

ATA Security feature Set Clarifications

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Revision History:

- 0: Initial revision
- 1: Incorporate feedback from Dec. 2005 plenary. Split the Enhancements to a separate proposal.
- 2: Incorporate feedback from March 14, 2006 ad hoc meeting.
- 3: Incorporate feedback from March 28, 2006 ad hoc meeting.
- 4: Incorporate feedback from Plenary #58 (April 2006), and ad hoc meetings (May 17, 2006 and May 24, 2006)

Introduction

The purpose of this proposal is to clarify a number of vague and unspecified issues regarding the ATA Security feature set. This is the source of unpredictable behavior between vendors and models currently in the market. Locking down the specification of ATA Security is critical to ensuring reliable interoperability.

Proposal

I propose that the following be incorporated into ATA/ATAPI-8 ACS as a full replacement for the referenced sections.

These terms are to be added to the Glossary

Security Is Not Supported	The Security feature set is not supported. The SECURITY commands (see 1.1.5) are not supported and shall be command aborted. IDENTIFY DEVICE reports that the Security feature set is 'not supported'.
Security Is Disabled	The Security feature set is supported, but that there is no valid User password. There is a Master password. Access to user data is not restricted by the Security feature set. The terms 'Security Is Locked' and 'Security Is Unlocked' are not applicable. (e.g. Security states SEC0, SEC1, SEC2).
Security Is Enabled	The Security feature set is supported, and a valid User password has been set. (e.g. Security states SEC3, SEC4, SEC5, SEC6).
Security Is Locked	Security is enabled. In addition, access to the device is restricted. (e.g. Security state SEC4).
Security Is Unlocked	Security is enabled. A SECURITY UNLOCK command was successful, allowing access to the device. (e.g. Security state SEC5, SEC6).
Security Is Frozen	Security may be either enabled or disabled. Changes to Security states are not allowed until after the next power-on or hardware reset. (e.g. Security states SEC2, SEC6).
Security Is Not Frozen	Security may be either enabled or disabled. Changes to Security states are allowed (e.g. Security states SEC1, SEC4, SEC5).
Master Password Capability	The Master Password Capability indicates whether or not the Master password may be used to unlock the device. This was formerly know as 'Security Level'.
Security Level	See Master Password Capability .
Password Attempt Counter Exceeded	There were too many attempts to unlock the device with an incorrect password. Further unlock attempts are denied until a power-on or hardware reset.

1.1 Security feature set

1.1.1 Overview

The optional Security feature set is a password system that restricts access to user data stored on a device. In addition, access to some configuration capabilities is restricted.

See also the ‘Master Password Identifier’ feature (1.2) which is an optional enhancement to the Security feature set.

1.1.2 Passwords

The system has two types of passwords: User and Master .

1.1.2.1.1 User Password

The User password is used to create a lock to block execution of some commands, including preventing access to all user data on the device. The User password may be used to unlock the device to allow access.

Security is enabled by setting a User password with the SECURITY SET PASSWORD command. When the security is Enabled, the device is automatically Locked (i.e., access to user data on the device is denied) after a power-on reset is processed until a SECURITY UNLOCK command completes successfully.

1.1.2.1.2 Master Password

The Master password is a password that may be used to unlock the device if the User password is lost or if an administrator requires access (e.g. to repurpose a device).

A factory-installed Master password may be valid before an initial SECURITY SET (master) PASSWORD command has been successfully executed. A device may contain both a valid Master and a valid User password. Setting the Master password does not enable Security (i.e., does not Lock the device after the next power-on reset has been processed).

1.1.3 Master Password Capability

A device with Security enabled has two ways of using the Master password. This capability has values of ‘High’ or ‘Maximum’.

When the Master Password Capability is set to High, either the User or Master password may be used interchangeably. See Table 1 .

When the Master Password Capability is set to Maximum, the Master password cannot be used with the SECURITY DISABLE PASSWORD and SECURITY UNLOCK commands. The SECURITY ERASE UNIT command, however, does accept the either the User or Master password.

Table 1 - Interaction of Master Password Capability and Passwords [Editors note: only when not frozen]

Security Enabled	Master Password Capability	Passwords Defined	Password Supplied	Actions Taken by Security Commands		
				SECURITY DISABLE PASSWORD	SECURITY UNLOCK	Properly Prefaced SECURITY ERASE UNIT
No	N/A	master only	master (correct)	N	N	E
No	N/A	master only	user (not valid)	A	A	A
Yes	High	master and user	master (correct)	E	E	E
Yes	High	master and user	user (correct)	E	E	E
Yes	Maximum	master and user	master (correct)	A	A	E
Yes	Maximum	master and user	user (correct)	E	E	E

Key:

- N NOP – Do nothing, but return normal completion.
- A Return command aborted
- E Execute the command (if all other validations pass); otherwise return command aborted.

1.1.4 Frozen Mode

The SECURITY FREEZE LOCK command prevents changes to all Security states until a following power-on reset or hardware reset. The purpose of the SECURITY FREEZE LOCK command is to prevent password setting attacks on the security system. [Editors note: fix the figure or fix this text]

1.1.5 Commands

A device that implements the Security feature set shall implement the following set of commands:

- SECURITY SET PASSWORD
- SECURITY UNLOCK (requires a password)
- SECURITY ERASE PREPARE
- SECURITY ERASE UNIT (requires a password)
- SECURITY FREEZE LOCK
- SECURITY DISABLE PASSWORD (requires a password)

1.1.6 IDENTIFY DEVICE data

Support of the Security feature set is indicated in IDENTIFY DEVICE and IDENTIFY PACKET DEVICE data word 82 and data word 128.

Security information in words 82, 89 and 90 is fixed until the next power-on reset and shall not change unless DEVICE CONFIGURATION OVERLAY removes support for the Security feature set.

Security information in words 85, 92 and 128 are variable and may change.

If the Security feature set is not supported, then words 89, 90, 92 and 128 are N/A.

