

Renesas Synergy™ Platform

USBX™ Host Class Mass Storage Module Guide

Introduction

This module guide will enable you to effectively use a module in your own design. Upon completion of this guide, you will be able to add this module to your own design, configure it correctly for the target application, and write code using the included application project code as a reference and an efficient starting point. References to more detailed API descriptions and suggestions of other application projects that illustrate more advanced uses of the module are included in this document and will be valuable resources for creating more complex designs.

The USBX™ Host Class Mass Storage module is a high-level API for USBX Host Class Mass Storage applications and is implemented on `g_ux_host`. The USBX Host Class Mass Storage module uses the USB and data-transfer peripherals on the Synergy MCU.

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1. Features

- Host controller for USB 2.0 with support for:
 - Root hub
 - Power Management
 - Endpoints
 - Transfers
- High-level APIs simplify storage operations
- Supports optional data transfers using MCU hardware for improved efficiency

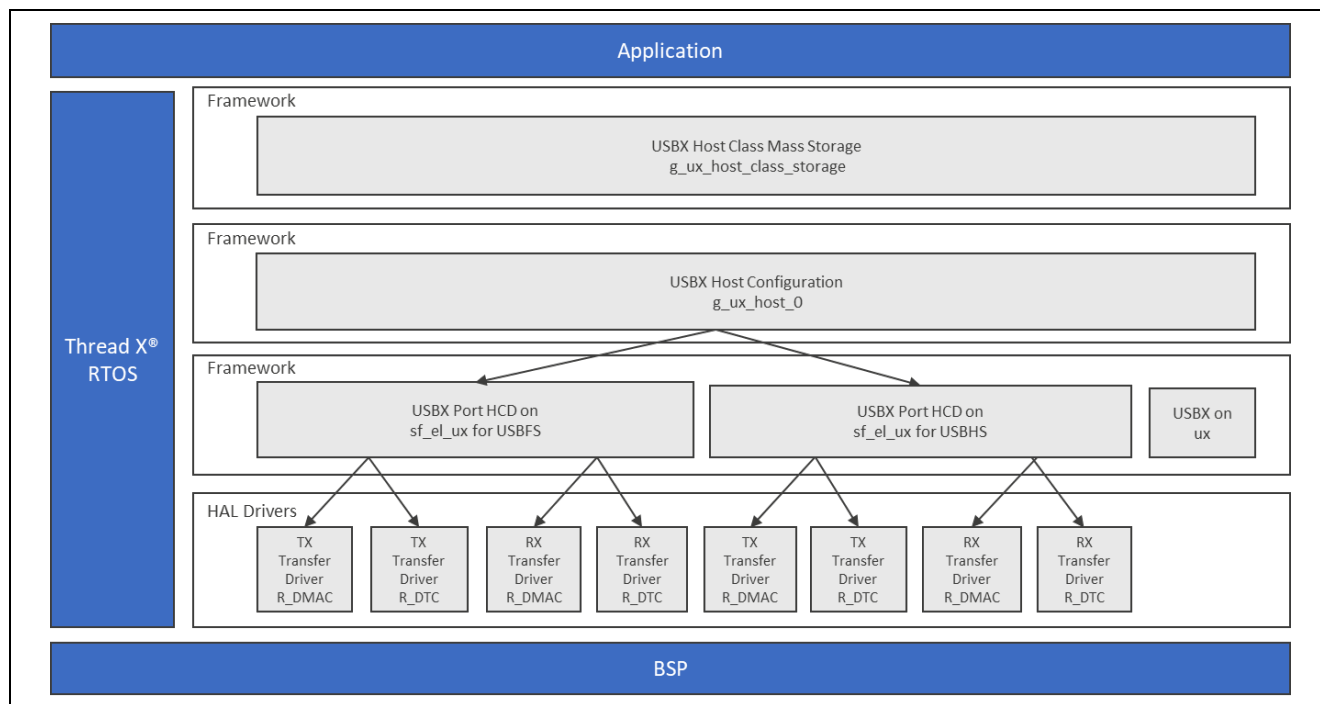


Figure 1. USBX Host Class Mass Storage Module Organization, Options, and Stack Implementations

2. Overview

The USBX Host Class Mass Storage module does not have a separate API available for user applications. When a USB media is connected, it is attached to the FileX® member included in the USBX Host Class Mass Storage instance. The user application uses this FileX member to access files on the USB media. For FileX APIs, refer to the Azure RTOS APIs which can be found in the Azure RTOS FileX documentation page <https://docs.microsoft.com/en-us/azure/rtos/filex/overview-filex>.

3. Operational Overview

Initialization of USBX Resources

The USBX has its own memory manager. The memory needs to be allocated to the USBX before the host or device side of the USBX is initialized. The USBX memory manager can accommodate systems where memory can be cached.

Definition of USB Host Controllers

At least one USB host controller must be defined for the USBX to operate in host mode. The application initialization file should contain this definition.

Definition of Host Classes

One or more host classes must be defined with the USBX. A USB class is required to drive a USB device after the USB stack has configured the USB device. A USB class is very specific to the device. One or more classes may be required to drive a USB device, depending on the number of interfaces contained in the USB device descriptors.

USB Class Binding

When the device is configured, the topology manager will let the class manager continue the device discovery by looking at the device-interface descriptors. A device can have one or more interface descriptors.

An interface represents a function in a device. A USB speaker has three interfaces; one for audio streaming, one for audio control, and one to manage the various speaker buttons.

