# Motorola GGM 8000 Gateway

## FIPS 140-2 Cryptographic Module Non-Proprietary Security Policy

**Version: 3.6**

**Date: 4/27/2021**

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# 1 Introduction

This document defines the Security Policy for the Motorola GGM 8000 Gateway, hereafter denoted the Module. The Module is a modular purpose-built gateway that can easily be configured to support a variety of public safety network applications. The Module meets FIPS 140-2 overall Level 2 requirements.

**Table 1– Cryptographic Module Configurations**

| | Module | HW P/N and Version | FW Version |
|---|---|---|---|
| 1 | GGM 8000 Base Unit | CLN1841F Rev AG | 18.2.2.03 |
| 2 | GGM 8000 AC Power Supply option | CLN1850A Rev GB | N/A |
| 3 | GGM 8000 DC Power Supply option | CLN1849C Rev AB | N/A |
| 4 | FIPS Kit | CLN8787A Rev B | N/A |

The Module is intended for use by US Federal agencies and other markets that require FIPS 140-2 validated network appliances. The Module is a multi-chip standalone embodiment; the cryptographic boundary is the gateway's enclosure which includes all components, and one of the power supply options (AC or DC) identified in Table 1.

The FIPS 140-2 security levels for the Module are as follows:

**Table 2 – Security Level of Security Requirements**

| Security Requirement | Security Level |
|---|---|
| Cryptographic Module Specification | 2 |
| Cryptographic Module Ports and Interfaces | 2 |
| Roles, Services, and Authentication | 2 |
| Finite State Model | 2 |
| Physical Security | 2 |
| Operational Environment | N/A |
| Cryptographic Key Management | 2 |
| EMI/EMC | 2 |
| Self-Tests | 2 |
| Design Assurance | 3 |
| Mitigation of Other Attacks | N/A |

The Module implementation is compliant with:

- FIPS 140-2
- FIPS 197
- SP 800-38A
- SP 800-90A
- FIPS 198-1
- SP 800-135
- FIPS 186-4
- FIPS 180-4
- SP 800-56Arev3
- SP 800-132

## 1.1 Hardware and Physical Cryptographic Boundary

The physical cryptographic boundary of the Module is depicted in Figure 1. In the photo, there is a slot that can hold an optional expansion module for increased device connectivity. The optional expansion module is not included within the Motorola GGM 8000 Gateway cryptographic boundary.

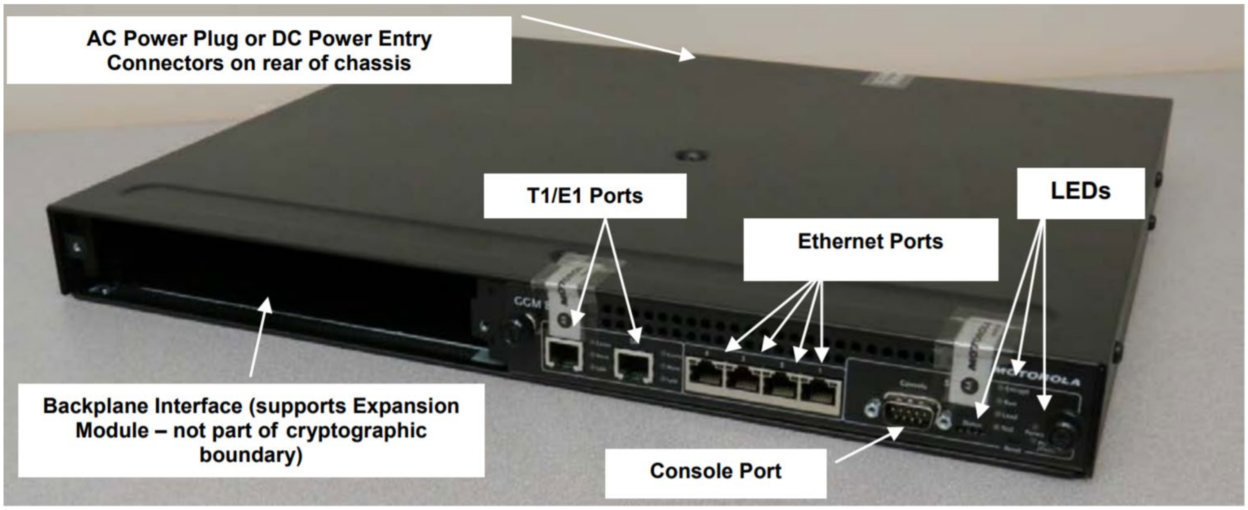

AC Power Plug or DC Power Entry Connectors on rear of chassis
T1/E1 Ports
LEDs
Ethernet Ports
Backplane Interface (supports Expansion Module – not part of cryptographic boundary)
Console Port

**Figure 1: Motorola GGM 8000 Gateway with Ports**

**Table 3 – Ports and Interfaces**

| Port | Description | Logical Interface Type |
|---|---|---|
| Ethernet (Qty. 4) | LAN ports that provide connection to Ethernet LANs using either 10BASE-T, 100BASE-TX, or 1 Gigabit Ethernet | Control in \| Data in \| Data out \| Status out |
| T1/E1 (Qty. 2) | T1/E1 interfaces that support T1/E1 CSU/DSU | Control in \| Data in \| Data out \| Status out |
| Console (Qty. 1) | RS-232 interface | Control in \| Status out |
| Backplane interface<br>Supports expansion module containing optional interface cards (expansion module not part of cryptographic boundary) | High-speed multifunction serial interfaces that provide connection to industry-standard V.35, Data Communications Equipment (DCE) or Data Terminal Equipment (DTE) serial devices | Control in \| Data in \| Data out \| Status out |
| AC power plug | | Power |
| **-OR-** DC power entry connectors (Qty. 1 or 2) | External AC power input port **-OR-** External DC power input ports | Power |
| LEDs (Qty. 7) | Provide Module status for traffic and module power | Status out |

## 1.2 Modes of Operation

The module supports both an Approved FIPS mode and non-Approved mode of operation. To enter FIPS mode, the Crypto-Officer must follow the procedure outlined in Table 4 below. For details on individual gateway commands, use the online help facility or review the *Enterprise OS Software User Guide* and the *Enterprise OS Software Reference Guide*.

