Hydra PC Locksmith Security Policy

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SPYRUS, Inc.
info@spyrus.com>
<http://www.spyrus.com>

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1 Introduction

This Security Policy specifies the security rules under which the Hydra PC Locksmith operates. Included in these rules are those derived from the security requirements of FIPS 140-2 and additionally, those imposed by SPYRUS, Inc. These rules, in total, define the interrelationship between:

1. Operators,
2. Services, and
3. Critical Security Parameters (CSPs).

Figure 1 Hydra PC Locksmith (Topside)

Figure 2 Hydra PC Locksmith (Top and Front View)

Figure 3 Hydra PC Locksmith (Rear and Underside View)

1.1 Hydra PC Locksmith Overview

The Hydra PC Locksmith enables security critical capabilities such as operator authentication and secure storage in rugged, tamper-evident hardware. The Hydra PC Locksmith communicates with a host computer via the USB interface. Hydra PC Locksmith protects data for government, large enterprises, small organizations, and home users. Key features:

- Encryption technology uses Suite B algorithms approved by the U.S. government for protecting both Unclassified and Classified data
- Encrypted file storage on non-removable flash card
- Strong protection against intruder attacks

Access protection is as important as encryption strength. Data encrypted with the Hydra PC Locksmith cannot be decrypted until the authorized user gains access to the device.

1.2 Hydra PC Locksmith Implementation

The Hydra PC Locksmith is implemented as a multi-chip standalone module as defined by FIPS 140-2. The FIPS 140-2 module identification data for the Hydra PC Locksmith is shown in the table below:

Part Number	FW Version	HW Version
88007021F	03.00.04	01.00.02

The Hydra PC Locksmith is available with a USB interface compliant to the *Universal Serial Bus Specification*, Revision 2.0, dated 23 September 1998. All Interfaces have been tested for compliance with FIPS 140-2. The Hydra PC Locksmith also has an LED interface which supplies status output.

1.3 Hydra PC Locksmith Cryptographic Boundary

The Cryptographic Boundary is defined to be the physical perimeter of the outer metal case of the Hydra PC Locksmith. Please see Figures 1. 2, and 3.

No hardware or firmware components that comprise the Hydra PC Locksmith are excluded from the requirements of FIPS 140-2.

1.4 Approved Mode of Operations

The Hydra PC Locksmith operates only in a FIPS Approved mode. The indicator that shows the operator that the module is in the Approved mode is the "GetCapabilities" command, which shows the module's firmware and hardware versions as well as the product indicator.

The Hydra PC Locksmith supports the FIPS 140-2 Approved and FIPS 140-2 non-Approved, but allowed, algorithms in Table 1-1 below.

Table 1-1 Approved Algorithms supported by Hydra PC Locksmith

Encryption & Decryption
AES -128/192/256 (Certs. #1015 and #1016)
Digital Signatures
ECDSA - key sizes: 256, 384, 521 (Cert. #122)
Key Transport / Key Agreement
EC-Diffie-Hellman (ECDH) - key sizes: 256, 384, 521 (SP 800-56A, vendor affirmed, key agreement; key establishment methodology provides 80 bits of encryption strength)
Hash
SHA-224, SHA-256, SHA-384, SHA-512 (Certs. #972 and #973) SHA-1 (Cert. #974)
RNG
HASH_DRBG (SP 800-90) (Cert. #10)
RNG for Seeding
FIPS 186-2 RNG(Cert. #582)
Other Algorithms – Allowed, but not FIPS 140-2 Approved
Key Transport / Key Agreement
EC-Diffie-Hellman (ECDH) - key sizes: 256, 384, 521 (key agreement; key establishment methodology provides 80 bits of encryption strength)

2 FIPS 140-2 Security Levels

The Hydra PC Locksmith cryptographic module complies with the requirements for FIPS 140-2 validation to the levels defined in Table 2.1. The FIPS 140-2 overall rating of the Hydra PC Locksmith is Level 2

