commands read out 512Bytes of drive parameter information. Parameter Information consists of the arrangement and value as shown in the following table. This command enables the host to receive the Identify Drive Information from the device.

The following commands contain drive-specific features that may not be included in the Draft ATA-7 Standard.

F/V = Fixed/variable content

F = the content of the word is fixed and does not change. For removable media devices, these values may change when media is removed or changed.

V = the contents of the word is variable and may change depending on the state of the device or the commands executed by the device.

X = the content of the word may be fixed or variable.

Table 12: IDENTIFY DEVICE returned data

Word	Value	F/V	Description	
			General configuration bit-significant information:	
		F	15	0 = ATA device
0	0040h	X	14-8	Retired
		F	7	1 = removable media device
		X	6	Obsolete
		X	5-3	Retired
		F	2	Reserved
		X	1	Retired
		F	0	Reserved
1	XXXXh	X	Number of logical cylinders	
2	C837h	V	Specific configuration	
3	00XXh	X	Number of logical heads	

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Word	Value	F/V	Description	
4-5	XXXXh	X	Retired	
6	XXXXh	X	Number of logical sector per logical track	
7-8	XXXXh	V	Reserved for assignment by the CompactFlash_ Association	
9	000Eh	X	Retired	
10-19	XXXXh	F	Serial number (20 ASCII characters)	
20-21	XXXXh	X	Retired	
22	003Fh	X	Obsolete	
23-26	XXXXh	F	Firmware revision (8 ASCII characters)	
27-46	XXXXh	F	Model number (40 ASCII characters)	
47	8000h	F	15-8	80h
		F	7-0	00h = Reserved
		F		01h = Maximum number of 1 sectors on READ/WRITE MULTIPLE commands
48	4000h	F	Reserved	
49	2F00h	Capabilities		
		F	15-14	Reserved for the IDENTIFY PACKET DEVICE command.
		F	13	1 = Standby timer values as specified in this standard are supported
				0 = Standby timer values shall be managed by the device
		F	12	Reserved for the IDENTIFY PACKET DEVICE command.
		F	11	1 = IORDY supported
				0 = IORDY may be supported
		F	10	1 = IORDY may be disabled
		F	9	1 = LBA supported
		F	8	1 = DMA supported.
X	7-0	Retired		
50	4000h	Capabilities		
		F	15	Shall be cleared to zero.
		F	14	Shall be set to one.
		F	13-2	Reserved.
		X	1	Obsolete
F	0	Shall be set to one to indicate a device specific Standby timer value minimum.		
51	0280h	X	15-8	PIO data transfer cycle timing mode
			7-0	Reserved
52	0000h	X	Obsolete	
53	0007h	F	15-3	Reserved
		F	2	1 = the fields reported in word 88 are valid
				0 = the fields reported in word 88 are not valid
		F	1	1 = the fields reported in words 70:64 are valid
				0 = the fields reported in words 70:64 are not valid
X	0	1 = the fields reported in words 58:54 are valid		
		0 = the fields reported in words 58:54 are not valid		
54	XXXXh	X	Number of current cylinders	

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Word	Value	F/V	Description	
55	00XXh	X	Number of current heads	
56	XXXXh	X	Number of current sector per track	
57-58	XXXXh	X	Current capacity in sectors	
59	0000h	F	15-9	Reserved
		V	8	1 = Multiple sector setting is valid
		V	7-0	xxh = Setting for number of sectors that shall be transferred per interrupt on R/W Multiple command
60-61	XXXXh	F	Total number of user addressable sectors	
62	0000h	X	Obsolete	
63	0007h	F	15-1 1	Reserved
		V	10	1 = Multiword DMA mode 2 is selected
				0 = Multiword DMA mode 2 is not selected
		V	9	1 = Multiword DMA mode 1 is selected
				0 = Multiword DMA mode 1 is not selected
		V	8	1 = Multiword DMA mode 0 is selected
				0 = Multiword DMA mode 0 is not selected
		F	7-3	Reserved
F	2	1 = Multiword DMA mode 2 and below are supported		
F	1	1 = Multiword DMA mode 1 and below are supported		
F	0	1 = Multiword DMA mode 0 is supported		
64	0003h	F	15-8	Reserved
		F	7-0	Advanced PIO modes supported
65	0078h	F	Minimum Multiword DMA transfer cycle time per word	
66	0078h	F	Manufacturer's recommended Multiword DMA transfer cycle time	
67	0078h	F	Minimum PIO transfer cycle time without flow control	
68	0078h	F	Minimum PIO transfer cycle time with IORDY flow control	
69-79	0000h	F	Reserved (for future command overlap and queuing)	
80	01FEh	Major version number 0000h or FFFFh = device does not report version		
		F	15	Reserved
		F	14	Reserved for ATA/ATAPI-14
		F	13	Reserved for ATA/ATAPI-13
		F	12	Reserved for ATA/ATAPI-12
		F	11	Reserved for ATA/ATAPI-11
		F	10	Reserved for ATA/ATAPI-10
		F	9	Reserved for ATA/ATAPI-9
		F	8	Reserved for ATA/ATAPI-8
		F	7	1 = supports ATA/ATAPI-7
		F	6	1 = supports ATA/ATAPI-6
		F	5	1 = supports ATA/ATAPI-5

