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# ***User HSM Installation and Setup***

***User Guide***

***For Libero SoC v11.7 SP1***



**Power Matters.™**

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# Introduction

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This User Guide provides installation and setup instructions for the User HSM (U-HSM) Server. The U-HSM server is configured to generate HSM jobs. The U-HSM server can generate jobs for the following scenarios:

- Test-execution of the job on the same U-HSM server utilizing the Manufacturer HSM Server (M-HSM) function of U-HSM.
- Job execution is done on the contract manufacturer side using M-HSM.
- Job execution is done by the Secure In-house Programming Solution (SIHP).

Refer to the [Secure Production Programming Solution \(SPPS\) User Guide](#) for information about the scenarios above and a description of the HSM flow.

This User Guide contains the following chapters:

Chapter 1, "[U-HSM Server](#)", describes the U-HSM server components and system requirements.

Chapter 2, "[U-HSM Installation and Setup Scenarios](#)", provides a general description of the installation scenarios.

Chapter 3, "[Initial U-HSM Server Installation and Setup](#)", explains the installation and setup process.

Chapter 4, "[U-HSM Reconfiguration and Post-Installation Actions](#)", provides instructions for the setup and maintenance actions that can be performed on an installed and provisioned U-HSM server.

Chapter 5, "[U-HSM Server Replication](#)", explains how to replicate an existing U-HSM server to one or more new U-HSM servers.

For installation and setup instructions for the Contract Manufacturer HSM (M-HSM), refer to the [Manufacturer HSM Installation and Setup Guide](#).

## Referenced Documents

This User Guide references the following documents:

- [Secure Production Programming Solution \(SPPS\) User Guide](#) (Microsemi SOC)
- [Programming Job Manager User Guide](#) (Microsemi SOC)
- [FlashPro Express User's Guide](#) (Microsemi SOC)
- [Libero User's Guide](#) (Microsemi SOC)
- [nShield Edge and Solo User Guide for Windows](#) (Thales)
- [Manufacturer HSM Installation and Setup Guide](#) (Microsemi SOC)

# 1 – U-HSM Server

The U-HSM server is used to generate programming jobs and securely send them for execution to a contract manufacturer or Secure In-house Programming Solution (sIHP) system. Test-execution of the HSM job can be done using the M-HSM function of the U-HSM server.

The U-HSM server is designed to serve requests from the Job Manager Tool which, once the U-HSM server is up and running, needs to be configured to work with it. Refer to the [Programming Job Manager User Guide](#) for more information.

## Server Components

Figure 1-1 shows the components of the U-HSM server.

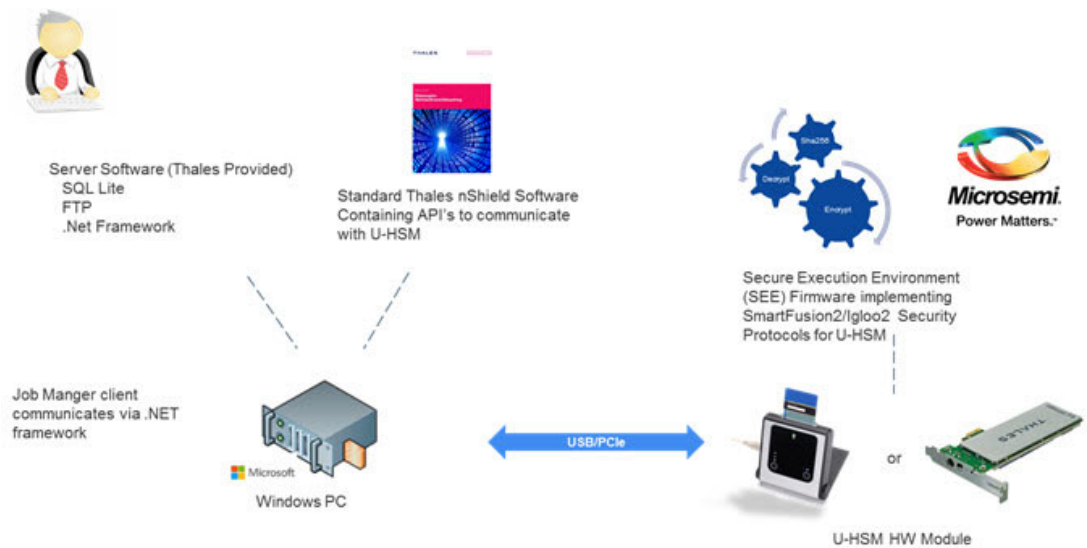


Figure 1-1 • U-HSM Server Components

## Security World and HSM Modules

The most important component of the U-HSM server is the HSM module. The HSM module carries out cryptographic operations involving protected security keys. All data is stored outside the module on the disk of the host system in encrypted form. Every module is associated with the Security World (see the *nShield Edge and Solo User Guide for Windows*) that combines a set of keys giving module access to the information in the database located on the PC side. The same Security World can be replicated to multiple HSM servers, if needed. The HSM module is controlled via standard Thales nShield software that includes hardware drivers and low level components providing access to the services inside the module. Custom SEE firmware (algorithms related to the protocols implemented in Microsemi devices) and known as the SEE Machine is stored on the disk of the host PC, and is loaded into the module as part of the power up process.

## HSM Module Types

Microsemi is the official redistributor of nShield Edge (Figure 1-2) and nShield Solo HSM Modules (Figure 1-3).

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**Figure 1-2 • Thales nShield Edge HSM Module**

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**Figure 1-3 • nShield Solo PCIe HSM Module**

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The nShield Edge module is attached to USB 2.0 port of the PC and has an integrated card reader. The nShield Solo module is PCIe-based and requires a desktop PC with a spare PCIe port. The card reader is attached to the module via cable.

**Note:** For the HSM module specification, including performance characteristics, refer to the *nShield Edge and Solo User Guide for Windows*.

## Security World Cards

Both types of HSM modules are shipped with the nShield Security World cards (Figure 1-4) that can be used to create an Administrator Card Set (ACS). The ACS provides access to the administrative functions of the Security World:

- Control access to Security World configuration
- Authorize recovery and replacement operations

ACS cards are initialized upon creation of the Security World.

---



**Figure 1-4 • Example of nShield Security World Card**

**Note:** There is a special requirement regarding total and quorum numbers of ASC cards. Refer to the *nShield Edge and Solo User Guide for Windows* for more information.

## Activator Card and Feature Licensing (Thales)

The Activator Card (Figure 1-5) enables HSM Module product features and is generated along with the license purchase. Installation instructions in this document show how to use this type of card.

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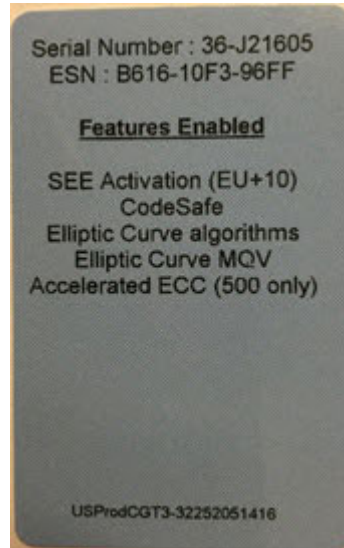


**Figure 1-5 • Example of Activator Card**

This card is linked to the specific hardware module and must match the module serial number (see [Figure 1-6](#)). The "Serial Number" field shown on the back of the card should match the Serial Number of the module.

All features that can be enabled by this card are listed on the back of the card.

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**Figure 1-6 • Back of the Activator Card**

**Note:** In addition to Activation Cards, licensing features can be enabled using a file on disk or by entering an initialization bitstream from the keyboard. Additional licensing features can be added to the module later via a separate PO process.

## Module Warrant File (Thales)

Every nShield HSM Module comes with a warrant file generated by Thales. This file provides cryptographic proof of module origin (explained in the key management section of the [Secure Production Programming Solution \(SPPS\) User Guide](#)). The warrant file is provided via the HSM Module purchase process.

## HSM Module License File (Microsemi)

Microsemi provides a Microsemi-generated license file that binds the user-created Security World with one or more HSM modules through their serial numbers.

## System Requirements

The U-HSM server can run on Windows 7 x64 Pro or Windows 8.1 x64 operating systems. Server software is installed on a dedicated physical machine with one nShield Edge or Solo HSM module attached.

**Note:** It is possible to use a virtual machine to run HSM server. However, Microsemi has only validated U-HSM server functionality on the nShield Edge module using a VMWare virtual machine. Validation was performed using the Thales-suggested method of connecting the Edge module directly to the host system and then giving the virtual machine module access via a virtual COM interface added to the host system by the module driver. See the *nShield Edge and Solo User Guide for Windows* for setup instructions.

## Acquire the U-HSM Components

HSM hardware modules are purchased directly from Microsemi. Every module comes with the components described in "Security World and HSM Modules" on page 4.