Table 2-1 FIPS 140-2 Certification Levels

FIPS 140-2 Category	Level
1. Cryptographic Module Specification	3
2. Cryptographic Module Ports and Interfaces	2
3. Roles, Services, and Authentication	3
4. Finite State Model	2
5. Physical Security	2
6. Operational Environment	N/A
7. Cryptographic Key Management	2
8. EMI/EMC	3
9. Self-tests	2
10. Design Assurance	3
11. Mitigation of Other Attacks	N/A

3 Security Rules

The Hydra PC Locksmith enforces the following security rules. These rules are separated into two categories: 1) rules imposed by FIPS 140-2; and 2) rules imposed by SPYRUS.

3.1 FIPS 140-2 Imposed Security Rules

Table 3-1 FIPS 140-2 Policies and Rule Statements

Policy	Rule Statement
Authentication Feedback	The Hydra PC Locksmith shall obscure feedback of authentication data to an operator during authentication (e.g., no visible display of characters result when entering a password).
Authentication Mechanism	The Hydra PC Locksmith shall enforce Identity-Based authentication.
Authentication Strength (1)	The Hydra PC Locksmith shall ensure that feedback provided to an operator during an attempted authentication shall not weaken the strength of the authentication mechanism.

Policy	Rule Statement
Authentication Strength (2)	The Hydra PC Locksmith shall satisfy the requirement for a single–attempt false acceptance rate of no more than one in 1,000,000 authentications.
Authentication Strength (3)	The Hydra PC Locksmith shall satisfy the requirement for a false acceptance rate of no more than one in 100,000 for multiple authentication attempts during a one minute interval.
Configuration Management	The Hydra PC Locksmith shall be under a configuration management system and each configuration item shall be assigned a unique identification number.
CSP Protection	The Hydra PC Locksmith shall protect all CSPs from unauthorized disclosure, modification, and substitution.
Emissions Security	The Hydra PC Locksmith shall conform to the EMI/EMC requirements specified in FCC Part 15, Subpart B, Class B.
Error State (1)	The Hydra PC Locksmith shall inhibit all data output via the data output interface whenever an error state exists and during self-tests.
Error State (2)	The Hydra PC Locksmith shall not perform any cryptographic functions while in an Error State.
Guidance Documentation	The Hydra PC Locksmith documentation shall provide Administrator and User Guidance per FIPS 140-2, Section 4.10.4.
Hardware Quality	The Hydra PC Locksmith shall contain production quality ICs with standard passivation.
Interfaces (1)	The Hydra PC Locksmith interfaces shall be logically distinct from each other.
Interfaces (2)	The Hydra PC Locksmith shall support the following five (5) interfaces: • data input • data output • control input • status output • power input
Key Association	The Hydra PC Locksmith shall provide that: a key entered into, stored within, or output from the Hydra PC Locksmith is associated with the correct entity to which the key is assigned.

Policy	Rule Statement
Logical Separation	The Hydra PC Locksmith shall logically disconnect the output data path from the circuitry and processes performing the following key functions: • key generation, • key zeroization
Mode of Operation	The Hydra PC Locksmith services shall indicate that the module is in an Approved mode of operation with a standard success return code and the output of the "GetCapabilities" command.
Public Key Protection	The Hydra PC Locksmith shall protect public keys against unauthorized modification and substitution.
Re-authentication	The Hydra PC Locksmith shall re-authenticate an identity when it is powered-up after being powered-off.
RNG Strength	The Hydra PC Locksmith shall use a 'seed input' into the deterministic random bit generator of sufficient length that ensures at least the same amount of operations are required to determine the value of the generated key.
Secure Development (1)	The Hydra PC Locksmith source code shall be annotated.
Secure Development (2)	The Hydra PC Locksmith firmware shall be implemented using a high-level language except limited use of a low-level language to enhance the performance of the module.
Secure Distribution	The Hydra PC Locksmith documentation shall include procedures for maintaining security while distributing and delivering the module.
Self-tests (1)	The power up tests shall not require operator intervention in order to run.
Self-tests (2)	The Hydra PC Locksmith shall perform the self-tests identified in Section 7.
Self-tests (3)	The Hydra PC Locksmith shall enter an Error State and output an error indicator via the status interface whenever self-test is failed.
Services	The Hydra PC Locksmith shall provide the following services: (see Reference Table 4.2).
Firmware Integrity	The Hydra PC Locksmith shall apply a SHA-384 hash to check the integrity of all firmware components