**Table 4 - FIPS Approved Mode Configuration**

| Step | Description |
|---|---|
| 1. | To ensure the module does not retain any CSPs between mode changes, issue the **ZEROize** command. |
| 2. | Enable FIPS mode by issuing the **SETD -SYS FIPS=ON** command. |
| 3. | Create a new KEK using the **KEKGenerate** command. |
| 4. | Change the Crypto-Officer and User passwords using the **SysPassWord** command. Recreate all necessary local users using the **UserManager** menu. |
| 5. | Ensure the module is not configured to use IKEv2 (only v1 is supported in FIPS mode). |
| 6. | Configure the parameters for the IKE negotiations using the **ADD -CRYPTO IKEProfile** command. For FIPS mode, only the following values are allowed: Diffie-Hellman Group (Group 14 required for 112-bit key strength, Group 19 for 128-bit key strength or Group 20 for 192-bit key strength), Encryption Algorithm (AES), Hash Algorithm (SHA, SHA-256 or SHA-384), and Authentication Method (PreSharedKey, RSA-Signature, ECDSA-256 or ECDSA-384). |
| 7. | If PreSharedKey is used as Authentication Method, electronically establish via the local console port the pre-shared key (PSK) to be used for the IKE protocol using:<br>**ADD -CRYPTO FipsPreShrdKey <peer_ID> <pre-shared_key> <pre-shared_key>**<br>For FIPS mode, minimum key length is 14 bytes. |
| 8. | If RSA-Signature, ECDSA-256 or ECDSA-384 is used as Authentication Method:<br>a. Unlock PKI database using:<br>**SETD -PKI CONTrol = Unlocked**<br>b. Generate key pair using:<br>**ADD -PKI KeyPair [<profile>] [<RSA\|ECDSA>] <256\|384\|2048>**<br>c. Set identity of the device by executing at least one of the following commands:<br>**SETD -PKI DNSName = <dns-name>**<br>**SETD -PKI IPADDress = <ip-address>**<br>**SETD -PKI EmailADDress = <email-address>**<br>**SETD -PKI SubjectName = <subject-name>**<br>d. Generate CSR using:<br>**ADD -PKI CertReq <certreq-profile>**<br>e. Use external CA to generate certificate from CSR<br>f. Install chain of certificates using:<br>**ADD -PKI CERTificate <profile> <Self\|TrustedCA\|UnTrusted> InputFile <local-file-name>** |

| | |
|---|---|
| | g. Lock PKI database using:<br>**SETD -PKI CONTrol = Locked** |
| 9. | If IPsec is used, configure IPsec transform lists using the **ADD -CRYPTO TransformLIst** command. For FIPS mode, only the following values are allowed: Encryption Transform (ESP-AES) and Authentication Transform (ESP-SHA). |
| 10. | If FRF.17 is used, configure FRF.17 transform lists using the **ADD -CRYPTO TransformLIst** command. For FIPS mode, only the following values are allowed: Encryption Transform (FRF-AES) and Authentication Transform (FRF-SHA). |
| 11. | Configure the selector list using command(s):<br>**ADD -CRYPTO SelectorLIst <slctrlist_name> <priority> [<actions>] <filters> (<src_ipaddr/mask> \| <src_ip_range>) (<dst_ipaddr/mask> \| <dst_ip_range>)**<br>The selector list defines the rules for network traffic to be protected. In particular, the selector list can be defined to protect all network traffic. |
| 12. | For each port for which encryption is required, bind a dynamic policy to the ports using:<br>**ADD [!<portlist>] -CRYPTO DynamicPOLicy <policy_name> <priority>**<br>**<mode> <selctrlist_name> <xfrmlist_name> [<pfs>] [<lifetime>] [<preconnect>]**<br>To be in FIPS mode, the selector list and transform list names must be defined as in previous steps. |
| 13. | If PIM authentication (RFC 4601) is enabled, configure Manual Key set using the **ADD -CRYPTO ManKeySet** command. For FIPS mode, minimum authentication key length is 14 bytes. |
| 14. | If SNMPv3 is enabled, configure authentication and encryption passphrases for all SNMP users with AuthPriv privileges. For FIPS mode, minimum authentication passphrase length is 14 bytes. |
| 15. | If SSHv2 is enabled, generate RSA 2048 bit keys using **GenSshKey RSA 2048**. |
| 16. | If Radius server is used for user authentication:<br>• Add a radius secret using the **setd -ac secret** command.<br>• Configure IPsec tunnel between the module and the Radius server as described in steps: 6-12. |
| 17. | For each port for which encryption is required, enable encryption on that port using:<br>**SETDefault [!<portlist>] -CRYPTO CONTrol = Enabled** |
| 18. | DSA keys must not be used in FIPS mode. |
| 19. | Use the **Show -SYS SwSignatureAlgorithm** command to verify that firmware signing algorithm is set to SHA2withRSA2048. If not use the **SetD -SYS SwSignAlgorithm = SHA2withRSA2048** command to change signing algorithm. |
| 20. | **Copy** command must not be used to transfer files outside the module in FIPS mode. SCP protocol can be used instead of. |
| 21. | Telnet access to the module should be blocked by issuing the following command: **SETDefault -SYS NetAccess = NoTelnet.** |
| 22. | FIPS-140-2 mode achieved. |

Note: To switch the Module to a non-approved mode, perform Step 1 to zeroize the CSPs and use the **SETD -SYS FIPS=OFF** command.

## 2 Cryptographic Functionality

The Module implements the FIPS Approved and Non-Approved but Allowed cryptographic functions listed in the table(s) below.

**Table 5 – Approved and CAVP Validated Cryptographic Functions**

| Algorithm | Description | Cert # |
|---|---|---|
| AES (Hardware Implementation) | [FIPS 197, SP 800-38A]<br>Functions: Encryption, Decryption<br>Modes: ECB, CBC, CTR,<br>Key sizes: 128, 256 bits | 962 |
| AES (Firmware Implementation) | [FIPS 197, SP 800-38A]<br>Functions: Encryption, Decryption<br>Modes: ECB, CBC, CFB128, CTR<br>Key sizes: 128 (ECB, CBC, CFB, CTR), 192 (ECB, CBC, CTR), 256 (ECB, CBC, CTR) bits | C1721 |
| DRBG | [SP 800-90A]<br>Functions: Hash DRBG<br>Security Strengths: 256 bits | C1721 |
| ECDSA | [FIPS 186-4]<br>Functions: Key Pair Generation, Signature Generation, Signature Verification, Public Key Validation<br>Curves: P-256 with SHA-256, P-384 with SHA-384 | C1721 |
| HMAC (Hardware Implementation) | [FIPS 198-1]<br>Functions: Generation, Verification<br>SHA sizes: SHA-1<br>Key Size: 160 bits | 1487 |
| HMAC (OpenSSL Firmware Implementation) | [FIPS 198-1]<br>Functions: Generation, Verification<br>SHA sizes: SHA-1, SHA-256, SHA-384, SHA-512<br>Key Size: minimum 160 bits, maximum 1160 bits | C1721 |
| HMAC (OpenSSH Firmware Implementation) | [FIPS 198-1]<br>Functions: Generation, Verification<br>SHA sizes: SHA-1, SHA-256<br>Key Size: minimum 160 bits, maximum 640 bits. | C1722 |
| KDF, Existing Application-Specific (CVL) | [SP 800-135] Functions: | |
| | SSH KDF | C1722 |

