



CYPRESS

Cypress USB 2.0 Mass Storage Device Driver for Windows

Introduction

Microsoft Windows® Operating Systems such as Windows ME, Windows 2000 and Windows XP were released with a USB Mass Storage Class (MSC) Driver built into them. Because of this, no other device driver is required for a Mass Storage Compliant device to operate on these operating systems. Windows 98SE on the other hand, does not have a MSC driver and so a device driver must be provided. The exception to this is with an ISD-200 attached to an ATA device. In this case the Cypress driver is required in any OS. On the operating systems that do include a Mass Storage Class driver, the feature set is limited to the required features. To achieve functionality beyond what the MSC drivers provide, and to provide support for Windows 98SE, Cypress has developed their own Mass Storage Class driver.

Note: This document is not intended to instruct the reader on how to create a Mass Storage driver. For details on how to create a Mass Storage driver visit Microsoft's web page.

Background

The MSC driver included in Windows ME, Windows 2000 and Windows XP has basic functionality to communicate with mass storage devices through the USB 2.0 host. For many operations this is completely satisfactory. There may be other cases where a customer desires additional functionality.

The Cypress driver has the following additional features available:

- Supports the ATA Security feature set, allowing password protection to be set on an ATA device.
- Provides support for interrupt driven events.
- Gives the user the ability to hide the device from the tray icon.
- Supports a performance enhancement feature for High-speed devices.
- Allows custom strings to be displayed in the Device Manager.
- Issues extra commands during initialization for a higher device connectivity rate with ISD-200 and ISD-300 devices.

The Cypress MSC driver can be downloaded from the Cypress web site at www.cypress.com and is found in the reference design area. Once the driver is downloaded the .inf file must be modified to include the VID/PID and strings for your company. This is required for the Operating System (OS) to use the Cypress driver. Instructions for modifying the VID/PID and custom strings can be found with the drivers on the Cypress web site.

The intent of this document is to explain the additional features of the Cypress driver in more detail and outline how to use them. Note that the pictures shown in this document are

taken from a Windows 2000 operating system. If you are using a different Windows operating system the operations explained may be slightly different. Refer to Windows help in your OS for assistance in accessing Windows functions such as device manager.

Accessing Driver Features

The easiest way to access the options available through the Cypress MSC driver is to place the mouse pointer over the Cypress tray icon in the system tray and press the right mouse button. When this is done you should see something similar to *Figure 1*. The text found in the pop-up box will be determined during enumeration from an identify command. In this case an IBM-DJSA-210 HDD (Hard Disk Drive) was connected to the bridge chip. If multiple devices were enumerated using the Cypress MSC driver on the system they would also be displayed in this list.

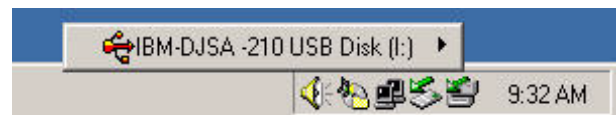


Figure 1.

When the cursor is moved up to the pop-up box (in this case IBM-DJSA-210), you should see something like what is shown in *Figure 2*. This is the easiest way to access the HDD security feature (Protect) and the driver properties. If the connected drive does not support security features or the driver has been modified to disallow the security features, the Protect selection will not be displayed.



Figure 2. Access Driver Options

Safely Remove

The top selection shown in *Figure 2* is labeled Safely Remove. This does exactly the same thing as if the left mouse button was pressed when the cursor was over the tray icon and Safely Remove was selected. A Safe removal should always be done before a device is disconnected from the USB bus to ensure the cache is flushed before unplugging the connected device. This will keep the device from losing or corrupting data. A safe removal will also make sure the device is not being accessed by another program and alert the user if necessary.

Protect

The next selection, labeled "Protect," will give the user the ability to password protect their HDD. There are three items that must be true to enable password protection. These are:

1. The attached device must support the Security Mode Feature set as defined in the ATA/ATAPI specification. The support of Security is determined from an IDENTIFY DEVICE command (Word 128 bit 0).
2. The attached device must be an ATA device.
3. The bridge chip must support ATACB command. The ISD-300A1 and the ISD-200 parts are examples of such ICs.
4. ATA Security must be enabled in the driver's .inf file.

The Cypress driver uses the Maximum level of security defined. The master password is fixed and can only perform a security erase if the user forgets the password. The master password cannot unlock the user data on the drive. When protecting the drive, the complete drive will be protected even if it has multiple partitions.

