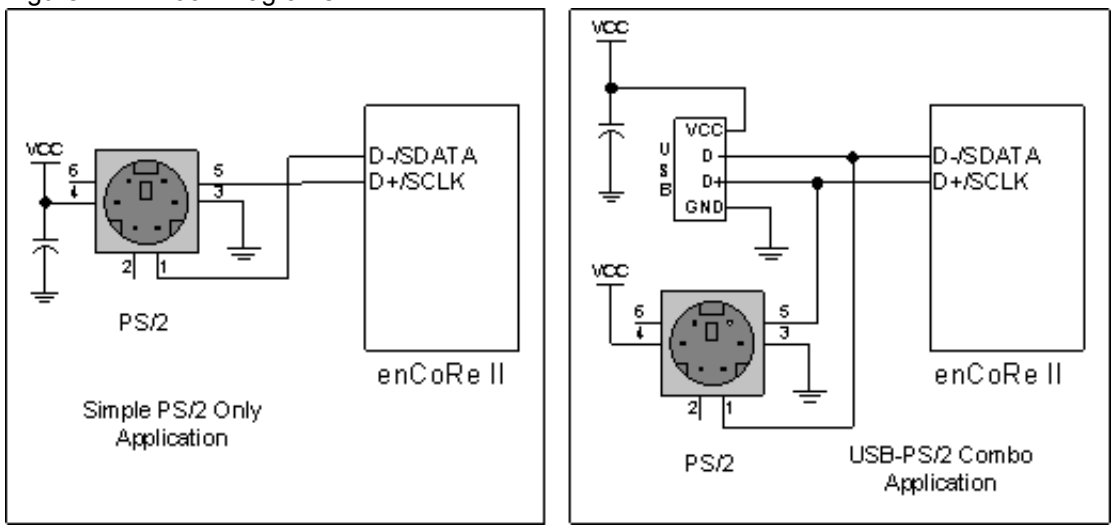
PS/2 Device Datasheet PS2D V 1.2

Resources	API Memory (Bytes)		Pins
	flash	RAM	
CY7C639/638/633/602/601xx			
Mouse Support	935	17 (including 4 byte transfer buffer)	2
Keyboard Support	810	17 (including 4 byte transfer buffer)	2

Features and Overview

- PS/2 Device Interface
- Selectable command sets for mouse or keyboard applications
- Custom feature unlock mechanism
- Integrated with the USB SIE for combo USB-PS/2 applications

Figure 1. Block Diagrams



Functional Description

The PS/2 Device User Module supports a standard PS/2 keyboard or a standard PS/2 mouse. A PS/2 connector is a 6-pin mini-DIN connector. It can be used for connecting either a keyboard or a mouse with a compatible computer. You must choose to support either a keyboard or a mouse with the PS/2 Device User Module. Choose to support either the keyboard command set or the mouse command set when you select the user module. If you wish to change from one to the other after the user module is selected, right click on the user module icon and select **User Module Selection Options**. By convention, connectors that support keyboards are color coded purple, and ports that support mice are color coded green. With the addition of the USB Device User Module, you can create a single device that supports a USB and PS/2 combination device.

Data Format

Host to Device Data Format (12 bits):

- Request to Send. (0)
- 8 data bits.
- Parity bit. (Odd Parity)
- Stop bit. (1)
- Acknowledge. (1)

Device to Host Data Format (11 bits):

- Start bit. (0)
- 8 data bits.
- Parity bit. (Odd Parity)
- Stop bit. (1)

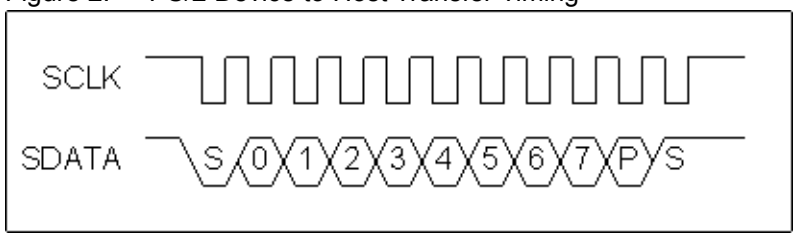
DC and AC Electrical Characteristics

See the device datasheet for your enCoRe device for electrical characteristics.