1.1.7 Security initial setting

When the device is shipped by the manufacturer, Security shall be disabled (e.g. is not Locked). The initial Master password value is not defined by this standard.

1.1.8 Password Rules

This section applies to any Security command that accepts a password, and for which there exists a valid password. This section does not apply while Security is Frozen. If Security is disabled and there is a valid Master password, then the Master password may be used.

The SECURITY ERASE UNIT command ignores the Master Password Capability value when comparing passwords, and shall accept either a valid Master or User password.

If the User password sent to the device does not match the user password previously set with the SECURITY SET PASSWORD command, the device shall return command aborted.

If the Master Password Capability was set to High during the last SECURITY SET (user) PASSWORD command, the device shall accept the Master password and complete normally.

If the Master Password Capability was set to Maximum during the last SECURITY SET (user) PASSWORD command, the device shall return command aborted for SECURITY UNLOCK or SECURITY DISABLE PASSWORD if the Master password is supplied. .

1.1.9 Password Attempt Counter

The device shall have a password attempt counter. The purpose of this counter is to defeat repeated trial attacks. The counter shall only be decremented while in state SEC4, whenever the SECURITY UNLOCK command fails because of an invalid User or Master password.

SECURITY ERASE UNIT and SECURITY DISABLE PASSWORD commands may decrement the counter for failed password comparisons [editors note: from which states ?].

Once the counter reaches zero, it shall not be decremented, and the PasswordAttemptCounterExceeded bit (IDENTIFY DEVICE data word 128, bit 4) shall be set to one, and the SECURITY UNLOCK and SECURITY ERASE UNIT commands shall be command aborted until after the next power-on or hardware reset.

The PasswordAttemptCounterExceeded bit shall be cleared to zero [editors note “(only)” ?] by either a power-on or hardware reset. [editors note: should hardware reset not clear the counter ?] None of the commands in the Security feature set shall clear this bit.

The counter shall be set to five (5) [editors note “(only)” ?] after a power-on or hardware reset. [editors note: should hardware reset not initialize the counter ?] None of the commands in the Security feature set shall re-initialize this counter.

1.1.10 Security states

See Figure 1 and Table 2. When the power is off, the Security characteristics are as in Table 2, but are not reportable.

Table 2 - Summary of Security States and Characteristics

Security State	Security Characteristics				
	Power	Enabled (ID word 85, bit 1)	Locked (ID word 128, bit 2)	Frozen (ID word 128, bit 3)	Password Attempts Exceeded (ID word 128, bit 4)
SEC0	off	0	N/A	N/A	N/A
SEC1	on	0	0	0	0
SEC2	on	0	0	1	varies
SEC3	off	1	N/A	N/A	N/A
SEC4	on	1	1	0	varies
SEC5	on	1	0	0	varies
SEC6	on	1	0	1	varies

