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A	CO01053	All	Initial release in Infogard security policy template format	J. Steinmetz	Oct 16 2003
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C	CO03399	1	Added PCNs for USA and Canada	D. Clark	Dec 17 2003
		7, figure 7	Removed reference to key , P'UpsdP KER		
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		1	Changed Canada PCN from 1LAC to 1LEC		
F	CO03946	1	Changed US PCN from 1L000 to 1L00	J. Steinmetz	Apr 20 2004
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J	CO07402	1	Changed PCN list to include 1L000AAD and 1LECAAD, reflecting update to CL software.	D. Clark	Feb 24 2005

PRODUCT CODE NO. 1LXX



**Pitney Bowes**

APPROVALS

BY

DATE

TITLE

Pitney Bowes Cygnus X-1 PSD  
Security Policy

PREPARED

J. Steinmetz

DATE

Oct 5 2004

CHECKED

D. Clark

DATE

Oct 5 2004

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# 1 Module Overview

This document describes the security policy for the Pitney Bowes Cygnus X-1 Postal Security Device (PSD). It is intended to describe the requirements for the secure processor only and not the entire system.

Digital postal payment systems, such as the United States Postal Service's Information-based Indicia Program, rely on secure accounting of postage funds and printing a cryptographic digital postage mark on a mail piece. A PSD provides security services to support the creation of digital postage marks that are securely linked to accounting. A PSD provides two types of data protection: secrecy of critical security parameters (CSPs), such as cryptographic keys, and data integrity protection for funds relevant data items (FRDIs) such as accounting data. CSPs and FRDIs reside in the PSD. The Cygnus X-1 PSD cryptographic module consists of a multi-chip standalone module residing within a tamper resistant enclosure. The module provides a logical USB interface.

The module configurations under FIPS 140-2 validation are:

- United States PSD Configuration: 1L00 AAA, 1L00 AAC, 1L00 AAD
- Canadian PSD Configuration: 1LEC AAA, 1LEC AAC, 1LEC AAD

## 1.1 Implementation Architecture

The User Interface Controller (UIC) is a common component for multiple product lines within Pitney Bowes. The hardware is structured to fit the general requirements for a mailing system controller. Different product control numbers (PCN) will be accommodated by downloading different software into the UIC. Similarly, the Cygnus X-1 PSD will be customized in manufacturing to match the specific PCN.

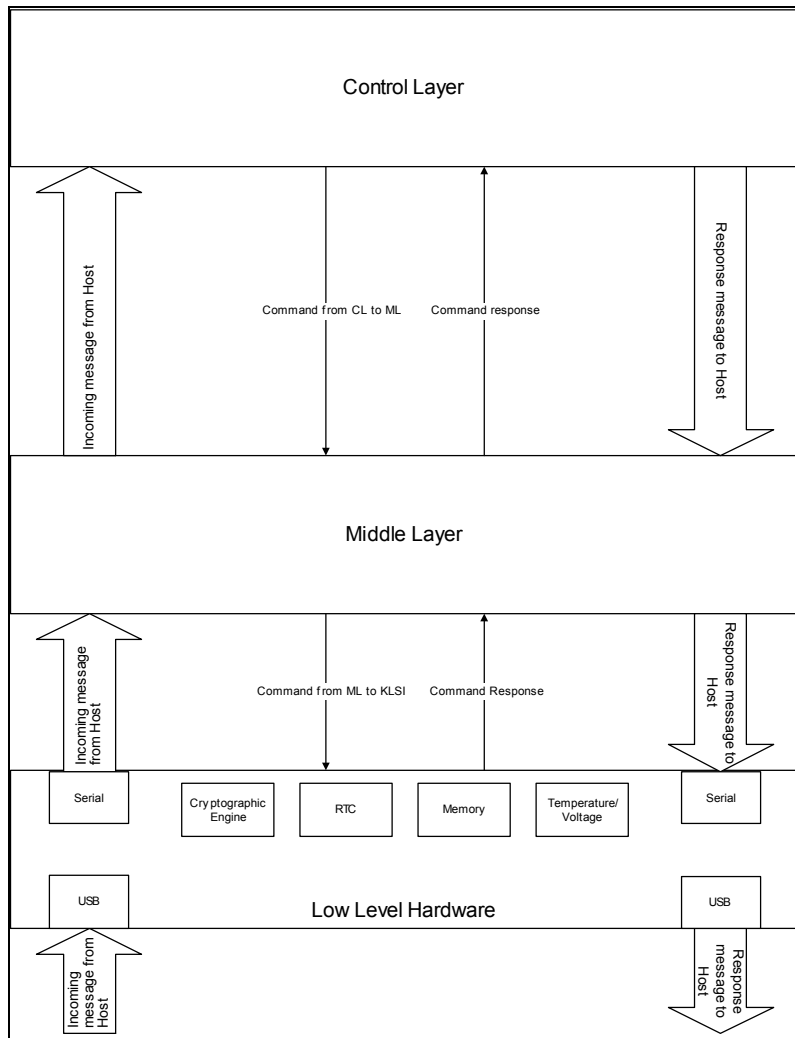
The Cygnus X-1 PSD software is organized into discrete layers as shown in Figure 1 – Logical View of Software Architecture.