Timing

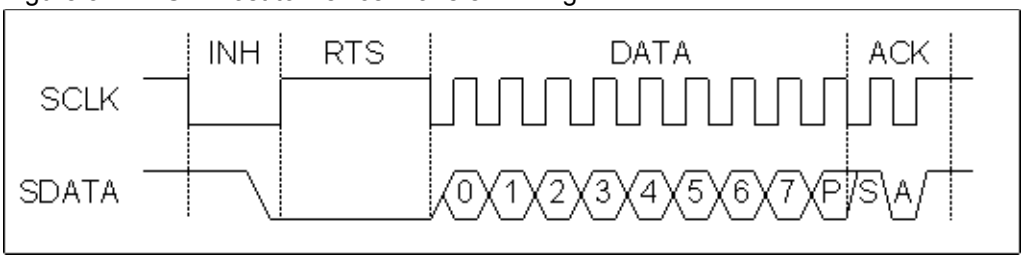
The following timing diagrams describe the PS/2 timing requirements for proper PS/2 data transmission and reception. The PS/2 Device is responsible for generating all of the clock signals on SCLK for both Host to Device and Device to Host transfers.

Figure 2. PS/2 Device to Host Transfer Timing



During Device to Host transfers, the Device controls both SCLK and SDATA. The Device maintains a consistent SCLK cycle between 10 kHz and 14.6 kHz. The Device updates SDATA on while SCLK is high, and the Host sample SDATA when SCLK is low.

Figure 3. PS/2 Host to Device Transfer Timing



Four distinct phases occur during a Host to Device transfer. First, the Host pulls SCLK low, indicating an Host Inhibit condition. During an Inhibit, the Device must stop any transfer in progress and release both SCLK and SDATA. Next, the Host pulls SDATA low, and releases SCLK, signaling a Request to Send to the Device. During the data transfer phase, the Device cycles SCLK. The Host updates SDATA when SCLK is low. The Device samples SDATA when SCLK is high. The falling edge of the parity bit starts the Acknowledgment Phase. The Host releases SDATA, forming the stop bit. After sampling SDATA, the Device acknowledges receipt of the data, by driving SDATA low. The Host samples SDATA on the low SCLK for the acknowledgment.

Placement

The PS2 Device User Module is software only and does not consume enCoRe blocks.

Parameters and Resources

PS2D Port

Choose the port for the PS2 data and clock pins. If you plan to create a dual PS2/USB device, choose the port that the USB transceiver is attached to.

TxBufferSize

This parameter determines how many RAM locations are reserved for the transmit buffer. The transit buffer must accommodate the largest data packet generated by the application.

Application Programming Interface

The Application Programming Interface routines in this section allow programmatic control of the PS/2 User Module. The following tables list the basic and device specific API functions.

Note When using this the PS2D User Module and GPIO pins from Port n (Pn.2-Pn.7), the application should use the Port_n_Data_SHADE shadow register to ensure consistent data handling. From assembly language, you can access the Port_n_Data_SHADE RAM location directly. From C language, you should include an extern reference:

```
extern BYTE Port_n_Data_SHADE;// Where n is the port number
```

Table 1. Basic PS/2 Device API

Function	Description
void PS2D_Start(void)	Enable user module.
void PS2D_Stop(void)	Disable user module.
BYTE PS2D_DoCommand(void)	Receives and processes a PS/2 Host Command if the Host requests to send one. This function should be called at least once every 1-2 milliseconds.
void PS2D_SendNextByte(void)	Transmit the next byte in the transmit buffer.
BYTE PS2D_TranserInProgress(void)	Returns 1 if a transfer to the PS/2 Host is in progress, otherwise returns 0
void PS2D_SendResponseResend(void)	Resend the contents of the PS/2 transmit buffer.
void PS2D_AbortTransfer(void)	Abort the current transfer.