The class manager has two mechanisms to join the device interface(s) to one or more classes. It can either use the combination of a PID/VID (product ID and vendor ID) found in the interface descriptor or the combination of Class/Subclass/Protocol.

The PID/VID combination is valid for interfaces that cannot be driven by a generic class. The Class/Subclass/Protocol combination is used by interfaces that belong to a USB-IF certified class such as a printer, hub, storage, audio, or HID.

The class manager contains a list of registered classes from the initialization of the USBX. The class manager will call each class one-at-a-time until one class agrees to manage the interface for that device; each class can only manage one interface. (In the case of the USB audio speaker, the class manager will call all the classes for each of the interfaces.)

Once a class accepts an interface, a new instance of that class is created. The class manager searches for the default alternate setting for the interface. A device may have one or more alternate settings for each interface. The alternate setting **0** will be the one used by default until a class decides to change it.

For the default alternate setting, the class manager will mount all the endpoints contained in the alternate setting. If the mounting of each endpoint is successful, the class manager will complete its job by returning to the class that will finish the initialization of the interface.

3.1 Operational Notes and Limitations

3.1.1 Operational notes

- Use a class container for the USBX Host Class Mass Storage module obtained by auto-generated code to get a mass storage instance.
- Poll the flag `ux_host_class_storage_state` in and make sure the status is live.
- Wait until the first media of the class container is attached.
- Access the file on the media with the FileX API.

3.1.2 Limitations

If the module uses the interrupt of a USB controller, set the appropriate interrupt-priority level in the Synergy Configuration tool to ensure proper operation.

If the module uses the interrupt of a transfer module (implemented as DMAC or DTC), set the appropriate priority level in the Synergy Configuration tool. The level must be higher than a USB Controller to ensure proper operation.

Refer to the most recent *SSP Release Notes* for any additional operational limitations for this module.

4. Including the USBX Host Class Mass Storage Module in an Application

This section describes how to include the USBX Host Class Mass Storage module in an application using the SSP configurator.

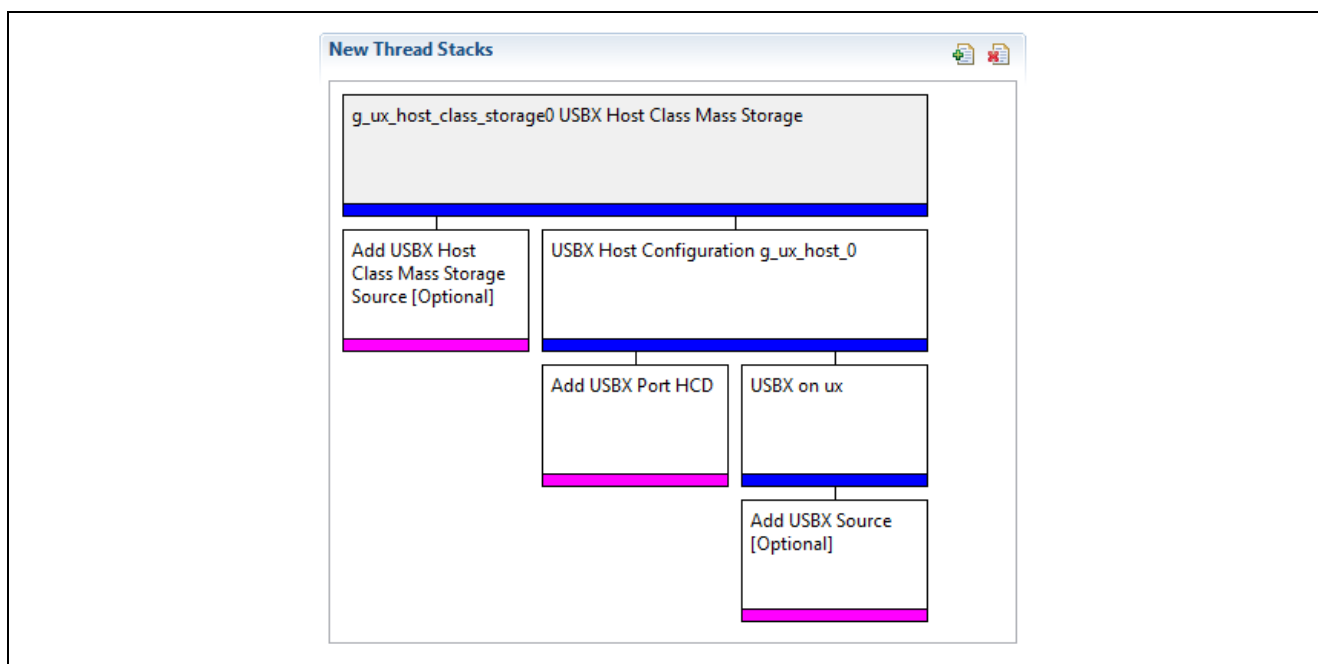
Note: This section assumes you are familiar with creating a project, adding threads, adding a stack to a thread, and configuring a block within the stack. If you are unfamiliar with any of these items, refer to the first few chapters of the *SSP User's Manual* to learn how to manage each of these important steps in creating SSP-based applications.

To add the USBX Host Class Mass Storage module to an application, simply add it to a thread using the stacks selection sequence given in the following table. (The default name for the USBX Host Class Mass Storage is `g_ux_host_class_storage0`. This name can be changed in the associated **Properties** window.)