Table 4 - Security mode command actions

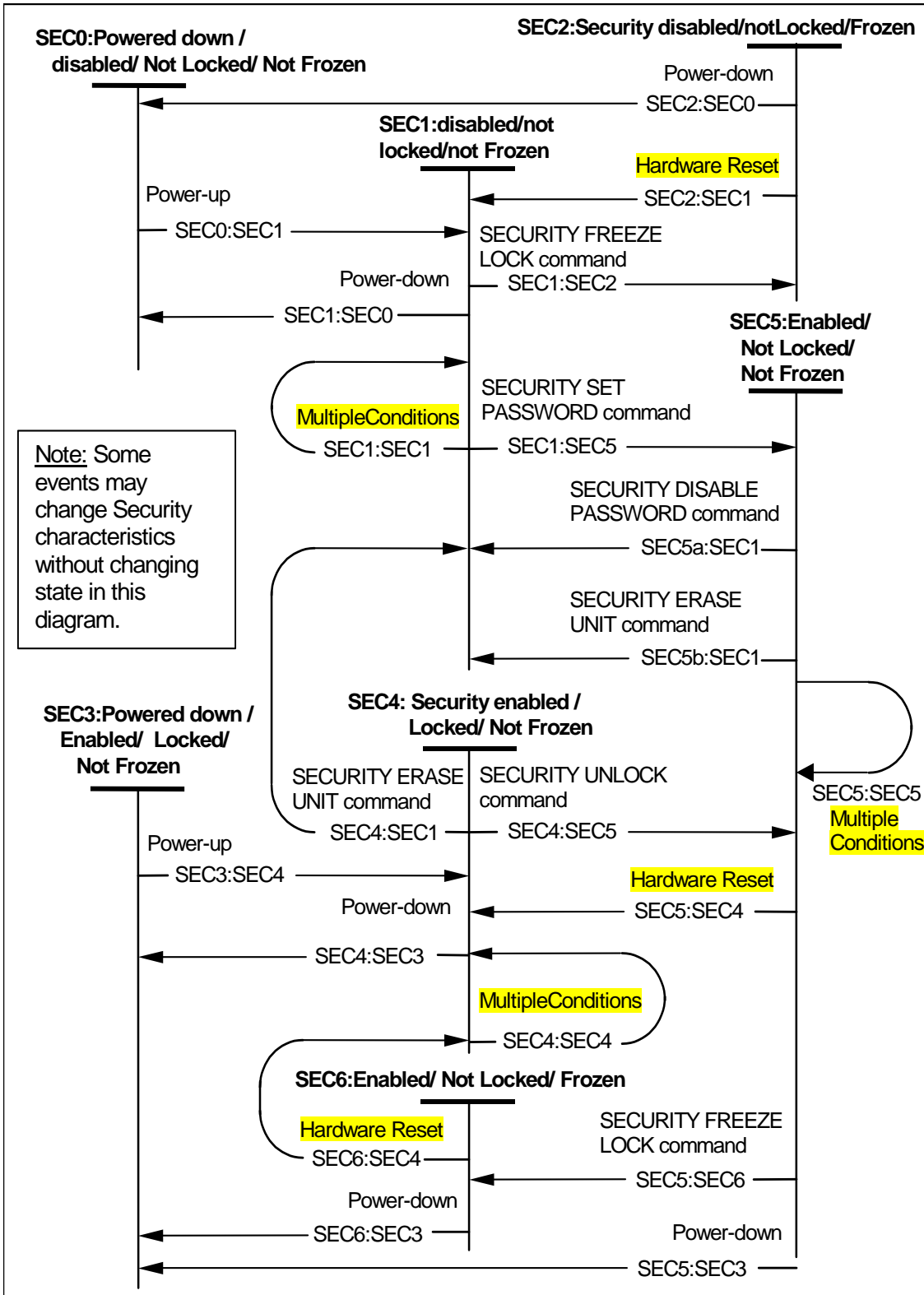
Command	Disabled (SEC1) [Editors note: this entire column is new]	Locked (SEC4)	Unlocked (SEC5)	Frozen (SEC2 or SEC6)
CFA ERASE SECTORS	Executable	Command aborted	Executable	Executable
CFA REQUEST EXTENDED ERROR CODE	Executable	Executable	Executable	Executable
CFA TRANSLATE SECTOR	Executable	Executable	Executable	Executable
CFA WRITE MULTIPLE WITHOUT ERASE	Executable	Command aborted	Executable	Executable
CFA WRITE SECTORS WITHOUT ERASE	Executable	Command aborted	Executable	Executable
CHECK MEDIA CARD TYPE	Executable	Command aborted	Executable	Executable
CHECK POWER MODE	Executable	Executable	Executable	Executable
CONFIGURE STREAM	Executable	Command aborted	Executable	Executable
DEVICE CONFIGURATION	Executable	Command aborted	Executable	Executable
DEVICE RESET	Executable	Executable	Executable	Executable
DOWNLOAD MICROCODE	Vendor Specific	Vendor Specific	Vendor Specific	Vendor Specific
EXECUTE DEVICE DIAGNOSTIC	Executable	Executable	Executable	Executable
FLUSH CACHE	Executable	Command aborted	Executable	Executable
FLUSH CACHE EXT	Executable	Command aborted	Executable	Executable
GET MEDIA STATUS	Executable	Command aborted	Executable	Executable
IDENTIFY DEVICE	Executable	Executable	Executable	Executable
IDENTIFY PACKET DEVICE	Executable	Executable	Executable	Executable
IDLE	Executable	Executable	Executable	Executable
IDLE IMMEDIATE	Executable	Executable	Executable	Executable
MEDIA EJECT	Executable	Command aborted	Executable	Executable
MEDIA LOCK	Executable	Command aborted	Executable	Executable
MEDIA UNLOCK	Executable	Command aborted	Executable	Executable
NOP	Executable	Executable	Executable	Executable
NV CACHE	Executable	Command aborted	Executable	Executable
PACKET	Executable	Command aborted	Executable	Executable
READ BUFFER	Executable	Executable	Executable	Executable
READ DMA	Executable	Command aborted	Executable	Executable
READ DMA EXT	Executable	Command aborted	Executable	Executable
READ DMA QUEUED	Executable	Command aborted	Executable	Executable
READ DMA QUEUED EXT	Executable	Command aborted	Executable	Executable
READ LOG EXT	Executable	Executable	Executable	Executable
READ LOG DMA EXT	Executable	Executable	Executable	Executable
READ MULTIPLE	Executable	Command aborted	Executable	Executable
READ MULTIPLE EXT	Executable	Command aborted	Executable	Executable
READ NATIVE MAX ADDRESS	Executable	Executable	Executable	Executable
READ NATIVE MAX ADDRESS EXT	Executable	Executable	Executable	Executable
READ SECTOR(S)	Executable	Command aborted	Executable	Executable
READ SECTOR(S) EXT	Executable	Command aborted	Executable	Executable
READ STREAM DMA EXT	Executable	Command aborted	Executable	Executable
READ STREAM EXT	Executable	Command aborted	Executable	Executable
READ VERIFY SECTOR(S)	Executable	Command aborted	Executable	Executable
READ VERIFY SECTOR(S) EXT	Executable	Command aborted	Executable	Executable
SCT Long Segment Access	Executable	Command aborted	Executable	Executable
SCT Write Same	Executable	Command aborted	Executable	Executable
SCT Error Recovery Control	Executable	Command aborted	Executable	Executable
SCT Feature Control	Executable	Command aborted	Executable	Executable
SCT Data Tables	Executable	Command aborted	Executable	Executable
SCT Read Status	Executable	Executable	Executable	Executable
SECURITY DISABLE PASSWORD	Executable	Command aborted	Executable	Command aborted
SECURITY ERASE PREPARE	Executable	Executable	Executable	Command aborted
SECURITY ERASE UNIT	Executable	Executable	Executable	Command aborted
SECURITY FREEZE LOCK	Executable	Command aborted	Executable	Executable