Table 2. Device Specific API (Mouse)

Function	Description
BYTE PS2D_GetDeviceID(void);	Returns the Device ID. The PS2D supports two mouse Device IDs. Device ID 0 is returned as the default Mouse Device Id. The host expects a three byte mouse data packet for Device ID 0. Device ID 3 is return for scroll wheel mice. This feature is automatically activated by a series of Set Resolutions Commands from the host. (200, 100, 80). The host expects a four byte mouse data packet for Device ID 3.
BYTE PS2D_IsEnabled(void)	Returns 1 if the host has enabled Data Reporting with the "Enable Data Reporting", otherwise returns 0.
BYTE PS2D_IsStreamMode(void);	Returns 1 if the interface is in streaming mode, otherwise 0.
BYTE PS2D_GetSampleInterval(void);	Returns the sample interval (milliseconds).

Table 3. Device Specific API (Keyboard)

Function	Description
WORD PS2D_GetDeviceID(void);	Returns the Device ID.
BYTE PS2D_IsEnabled(void)	Returns 1 if the host has enabled the keyboard, otherwise returns 0.
BYTE PS2D_GetScanCodeSet(void);	Returns the current Scan Code Set selected by the PS/2 Host
BYTE PS2D_GetRepeatRate(void);	Returns the current Typematic Repeat Rate selected by the PS/2 Host
BYTE PS2D_GetDelay(void);	Returns the current Typematic Delay selected by the PS/2 Host
BYTE PS2D_GetLED(void);	Returns the current LED settings selected by the PS/2 Host

PS2D_Start

Description:

Performs all required initialization for PS/2 Device User Module.

C Prototype:

```
void  PS2D_Start(void)
```

Assembly:

```
lcall  PS2D_Start
```

Parameters:

None

Return Value:

None

Side Effects:

The A and X registers may be altered by this function.

PS2D_Stop

Description:

Performs all necessary shutdown task required for the PS/2 User Module. This function should be called in PS/2-USB combi applications when the actual interface is determined to be connected to a USB host.

C Prototype:

```
void  PS2D_Stop(void)
```

Assembly:

```
lcall  PS2D_Stop
```

Parameters:

None

Return Value:

None

Side Effects:

The A and X registers may be altered by this function.

PS2D_DoCommand

Description:

Receive and process a command from the PS/2 Host

C Prototype:

```
BYTE  PS2D_DoCommand(void)
```

Assembly:

```
lcall  PS2D_DoCommand
```

Parameters:

None

Return Value:

Returns a non-zero value if a PS/2 command had been received and processed.

Side Effects:

The A and X registers may be altered by this function.

PS2D_SendNextByte

Description:

Sends the next byte in the transmit buffer to the PS/2 Host.

C Prototype:

```
void  PS2D_SendNextByte(void)
```

Assembly:

```
lcall  PS2D_SendNextByte
```

Parameters:

None

Return Value:

None

Side Effects:

The A and X registers may be altered by this function.

PS2D_TransferInProgress

Description:

Determines if a PS/2 transfer is in progress.

C Prototype:

```
BYTE  PS2D_TranserInProgress(void)
```

Assembly:

```
lcall  PS2D_TranserInProgress
```

Parameters:

None

Return Value:

Returns a non-zero value if a PS/2 transfer is in progress.

Side Effects:

The A and X registers may be altered by this function.

PS2D_SendResponseResend

Description:

Resend the contents of the PS/2 transmit buffer.

C Prototype:

```
void  PS2D_SendResponseResend(void)
```

Assembly:

```
lcall  PS2D_SendResponseResend
```

Parameters:

None

Return Value:

None

Side Effects:

The A and X registers may be altered by this function.

PS2D_AbortTransfer

Description:

Abort the current transfer.

C Prototype:

```
void  PS2D_AbortTransfer(void)
```

Assembly:

```
lcall  PS2D_AbortTransfer
```

Parameters:

None

Return Value:

None

Side Effects:

The A and X registers may be altered by this function.