If the above mentioned conditions are met and the user selects Protect, the dialog box shown in *Figure 3* will be displayed. There are some applications where you do not want the security protection to be allowed at all. In this case the .inf file can be modified to disable the security feature (See Flags section of this document for more details).



Figure 3. Password Entry

Note that the device that you are about to protect is labeled in the title box of this window to assist the user in identifying which drive is going to be protected. To enable this feature enter a password once in the Enter Password box and again in the Verify Password box, which reduces the possibility of spelling errors that would keep the user from being able to access their data at a later time. If the password is forgotten, the only way to get access to the drive again is to erase the drive and the user will lose all information previously stored on the drive.

Once the drive is password protected the Tray Icon will change to indicate a locked device is connected. This icon is shown in *Figure 4*. Any time the drive is re-enumerated the operator will be required to enter the password to gain access to the data on the drive again.



Figure 4. Locked Tray Icon

To gain access to the drive contents or remove the password protection from the HDD right-click on the "Locked tray icon" and select "UnProtect" as shown in *Figure 5*.



Figure 5. Unprotect HDD

Figure 6 shows the dialog box that will prompt the user for the correct password. To disable protection from this point forward check the box labeled "Disable Protection". The dialog box shown in *Figure 7* shows a successful unprotect operation, which will gain access to the HDD contents. The next time the drive is reconnected it will go through this process again unless of course Disable Protection was checked.



Figure 6. UnProtect Dialog Box



Figure 7. Drive Successfully Unprotected

I Forgot

If the user cannot remember the password that was assigned to the HDD and presses the "I Forgot" button shown in *Figure 6*, a dialog box will be displayed with a warning letting them know that to gain access to the HDD all data will be permanently erased from the HDD. There will be an option to continue with the erase or to abort. If the user chooses to erase the data a Security Erase Prepare followed by a Security Erase Unit will be performed (these commands are documented in the ATA/ATAPI specification).

Properties

When the user selects "Properties" in the pop-up menu from the tray icon (see *Figure 2*), the properties sheet will be displayed as shown in *Figure 8*. There are two options in the properties sheet.

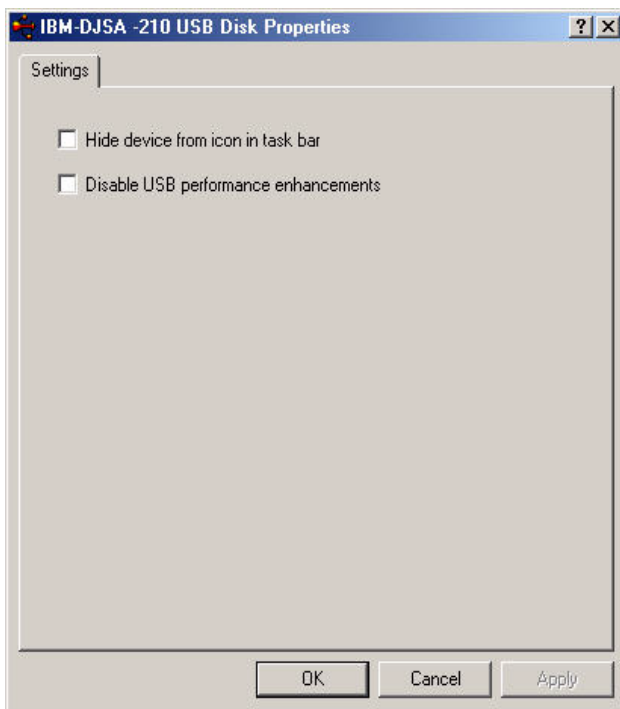


Figure 8. Properties Sheet

Hide Device from Icon Bar

When the "Hide device from icon in task bar" box is checked the chosen device, in this example the IBM-DJSA-210 HDD, will be hidden in the system tray. If there is more than one device connected using the Cypress MSC driver, then by default all the devices will be shown when you select the tray icon. By checking the "Hide device from icon in task bar," that device will no longer show up in the list of devices. If there is only one device connected with the Cypress driver, then the tray icon associated with the Cypress driver will no longer be visible.

To make the tray icon visible in the System Tray again, the user would need to go to the Device Manager to get access to the driver. To get to the Device Manager, right-click on My Computer (in Windows XP "My Computer" is accessed from the "Start" bar) and select Properties as shown in *Figure 9*.

