SEMTECH

PixiPoint™ Z Serial UR7HCPXZ-S440
Advanced "Click-to-Select" No-Drift™ Pointing Stick Controller

HID & SYSTEM MANAGEMENT PRODUCTS, MOUSECODER™ FAMILY

DESCRIPTION

The PixiPoint™ Z Serial mouse encoder is a cost-effective, high-functionality IC for strain gauge "miniature joysticks" with Z-axis functionality, such as the CTS series 106, 108 & 109. Ideal for portable and other systems that need to interface a mouse to a serial port, the low-power (typically less than 3mA) PixiPoint™ Z offers an advanced algorithm for enhanced motion control.

The IC implements the Tap (select) and Double Tap (execute) and Press Hold (drag) functions in firmware. No special drivers are needed to access these "Z" functions. Other special features provided by the IC include CleanStop™, which allows the cursor to stop exactly when you want it to and EasyDrag™, which reduces the speed of the cursor during drag, making it easier to handle.

The PixiPoint™ Z utilizes a special, patented signal conditioning circuit which enables a low-cost, simple and real estate-saving implementation. Just a few low tolerance external components are needed.

Serial transmission use speed of 1200 Baud with 7N1 framing. The IC, a CMOS device operating at 4 MHz, utilizes the standard serial mouse protocol, including Plug-n-Play identification for MouseWheel support.

The PixiPoint™ Z IC is also available for PS/2-enabled systems.

FEATURES

- Interfaces the system via serial port, making it ideal for non-PC systems
- Accurate No-Drift™ cursor control via Semtech's advanced algorithm
- Interfaces strain gauge "miniature joysticks" with Z-Axis functionality, such as those from CTS
- Implements the Tap (select), Double Tap (execute) and Press Hold (drag) in firmware – no special serial drivers required
- EasyDrag™ feature reduces the speed of the cursor during drag, making it easier to handle
- Offers CleanStop™ so cursor stops when you want it to
- Supports Scrolling (MouseWheel)
- Low-power consumption of typically less than 3mA makes it ideal for battery-operated systems
- Operates at 3-5V in extended temperature range
- Uses small 32-pin 7mm X 7mm LQFP package
- Inexpensive, turn-key solution
- Utilizes sophisticated, patented signal conditioning circuit requiring less than 15 components
- Customized versions available

APPLICATIONS

- Handhelds/Notebooks
- Smart Phones
- Internet appliances
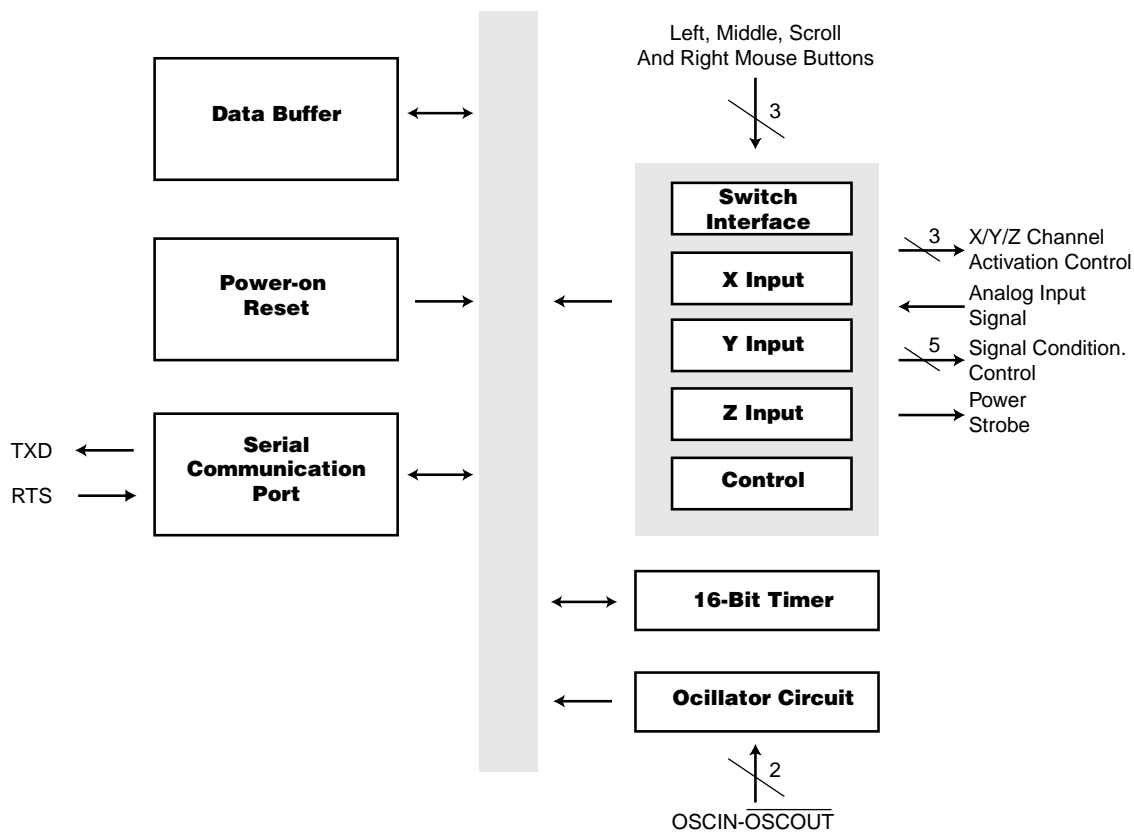- Instrumentation