| | | |
|---|---|---|
| | SNMP KDF | C1723 |
| | IKE v1 KDF | C2054 |
| KTS | [SP800-38F §3.1]<br>Functions: Key Unwrap<br>Modes: AES-CTR + HMAC-SHA-1 (160 bits) or HMAC SHA-256, AES-CBC + HMAC SHA-1(160 bits) or HMAC SHA-256 | AES #C1721<br>HMAC #C1721, C1722 |
| RSA | [FIPS 186-4, PKCS #1 v2.1 (PKCS1.5)]<br>Functions: Key Generation, Signature Generation, Signature Verification<br>Key sizes: 1024 (RSA Verify only), 2048 bits; with SHA-1 (Verify only), SHA-256 and SHA-384 | C1721 |
| SHS (Hardware Implementation) | [FIPS 180-4]<br>Functions: Message Digest<br>SHA sizes: SHA-1 | 933 |
| SHS (Firmware Implementation) | [FIPS 180-4]<br>Functions: Digital Signature Generation, Digital Signature Verification, non-Digital Signature Applications<br>SHA sizes: SHA-1, SHA-256, SHA-384, SHA-512 | C1721 |

**Table 6 – Approved Cryptographic Functions Tested with Vendor Affirmation**

| Algorithm | Description |
|---|---|
| CKG | [SP 800-133]<br>In accordance with FIPS 140-2 IG D.12, the cryptographic module performs Cryptographic Key Generation as per scenario 1 of section 4 in SP800-133. The resulting generated symmetric key and the seed used in the asymmetric key generation are the unmodified output from SP800-90A DRBG. |
| KAS | [SP 800-56A rev3]<br>Functions: Key Pair Generation, Full Validation<br>Modes: FFC, ECC<br>Roles: Initiator, Responder<br>Parameter sets for FFC mode: DH Groups 14, 16 and 18<br>Parameter sets for ECC mode: DH Groups 19 and 20 |
| PBKDF | [SP 800-132]<br>This function is used only in the Password Storage component. The 64-byte long Master Key is calculated from the variable length PBKDF Password and 16 random bytes of salt, using HMAC-SHA-512 as a Pseudorandom Function and the iteration count set to 1000. The PBKDF |

| | |
|---|---|
| | Password is either 16 bytes of the hashed (MD5) user password (for Crypto Officer and Admin roles) or concatenated username and variable length (7-15 bytes) user password (for Network Manager and User roles). The Master Key (equivalent to Data Protection Key – Option 1a is chosen as described in the referenced Special Report) is stored together with the randomly generated salt for each user and it is used in the process of user's authentication.<br>For Crypto Officer and Admin roles, the probability that a random attempt of guessing PBKDF Password will succeed is 1/256^16 which is less than 1/10^38. Note however that the user cannot pass the PBKDF Password directly to the algorithm, since it is internally calculated from the user's password. In this case the probability that a random attempt of guessing PBKDF Password will succeed is given in  Section 3.2 of this document.<br>For Network Manager and User roles, the probability that a random attempt of guessing PBKDF Password will succeed is given in  Section 3.2 of this document.<br>The derived keys from the PBKDF may only be used in storage applications. |

**Table 7 – Non-Approved but Allowed Cryptographic Functions**

| Algorithm | Description |
|---|---|
| HMAC-MD5 | Used in Radius in approved mode but no security is claimed |
| NDRNG | [Annex C]<br>Hardware Non-Deterministic RNG; minimum of 256 bits per access. The NDRNG output (256 bits) is used to seed the FIPS Approved DRBG. |

**Table 8  – Protocols Allowed in FIPS Mode**

| Protocol | Description |
|---|---|
| IKE v1 | [IG D.8 and SP 800-135]<br>Cipher Suites:<br>• Oakley Group 14 DH key agreement or Oakley Group 19 and 20 ECDH key agreement<br>• PreSharedKey, RSA-Signature, ECDSA-256 or ECDSA-384 authentication<br>• AES CBC encryption<br>• SHA-1, SHA-256 or SHA-384 hashing<br>• HMAC as PRF |
| SNMPv3 | [IG D.8 and SP 800-135]<br>Allowed only with the *SP 800-135* SNMP KDF and AES encryption/decryption |
| SSH v2 | [IG D.8 and SP 800-135]<br>Cipher Suites: RSA 2048, DH group 14 SHA-1 and SHA-256, DH groups 16 and 18 SHA-512 key establishment, AES CBC or CTR encryption, HMAC-SHA-1 MAC, HMAC-SHA-256 MAC |

Note: The IKEv1, SNMPv3 and SSH protocols, other than the KDF, have not been tested by the CMVP or CAVP as per FIPS 140-2 Implementation Guidance D.11.

Non-Approved Cryptographic Functions for use in non-Approved mode only:

- DES
- Triple-DES
- FIPS 186-2 RSA Signature Generation: 4096 bit keys with SHA-2
- MD5
- AES CCM (non-compliant)
- HMAC-SHA-1-96
- DSA 1024-bit – for public/private key pair generation and digital signatures (non-compliant)
- RSA 1024 – for key transport within SSH v2
- Non approved SW RNG: Provides random numbers for networking functions (non-compliant)
- Diffie-Hellman Group 1, 2 and 5
- IKEv2 KDF (non-compliant)
- Non-SP 800-38F Compliant Key Wrap: AES-ECB Key Wrap and Key Unwrap (key wrapping; key establishment methodology provides 128 bits of encryption strength)

## 2.1 Critical Security Parameters

All CSPs used by the Module are described in this section. All usage of these CSPs by the Module (including all CSP lifecycle states) is described in the services detailed in Section 4.

**Table 9 – Critical Security Parameters (CSPs)**

| CSP | Description / Usage |
|---|---|
| KEK | This is the master key that encrypts persistent CSPs stored within the module.<br>KEK-protected keys include PSK and passwords.<br>Encryption of keys uses AES128ECB |
| IKE Preshared Keys | Minimum 14 bytes long key used to authenticate peer to peer during IKE session |
| PKI private key | 2048-bit RSA or 256/384-bit ECDSA key used for certificate request signing and IKEv1 authentication |
| SKEYID | HMAC-SHA-1, HMAC-SHA-256 or HMAC-SHA-384 (160-384 bits), used in IKE to provide for authentication of peer router.<br>Generated for IKE Phase 1 by hashing preshared keys with responder/receiver nonce |
| SKEYID_d | HMAC-SHA-1, HMAC-SHA-256, or HMAC-SHA-384 (160-384 bits) of Preshared Session key, DH keys and cookies.<br>Phase 1 key used to derive keying material for IKE SAs |
| SKEYID_a | HMAC-SHA-1, HMAC-SHA-256, or HMAC-SHA-384 (20-48 bytes) of SKEYID_d, DH keys and cookies.<br>Key used for integrity and authentication of the phase 1 exchange |
| SKEYID_e | HMAC-SHA-1, HMAC-SHA-256, or HMAC-SHA-384 of SKEYID_a, DH keys and cookies.<br>Key used for AES data encryption of phase 1 exchange |

