



Technical Reference Manual

PixiPoint® Extended PS/2 Protocol Specification

Preliminary

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Document revisions

Document revision history

Date	Version	Comments
2002/02/21	0.69	C.A. Edited for Semtech; terminology updates
1999/10/21	0.68	V.M. Added ESR.b6 (Disable USAR Gesture), defined default values for the XY / Z Gain and Direction Register when the Select pin is grounded.
1999/09/17	0.67	C.A. Reformatted and edited. Added a table listing the commands.
1999/09/16	0.66	V.M. Added commands and Table 5 for Direction control, changed logistics of Extended PS/2 commands and USAR "knocking" / Device ID.
1999/08/18	0.65	V.M. Added setting for disabling of the Z axis sampling (in Tap Sensitivity Register), Note for ESR.b1-b3, and changed wording in EStatus Register
1999/08/12	0.64	V.M. Added levels for Tap Sensitivity, Note for the value of the Extended Status Register, and changed text for the Power-down command
1999/07/02	0.63	V.M. Added commands for Z Gain and Code CheckSum
1999/05/07	0.62	V.M. Corrected size of Extended Status Register (Table 4)
1999/05/06	0.61	V.M. Added commands for Device Type, Version, and XY Gain
1999/04/22	0.60	V.M. First Draft

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PixiPoint® extended PS/2 specification

Normal operations

At power-up or reset, the PixiPoint® PS/2 pointing device acts as a standard legacy three-button mouse; as such, it fully supports all applicable PS/2 commands, issues three-byte reports, and has a device ID equal to zero. It can also be switched into wheelmouse mode by the special wheelmouse command sequence; in wheelmouse mode, it fully supports all PS/2 commands a standard wheelmouse supports, issues four-byte reports, and has a device ID equal to three.

These standard functions do not affect or interfere with the PixiPoint® extended PS/2 protocol or its proprietary controls.

Extended operations

The PixiPoint® extended PS/2 protocol includes (currently) 14 commands, 0xC0 through 0xCD. All these PixiPoint® extended PS/2 commands are available at any time regardless of the current mode of the device (either standard legacy mode with ID 0 and 3-byte reports, or wheelmouse mode with ID 3 and 4-byte reports).

In order to determine whether the device can accept the PixiPoint® extended PS/2 commands, the driver should perform a special "sequential" (a.k.a. "knocking") command, shown in Table 1 below. All elements of this sequential command are valid mouse commands, but the exact order and number of these commands are very unlikely to happen during operations of a standard mouse driver. The last command in the set is "Read device type" (0xF2). A PixiPoint® extended PS/2 protocol device responds to this command by returning a special value device ID; which value it returns depends on its capabilities. A special value is returned for the device ID only for a single "Read device type" (0xF2) command issued as part of the special sequential command. Other "Read device type" (0xF2) commands, not issued as part of the special sequential command, return the standard device ID for the current mode, either 0 or 3.

Read PixiPoint® extended ID sequential command

Command / data description	Host Data	Device Data
Set sampling rate	0xF3	
Acknowledgement		0xFA
80 reports/second	0x50	
Acknowledgement		0xFA
Set Sampling Rate	0xF3	
Acknowledgement		0xFA
60 reports/second	0x3C	
Acknowledgement		0xFA
Set sampling rate	0xF3	
Acknowledgement		0xFA
100 reports/second	0x64	
Acknowledgement		0xFA
Read device type	0xF2	
Acknowledgement		0xFA
PixiPoint® extended device ID		0x20

Table 1. Read PixiPoint® extended ID sequential command

The driver must check the device ID returned by the sequential command. Normal-mode-only pointing devices should always return a device ID of 0x00 or 0x03. If a device ID other than 0x20 is returned, it can not be assumed that the device can properly process PixiPoint® extended PS/2 commands.

If the correct device ID (0x20) is received, the driver may further initialize the pointing device with any appropriate proprietary controls, the correct mode (three-byte or four-byte report mode), the sampling rate, stream/prompt mode, and issue an Enable command to start operations.

Commands for the proprietary controls

Proprietary controls for the PixiPoint® pointing device are serviced with the following commands.

PixiPoint® extended PS/2 commands

Command byte	Command name	Number of data bytes sent to PixiPoint® (excluding command byte)	Number of data bytes returned by PixiPoint® (excluding acknowledge bytes)
0xC0	Set tap sensitivity	1	0
0xC1	Set translation profile	1	0
0xC2	Read extended status	0	1
0xC3	Write extended status	1	0
0xC4	Power down	0	0
0xC5	Read device type	0	1
0xC6	Read device version	0	1
0xC7	Read XY gain	0	1
0xC8	Write XY gain	1	0
0xC9	Read Z gain	0	1
0xCA	Write Z gain	1	0
0xCB	Read Checksum	0	3
0xCC	Read direction	0	1
0xCD	Write direction	1	0

Table 2. List of PixiPoint® extended PS/2 commands

Set tap sensitivity (0xC0)

This command byte is followed by one byte of data. The extended mode device responds to each of the two bytes with Acknowledge (0xFA). The value of the second byte is written to the tap sensitivity register which controls the tapping sensitivity of the PixiPoint® as shown in the following table.