Table 4 - Security mode command actions

Command	Disabled (SEC1) [Editors note: this entire column is new]	Locked (SEC4)	Unlocked (SEC5)	Frozen (SEC2 or SEC6)
SECURITY SET PASSWORD	Executable	Command aborted	Executable	Command aborted
SECURITY UNLOCK	Executable	Executable	Executable	Command aborted
SERVICE	Executable	Command aborted	Executable	Executable
SET FEATURES	Executable	Executable	Executable	Executable
SET MAX ADDRESS	Executable	Command aborted	Executable	Executable
SET MAX ADDRESS EXT	Executable	Command aborted	Executable	Executable
SET MAX SET PASSWORD	Executable	Command aborted	Executable	Executable
SET MAX LOCK	Executable	Command aborted	Executable	Executable
SET MAX FREEZE LOCK	Executable	Command aborted	Executable	Executable
SET MAX UNLOCK	Executable	Command aborted	Executable	Executable
SET MULTIPLE MODE	Executable	Executable	Executable	Executable
SLEEP	Executable	Executable	Executable	Executable
SMART DISABLE OPERATIONS	Executable	Executable	Executable	Executable
SMART ENABLE/DISABLE AUTOSAVE	Executable	Executable	Executable	Executable
SMART ENABLE OPERATIONS	Executable	Executable	Executable	Executable
SMART EXECUTE OFF-LINE IMMEDIATE	Executable	Executable	Executable	Executable
SMART READ DATA	Executable	Executable	Executable	Executable
SMART READ LOG	Executable	Executable	Executable	Executable
SMART RETURN STATUS	Executable	Executable	Executable	Executable
SMART WRITE LOG ¹	Executable	Executable	Executable	Executable
STANDBY	Executable	Executable	Executable	Executable
STANDBY IMMEDIATE	Executable	Executable	Executable	Executable
TRUSTED RECEIVE	Executable	Command aborted	Executable	Executable
TRUSTED RECEIVE DMA	Executable	Command aborted	Executable	Executable
TRUSTED SEND	Executable	Command aborted	Executable	Executable
TRUSTED SEND DMA	Executable	Command aborted	Executable	Executable
WRITE BUFFER	Executable	Executable	Executable	Executable
WRITE DMA	Executable	Command aborted	Executable	Executable
WRITE DMA EXT	Executable	Command aborted	Executable	Executable
WRITE DMA FUA EXT	Executable	Command aborted	Executable	Executable
WRITE DMA QUEUED	Executable	Command aborted	Executable	Executable
WRITE DMA QUEUED EXT	Executable	Command aborted	Executable	Executable
WRITE DMA QUEUED FUA EXT	Executable	Command aborted	Executable	Executable
		Executable [Editors note: in ATA7 this was 'aborted'. This proposal would change this to Executable because SMART WRITE LOG is executable]		
WRITE LOG EXT ¹	Executable	Executable	Executable	Executable
WRITE LOG DMA EXT ¹	Executable	Executable	Executable	Executable
WRITE MULTIPLE	Executable	Command aborted	Executable	Executable
WRITE MULTIPLE EXT	Executable	Command aborted	Executable	Executable
WRITE MULTIPLE FUA EXT	Executable	Command aborted	Executable	Executable
WRITE SECTOR(S)	Executable	Command aborted	Executable	Executable
WRITE SECTOR(S) EXT	Executable	Command aborted	Executable	Executable
WRITE STREAM DMA EXT	Executable	Command aborted	Executable	Executable
WRITE STREAM EXT	Executable	Command aborted	Executable	Executable

¹ Writing to SMART Log E0h or E1h (SCT) is prohibited when Security is Locked.

Figure 1 - Security State Diagram



1.1.11 Details about each state and transition

[editors note: resume here - - - - -]

State SEC0: Powered down/Security Disabled/Not Locked/ Not Frozen: This state shall be entered when the device is powered-down with the Security feature set disabled.

Transition SEC0:SEC1: When the device is powered-up, the device shall make a transition to the SEC1: Security disabled/not Frozen state.

State SEC1: Security Disabled/Not Locked/ Not Frozen: This state shall be entered when the device is powered-up or a hardware reset is received with the Security feature set disabled or when the Security feature set is disabled by a SECURITY DISABLE PASSWORD or SECURITY ERASE UNIT command.

In this state, the device shall respond to all commands except those indicated as Command Aborted in “Disabled” column of Table 4.

When entering this state from power-on or hardware reset, the device shall set the password attempt counter to five.

While in this state, IDENTIFY DEVICE and IDENTIFY PACKET DEVICE shall report values as described in Table 5.

Table 5 - IDENTIFY values reported in Security state SEC1

Word	Bit position	Value	Description
82	1	1	Security feature set is supported
85	1	0	There is no active User password.
128	0	copy of word 82, bit 1	Security feature set is supported
128	1	copy of word 85, bit 1	Security feature set is disabled
128	2	0	device is not locked
128	3	0	device is not frozen
128	4	varies	PasswordAttemptCounterExceeded flag. On power-on or hardware reset, clear to zero; otherwise, do not modify this value.
128	8	0	Master Password Capability is not ‘maximum’

Transition SEC1:SEC0: When the device is powered-down, the device shall make a transition to the SEC0 state.

Transition SEC1:SEC1:

When a Hardware reset occurs the device shall remain in state SEC1.

[Editors note: do we need this loopback ? what about non-security commands ? is this list of events inclusive or exclusive ?] [only needed if something special is done in the state – so not needed]

When a hardware reset occurs, the device shall clear the PasswordAttemptLimitExceeded flag and remain in state SEC1.

[Editors note: if the loopback is kept, should it be labeled ?]

When a successful SECURITY SET (master) PASSWORD command is received, the Master password and the optional Master Password Identifier shall be saved, and the device shall remain in state SEC1. The Master Password Capability shall remain unchanged.

In this state, the device shall respond to all commands except those indicated as Command Aborted in “Disabled” column in Table 4 [global]. With the exception of the SECURITY commands, execution of these commands does not cause a transition from state SEC1.

Transition SEC1:SEC2: When a SECURITY FREEZE LOCK command is successful, the device shall make a transition to the SEC2 state.

Transition SEC1:SEC5: When a SECURITY SET (user) PASSWORD command is successful, the device shall save the User password, update the Master Password Capability and make a transition to the SEC5 state.

State SEC2: Security Disabled/ Not Locked/ Frozen: This state shall be entered when the device receives a SECURITY FREEZE LOCK command while in the SEC1 state.

In this state, the device shall respond to all commands except those indicated as Command Aborted in “Frozen” column. Execution of these commands does not cause a transition from state SEC2.

The device shall report the following IDENTIFY DEVICE or IDENTIFY PACKET DEVICE data when in this state:

word 128, bit 3 shall be set to one (frozen)

Transition SEC2:SEC0: When the device is powered-down, the device shall make a transition to the SEC0 state.

Transition SEC2:SEC1: When the device receives a hardware reset, the device shall make a transition to the SEC1 state.

State SEC3: Powered down/Security Enabled/ Locked/ Not Frozen: This state shall be entered when the device is powered-down with the Security feature set enabled.