| | |
|---|---|
| Ephemeral DH Phase-1 private key (a) | 2048/6144/8192-bit key generated for IKEv1 Phase 1 key establishment |
| Ephemeral ECDH Phase-1 private key | 256/384-bit key generated for IKEv1 Phase 1 key establishment |
| Ephemeral DH Phase-2 private key (a) | Phase 2 2048/6144/8192-bit Diffie-Hellman private keys used in PFS for key renewal |
| Ephemeral ECDH Phase-2 private key | Phase 2 256/384-bit Elliptic Curve Diffie-Hellman private keys used in PFS for key renewal |
| IPsec Session Enc Key | 128/256-bit AES-CBC keys are used to encrypt IPsec ESP packets |
| IPsec Session Auth Key | 160-bit key HMAC-SHA-1 is used to authenticate IPsec ESP packets |
| FRF.17 Session Enc Key | 128/256-bit AES-CBC keys are used to encrypt FRF.17 Mode 2 |
| FRF.17 Session Auth Key | 160-bit key HMAC-SHA-1 is used to authenticate FRF.17 Mode 2 |
| SSH-RSA Private Key | 2048-bit RSA Key used to authenticate oneself to peer |
| SSH Session Enc Key | 128/192/256-bit AES-CBC or AES-CTR keys are used to encrypt SSH packets |
| SSH Session Auth Key | 256-bit HMAC-SHA-2-256 key is used to authenticate SSH packets |
| SSH DH Private Key | Generated for SSH key establishment |
| SNMPv3 Passphrases | Passphrases with a minimum length of 14 bytes, used in generation of SNMPv3 session keys |
| SNMPv3 Session Keys | 128-bit keys used to encrypt and authenticate SNMPv3 packets |
| RADIUS Secret | Used for authentication of packets sent/received to RADIUS Server, up to 32 characters.<br>By default, RADIUS connection is not used. To enable it, at least the following commands need to be executed:<br>SETDefault -AC PrimACcntSrvr = <radius_server_ip_address><br>SETDefault -AC RESolutionOrder = Radius<br>SETDefault -RAS SecurityType = Radius<br>Only then, when the user will try to log in, the module will exchange packets with the RADIUS server. |
| Hash-DRBG Seed | Initial 256 bit seed for FIPS-Approved DRBG |
| Hash-DRBG Internal State | Internal state/context for FIPS-Approved DRBG. The critical security parameters are the values V and C. |

| | |
|---|---|
| Passwords<br>• Crypto-Officer (Super User)<br>• Network Manager<br>• Admin<br>• User | 7 (to 15) character password used to authenticate to the module |

## 2.2 Public Keys

**Table 10 – Public Keys**

| Key | Description / Usage |
|---|---|
| RSA Firmware Load Key | RSA 2048 bit key used for firmware authentication |
| SSH-RSA Key | (RSA 2048-bit) Distributed to peer, used for SSH authentication |
| SSH Known Host Keys | (RSA 1024 and 2048-bit) Distributed to module, used to authenticate peer |
| IKE DH public key (g^a) | (2048-bit) Generated for IKE Phase 1 key establishment |
| IKE ECDH public key | (256/384-bit) Generated for IKEv1 Phase 1 key establishment |
| IKE DH phase-2 public (g^a) key | (2048–bit) Phase 2 Diffie-Hellman public keys used in PFS for key renewal (if configured) |
| IKE ECDH phase-2 public key | (256/384-bit) Phase 2 Elliptic Curve Diffie-Hellman public keys used in PFS for key renewal (if configured) |
| SSH DH Key | (2048-bit) Generated for SSH key establishment |
| PKI public key | (RSA 2048-bit or ECDSA 256/384-bit) Generated for IKEv1 authentication |

# 3 Roles, Authentication and Services

## 3.1 Assumption of Roles

The module supports seven distinct operator roles, Cryptographic Officer (Super User), Admin, Network Manager, User, MotoAdmin, MotoMaster, and MotoInformA/B. The cryptographic module enforces the separation of roles using Role-based authentication. Authentication as the Crypto Officer and Network Manager means also authentication as User role and allows to drop down to the User privilege level without a password.

Table 9 lists all operator roles supported by the module. The Module supports concurrent operators. Each operator has an independent session with the gateway, either though SSH (via the console), or over SNMPv3 (via Ethernet port) when specified. Once authenticated to a role, each operator can access only those services for that role. In this way, separation is maintained between the role and services allowed for each operator.

**Table 11 – Roles Description**

| Role ID | Role Description | Authentication Type | Authentication Data |
|---|---|---|---|
| Crypto-Officer (Super User) | The owner of the cryptographic module with full access to services of the module. | Role-based operator authentication. | Username and Password |
| Network Manager (NM) | An operator of the module with almost full access to services of the module. | Role-based operator authentication. | Username and Password |
| Admin | An assistant to the Crypto-Officer that has read only access to a subset of module configuration and status indications. | Role-based operator authentication. | Username and Password |
| User | A user of the module that has read only access to a subset of module configuration and status indications. | Role-based operator authentication. | Username and Password |
| MotoAdmin (MO) | A SNMPv3 user who can issue any command from the SNMP V3 User Manager menu. | Role-based operator authentication. | Passphrase |
| MotoMaster (MM) | A SNMPv3 user who can change its own passphrases from the SNMP V3 User Manager menu. | Role-based operator authentication. | Passphrase |
| MotoInformA/B (MI) | A SNMPv3 user who receives and transmits reliable messages over SNMPv3. | Role-based operator authentication. | Passphrase |

## 3.2 Authentication Methods

**Username and Password**

Passwords are alphanumeric strings consisting of 7 to 15 characters chosen from the 94 standard keyboard characters. The probability that a random attempt will succeed, or a false acceptance will occur is 1/94^7 which is less than 1/1,000,000. After three consecutive unsuccessful login attempts, an operator is locked out for two minutes, ensuring that that the probability is less than one in 100,000 per minute, that random multiple attempts will succeed, or a false acceptance will occur.

**Passphrase**

Each SNMPv3 user has its own pair of encryption and authentication passphrases. The SNMPv3 user authentication or encryption passphrase must be 8-64 characters long and may contain uppercase and lowercase alphabetic characters (A-Z) and (a-z); numeric characters (0-9); and any of the following special characters (! " % & " ( ) * + , - . /: ; < = > ?).

The probability that a random attempt will succeed, or a false acceptance will occur is 1/81^8 which is less than 1/1,000,000. The timing of the SNMPv3 authentication protocol as implemented limits the probability of randomly guessing a SNMPv3 passphrase in 60 seconds to less than 1 in 100,000. Assuming 1 ms for processing each authentication attempt, the probability that a false acceptance will occur in a one-minute period is 60000/81^8 = 3.24/10^11 and it is less than 1/10^5. One authentication attempt takes about 100 ms in real-life scenario.