Word	Value	F/V	Description
		F 4	1 = supports ATA/ATAPI-4
		F 3	Obsolete
		X 2	Obsolete
		X 1	Obsolete
		F 0	Reserved
81	0021h	F	Minor version number
82	0068h		Command set supported.
		X 15	Obsolete
		F 14	1 = NOP command supported
		F 13	1 = READ BUFFER command supported
		F 12	1 = WRITE BUFFER command supported
		X 11	Obsolete
		F 10	1 = Host Protected Area feature set supported
		F 9	1 = DEVICE RESET command supported
		F 8	1 = SERVICE interrupt supported
		F 7	1 = release interrupt supported
		F 6	1 = look-ahead supported
		F 5	1 = write cache supported
		F 4	Shall be cleared to zero to indicate that the PACKET Command feature set is not supported.
		F 3	1 = mandatory Power Management feature set supported
		F 2	1 = Removable Media feature set supported
F 1	0 = Security Mode feature set unsupported		
F 0	1 = S.M.A.R.T. feature set supported		
83	5000h		Command sets supported.
		F 15	Shall be cleared to zero
		F 14	Shall be set to one
		F 13-9	Reserved
		F 8	1 = SET MAX security extension supported
		F 7	Reserved
		F 6	1 = SET FEATURES subcommand required to spinup after power-up
		F 5	1 = Power-Up In Standby feature set supported
		F 4	1 = Removable Media Status Notification feature set supported
		F 3	1 = Advanced Power Management feature set supported
		F 2	1 = CFA feature set supported
		F 1	1 = READ/WRITE DMA QUEUED supported
		F 0	1 = DOWNLOAD MICROCODE command supported
84	4000h		Command set/feature supported extension.
		F 15	Shall be cleared to zero
		F 14	Shall be set to one
		F 13-2	Reserved

Word	Value	F/V	Description
		F 1	1 = S.M.A.R.T. self-test supported
		F 0	1 = S.M.A.R.T. error logging supported
85	0008h		Command set/feature enabled.
		X 15	Obsolete
		F 14	1 = NOP command enabled
		F 13	1 = READ BUFFER command enabled
		F 12	1 = WRITE BUFFER command enabled
		X 11	Obsolete
		V 10	1 = Host Protected Area feature set enabled
		F 9	1 = DEVICE RESET command enabled
		V 8	1 = SERVICE interrupt enabled
		V 7	1 = release interrupt enabled
		V 6	1 = look-ahead enabled
		V 5	1 = write cache enabled
		F 4	Shall be cleared to zero to indicate that the PACKET Command feature set is not supported.
		F 3	1 = Power Management feature set enabled
		F 2	1 = Removable Media feature set enabled
V 1	1 = Security Mode feature set enabled		
V 0	1 = S.M.A.R.T. feature set enabled		
86	5000h		Command set/feature enabled.
		F 15-9	Reserved
		F 8	1 = SET MAX security extension enabled by SET MAX SET PASSWORD
		F 7	See Address Offset Reserved Area Boot, INCITS TR27:2001
		F 6	1 = SET FEATURES subcommand required to spin-up after power-up
		V 5	1 = Power-Up In Standby feature set enabled
		V 4	1 = Removable Media Status Notification feature set enabled
		V 3-1	1 = Advanced Power Management feature set enabled
F 0	1 = DOWNLOAD MICROCODE command supported		
87	4000h		Command set/feature default.
		F 15	Shall be cleared to zero
		F 14	Shall be set to one
		F 13-2	Reserved
		F 1	1 = S.M.A.R.T. self-test supported
		F 0	1 = S.M.A.R.T. error logging supported
88	203Fh	15-13	Reserved
		V 12	1 = Ultra DMA mode 4 is selected 0 = Ultra DMA mode 4 is not selected
		V 11	1 = Ultra DMA mode 3 is selected 0 = Ultra DMA mode 3 is not selected
		V 10	1 = Ultra DMA mode 2 is selected