Transition SEC3:SEC4: When the device is powered-up, the device shall make a transition to the SEC4 state.

State SEC4: Security Enabled/ Locked/ Not Frozen: This state shall be entered when the device is powered-up or a hardware reset is received with the Security feature set enabled.

In this state, the device shall respond to all commands except those indicated as Command Aborted in “Locked” column. With the exception of the SECURITY commands, execution of these commands does not cause a transition from state SEC4.

When entering this state from power-on or hardware reset, the device shall set the password attempt counter to five.

The device shall report IDENTIFY DEVICE or IDENTIFY PACKET DEVICE field values in accordance with Table 6 .

Table 6 - IDENTIFY settings for Security state SEC4

Word	Bit(s)	Value	Description
82	1	1	Security feature set is supported
85	1	1	There is an active User password.
128	0	copy of word 82, bit 1	Security feature set is supported
128	1	copy of word 85, bit 1	Security feature set is enabled.
128	2	1	device is locked
128	3	0	device is not frozen
128	4	varies	PasswordAttemptCounterExceeded flag. On power-on or hardware reset, clear to zero; otherwise, do not modify this value.
128	8	varies	security level

Transition SEC4:SEC1: When a SECURITY ERASE PREPARE command is successful and is followed by a successfully completing SECURITY ERASE UNIT command, the device shall make a transition to the SEC1 state.

Transition SEC4:SEC3: When the device is powered-down, the device shall make a transition to the SEC3 state.

Transition SEC4:SEC4: When the device receives a hardware reset, the device shall remain in state SEC4. [Editors note: do we need this loopback ? what about non-security commands ? is this list of events inclusive or exclusive ?]

When a SECURITY UNLOCK command is received with an incorrect password, the password attempt counter shall be decremented by 1, and remain in state SEC4. If password attempt counter reaches 0, the PasswordAttemptCounterExceeded bit (IDENTIFY DEVICE word 128, bit 4) shall be set to 1.

Transition SEC4:SEC5: When a SECURITY UNLOCK command is successful, the device shall make a transition to the SEC5 state.

State SEC5: Security Enabled/ Not Locked/ Not Frozen: This state shall be entered when either a SECURITY SET (user) PASSWORD command or a SECURITY UNLOCK command is successful.

In this state, the device shall respond to all commands except those indicated as Command Aborted in “Unlocked” column. With the exception of the SECURITY commands, execution of these commands does not cause a transition from state SEC5.

The device shall report the following IDENTIFY DEVICE or IDENTIFY PACKET DEVICE data when in this state:

word 128, bit 1	shall be set to one (enabled)
word 128, bit 2	shall be cleared to zero (not locked)
word 128, bit 8	shall be set to one if the Master Password Capability is ‘maximum’ shall be cleared to zero if the Master Password Capability is ‘high’

Transition SEC5:SEC1: When a SECURITY DISABLE PASSWORD command is successful, the device shall make a transition to the SEC1 state.

Transition SEC5:SEC3: When the device is powered-down, the device shall make a transition to the SEC3 state.

Transition SEC5:SEC4: When the device receives a hardware reset, the device shall make a transition to the SEC4 state.

Transition SEC5:SEC5: [Editors note: do we need this loopback ? what about non-security commands ? is this list of events inclusive or exclusive ?]

When a successful SECURITY SET (master) PASSWORD command is received, the Master password and the optional Master Password Identifier shall be saved and the device shall remain in state SEC5. The Master Password Capability shall remain unchanged.

When a SECURITY SET (user) PASSWORD command is successful, the device shall save the User password, update the Master Password Capability and make a transition to the SEC5: state.

Transition SEC5:SEC6: When a SECURITY FREEZE LOCK command is successful , the device shall make a transition to the SEC6 state.

State SEC6: Security Enabled/ Locked/ Frozen: This state shall be entered when the device receives a SECURITY FREEZE LOCK command while SEC5state.

In this state, the device shall respond to all commands except those indicated as Command Aborted in “Frozen” column. Execution of these commands does not cause a transition from state SEC6.

The device shall initialize the following IDENTIFY DEVICE or IDENTIFY PACKET DEVICE data when in this state:

word 128, bit 3 shall be set to one (frozen)

Transition SEC6:SEC4: When the device receives a hardware reset, the device shall make a transition to the SEC4 state.

Transition SEC6:SEC3: When the device is powered-down, the device shall make a transition to the SEC3 state.

1.2 Master Password Identifier feature

This is an optional enhancement to the Security feature set, which is a prerequisite.

1.2.1 Use Case (Informative)

The intended purpose of this feature is to assist an administrator that uses several sets of Master passwords (for use in different deployments of devices). The administrator may maintain a mapping of actual Master passwords and a corresponding Identifier. When an administrator sets a Master password, the corresponding Master Password Identifier could be also set.

When the time comes to redeploy a device for which a User password had been set (and subsequently lost), the administrator needs to know which Master password is actually valid for this individual device. Since the device never reveals the Master password but does reveal the Identifier, the administrator may obtain a hint as to which Master password was previously set.

1.2.2 Requirements

The device shall maintain a 2-byte host vendor-specific data value associated with the Master Password.

The Master Password Identifier does not indicate whether a Master Password exists or is valid.

Support for this feature is reported in the IDENTIFY DEVICE or IDENTIFY PACKET DEVICE data in word 92. Valid identifiers are 0001h through FFFEh. A value of 0000h or FFFFh indicates that the this feature is not supported.

If the device supports this feature,

- A. The device shall store a non-volatile identifier field with the stored Master password. The identifier is maintained for the benefit of the host. The value is not modified by the device.
- B. Prior to first use, the initial Master Password Identifier shall be set to FFFEh by the manufacturer.

1.3 DEVICE CONFIGURATION SET - B1h/C3h, PIO Data Out

1.3.1.1.1 Word 7: Command/features set supported part 1

Word 7 bit 3 is cleared to zero to disable support for the Security feature set if Security is disabled, and has the effect of changing the IDENTIFY DEVICE or IDENTIFY PACKET DEVICE response: clear word 82 bit 1 to zero, clear word 85 bit 1 to zero, clear words 89, 90, 92 and 128 to zero. If Security is enabled, then the device shall return command aborted and make no changes.

