TouchPad Interfacing Guide Addendum: Multiple-Button Support Specification

P/N 511-000024-01 Rev. A

Introduction

The *Synaptics TouchPad Interfacing Guide* describes how to support two- or four-button TouchPad™ modules. This addendum describes how Synaptics PS/2® TouchPad products support up to eight extra buttons. It provides information on the hardware and software considerations as well as implementation instructions.

Note: The Synaptics driver is required for multiple-button support as described in this specification.

Hardware considerations

The T1004 ASIC on the TouchPad module, in its most common package, has 14 I/O pins. Of these, two I/O pins are used for special hardware purposes, two for PS/2 communication, and two are reserved for pass-through functionality. This leaves eight I/O pins for button inputs. Depending on the TouchPad model, these pins can be divided into two configurations:

- Support three buttons as standard (Left, Middle, and Right), and up to five extended buttons.
- Support two buttons as standard (Left and Right), and up to six extended buttons.

If the PS/2 pass-through pins are not reserved, then it is possible to wire up two more buttons. This document describes how up to 11 buttons can be reported (although the actual number is dependent on the hardware configuration). To find the actual number of buttons supported by a particular TouchPad model, refer to the Product Specification for that model or use the queries described in this document.

Software considerations

A TouchPad device has two modes of operation, Relative mode and Absolute mode. In Relative mode, the TouchPad device behaves like a mouse and emits 3-byte packets that encode the amount of motion in the horizontal and vertical direction made by a finger touching the pad. This mode is compatible with the standard mouse driver in the Windows operating system.

Absolute mode is defined by Synaptics to encode the absolute horizontal and vertical position of a finger touching the pad. Data is transmitted in 6-byte packets to the host and decoded by the Synaptics TouchPad driver.

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Implementation details

At power-up, in common with most other PS/2 pointing devices the TouchPad device will be in Relative mode in a disabled state. The Host will normally send an Enable ($F4) command to allow the TouchPad device to start transmitting motion packets. The 3-byte Relative mode packet format is shown in Figure 1:

	Bit 7	*Bit 6*	*Bit 5*	*Bit 4*	*Bit 3*	*Bit 2*	*Bit 1*	*Bit 0*
Byte 1	Y ovfl	X ovfl	Y sign	X sign	1	M	R	L
Byte 2	ΔX[7..0]							
Byte 3	ΔY[7..0]							

Figure 1. PS/2 Relative motion packet

If it is only necessary to add one button to a TouchPad module, then its state can be reported in the Middle button bit in the PS/2 Relative mode packet; however, there is no equivalent position in the Absolute mode packet format, which is shown in Figure 2. (A special command sequence is used to set the TouchPad device into Absolute mode and to turn on the pad's Wmode reporting feature; see the *Synaptics TouchPad Interfacing Guide.*)

	Bit 7	*Bit 6*	*Bit 5*	*Bit 4*	*Bit 3*	*Bit 2*	*Bit 1*	*Bit 0*
Byte 1	1	0	W[3..2]		0	W[1]	R	L
Byte 2	Y[11..8]				X[11..8]			
Byte 3	Z[7..0]							
Byte 4	1	1	Y[12]	X[12]	0	W[0]	R	L
Byte 5	X[7..0]							
Byte 6	Y[7..0]							

Figure 2. PS/2 Absolute X/Y/Z/W motion packet (Wmode = 1)

It can been seen from Figure 2 that there are no spare bits available to report the state of any additional buttons; however, the *Synaptics TouchPad Interfacing Guide* describes a way to encode four buttons when there appears to be only space for two. The firmware in a four-button pad takes the current value to report for the two extra buttons (Up and Down) and XORs them with the current value of the Right and Left buttons, as shown in Figure 3. The driver can decode the state of the two extra buttons by reversing this operation.

	Bit 7	*Bit 6*	*Bit 5*	*Bit 4*	*Bit 3*	*Bit 2*	*Bit 1*	*Bit 0*
Byte 1	1	0	W[3..2]		0	W[1]	R	L
Byte 2	Y[11..8]				X[11..8]			
Byte 3	Z[7..0]							
Byte 4	1	1	Y[12]	X[12]	0	W[0]	R^D	L^U
Byte 5	X[7..0]							
Byte 6	Y[7..0]							

Figure 3. Four button Absolute mode packet (Wmode = 1)

For products with middle buttons or more than four buttons, Synaptics uses an alternate "extended button" packet format as shown in Figure 4.

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	Bit 7	*Bit 6*	*Bit 5*	*Bit 4*	*Bit 3*	*Bit 2*	*Bit 1*	*Bit 0*
Byte 1	1	0	W[3..2]		0	W[1]	R	L
Byte 2	Y[11..8]				X[11..8]			
Byte 3	Z[7..0]							
Byte 4	1	1	Y[12]	X[12]	0	W[0]	R^Ext	L^M
Byte 5	X[7..4]				b7	b5	b3	b1
Byte 6	Y[7..4]				b8	b6	b4	b2

Figure 4. Extended button Absolute mode packet (Wmode = 1)

The TouchPad device reports the number of extended buttons it has, and whether it supports a middle button, in its Capability Bits (see later). *Extended buttons* are any buttons other than the standard Left, Right, and Middle buttons. In the extended button packet format, if the middle button is present its state is always encoded in bit 0 of byte 4 by XORing it with the current state of the Left button bit. Up to eight extended button states (b1 to b8) are reported in the low order bits of the X and Y position, which means that the low order position bits are lost. However, the extended button states are only reported if any one of them is actually pressed, so that position data reporting is only compromised when an extended button is being pressed. This is indicated by the *Ext* bit, which is XORed with the Right button state and encoded in bit 1 of byte 4. If *Ext* is 1 then one or more extended buttons are being pressed, and some bits in byte 5 and byte 6 now represent button states. If *Ext* is 0 then there are no external buttons being pressed (or all external buttons have been released). The firmware only compromises the minimum number of bits necessary to support the number of buttons attached, and the other bits remain as valid position data.