Device Specific API (Mouse)

PS2D_GetDeviceID

Description:

Returns the Device ID.

C Prototype:

```
BYTE  PS2D_GetDeviceID(void)
```

Assembly:

```
lcall  PS2D_GetDeviceID
```

Parameters:

None

Return Value:

Device ID

Side Effects:

The A and X registers may be altered by this function.

PS2D_IsEnabled

Description:

Returns 1 if the interface is enabled, otherwise returns 0.

C Prototype:

```
BYTE  PS2D_IsEnabled(void)
```

Assembly:

```
lcall  PS2D_IsEnabled
```

Parameters:

None

Return Value:

None

Side Effects:

The A and X registers may be altered by this function.

PS2D_IsStreamMode

Description:

Returns 1 if the interface is in streaming mode, otherwise 0.

C Prototype:

```
BYTE  PS2D_IsStreamMode(void)
```

Assembly:

```
lcall  PS2D_IsStreamMode
```

Parameters:

None

Return Value:

Stream Mode

Side Effects:

The A and X registers may be altered by this function.

PS2D_GetSampleInterval

Description:

Returns the sample interval (milliseconds) set by the PS/2 Host

C Prototype:

```
BYTE  PS2D_GetSampleInterval(void)
```

Assembly:

```
lcall  PS2D_GetSampleInterval
```

Parameters:

None

Return Value:

Sample Interval

Side Effects:

The A and X registers may be altered by this function.

Device Specific API (Keyboard)

PS2D_GetDeviceID

Description:

Returns the PS/2 ID for keyboards

C Prototype:

```
WORD  PS2D_GetDeviceID(void)
```

Assembly:

```
lcall  PS2D_GetDeviceID
```

Parameters:

None

Return Value:

PS/2 ID for keyboards (0xAB83)

Side Effects:

The A and X registers may be altered by this function.

PS2D_IsEnabled

Description:

Returns 1 if the interface is enabled, otherwise returns 0.

C Prototype:

```
BYTE  PS2D_IsEnabled(void)
```

Assembly:

```
lcall  PS2D_IsEnabled
```

Parameters:

None

Return Value:

None

Side Effects:

The A and X registers may be altered by this function.

PS2D_GetScanCodeSet

Description:

Returns the Scan Code Set selected by the PS/2 Host

C Prototype:

```
BYTE  PS2D_GetScanCodeSet(void)
```

Assembly:

```
lcall  PS2D_GetScanCodeSet
```

Parameters:

None

Return Value:

Scan Code Set

Side Effects:

The A and X registers may be altered by this function.

PS2D_GetRepeatRate

Description:

Returns the Typematic Rate selected by the PS/2 Host

C Prototype:

```
BYTE  PS2D_GetRepeatRate(void)
```

Assembly:

```
lcall  PS2D_GetRepeatRate
```

Parameters:

None

Return Value:

Repeat Rate

Side Effects:

The A and X registers may be altered by this function.

PS2D_GetDelay

Description:

Returns the Typematic Delay selected by the PS/2 Host

C Prototype:

```
BYTE  PS2D_GetDelay(void)
```

Assembly:

```
lcall  PS2D_GetDelay
```

Parameters:

None

Return Value:

Typematic Delay

Side Effects:

The A and X registers may be altered by this function.

PS2D_GetLED

Description:

Returns the current LED setting set by the PS/2 Host

C Prototype:

```
BYTE  PS2D_GetLED(void)
```

Assembly:

```
lcall  PS2D_GetLED
```

Parameters:

None

Return Value:

```
LED Setting Bitmap.
Bit 0 Scroll Lock (0=Off, 1=On)
Bit 1 Num Lock (0=Off, 1=On)
Bit 2 Caps Lock (0=Off, 1=On)
```

Side Effects:

The A and X registers may be altered by this function.