Policy	Rule Statement
Status Output	The Hydra PC Locksmith shall provide an indication via the "GetUserState" command if all of the power up tests are passed successfully.
Strength of Key Establishment	The Hydra PC Locksmith shall use a key establishment methodology that ensures at least the same amount of operations are required to determine the value of the transported/agreed upon key.
Unauthorized Disclosure	The Hydra PC Locksmith shall protect the following keys from unauthorized disclosure, modification and substitution: • secret keys • private keys.
Zeroization (1)	The Hydra PC Locksmith shall provide a zeroization mechanism that can be performed either procedurally by the operator *or* automatically by the Hydra PC Locksmith interface firmware on the connected host platform.
Zeroization (2)	The Hydra PC Locksmith shall provide the capability to zeroize all plaintext cryptographic keys and other unprotected critical security parameters within the Hydra PC Locksmith (HPC140-F).

3.2 SPYRUS Imposed Security Rules

Table 3-2 SPYRUS Imposed Policies and Rule Statements

Policy	Rule Statement
Single User Session	The Hydra PC Locksmith shall not support multiple concurrent operators.
No Maintenance Interface	The Hydra PC Locksmith shall not provide a maintenance role/interface.
No Bypass Mode	The Hydra PC Locksmith shall not support a bypass mode.

3.3 Identification and Authentication Policy

The table below describes the type of authentication and the authentication data to be used by operators, by role. For a description of the roles, see section 4.2.

Table 3-3 Identification and Authentication Roles and Data

Role	Type of Authentication	Authentication Data / Identification
Administrator (CO)	Identity-based	Service and ECDSA Signature (384-bits)
User	Identity-based	Service and PIN (minimum 7 to 262 characters)

4 Hydra PC Locksmith Roles and Services

4.1 Roles

The Hydra PC Locksmith supports two roles, Administrator (Crypto-Officer or CO) and User, and enforces the separation of these roles by restricting the services available to each one. Each role is uniquely identified by the service that has been requested and is associated with the role.

Table 4-1 Roles and Responsibilities

Role	Responsibilities
Administrator	The Administrator is responsible for performing Firmware Updates and setting configuration of the Hydra PC Locksmith (HPC140-F). The Hydra PC Locksmith authenticates the Administrator identity by way of a signature verification before accepting any FirmwareUpdate or SetConfiguration commands. The loading of new firmware will invalidate the module unless the firmware has been FIPS 140-2 validated.
User	The User role is available after the Hydra PC Locksmith has been initialized. The user can generate and use secret keys for encryption services.

The Hydra PC Locksmith authenticates the User identity by password before access is granted.

4.2 Services

The following table describes the services provided by the Hydra PC Locksmith (HPC140-F).

Table 4-2 Hydra PC Locksmith Services

Service	CO	User	Unauthenticated	Description
ChangePassword		X		Changes User Password
Format		X		Formats the mounted CDROM
GetCapabilities			X	Returns the current capabilities of the system including: global Information, media storage size and the product name. This service provides a response that indicates the approved mode of operation (see Section 3.1).
GetConfig			X	Returns the card configuration structure
GetUserState			X	Returns the state and the Logon attempts remaining.
Initialize		X		Generates a new encryption key and changes the PIN. Secure channel is required. Formats the media.
LogOff		X		Log Off; Return to unauthenticated state.
LogOn		X		Log on with the user PIN if system is initialized.
MountCDROM		X		Allows the CDROM drive to be mounted as the read/write drive. This permits the CDROM software to be updated by a user application.
ReadMedia		X		Read user media from SCSI drive.