For example, a pad that has four extended buttons will mask off bits 0 and 1 of bytes 5 and 6, and report the extended button states in those bits. If the pad has only one extended button then bit 0 of bytes 5 *and* 6 are still masked, but only bit 0 of byte 5 is relevant. If a pad has *n* extended buttons, then (*n*+1)>>1 low order bits are masked off from X *and* Y.

Masking off some low bits of X and Y will result in degraded pointer resolution, but in typical TouchPad usage the effect proves to be quite minor. Also, note that all bits of X and Y report valid position information when the Ext bit is '0' (i.e., when bit 1 of byte 4 of the packet is the same as bit 1 of byte 1). Thus, the minor degradation in pointing resolution occurs only when one or more extended buttons are pressed.

Capability bits

Query number $02 reports the basic capability bits, as described in the *Synaptics TouchPad Interfacing Guide*. It has been extended as follows:

Bit 15	*Bit 14*	*Bit 13*	*Bit 12*	*Bit 11*	*Bit 10*	*Bit 9*	*Bit 8*
cExtended	nExtQry[2..0]			-	cMiddle	-	-

Bit 7	*Bit 6*	*Bit 5*	*Bit 4*	*Bit 3*	*Bit 2*	*Bit 1*	*Bit 0*
-	-	-	-	c4Button	-	-	-

Figure 5. TouchPad capability bits

Note: A dash (-) indicates reserved bits or bits whose meanings are beyond the scope of this document.

capMiddleButton (bit 10)

This bit is set if the pad has a middle button. If this bit is set then the pad will report the middle button state in the appropriate place in the Relative mode packet, and as indicated in Figure 4 in the Absolute mode packet (when Wmode=1). The middle button is not considered to be an extended button.

capFourButton (bit 3)

This bit is set for old-style four-button support, as described in Figure 3 above and the *Synaptics TouchPad Interfacing Guide* (version 2.4 and above).

nExtendedQueries[2..0] (bits 14..12)

These bits represent the number of extended queries the pad supports. Taken together they form a 3-bit number which encodes the number of extended Query pages that the pad can report. If *nExtendedQueries* is zero, there are no extended buttons. If *nExtendedQueries* is 1 or greater, then the host can perform query number $09 to see how many extended buttons, if any, are supported.

Query number $09:

Bit 23	*Bit 22*	*Bit 21*	*Bit 20*	*Bit 19*	*Bit 18*	*Bit 17*	*Bit 16*
-	-	-	-	-	-	-	-

Bit 15	*Bit 14*	*Bit 13*	*Bit 12*	*Bit 11*	*Bit 10*	*Bit 9*	*Bit 8*
nExtBtn[3..0]				-	-	-	-

Bit 7	*Bit 6*	*Bit 5*	*Bit 4*	*Bit 3*	*Bit 2*	*Bit 1*	*Bit 0*
-	-	-	-	-	-	-	-

Figure 6. TouchPad extended Queries page 1 bits

nExtendedButtons[3..0] (bits 15..12)

These bits enumerate the number of extended buttons supported by this pad. Taken together, they form a 4-bit number *n* which represents the total number of extended buttons. (n+1)>>1 shows how many bits must be masked from both X and Y in the Absolute mode packet (or conversely, how many bits are lost when an extended button press is reported). If *n* is zero then this pad does not support extended buttons, and the *Ext* bit decoded from the packet in Figure 4 will never be set. The pad will only report extended button presses in Absolute mode when Wmode=1, and will not report any extended button states in Relative mode.

If *nExtendedQueries* is zero, then query number $09 is not supported and *nExtendedButtons* is implicitly zero.

Note: If *nExtBtn* is greater than eight then for the purposes of this specification *nExtBtn* should be considered to be invalid and treated as zero. Later specifications may use these larger values to represent further configurations of the packet format.

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Note: *c4Button* and *cMiddle* / *nExtBtn* are mutually exclusive. If a pad reports *c4Button* set then *cMiddle* will be clear and *nExtBtn* will be zero. However, *cMiddle* and *nExtBtn* are independent of each other; either, both, or none may be set as long as *cMiddle* is clear.

Other capability bits, and the mechanism to read them, are described in the *Synaptics TouchPad Interfacing Guide*.

Additional Information

Reference documentation

For additional information, refer to the following documents:

- *Synaptics TouchPad Interfacing Guide* (P/N 510-000080)
- *Synaptics TouchPad Product Brief*
- *Synaptics TouchPad Product Marketing Specification*
- *Synaptics TouchPad Product Profile* (P/N 509-000005)

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