## 3.3 Services

All services implemented by the Module are listed in the tables below. Each service description also describes all usage of CSPs by the service.

**Table 12 – Authenticated Services**

| Service | Description | CO | NM | Admin | User | MO | MM | MI |
|---|---|---|---|---|---|---|---|---|
| Firmware Update | Load firmware images digitally signed by RSA (2048 bit) algorithm | X | X | | | | | |
| Key Entry | Enter Pre-Shared Keys (PSK) | X | X | | | | | |
| User Management | Add/Delete and manage operator passwords | X | X | | | | | |
| Reboot | Force the module to power cycle via a command | X | X | | | | | |
| Zeroization | Actively destroy all plaintext CSPs and keys | X | X | | | | | |
| Crypto Configuration | Configure IPsec and FRF.17 services | X | X | | | | | |
| IKE | Key establishment utilizing the IKE protocol | X | X | | | | | |
| PKI | Peer to peer authentication for IKEv1 | X | X | | | | | |

|  |  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|
| IPSec Tunnel Establishment | IPsec protocol | X | X |  |  |  |  |  |
| FRF.17 Tunnel Establishment | Frame Relay Privacy Protocol | X | X |  |  |  |  |  |
| Alternating Bypass | Provide some services *with* cryptographic processing and some services *without* cryptographic processing | X | X |  |  |  |  |  |
| SSHv2 | For remote access to the gateway | X | X |  |  |  |  |  |
| Network Configuration | Configure networking capabilities | X | X |  |  |  |  |  |
| SNMPv3 | Network management, including traps and configuration | X | X |  |  | X | X | X |
| Enable Ports | Apply a security policy to a port | X | X |  |  |  |  |  |
| File System | Access file system | X | X |  |  |  |  |  |
| Authenticated Show Status | Provide status to an authenticated operator | X | X | X | X |  |  |  |
| Access Control | Provide access control for Crypto-Officer, Network Manager, Admin, and User | X | X | X | X |  |  |  |

**Table 13 – Unauthenticated Services**

| Service | Description |
|---|---|
| Unauthenticated Show Status | Provide the status of the cryptographic module – the status is shown using the LEDs on the front panel |
| Power-up Self-tests | Execute the suite of self-tests required by FIPS 140-2 during power-up (by Reboot service, or by physically power cycling the module) |

All Services available in FIPS Approved mode are also available in FIPS Non-Approved mode. The Approved mode is defined by the correct configuration.

Table 13 defines the relationship between access to CSPs and the different module services. The modes of access shown in the table are defined as:

- R = Read: The module reads the CSP. The read access is typically performed before the module uses the CSP.
- G = Generate: The module generates the CSP.
- E = Execute: The module executes using the CSP.
- W = Write: The module writes the CSP. The write access is typically performed after a CSP is imported into the module, when the module generates a CSP, or when the module overwrites an existing CSP.
- Z = Zeroize: The module zeroizes the CSP.

| CSP | Firmware Update | Key entry | User Management | IKE | PKI | IPsec tunnel establishment | FRF.17 tunnel establishment | SSHv2 | Reboot | Zeroization | Crypto Configuration | Network Configuration | SNMPv3 | Alternating Bypass | Enable Ports | File System* | Authenticated Show Status | Access Control |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| KEK | - | - | *E* | - | - | - | - | - | *E* | *Z* | *GE* | - | - | - | - | - | - | - |
| IKE Pre-shared Key | - | *W* | - | *E* | - | - | - | - | - | *Z* | *RW* | - | - | - | - | *REW* | *E* | - |
| PKI private key | - | - | - | *R* | *EG* | - | - | - | - | *Z* | - | - | - | - | - | *RW* | - | - |
| SKEYID | - | - | - | *EG* | - | - | - | - | *Z* | *Z* | - | - | - | - | - | - | - | - |
| SKEYID_d | - | - | - | *EG* | - | - | - | - | - | *Z* | - | - | - | - | - | - | - | - |
| SKEYID_a | - | - | - | *EG* | - | - | - | - | - | *Z* | - | - | - | - | - | - | - | - |
| SKEYID_e | - | - | - | *EG* | - | - | - | - | - | *Z* | - | - | - | - | - | - | - | - |
| Ephemeral DH Phase-1 private key (a) | - | - | - | *EG* | - | - | - | - | - | *Z* | - | - | - | - | - | - | - | - |
| Ephemeral ECDH Phase-1 private key | - | - | - | *EG* | - | - | - | - | - | *Z* | - | - | - | - | - | - | - | - |
| Ephemeral DH Phase-2 private key (a) | - | - | - | *EG* | - | - | - | - | - | *Z* | - | - | - | - | - | - | - | - |
| Ephemeral ECDH Phase-2 private key | - | - | - | *EG* | - | - | - | - | - | *Z* | - | - | - | - | - | - | - | - |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| IPsec Session Enc Key | - | - | - | *EG* | - | *E* | - | - | - | *Z* | - | - | - | - | - | - | - | - |
| IPsec Session Auth  Key | - | - | - | *EG* | - | *E* | - | - | - | *Z* | - | - | - | - | - | - | - | - |
| FRF.17 Session Enc Key | - | - | - | *EG* | - | - | *E* | - | - | *Z* | - | - | - | - | - | - | - | - |
| FRF.17 Session Auth Key | - | - | - | *EG* | - | - | *E* | - | - | *Z* | - | - | - | - | - | - | - | - |
| SSH-RSA Private Key | - | - | - | - | - | - | - | *EG* | - | *Z* | *EG* | - | - | - | - | *RW* | - | - |
| SSH Session Enc Key | - | - | - | - | - | - | - | *EG* | - | *Z* | - | - | - | - | - | - | - | - |
| SSH Session Auth Key | - | - | - | - | - | - | - | *EG* | - | *Z* | - | - | - | - | - | - | - | - |
| SSH DH Private Key | - | - | - | - | - | - | - | *EG* | - | *Z* | - | - | - | - | - | - | - | - |
| Passwords | - | - | *EW* | - | - | - | - | - | - | *Z* | - | - | - | - | - | *RW* | - | *E* |
| RADIUS Secret | - | - | - | - | - | - | - | - | - | Z | - | - | - | - | - | *RW* | - | EW |
| SNMPv3 Passphrase | - | - | *EW* | - | - | - | - | - | - | *Z* | - | - | *E* | - | - | *RW* | - | - |
| SNMPv3 Session Keys | - | - | - | - | - | - | - | - | - | - | - | - | *EGZ* | - | - | - | - | - |
| DRBG Seed | - | - | - | *EG* | - | - | - | - | - | *Z* | - | - | - | - | - | - | - | - |
| DRBG Internal State | - | - | - | *EG* | - | - | - | - | - | *Z* | - | - | - | - | - | - | - | - |

**Table** 14 **– CSP Access Rights within Services**

*For the “File System” service, access to all available keys is limited to the input and output of the ciphertext key block (encrypted with KEK) and password bank (hashed with PBKDF2) as well as on-module backup and restoration.

