HulaPoint - Ergonomic Mouse PS2/RS232 Encoder HulaCoder™ UR7HCDMP

Description

The HulaCoder™ UR7HCDMP is an easy-to-use single-chip encoder that interfaces an innovative sensor developed by Fujitsu. Together they make the HulaPoint™. Equipped with an advanced motion algorithm, the UR7HCDMP offers low power consumption in a small footprint package. The device can be linked through either the serial or PS/2-type mouse port of the host system.

The UR7HCDMP is compatible with the IBM and Microsoft two-button and the Logitech three-button mouse communication protocols.
The device will auto switch between the Serial and the PS/2 mouse communication protocol depending on the port to which the device is actually connected.

Communication through the serial port is half-duplex at a fixed speed of 1200 Baud. PS/2 communication is bidirectional at 10 kbps.
The HulaPoint's™ HulaCoder™ implements all commands from and to the system, as defined in the IBM PS/2 Mouse Communication Protocol.

The UR7HCDMP is a CMOS device operating at 4 MHz. The low-power consumption of the IC makes it suitable for battery operated systems. Power in the serial mode, as in any standard mouse, can be drawn from the RS232 lines of the host system.

The UR7HCDMP is available in Plastic DIP and SOIC packages.
Custom versions are also available to suit a wide range of pointing device applications.

Features

- *Equipped with Advanced Motion Control algorithm*
- *Low power consumption in a 3 to 6 Volt operating range*
- *Effortless and accurate cursor control with 10 degree movement in every direction*
- *Responds to feather-light touch without resistance*
- *Works with innovative proprietary sensor technology developed by Fujitsu microelectronics*
- *Compatible with IBM/Microsoft two-button and Logitech three-button mouse*
- *Autoselectable RS232 or PS/2 hardware interface*
- *Small 18 pin plastic PDIP and SOIC Packages available*
- *Customized versions available*

Applications

- *Embedded HulaPoints*
- *Industrial Panels*
- *Instrumentation*

Pin Configuration

Ordering Code

PACKAGES	TA = 0°C TO +70°C	TA = -40°C TO +85°C
18 pin, Plastic DIP	UR7HCDMP-P	UR7HCDMP-CP
18 pin, SOIC	UR7HCDMP-DW	UR7HCDMP-CDW

Functional Diagram

Functional Description

The UR7HCDMP consists functionally of five major sections (see Functional Diagram, previous page). These are the Sensor Interface, the Sixteen Bit Timer, the Oscillator Circuit, the PS/2 Communication Port and the RS232 Communication Port. All sections communicate with each other and operate concurrently.

Autoselect

At power-up the UR7HCDMP will execute a power-on reset and determine the mode of operations.

PS/2 Mode

At start-up or upon receiving a reset command, Clock and Data lines of the HulaCoder™ can be pulled to a positive level. The UR7HCDMP will then wait between 300 and 500 milliseconds before sending an AAh to the host followed by a device ID of 00h. Then the IC will set itself to its default values, i.e. Incremental Stream Mode with 1:1 scaling, and a report rate of 100 Hz. The device will then disable itself until a command is sent from the host.

Error Handling

For every correct command or parameter received from the host, the UR7HCDMP sends an Acknowledge (FAh). If an invalid command or parameter is received, the UR7HCDMP issues a Resend Request (FEh). If an invalid input is again received, the device transmits an Error Code (FCh) to the host. Both error and Resend request responses are sent by the device within 25 milliseconds. The host may not issue any new commands until either the HulaCoder™ has responded or until 25 milliseconds have elapsed.

Pin Description

	Pin Numbers			
Mnemonic	**DIP**	**SOIC**	**TYPE**	**NAME AND FUNCTION**
CHX	1	1	Analog Input	**Horizontal Input**
RTSIN	2	2	I/O	**RTS Sense, Power Save Out**
$\overline{\text{SEROUT}}$	3	3	O, Open Drain	**Serial Tx Data**
$\overline{\text{RESETIN}}$	4	4	I	**Reset:** apply 0 V for orderly start up.
GND	5	5	Power	**Ground**
PS2CLK	6	6	I/O	**PS/2 Clock**
PS2DAT	7	7	I/O	**PS/2 Data**
$\overline{\text{RIGHTSW}}$	8	8	I w/ Pullup	**Right Switch:** Low = On.
$\overline{\text{LEFTSW}}$	9	9	I w/ Pullup	**Left Switch:** Low = On.
$\overline{\text{MIDDLESW}}$	10	10	I w/ Pullup	**Middle Switch:** Low=On.
D/A-0	11	11	O	**Resolution enhancement D/A:** LSB.
D/A-1	12	12	O	**Resolution enhancement D/A**
D/A-2	13	13	O	**Resolution enhancement D/A:** MSB.
VCC	14	14	Power	**Power Supply**
OSCOUT	15	15	O	**Oscillator Output**
OSCIN	16	16	I	**Oscillator Input**
$\overline{\text{PWRON}}$	17	17	O	**Sensor Power Strobing Control**
CHY	18	18	Analog Input	**Vertical Input**

Pin Description Notes

The Internal Oscillator has a built-in feedback resistor. Only one (1) external component is needed for Clock generation. USAR recommends a 4.00 MHz Ceramic Resonator with built-in load capacitors.