Application Data Transfer API

For efficiency considerations, the PS2D User Module does not provide a function interface for loading the transfer buffer. Instead, the application loads the transfer buffer directly. The application is responsible for making sure no transfer is underway before loading the transfer buffer by calling PS2D_TranserInProgress. The application must guard against a buffer overrun using the PS2D_TX_BUFFER_SIZE. After the buffer is loaded, a transfer is started by invoking the PS2D_StartTransfer macro, specifying the transfer size as the only parameter.

PS/2 Low Level Driver

The PS2D User Module low level driver handles all data transfer between the application and the PS/2 Host. The driver is invoked by periodic calls to PS2D_DoCommand and PS2D_SendNextByte. PS2D_DoCommand must be call at least every 5 milliseconds. When PS2D_TransferInProgress indicates that a transfer is active, PS2D_SendNextByte should be called at intervals of not greater than 2 ms.

In order to guarantee proper responses to host commands, the application must not start a data transfer unless the preceding call to PS2D_DoCommand indicates that no command was not processed. Certain commands require additional data exchange for specific command parameters. Of course, the application must not start a new data transfer while an existing transfer is in progress.

Mouse Application Support

The following table displays a list of the commands that may be sent to the mouse. Before sending any other commands, check the status of the mouse - if the mouse is in stream mode, the host should disable the reporting of data. Command 0xF5 may be used to disable data reporting.

Table 4. Mouse Command Set

Command	Description	S=Supported U=Unsupported
0xFF (Reset)	The mouse responds to this command with "acknowledge" (0xFA) then enters Reset Mode.	S
0xFE (Resend)	The host sends this command whenever it receives invalid data from the mouse. The mouse responds by resending the last packet it sent to the host. If the mouse responds to the "Resend" command with another invalid packet, the host may either issue another "Resend" command, issue an "Error" command, cycle the mouse's power supply to reset the mouse, or it may inhibit communication (by bringing the Clock line low). The action taken depends on the host.	S
0xF6 (Set Defaults)	The mouse responds with "acknowledge" (0xFA) then loads the following values: Sampling rate = 100, Resolution = 4 counts/mm, Scaling = 1:1, Disable Data Reporting. The mouse then resets its movement counters and enters stream mode.	S
0xF5 (Disable Data Reporting)	The mouse responds with "acknowledge" (0xFA) then disables data reporting and resets its movement counters. This only effects data reporting in Stream mode and does not disable sampling. Disabled stream mode functions the same as remote mode.	S
0xF4 (Enable Data Reporting)	The mouse responds with "acknowledge" (0xFA) then enables data reporting and resets its movement counters. This command may be issued while the mouse is in Remote Mode (or Stream mode), but it only effects data reporting in Stream mode.	S
0xF3 (Set Sample Rate)	The mouse responds with "acknowledge" (0xFA) then reads one more byte from the host. The mouse saves this byte as the new sample rate. After receiving the sample rate, the mouse again responds with "acknowledge" (0xFA) and resets its movement counters. Valid sample rates are 10, 20, 40, 60, 80, 100, and 200 samples/sec.	S
0xF2 (Get Device ID)	The mouse responds with "acknowledge" (0xFA) followed by its device ID (0x00 for the standard PS/2 mouse.) The mouse should also reset its movement counters.	S
0xF0 (Set Remote Mode)	The mouse responds with "acknowledge" (0xFA) then resets its movement counters and enters remote mode.	S
0xEE (Set Wrap Mode)	The mouse responds with "acknowledge" (0xFA) then resets its movement counters and enters wrap mode.	S

Command	Description	S=Supported U=Unsupported
0xEC (Reset Wrap Mode)	The mouse responds with "acknowledge" (0xFA) then resets its movement counters and enters the mode it was in before wrap mode (Stream Mode or Remote Mode.)	S
0xEB (Read Data)	The mouse responds with acknowledge (0xFA) then sends a movement data packet. This is the only way to read data in Remote Mode. After the data packets has been successfully sent, it resets its movement counters.	S
0xEA (Set Stream Mode)	The mouse responds with "acknowledge" then resets its movement counters and enters stream mode.	S
0xE9 (Status Request)	The mouse responds with "acknowledge" then sends the following 3-byte status packet (then resets its movement counters.):	S
0xE8 (Set Resolution)	The mouse responds with acknowledge (0xFA) then reads one byte from the host and again responds with acknowledge (0xFA) then resets its movement counters. The byte read from the host determines the resolution.	S
0xE7 (Set Scaling 2:1)	The mouse responds with acknowledge (0xFA) then enables 2:1 scaling.	S
0xE6 (Set Scaling 1:1)	The mouse responds with acknowledge (0xFA) then enables 1:1 scaling.	S