Word 7 bit 3 is set to one to allow reporting of support for the Security feature set and if the device does support the feature set has the effect of changing the IDENTIFY DEVICE or IDENTIFY PACKET DEVICE response: set word 82 bit 1 to one; clear word 85 bit 1 to zero; set word 128 bit 0 to one; set word 128 bit 5 to one if the enhanced security erase feature is supported; and setting words 89, 90 and 92 to a valid value.

1.4 IDENTIFY DEVICE - ECh, PIO Data-in

1.4.1.1 Words (84:82): Features/command sets supported

If bit 1 of word 82 is set to one, the Security feature set is supported.

1.4.1.2 Words (87:85): Features/command sets enabled

If bit 1 of word 85 is set to one, then Security has been enabled by setting a User password via the SECURITY SET PASSWORD command. If bit 1 of word 85 is cleared to zero, there is no valid User password. If the Security feature set is not supported, this bit shall be cleared to zero.

1.4.1.3 Word 89: Time required for Security erase unit completion

Word 89 specifies the estimated time required for the SECURITY ERASE UNIT command to complete its normal mode erasure. Support of this word is mandatory if the Security feature set is supported. If the Security feature set is not supported, this word shall be cleared to zero.

Value	Time
0	Value not specified
1-254	(Value*2) minutes
255	>508 minutes

1.4.1.4 Word 90: Time required for Enhanced security erase unit completion

Word 90 specifies the estimated time required for the SECURITY ERASE UNIT command to complete its enhanced mode erasure. Support of this word is mandatory if support of the Security feature set is supported. If the Security feature set is not supported, this word shall be cleared to zero.

Value	Time
0	Value not specified
1-254	(Value*2) minutes
255	>508 minutes

1.4.1.5 Word 92: Master Password Identifier

If either the Security feature set or the Master Password Identifier feature are not supported, word 92 shall contain the value 0000h or FFFFh

If the Security feature set and the Master Password Identifier feature are supported, word 92 contains the value of the Master Password Identifier set when the Master Password was last changed. .

1.4.1.6 Word 128: Security status

Support of this word is mandatory if the Security feature set is supported. If the Security feature set is not supported, this word shall be cleared to zero,

Bit 8 of word 128 indicates the Master Password Capability. If security is enabled and the Master Password Capability is high, bit 8 shall be cleared to zero. If security is enabled and the Master Password Capability is maximum, bit 8 shall be set to one. When security is disabled, bit 8 shall be cleared to zero.

Bit 5 of word 128 set to one indicates that the enhanced mode of the SECURITY ERASE UNIT command is supported.

Bit 4 of word 128 set to one indicates that the password attempt counter has decremented to zero. This is also known as the “PasswordAttemptCounterExceeded” bit.

Bit 3 of word 128 set to one indicates that security is frozen.

Bit 2 of word 128 set to one indicates that security is locked.

Bit 1 of word 128 set to one indicates that security is enabled. This is a copy of word 85, bit 1.

Bit 0 of word 128 set to one indicates that the Security feature set is supported. This is a copy of word 82, bit 1.

1.5 IDENTIFY PACKET DEVICE - A1h, PIO Data-in

1.5.1.1 Words (84:82): Features/command sets supported

Words (84:82) shall have the content described for words (84:82) of the IDENTIFY DEVICE command except that bit 4 of word 82 shall be set to one to indicate that the PACKET Command feature set is supported.

1.5.1.2 Words (87:85): Features/command sets enabled

Words (87:85) shall have the content described for words (87:85) of the IDENTIFY DEVICE command except that bit 4 of word 85 shall be set to one to indicate that the PACKET Command feature set is supported.

1.5.1.3 Word 89: Time required for Security erase unit completion

Word 89 shall have the content described for word 89 of the IDENTIFY DEVICE command.

1.5.1.4 Word 90: Time required for Enhanced security erase unit completion

Word 90 shall have the content described for word 90 of the IDENTIFY DEVICE command.

1.5.1.5 Word (92:91): Reserved

Word 92 shall have the content described for word 92 of the IDENTIFY DEVICE command.

[Editors note: Add Words 89, 90, 92 to ID Packet Device table]

1.5.1.6 Word 128: Security status

Word 128 shall have the content described for word 128 of the IDENTIFY DEVICE command. Support of this word is mandatory if the Security feature set is supported.

1.6 SECURITY DISABLE PASSWORD - F6h, PIO data-out

1.6.1 Feature Set

This command is mandatory for devices that implement the Security feature set.

1.6.2 Description

The SECURITY DISABLE PASSWORD command transfers 512 bytes of data from the host. Table 7 defines the content of this information.

If the password selected by word 0 matches the password previously saved by the device, the device shall disable the User password, and return the drive to the SEC1 state.

This command shall not change the Master password.

This command shall return command aborted if the Security feature set is not supported, if Security is Locked (SEC4) or is Frozen (states SEC2 or SEC6).

When Security is Disabled: : [Editors note: is this an enhancement or clarification ?]

- a. If the Identifier bit is set to Master, then the password supplied shall be compared with the stored Master password. [Editors note: should this case be ‘ignore the password and succeed ? or check the password always ?][erase unit ?]
- b. If the Identifier bit is set to User, then the device shall return command aborted.

When Security is Enabled, and the Master Password Capability is ‘High’:

- a. If the Identifier bit is set to Master, then the password supplied shall be compared with the stored Master password.
- b. If the Identifier bit is set to User, then the password supplied shall be compared with the stored User password.

When Security is Enabled, and the Master Password Capability is ‘Maximum’

- a. If the Identifier bit is set to Master, then the device shall return command aborted, even if the supplied Master password is valid.
- b. If the Identifier bit is set to User, then the password supplied shall be compared with the stored User password.