The following is a list of the U-HSM components. Figure 1-7 provides a high level flow view:

1. nShield Edge or Solo HSM Module
  - Module
  - Card Reader (Solo module only. Edge module has integrated card reader)
  - Mounting hardware for regular and compact desktop form factors (Solo module only)
  - Set of Security World cards
  - Activator Card (additional licensing features can be provided in a separate file)
2. Warrant File (created by Thales, supplied by Microsemi)
3. Licensing File (created and provided by Microsemi after a Security World UUID is issued)
4. User provides PC with supported operating systems installed (see "System Requirements" on page 7)
5. U-HSM Installation Utility (download from Microsemi website)
  - Third party software prerequisite packages
  - Thales nShield standard software
  - U-HSM Server Software, including SEE Machine images

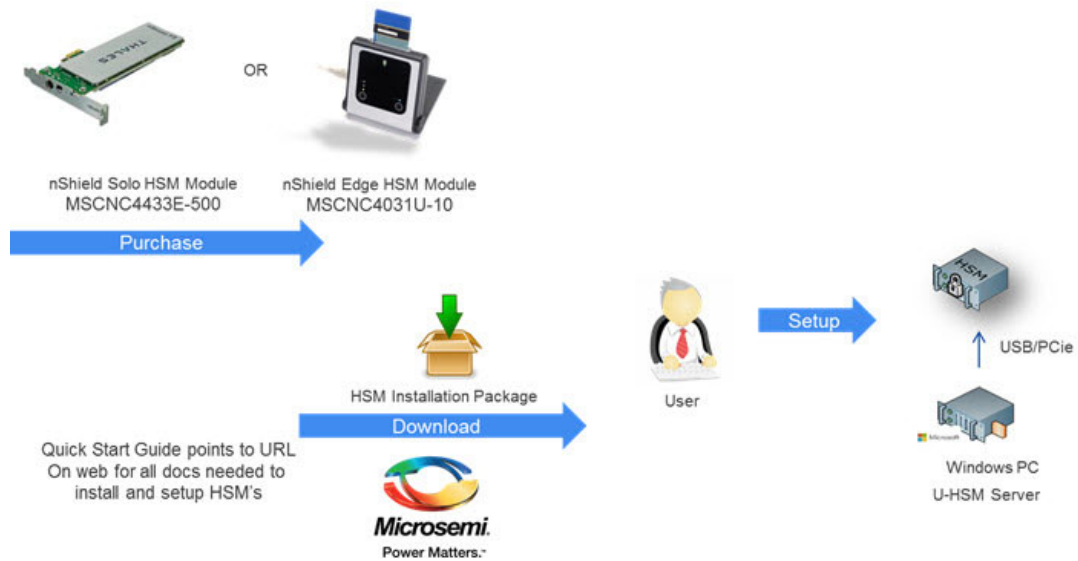


Figure 1-7 • Acquiring U-HSM Parts



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## 2 – U-HSM Installation and Setup Scenarios

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This User Guide describes the following installation and setup options:

### 1. Initial installation

- a. Install all required software components.
- b. Update all required configuration files.
- c. Install the HSM module.
- d. Provision the U-HSM server.
  - Create new Security World and Administrator Card Set (ACS).
  - Generate all required keys.
  - Exchange public keys with M-HSM or sIHP server and send public key to the Microsemi MFG server.
  - Import Diversified Factory Key Database (DFK DB) (see the [Secure Production Programming Solution \(SPPS\) User Guide](#) for information about DFK DB) and the MFG keys received from Microsemi.
  - If job execution is done with the help of a contract manufacturer, prepare DFK DB and MFG keys for use by M-HSM.

### 2. Replication of the existing U-HSM server (creates a copy of already provisioned U-HSM server)

- a. Install all required software components.
- b. Copy Security World from the source U-HSM server.
- c. Copy the U-HSM server software.
- d. Copy the existing DFK DB.
- e. Install and connect an HSM module to the Security World new HSM module.

### 3. Post-installation (maintenance) steps

- a. Upgrade the HSM Module Firmware.
- b. Replace the HSM module.
- c. Import the public key of an M-HSM.
- d. Export the public key for sending to an M-HSM.
- e. Prepare the DFK DB for sending to an M-HSM.

---

## 3 – Initial U-HSM Server Installation and Setup

---

This chapter describes how to install and set up a new U-HSM server.

**Note:** Text highlighted in red in this chapter indicates commands or other information to take note of.

### Software Installation

U-HSM server software installation is normally done using the Microsemi U-HSM installation utility. This section explains the manual installation process.

One of the supported operating systems must be installed with all security and stability updates applied.

1. Microsoft Visual C++ 2010 Redistributable Package (x64) [available from Microsoft](#)
2. Visual C++ Redistributable for Visual Studio 2012 (x64) [available from Microsoft](#)
3. .NET Framework 4.0 or up [available from Microsoft](#)
4. FTP Server (e.g. [FileZilla](#))
5. Java Runtime 2 [available from Oracle](#)
6. Latest version of the nShield Security World Software (coming with the HSM modules).
  - The installation disk contains a folder with documentation in PDF format.
  - Installation of SNMP client can be ignored as the software for this implementation does not use it.
  - The default installation directory for the Security World is C:\Program Files (x86)\nCipher\ncfast.
  - All Security World utilities referred to in this guide are located in %NFAST\_HOME%\bin.
  - The Microsemi SPPS solution is tested against the specific version of the Security World. Refer to the U-HSM server Release Notes for the compatible version number.

### U-HSM Server Software Installation

1. Create the top level directory.  
*Note:* This User Guide uses C:\Microsemi as an example
2. Unpack all files and subdirectories from the provided zip file under the *U-HSM* directory and copy to C:\Microsemi.
3. Verify that the following additional subdirectories exist:
  - C:\Microsemi\DFKDB - This location will be used for storing imported DFK databases
  - C:\Microsemi\JobDB - This location will store job ticket database files
  - C:\Microsemi\JobDB\JobDBArchive - Folder for archiving completed job ticket database files
  - C:\Microsemi\Logs - For log files

### HSM Hardware Module Installation

**Note:** This section provides the steps to connect a new HSM module to the PC. If you are replacing the HSM module on a configured U-HSM server, start from "HSM Module Replacement" on page 35. If you are replicating the U-HSM server, refer to "Set Up a New HSM Module" on page 35.

The U-HSM server requires the presence of a single HSM module. After the installation of nShield software, as shown in "Software Installation" on page 10, the system should have module drivers and all nShield utilities installed.

## Connect the HSM Module to the PC

Follow the instructions in the *nShield Edge and Solo User Guide for Windows* to physically connect the module to the PC.

Once the module is connected, read module status with the `nfkminfo` utility. The output of `nfkminfo` shows information about the attached module, such as ESN (serial number), status, etc. If the module is not detected or in the "failed" state, restart the `nfast` server and read the module status again:

```
net stop "nfast server"
```

```
net start "nfast server"
```

**Note:** If necessary, the HSM module can be erased to the factory state using the `new-world` command. *Example:* `new-world -e -m1` erases the module with the ID=1 to the factory state. This operation is done in the pre-initialization mode.

## Upgrade HSM Module Firmware

This section provides instructions for Thales firmware upgrade. This firmware physically resides inside the HSM module and is different from the Microsemi-provided SEE machine.

### ***Firmware Revisions***

The firmware revision of the HSM module that is used in SPPS must be approved by Microsemi. The list of the approved firmware revisions is available in the U-HSM Release Notes. Additional instructions about firmware revisions may be published via Microsemi security advisories.

**Note:** **Any HSM firmware revision that is not approved by Microsemi is not guaranteed to work and is not guaranteed to satisfy security requirements of the SPPS solution. The use of such firmware revisions is done at customer's own risk.**

Thales HSM module firmware images are available in the HSM Installation media, or can be obtained directly from Thales customer service.

**Note:** Installation media may include various versions of the firmware that may be FIPS certified or awaiting FIPS certification. Your choice depends on the security policies of your organization.

### ***Compatibility of Firmware Revisions***

**Warning!** The firmware upgrade may be non-reversible. Read this section for important details.

Thales HSM module firmware has two versioning characteristics:

- Firmware revision number
- Version Security Number (VSN)

The firmware revision number identifies the individual version of the firmware, while the VSN can group multiple revisions together and is used to restrict revision downgrade, so that intruders cannot move a module to the firmware with known security issues. The downgrade is possible to any firmware revision with the same VSN as the one in the module. The upgrade can be done to any revision with the same or higher VSN number.

Information about firmware revisions and their respective VSN numbers is available on the Security World installation media of firmware upgrade media distributed as part of Thales security advisories.

### ***Read the HSM Module Firmware Revision Info***

The current revision of the HSM firmware can be checked using the "enquiry" Security World utility.

An example of reading the firmware revision number is shown in [Figure 3-1](#).

---

```

Module #1:
enquiry reply flags none
enquiry reply level Six
serial number 1301-C8A9-BEF7
mode operational
version 2.55.1
speed index 544
rec. queue 19..152
level one flags Hardware HasTokens
version string 2.55.1cam7 built on Jul 08 2015 14:24:15
checked in 000000004856847b Mon Jun 16 08:19:23 2008
level two flags none
max. write size 8192
level three flags KeyStorage
level four flags OrderlyClearUnit HasRTC HasNVRAM HasNSOPermsCmd ServerHasPollCmds
FastPollSlotList HasSEE HasKLF H
asShareACL HasFeatureEnable HasFileOp HasPCIPush HasKernelInterface HasLongJobs ServerHasLongJobs
AESModuleKeys NTokenCm
ds JobFragmentation LongJobsPreferred Type2Smartcard ServerHasCreateClient HasInitialiseUnitEx
module type code 7
product name nC1003P/nC3023P/nC3033P
device name #1 PCI bus 6 slot 5
EnquirySix version 6
impath kx groups DHPrime1024 DHPrime3072
feature ctrl flags LongTerm
features enabled GeneralSEE StandardKM
version serial 26
rec. LongJobs queue 18
SEE machine type PowerPCSXF
supported KML types DSAP1024s160 DSAP3072s256

```

---

**Figure 3-1 • Reading HSM Module Firmware Revision**

## ***Upgrade Firmware***

This section provides general guidance for the firmware update. If the firmware upgrade is done due to a Microsemi security advisory, please follow the instructions in the advisory. General description of the upgrade process and instruction for switching HSM module into specific mode is available in the *nShield Edge and Solo User Guide for Windows*.