Tap sensitivity register

Value	Meaning	Comment
0x00	OFF	Tap feature is disabled
0x01	Soft	Default, recommended setting
0x02	-	
0x03	Medium	
0x04	-	
0x05	Hard	
0x06	-	
0x07	Very Hard	
0x08 – 0x7F	-	All these values are reserved
0x80	OFF	Z-axis sampling is stopped
0x81 – 0xFF	-	All these values are reserved

Table 3. Tap sensitivity register

Note: If Z-axis functionality is not required, some 25% savings in power consumption by the PixiPoint® can be realized by termination of the Z-axis sampling. Whenever the value of the tap sensitivity register changes to or from the value of 0x80, the PixiPoint® performs a self-calibration cycle of approximately 500 ms duration. The sensor should not be touched while the self-calibration cycle is in progress.

Preliminary*MouseCoder™ product***Set translation profile (0xC1)**

This command byte is followed by one byte of data. The extended mode device responds to each of the two bytes with Acknowledge (0xFA). The value of the second byte controls the translation profile between the force on the PixiPoint® sensor and relative motion as shown in the following table.

Translation profile register

Value	Meaning	Comment
0x00	Semtech Profile #1	Default, recommended setting
0x01 – 0xFF		All these values are reserved

Table 4. Translation profile register

Read extended status (0xC2)

The extended mode device responds to the command byte with an Acknowledge (0xFA), and then returns a one-byte value. See the section on the Write extended status command for the description of the extended status register.

Write extended status (0xC3)

This command byte is followed by one byte of data. The extended mode device responds to each of the two bytes with Acknowledge (0xFA). The value of the second byte is written to the extended status register. See Table 5 below for the description of individual bits.

Note: Possible values for the extended status register are 0x00 to 0x7F (i.e. it is NOT required to pass "special" values like 0xFF, 0xFE, etc. via the 8042 host).

Extended status register

Bit number	Name	Default / power-up value	Comment
0	Right Primary Enable	0	When set (=1) this bit directs sensor press activation to the Right button. When this bit is reset (=0) sensor press activation is directed to the Left button.
1	Left Wakeup Enable	0	When set (=1) AND the PixiPoint® is in the extra-low-power mode, press on the Left Button triggers generation of the Left Button Press (and, possibly, zero motion) report. When cleared (=0), the Left button is driven low and ignored in the extra-low-power mode mode. See note below.
2	Right Wakeup Enable	0	When set (=1) AND the PixiPoint® is in the extra-low-power mode, press on the Right Button triggers generation of the Right Button Press (and, possibly, zero motion) report. When cleared (=0), the Right button is driven low and ignored in the extra-low-power mode mode. See note below.
3	Middle Wakeup Enable	0	When set (=1) AND the PixiPoint® is in the Zero-Power™ mode, press on the Middle Button triggers generation of the Middle Button Press (and, possibly, zero motion) report. When cleared (=0), the Middle button is driven low and ignored in the extra-low-power mode mode. See note below.
4	Middle Normal Mode	0	When set (=1) this bit forces normal operation of the Middle switch. In "Middle Normal Mode" PixiPoint® always sends Z_Data=0, and Middle button event in response to the Middle switch activation. When cleared (=0), the middle switch controls generation of Z_Data, and/or clicks, and/or presses of the middle button, used in panning and scrolling operations with the "standard" wheel mouse driver, as permitted by the setting of bit 6. If the device operates in the normal (3-Byte) Mouse mode, normal operation of the Middle button is enforced even if this bit is cleared (=0).
5	Slow Drag Disable	0	When set (=1) this bit disables slowing-down of the cursor speed when primary button is activated by sensor press. When cleared (=0), the speed of the cursor is reduced when primary button is activated by sensor press.
6	Semtech Gesture Disable	0	When set (=1) this bit inhibits reporting of all Middle button events, and forces the PixiPoint® to send Z_Data in response to the force in the Y direction when the Middle switch is pressed. When cleared (=0), the generation of Z_Data and Middle button events is controlled by the Semtech Gesture Algorithm. If the device operates in the normal (3-Byte) Mouse mode, state of this bit has no effect on the operation of the device.
7	Reserved	0	Ignored, keep cleared (=0)

Table 5. Extended status register

Note: If reports from the PixiPoint® are disabled while the "Power down" command is issued, the left, middle, and right buttons' pins are driven low and ignored in extra-low-power mode, regardless of the state of bit 1 through bit 3 of the extended status register.