The Control Layer (CL) communicates with the Middle Layer (ML) software which provides low-level functions such as cryptographic functions, file management, communications, etc. It communicates with the Cygnus X-1 PSD host and interfaces with other hardware and firmware elements. Generally, the host is the electronic package of a PB meter installed in a mailing machine, which may be in communication with the computer services of the PB Infrastructure Data Center. The Control Layer accesses the nonvolatile memory (NVM) and the real-time clock via the Middle Layer functions. Both layers co-exist on the same processor with a single thread of control.

When the power is applied, the Middle Layer software has control of the processor until it has successfully completed power up checks, after which the Middle Layer passes control to the CL to perform its power up routines. After the CL has successfully initialized, it returns control to the ML, which waits for host messages. Once a message is received, the Middle Layer firmware calls the Control Layer firmware to process the message.

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**Figure 1 – Logical View of Software Architecture**



**Figure 2 - Photograph of Physical Configuration**

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## 2 Security Level

The Cygnus X-1 PSD cryptographic module meets the overall requirements applicable to Level 3 security of FIPS 140-2.

Security Requirements Section	Level
Cryptographic Module Specification	3
Module Ports and Interfaces	3
Roles, Services and Authentication	3
Finite State Model	3
Physical Security	3 + EFP
Operational Environment	N/A
Cryptographic Key Management	3
EMI/EMC	3
Self-Tests	3
Design Assurance	3
Mitigation of Other Attacks	N/A

Figure 3 - Module Security Level Specification

## 3 Modes of Operation

The module shall not be designed with a non-FIPS Approved mode of operation. Hence, the module will always be in a FIPS Approved mode of operation.

The module supports the following FIPS Approved algorithms:

- DSA - FIPS 186-2: This algorithm is used to digitally sign and verify signatures.
- ECDSA – FIPS 186-2: This algorithm is used to digitally sign and verify signatures.
- HMAC SHA-1 – FIPS 198
- SHA-1 - FIPS 180-2: This hashing algorithm is used as part of the digital signature process for DSA and ECDSA. This same algorithm is used in the HMAC-SHA-1 algorithm.

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- Triple-DES - FIPS 46-3, FIPS 81: This encryption algorithm is used to encrypt and decrypt other cryptographic keys for secure storage. The module supports TDES ECB and CBC.
- Triple-DES MAC: This algorithm is used to create and verify MACs.
- PRNG per FIPS 186-2, Appendix 3 with SHA-1 based G function

The module supports the following non-FIPS Approved algorithm:

- Diffie-Hellman: This algorithm is used as a key agreement method when establishing session keys between the module and the Infrastructure. While Diffie-Hellman is not FIPS Approved, it can be used in a FIPS Approved mode of operation.

## 4 Ports and Interfaces

The Cygnus X-1 PSD was designed with a single 12-pin physical edge connector where all power input, data input, data output, control input, and status output interfaces are logically assigned. The edge connector was designed as a logical USB interface.

Pin	Description	Interface Type
1	Not Used	N/A
2	Ground	Power
3	LED	Status Output
4	Ground	Power
5	Not Used	N/A
6	USB Voltage Supply	Power
7	Not Used	N/A
8	I/O	Data Input, Data Output, Control Input, & Status Output
9	LED	Status Output
10	I/O	Data Input, Data Output, Control Input, & Status Output
11	Not Used	N/A
12	Ground	Power

Figure 4 – Interface Table

## 5 Identification and Authentication Policy

There is no login process for an operator for any role in the Cygnus X-1 PSD design. No role or identity is active other than during the processing of a valid authorized transaction.

Each request sent to the Cygnus X-1 PSD is signed with a particular key. The Cygnus X-1 PSD authenticates the entity by verifying the digital signature with the associated public certificate. Every transaction requires authentication; no transaction is made "available" to a user without authentication per transaction.

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Role	Authentication Method	Authentication Type
Crypto-Officer	Digital Signature Verification	Identity-based
PSD Administrator	Digital Signature Verification	Identity-based
Printhead Administrator	Digital Signature Verification	Identity-based
Financial Officer	Digital Signature Verification	Identity-based
Customer	On behalf of the PSD Administrator, Printhead Administrator, or Financial Officer	None

**Figure 5 – Roles and Authentication Type**

Authentication Mechanism	Strength Mechanism
Digital Signature	<p>Based on number of protected bits in key or signature, the probability is 1 in <math>2^x B</math> tries where x is the number of protected bits.</p> <p>The digital signature algorithm, with the associated cryptographic key, provides 80 bits of key strength or a probability of random success of 1 in 1,208,925,819,614,630,000,000,000.</p> <p>The module can execute 9.6 transactions per second therefore the probability of a success in a one minute period is 1 in 2,098,829,547,942,060,000,000.</p>

**Figure 6 –Authentication Strength**

## 6 Access Control Policy

Each identity and corresponding services are described in the following section.