Next, select Device Manager in the Hardware Page as shown in *Figure 10*. Again accessing the Device Manager in the various versions of Windows varies slightly. By default the tray icon is displayed, but there are some cases where you may want the tray icon to be off by default. To force the tray icon to be off by default you can modify the appropriate information file (i.e., tpp300.inf). For more details on how set the defaults, see the "Flags" section of this document. This will need to be done before the driver is installed or during the installation the operating system will make registry modifications and the changes you make will not take effect.



Figure 9.

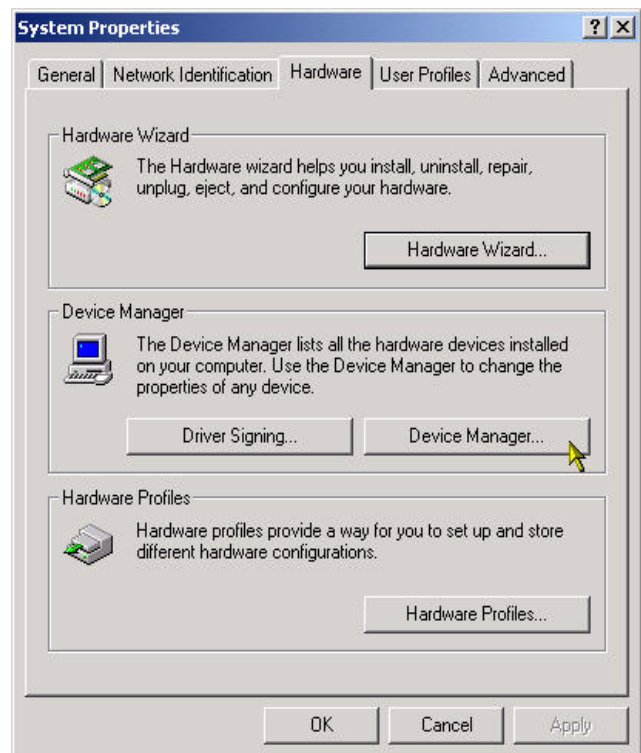


Figure 10.

Figure 11 shows a typical device manager window with the USB controllers section expanded. In this case there are two devices enumerated on the system. One is using the Microsoft Mass Storage Class driver while the other device is using the Cypress Mass Storage Class driver. The string displayed for the Cypress driver will vary depending on the customization done in the driver for each Vendor ID (VID) and Product ID (PID). To access the property sheet for the Cypress driver right-click on the Cypress driver string, which in this example is "USB Storage Adapter V3 (TPP)". The user will then see the driver property sheet shown in Figure 8 and the tray icon can be turned back on.



Figure 11.

Disable USB Performance Enhancements

The second option available under the Properties sheet (see Figure 8) is to Disable USB Performance Enhancements. Mass Storage transactions over USB consist of three phases: Command, Data, and Status phase. Normally these phases occur sequentially. The performance enhancement will set up all phases at once to reduce the set-up overhead. This results in decreased latency and improves performance in some cases. Not all devices benefit from the performance enhancement feature so this option can be disabled if it is causing problems for a particular device. This option will not be available or even visible if the device is enumerated on a Full-speed host or if it is disabled in the information file. For details on how to disable this in the .inf file see the flags section of this document. The modifications to the .inf file must be done before the driver is installed or the registry will not get updated to reflect the changes.

Note: In Windows XP Service Pack 1 and Windows 2000 Service Pack 3, the EHCI (Enhanced Host Controller Interface) drivers are incompatible with the Performance Enhancement feature.

Interrupt Support

The Cypress Mass Storage driver has support for interrupt driven events. Interrupts are received by the Cypress MSC driver and held until a background application, TPPALDR (AutoLoader), polls the driver and detects the interrupt. The polling interval for TPPALDR can be set via registry entry.

When the Cypress driver loads, TPPALDR is also launched. It in turn, can be set up to spawn an interrupt handling application. Presently, the application that TPPALDR spawns is

the tray icon application to safely remove the device. When TPPALDR detects an interrupt, it broadcasts the information so any application on the system can monitor the interrupts generated from the ISD-300A1 or FX2.

TPPALDR can be configured in the .INF file to load a different application, additional applications, or no application at all. If configured not to load the system tray application, then the tray icon would no longer appear, but interrupts would still be enabled.