**Note:** The firmware upgrade process erases all information contained in the module, except the enabled licensing features explained in ["Enable the Module Licensing Feature" on page 13](#).

### **Step 1**

Switch the module mode to the "maintenance" mode.

To switch the nShield Edge module to maintenance state, use the Mode button to change mode to the "M" (maintenance mode) and then push and hold down the "Clear" button to activate the "M" state.

The mode switching on the Solo HSM module is done by moving the three-position switch to the "M" state and resetting the module using a paper clip. Both module controls are located on the Solo module and are accessible outside the PC box.

For more detailed mode switching instructions, refer to the *nShield Edge and Solo User Guide for Windows*.

### **Step 2**

Load the new firmware using the "loadrom" command, pointing to the firmware image.

**Note:** When entered, the "loadrom" command starts without prompting for user confirmation.

An example of the output during firmware upgrade is shown in Figure 3-2.

---

```
C:\>loadrom -ml C:\shared\FWUpgrade\firmware\2-55-1\ncxlz-26.nff

 version 2.50.16cam18 built on Sep 23 2010 20:36:19
programming module #1
module erased
starting programming *+
firmware integrity mech. DSAhSHA256
module accepted signature
block size allowed by unit 1910, using 1910
loading chunk 0 ++++++ programming done
loading chunk 1 ++++++ programming done
loading chunk 2 ++++++ programming done
loading chunk 3 ++++++ programming done
loading chunk 4 ++++++ programming done
loading chunk 5 ++++++ programming done
loading chunk 6 ++++++ programming done
loading chunk 7 ++++++ programming done
loading chunk 8 ++++++ programming done
loading chunk 9 ++++++ programming done
loading chunk 10 ++++++ programming done
loading chunk 11 ++++++ programming done
programming done
```

---

**Figure 3-2 • Firmware Upgrade**

### Step 3

Switch module mode to the "pre-init" mode.

### Step 4

Initialize the module using the "initunit" command:

---

```
C:\>initunit
Initialising Unit 1 (SetNSOPerms)
Setting dummy HKNSO
Module Key Info:
HKNSO is:C8 39 AC 0D EE D9 A9 65 AC F9 12 0F F2 02 F9 79 8C 2C A4 5D
HKM[0] is:FD 2D 47 53 86 05 CF F4 27 53 1A 01 FD 8D E8 02 00 DD C7 55
```

---

**Figure 3-3 • Module Initialization during firmware upgrade**

### Step 5

Confirm module firmware revision is upgraded as expected using the "enquiry" command.

## Enable the Module Licensing Feature

This section shows how to enable specific HSM module features.

**Note:** To activate new license features using the fet utility, the module must be switched to the pre-initialization mode.

To run custom firmware created for the SPSS system (SEE Machine), the module must have the "SEE Activation (EU+10)" feature enabled as shown in the sample in [Figure 3-4](#). Feature status of the module can be checked or activated using fet (feature enabling tool).

```
C:\>fet

                                Feature Enable Tool
                                =====

                                payShield Activation
                                | ISO Smart Card Support
                                | | Remote Operator
                                | | | Korean Algorithms
                                | | | | SEE Activation (EU+10)
                                | | | | SEE Activation (Restricted)
                                | | | | CodeSafe SSL
                                | | | | | Elliptic Curve algorithms
                                | | | | | | Elliptic Curve MQV
                                | | | | | | Accelerated ECC
Mod   Electronic | | | | | | | | | |
No.   Serial Number
    1  586F-B963-9146 -- NO NO NO NO YES NO NO NO NO NO

0. Exit Feature Enable Tool.
1. Read FEM certificate(s) from a smart card or cards.
2. Read FEM certificate from a file.
3. Read FEM certificate from keyboard.
4. Write table to file.

Enter option :
```

**Figure 3-4 • Sample output of the Feature Activation Tool**

Choose option #1 and activate the features listed on your Activator Card (see ["Activator Card and Feature Licensing \(Thales\)" on page 6](#)). The feature activating tool auto-detects the card and performs activation. New activation status is printed on the screen.

If your Activator Card did not include the "SEE Activation (EU+10)" feature, it may have been provided to you in a separate file. The file name includes the module serial number, for example:

*USProdCGT3-01253481317\_SEEUE\_8FD6-2609-F7A2.txt*

This file can be used during activation independently from the Activator Card by selecting option #2.

**Note:** Erasing a module to the factory settings does not remove licensing features enabled using the fet tool. Licensing feature reset can only be done at the factory.

## U-HSM Server Provisioning

### Create the Security World

Security World is created with the new-world utility documented in the *nShield Edge and Solo User Guide for Windows*. The module must be moved to the pre-initialization mode.

The example shown in [Figure 3-5](#) creates a new Security World:

- i Creates a new Security World.
- m Specifies ID of the physical HSM module to be added to the Security World.
- Q Specifies the minimum number of smart cards needed from the ACS to authorize a feature and the total number of smart cards to be used in the ACS. This example has a total of two cards, with only one card needed to authorize a feature.
- c Tells the utility what type of key to use for the new Security World. This example uses the 1024 bit AES key. Options should be considered based on desired security strength.

During creation of the Security World, the user is prompted to insert and initialize all ACS cards specified by the -Q option.

---

```
C:\Microsemi\Tools>new-world -i -m 1 -Q 1/2 -c DLf1024s160mRijndael dseeall

Create Security World:
Module 1: 0 cards of 2 written
Module 1 slot 0: empty
Module 1 slot 0: unknown card
Module 1 slot 0:- no passphrase specified - overwriting card
Module 1: 1 card of 2 written
Module 1 slot 0: remove already-written card #1
Module 1 slot 0: empty
Module 1 slot 0: unknown card
Module 1 slot 0:- no passphrase specified - overwriting card
Card writing complete.

security world generated on module #1; hknso = 15d0780e37252b3a1d8bf339a9bd6d779d1991bc
```

---

### Figure 3-5 • Sample output from creation of new Security World

**Tip:** The values of the hknso parameters can be used to uniquely identify the Security World.

**Tip:** If the module is not in the pre-initialization state, creation of the Security World may encounter an error, as shown in [Figure 3-6](#).

---

```
12:46:57 WARNING: Module #1: Module has failed
new-world: module 1 not suitable: module key type Rijndael not supported
new-world: Aborting world operation.
```

---

### Figure 3-6 • Error message if module is not in pre-initialization state

The new Security World is a file that is created in the following location: %NFAST\_KMDATA%\local

**Note:** This location also contains all other related security keys.

Once the Security World is created, the module should be moved to the operational mode.

### ***Read the Status of the Security World***

The status information related to the existing Security World and attached module(s) can be viewed using the nfkmfinfo utility. Refer to the *nShield Edge and Solo User Guide for Windows* for more information.

To use this and most of the commands listed in the sections below, the module must be in the operational mode.

[Figure 3-7](#) shows sample output of the nfkmfinfo utility.

This status information contains several important fields. The *hknso* and *hkm* fields allow the user to uniquely identify the specific Security World.





Example: copy C:\Microsemi\SEE\key\_seeinteg\_userdata-signer %NFAST\_KMDATA%\local

Proper installation of the SEE Signer Key can be confirmed using the "nfkminfo -k" command, as shown in Figure 3-8.

---

```
C:\Program Files (x86)\nCipher\nfast\bin>nfkminfo -k
```

```
Key list - 1 key
  AppName seeinteg          Ident userdata-signer
```

---

**Figure 3-8 • Confirming correct installation of the SEE Signer key**

### **Get Hash of the SEE Integ Key**

The hash of the signer key is used for key identification and referencing key signer during various operations such as creation of the HSM private/public key pairs.

The hash value of the key signer can be retrieved using nfkminfo:

```
nfkminfo -k seeinteg userdata-signer | find "hash"
```

See the example below:

---

```
hash          72ae19963f2f9a88e49babb09ffb039328c94f3a
```

---

## **Create NVRAM-based Storage in the HSM Module**

This step uses the nvram-sw utility to create an internal flash-based storage file for ticket processing and other tasks that must keep certain information inside the physical module (i.e., make them physically uncloneable). The example in Figure 3-9 shows output during NVRAM creation.

To run this action:

- The module must be in the operational mode.
- The ACS (admin) card must be inserted into the card reader.

Enter the following command to create NRAM:

```
nvram-sw.exe -a -b 8096 -n udsigner -k seeinteg,userdata-signer
```

The -b parameter specifies memory size. The value of 8096 specifies partition size. This value is fixed in the current version of the U-HSM server.