### **Crypto-Officer (CO):**

The CO is responsible for the high level key management within the box. The primary functions are to load keys into the Cygnus X-1 PSD and to authorize the generation and use of an IBI key. The services allocated to this role are as follows:

- Authorize PSD Key: The Authorize PSD Key message shall cause the Cygnus X-1 PSD to complete the Generate PSD Key transaction. This shall place the Cygnus X-1 PSD in Full Postal State. The Authorize PSD Key command shall instruct the Cygnus X-1 PSD to begin using the new key that was created by the previous Generate PSD Key command. The PB Infrastructure Data Center message with a PSD Key Record shall be included in the transaction. This record shall include the PSD public key and

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the Certificate ID that was received from the certificate authority. The record shall be signed with the PB Infrastructure Data Center authentication certificate private key. The Cygnus X-1 PSD shall validate the message header and data content and then shall make the new key active. The Cygnus X-1 PSD shall also prepare the Authorize PSD record and shall sign it with the unique PSD Authentication Information Based Indicia (IBI) private key.

- Delete All Keys and Control Layer: In response to the Host, the Cygnus X-1 PSD shall zeroize all private and secret keys in the system and shall remove the control layer from the system and place the Cygnus X-1 PSD in Transport Mode.
- Generate Key Exchange Key: The host shall instruct the Cygnus X-1 PSD to establish a Triple-DES secret key in coordination with the Host via a Diffie-Hellman process. This secret key will be used as a one time Key Exchange Key to load a secret key into the Cygnus X-1 PSD. This key has a deterministic life of 30 minutes from generation before it becomes inactive. It is destroyed immediately upon completion of a Load Secret Key transaction. This service is only available when the PSD is configured for the Canadian market.

The Diffie-Hellman process and the Triple-DES key being established are both 80 bits in strength.

This process is based on transmission of a parameter set and a 'public key' from the host followed by the generation of a 'private' key and associated public key and computation (establishment) of the shared secret key by the Cygnus X-1 PSD. The Cygnus X-1 PSD then transmits its 'public' key back to the host so the host can compute the shared secret key.

- Generate PSD Key: The public and private key pair that is the PSD Authentication Key shall be generated by the Cygnus X-1 PSD, when the Host sends this command message. It shall generate either a DSA public/private key set or an ECDSA public/private key set based upon PCN configuration. The message shall include the Signed Key Record (SKR), with parameters to be used. The cryptographic algorithm used by the Cygnus X-1 PSD for IBI is either DSA or ECDSA per configuration data. The Record Type and the Key Name in the SKR shall determine the algorithm to be used. In this state, the Cygnus X-1 PSD shall verify the signature on the incoming message. It shall use the middle layer key pair generation algorithm, GenerateKeyPair. The key that is generated cannot be used for debit functions, until authorized by the post office, but it may be used for other operations, for example: Audit processing and self-signing of the response message (e.g., public key); retrieve a public key and sign a response back to the Host.
- Get Certificate Key: This service shall cause the Cygnus X-1 PSD to output the signed crypto key record that contains the public data included in the specified Certificate key.
- Get Key Exchange Key: In response to this command, the Cygnus X-1 PSD shall output the signed crypto key record that contains the public data included in the PSD Key Exchange Key. If a key exchange key has not been generated, this service will return an error.

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- Get PSD Certificate: The Host instructs the Cygnus X-1 PSD to send the signed key record that shall contain the public data associated with the PSD Authentication Key. This command provides the PSD public key data. The command is used by the Print Head controller. The middle layer service that is called by the Control Layer software is the Get Public service.
- Get Public Key Data: After the Load Public Key command has been executed, in order to load the public crypto key data into the Cygnus X-1 PSD, the Host shall use this command to retrieve the public key data from the Cygnus X-1 PSD.
- Load Certificate Key: The Load Certificate Key message shall cause the Cygnus X-1 PSD to pass the certificate key to the middle layer for storage. The incoming signed message shall be verified prior to taking action on the request.
- Load Public Key: The Cygnus X-1 PSD shall be instructed by the Host to load a public key, which is to be stored in the NVM. In this state, the Cygnus X-1 PSD shall verify the incoming message signature and shall verify that the key that is loaded is signed with the appropriate key. The incoming message shall include the new public key data for storage, key identifier, and the signature. The middle layer service that is called by the software is the StorePublicKey service. Upon successful completion of this service, the key attributes shall be retained.
- Load Secret Key: The Load Secret Key is required for various international configurations and is not used in the US postal implementation.

This command from the Host shall cause the Cygnus X-1 PSD to load the signed key record that contains an encrypted secret key. In this state, the Cygnus X-1 PSD shall verify the signature on the incoming message and shall verify that the key that is being loaded is signed with the appropriate key. The incoming message shall include the encrypted secret key for storage, key identifiers, and the signature. The middle layer service that is called by the embedded program is the StoreSecretKey service. Upon successful completion of data processing by this service, which included decrypting the secret key with the Key Exchange Key and then re-encrypting it with the Key Encryption Key for storage, the key attributes shall be retained.

In Canada, the HMAC SHA-1 Key is loaded using this transaction.

- Revoke Key: The revoke key message is a signed message that instructs the Cygnus X-1 PSD to remove a key from the key table.

### **PSD Administrator (PSDA):**

The PSD Administrator manages non-key data used to set internal parameters and settings in the Cygnus X-1 PSD. The Postage by Phone system and the Manufacturing Systems are the only individuals who act as the PSD Administrator.

- Disable PSD: This command shall place the Cygnus X-1 PSD in the Disabled state. No indicia shall be generated and no postage value downloads shall be performed.