Table 1. USBX Host Class Mass Storage Selection Sequence

Resource	ISDE Tab	Stacks Selection Sequence
g_ux_host_class_storage0 USBX Host Class Mass Storage	Threads	New Stack > X-Ware > USBX > Host > Classes > Mass Storage > USBX Host Class Mass Storage

When the USBX Host Class Mass Storage is added to the thread stack as shown in Figure 2, the configurator automatically adds any needed lower-level drivers. Any drivers that need additional configuration information will be box text highlighted in **red**. Modules with a **gray** band are individual modules that stand alone. Modules with a **blue** band are shared or common and need only be added once and can be used by multiple stacks. Modules with a **pink** band can require the selection of lower-level drivers; these are either optional or recommended. (This is indicated in the block with the inclusion of this text.) If the addition of lower-level drivers is required, the module description will include **Add** in the text. Clicking on any **pink** banded modules will bring up the **New** icon and then display the possible choices.

**Figure 2. USBX Host Class Mass Storage Module Stack**

5. Configuring the Storage Module

You must configure the USBX Host Class Mass Storage module for the desired operation. The SSP configuration window will automatically identify (by highlighting the block in red) any required configuration selections, such as interrupts or operating modes, that must be configured for lower-level modules for successful operation. Only those properties that can be changed without causing conflicts are available for modification. Other properties are **locked** and are not available for changes and are identified with a lock icon for the **locked** property in the Properties window in the ISDE. This approach simplifies the configuration process and makes it much less error-prone than previous manual approaches to configuration. The available configuration settings and defaults for all the user accessible properties are given in the properties tab within the SSP Configurator and are shown in the following tables for easy reference.

One of the properties most often identified as requiring a change is the interrupt priority; this configuration setting is available within the **Properties** window of the associated module. Simply select the indicated module and then view the **Properties** window. The interrupt settings are often toward the bottom of the properties list, so scroll down until they become available. Note that the interrupt priorities listed in the **Properties** window in the ISDE will include an indication as to the validity of the setting based on the targeted MCU (CM4 or CM0+). This level of detail is not included in the following configuration properties tables but is easily visible with the ISDE when configuring interrupt priority levels.

Note: You may want to open your ISDE, create the module, and explore the property settings in parallel with looking over the following configuration table settings. This will help orient you and can be a useful hands-on approach to learning the ins and outs of developing with SSP.

Table 2. Configuration Settings for the USBX Host Class Mass Storage Module

ISDE Property	Value	Description
Name	g_ux_host_class_storage0	Module name

Note: The example settings and defaults are for a project using the S7G2 Synergy Group. Other MCUs may have different default values and available configuration settings.

In some cases, settings other than the defaults for a module can be desirable. For example, it might be useful to select a different clock source than the default. The configurable properties for the lower-level stack modules are given in the following sections for completeness and as a reference.

Note: Most of the property settings for lower-level modules are intuitive and usually can be determined by inspection of the associated properties window from the SSP configurator.

5.1 Configuration Settings for Low-Level Modules

Typically, only a small number of settings must be modified from the default for lower-level modules as indicated via the red text in the thread stack block. Notice that some of the configuration properties must be set to a certain value for proper framework operation and will be locked to prevent user modification. The following table identifies all the settings within the properties section for the module.

Table 3. Configuration Settings for the USBX Host Configuration

ISDE Property	Value	Description
Name	g_ux_host0	Module name

Table 4. Configuration Settings for the USBX Port HCD on sf_el_ux for USBFS

ISDE Property	Value	Description
Full Speed Interrupt Priority	Priority 0 (highest), Priority 1:2, Priority 3 (CM4: valid, CM0+: lowest- not valid if using ThreadX), Priority 4:14 (CM4: valid, CM0+: invalid), Priority 15 (CM4 lowest - not valid if using ThreadX, CM0+: invalid) Default: Disabled	Full speed interrupt priority selection
VBUSEN pin Signal Logic	Active Low, Active High Default: Active High	VBUSEN pin signal logic selection
Name	g_sf_el_ux_hcd_fs_0	Module name
USB Controller Selection	USBFS	USB controller selection

Note: The example settings and defaults are for a project using the S7 Synergy MCU Group. Other MCUs may have different default values and available configuration settings.

Table 5. Configuration Settings for the USBX HCD on sf_el_ux for USBHS

ISDE Property	Value	Description
High Speed Interrupt Priority	Priority 0 (highest), Priority 1:2, Priority 3 (CM4: valid, CM0+: lowest- not valid if using ThreadX), Priority 4:14 (CM4: valid, CM0+: invalid), Priority 15 (CM4 lowest - not valid if using ThreadX, CM0+: invalid) Default: Disabled	High speed interrupt priority selection
FIFO size for Bulk Pipes	512, 1024, 1536, 2048 bytes Default: 512 bytes	FIFO size for bulk pipes selection
VBUSEN pin Signal Logic	Active Low, Active High Default: Active High	VBUSEN pin signal logic selection

ISDE Property	Value	Description
Name	g_sf_el_ux_hcd_hs_0	Module name
USB Controller Selection	USBHS	USB controller selection

Note: The example settings and defaults are for a project using the Synergy S7 MCU Group. Other MCUs may have different default values and available configuration settings.

Table 6. Configuration Settings for USBX on ux

ISDE Property	Value	Description
USBX Pool Memory Name	g_ux_pool_memory	USBX pool memory name selection.
USBX Pool Memory Size	18432	USBX pool memory size selection.
User Callback for Host Event Notifications (Only valid for USB Host)	NULL	Callback name

Note: The example settings and defaults are for a project using the S7 Synergy MCU Family. Other MCUs may have different default values and available configuration settings.