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Word	Value	F/V	Description		
		V	9	0 = Ultra DMA mode 2 is not selected 1 = Ultra DMA mode 1 is selected 0 = Ultra DMA mode 1 is not selected	
			8	1 = Ultra DMA mode 0 is selected 0 = Ultra DMA mode 0 is not selected	
				7-5	Reserved
		4	1 = Ultra DMA mode 4 and below are supported		
		3	1 = Ultra DMA mode 3 and below are supported		
		2	1 = Ultra DMA mode 2 and below are supported		
		1	1 = Ultra DMA mode 1 and below are supported		
		0	1 = Ultra DMA mode 0 is supported		
		89	0000h	F	Time required for security erase unit completion
		90	0000h	F	Time required for Enhanced security erase completion
91	0000h	V	Current advanced power management value		
92	0000h	V	Master Password Revision Code		
93	0000h	X	Hardware reset result		
94-126	0000h	V	Reserved		
127	0000h	F	15-2	Reserved	
			1-0	00 = Removable Media Status Notification feature set not supported 01 = Removable Media Status Notification feature supported	
				10 = Reserved	
				11 = Reserved	
				Security status	
128	0001h	F	15-9	Reserved	
			8	Security level 0 = High, 1 = Maximum	
		F	7-6	Reserved	
			5	1 = Enhanced security erase supported	
		V	4	1 = Security count expired	
		V	3	1 = Security frozen	
		V	2	1 = Security locked	
		V	1	1 = Security enabled	
		F	0	0 = Security unsupported	
		129-159	0000h	X	Vendor specific
160-254	0000h	X	Reserved		
255	0000h	X	15-8	Checksum	
			7-0	Signature	

3.3.5 IDLE (E3h)

This command causes the device to set BSY, enter the Idle mode, clear BSY and generate an interrupt. If sector count is non-zero, the automatic power down mode is enabled. If the sector count is zero, the automatic power mode is disabled.

3.3.6 IDLE IMMEDIATE (E1h)

This command causes the device to set BSY, enter the Idle(Read) mode, clear BSY and generate an interrupt.

3.3.7 INITIALIZE DEVICE PARAMETERS (91h)

This command enables the host to set the number of sectors per track and the number of tracks per heads.

3.3.8 READ DMA (C8h)

Reads data from sectors during Ultra DMA and Multiword DMA transfer. Use the SET FEATURES command to specify the mode value. A sector count of zero requests 256 sectors.

3.3.9 READ MULTIPLE (C4h)

This command performs similarly to the Read Sectors command. Interrupts are not generated on each sector, but on the transfer of a block which contains the number of sectors defined by a Set Multiple command.

3.3.10 READ SECTOR(S) (20h/21h)

This command reads 1 to 256 sectors as specified in the Sector Count register from sectors which is set by Sector number register. A sector count of the requests 256 sectors. The transfer beings specified in the Sector Number register.

3.3.11 READ VERIFY SECTOR(S) (40h/41h)

This command verifies one or more sectors on the drive by transferring data from the flash media to the data buffer in the drive and verifying that the ECC is correct. This command is identical to the Read Sectors command, except that DRQ is never set and no data is transferred to the host.

3.3.12 RECALIBRATE (10h)

The current drive performs no processing if it receives this command. It is supported for backward compatibility with previous devices.

3.3.13 SEEK (7xh)

This command is effectively a NOP command to the device although it does perform a range check.

3.3.14 SET FEATURES (EFh)

This command set parameter to Features register and set drive's operation. For transfer mode, parameter is set to Sector Count register. This command is used by the host to establish or select certain features.

Table 13: Featured register and valid operating mode

Value	Function
02h	Enable write cache
03h	Set transfer mode based on value in Sector Count register.
55h	Disable read look-ahead feature
82h	Disable write cache
AAh	Enable read look-ahead feature

3.3.15 SET MULTIPLE MODE (C6h)

This command enables the device to perform READ MULTIPLE and WRITE MULTIPLE operations and establishes the block count for these commands.

3.3.16 SLEEP (E6h)

This command causes the device to set BSY, enter the Sleep mode, clear BSY and generate an interrupt.

3.3.17 S.M.A.R.T. Function Set (B0h)

Performs different processing required for predicting device failures, according to the subcommand specified in the Features register. If the Features register contains an unsupported value, the Aborted Command error is returned. If the S.M.A.R.T. function is disabled, any subcommand other than S.M.A.R.T. ENABLE OPERATIONS results in the Aborted Command error.

3.3.18 STANDBY (E2h)

This command causes the device to set BSY, enter the Sleep mode (which corresponds to the ATA "Standby" Mode), clear BSY and return the interrupt immediately.

3.3.19 STANDBY IMMEDIATE (E0h)

This command causes the drive to set BSY, enter the Sleep mode (which corresponds to the ATA "Standby" Mode), clear BSY and return the interrupt immediately.

3.3.20 WRITE DMA (CAh)

Write data to sectors during Ultra DMA and Multiword DMA transfer. Use the SET FEATURES command to specify the mode value.

3.3.21 WRITE MULTIPLE (C5h)

This command is similar to the Write Sectors command. Interrupts are not presented on each sector, but on the transfer of a block which contains the number of sectors defined by Set Multiple command.

3.3.22 WRITE SECTOR(S) (30h/31h)

Write data to a specified number of sectors (1 to 256, as specified with the Sector Count register) from the specified address. Specify "00h" to write 256 sectors.

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