PIN ASSIGNMENTS
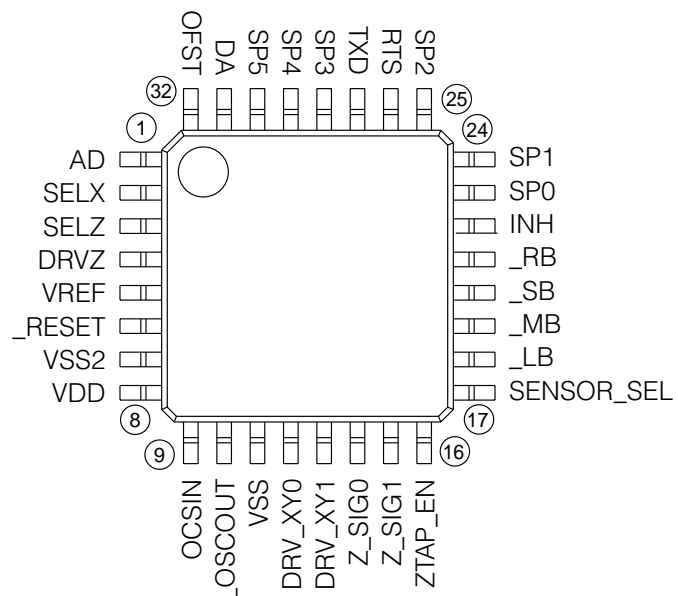
SEMTECH

BLOCK DIAGRAM

PixiPoint™ Z Serial

SEMTECH

FUNCTIONAL DESCRIPTION

The UR7HCPXZ-S440 consists functionally of four major sections (see Functional Diagram, previous page). These are the PixiPoint™ Z Interface, the 16-Bit Timer, the Oscillator Circuit and the Serial Communication Port. All sections communicate with each other and operate concurrently.

SIGNAL CONDITIONING CIRCUIT

The PixiPoint™ Z sensor is a flexible (but very firm) "beam" with four Strain Gauges – one on each of the sides. If force is applied precisely in the X direction, then it will produce a change of resistance of only the two X gauges. Force in the Y direction will cause changes only in the Y gauges. One of the pair of the gauges will increase, while the other will concurrently decrease in resistance.

If the user presses on the sensor from the top (Z-Axis), all of the strain gauges will decrease the resistance.

When a test current is passed through the gauges, these resistance changes are converted into the voltage changes. These signals are very small, typically under 1 mV Full Scale.

The patented Signal Conditioning Circuit balances and amplifies the incoming signals for digitizing by a built-in A/D converter.