Table 7. Configuration for RX Transfer Driver on r_dmac

ISDE Property	Value	Description
Parameter Checking	BSP, Enabled, Disabled (Default: BSP)	Selects if code for parameter checking is to be included in the build
Name	g_transfer0	Module name
Channel	0	Channel number
Mode	Block	Mode selection
Transfer Size	1 Byte	Transfer size selection
Destination Address Mode	Incremented	Destination address mode selection
Source Address Mode	Fixed	Source address mode selection
Repeat Area (Unused in Normal Mode)	Source	Repeat area selection
Destination Pointer	NULL	Destination pointer selection
Source Pointer	NULL	Source pointer selection
Number of Transfers	0	Number of transfers selection
Number of Blocks (Valid only in Block Mode)	0	Number of blocks selection
Activation Source (Must enable IRQ)	Software Activation	Activation source selection
Auto Enable	FALSE	Auto enable selection
Callback (Only valid with Software start)	NULL	Callback selection
Interrupt Priority	Priority 0 (highest), 1,2,3,4,5,6,7,8,9,10,11,12,13,14,15 (lowest, not valid if using Thread X), Disabled (Default: Disabled)	Interrupt priority selection

Note: The above setting examples and defaults are for a project using the S7G2 Synergy MCU. Other MCUs may have different default values and available configuration settings.

Table 8. Configuration for TX Transfer Driver on r_dmac

ISDE Property	Value	Description
Parameter Checking	BSP, Enabled, Disabled (Default: BSP)	Selects if code for parameter checking is to be included in the build
Name	g_transfer0	Module name
Channel	0	Channel number
Mode	Block	Mode selection
Transfer Size	1 Byte	Transfer size selection
Destination Address Mode	Incremented	Destination address mode selection
Source Address Mode	Fixed	Source address mode selection
Repeat Area (Unused in Normal Mode)	Source	Repeat area selection
Destination Pointer	NULL	Destination pointer selection
Source Pointer	NULL	Source pointer selection
Number of Transfers	0	Number of transfers selection
Number of Blocks (Valid only in Block Mode)	0	Number of blocks selection
Activation Source (Must enable IRQ)	Software Activation	Activation source selection
Auto Enable	FALSE	Auto enable selection
Callback (Only valid with Software start)	NULL	Callback selection
Interrupt Priority	Priority 0 (highest), 1,2,3,4,5,6,7,8,9,10,11,12,13,14,15 (lowest, not valid if using Thread X), Disabled (Default: Disabled)	Interrupt priority selection

Note: The above setting examples and defaults are for a project using the S7G2 Synergy MCU. Other MCUs may have different default values and available configuration settings.

5.2 Clock configuration

The USB peripheral module uses UCLK as its clock source. The UCLK should be configured for 48-MHz operation and can be checked in the Clocks tab of the SSP configuration window.

5.3 Pin configuration

The USB peripheral module uses pins on the MCU to communicate to external devices. I/O pins must be selected and configured as required by the external device. The following tables illustrate the method for selecting the pins within the SSP configuration window and the subsequent table illustrates an example selection for USB pins.

Note: The operation mode selection determines what peripheral signals are available and thus what MCU pins are required.

Table 9. Pin Selection Sequence for USBFS and USBHS

Resource	ISDE Tab	Pin Selection Sequence
USBFS	Pins	Select Peripherals > Connectivity: USBFS> USBFS0
USBHS	Pins	Select Peripherals > Connectivity: USBHS> USBHS0

Note: The selection sequence assumes USBFS0 or USBHS0 are the desired hardware target for the driver.

Table 10. Pin Configuration Settings for the USBFS

Property	Value	Description
Operation Mode	Disabled, Custom, Device, Host, OTG (Default: Disabled)	Select Device as the Operation Mode
USBDP	USBDP	USBDP Pin
USBDM	USBDM	USBDM Pin
OVRCURB	None	OVRCURB Pin
OVRCURA	None	OVRCURA Pin
VBUSEN	None	VBUSEN Pin
VBUS	None, P407 (Default: P407)	VBUS Pin
EXICEN	None	EXICEN Pin
ID	None	ID Pin
VCCUSB	VCCUSB	VCCUSB Pin
VSSUSB	VSSUSB	VSSUSB Pin

Note: The example settings are for a project using the S7G2 Synergy MCU Group and the SK-S7G2 Kit.
Other Synergy Kits and other Synergy MCUs may have different available pin configuration settings.

Table 11. Pin Configuration Settings for the USBHS

Property	Value	Description
Operation Mode	Disabled, Custom, Device, Host, OTG (Default: Disabled)	Select Device as the Operation Mode
USBHSDP	USBHSDP	USBHSDP Pin
USBHSDM	USBHSDM	USBHSDM Pin
OVRCURB	None	OVRCURB Pin
OVRCURA	None	OVRCURA Pin
VBUSEN	None	VBUSEN Pin
VBUS	None	VBUS Pin
EXICEN	None	EXICEN Pin
ID	None	ID Pin
USBHSRREF	USBHSRREF	USBHSRREF Pin
AVCCUSBHS	AVCCUSBHS	AVCCUSBHS Pin
AVSSUSBHS	AVSSUSBHS	AVSSUSBHS Pin
PVSSUSBHS	PVSSUSBHS	PVSSUSBHS Pin

Note: The example settings are for a project using the S7G2 Synergy MCU Group and the SK-S7G2 Kit.
Other Synergy Kits and other Synergy MCUs may have different available pin configuration settings.