**Note:** The -k parameter must follow the exact format: comma separated values with no spaces.

---

```
C:\>nvram-sw.exe -a -b 8096 -n udsigner -k seeinteg,userdata-signer
Load Admin Card (for KNV):
  Module 1 slot 0: `SEEOCS' #2
  Module 1 slot 0: empty
Card reading complete.
```

---

**Figure 3-9 • Creating ENVM storage inside the HSM module**

### **Erase Already Created NVRAM**

If NVRAM already exists in the module, it can be removed by entering the following command:

```
nvram-sw.exe -d -n udsigner
```

**Note:** Deletion of the existing NVRAM file erases all tickets (if loaded into the module).

## **Configure the U-HSM Server and Tools**

This section provides setup instructions for the U-HSM server. It assumes that the directory structure for the U-HSM server was created in the default location C:\Microsemi.

## Update Server and Tools Configuration

The U-HSMMaster.config file contains settings for the U-HSM server. Currently, there are two separate config files with the same name and identical content. For the default installation location, the file path is:

C:\Microsemi\Server\U-HSMMaster.config

and

C:\Microsemi\Tools\U-HSMMaster.config

Change the following settings as shown:

- DFK database location - confirm the location matches actual path:  
<add key="G4HSMAPI.DFKDBPath" value="C:\Microsemi\DFKDB" />
- Ticket database location - confirm the location matches actual path:  
<add key="G4HSMAPI.JobTicketDBPath" value="C:\Microsemi\JobDB"/>
- Ticket archive directory:  
<add key="G4HSMAPI.JTLogArchivePath" value="C:\Microsemi\JobDB\JobDBArchive"/>
- U-HSM UUID 32 symbols long hex string obtained from Microsemi (00..01 in this example):  
<add key="My\_UUID" value=" 00000000000000000000000000000001"/>
- SEEK Secret key: g4cu-seesk-<U\_HSM\_UUID> (00..01 in this example):  
<addkey="G4HSMAPI.CSEEKey" value="g4cu-seesk- 00000000000000000000000000000001" />

## Generate the ISK key (\*g4see-isk)

The ISK key is a global system key used for internal system functions such as import of the seepk (M-HSM or sIHP public keys).

Generate the ISK key as follows:

- Open the command prompt as an administrator and change directory to C:\Microsemi\Tools.
- Execute the following script (see the sample output in [Figure 3-10](#)).

**"%nfast\_home%\python\bin\python.exe" C:\Microsemi\Tools\gensymmkey.py -u userdata-signer -i g4see-isk.**

---

```
C:\Microsemi\Tools>"%nfast_home%\python\bin\python.exe" C:\Microsemi\Tools\gensymmkey.py -u
userdata-signer -i g4see-isk
=====
= Generating symmetric key with ExportAsPlain enabled
=
= KeyIdent:      simple/g4see-isk
= KeyHash:      7a7895eb 081498b9 0f05d9de 257ae43d 7896dacd
= SEE App KeyIdent: seeinteg/userdata-signer
= SEE APP KeyHash: 57827118 b0e20b11 2ff56be0 820a6020 7154b8a7
=
= Open group perms: DuplicateHandle|ReduceACL|GetACL
= SEE App perms:    ExportAsPlain|GetAppData
=====
Success! Generated key simple/g4see-isk
```

---

**Figure 3-10 • Sample output from generation of the ISK key**

## Generate the U-HSM Master Key (g4mcu)

This is a symmetric encryption key that protects all internal project information such as keys, tickets, security protocol data, etc. while processing inside the U-HSM.

Generate the U-HSM Master Key as follows:

- Open the command prompt as an administrator and change directory to C:\Microsemi\Tools.
- Execute the following command (see the sample output in [Figure 3-11](#)).







## Install the HSM Module License File

The license file is issued by Microsemi and binds the UUID used by Security World and one or more HSM modules.

Once available, this file must be put in the Server and Tools directories of the current installation.

## Open the Server Port

To make the U-HSM server accessible to the clients running outside the host operating system, the firewall rules must be changed to open 8000.

## Start Up the U-HSM Server

The U-HSM server executable is located in the Server directory, and the full path for the default installation location is:

C:\Microsemi\Server\U-HSMServer.exe

The server must be started in "As Admin" mode. The session can be terminated by pressing the "Enter" key. Sample output is shown in [Figure 3-18](#).

---

```
C:\Microsemi\Server>U-HSMServer.exe
The service Running
Press <ENTER> to exit.
```

---

**Figure 3-18 • Starting U-HSM Server**

**Tip:** During the session, the server produces log output to the file located here:

C:\ProgramData\G4KMSServer\G4KMSSHSMAPI.log

## Key Exchange with Microsemi

Before the U-HSM server can receive data from the Microsemi HSM, both HSMs need to exchange the public keys.

The Microsemi HSM needs to import the U-HSM public encryption key so that it can securely send encrypted data to the U-HSM. See "[Export the U-HSM Public Keys](#)" on page 21, which explains how to export this public encryption key.

The U-HSM needs to import the Microsemi HSM public verify key so that it can authenticate the digitally signed files it receives from Microsemi. See "[Import the Microsemi HSM Public Verify Key](#)" on page 22, which explains how to import the Microsemi HSM public key.

Refer to the Microsemi portal for all operations listed in this step.

### ***Import the Microsemi HSM Public Verify Key***

Once the customer receives the Microsemi HSM public verify key, they need to import it into the U-HSM.

Use the U-HSMGenImp utility for this type of import:

**U-HSMGenImp -p g4cusee -i -n g4mf-seespk -a pkg-g4mf-seespk-<hex> -k g4see- isk**

pkg-g4mf-seespk-<hex>: This is the file on the disk with the key to be imported for verifying signature.

*Example:* pkg-g4mf-seespk-121187e7

The resulting files are created in the Security World key folder. Information about these keys can be viewed using the "nfkminfo -k" command.

*Example of resulting key file:* key\_simple\_g4mf-seespk

Sample output is shown in [Figure 3-19](#).

---

```
C:\Microsemi\Tools>U-HSMGenImp -p g4cusee -i -n g4mf-seespk -a pkg-g4mf-seespk-121187e7 -k g4see-isk
RedeemTicket successful
Starting to import SEE public key...
Vimport successful
SEE public key, g4mf-seespk, imported successfully
```

---

**Figure 3-19 • Starting U-HSM Server**

## Obtain the DFK Database from Microsemi

For each customer, Microsemi generates a database of the diversified factory keys (DFK DB) for all devices they use. Those keys are stored in encrypted form. The key exchange step as mentioned in "[Key Exchange with Microsemi](#)" on [page 22](#) must be completed before the DFK database can be obtained.

### **Request the DFK Database**

Send the DFK DB request to Microsemi. Refer to the Microsemi portal for information about how this can be done.

The file with the DFK DB has the extension DFK DB. This database needs to be imported (merged into the U-HSM server).

DFK DB file name example: DFKUPD- 00000000000000000000000000000001-20150115.DFKDB

### **Import (Merge) the DFKDB into the U-HSM Server**

The import is done using U-HSMDFKDBMerger utility in the Tools folder. The "-f" flag must be used for the first import. This creates a new database file.

For subsequent DFKDB imports, the "-f" flag should not be used. If a re-import of the DFK DB is necessary, use the "-ForceMerged" flag.

The import must be executed in the DFKDB location specified in the configuration file (see "[Update Server and Tools Configuration](#)" on [page 18](#) for details).

Import the DFKDB as follows:

1. Go to the DFKDB directory as specified in the configuration file. For the default installation path:  
cd C:\Microsemi\DFKDB.
2. For the first time import, this directory should be empty, because U-HSM DFK DB has not yet been created.
3. Copy the DFK DB file received from Microsemi to C:\Microsemi\DFKDB.  
Example of the file DFK DB file name:  
DFKUPD- 00000000000000000000000000000001-20150115.DFKDB
4. Execute the merge as shown on the example below, specifying your DFK DB file name.
  - For the first time merge, use the "-f" flag.
  - To force a merge again for the same file, use the "-ForceMerged" flag.

```
C:\Microsemi\Tools>U-HSMDFKDBMerger.exe -f DFKUPD- 00000000000000000000000000000001-20150115.DFKDB
```

5. Confirm that the first time merge was successful. The DFKDB directory will show that a new file has been created. The file name follows the example below (the highlighted field is the same as your customer UUID):

```
DFK- 00000000000000000000000000000001.DFKDB
```

See the sample output in [Figure 3-20](#).

---

```
C:\Microsemi\DFKDB>C:\Microsemi\Tools\U-HSMDFKDBMerger -f DFKUPD- 00000000000000000000000000000001-20150115.DFKDB
G4DFKDBMerger Starting
DFKUpdate (DFKUPD-00000000000000000000000000000001-20150115.DFKDB) is merged into DFK-00000000000000000000000000000001.DFKDB successfully
```

---

**Figure 3-20 • First time import of the DFK Database into U-HSM**

### ***Import Manufacturing Keys from the DFK DB***

This step imports device-type specific keys that are used for bitstream generation and other tasks. These keys are part of the DFK DB. The U-HSMImportMFKeys utility is used for the key import in the following format:

U-HSMImportMFKeys <import\_key\_file>

import\_key\_file: file with the DFK DB

*Example:* DFKUPD- 00000000000000000000000000000001 -20150115.DFKDB

---

```
C:\Microsemi\DFKDB>C:\Microsemi\Tools\U-HSMImportMFKey DFKUPD-00000000000000000000000000000001-20150115.DFKDB
Imported MF 2 keys successfully
```

---

**Figure 3-21 • Import for the MFG Keys**

## **Import the U-HSM Server's Public Keys to Enable the M-HSM Function**

The U-HSM server needs to import its public keys to execute its jobs or send jobs for execution to another U-HSM server running the same Security World.