Upon successful completion, these fields of IDENTIFY DEVICE or IDENTIFY PACKET DEVICE shall be updated:

word 85, bit 1	shall be cleared to zero (no active User password)
word 128, bit 1	is a copy of word 85, bit 1
word 128, bit 8	shall be cleared to zero (Master Password Capability is not Maximum)

1.6.3 Inputs

Word	Name	Description
00h	Feature	N/A
01h	Count	N/A
02h-04h	LBA	N/A
05h	Command	F6h

1.6.4 Normal outputs

See [Table 62]

1.6.5 Error outputs

The device shall return command aborted if the command is not supported, the device is in Locked mode, or the device is in Frozen mode. The device may return error status if an Interface CRC error has occurred. See [Table 76].

1.6.6 Output Data Structure (Sent by the Host)

Table 7 – SECURITY DISABLE PASSWORD data

Word	Content									
0	Control word <table border="1"> <thead> <tr> <th>Bit</th> <th>Field Name</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Identifier</td> <td>0=compare User password 1=compare Master password</td> </tr> <tr> <td>(15:1)</td> <td>Reserved</td> <td></td> </tr> </tbody> </table>	Bit	Field Name	Description	0	Identifier	0=compare User password 1=compare Master password	(15:1)	Reserved	
Bit	Field Name	Description								
0	Identifier	0=compare User password 1=compare Master password								
(15:1)	Reserved									
1-16	Password (32 bytes)									
17-255	Reserved									

1.7 SECURITY ERASE PREPARE - F3h, Non-data

1.7.1 Feature Set

This command is mandatory for devices that implement the Security feature set.

1.7.2 Description

The SECURITY ERASE PREPARE command shall be issued immediately before the SECURITY ERASE UNIT command.

1.7.3 Inputs

Word	Name	Description
00h	Feature	N/A
01h	Count	N/A
02h-04h	LBA	N/A
05h	Command	F3h

1.7.4 Normal outputs

See [Table 62]

1.7.5 Error outputs

Abort shall be set to one if the device is in Frozen mode. See [Table 76]

1.8 SECURITY ERASE UNIT - F4h, PIO data-out

1.8.1 Feature Set

This command is mandatory for devices that implement the Security feature set.

1.8.2 Description

This command transfers 512 bytes of data from the host. Table 8 defines the content of this information.

If the password does not match the password previously saved by the device, the device shall return command aborted.

The SECURITY ERASE PREPARE command shall be completed immediately prior to the SECURITY ERASE UNIT command. If the device receives a SECURITY ERASE UNIT command and the previous command was not a successful SECURITY ERASE PREPARE command, the device shall return command aborted for the SECURITY ERASE UNIT command.

If the password attempt counter has already decremented to zero, then the device shall return command aborted even if a correct password has been supplied.

[editors note: resume here -----]

When Security is Disabled: [Editors note: is this an enhancement or clarification ?][the interpretation that closes the hole should prevail ?]

- a. If the Identifier bit is set to Master, then the password supplied shall be compared with the stored Master password.
- b. If the Identifier bit is set to User, then the device shall return command aborted.

When Security is Enabled, and the Master Password Capability is 'High':

- a. If the Identifier bit is set to Master, then the password supplied shall be compared with the stored Master password.
- b. If the Identifier bit is set to User, then the password supplied shall be compared with the stored User password.

When Security is Enabled, and the Master Password Capability is 'Maximum':

- a. If the Identifier bit is set to Master, then the password supplied shall be compared with the stored Master password.
- c. If the Identifier bit is set to User, then the password supplied shall be compared with the stored User password.

When Normal Erase mode is specified, the SECURITY ERASE UNIT command shall write binary zeroes to all user data areas (as determined by READ NATIVE MAX or READ NATIVE MAX EXT). IDENTIFY DEVICE or IDENTIFY PACKET DEVICE word 89 gives an estimate of the time required to complete the erasure.

The Enhanced Erase mode is optional. IDENTIFY DEVICE or IDENTIFY PACKET DEVICE word 128, bit 5 indicates whether it is supported. When Enhanced Erase mode is specified, the device shall write predetermined data patterns to all user data areas. In

Enhanced Erase mode, all previously written user data shall be overwritten, including sectors that are no longer in use due to reallocation. IDENTIFY DEVICE or IDENTIFY PACKET DEVICE word 90 gives an estimate of the time required to complete the erasure.

On successful completion, this command shall disable Security (e.g. returns the device to Security state SEC1), and invalidate any existing User password. . Any previously valid Master password remains valid and active.

Upon successful completion, these fields of IDENTIFY DEVICE or IDENTIFY PACKET DEVICE shall be updated:

word 85, bit 1	shall be cleared to zero (no active user password)
word 128, bit 1	shall be cleared to zero (no active user password)
word 128, bit 8	shall be cleared to zero (Master Password Capability is not Maximum)

1.8.3 Inputs

Word	Name	Description
00h	Feature	N/A
01h	Count	N/A
02h-04h	LBA	N/A
05h	Command	F4h

1.8.4 Normal outputs

See [Table 62]

1.8.5 Error outputs

The device shall return command aborted if the not immediately preceded by a SECURITY ERASE PREPARE command, or if Enhanced mode was requested but the device does not support it, or of an invalid password was specified, or if the data area is not successfully overwritten. The device may return error status if an Interface CRC error has occurred. See [Table 76].

1.8.6 Output Data Structure (Sent by the Host)

Table 8 - SECURITY ERASE UNIT data

Word	Content		
0	Control word		
	Bit	Field Name	Description
	0	Identifier	0=Compare User password 1=Compare Master password
	1	Erase mode	0=Normal Erase mode 1=Enhanced Erase mode
	(15:2)	Reserved	
1-16	Password (32 bytes)		
17-255	Reserved		

1.9 SECURITY FREEZE LOCK - F5h, Non-data

1.9.1 Feature Set

This command is mandatory for devices that implement Security feature set.