Keyboard Application Support

The following table displays a list of all the commands the host may send to the keyboard:

Table 5. Keyboard Command Set

Command	Description	S=Supported U=Unsupported
0xFF (Reset)	Keyboard responds with "ack" (0xFA), then enters "Reset" mode.	S
0xFE (Resend)	Keyboard responds by resending the last-sent byte. The exception to this is if the last-sent byte was "resend" (0xFE). If this is the case, the keyboard resends the last non-0xFE byte. This command is used by the host to indicate an error in reception.	S
0xFD (Set Key Type Make)	Disable break codes and typematic repeat for specified keys. Keyboard responds with "ack" (0xFA), then disables scanning (if enabled) and reads a list of keys from the host. These keys are specified by their set 3 make codes. Keyboard responds to each make code with "ack". Host terminates this list by sending an invalid set 3 make code (for example, a valid command.) The keyboard then re-enables scanning (if previously disabled).	U
0xFC (Set Key Type Make/Break)	Similar to the Set Key Type Make command, except this one only disables typematic repeat.	U

Command	Description	S=Supported U=Unsupported
0xFB (Set Key Type Typematic)	Similar to the Set Key Type Make command and the Set Key Type Make/Break command, except this command only disables break codes.	U
0xFA (Set All Keys Typematic/Make/Break)	Keyboard responds with "ack" (0xFA). Sets all keys to their normal setting (generate scan codes on make, break, and typematic repeat)	U
0xF9 (Set All Keys Make)	Keyboard responds with "ack" (0xFA). Similar to 0xFD, except applies to all keys.	U
0xF8 (Set All Keys Make/Break)	Keyboard responds with "ack" (0xFA). Similar to 0xFC, except applies to all keys.	U
0xF7 (Set All Keys Typematic)	Keyboard responds with "ack" (0xFA). Similar to 0xFB, except applies to all keys.	U
0xF6 (Set Default)	Load default typematic rate/delay (10.9cps / 500ms), key types (all keys typematic/make/break), and scan code set.	S
0xF5 (Disable)	Keyboard stops scanning, loads default values, and waits further instructions.	S
0xF4 (Enable)	Re-enables keyboard after disabled using previous command.	S
0xF3 (Set Typematic Rate/Delay)	Host follows this command with a one-argument byte that defines the typematic rate and delay.	S
0xF2 (Read ID)	The keyboard responds by sending a two-byte device ID of 0xAB, 0x83. (0xAB is sent first, followed by 0x83.)	S
0xF0 (Set Scan Code Set)	Keyboard responds with "ack", then reads argument byte from the host. This argument byte may be 0x01, 0x02, or 0x03 to select scan code set 1, 2, or 3, respectively. The keyboard responds to this argument byte with "ack". If the argument byte is 0x00, the keyboard responds with "ack" followed by the current scan code set.	S
0xEE (Echo)	The keyboard responds with "Echo" (0xEE).	S
0xED (Set/Reset LEDs)	The host follows this command with a one-argument byte that specifies the state of the keyboard's Num Lock, Caps Lock, and Scroll Lock LEDs.	S

Sample Firmware Source Code

For examples of this user module usage, please refer to the CY4623 Kit projects available at www.cypress.com/go/cy4623.

Version History

Version	Originator	Description
1.2	DHA	Added Version History.

Note PSoC Designer 5.1 introduces a Version History in all user module datasheets. This section documents high level descriptions of the differences between the current and previous user module versions.