$\overline{\text{RIGHTSW}}$, $\overline{\text{LEFTSW}}$, and $\overline{\text{MIDDLESW}}$ inputs have built-in pull-up resistors. No additional components are required for a three-button design. However, if high levels of ESD and EMI are expected, than series protection resistors (47 Ohms to 1k Ohms) are recommended between the switches and the switches' inputs on the IC.

PS/2 Data Format

The following table shows the data report format. Values are expressed in a Two's Complement Format with a separate sign bit. If there is an overflow of the accumulator, the maximum positive or negative count is reported and the corresponding overflow bit is set.

Data Report Format Table

Byte 1			
	b0	Left Button status	1 = depressed
	b1	Right Button Status	1 = depressed
	b2	Middle Button Status	1 = depressed
	b3	Always = 1	
	b4	X data sign	1 = negative
	b5	Y data sign	1 = negative
	b6	X data overflow	1 = overflow
	b7	Y data overflow	1 = overflow
Byte 2			
	b0	X0: LSB of X data	
	b1	X1	
	b2	X2	
	b3	X3	
	b4	X4	
	b5	X5	
	b6	X6	
	b7	X7: MSB of X data	
Byte 3			
	b0	Y0: LSB of Y data	
	b1	Y1	
	b2	Y2	
	b3	Y3	
	b4	Y4	
	b5	Y5	
	b6	Y6	
	b7	Y7: MSB of Y data	

Status Report Format Table

Byte 1			
	b0	Right Button	1 = depressed
	b1	Middle Button	1 = depressed
	b2	Left Button	1 = depressed
	b3	Always = 0	
	b4	Scaling - 1:1 (0) / 2:1 (1)	
	b5	Disable - (0) / enable (1)	
	b6	Stream - (0) / prompt (1) mode	
	b7	Always = 0	
Byte 2			
	b0 - 1	Current resolution setting	
	b2 - 7	Always = 0	
Byte 3			
	b0-7	Current sampling rate	

PS/2 Mode Commands

When the **Reset Command (FFh)** is enacted, the UR7HCDMP sets the following default parameters: Incremental Stream Mode, 1:1 scaling, disabled, and a report rate of 100 Hz and then sends AAh to the host followed by a device ID of 00h.

The host sends the **Resend Last Data Stream Command (FEh)** when it detects an error in any UR7HCDMP transmission. The device then resends the last output data stream to the host. This transmission occurs after a HulaCoder™ transmission and before the host enables the interface allowing the next HulaCoder™ output.

The **Set Default Status Command (F6h)** re-initializes the device to its condition at power-up.

The **Disable Command (F5h)** stops the device from transmitting all reports. However, the mode does not change; the HulaCoder™ is still able to respond to commands. If the Disable Command is issued while the device is transmitting a report, the UR7HCDMP immediately stops the transmission and disables itself.

If the HulaCoder™ is in Incremental Stream Mode, the **Enable Command (F4h)** will allow it to begin data transmission. If the device is in Prompt Mode, the Enable Command will update the internal status of the HulaCoder™, but will not allow the device to transmit data to the host either while it is moving or when a button is depressed.

The HulaCoder™ will respond to the **Set Sampling Rate Command (F3h)** in both Stream and Prompt Modes but will only update its internal status if this command is enacted while the device is in Stream Mode

UR7HCDMP responds to the the **Read Device Type Command (F2h)** immediately after the Acknowledge with a 00h.

The **Set Prompt (Remote) Mode Command (F0h)** sets the device to Prompt Mode. Data values are then only reported in response to a **Read Report Command (EBh).**

PS/2 Mode Commands Cnt.

If the **Set Echo Mode Command (EEh)** is enacted, the HulaCoder™ will immediately return any data bytes except FF or EC.

The **Reset Echo Mode Command (ECh)** returns the device to its previous mode - disabled. If this command occurs while the UR7HCDMP is in either Stream or Prompt Modes, the command is ignored.

The **Read Report Command (EBh)** prompts the HulaCoder™ for a report. The report occurs even if the device did not move or if the status of the switches did not change. The report is sent by the UR7HCDMP following an Acknowledge.

The **Set Incremental Stream Mode Command (EAh)** sets the HulaCoder to Stream Mode and disables the device.

The **Status Request Command (E9h)** returns a 3 byte status report.

The **Set Resolution Command (E8h)** controls resolution, and the **Set 2:1 Scaling Command (E7h)** enables a coarse/fine tracking response. Due to the Advanced Motion Algorithm, Set Resolution and Scaling Command are acknowledges and reported as activated, but their status is ignored.

The **Set 1:1 Scaling Command (E6h)** enables the values of movements to be transmitted to the host without any scaling.