Service	CO	User	Unauthenticated	Description
ReadUserArea			X	Get a block of data from a specified user area.
SelfTest			X	Pass/Fail Test of HYDRA PC LOCKSMITH. Will run the Power On Self Tests again.
SetConfig	X			Writes the card configuration structure if the signature on the structure is valid
SetupBasicSecureChannel			X	Initializes secure channel.
UpdateFirmware	X			Writes signed blocks to the firmware area of the HYDRA PC LOCKSMITH.
WriteMedia		X		Writes user media to SCSI drive.
WriteUserArea		X		Write a block of data to a specified user area. All areas will require the token to be logged on for writes and updates
Zeroize			X	Clears the encryption keys. Requires the Initialize command to be run again.

5 Identification and Authentication

5.1 Initialization Overview

The Hydra PC Locksmith modules are initialized at the factory to be in the zeroized state. Before an operator can access or operate a HYDRA PC Locksmith, the User must first initialize the module with a User identity and PIN.

5.2 Operator Authentication

Operator Authentication is accomplished by PIN entry by the User or valid ECDSA signature by the CO. Once valid authentication information has been accepted, the Hydra PC Locksmith is ready for operation.

The Hydra PC Locksmith stores the number of User logon attempts in non-volatile memory. The count is reset after every successful entry of a User PIN. If an incorrect PIN is entered during the authentication process, the count of unsuccessful logon attempts is incremented by one.

If the User fails to log on to the Hydra PC Locksmith in 10 consecutive attempts, the Hydra PC Locksmith will block the user's access to the module, by transitioning to the blocked state. To restore operation to the Hydra PC Locksmith (HPC140-F), the operator will have to zeroize the token and reload the User PIN and optional details. When the Hydra PC Locksmith is inserted after zeroization, it will power up and transition to the Zeroized State, where it can be initialized by the User.

5.3 Generation of Random Numbers

The Random Number Generators are not invoked directly by the user. The Random Number output is generated by the HASH-DRBG algorithm specified in SP 800-90 in the case of static private keys and associated key wrapping keys, ephemeral keys and symmetric keys.

5.4 Strength of Authentication

The strength of the authentication mechanism is stated in Table 5-1 below.

Table 5-1 Strength of Authentication

Authentication Mechanism	Strength of Mechanism
User Single PIN-entry attempt / False Acceptance Rate	The probability that a random PIN-entry attempt will succeed or a false acceptance will occur is 1.66 x10^{-14}. The requirement for a single–attempt / false acceptance rate of no more than 1 in 1,000,000 (i.e., less than a probability of 10^{-6}) is therefore met.
User Multiple PIN-entry attempt in one minute	Hydra PC Locksmith authentication mechanism has a feature that doubles the time of authentication with each successive failed attempt. There is also a maximum bound of 10 successive failed authentication attempts before zeroization occurs. The probability of a successful attack of multiple attempts in a one minute period is 1.66 x10^{-13} due to the time doubling mechanism. This is less than one in 100,000 (i.e., 1×10^{-5}), as required.
Crypto-Officer Single attempt / False Acceptance Rate	The probability that a random ECDSA signature verification authentication attempt will succeed or a false acceptance will occur is 1/2^192. The requirement for a single–attempt / false acceptance rate of no more than 1 in 1,000,000 (i.e., less than a probability of 10^{-6}) is therefore met.
Crypto-Officer Multiple PIN-entry attempt in one minute	The probability of a successful attack of multiple ECDSA signature authentication attempts in a one minute period is 1/2^192. The computational power needed to process this is outside of the ability of the module. This is less than one in 100,000 (i.e., 1×10^{-5}), as required.

6 Physical Security

The Hydra PC Locksmith utilizes production-grade components with an opaque metal enclosure and tamper evident seals. Tamper evident seals are applied during manufacturing. The operator should ensure that the tamper evident seals are intact, with no visible signs of tamper.

The cryptographic boundary for the module is defined as the physical perimeter of the module's metal case, which contains all hardware and firmware required for the performance of all services offered by the module.