PIN DEFINITIONS

Mnemonic	Pin #	Type	Name and Function
VDD	8	P	**Power Supply:** +5V
VSS	11	P	**Ground**
VSS2	7	P	**Ground**
OSCIN	9	I	**Oscillator Input:** external clock input or one side of the Ceramic Resonator with built-in Load Capacitors
_OSCOUT	10	O	**Oscillator Output:** open for external clock input or other side of the Ceramic Resonator with built-in Load Capacitors
_RESET	6	I	**Reset:** apply 0V to provide orderly start-up
RTS	26	I	**Request to Send:** High = Disable TX
TXD	27	I	**Transmit to Host:** Idle High
_LB	18	I/O (nd)	**Left Button:** active low, strobed sampling
_MB	19	I/O (nd)	**Middle Button:** active low, strobed sampling
_SB	20	I/O (nd)	**Scroll Button:** active low, strobed sampling
_RB	21	I/O (nd)	**Right Button:** active low, strobed sampling
DRV_XY0	12	I/O	**Sensor's Excitation Driver**
DRV_XY1	13	I/O	**Sensor's Excitation Driver:** connect to DRV_XY0
Z_SIG0	14	I/O	**Sensor's Excitation Driver**
Z_SIG1	15	I/O	**Sensor's Excitation Driver:** connect to Z_SIG0
DRVZ	4	I/O	**Sensor's Excitation Driver**
SELX	2	O	**Select X:** control line for analog multiplexer
SELZ	3	O	**Select Z:** control line for analog multiplexer
INH	22	O	**Multiplexer Inhibit Signal:** active high
VREF	5	AI	**Reference Voltage** for built-in A/D
AD	1	AI	**Analog to Digital Converter Input**
DA	31	I/O	**Digital to Analog Converter Output**
OFST	32	I/O	**Offset:** resets the offset circuit during inactivity
SP0	23	I/O	**Switched Power Driver**
SP1	24	I/O	**Switched Power Driver:** connect to SP0
SP2	25	I/O	**Switched Power Driver:** connect to SP0
SP3	28	I/O	**Switched Power Driver:** connect to SP0
SP4	29	I/O	**Switched Power Driver:** connect to SP0
SP5	30	I/O	**Switched Power Driver:** connect to SP0
SENSOR_SEL	17	I/O(nd)	**Sensor Select Pin:** Float - CTS, Low - Bokum
ZTAP_EN	16	I/O(nd)	**ZTAP Z Enable Pin:** Float - Enabled, Low - Disable

Note: An underscore before a pin mnemonic denotes an active low signal. For SENSOR_SEL and ZTAP_EN Pins: Upon power-up they are inputs with pull-up. After initialization, the chip will switch the pull-ups off and drive these pins low. Selection of a particular mode is made by connecting the pin to ground or leaving it not connected (floating).

Pin Types Legend: AI=Analog Input; I=Input; O=Output; I/O=Input or Output; I/O (nd)=Input or Output with N-channel Open Drain driver

SIGNAL CONDITIONING CIRCUIT (CON'T)

Semtech's proprietary circuit can correct a significant imbalance between the gauges in each X and Y pair (+/- 25%), allowing relaxed manufacturing tolerances for the sensors, interconnecting cabling, and temperature-shift induced errors (no performance degradation over the full operating temperature range and for large temperature gradients between the paired gauges).

www.semtech.com

SEMTECH

BUILT-IN FEATURES

Semtech utilizes the scroll button to switch the PixiPoint™ Z from normal operation mode to scroll mode. When scroll button is pressed, the UR7HCPXZ-S440 will convert the Y-axis data to Z-axis data (scroll data) and output zero motion for X-axis and Y-axis. When the scroll button is released, the UR7HCPXZ-S440 outputs X/Y motion data and zero displacement for Z-Axis.

Tap — Select.

Double Tap — Execute.

Press Hold — Drag.

EasyDrag™ — reduces the speed of the cursor when the user is dragging an object on the desktop, making it simple to accurately handle the object.

CleanStop™ — ensures that the cursor stops the instant the user needs it to.

No special drivers are needed to access any of these features. Scrolling (MouseWheel) operations require IntelliMouse-compatible Driver with Plug-n-Play support.

POWER CONSUMPTION

The UR7HCPXZ-S440 typically consumes less than 3mA. Low-power consumption makes it suitable for use in battery-operated systems.

SERIAL COMMUNICATION

Communication through the serial port is uni-directional at a fixed speed of 1200 Baud, 7N1 protocol (7 data bits, 1 stop bit, no parity check).