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- Enable PSD: This command may transition the Cygnus X-1 PSD from the Disabled state to the Serial Number Locked state. It shall be valid only if no other lockout states are met.
- Reinitialize PSD: Immediately before this command is issued, the Get Challenge command function must have been executed. When the Host instructs the Cygnus X-1 PSD to reinitialize, the file system shall be cleared. Except for the Key Encryption Key, software and transport crypto keys, all keys shall be cleared. The Cygnus X-1 PSD shall be placed in the Transport Mode by the command. The command will not be accepted if there are any funds in the Cygnus X-1 PSD.

**Printhead Administrator (PHA):**

The Printhead Administrator is in charge of downloading information used in conjunction with the Printhead such as postage critical and non-critical graphics bit-maps.

- Verify and Sign Hash: The Cygnus X-1 PSD shall be instructed to verify the signature on the cryptographic hash that is in a signed data record and then to re-sign the hash with the PSD key and output a new SDR. The embedded program call is for the VerifySignature service.

**Financial Officer (FO):**

Funds transfer into and out of the Cygnus X-1 PSD is the responsibility of the Financial Officer. This corresponds to the “User” role as identified by FIPS 140-2. Postage by Phone is the Financial Officer.

- Create Postage Value Refund Request: Requests a return of funds from the Cygnus X-1 PSD to the PbP account.
- Generate Postage Value Download Request: This command shall initiate a Postage Value Download (PVD) request.
- Load Postal Configuration Data: For the Cygnus X-1 PSD to load configuration information that is specific for the postal application, it must receive this command. The specific Postal Configuration Data shall be contained in a signed data record (SDR).
- Perform Postage Value Download: To perform a download of postage value (PVD), the Host sends the message to the Cygnus X-1 PSD, which shall verify the signature on the incoming signed data record.
- Perform Postage Value Refund: This command shall be required to complete the postage refunding operation that was started with the Create Postage Value Refund Request command. The Cygnus X-1 PSD shall verify the signature of the included SDR.
- Process Audit Results: The PCN parameter settings shall cause the Cygnus X-1 PSD to clear inspection lockout or to reset the next inspection due date in response to this command. The Prepare Audit Record command must immediately precede this

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command in order for the Cygnus X-1 PSD to process the signed data record that is returned from the PB Infrastructure Data Center.

- Prepare Audit Record: At the time that Cygnus X-1 PSD is manufactured, the Message Definition File shall be created and written with information that is appropriate for a specific country. The Cygnus X-1 PSD shall use the data in this file to prepare a signed Audit Record, in response to this command from the Host.

**Customer (CU):**

This role performs services on behalf of the PSD Administrator, Financial Officer and Printhead Administrator; services allocated to this role require other authorized transactions to occur in conjunction with the service being invoked.

- Complete Debit: Completes the update of all information based on the last Perform Debit request. This is done on behalf of the Financial Officer.
- Non Secure Print Head ID Data: This service is used by the Authenticate to PHC services as part of one of the optional authentication procedures. This is done on behalf of the Printhead Administrator.
- Perform Debit: Based upon the Pre-Debit command, cryptographic functions that were required and that were not computed shall be completed in accordance with the PCN parameter settings. The Cygnus X-1 PSD shall deduct the postage value in the Pre-Debit message from the Descending register and shall update the Ascending Register, Control Sum and Piece Count registers appropriately. These functions shall only be performed in Full Postal state. The indicia record signed with the UNIQUE\_PSD\_AUTH\_IBI\_DSA1024\_PRIVATE key in the United States or the UNIQUE\_PSD\_AUTH\_IBI\_ECDSA\_FP160\_PRIVATE key in Canada shall be output. This is done on behalf of the Financial Officer.
- Pre-Debit: Based upon the PCN parameter setting, the invocation of this command shall cause the required cryptographic calculations to be made in preparation for use in the upcoming accounting debit. Typical data included in the command are Postage Value, Mail Date and Rate Category. However, these are variables that are PCN specific. At the time that the Cygnus X-1 PSD is manufactured, these data items are defined in the Message Definition File. This command shall only function in Full Postal state. This is done on behalf of the Financial Officer.
- Get Challenge: The Host shall instruct the Cygnus X-1 PSD to output an eight byte nonce (random number), which shall be used in a subsequent command that requires that nonce word for authentication. This is always done in conjunction with another authorized transaction, and is then considered as being done on behalf of any role that requires a nonce value.
- Toggle Out of Service Lockout: This command shall toggle the Cygnus X-1 PSD to enter or exit its Out of Service Lockout state. This is done on behalf of the PSD Administrator to manage the PSD state.

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## Unauthenticated Services:

Miscellaneous functions that do not require the Cygnus X-1 PSD authentication of the entity; Unauthenticated Services are available to all roles, both authenticated and unauthenticated.