Figure 4 Hydra PC Locksmith (Tamper Label Placement)

7 Operational Environment

The Hydra PC Locksmith is a limited operational environment and only executable code validated by SPYRUS, Inc. may be loaded and executed on the module; therefore, the operating system requirements of FIPS 140-2 do not apply.

8 Access Control

8.1 Critical Security Parameters (CSPs) and Public Keys

Table 8-1 Hydra PC Locksmith CSPs

CSP Designation	Algorithm(s) / Standards	Symbolic Form	Description
Disk Ephemeral Private	SP 800-56A	$d_{e,U}$	ECDH ephemeral private key used to generate shared secret.
Disk Key Encryption Key (DKEK)	AES 256	DKEK	AES key used to unwrap the Disk Encryption Key (DEK) .
Drive Encryption Key (DEK)	AES 512	DEK	A pair of AES 256 keys. The concatenated value is used to encrypt and decrypt the User's encrypted drive.
Hash-DRBG Seed	SP 800-90	S	FIPS 186-2-generated value used to seed the Hash-DRBG RNG.
Hash-DRBG State	SP 800-90	S_{HDRBG}	Hash_DRBG state value.
Master Encryption Key (MEK)	AES 256	MEK	AES 256 wraps / unwraps user's static private keys in storage.
Secure Channel HYDRA Private	SP 800-56A	$d_{e,SCHP}$	ECDH Ephemeral Transport Private.
Secure Channel Session Key	SP 800-56A	k_{SCSK}	256 bit AES key used to encrypt and decrypt commands and responses to and from the card.
User PIN		PIN	The User's minimum 7 character PIN for authentication to the module.
User's Static Signature Private	X9.62	$d_{ECDSA,s,U}$	ECDSA Static Signature private key.
FIPS 186-2 RNG seed key	FIPS 186-2 – 512 bits		Seed key used to seed the Hash-DRBG.
User's Static Transport Private	SP 800-56A	$d_{s,U}$	ECDH Static Transport private key.

Table 8-2 HYDRA PC Locksmith Public Keys

Key	Algorithm(s) Standards	**Description/Usage**
Configuration Update Key	ANSI X9.62	The ECDSA P-384 public Key is used to verify the signature of the CO before the settings are changed.
Card Firmware Update Key	ANSI X9.62	The ECDSA P-384 public Key is used to verify the signature of the CO before loading firmware.

Key	Algorithm(s) Standards	Description/Usage
Disk Ephemeral Public	SP 800-56A	ECDH Ephemeral Transport Public P384. The key is used to generate a shared secret using ECDH with the User's Static Transport Private key.
Secure Channel Host Public	SP 800-56A	ECDH Ephemeral Transport Public P256.
Secure Channel HYDRA Public	SP 800-56A	ECDH Ephemeral Transport Public P256. The key is used to generate a shared secret between the host and the card.
User's Static Signature Public	SP 800-56A	ECDH Static Signature Public P384. The key for ECDSA.
User's Static Transport Public	SP 800-56A	ECDH Static Transport Public P384. The key for ECDH.

8.2 CSP Access Modes

Table 8-3 Hydra PC Locksmith Access Modes

Access Type	Description
Generate (G)	"Generate" is defined as the creation of a CSP
Delete (D)	"Delete" is defined as the zeroization of a CSP
Use (U)	"Use" is defined as the process in which a CSP is employed. This can be in the form of loading, encryption, decryption, signature verification, or key wrapping.

8.3 Access Matrix

The following table shows the services (see section 4.2) of the Hydra PC Locksmith (HPC140-F), the roles (see section 4.1) capable of performing the service, the CSPs (see section 6.1) that are accessed by the service and the mode of access (see section 6.3) required for each CSP. The following convention is used: if the role column has an 'X', then that role may execute the command.