6. Using the USBX Host Class Mass Storage Module in an Application

The configurator generates processing to create and register the USBX Host Class Mass Storage module. File access must be done after the device is connected. Because FileX is used, checking **[Express Logic] [fx]** on the **Components** tab of the configurator is necessary.

The typical steps in using the USBX Host Class Mass Storage module in an application are:

1. Get the first instance of the connected device with `ux_host_stack_class_instance_get` API.
2. Wait until successful.
3. Wait for the device status to become live.
4. Wait for media to be mounted.
5. Access the file on the media with the FileX API.

These common steps are illustrated in a typical operational flow diagram in Figure 3:

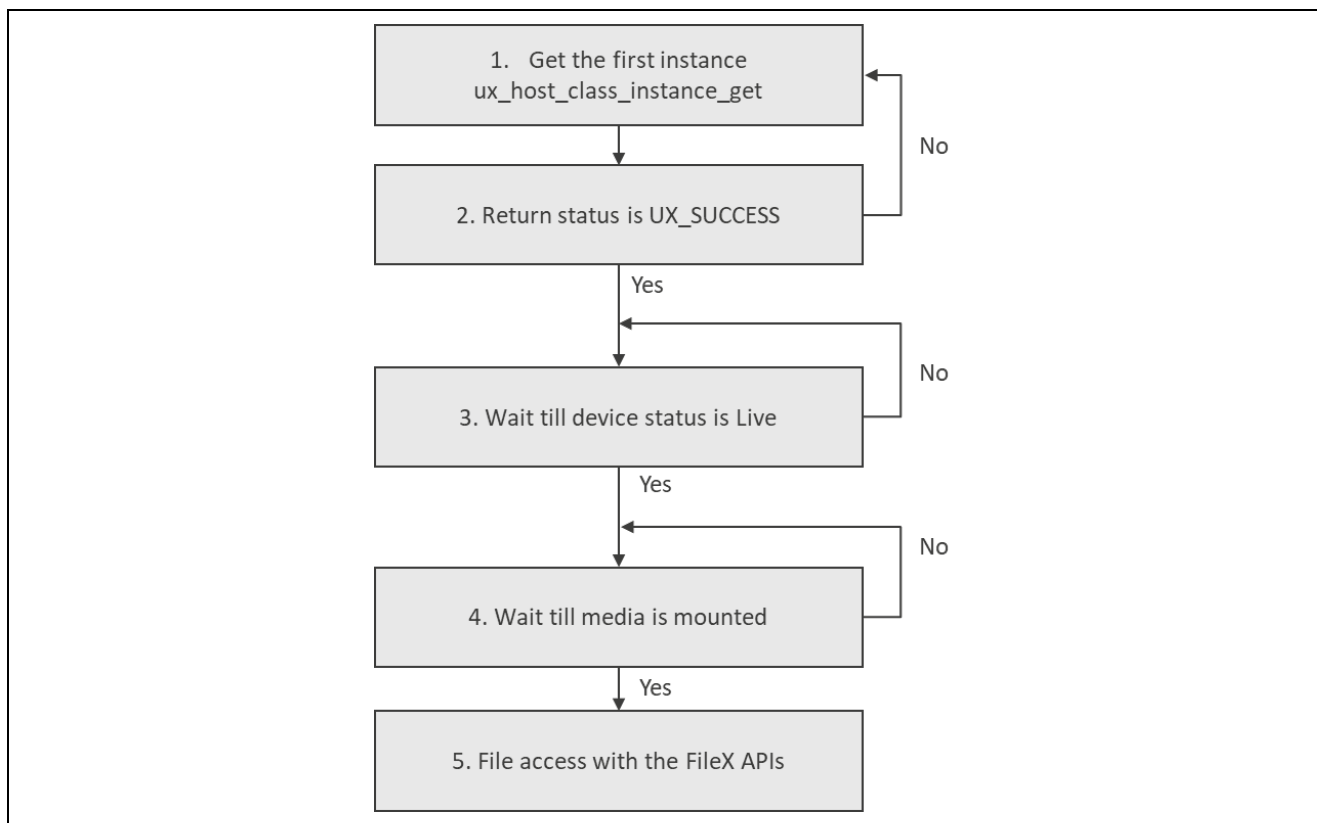


Figure 3. Flow Diagram of a Typical USBX Host Class Mass Storage Module Application

7. Application Project

The application project associated with this module guide demonstrates the mentioned steps in a full design. The project can be found using the link provided in the Reference Information section at the end of this document. You may want to import and open the application project within the ISDE and view the configuration settings for the USBX Host Class Mass Storage module. You can also read over the code (in `usb_thread_entry.c`) used to illustrate the USBX Host Class Mass Storage module APIs in a complete design.