- Class Support Request: Used to determine whether the Cygnus X-1 PSD supports a particular class of messages.
- General Class Support Request: Used to get information from the Cygnus X-1 PSD on all supported message classes via a single message.
- Get Real Time Clock with Offsets: This command shall cause the Cygnus X-1 PSD to return the value of the real time clock with all of the offsets calculated, including the GMT offset and drift correction.
- Get Real Time Clock Value with no Offsets: Returns the real time clock, with no offsets.
- Get Real Time Clock Offsets: Returns the Cygnus X-1 PSD clock offset values.
- Set Clock Drift Correction: The Host shall use this command to set the clock drift correction factor into the Cygnus X-1 PSD.
- Set GMT Offset: The user may apply time zone and daylight savings time offsets to produce the Greenwich Mean Time (GMT) offset in the Cygnus X-1 PSD, by using this command from the Host.
- Perform Diagnostic Test: This command shall cause the Cygnus X-1 PSD to perform the diagnostic test specified in the message.
- Perform Full Diagnostics: The Cygnus X-1 PSD shall perform its full diagnostics routines when the Host issues this command.
- Get File Attributes: Causes the Cygnus X-1 PSD to get and output the attributes from a specified file.
- Read Cyclic File: Causes the Cygnus X-1 PSD to read an output a specified record from a cyclic file.
- Read Linear File: Causes the Cygnus X-1 PSD to read and output the next record from a linear file.
- Setup Cyclic File for Read: Sets up the parameters for a cyclic file so a specified record can be read.
- Write Cyclic File: Causes the Cygnus X-1 PSD to write the specified record into a cyclic file.
- Write Linear File: Causes the Cygnus X-1 PSD to write a record into the end of a linear file.
- Get Key List: Instructs the Cygnus X-1 PSD to return a list of all active keys stored in the Cygnus X-1 PSD.

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- Modify ACK Timeout Request: Provides a means of modifying the timeout period, prior to the retransmission of an unacknowledged message.
- Product Code Number (PCN) Request: Commands the postal security device to return its PCN.
- Set Unsolicited Message Capability Request: Tells the Cygnus X-1 PSD whether or not it can send unsolicited message.
- Get PSD Status: If the Cygnus X-1 PSD is in a state where a specified command is expected, this command is used by the Cygnus X-1 PSD to its Idle state.
- Get PSD Attributes: The Host requires that the Cygnus X-1 PSD identify itself by its attributes.
- Get Middle Layer Attributes: The command shall call the Cygnus X-1 PSD to report the attributes of the Middle Layer.
- Get Low Level PSD Status: The Host shall get low level Cygnus X-1 PSD status information with this command.
- Get Middle Layer Error Log: Returns the Middle Layer Error/Event log.

## 7 Definition of Critical Security Parameters (CSPs)

The following table describes the CSPs contained in the module:

Key	Description / Usage	Generation / Agreement	Storage	Entry / Output	Destruction
KUPsdP-KY3DESCBC	TDES 2key Key Encryption Key US & Canada Configuration	Internally by FIPS approved PRNG	Clear text	Entry: N/A Output: N/A	On tamper event and Delete All Keys and Control Layer service
KSPsdP-KECB	TDES 2key CBC session key exchange key Canada Configuration	Diffie-Hellman process with Infrastructure	Ciphertext	Entry: N/A Output: N/A	Delete All Keys and Control Layer service
KUPsdA-IDHM	HMAC SHA-1 key used in Canadian Indicia Canada Configuration	Externally	Ciphertext	Entry: Encrypted via KSPsdP-KECB Output: N/A	Delete All Keys and Control Layer service

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Key	Description / Usage	Generation / Agreement	Storage	Entry / Output	Destruction
P'UPsdA-IBD	DSA IBI authorization key that is also used to authenticate the Cygnus X-1 PSD US Configuration	Internally by a FIPS Approved PRNG	Ciphertext	Entry: N/A Output: N/A	Delete All Keys and Control Layer service
P'UPsdA-IBE1	ECDSA IBI authorization key that is also used to authenticate the Cygnus X-1 PSD Canada Configuration	Internally by a FIPS Approved PRNG	Ciphertext	Entry: N/A Output: N/A	Delete All Keys and Control Layer service
P'UPsdP-KEDH	DH1024 key Canada Configuration	Internally by a FIPS Approved PRNG	N/A	Entry: N/A Output: N/A	End of transaction
New_Key	A generic 3DES Key that is loaded into the module. This key is country or market specific.	Externally	Ciphertext in BRAM	Entry: Encrypted via KSPsdP-KECB	Delete All Keys and Control Layer service

Figure 7 – CSP Table

The following table describes the public keys contained in the module:

Key	Description / Usage	Generation / Agreement	Storage	Entry / Output
PDInfA-CD	DSA Certificate Authentication	Externally	Plaintext	Entry: Certificate form Output: Certificate form

Key	Description / Usage	Generation / Agreement	Storage	Entry / Output
PDInfA-GCD	DSA Postal Critical Graphics Authentication	Externally	Plaintext	Entry: Certificate form Output: Certificate form
PDInfA-KUD	DSA Key Update Authentication	Externally	Plaintext	Entry: Certificate form Output: Certificate form
PDInfA-PVD	DSA Postage Value Download authentication	Externally	Plaintext	Entry: Certificate form Output: Certificate form
PDInfA-RootD	DSA root authentication	Externally	Plaintext	Entry: Certificate form Output: Certificate form
PDInfA-VD	DSA vendor authentication	Externally	Plaintext	Entry: Certificate form Output: Certificate form
PDInfC-NPcGD	DSA verifying signature on non-postal critical graphics	Externally	Plaintext	Entry: Certificate form Output: Certificate form
PUPsdA-IBD	DSA public IBI authorization key	Internally	Plaintext	Entry: N/A Output: Certificate form
PUPsdA-IBE1	ECDSA public IBI authorization key	Internally	Plaintext	Entry: N/A Output: Certificate form
PUPsdP-KEDH	DH1024 public key	Internally	N/A	Entry: N/A Output: Certificate form

**Figure 8 – Public Key Table**

The following table describes the modes of access for each key to each role supported by the

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module. The modes of access are defined as:

- Zeroize: The Cygnus X-1 PSD zeros the key memory location.
- Generates: The Cygnus X-1 PSD generates the key using the FIPS Approved PRNG.
- Establishes: A key agreement process is used to establish the specified key.
- Load: Inputs the key.
- Decrypt: Decrypts something with the specified key.
- Sign: Signs something with the specified key.
- MAC: Performs a MAC with the specified key.