# 4 Self-tests

Each time the Module is powered up it tests that the cryptographic algorithms still operate correctly, and that sensitive data have not been damaged. Power up self–tests are available on demand by power cycling the module.

On power up or reset, the Module performs the self-tests described in Table 14 below. All KATs must be completed successfully prior to any other use of cryptography by the Module. If one of the KATs fails, the Module enters the error state. KAT failure is indicated by the Encryption LED being unlit when test fails. Device is not able to power up if self-test fails.

**Table 15 – Power Up Self-tests**

| Test Target | Description |
|---|---|
| Firmware Integrity | 16-bit CRC performed over all code in flash |
| AES (Hardware implementation) | KATs: Encryption, Decryption<br>Modes: CBC<br>Key sizes: 128 bits |
| AES (Firmware implementation) | KATs: Encryption, Decryption<br>Modes: ECB, CBC, CTR<br>Key sizes: 128, 192, 256 bits |
| DRBG | KATs: HASH DRBG<br>Security Strengths: 256 bits |
| DRBG Health Checks | Performed on power-up per SP 800-90A Section 11.3 - all health tests performed. |
| HMAC (Hardware implementation) | KATs: Generation, Verification<br>SHA sizes: SHA-1<br>Includes hardware SHA-1 KAT |
| HMAC (Firmware implementation) | KATs: Generation, Verification<br>SHA sizes: SHA-1, SHA-256, SHA-384, SHA-512<br>Performed independently for HMAC Cert. #C1721 and for HMAC Cert. #C1722 (SHA-1, SHA-256 only) |
| RSA | KATs: Signature Generation, Signature Verification<br>Key sizes: 2048 bits |
| ECDSA | KATs: Signature Generation, Signature Verification:<br>Curves: P-256, P-384 |
| SHA | KATs: SHA-1, SHA-256, SHA-384, SHA-512 |
| PBKDF2 | KATs: Password hash generation |

**Table 16 – Conditional Self-tests**

| Test Target | Description |
|---|---|
| NDRNG | NDRNG Continuous Test performed when a random value is requested from the NDRNG. |
| DRBG | DRBG Continuous Test performed when a random value is requested from the DRBG. |
| Firmware Load | RSA 2048 signature verification performed when firmware is loaded. |

| | |
|---|---|
| RSA Pairwise Consistency | Pair-wise consistency test for public and private key generation (RSA) |
| ECDSA Pairwise Consistency | Pair-wise consistency test for public and private key generation (ECDSA) |
| Bypass Test | Bypass Test performed when the service Alternating Bypass is called. |

## 5 Physical Security Policy

The Motorola GGM 8000 Gateway is composed of industry standard production-grade components. To meet FIPS 140-2 Level 2 requirements, the Motorola GGM 8000 Gateway must have the three (there is a 4th seal that is optional) tamper-evident seals applied as described in Section 10. It is the responsibility of the Crypto-Officer to maintain the tamper seals. The seals should be inspected for evidence of tamper every three (3) months. If evidence of tamper has been identified, the module should be considered compromised and Customer Service should be contacted for further instructions. The tamper-evident seals shall be installed for the module to operate in a FIPS Approved mode of operation. Please see Section 10 for specific instructions on installation of the tamper-evident seals.

Note: A FIPS label kit can be ordered by using part number CLN8787A, Rev. B

## 6 Operational Environment

The Module is designated as a limited operational environment under the FIPS 140-2 definitions. The Module includes a firmware load service to support necessary updates. New firmware versions within the scope of this validation must be validated through the FIPS 140-2 CMVP. Any other firmware loaded into this module is out of the scope of this validation and require a separate FIPS 140-2 validation.

The cryptographic module supports an alternating bypass mode. The following two independent actions are needed to activate bypass:

1. Using the Crypto Configuration service, the operator must disable encryption.

2. The user must apply that configuration to a virtual or physical port.

The module confirms the operator's decision by asking for confirmation, and the module checks the configuration file for valid configuration before entering bypass mode.

## 7 Mitigation of Other Attacks Policy

The Motorola GGM 8000 Gateway has not been designed to mitigate against other attacks outside the scope of FIPS 140-2.

## 8 Security Rules and Guidance

The Module design corresponds to the Module security rules. This section documents the security rules enforced by the cryptographic module to implement the security requirements of this FIPS 140-2 Level 2 module.

1. The Motorola GGM 8000 Gateway provides seven distinct operator roles: Crypto-Officer (Super User), Admin, Network Manager, User, MotoAdmin, MotoMaster, and MotoInformA/B. The Crypto-Officer role uses the Super User account.
2. The module shall provide role-based authentication.
3. The module shall clear previous authentications on power cycle.
4. When the module has not been placed in a valid role, the operator shall not have access to any cryptographic services.
5. The operator shall be capable of commanding the module to perform the power up self-tests by cycling power or resetting the module.
6. Power up self-tests do not require any operator action.
7. Data output shall be inhibited during key generation, self-tests, zeroization, and error states.
8. Status information does not contain CSPs or sensitive data that if misused could lead to a compromise of the module.
9. There are no restrictions on which keys or CSPs are zeroized by the zeroization service.
10. The module does not support a maintenance interface or role.
11. The module does not support manual key entry.
12. The module does not have any external input/output devices used for entry/output of data.
13. The module does not enter or output plaintext CSPs.
14. The module does not output intermediate key values.

The module is distributed to authorized operators wrapped in plastic with instructions on how to securely install the module. On initial installation, perform the following steps:

1. Power on the module and verify successful completion of power up self-tests from console port or inspection of log file. The following message will appear on the console interface: "power-on self-tests passed".
2. Authenticate to the module using the default operator acting as the Crypto-Officer with the default password and username.
3. Verify that the Hardware and Firmware P/Ns and version numbers of the module are the FIPS Approved versions.
4. Configure the module as described in Section 1.2.

The module supports a minimum password length of 7 characters and a maximum length of 15 characters. The Crypto-Officer controls the minimum password length through the **PwMinLength** parameter: **SETDefault -SYS PwMinLength = <length>**, where **<length>** specifies the minimum length.

The Zeroization Service should also be invoked to zeroize all CSPs prior to removing a gateway from service for repair.

# 9 References and Definitions

The following standards are referred to in this Security Policy.