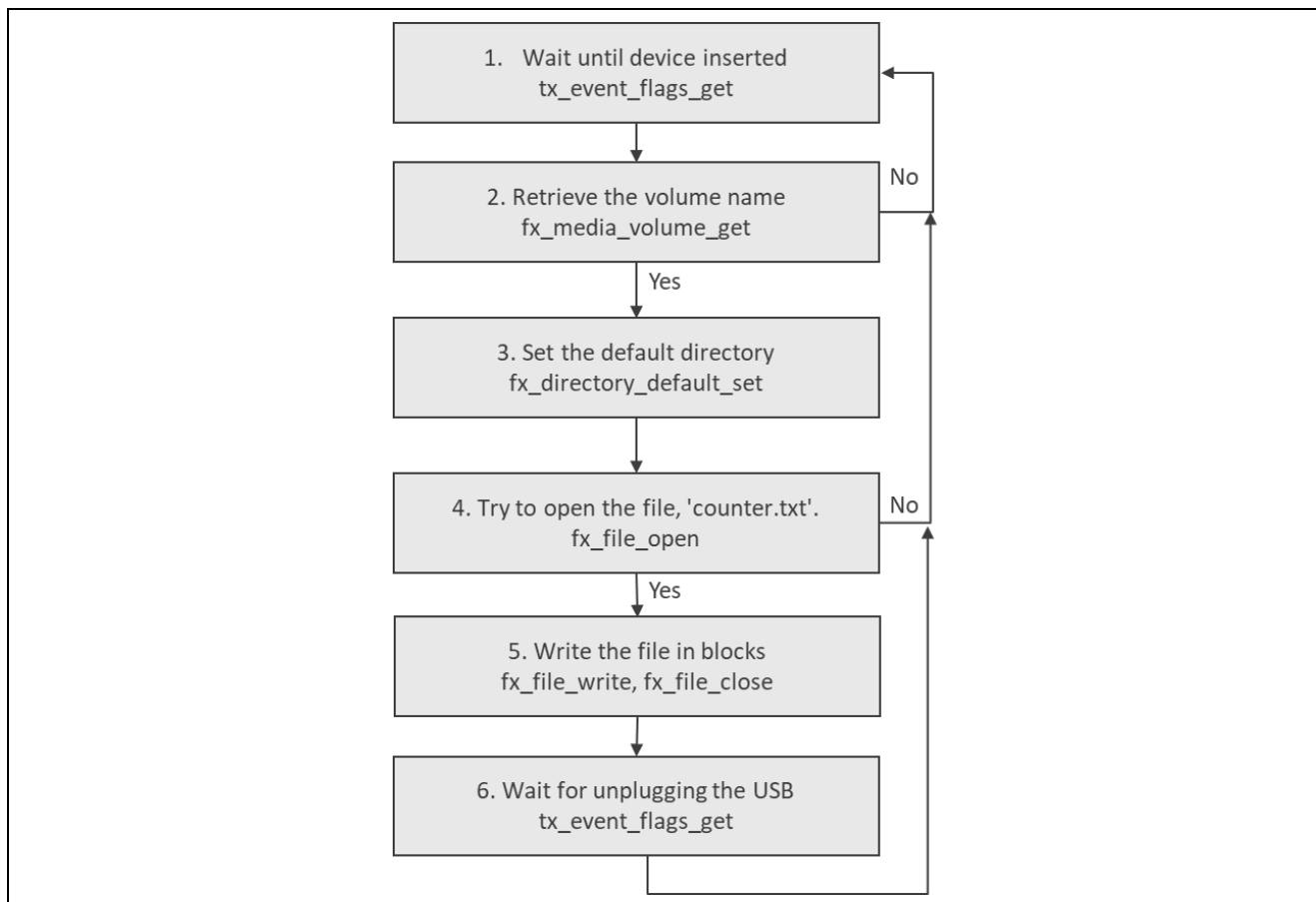
The application project demonstrates the typical use of the USBX Host Class Mass Storage module APIs. The application project main thread entry waits for the connection from the callback function, reads the `firstdir\counter.txt` file in the USB memory, and updates the described number. If `firstdir` does not exist, the directory information is ignored. If this file does not exist, create a file. After updating the file, the application waits until the USB memory is unplugged. The application uses LED2, LED1, and LED0 in sequence to provide status of the application. When all three or two LEDs (depending upon evaluation board) lights up, it indicates that the operation is complete, and you can disconnect the attached mass storage device. The application uses the SEMI-HOSTING feature. It displays relevant messages and errors to the user.

The user-callback function obtains a pointer of FileX by using `ux_system_host_storage_fx_media_get` and notifies the main thread of the plugged or unplugged state. Table 12 identifies the target versions for the associated software and hardware used by the application project.

Table 12. Software and Hardware Resources Used by the Application Project

Resource	Revision	Description
e ² studio	7.3.0 or later	Integrated Solution Development Environment
SSP	1.6.0 or later	Synergy Software Platform
IAR EW for Renesas Synergy	8.23.3 or later	IAR Embedded Workbench® for Renesas Synergy™
SSC	7.3.0 or later	Synergy Standalone Configurator
SK-S7G2	v3.0 to v3.3	Starter Kit

A simple flow diagram of the application project is given in Figure 4.

**Figure 4. USBX Host Class Mass Storage Module Application Project Flow Diagram**

The `usb_thread_entry.c` file is located in the project once it has been imported into the ISDE. You can open this file within the ISDE and follow along with the following description to help identify key uses of APIs.

The first section of `usb_thread_entry.c` is a header file for the user thread. The following section is a callback function where USB memory is connected or disconnected. The last section is the user thread that reads from and writes to the USB memory. When connected to USB memory, `usb_host_plug_event_notification` is called. This callback function determines the connected device from the argument, saves the pointer of the FileX instance, and notifies the user thread. This callback function is also called when the USB memory was unplugged. The user thread receives notification from the callback function and starts access to the USB memory. The user thread gets the volume name of the media and sets the default directory to `firstdir`, open `counter.txt`, update the first written character, and write it again. Close the media and wait for the USB memory to be unplugged.

The application implements primary error handling. On detection of any error, the application displays the error on the **Renesas virtual debugging console** and halts the thread execution.