Roles					Services	CSP Modes of Access
CO	PSDA	PHA	FO	CU		
X					Authorize PSD Key	N/A
X					Delete All Keys and Control Layer	Zeroizes all CSPs in Figure 7
X					Generate Key Exchange Key	Generates P'UpsdP-KEDH Establishes KSPsdP-KECB
X					Generate PSD Key	Generates P'UPsdA-IBD Generates P'UPsdA-IBE1
X					Get Certificate Key	N/A
X					Get Key Exchange Key	N/A
X					Get PSD Certificate	N/A
X					Get Public Key Data	N/A
X					Load Certificate Key	N/A
X					Load Public Key	N/A
X					Load Secret Key	Load KUPsdsA-IDHM Decrypt with KSPsdP-KECB
X					Revoke Key	N/A
			X		Create Postage Value Refund	N/A

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Roles					Services	CSP Modes of Access
CO	PSDA	PHA	FO	CU		
					Request	
			X		Generate Postage Value Download	N/A
			X		Load Postal Configuration Data	N/A
			X		Perform Postage Value Download	N/A
			X		Perform Postage Value Refund	N/A
			X		Process Audit Results	N/A
			X		Prepare Audit Record	Sign with P'UPsdA-IBD Sign with P'UPsdA-IBE1
		X			Verify and Sign Hash	Sign with P'UPsdA-IBD
	X				Disable PSD	N/A
	X				Enable PSD	N/A
	X				Reinitialize PSD	N/A
				X	Complete Debit	Sign with P'UPsdA-IBD Sign with P'UPsdA-IBE1
				X	Get Challenge	N/A
				X	Perform Debit	Sign with P'UPsdA-IBD Sign with P'UPsdA-IBE1 MAC with KUPsdA-IDHM
				X	Pre Debit	Sign with P'UPsdA-IBD
				X	Non Secure Printhead ID Data	N/A
				X	Toggle Service Lockout	N/A
X	X	X	X	X	Class Support Request	N/A
X	X	X	X	X	General Class Support	N/A

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Roles					Services	CSP Modes of Access
CO	PSDA	PHA	FO	CU		
X	X	X	X	X	Get File Attributes	N/A
X	X	X	X	X	Get Key List	N/A
X	X	X	X	X	Get Low Level PSD Status	N/A
X	X	X	X	X	Get Middle Layer Attributes	N/A
X	X	X	X	X	Get Middle Layer Error Log	N/A
X	X	X	X	X	Get PSD Attributes	N/A
X	X	X	X	X	Get PSD Status	N/A
X	X	X	X	X	Get Real Time Clock Offsets	N/A
X	X	X	X	X	Get Real Time Clock Value with No Offsets	N/A
X	X	X	X	X	Get Real Time Clock with Offsets	N/A
X	X	X	X	X	Modify ACK Timeout Requests	N/A
X	X	X	X	X	PCN Request	N/A
X	X	X	X	X	Perform Diagnostic Test	N/A
X	X	X	X	X	Perform Fully Diagnostics	N/A
X	X	X	X	X	Read Cyclic File	N/A
X	X	X	X	X	Read Linear File	N/A
X	X	X	X	X	Set Clock Drift Correction	N/A
X	X	X	X	X	Set GMT Offset	N/A
X	X	X	X	X	Set Unsolicited Msg Capability Request	N/A
X	X	X	X	X	Setup Cyclic File for Read	N/A
X	X	X	X	X	Write Cyclic File	N/A

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Roles					Services	CSP Modes of Access
CO	PSDA	PHA	FO	CU		
X	X	X	X	X	Write Linear File	N/A

Figure 9 – CSP Modes of Access

## 8 Funds Relevant Data Items

FRDIs are data items whose authenticity and integrity are critical to the protection of postage funds, but which are not CSPs and should not be zeroized. In Cygnus X-1 PSD, all FRDIs are stored in nonvolatile memory in the Cygnus X-1 PSD. FRDIs include:

- Indicia Serial Number is the identification number registered with the USPS for the meter license.
- Ascending Register. This register contains the total amount of funds spent over the lifetime of the module.
- Descending Register: This register contains the amount of funds currently available in the module.
- Control Sum: This register contains the total amount of funds credited to the module over the lifetime of the module. The Control Sum must equal the sum of the Ascending Register and the Descending Register values.
- PSD Piece Count: The number of indicia plus the number of correction indicia dispensed by the Cygnus X-1 PSD.

## 9 Operational Environment

The FIPS 140-2 Area 6 Operational Environment requirements for the Cygnus X-1 PSD are not applicable because the device does not contain a modifiable operational environment.