Use the U-HSMGenImp utility for this type of import:

**U-HSMGenImp -p g4cusee -i -n g4cu-seepk-<U\_UUID> -a pkg-g4cu-seepk--<U\_UUID> -k g4see-isk**

**U-HSMGenImp -p g4cusee -i -n g4cu-seespk-<U\_UUID> -a pkg-g4cu-seespk-<U\_UUID> -k g4see-isk**

U\_UUID: 32 symbols long UUID of this U-HSM server

*Example:* "00000000000000000000000000000001"

This U\_UUID is used by the client application (JobManager) to refer to this key. Therefore, it needs to be set up in the application settings.

pkg-g4cu-seepk-<U\_UUID>: This is the prefix of the file on the disk with the key to be imported for encryption.

*Example:* pkg-g4cu-seepk-00000000000000000000000000000001-8eb9680a

pkg-g4cu-seespk-<U\_UUID>: This is prefix of the file on the disk with the key to be imported for verifying signature.

*Example:* pkg-g4cu-seespk-00000000000000000000000000000001-0754c1eb

The resulting files are created in the Security World key folder.

Example of resulting key files: key\_simple\_g4cu-seepk-00000000000000000000000000000001 and

key\_simple\_g4cu-seespk-00000000000000000000000000000001

Information about these keys can be viewed using the "nfkminfo -k" command.



Sample output is shown in [Figure 3-22](#).

---

```
C:\Microsemi\Tools> U-HSMGenImp -p g4cusee -i -n g4cu-seepk-00000000000000000000000000000001-a pkg-
g4cu-seepk-00000000000000000000000000000001-8eb9680a -k g4see-isk

RedeemTicket successful
Starting to import SEE public key...
Vimport successful
SEE public key, g4cu-seepk-00000000000000000000000000000001, imported successfully

C:\Microsemi\Tools> U-HSMGenImp -p g4cusee -i -n g4cu-seespk-
00000000000000000000000000000001-a pkg-g4cu-seespk-00000000000000000000000000000001-0754c1eb -k
g4see-isk

RedeemTicket successful
Starting to import SEE public key... Vimport successful
SEE public key, g4cu-seespk-00000000000000000000000000000001, imported successfully
```

---

**Figure 3-22 • Importing U-HSM Public Keys**

## Import the M-HSM Public Keys

The U-HSM server needs public keys for every M-HSM, including the IHP that executes jobs from this U-HSM server, to send information to it in a secured way.

Use the U-HSMGenImp utility for this type of import:

**U-HSMGenImp -p g4cusee -i -n g4cm-seepk-<M\_UUID> -a pkg-g4cm-seepk-<M\_UUID> -k g4see-isk**

**U-HSMGenImp -p g4cusee -i -n g4cm-seespk-<M\_UUID> -a pkg-g4cm-seespk-<M\_UUID> -k g4see-isk**

M\_UUID: 40 hex characters long UUID for the imported M-HSM public key.

*Example:* "00000000000000000000000000000002"

The M\_UUID is used by the client application (JobManager) to refer to this key. Therefore, it needs to be set up in the application settings.

*pkg-g4cm-seepk-<M\_UUID>:* This is the prefix of the file on the disk with the key to be imported for encryption.

*Example:* pkg-g4cm-seepk- 00000000000000000000000000000002-2db19054

*pkg-g4cm-seespk-<M\_UUID>:* This is prefix of the file on the disk with the key to be imported for verifying signature.

*Example:* pkg-g4cm-seespk- 00000000000000000000000000000002- f5544785

The resulting files are created in the Security World key folder. Information about these keys can be viewed using the "nfkminfo -k" command.

*Example of resulting key files:* key\_simple\_g4cm-seepk-00000000000000000000000000000002 and key\_simple\_g4cm-seespk-00000000000000000000000000000002



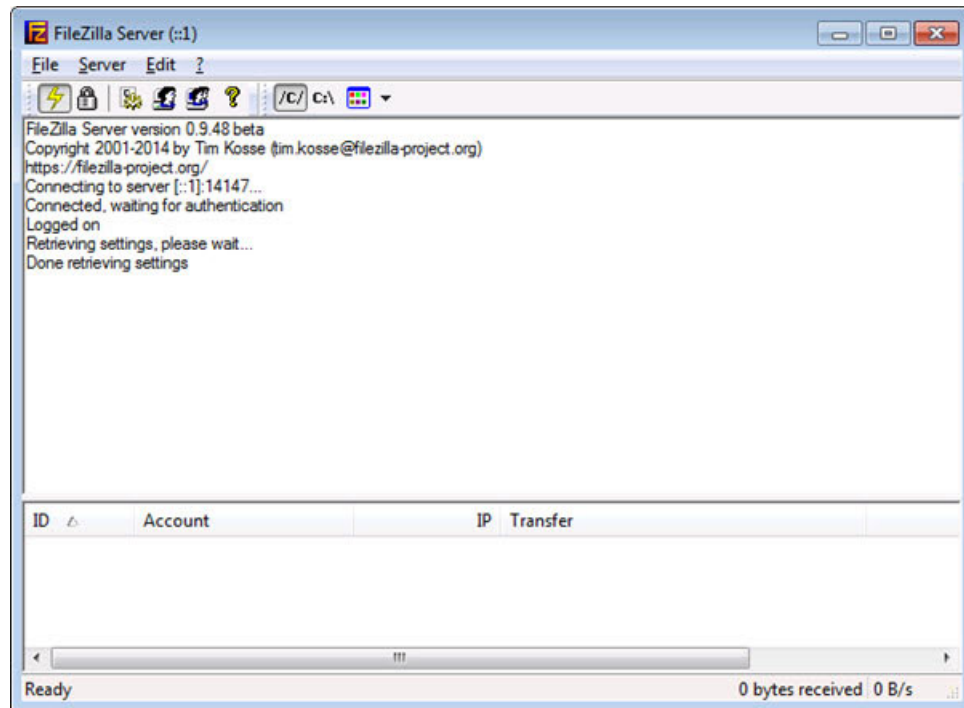
## FTP Server Setup

An FTP server is required on the U-HSM server for the M-HSM function. It provides access to the job status and job termination functions for the administrator on FlashProExpress. The server is used to retrieve information from the ticket database located in the directory specified by G4CUMaster.config file (see "Update Server and Tools Configuration" on page 18 for details).

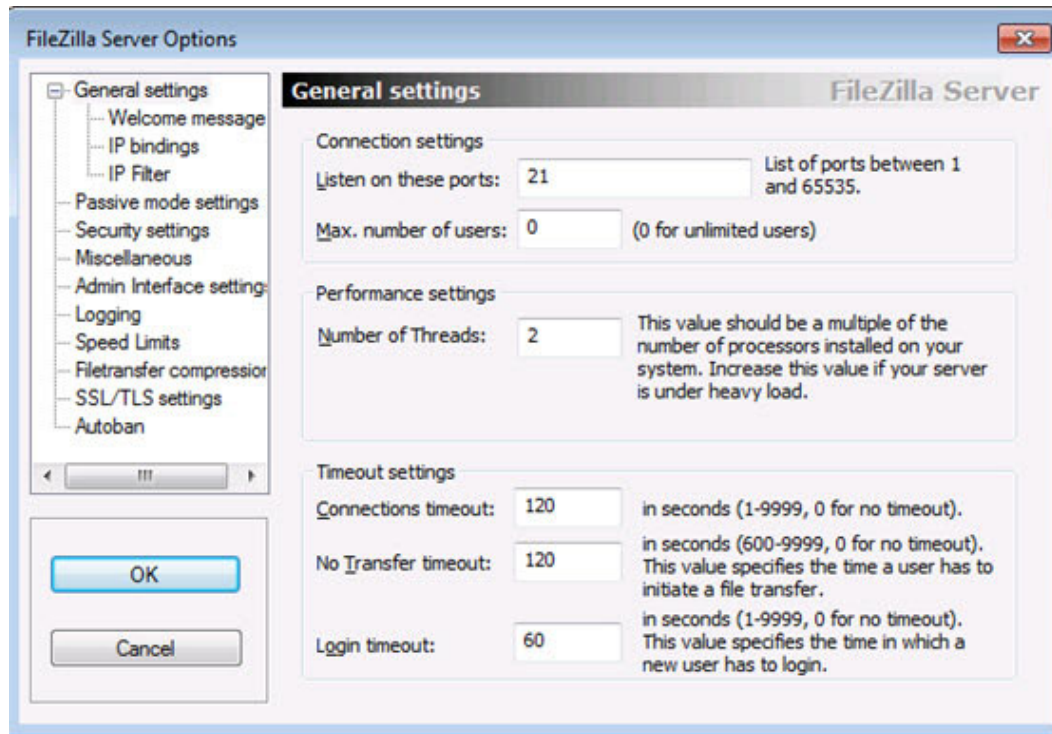
The following example shows how to set up the FTP server using FileZilla.

The FTP port is set to 21. The home directory is set to C:\Microsemi\ftp, and the ticket DB (/JobDB) is set to C:\Microsemi\JobDB.