A few key properties are configured in this application project to support the required operations and the physical properties of the target board and MCU. The properties with the values set for this specific project are listed in Table 13. You can also open the application project and view these settings in the **Properties** window as a hands-on exercise.

Table 13. USBX Host Class Mass Storage Module Configuration Settings for the Application Project

ISDE Property	Value Set
USBX Port HCD on sf_el_ux for USBHS High Speed Interrupt Priority	Priority 3
VBUSEN pin Signal Logic	Active Low
USBX on ux USBX Pool Memory Size	63488
User Callback for Host Event Notification (Only valid for USB Host)	usb_host_plug_event_notification

Table 14. Configuration for RX Transfer Driver on r_dmac for Application Project

ISDE Property	Value	Description
Parameter Checking	BSP, Enabled, Disabled (Default: BSP)	Selects if code for parameter checking is to be included in the build
Name	g_transfer0	Module name
Channel	0	Channel number
Mode	Block	Mode selection
Transfer Size	1 Byte	Transfer size selection
Destination Address Mode	Incremented	Destination address mode selection
Source Address Mode	Fixed	Source address mode selection
Repeat Area (Unused in Normal Mode)	Source	Repeat area selection
Destination Pointer	NULL	Destination pointer selection
Source Pointer	NULL	Source pointer selection
Number of Transfers	0	Number of transfers selection
Number of Blocks (Valid only in Block Mode)	0	Number of blocks selection
Activation Source (Must enable IRQ)	Software Activation	Activation source selection
Auto Enable	FALSE	Auto enable selection
Callback (Only valid with Software start)	NULL	Callback selection
Interrupt Priority	Priority 2	Interrupt priority selection

Note: The above setting examples and defaults are for a project using the S7G2 Synergy MCU. Other MCUs may have different default values and available configuration settings.

Table 15. Configuration for TX Transfer Driver on r_dmac for Application Project

ISDE Property	Value	Description
Parameter Checking	BSP, Enabled, Disabled (Default: BSP)	Selects if code for parameter checking is to be included in the build
Name	g_transfer1	Module name
Channel	1	Channel number
Mode	Block	Mode selection
Transfer Size	1 Byte	Transfer size selection
Destination Address Mode	Incremented	Destination address mode selection
Source Address Mode	Fixed	Source address mode selection
Repeat Area (Unused in Normal Mode)	Source	Repeat area selection
Destination Pointer	NULL	Destination pointer selection
Source Pointer	NULL	Source pointer selection
Number of Transfers	0	Number of transfers selection
Number of Blocks (Valid only in Block Mode)	0	Number of blocks selection
Activation Source (Must enable IRQ)	Software Activation	Activation source selection

ISDE Property	Value	Description
Auto Enable	FALSE	Auto enable selection
Callback (Only valid with Software start)	NULL	Callback selection
Interrupt Priority	Priority 2	Interrupt priority selection

Note: The above setting examples and defaults are for a project using the S7G2 Synergy MCU. Other MCUs may have different default values and available configuration settings.

8. Customizing for a Target Application

Some configuration settings will normally be changed by the user from those shown in the application project. For example, you can also add a data-transfer module for data transfer of USBX Port HCD. This data-transfer module can be added simply by clicking on the box for TX or RX displayed under the USBX Port HCD box of the configurator.

9. Running the Application Project

To run the USBX Host Class Mass Storage module application project and to see it executed on a target kit, you can simply import it into your ISDE, compile, and run debug. Refer to the *Renesas Synergy™ Project Import Guide* (r11an0023eu0121-synergy-ssp-import-guide) included in this package for instructions on importing the project into e² studio or IAR Embedded Workbench® for Renesas Synergy™ and building/running the application.

To implement the USBX Host Class Mass Storage module application in a new project, follow the steps for defining, configuring, auto-generating files, adding code, compiling, and debugging on the target kit. Following these steps is a hands-on approach that can help make the development process with SSP more practical.

Note: The following steps are described in sufficient detail for someone experienced with the basic flow through the Synergy development process. If these steps are not familiar, refer to the first few chapters of the *SSP User's Manual* for a description of how to accomplish these steps.

To create and run the USBX Host Class Mass Storage application project, simply follow these steps:

1. Create a new Renesas Synergy project for the S7G2-SK called `USBX_Mass_Storage_Host`.
2. Select the **Threads** tab.
3. Add the `usb_thread` to **Threads**.
4. Add the Event Flags on USB Thread Objects.
Name: **USB Plug Event Flags**
Symbol: **g_usb_plug_events**
5. Add the **FileX on USBX Mass Storage** module to the USB Thread Stacks.
6. Click the **USBX on ux** box on the USB Thread Stacks.
7. Change the USBX Pool Memory Size to **63488** on the **Property** window.
8. Change the User Callback for Host Event Notification (Only valid for USB Host) to `usb_host_plug_event_notification` on the **Property** window.
9. Click the **Add USBX Port HCD** box and select the **USBX Port HCD** on `sf_el_ux` for **USBHS**.
10. Change the **High Speed Interrupt Priority** to **Priority 3** on the property window.
11. Change the **VBUSEN pin Signal Logic** to **Active Low** on the property window.
12. Click on the **Generate Project Content** button.
13. Add the code from the supplied project file `usb_thread_entry.c` or copy over the generated `usb_thread_entry.c` file also build the project.
14. Connect to the host PC via a micro USB cable to J19 on SK-S7G2. Note: If an S3A7 board is used, switch S6 USBF should be set to off state.
15. Start to debug the application.
16. Insert the USB memory into J6 connector on SK-S7G2.
17. Wait for the three LEDs on SK-S7G2 to light up.
18. Remove the USB memory from SK-S7G2.
19. The written file to the USB memory can be seen on the host PC.