The following lines show an example of the inf file where the application and polling interval is specified. Note that there is a different section for Windows 98 based systems (98SE and ME) and Windows NT systems (XP and 2000)

```
[TPP300.AddReg.AutoLoader]
```

```
HKLM,%REGRUNONCE%,AutoLoaderSetup,, "tppaldr.exe -setup"
```

HKR,,AutoLoader,, "tppstay.exe" ; This line specifies tpp-systray.exe is executed when an interrupt is generated.

HKR,,ALTimer,0x00010001,3000 ; This line specifies that the polling interval is 3 seconds.

```
[TPP300.AddRegNT.AutoLoader]
```

```
HKR,,AutoLoader,, "tppntry.exe" ; This line specifies tpp-systray.exe is executed when an interrupt is generated.
```

```
HKR,,ALTimer,0x00010001,3000 ; This line specifies that the polling interval is 3 seconds.
```

To utilize the interrupts on the ISD-300A1 several items must be considered.

1. The board must be laid out to invoke the interrupt.
2. The EEPROM must be configured to use the GPIO pins.
3. Cypress driver 6.0 or greater is required with the appropriate inf file modified to enable the interrupt and tppaldr for the application.
4. The driver must be customized for specific VID/PID combinations.

The full interrupt support is beyond the scope of this application note and is mentioned here merely to make the reader aware of the interrupt functionality. A separate application note may be available covering all the details necessary for implementing interrupts.

Cypress Driver Icon Descriptions

The Cypress driver uses various icons to visually show the user the status of the connected device. This section describes what the various icons are intended to show.

Device icons seen in pop ups from system tray icons.



This device icon shows that the device is connected as a high-speed device. The user will see this to the left of the identify information of each device. An example of this can be seen in Figure 1.



This device icon shows that the connected device is a high-speed device and it is currently password protected and locked. An example of this can be seen in Figure 5.



This device icon indicates that the connected device is enumerated as a full-speed device.



This device icon indicates that the connected device is full-speed and it is password protected and locked.

System Tray Icons Seen in the System Tray



This tray icon is the standard icon seen in the task bar, which gives the user access to the features of the driver. An example of this is shown in *Figure 1*.



This tray icon indicates that the device cannot access the media in the drive.



This tray icon indicates that there are unlocked password protected disks attached to the driver. An example of this is shown in *Figure 5*.

Driver File Definition

The driver consists of several files. Each of the files are listed below with a brief description of their purpose. The filenames are shown with their Cypress default names. Starting with version 6.0 of the Cypress MSC driver, the first three letters of the filename can be customized for individual customers on request (contact your local Sales/FAE for assistance in this process).

Note: the various .inf files communicate the pertinent information to the OS for a proper installation of the driver.

tp200.inf: Windows information file for ISD-200 based products (supported in Version 5.x of the Cypress MSC driver only).

tp200.sys: System driver file for ISD-200 based products (supported in 5.x Cypress MSC driver only).

tp300.inf: Windows information file for ISD-300 based products.

tp300.sys: System driver file for ISD-300 based products.

tpafx.inf: Windows information file for EZ-USB FX™, EZ-USB FX2™ and EZ-USB AT2™ based storage products.

tpafx.sys: System driver file for EZ-USB FX, EZ-USB FX2 and EZ-USB AT2 based storage products.

tpsl11r.inf: Windows information file for SL11R-IDE based storage products.

tpsl11r.sys: System driver file for SL11R-IDE based storage products.

tpiostb.inf: Windows information file for the tpiostb.sys file.

tpiostb.pdr: I/O supervisor port driver used in Windows 98SE and ME to interface to the host driver.

tpiosmp.sys: I/O supervisor filter driver used in Windows 98SE and ME to interface between the OS and the next level drivers.

tpalldr.exe: Autoloader background application.

tpntry.exe: System tray application for Windows 2000 and Windows XP.

tpstray.exe: System tray application Windows 98SE and Windows ME.

TPUI16.dll: 16-bit user interface library (Property sheet).

TPUI32.dll: 32-bit user interface library (Property sheet).

tpun.exe: Uninstaller program called by add/remove programs in the control panel.

tpcoins.dll: Coinstaller (starts tpalldr.exe at plug and play installation).

Driver Signing

The Cypress Mass Storage Driver is not a signed driver. This is more of an issue with the advent of Windows XP since it warns the user that the driver is not signed and that by installing the driver the system could become unstable as seen in *Figure 12*. Cypress has not taken the driver to be signed due to the fact that any time any portion of a driver changes, the driver must get a new digital signature. Since each customer has their own unique VID and PID, it would be unreasonable to do this for each customer. The complete signing is also done with the vendor's hardware, which prohibits Cypress from being able to provide a signed driver for each of its customers.