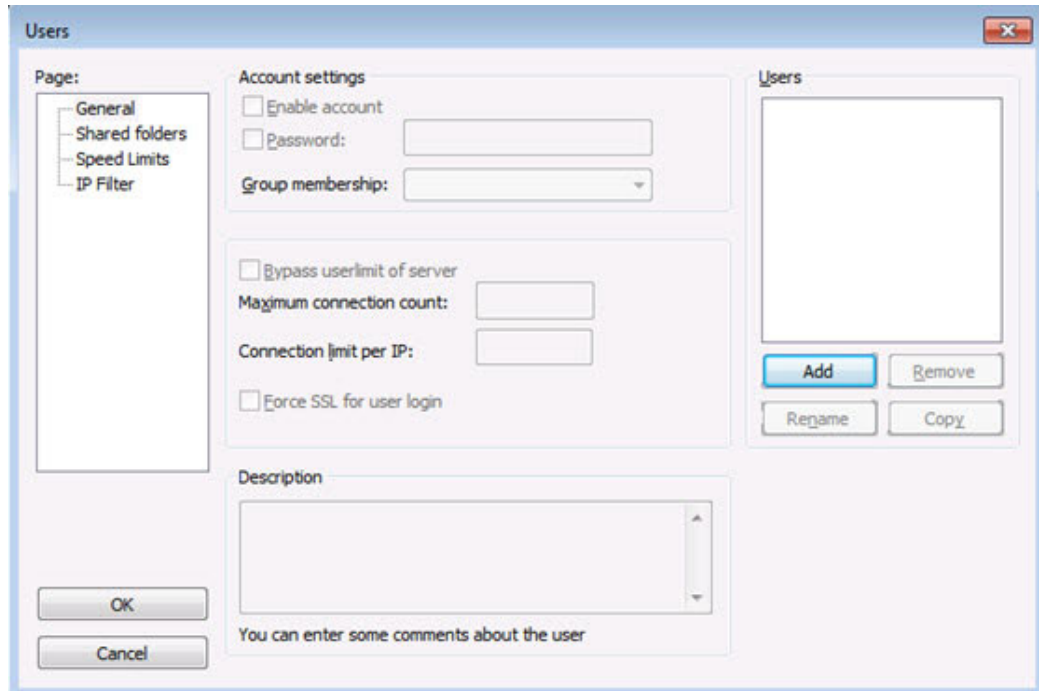
1. Open the FileZilla Server application.



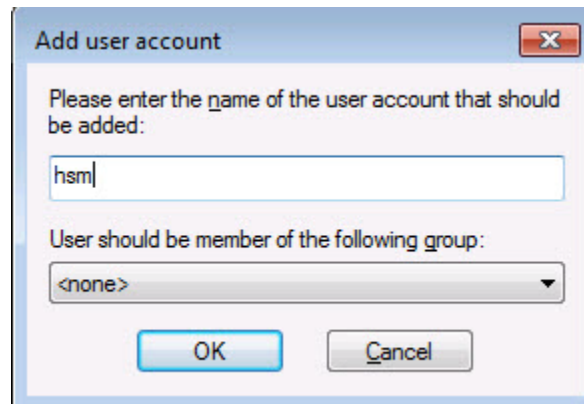
2. Go to **Menu->Edit->Settings**, make sure the default port is set to 21, and close the dialog box.



3. Open user settings: **Menu->Edit->Users**.
- 

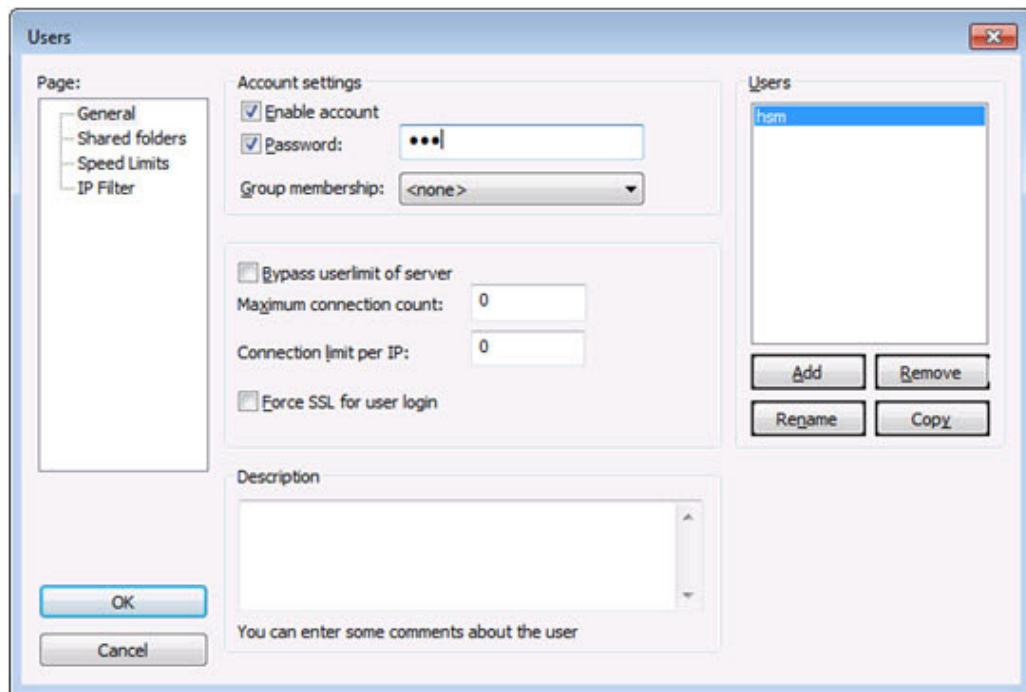


4. Click **Add** and enter the new user name as "hsm".
- 

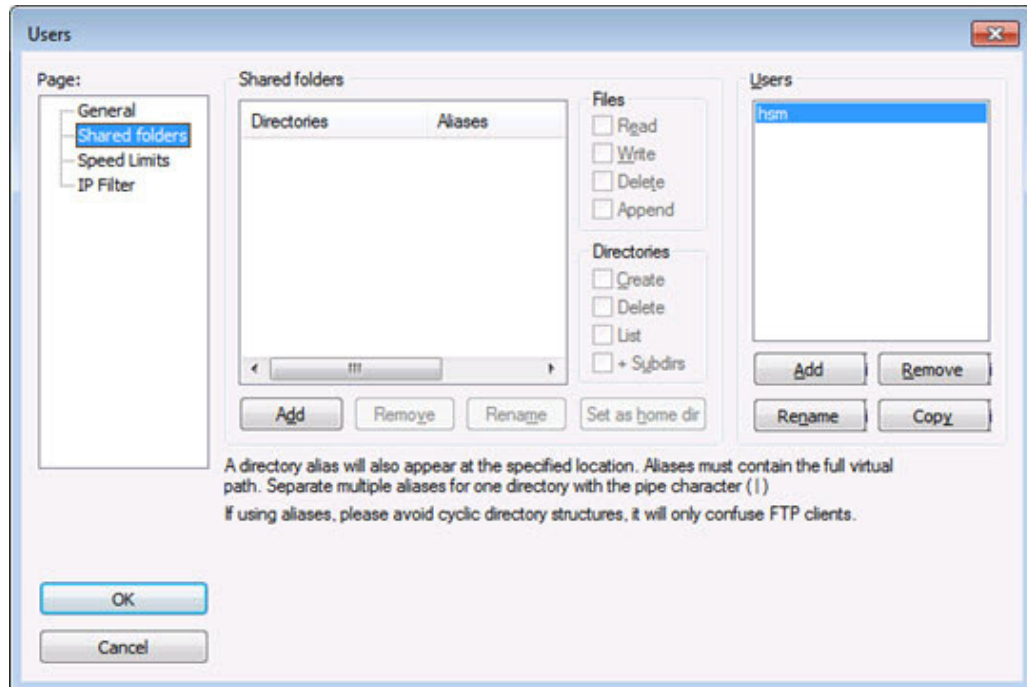


5. Click **OK**.
-

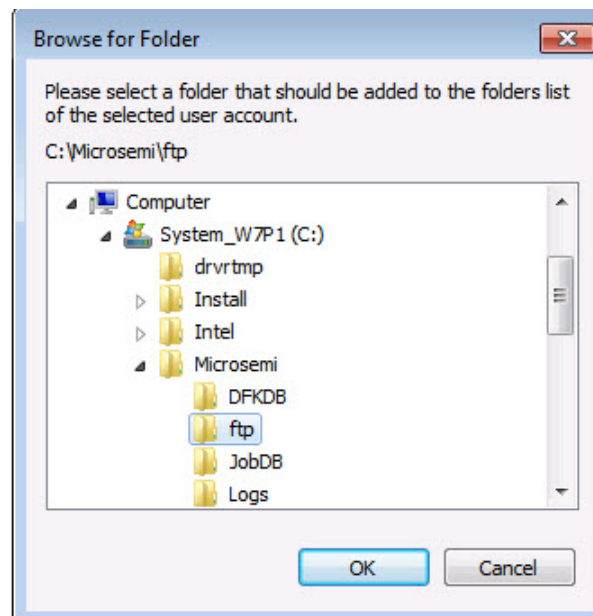
- In the Users dialog box, select the Password check box and enter your password, for example "hsm".