Note: When testing the application on DK-S3A7, make sure that the switch S6 (USBF) is turned off.

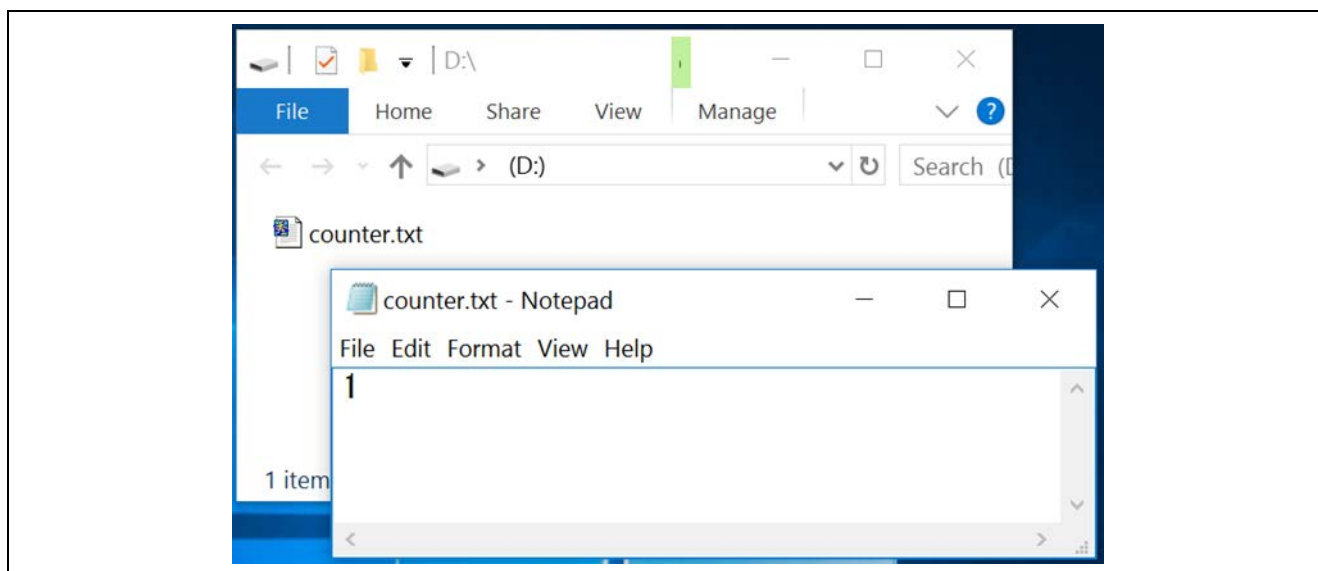


Figure 5. Example Initial File by USBX Host Class Mass Storage Module Application Project

10. Conclusion

This module guide has provided all the background information needed to select, add, configure, and use the module in an example project. Many of these steps were time consuming and error-prone activities in previous generations of embedded systems. The Renesas Synergy™ Platform makes these steps much less time consuming and removes the common errors, like conflicting configuration settings or incorrect selection of lower-level drivers. The use of high-level APIs as demonstrated in the application project illustrate additional development time savings by allowing work to begin at a high level and avoiding the time required in older development environments to use or in some cases, create, lower-level drivers.

11. Next Steps

After you have mastered a simple USBX Host Class Mass Storage module project you may want to review a more complex example. Other application projects and application notes that demonstrate USBX Host Class Mass Storage use can be found as described in the References section below.

12. Reference Information

SSP User's Manual: Available in html format in the SSP distribution package and as a pdf from the Renesas Synergy Gallery.

Links to all the most up-to-date USBX Host Class Mass Storage module reference materials and resources are available on the Renesas Synergy Knowledge Base: <https://en-support.renesas.com/knowledgeBase/16977576>.

Website and Support

Visit the following vanity URLs to learn about key elements of the Synergy Platform, download components and related documentation, and get support.

Synergy Software	www.renesas.com/synergy/software
Synergy Software Package	www.renesas.com/synergy/ssp
Software add-ons	www.renesas.com/synergy/addons
Software glossary	www.renesas.com/synergy/softwareglossary
Development tools	www.renesas.com/synergy/tools
Synergy Hardware	www.renesas.com/synergy/hardware
Microcontrollers	www.renesas.com/synergy/mcus
MCU glossary	www.renesas.com/synergy/mcuglossary
Parametric search	www.renesas.com/synergy/parametric
Kits	www.renesas.com/synergy/kits
Synergy Solutions Gallery	www.renesas.com/synergy/solutionsgallery
Partner projects	www.renesas.com/synergy/partnerprojects
Application projects	www.renesas.com/synergy/applicationprojects
Self-service support resources:	
Documentation	www.renesas.com/synergy/docs
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Revision History

Rev.	Date	Description	
		Page	Summary
1.00	Jul.31.17	-	Initial release
1.01	Nov.27.17	-	Update to Hardware and Software Resources Table Editing and release
1.02	Jan.31.19	-	Minor updates to application project settings
1.03	Apr.26.19	-	Updated for SSP v1.6.0
1.04	Sep.30.19	-	Updated for SSP v1.7.0
1.05	Jul.14.22	-	Updated for SSP v2.2.0

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