Figure 12.

Starting with Version 6.0 of the Cypress MSC driver, it is possible to get a unique GUID and custom filenames for each customer. To request this feature, contact your local Sales/FAE and they can assist you in your request.

The submittal process for getting a driver signed by Microsoft is explained in detail in their WHQL (Windows Hardware Quality Labs) web pages. A simple search for "WHQL driver signature" should provide you with links to good resources and information you need for getting your version of the driver signed.

The following is a list of steps that should be considered when getting the driver signed.

1. First it will be necessary to generate a 0 length Catalog file for all drivers that have an inf file associated with them. For example a typical inf file in the Cypress driver would be the tpp300.inf file. You would need to create a file that has nothing in it and name it tpp300.cat. This would be the file for Windows 98 based OS. It is also necessary to create a catalog file for NT based OS and rename it tpp300nt.cat. The name of this file must correlate to the file stated in the next step.
2. A reference to the catalog file must be placed in the inf file. This is done as shown in the following example of a tpp300.inf file:


```
[Version]
Signature = "$CHICAGO$"
Class = USB
ClassGUID =
{36FC9E60-C465-11CF-8056-444553540000}
Provider = %CY%
CatalogFile = tpp300.cat
CatalogFile.NT = tpp300nt.cat
DriverVer=04/06/2002
```
3. Run the tools available from Microsoft for verifying the signability of the driver.
4. Submit the driver according to the procedures outlined on Microsoft's web.

Flags (.inf file configurable)

The Cypress driver's features can be modified during the initial installation by modifying the flags. Once the driver is installed, the values of the flags are recorded in the registry. This means if you modify the flags at a different time you would need to completely uninstall the driver and re-install it. This may require editing of the registry.

Configurable Flags

The .inf file for the appropriate driver must be modified for the various options. Not all options are available in the various drivers. For example password protection is not normally supported in the FX2 mass storage design. The flags are set or cleared in the tppflags entry found under the [tppxx.AddReg.Flags] section in the .inf file.

For this example the tpp300.inf file will be referenced because it has the most available options.

In tpp300.inf the tppflags entry would normally be set to:

```
[TPP300.AddReg.Flags]
```

```
HKR,,TPPFlags,0x00010001,0x00100000
```

There are two double words (dWord) in this entry. The first dWord indicates that the Windows Registry entry is a dWord.

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We will only concern ourselves with the second dWord, which is 0x00100000. *Table 1* shows a mapping of the bits.

Bit 4 of byte 2, which is set to 1 in the above example, is an enable for the ATA Security features. When set to 1 the driver will enable security features if all other conditions are met. In some cases, you may not want the user to ever be able to enable the security features on the HDD and can clear this bit.

Bit 3 of Byte 2 enables interrupt-driven events.

Bit 2 of Byte 2 enables APM on the ISD-200 based products.

Table 1. TPPFlags

Byte	Byte 3				Byte 2				Byte 1				Byte 0													
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0		
Val	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Another option for configuring settings in the driver is with an entry called TPPSettings. This is very similar to TPPFlags but may not be available in all versions of the driver. Also note that between version 5.x and 6.x the driver definition for these settings has changed. TPPSettings has to do with the default condition of the items in the driver property sheet. These items are defined in a previous section of this document. The definition in the inf file would look like the following:

```
[TPP300.AddReg.Flags]
```

```
HKR,,TPPFlags,0x00010001,0x00100000
```

```
HKR,,TPPSettings,0x00010001,0x00000002
```

In this example we again are concerned with the second value, which in this case is 0x00000002. The configurable bits for the TPPSettings are:

In version 6.x of the Cypress MSC driver, Bit 0 of Byte 0 enables the visibility of the tray Icon in the system tray.

In version 5.x of the Cypress MSC driver setting the bit will set the "Hide icon from tray" bit thus hiding the tray icon in the system tray (see Driver Properties sheet explanation earlier in this document).

Bit 1 of Byte 0, which in our example is set to 0, controls the "Disable Performance enhancements" feature in the property sheet.

In version 6.x of the Cypress MSC driver this bit would be set to 0, which does not enable the performance enhancements.

In version 5.x of the Cypress MSC driver this bit would be set to 1, which disables performance enhancements.

Table 2. TPPSettings

Byte	Byte 3				Byte 2				Byte 1				Byte 0											
Bit	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0
Val	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1