Power down (0xC4)

The extended mode device responds to the command byte with Acknowledge (0xFA). The "Power down" command forces the PixiPoint® into extra-low-power mode.

If external PS/2 device is connected to the pass-through PS/2 port, the PixiPoint® receives but ignores any motion reports from the external device until the PixiPoint® returns to normal operating mode. The PixiPoint® operates in normal (high) power mode for the duration of the transmissions from the external PS/2 device, but returns to extra-low-power mode as soon as the transmissions finish. Hot-plug of the external PS/2 pointing device operates normally in extra-low-power mode.

The PixiPoint® receives and acknowledges all commands from the host while it is in extra-low-power mode by temporarily resuming normal operations for the duration of transmission, but returns to extra-low-power mode immediately after the last Acknowledge to host is transmitted (see the two exceptions below).

To resume normal operations, the host should do one of these two actions:

1. Issue an Enable (0xF4) command. In this case reinitialization is not needed, and normal operations commence after a brief recalibration delay (~500ms; all communications are active during recalibration).
2. Issue a Reset (0xFF) command and re-initialize the PixiPoint®.

Read device type (0xC5)

The extended mode device responds to the command byte with Acknowledge (0xFA), and then returns a one-byte value. This data is used for identification of the IC; it is hard-coded in the firmware.

Read device version (0xC6)

The extended mode device responds to the command byte with Acknowledge (0xFA), and then returns a one-byte value. This data is used for identification of the IC; it is hard-coded in the firmware.

Read XY Gain (0xC7)

The extended mode device responds to the command byte with Acknowledge (0xFA), and then returns a one-byte value. See the "Write XY gain" command for the description of the data.

Write XY gain (0xC8)

This command byte is followed by one byte of data. The extended mode device responds to each of the two bytes with Acknowledge (0xFA). The value of the second byte is written to the XY gain register. This parameter allows fine control of the gain in the X/Y (but not Z) A/D processing channels, in order to accommodate various sensors and/or heights of the sensors. Power-up value is 0x80 (Gain=1, weight of individual bit = TBD) if the Select pin (pin 19) is floating. Power-up value is 0x6C if the Select pin (pin 19) is grounded.

Read Z gain (0xC9)

The extended mode device responds to the command byte with Acknowledge (0xFA), and returns a one-byte value. See the "Write Z gain" command for the description of the data.

Write Z gain (0xCA)

This command byte is followed by one byte of data. The extended mode device responds to each of the two bytes with an Acknowledge (0xFA). The value of the second byte is written to the Z gain register. This parameter allows fine control of the gain in the Z (but not X/Y) A/D processing channel, in order to accommodate various sensors. Power-up value is 0x80 (Gain=1, weight of individual bit = TBD) if the Select pin (pin 19) is floating. Power-up value is 0x58 if the Select pin (pin 19) is grounded.

Read CheckSum (0xCB)

The extended mode device responds to the command byte with Acknowledge (0xFA), and then calculates and returns a three-byte value (24-bit CheckSum). This command is intended for generation of the digital signature of the firmware, and quick manufacturing test of the ROM-mask devices. The data set consisting of data returned by "Read device type," "Read device version," and "Read CheckSum" is constant (i.e., for a device with the specific Type and Version, the CheckSum can only have a single, non-changing value). The range of ROM addresses over which the CheckSum is calculated is preset in the device's firmware and can not be changed.

Read direction (0xCC)

The extended mode device responds to the command byte with Acknowledge (0xFA), and returns a one-byte value. See the "Write direction" command for the description of the data.

Write direction (0xCD)

This command byte is followed by one byte of data. The extended mode device responds to each of the two bytes with an Acknowledge (0xFA). The value of the second byte is written to the direction register. This register allows control of the direction (swapping of X and Y signals), and polarity of the X, Y, and Z signals, in order to accommodate various sensors. Power-up value is 0x00 if the Select (pin 19) is floating. Power-up value is 0x80 if Select (pin 19) is grounded. See Table 6 (Direction register) below for the description of individual bits.

Direction register

Bit number	Description	Power-up value (when Select is floating)	Power-up value (when Select is grounded)	Comment
0	X sign	0	0	A value of 1 inverts the X signal
1	Y sign	0	0	A value of 1 inverts the Y signal
2	XY swap	0	0	A value of 1 swaps the X and Y signals
3	Z sign	0	1	A value of 0 inverts the Z signal
4	Reserved	0	0	Ignored, keep cleared
5	Reserved	0	0	Ignored, keep cleared
6	Reserved	0	0	Ignored, keep cleared
7	Reserved	0	0	Ignored, keep cleared

Table 6. Direction register

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