**Table 17 – References**

| Abbreviation | Full Specification Name |
|---|---|
| [FIPS140-2] | *Security Requirements for Cryptographic Modules*, May 25, 2001 |
| [SP800-131A] | *Transitions: Recommendation for Transitioning the Use of Cryptographic Algorithms and Key Lengths*, March 2019 |

**Table 18 – Acronyms and Definitions**

| Acronym | Definition |
|---|---|
| AES | Advanced Encryption Standard |
| CA | Certificate Authority |
| CBC | Cipher Block Chaining |
| CLI | Command Line Interface |
| CSP | Critical Security Parameter |
| CSR | Certificate Signing Request |
| CTR | Counter |
| DES | Data Encryption Standard |
| DH | Diffie-Hellman |
| DRBG | Deterministic Random Bit Generator |
| DSA | Digital Signature Algorithm |
| ECB | Electronic Codebook |
| ECC | Elliptic Curve Cryptography |
| ECDH | Elliptic Curve Diffie-Hellman |
| ECDSA | Elliptic Curve Digital Signature Algorithm |
| ESP | Encapsulating Security Payload |
| FRF | Frame Relay Forum |
| FRF.17 | Frame Relay Privacy Implementation Agreement |
| FRPP | Frame Relay Privacy Protocol |
| HMAC | Hash Message Authentication Code |
| IKE | Internet Key Exchange |
| IP | Internet Protocol |
| IPsec | Internet Protocol Security |
| KAS | Key Agreement Scheme |
| KAT | Known Answer Test |
| KDF | Key Derivation Function |
| KEK | Key Encrypting Key |
| MNR | Motorola Network Router |
| NDRNG | Non-Deterministic Random Number Generator |
| OSPF | Open Shortest Path First |

| | |
|---|---|
| PBKDF | Password-based Key Derivation Function |
| PFS | Perfect Forward Secrecy |
| PIM | Protocol Independent Multicast |
| PKI | Public Key Infrastructure |
| PSK | Pre-Shared Key |
| RNG | Random Number Generator |
| RSA | Rivest, Shamir and Adleman |
| SHA | Secure Hash Algorithm |
| SSH | Secure Shell |
| SNMP | Simple Network Management Protocol |
| Tanapa | The part number that is built and stocked for customer orders |

# 10 GGM 8000 Gateway Tamper Evidence Seal Installation Instructions

Each tamper-evident seal consists of two (2) separate seals placed one over the other. The top seal is a larger clear branding seal that is placed over and completely overlaps the bottom silver adhesive seal which is slightly smaller. These two seals are bonded at production as one seal with a kraft liner that covers the glue on the bottom of the bonded seal. Removing the applied seal, the large seal will peel off from the smaller seal and destroy the whole seal.

Follow these steps to install  tamper-evident seals on the GGM 8000 Gateway: The surface to which the seals will be attached must be at a temperature of at least +10°C (+50°F), and the surface must be clean and dry. Clean any grease, dirt, oil, or adhesive residue from the areas to which the seals are to be attached before applying the tamper-evident seals. If you are replacing tamper-evident seals (after a repair, for example), remove the old seals and any adhesive residue with isopropyl alcohol (99% concentration) prior to applying the new seals.

1. Wipe the surface clean with isopropyl alcohol (99% concentration) to remove surface contaminants. Please note that using a solution with an isopropyl alcohol concentration less than 99% is not acceptable
2. **Do not allow excess alcohol to air dry.** Use a clean paper towel or cotton cloth to completely remove any excess alcohol, thereby removing any residual contaminants.
3. Apply tamper evidence seals #1, #2, and #3 (optional) to secure the GGM 8000 base module and blank filler panel on the front of the chassis.

   Do not push seals #1, #2, and #3 all the way up under the top cover overhang or tuck the seals into the gap between the front panel and the top cover overhang). As shown in Detail A in Figure 2 the seals should come out at approximately a 45 degree angle from where they are affixed to the front panel to where they wrap around and over the top cover.

   a) Remove the Kraft liner from the back of seal 1 and attach the seal as illustrated in Figure 2 (GGM 8000 base unit (base module and blank filler panel)) Center the silver portion of the seal between the rightmost cooling hole and the Encrypt, Run, Load, and Test LEDs, with the Motorola logo on the seal lined up with the top of the Load LED. Starting from the short edge of the seal that is positioned on the front panel, affix the seal by applying pressure while pushing the seal up the front panel and onto the top cover.

b) Remove the Kraft liner from the back of seal 2 and attach the seal as illustrated in Figure 2 (GGM 8000 base unit (base module and blank filler panel)). Position the Motorola logo edge of the seal directly above the top edge of connector “5B” with the left edge of the clear portion of the seal aligned with the edge of the thumbscrew. Starting from the short edge of the seal that is positioned on the front panel, affix the seal by applying pressure while pushing the seal up the front panel and onto the top cover.

   Note: Seal 3 is optional and is not required for a FIPS-approved configuration. The additional tamper evidence seal provides additional tamper evidence beyond the module cryptographic boundary.

c) Remove the Kraft liner from the back of seal 3 and attach the seal as illustrated in Figure 2.

   Position the seal approximately in the middle of the blank panel with the perforation between the “T” and the “O” aligned with the edge of the top cover. Starting from the short edge of the seal that is positioned on the front panel, affix the seal by applying pressure while pushing the seal up the front panel and onto the top cover.

d) Rub the seals on the front and top of the chassis for two (2) seconds to ensure that the seals have adhered.

4. Apply tamper evidence seal 4 to secure the GGM 8000 power supply module on the rear of the chassis. Note: These instructions apply to a GGM 8000 equipped with either an AC or a DC power supply module.

   a) Remove the Kraft liner from the back of seal #4 and position the seal as illustrated in Figure 3. Note: Figure 3 illustrates the seal placement for the AC power supply module. The seal placement for the DC power supply module is the same. Position the Motorola logo edge of the seal directly above the mounting screw, with the right edge of the silver portion of the seal aligned with the right edge of the power supply module. Starting from the short edge of the seal that is positioned on the rear panel, affix the seal by applying pressure while pushing the seal up the rear panel and onto the top cover.

   b) Rub the seal on the top and rear of the chassis for 2 seconds to ensure that the seal has adhered.

5. Secure the unit in a restricted area.

6. Allow the applied seals to cure for at least 4 hours; do not touch the seals during this time.

If you need to re-apply the tamper evidence seals to the GGM 8000, repeat steps 1-6.