The Host can reset the device at any time by setting the RTS line High. When RTS is set Low after a delay of at least 100ms, the device will respond with an Identification and Plug-n-Play strings. This procedure is known as "RTS Toggle Handshaking." When RTS goes low, the device will send the ID characters "MZ" (0x4D, 0x5A) indicating wheel capability to the Host. Then a ZERO motion report (0x40, 0x00, 0x00, 0x00) is sent as a separator, followed by the Plug and Play string "vvPNP0F0A\\MOUSE\PNP0F0A\USAR SERIAL PIXZ MOUSEcc."

Plug and Play is a sequence of ASCII characters with their codes reduced by 0x20. Note, vv is a version number, 2 Bytes, and cc is a Check Sum, 2 Bytes. For further information, please refer to "Plug and Play External COM Device Specification," available from Microsoft.

4-Byte 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. Z3-Z0 is Z-displacement. It is 4-bit Two's Complement value from -8 to +7.
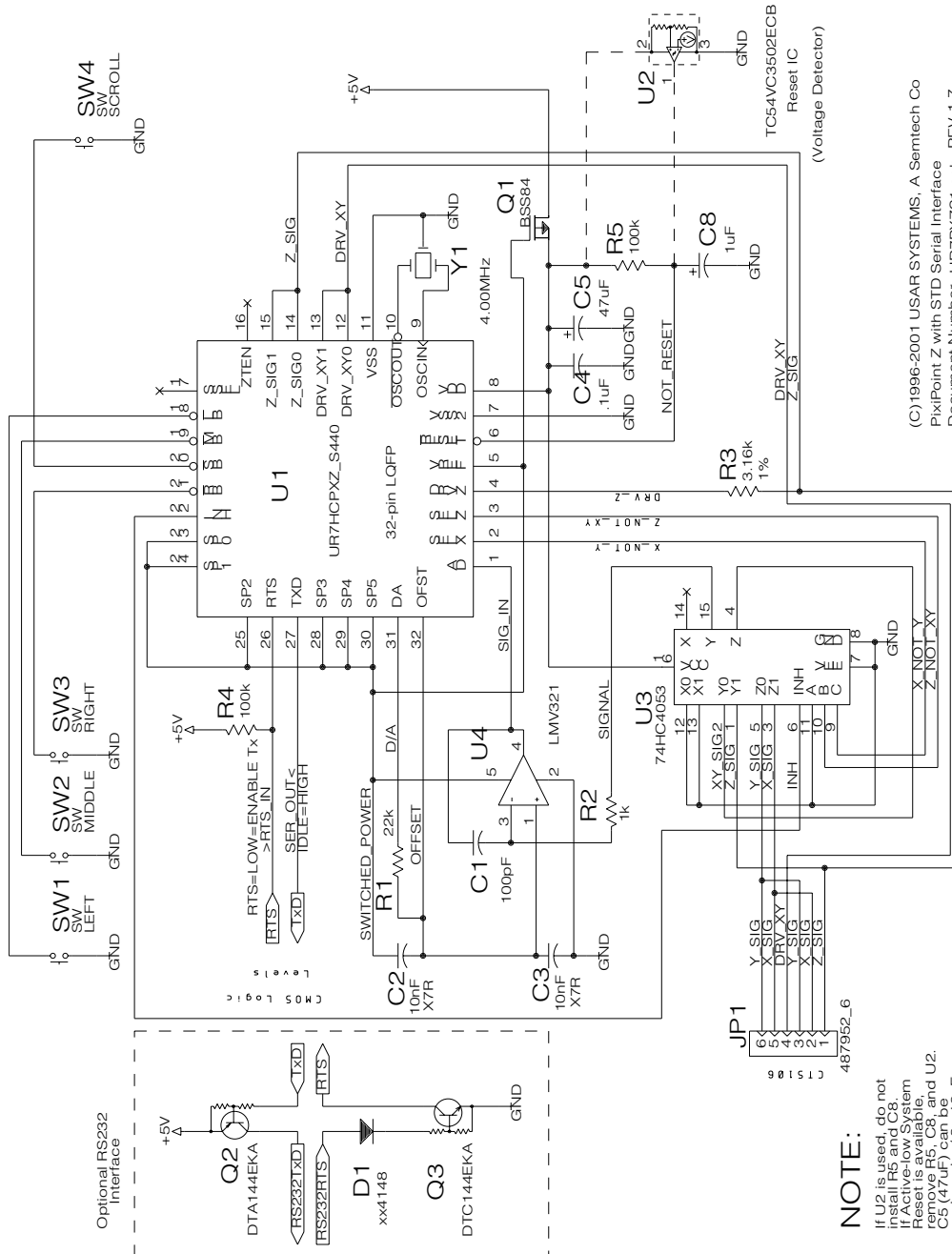
SEMTECH

The TXD and RTS lines are CMOS logic-level signals, suitable for direct connection to the pins of an UART. Interfacing via the RS-232 port requires an addition of an inverting driver and receiver. Simple one-transistor inverting driver and receiver can also be utilized. Contact Semtech for more details.