Table 8-4 Hydra PC Locksmith Access Matrix

Service Name	Roles			Access to Critical Security Parameters	
	Unauthenti-cated	Administrator (CO)	User	CSPs	Access Mode
ChangePassword			X	k_{SCSK} $d_{s,U}$ $d_{ECDSA,s,U}$ $d_{e,U,}$ DKEK DEK PIN	U U U U G, U, D U D,G
Format			X	$d_{e,U}$ DKEK, DEK	G, U, D G,U,D G,U
Initialize			X	k_{SCSK} $d_{s,U}$ $d_{ECDSA,s,U}$ $d_{e,U,}$ DKEK DEK MEK	U G G G, U, D G, U, D G U
LogOff			X		
LogOn			X	k_{SCSK} $d_{s,U}$ DKEK DEK PIN	U U G,U,D U U
MountCDROM			X	DEK	U
ReadMedia			X	DEK	U
SetConfig		X		$d_{s,U}$ $d_{ECDSA,s,U}$ DEK	D D D
UpdateFirmware		X		$d_{s,U}$ $d_{ECDSA,s,U}$ DEK	D D D
WriteMedia			X	DEK	U

Service Name	Roles			Access to Critical Security Parameters	
	Unauthenti-cated	Administrator (CO)	User	CSPs	Access Mode
WriteUserArea			**X**		
GetCapabilities	**X**	**X**	**X**		
GetConfig	**X**	**X**	**X**		
GetUserState	**X**	**X**	**X**		
ReadUserArea	**X**	**X**	**X**		
SelfTest	**X**	**X**	**X**	s, s_{HDRBG},	**G**
SetupBasicSecureChannel	**X**	**X**	**X**	$d_{e,SCHP}$ k_{SCSK}	**G,D** **G,D**
Zeroize	**X**	**X**	**X**	$d_{s,U}$ $d_{ECDSA,s,U}$ DEK MEK	**D** **D** **D** **D**

9 Self-Tests

The module performs both power-on and conditional self-tests. The module performs the following power-on self-tests:

- Cryptographic Algorithm Tests:
  - AES-128, 192, 256 KATs
  - ECDSA-256, 384, 521 KATs
  - EC-Diffie-Hellman-256, 384, 521 KATs
  - SHA-224 KAT
  - SHA-256 KAT
  - SHA-384 KAT
  - SHA-512 KAT
  - HASH-DRBG KAT
  - FIPS 186-2 RNG KAT
- Firmware Test
  - SHA-384 Hash

The module performs the following Conditional Tests:

- Firmware Load Test
  - ECDSA P-384 signed SHA-384 hash verification
- Pairwise Consistency Test
  - ECDSA key pair generation
  - EC-Diffie-Hellman key pair generation
- Continuous Random Number Generator Test
  - HASH-DRBG SP800-90
  - FIPS 186-2

10 Mitigation of Other Attacks

No claims of mitigation of other attacks listed in Section 4.11 of FIPS 140-2 by the HYDRA PC Locksmith are made or implied in this document.

11 Acronyms

AES	Advanced Encryption Standard
CBC	Cipher Block Chaining
CSP	Critical Security Parameter
DPA	Differential Power Analysis
DRBG	Digital Random Bit Generator
DSA	Digital Signature Algorithm
ECB	Electronic Code Book
ECDH	Elliptic Curve Diffie-Hellman
ECDSA	Elliptic Curve Digital Signature Algorithm
ECMQV	Elliptic Curve Menezes-Qu-Vanstone
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interface
FEK	File Encryption Key
FIPS	Federal Information Processing Standard
HAC	Host Authentication Code
MKEK	Master Key Encryption Key
NDRNG	Non-deterministic Random Number Generator
PC	Personal Computer
PCB	Printed Circuit Board
PIN	Personal Identification Number
RNG	Random Number Generator
RSA	Rivest, Shamir and Adleman Algorithm
SD	Secure Digital (flash memory card)
SDHC	Secure Digital High-capacity
SHA	Secure Hash Algorithm
SPA	Simple Power Analysis
SSD	Solid-state Drive
USB	Universal Serial Bus

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