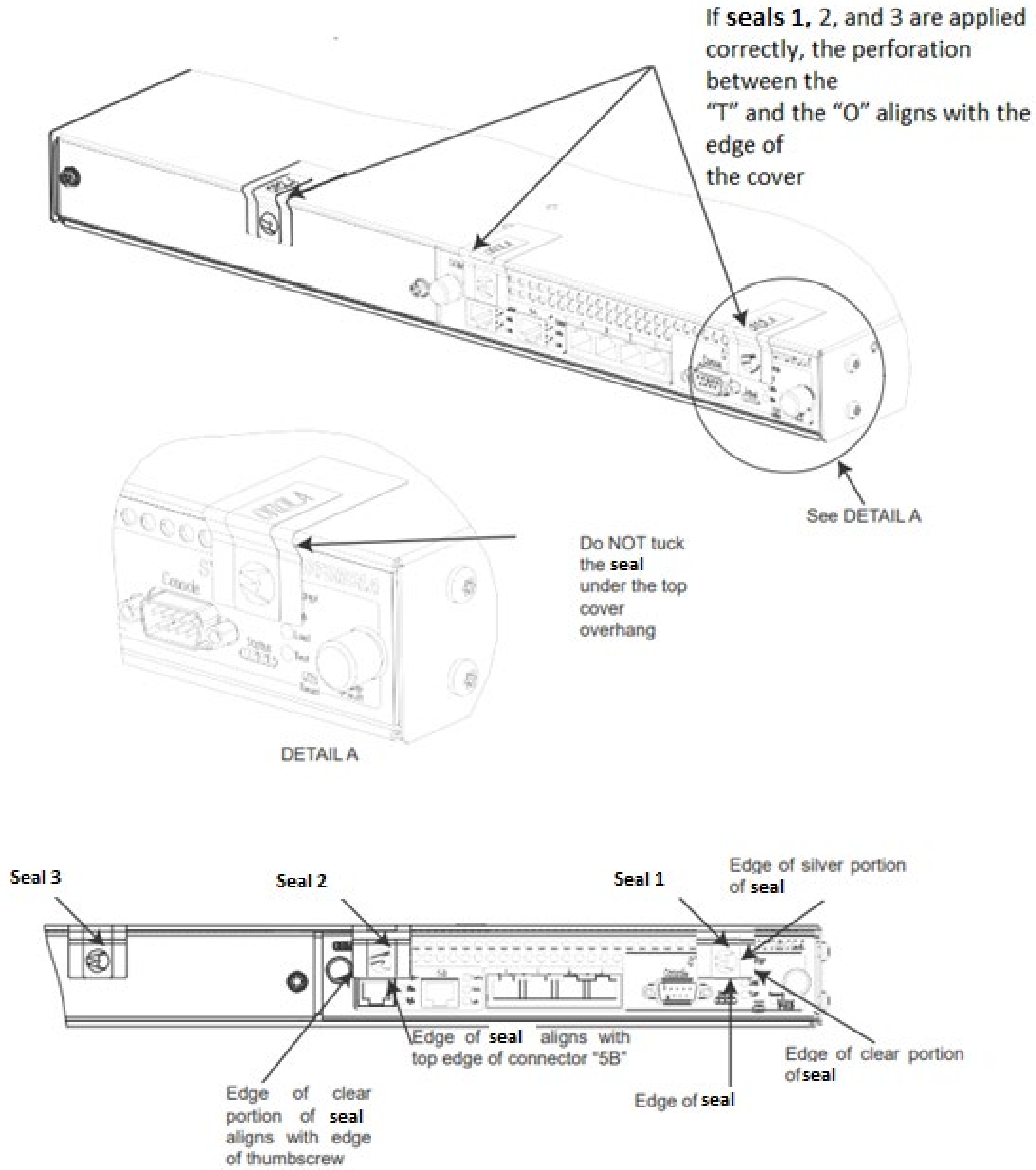
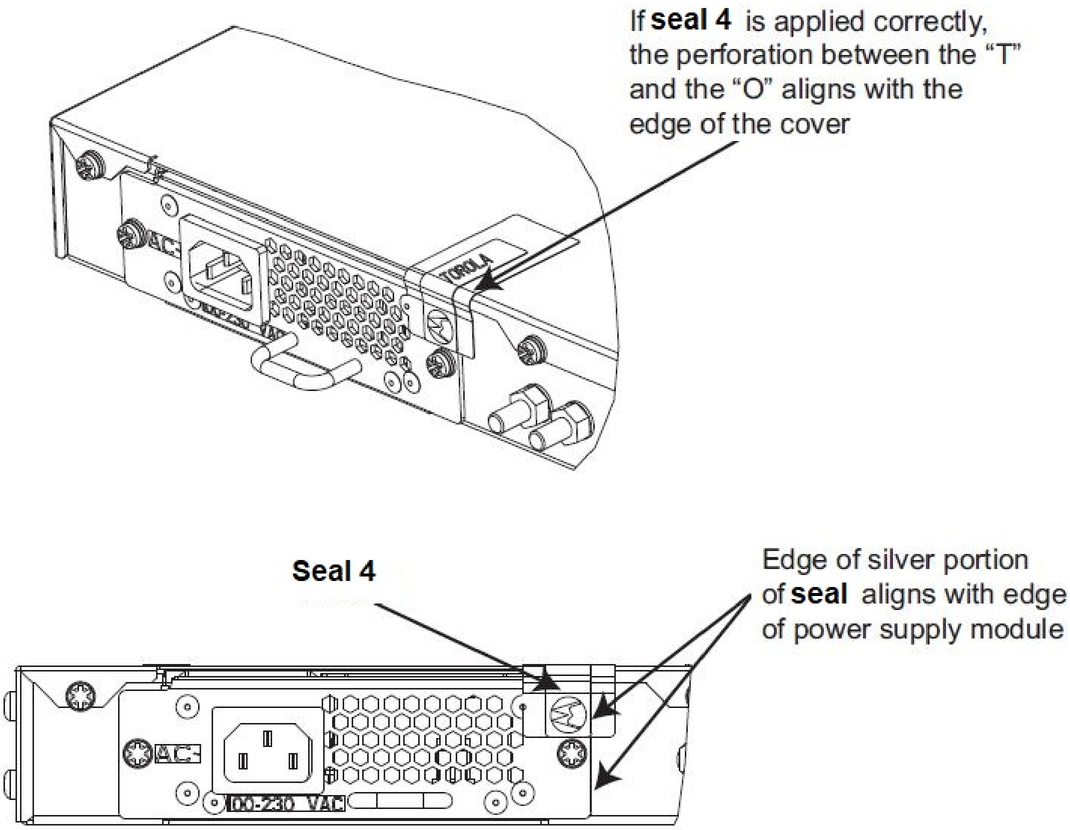

If seals 1, 2, and 3 are applied correctly, the perforation between the
"T" and the "O" aligns with the edge of
the cover
See DETAIL A
Do NOT tuck the seal under the top cover overhang
Console
DETAIL A
Seal 3
Seal 2
Seal 1
Edge of silver portion of seal
Edge of seal aligns with top edge of connector "5B"
Edge of clear portion ofseal
Edge of seal
Edge of clear portion of seal aligns with edge of thumbscrew

**Figure 2: Applying Seals 1, 2 and 3 to Secure the GGM8000 Base Unit**



If **seal 4** is applied correctly, the perforation between the "T" and the "O" aligns with the edge of the cover

**Seal 4**

Edge of silver portion of **seal** aligns with edge of power supply module

**Figure 3: Applying Seal 4 to Secure the Power Subsystem Module**