Sequential Commands

Unlike normal commands, sequential commands must be enacted with a sequence of commands. If the sequence is not consecutive or is incorrect, the HulaCoder™ aborts the detection and responds the way it would normally respond to a command.
The individual commands that comprise a sequential command have been designed so that the elements of a sequential command can be sent to the HulaCoder™ via the standard IBM PS/2 BIOS calls and the device only returns a valid response to the Standard Status Request. This ensures that, if the sequential command is sent via the BIOS, the status response will be accurately returned even if the BIOS does error detection. Thus, a programmer can have complete control of the mouse without having to access the device hardware port directly.

The UR7HCDMP HulaCoder™ implements a special sequential command that can be used to determine its ability to report three buttons. The sequential command is a series of commands to the HulaCoder™ that cause the device to respond to the last command (Read Status) with alternate information.

Sequence of commands:

1. Set Resolution = one count/ mm
   Direct: E8H,00H BIOS: INT15H, AX=C203H, BX=0
2. Set Scaling = 1:1
   Direct: E6H BIOS: INT15H, AX=C206H, BX=1
3. Set Scaling = 1:1
   Direct: E6H BIOS: INT15H, AX=C206H, BX=1
4. Set Scaling = 1:1
   Direct: E6H BIOS: INT15H, AX=C206H, BX=1
5. Read Status
   Direct: E9H BIOS: INT15H, AX=C206H, BX=0

The response to the Read Status Command is in the form:

Byte 1: Standard Status Information (buttons, scaling, etc.)

Byte 2: Number of mouse buttons (3)

Byte 3: Firmware Revision Number (encoded)

Serial Data Format

Serial Data Report Format Table

Byte 1			
	b0	X6	
	b1	X7: MSB of X Data	
	b2	Y6	
	b3	Y7: MSB of Y Data	
	b4	Right Button Status	1 = depressed
	b5	Left Button Status	1 = depressed
	b6	Always=1	
Byte 2			
	b0	X0: LSB of X data	
	b1	X1	
	b2	X2	
	b3	X3	
	b4	X4	
	b5	X5	
	b6	Always=0	
Byte 3			
	b0	Y0: LSB of Y data	
	b1	Y1	
	b2	Y2	
	b3	Y3	
	b4	Y4	
	b5	Y5	
	b6	Always=0	
Byte 4			
	b0 - 4	Always = 0	
	b5	Middle Button Status	1=depressed
	b6	Always=0	

Serial Mode

Communication through the serial port is half-duplex at a fixed speed of 1200 Baud, 7N2 protocol.

At start-up and after each RTS toggle the HulaCoder™ will send a two-character ASCII string “M3” indicating 3-button capability to the host.

A Data Report is sent if motion is detected, or if buttons are pressed or released. Motion is reported relative to the last Report sent, in a Two’s Complement Form and eight (8) bit resolution. In other words, the Maximum Motion values are -128 to +127, saturated at min/max for faster speeds. Byte 4 is sent only if the middle button is pressed, held-down or released.

HulaPoint™ Sensor Dimensions

HulaPoint™ Evaluation Board Mechanical

HulaPoint™ Alternate Kit with Rubber Overlay Mechanical

NOTES:

1.) R9-R16 are 1% Metal Film

2.) Not Used: R15, R16

3.) PCB Footprint for U2 (Voltage Detector)
will accomodate SOT23 and SOT23-5 devices

4.) For SUN Mode, L1 is installed AND the following components
are omitted: R2-R8, C2, C6, D1, D2, Q2-Q4, U3

Electrical Specifications

Absolute Maximum Ratings

Ratings	Symbol	Value	Unit
Supply Voltage	V_{DD}	0 TO 7.5	V
Input Voltage	V_{IN}	V_{SS} -0.6 to V_{DD} +0.6	V
Current Drain per Pin (not including V_{SS} or V_{DD})	I	20	mA
Operating Temperature UR7HCDMP-xx UR7HCDMP-Cxx	T_A	T_{LOW} to T_{HIGH} 0 to +70 -40 to +85	° C
Storage Temperature Range	T_{STG}	-65 to +150	° C
Ambient Temperature Under Bias	Tbias	-55 to +125	° C

DC Electrical Characteristics, Temperature range=T low to T high unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
Supply Voltage		3.0	5.0	6.0	V
Output Voltage	V_{OH} V_{OL}	V_{DD}–0.1		 0.1	V
Input High Voltage	V_{IH}	0.7xV_{DD}		V_{DD}	V
Input Low Voltage	V_{IL}	V_{SS}		0.2xV_{DD}	V
Input Current	I_{IN}			+/- 1	uA
Internal Pull-up Current	I_{PUP}	50	250	500	uA
Supply Current Vdd=5.0 Vdc+/-10%, Vss=0	I_{DD}		2.0	3.5	mA

Control Timing (Vdd=5.0 Vdc +/-10%, Vss=0 Vdc, Temperature range=T low to T high unless otherwise noted)

Characteristic	Symbol	Min	Typ	Max	Unit
Frequency of Operation ■ Crystal Option ■ External Clock Option	f_{OSC}		 4.0 4.0		MHz

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