FEATURES

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	Z0: LSB of Z data
b1	Z1
b2	Z2
b3	Z3: MSB of Z data
b4	Middle Button Status; 1=depressed
b5	Always=0
b6	Always=0

![SEMTECH logo]

Optional RS232 Interface

Q2 DTA144EKA
+5V
RS232TxD
TxD
RTS
D1 xx4148
Q3 DTC144EKA
RS232RTS
GND

SW4
SW SCROLL
GND

SW1 SW LEFT GND
SW2 SW MIDDLE GND
SW3 SW RIGHT GND

R4 100k
+5V
RTS=LOW=ENABLE Tx
>RTS_IN
RTS
TxD
SER_OUT<
IDLE=HIGH
CMOS Logic Levels

U1
UR7HCPXZ_S440
32-pin LQFP

16 X
15 Z_SIG
14 Z_SIG1
13 Z_SIG0
12 DRV_XY1
11 DRV_XY0
10 VSS
9 OSCOUT
OSCIN

25 SP2
26 RTS
27 TXD
28 SP3
29 SP4
30 SP5
31 DA
32 OFST

SP1
PON
RES
MB
LB
RB

Z_SIG
DRV_XY
Y1
GND
Y1 4.00MHz

Q1 BSS84

R5 100k
C5 47uF
C4 .1uF
GND GND GND
NOT_RESET

+5V

U2
TC54VC3502ECB
Reset IC
(Voltage Detector)
GND

C8 1uF
GND

DRV_XY
Z_SIG

R3 3.16k 1%

DRV_Z
Z_NOT_XY
X_NOT_Y

U4 LMV321
D/A
SWITCHED POWER
OFFSET
R1 22k
C1 100pF
R2 1k
SIGNAL

C2 10nF X7R
C3 10nF X7R
GND

U3
74HC4053

12 XY_SIG2
13 Z_SIG1
5 Y_SIG
3 X_SIG
INH

X0
X1
Y0
Y1
Z0
Z1
A
B
C
X Y Z
INH
GND
X NOT Y
Z NOT XY

JP1
6
5
4
3
2
1
487952_6
CTS106

Y_SIG
X_SIG
DRV_XY
Z_SIG
X_SIG
Z_SIG

NOTE:
If U2 is used, do not install R5 and C8.
If Active-low System Reset is available, remove R5, C8, and U2.
C5 (47uF) can be replaced w/3x 10uF.

(C)1996-2001 USAR SYSTEMS, A Semtech Co
PixiPoint Z with STD Serial Interface
Document Number UR7PXZS1.sch REV 1.7