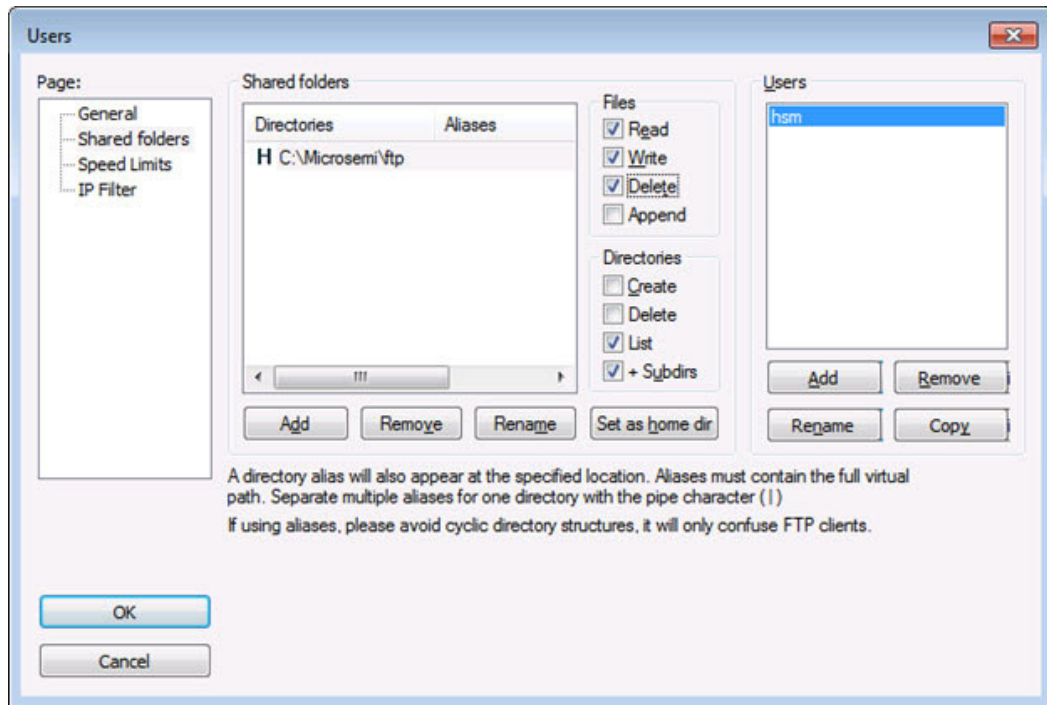
7. In the "Page" tree view, select the "Shared folders" option.



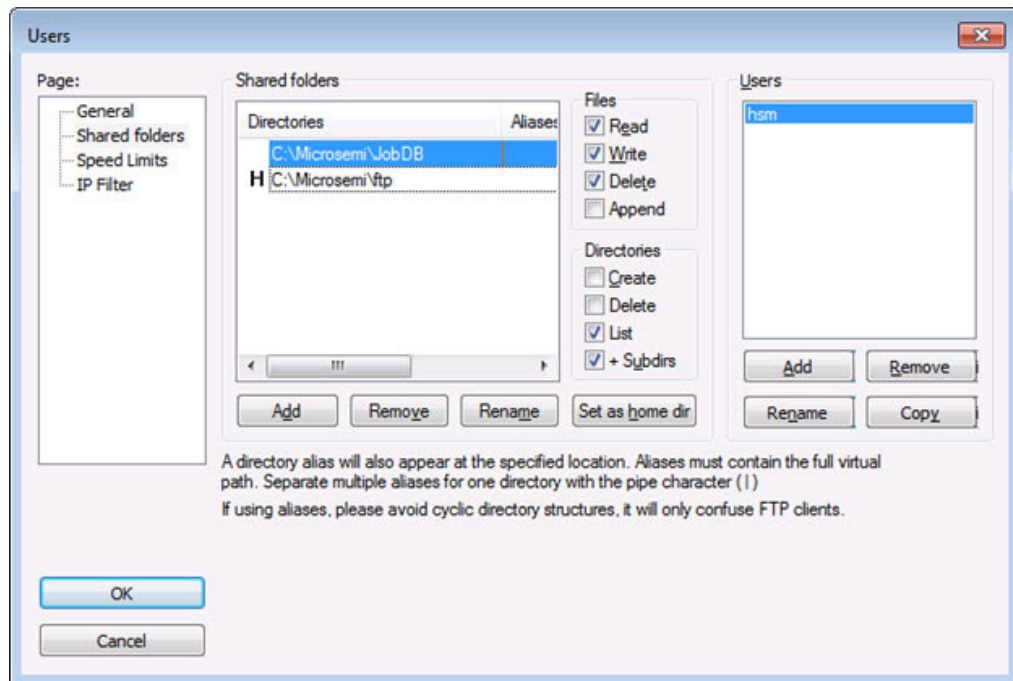
8. Click **Add**.
9. Navigate to the C:\Microsemi\ftp folder.
10. Click **OK**.



11. Set permissions for this directory to Read/Write/Delete.



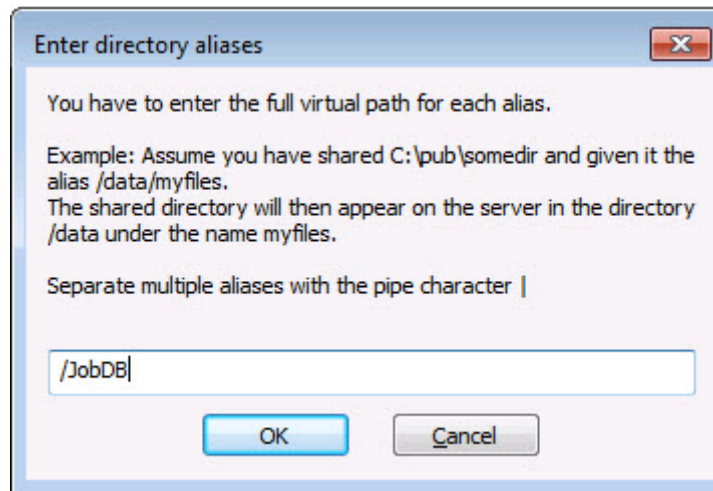
12. Repeat this step and add the location of the ticket database.



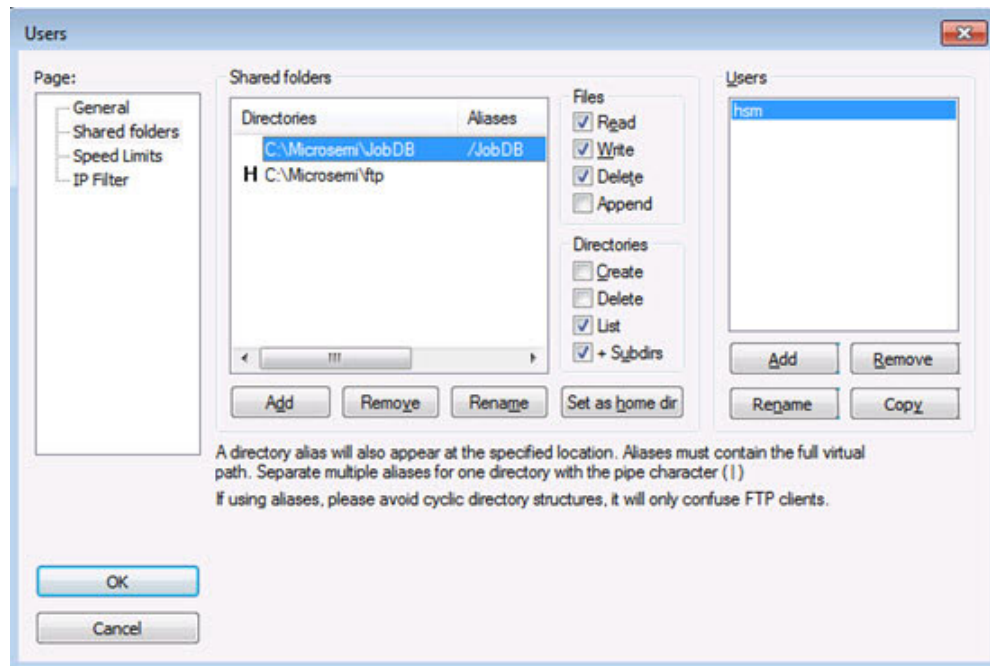
13. Make sure the JobDB has Read/Write/Delete permissions.



14. Right-click the JobDB entry and select "Edit aliases".
15. Set alias as "/JobDB".



16. Confirm the home directory is set to the ftp folder and alias to the JobDB, as shown below.



17. Confirm that the FTP server functions as expected. Follow the example in [Figure 3-24](#) below.

---

```
C:\Microsemi\DFKDB>ftp sjsocprgw7pl

Connected to sjsocprgw7pl.microsemi.net.
220-FileZilla Server version 0.9.48 beta
220-written by Tim Kosse (tim.kosse@filezilla-project.org)
220 Please visit https://filezilla-project.org/
User (sjsocprgw7pl.microsemi.net:(none)): hsm
331 Password required for hsm
Password:
230 Logged on

ftp> ls
200 Port command successful
150 Opening data channel for directory listing of "/"
JobDB
226 Successfully transferred "/"

ftp> cd JobDB
250 CWD successful. "/JobDB" is current directory.
ftp> ls
200 Port command successful
150 Opening data channel for directory listing of "/JobDB"
226 Successfully transferred "/JobDB"
ftp>
```

---

**Figure 3-24 • Checking setup of the FTP server**

18. Similarly, create the /JobDBArchive FTP location at the same level as /JobDB and pointing to C:\Microsemi\JobDB\JobDBArchive.