## 10 Security Rules

This section documents the security rules enforced by the Cygnus X-1 PSD to implement the security requirements of this FIPS 140-2 Level 3 module.

- The Cygnus X-1 PSD shall not process more than one request at a time (i.e., single threaded). While processing a transaction, prior to returning a response, the Cygnus X-1 PSD will ignore all other inputs to the Cygnus X-1 PSD. No output is performed until the transaction is completed, and the only output is the transaction response.
- The Cygnus X-1 PSD shall validate identities using digital signature.
- All keys generated in the module shall have 80-bits of strength.

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- All methods of key generation shall be at least as strong as the key being generated.
- All methods of key establishment shall be at least as strong as the key being established.
- Signed digital indicium data shall not be output unless the proper funds accounting has been performed.
- The Cygnus X-1 PSD shall sign digital indicium data using an approved USPS signature method as defined in the IBIP specification.
- The Cygnus X-1 PSD shall not provide a bypass state where plaintext information is just passed through the module.
- The Cygnus X-1 PSD shall not support a maintenance mode.
- The Cygnus X-1 PSD shall not support a safety state.
- The Cygnus X-1 PSD shall not provide a bypass state where plaintext information is just passed through the module.
- The Cygnus X-1 PSD shall not output any secret or private key in plaintext form.
- The Cygnus X-1 PSD shall not accept any secret or private key in plaintext form.
- There shall be no seed keys entered into the system.
- There shall be no manual entry of keys into the system.
- There shall be no entry or output of split keys from the system.
- There shall be no key archiving.
- Keys shall be either generated or entered into the system through valid processes (i.e., Load Secret Key, etc.).
- Only those keys necessary for the domain specified by the PCN shall be loaded during manufacturing or generated during operation
- The Cygnus X-1 PSD shall support the following conditional tests:
  - Pairwise consistency test for DSA and ECDSA key pair generation
  - Continuous RNG test for both the FIPS approved RNG and the non-FIPS approved RNG
- The Cygnus X-1 PSD shall support power up self-tests, which include:
  - GK2S Power On Self-Tests (POST)
  - Middle Layer Verification
  - Control Layer Verification
  - Application Code Self-Tests: After successful completion of the GK2S POST and prior to execution of the first service request, the Cygnus X-1 PSD shall perform the following additional tests via the middle layer code in FLASH memory. The

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tests are listed in order of execution. The tests performed are:

- SRAM Databus Test
- SRAM Address Bus Test
- SRAM Pattern Test
- BRAM pattern test
- Timer Test
- RTC Test
- SHA-1 Known Answer Test
- HMAC SHA-1 Known Answer Test
- 3DES Known Answer Test
- Triple-DESMAC Known Answer Test
- DSA Known Answer Test
- ECDSA Known Answer Test
- Diffie-Hellman Known Answer Test
- PRNG Known Answer Test

## 11 Physical Security Policy

The Cygnus X-1 PSD includes the following physical security mechanisms:

- Upon detecting a tamper event, the Cygnus X-1 PSD shall execute a zeroize activity that completely eliminates its ability to perform any operation requiring authentication.
- Upon detecting a tamper event, the Cygnus X-1 PSD shall abort any transaction in process.
- The module shall protect two types of data items: Funds relevant data items (FRDIs) and critical security parameters (CSPs).

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Physical Security Mechanisms	Recommended Frequency of Inspection/Test	Inspection/Test Guidance Details
Tamper Barrier	N/A	Periodic remote data communications
Battery Power	Continuous	Internal SW
Temperature Sensing	N/A	Proof of Design Test, Manufacturing Sampling
Voltage Sensing	N/A	Proof of Design Test, Manufacturing Sampling

**Figure 10 – Inspection/Testing of Physical Security Mechanisms**

## 12 Mitigation of Other Attacks Policy

The module has not been designed to mitigate any specific attacks.

## 13 References

The following documents are referenced by this document, are related to it, or provide background material related to it:

- Data Encryption Standard – FIPS PUB 46-3, October 25, 1999
- Financial Institution Retail Message Authentication – ANSI X9 .19, 1996
- Digital Signature Standard (DSA ) – FIPS PUB 186-2, January 27, 2000, including change notice of October 5, 2001
- Performance Criteria for Information-Based Indicia and Security Architecture for Closed IBI Postage Metering Systems, PCIBI-C, Draft January 12, 1999
- PKCS #1: RSA Encryption Standard version 1.5, November 1, 1993 – More current version available
- Secure Hash Standard – FIPS PUB 180-2, August 26, 2002
- Security Requirements for Cryptographic Modules – FIPS PUB 140-2, Change Notices December 3, 2002
- VA97013 MultiChip PSD Hardware Requirements, Rev D, January 24, 2003, Pitney Bowes
- 1L97006 Cygnus X-1 Middle Layer Interface Protocol

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## 14 Definitions and Acronyms

- Diffie-Hellman: A process where two secure facilities may establish a shared secret key using unsecured communications.
- Key Establishment: There are three methods for the establishment of a key within the Cygnus X-1 PSD. These are 1) internal generation 2) load from external source and 3) Diffie-Hellman process.
- Key Transaction Processor: The Key Transaction Processor or KTP is a master database system that contains and manages key material in encrypted data records. It is the repository for all meter related keys at Pitney Bowes and is the start or end point of a large number of secure transactions involving the distribution of keys.
- Secure Configuration Trusted Coprocessor: The secure box used in conjunction with Postage by Phone<sup>®</sup> for configuration management.
- Secure Financial Trusted Coprocessor: The secure box used in conjunction with Postage by Phone<sup>®</sup> for funds management.
- Secure Manufacturing Trusted Coprocessor: The secure box used in manufacturing a Cygnus X-1 PSD.