Detail F

Recommended PCB Footprint
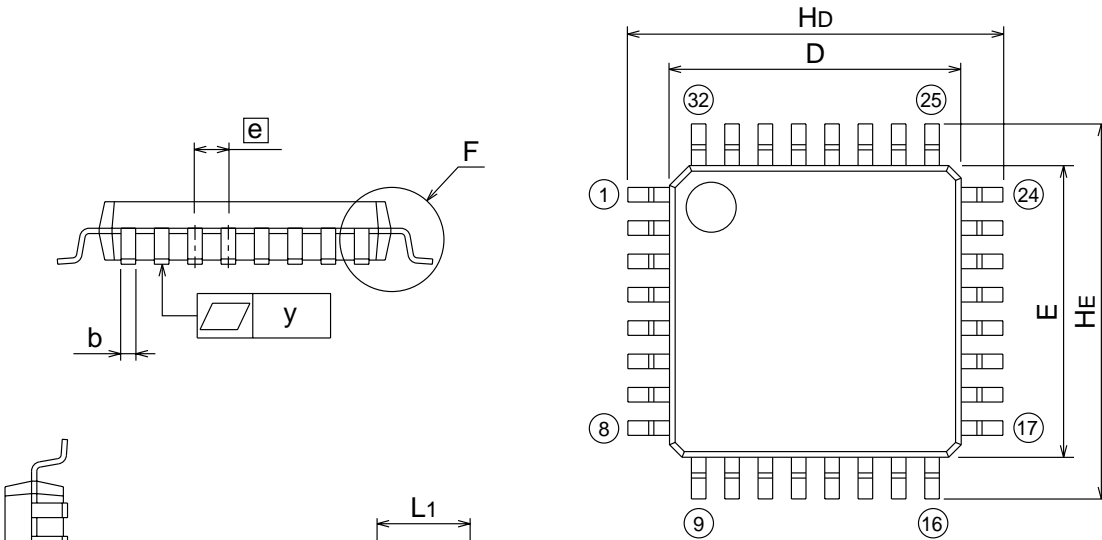
Symbol	Dimension in Millimeters		
	Min	Nom	Max
A	–	–	1.7
A1	0	0.1	0.2
A2	–	1.4	–
b	0.3	0.35	0.45
c	0.105	0.125	0.175
D	6.9	7.0	7.1
E	6.9	7.0	7.1
e	–	0.8	–
HD	8.8	9.0	9.2
HE	8.8	9.0	9.2
L	0.3	0.5	0.7
L1	–	1.0	–
y	–	–	0.1
θ	0ϒ	–	10ϒ
b2	–	0.5	–
l2	1.0	–	–
MD	–	7.4	–
ME	–	7.4	–

7

SEMTECH

ELECTRICAL SPECIFICATIONS

Absolute Maximum Ratings

Ratings	Symbol	Value	Unit
Supply Voltage	Vdd	-0.3 to 7.0	V
Input Voltage	Vin	Vss -0.3 to Vdd +0.3	V
Current Drain per Pin (not including Vss or Vdd)	I	20	mA
Operating Temperature UR7HCPXZ-S440	Ta	T low to T high -20 to +85	° C ° C
Storage Temperature Range	Tstg	-40 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	5.5	V
Output Voltage (10 µA load)	Voh	Vdd–0.1			V
	Vol			0.1	
Input High Voltage	Vih	0.8 x Vdd		Vdd	V
Input Low Voltage	Vil	Vss		0.2xVdd	V
Input Current	Iin			+/- 1	µA
Supply Current (Vdd=5.0 Vdc+/-10%, Vss=0)	Idd		3.0	TBD	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	fosc				MHz
■ Crystal Option			4.0		
■ External Clock Option			4.0		

Sensor Characteristics

Characteristic	Symbol	Min	Typ	Max	Unit
Resistance	Rx	2K		10K	Ohms
Matching	Rx1/Rx2	75		125	%
	Ry1/Ry2	75		125	%

www.semtech.com

SEMTECH

UR7HCPXZ-S440-FG BOM

Description	Quantity	Manufacturer	Part#	Description
Capacitors:				
C1	1	Generic	Any	100pF, 5%, Ceramic, NPO or X7R
C2, C3	2	Generic	Any	.01uF, 10% Ceramic, X7R
C4	1	Generic	Any	.1uF, 10%, Ceramic, X7R or Z5U
C5	1	Generic	Any	47uF, 10%, Ceramic, X7R or Z5U
C8	1	Generic	Any	1uF, +80/-20% Ceramic X5R, Z5U, Y5V
ICs:				
U4	1	National	LMV321M5	Single OpAmp, Low Voltage, SOT23-5
U3	1	Generic	74HC4053	Tri 2-ch Analog Mux
U1	1	Semtech	UR7HCPXZ-S440-FG	PixiPoint™ Z Controller
U2	1	TelCom	TC54VC2702ECB	Reset IC
Resistors:				
R2	1	Generic	Any	1k, 5%, 1/16W
R3	1	Generic	Any	3.16k, 1%, 1/16W
R1	1	Generic	Any	22k, 5%, 1/16W
R4,R5	2	Generic	Any	100k, 5%, 1/16W
Resonator:				
Y1	1	AVX	PBRC-4.00BR	4.00MHz Ceramic Resonator w/ Caps, SMT
Transistor:				
Q1	1	Zetex	BSS84ZXCT	MOSFET_P Transistor, SMT, SOT-23

www.semtech.com

SEMTECH