---

## 4 – U-HSM Reconfiguration and Post-Installation Actions

---

This chapter provides instructions for the setup and maintenance actions that can be performed on an installed and provisioned U-HSM.

### HSM Module Replacement

**Note:** Only one module at a time can be connected to U-HSM.

**Note:** If the old module is removed from the U-HSM, unfinished programming jobs will not be able to proceed.

For jobs in progress, certain ticket information is stored inside the NVRAM of the HW module, which makes job tickets physically uncloneable.

#### Remove the Old HSM Module

Physically disconnect the old module. The U-HSM Security World contains a file with the module information. While this file can co-exist with the files for other modules added to the system, the user can choose to remove it for security reasons. The file is located in the Security World directory: %NFAST\_KMDATA%\local directory. The file name follows the pattern "module\_<module\_ESN>". If needed, the user can also remove the licensing file from the Server and Tools directories: <U\_UUID>.g4sl.

#### Set Up a New HSM Module

After the module is installed on the system, it must be added to the Security World and set up to load SEE Machine firmware per module type.

##### **Module Installation**

1. Install a new HSM module (see "HSM Hardware Module Installation" on page 10)
2. Install the Microsemi-issued HSM module license (see "Install the HSM Module License File" on page 22)
3. Install the module warrant file (see "HSM Hardware Module Installation" on page 10)

##### **Add the HSM Module to the Security World**

The following steps require the Administrative Card Set (ACS). The number of required cards and their respective passphrases depend on the settings specified during Security World creation (see "Create the Security World" on page 14)

1. Set module to the pre-init state
2. Add the HSM module to the security world using the new-world command:  
`new-world --program --no-remoteshare-cert -m 1`
3. Create a new NVRAM file (see "Create NVRAM-based Storage in the HSM Module" on page 17)
4. Set module to the operational state
5. Setup HSM module to load SEE Machine firmware: follow instructions in "Set Up the SEE Machine Firmware for Loading into the HSM Module" on page 19.

### Key Exchange with Microsemi

Follow the instructions in "Key Exchange with Microsemi" on page 22.

## Import the Public Keys of the M-HSM

Follow the instructions in "Import the M-HSM Public Keys" on page 25.

## Export the Public Keys for Sending to an M-HSM

Follow the instructions in "Export the U-HSM Public Keys" on page 21.

## Create the DFK DB and Manufacturing Keys for the M-HSM

Follow the instructions in "Prepare and Send Device Data to the M-HSM" on page 26.

## Upgrade the HSM Module Firmware

This step shows how to upgrade HSM module firmware (not to be confuse with the SEE Machine firmware). The firmware upgrade may be necessary in following cases:

- The HSM module has a firmware revision that is not supported by the JobManger and/or FlashProExpress version used (see U-HSM release notes for the supported revisions)
- User wants to switch to another revision of Microsemi-supported firmware
- Microsemi issues a security advisory

**Note:** If the U-HSM has any active programming jobs (via M-HSM function of the U-HSM), they will be disabled through the firmware upgrade. Also, firmware upgrade will erase NVRAM and any information about module association with the World. Please follow the steps below to upgrade firmware of the HSM module and restore HSM module on the U-HSM server:

1. Read the important notes in "[Upgrade HSM Module Firmware](#)" regarding the firmware upgrade procedure and firmware revisions compatibilities:  
*Note:* If the firmware upgrade is initiated by a Microsemi security advisory, the instructions in the advisory shall supersede the instructions in this guide

2. Terminate any active job(s):

If M-HSM function of the U-HSM is used, and U-HSM has any unterminated jobs, the job should be terminated from FlashProExpress tool using complete\_prog\_job command TCL command (see the [FlashPro Express User's Guide](#))

3. Upgrade HSM module firmware

HSM module firmware upgrade instructions are provided in "[Upgrade HSM Module Firmware](#)" on [page 11](#).

4. Restore module association with the Security World.

Follow the instructions in "[Add the HSM Module to the Security World](#)".

5. Start U-HSM Server

Follow the instructions in "[Start Up the U-HSM Server](#)" on [page 22](#) and confirm successful server start

6. If M-HSM function of the U-HSM is used, re-submit new programming jobs, if needed

---

## 5 – U-HSM Server Replication

---

An existing U-HSM server can be replicated to one or more new U-HSM servers. As a result, the replicated server gets a copy of the Security World, all HSM keys, imported public keys, the DFK DB and manufacturing keys already existing on the source system.

**Note:** Programming jobs cannot be replicated, but they can be transferred. The overbuild protection does not allow cloning of any job that may exist in the source system. Job tickets reside inside the physical HSM module, and can only be transferred to the new system along with the physical module.

The M-HSM function of the U-HSM can be used across physically separate U-HSMs if they run the same Security World.

The following sections provide instructions for U-HSM server replication:

### Install the Software

Follow the instructions in "Software Installation" on page 10 and install all required software packages.

### Copy Over the Security World

Copy the content of the Security World directory from the source to the destination machine. The location of the security world directory is: %NFAST\_KMDATA%\local.

This step copies over the entire security environment:

- Security World data
- Created U-HSM keys
- Imported public keys
- Imported MFG keys

### Copy Over the U-HSM Server

1. Copy HSM server software components from the source HSM to the destination folder of the new server (the default location is C:\Microsemi)
2. On the destination machine, delete the ticket db files (job cannot be replicated):
  - C:\Microsemi\JobDB and
  - C:\Microsemi\JobDB\JobDBArchive

### Install a New HSM Module

Follow the instructions in "Set Up a New HSM Module" on page 35.

### Start the U-HSM Server

Follow the instructions in "Start Up the U-HSM Server" on page 22.

### Set Up the FTP Server

Follow the instructions in "FTP Server Setup" on page 27.

---

## A – Product Support

---

Microsemi SoC Products Group backs its products with various support services, including Customer Service, Customer Technical Support Center, a website, electronic mail, and worldwide sales offices. This appendix contains information about contacting Microsemi SoC Products Group and using these support services.

### Customer Service

Contact Customer Service for non-technical product support, such as product pricing, product upgrades, update information, order status, and authorization.

From North America, call **800.262.1060**

From the rest of the world, call **650.318.4460**

Fax, from anywhere in the world, **650.318.8044**

### Customer Technical Support Center

Microsemi SoC Products Group staffs its Customer Technical Support Center with highly skilled engineers who can help answer your hardware, software, and design questions about Microsemi SoC Products. The Customer Technical Support Center spends a great deal of time creating application notes, answers to common design cycle questions, documentation of known issues, and various FAQs. So, before you contact us, please visit our online resources. It is very likely we have already answered your questions.

### Technical Support

For Microsemi SoC Products Support, visit <http://www.microsemi.com/products/fpga-soc/design-support/fpga-soc-support>.

### Website

You can browse a variety of technical and non-technical information on the Microsemi SoC Products Group [home page](http://www.microsemi.com/soc), at [www.microsemi.com/soc](http://www.microsemi.com/soc).

### Contacting the Customer Technical Support Center

Highly skilled engineers staff the Technical Support Center. The Technical Support Center can be contacted by email or through the Microsemi SoC Products Group website.

#### Email

You can communicate your technical questions to our email address and receive answers back by email, fax, or phone. Also, if you have design problems, you can email your design files to receive assistance. We constantly monitor the email account throughout the day. When sending your request to us, please be sure to include your full name, company name, and your contact information for efficient processing of your request.

The technical support email address is [soc\\_tech@microsemi.com](mailto:soc_tech@microsemi.com).

## My Cases

Microsemi SoC Products Group customers may submit and track technical cases online by going to [My Cases](#).

## Outside the U.S.

Customers needing assistance outside the US time zones can either contact technical support via email ([soc\\_tech@microsemi.com](mailto:soc_tech@microsemi.com)) or contact a local sales office.

Visit [About Us](#) for sales office listings and corporate contacts.

Sales office listings can be found at [www.microsemi.com/soc/company/contact/default.aspx](http://www.microsemi.com/soc/company/contact/default.aspx).

## ITAR Technical Support

For technical support on RH and RT FPGAs that are regulated by International Traffic in Arms Regulations (ITAR), contact us via [soc\\_tech\\_itar@microsemi.com](mailto:soc_tech_itar@microsemi.com). Alternatively, within My Cases, select **Yes** in the ITAR drop-down list. For a complete list of ITAR-regulated Microsemi FPGAs, visit the ITAR web page.



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### About Microsemi

Microsemi Corporation (Nasdaq: MSCC) offers a comprehensive portfolio of semiconductor and system solutions for communications, defense & security, aerospace and industrial markets. Products include high-performance and radiation-hardened analog mixed-signal integrated circuits, FPGAs, SoCs and ASICs; power management products; timing and synchronization devices and precise time solutions, setting the world's standard for time; voice processing devices; RF solutions; discrete components; Enterprise Storage and Communication solutions, security technologies and scalable anti-tamper products; Ethernet solutions; Power-over-Ethernet ICs and midspans; as well as custom design capabilities and services. Microsemi is headquartered in Aliso Viejo, Calif. and has approximately 4,800 employees globally. Learn more at [www.microsemi.com](http://www.microsemi.com).

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