## 15 Acronyms

3DES	Triple Data Encryption Standard
ANSI	American National Standards Institute
CL	Control Layer
CM	Cryptographic Module
CSP	Critical Security Parameter
DEA	Data Encryption Algorithm
DES	Data Encryption Standard
DSA	Digital Signature Algorithm
DSS	Digital Signature Standards
ECDSA	Elliptic Curve Digital Signature Algorithm
EFP	Environmental Failure Protection
EFT	Environmental Failure Testing
EMC	Electromagnetic Compatibility
EMI	Electromagnetic interference
FIPS	Federal Information Processing Standards
FRDI	Funds Relevant Data Items

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GK2S Gate Keeper 2 SRAM ASIC (see Figure 3)  
 HMAC A hashing algorithm used for message authentication  
 IBI Information Based Indicia  
 ISO International Standards Organization  
 MAC Message Authentication Code  
 ML Middle Layer  
 NVM Nonvolatile Memory  
 OAEP Optimal Asymmetric Encryption Padding  
 PB Pitney Bowes  
 PbP Postage by Phone®  
 PCN Product Code Number  
 PHC Print Head Controller  
 PKCS Public Key Cryptography Systems  
 PSD Postal Security Device  
 PSN Postal Serial Number (Indicia Serial Number)  
 PVD Postage Value Download  
 RSA Rivest, Shamir, and Adelman  
 SDR Signed Data Record  
 SHA Secure Hash Algorithm  
 SKR Signed Key Record  
 TDEA Triple Data Encryption Algorithm  
 UIC User Interface Controller

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# 16 Revisions

## 16.1 Changes in Revision B

Section	Change
5. Identification and Authentication Policy	In Figure 5 – Roles and Authentication Types, Customer Authentication Method changed: From: “On behalf of Financial Officer” To: “On behalf of PSD Administrator, Printhead Administrator, of Financial Officer”
6. Access Control Policy, Crypto Officer, Load Secret Key	From: “In Canada, the HMAC Key is loaded using this transaction.” To: “In Canada, the HMAC SHA-1 Key is loaded using this transaction.”
6. Access Control Policy, Customer (CU)	From: “This role performs services on behalf of the Financial Officer and Printhead Administrator; ....” To: “This role performs services on behalf of the PSD Administrator, Financial Officer and Printhead Administrator;...”
7. Definition of Critical Security Parameters (CSPs), Figure 7 CSP Table	Add Key Encryption Key, KUPsdP-KY3DESCBC and its information as new first row in table
8. Definition of Critical Security Parameters (CSPs), Figure 9 – CSP Modes of Access	Under Load Secret Key From: “Load New Key” To: “Load KUPsdsA-IDHM”  Under Perform Debit, CSP Modes of Access, add: “MAC with KUPsdA-IDHM”

## 16.2 Changes in Revision C

Section	Change
1. Module Overview	Added Part Number and Revision Numbers for USA and Canada
7. Definition of Critical Security Parameters, Figure 7	Removed reference to key , P’UpsdP KER

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### 16.3 Changes in Revision D

Section	Change
6. Access Control Policy – Unauthenticated Services	Added Get Middle Layer Error Log
7. Definition of Critical Security Parameters, Figure 7	Added Get Middle Layer Error Log

### 16.4 Changes in Revision E

Section	Change
All	Replace “Cygnus” with “Cygnus X-1”
All	Remove Proprietary and Confidential footers from all pages
1. Module Overview	Changed Canada PSD Configuration from 1LAC to 1LEC

### 16.5 Changes in Revision F

Section	Change
1. Module Overview	Changed US PSD Configuration from 1L000 to 1L00

### 16.6 Changes in Revision G

Section	Change
3. Modes of Operation	Diffie-Hellman: Added “While Diffie-Hellman is not FIPS Approved, it can be used in a FIPS Approved mode of operation.”
6. Access Control Policy - Crypto Officer (CO)	In first paragraph for the Crypto Officer, changed: From: “The service allocated to this role is as follows:” To: “The services allocated to this role are as follows:” For Generate Key Exchange Key, added bullet to the item and corrected paragraph indenting

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Section	Change
6. Access Control Policy - Unauthenticated Services	<p>Changed</p> <p>From: “these services are permitted to all roles”</p> <p>To: “Unauthenticated Services are available to all roles, both authenticated and unauthenticated”</p>
9. Operational Environment	<p>In first sentence, changed:</p> <p>From: “because the example device does not”</p> <p>To: “because the device does not”</p>

### 16.7 Changes in Revision H

Section	Change
1. Module Overview	<p>Changed PCN list to include 1L000AAC and 1LECAAC, reflecting updates to ML and CL software.</p>

### 16.8 Changes in Revision J

Section	Change
1. Module Overview	<p>Changed PCN list to include 1L000AAD and 1LECAAD, reflecting update to CL software.</p>

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