1.9.2 Description

The SECURITY FREEZE LOCK command shall set the device to Frozen mode. After command completion any other commands that update the device Lock mode shall be command aborted. Frozen mode shall be disabled by power-off or hardware reset. If SECURITY FREEZE LOCK is issued when the device is in Frozen mode, the command executes and the device shall remain in Frozen mode.

See Table 4 for a list of commands disabled by SECURITY FREEZE LOCK.

Upon successful completion, these fields of IDENTIFY DEVICE or IDENTIFY PACKET DEVICE shall be updated:

word 128, bit 3 shall be set to one (frozen)

1.9.3 Inputs

Word	Name	Description
00h	Feature	N/A
01h	Count	N/A
02h-04h	LBA	N/A
05h	Command	F5h

1.9.4 Normal outputs

See [Table 62].

1.9.5 Error outputs

Abort shall be set to one if the device is in Frozen mode. See [Table 76].

1.10 SECURITY SET PASSWORD - F1h, PIO data-out

1.10.1 Feature Set

This command is mandatory for devices that implement the Security feature set.

1.10.2 Description

This command transfers 512 bytes of data from the host. Table 9 defines the content of this information. The command sets only one password at a time.

1.10.2.1 Setting the Master Password

If a Master password is specified, the device shall save the supplied Master password in a non-volatile location. The Master Password Capability shall remain unchanged. This does not cause any changes to IDENTIFY DEVICE or IDENTIFY PACKET DEVICE words 85 or 128.

If the device supports the Master Password Identifier feature and a valid identifier is supplied (see 1.2), the device shall save the identifier in a non-volatile location. This new value shall be returned in word 92 of IDENTIFY DEVICE or IDENTIFY PACKET DEVICE result data. If the host attempts to set the identifier to a invalid value (0000h or FFFFh), the device shall preserve the existing identifier and return command aborted.

If the device does not support the Master Password Identifier feature, the device shall not validate the identifier field, and shall not change word 92 of IDENTIFY DEVICE or IDENTIFY PACKET DEVICE. This shall not be cause to return command aborted.

1.10.2.2 Setting the User Password

If a User password is specified, the device shall save the User password in a non-volatile location and update the Security Level. The Master Password Identifier shall not be changed. These fields of IDENTIFY DEVICE or IDENTIFY PACKET DEVICE shall be updated:

word 85, bit 1	shall be set to one (Security enabled)
word 128, bit 1	shall be set to one (Security enabled)
word 128, bit 8	shall indicate the Security Level

1.10.3 Inputs

Word	Name	Description
00h	Feature	N/A
01h	Count	N/A
02h-04h	LBA	N/A
05h	Command	F1h

1.10.3.1 Output data structure (Sent by the Host)**Table 9 – SECURITY SET PASSWORD data**

Word	Content		
0	Control word		
	Bit	Field Name	Description
	0	Identifier	0=set User password 1=set Master password
	(7:1)	Reserved	
	8	Security Level	0=High 1=Maximum
	(15:9)	Reserved	
1-16	Password (32 bytes)		
17	Master Password Identifier (valid if word 0, bit 0 = 1, and if the device supports the Master Password Identifier feature)		
18-255	Reserved		

1.10.4 Normal outputs

See [Table 62]

1.10.5 Error outputs

Abort shall be set to one if the device is Locked or in Frozen mode. The device may return error status if an Interface CRC error has occurred. See [Table 76].

1.11 SECURITY UNLOCK - F2h, PIO data-out

1.11.1 Feature Set

This command is mandatory for devices that implement the Security feature set.

1.11.2 Description

This command transfers 512 bytes of data from the host. Table 11 defines the content of this information.

When Security is Disabled:

- c. If the Identifier bit is set to Master, then the password supplied shall be compared with the stored Master password.
- d. If the Identifier bit is set to User, then the device shall return command aborted.

When Security is Enabled, and the Master Password Capability is 'High':

- c. If the Identifier bit is set to Master, then the password supplied shall be compared with the stored Master password.
- d. If the Identifier bit is set to User, then the password supplied shall be compared with the stored User password.

When Security is Enabled, and the Master Password Capability is 'Maximum'

- b. If the Identifier bit is set to Master, then the device shall return command aborted.
- d. If the Identifier bit is set to User, then the password supplied shall be compared with the stored User password.

If the password attempt counter has already decremented to zero, then the device shall return command aborted even if a correct password has been supplied.

If the password compare fails then the device shall return command aborted to the host and decrements the password attempt counter. When this counter reaches zero, IDENTIFY DEVICE or IDENTIFY PACKET DEVICE word 128 bit 4 shall be set to one, and SECURITY UNLOCK and SECURITY ERASE UNIT commands shall return command aborted until a power-on reset or a hardware reset. SECURITY UNLOCK commands issued when the device is unlocked have no effect on the unlock counter.

Upon successful completion, this field of IDENTIFY DEVICE or IDENTIFY PACKET DEVICE shall be updated:

word 128, bit 2 shall be set to cleared to zero (not locked)

1.11.3 Inputs

Word	Name	Description
00h	Feature	N/A
01h	Count	N/A
02h-04h	LBA	N/A
05h	Command	F2h

1.11.4 Normal outputs

See [Table 62]

1.11.5 Error outputs

If the device is in Frozen mode or an invalid password is supplied or the password attempt counter has decremented to zero, the device shall return command aborted.

The device may return error status if an Interface CRC error has occurred. See [Table 76].

1.11.6 Output Data Structure (Sent by the Host)

Table 11 – SECURITY UNLOCK data

Word	Content									
0	Control word <table border="1"> <thead> <tr> <th>Bit</th> <th>Field Name</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Identifier</td> <td>0=compare User password 1=compare Master password</td> </tr> <tr> <td>(15:1)</td> <td>Reserved</td> <td></td> </tr> </tbody> </table>	Bit	Field Name	Description	0	Identifier	0=compare User password 1=compare Master password	(15:1)	Reserved	
Bit	Field Name	Description								
0	Identifier	0=compare User password 1=compare Master password								
(15:1)	Reserved									
1-16	Password (32 bytes)									
17-255	Reserved									