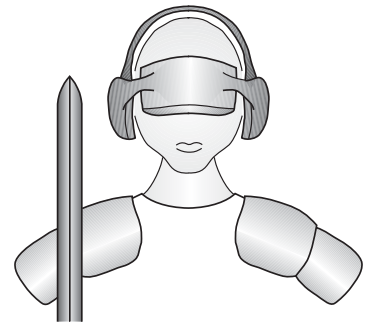


# JoyWarrior

Universal joystick and gamepad controller chips



**Code Mercenaries**

## 1. Features

- USB interface
- Full USB V1.1/2.0 compliance
- Full USB HID 1.1 compliance
- Available for analog and digital sticks
- Support for up to 8, 16, or 32 buttons
- Compatible with standard system drivers, no special drivers necessary
- Advanced driver software available for custom designs
- Single +5V power supply
- Available in 20 pin DIL, 20 pin SOIC, 24 pin DIL, or 24 pin SOIC

### 1.1 Variants

JoyWarrior is available in a number of standard variants. Customized versions are available.

#### JoyWarrior20 GP8

- Gamepad style controller, supports four switches for directions
- Supports up to 8 buttons, direct connected to the chip
- DIL20 and SOIC20 packages

#### JoyWarrior24 GP32

- Gamepad style controller, supports four switches for directions
- Supports up to 32 buttons, arranged in a 8x4 matrix, or up to 12 buttons direct connected
- Minimal external component count (1C, 1R)
- DIL24 and SOIC24 packages

#### JoyWarrior20 A8-8

- Four analog potentiometer axes with 8 bit resolution each
- Supports up to 8 buttons, direct connected to the chip
- Low cost external A/D converter for high precision
- DIL20 and SOIC20 packages

#### JoyWarrior20 A8-16

- Four analog potentiometer axes with 8 bit resolution each
- Supports up to 16 buttons, arranged in a 4x4 matrix
- Low cost external A/D converter for high precision
- DIL20 and SOIC20 packages

#### JoyWarrior20 A10-8

- Three analog potentiometer axes with 10 bit resolution each
- Supports up to 8 buttons, direct connected to the chip
- Low cost external A/D converter for high precision
- DIL20 and SOIC20 packages

#### JoyWarrior20 A10-16

- Three analog potentiometer axes with 10 bit resolution each
- Supports up to 16 buttons, arranged in a 4x4 matrix
- Low cost external A/D converter for high precision
- DIL20 and SOIC20 packages

#### JoyWarrior24 A8-8

- Three analog potentiometer axes with 8 bit resolution each
- Supports up to 8 buttons, direct connected to the chip
- Autocalibration and autocentering
- Minimal external component count (2C, 1R)
- Internal precision oscillator, needs no external components for clock generation
- Low cost yet high quality solution
- DIL24 and SOIC24 packages
- Fully assembled modules available

#### JoyWarrior24 A8-16

- Three analog potentiometer axes with 8 bit resolution each
- Supports up to 16 buttons, arranged in a 4x4 matrix
- Autocalibration and autocentering
- Minimal external component count (2C, 1R)
- Internal precision oscillator, needs no external components for clock generation
- Low cost yet high quality solution
- DIL24 and SOIC24 packages
- Fully assembled modules available

#### JoyWarrior24 RC

- Adapts model RC teacher/student interface as a USB joystick
- See separate data sheet supplement for details

**MouseWarrior24 J8 - see separate data sheet**

# JoyWarrior

## 1.2 Custom variants

Custom adaptations are available on request.

An advanced driver with programming functions is available for optional licensing.

Special function modifications, like controllers for pedals, steering wheels etc. are available on request. Support for more axes or buttons is possible.

## 2. Functional overview

The JoyWarrior family of joystick controllers allows to build USB compatible input devices without the need to acquire USB know how.

Mostly only electro-mechanical components need to be added to the JoyWarrior chips.

With the wide variety of controller versions most industrial and game control devices can be built very easily.

## 2.1 Product selection matrix

Type	Analog	Digital	A/D	Axes	Bit/Axis	Buttons	Matrix	DIL20	SOIC20	DIL24	SOIC24
JoyWarrior 20 GP8	-	√	-	-	n.a.	8	-	√	√	-	-
JoyWarrior 24 GP32	-	√	-	-	n.a.	32	8x4 or 12	-	-	√	√
JoyWarrior 24 A8-8	√	-	internal	3	8	8	-	-	-	√	√
JoyWarrior 24 A8-16	√	-	internal	3	8	16	4x4	-	-	√	√
JoyWarrior 20 A8-8	√	-	MAX1113	4	8	8	-	√	√	-	-
JoyWarrior 20 A8-16	√	-	MAX1113	4	8	16	4x4	√	√	-	-
JoyWarrior 20 A10-8	√	-	MAX1249	3	10	8	-	√	√	-	-
JoyWarrior 20 A10-16	√	-	MAX1249	3	10	16	4x4	√	√	-	-

# JoyWarrior

## 3.0 Pin Configurations (TOP VIEW!)

### JoyWarrior20 GP8-P/S 20 Pin PDIP or 20 Pin SOIC

B0	1	20	B4
B1	2	19	B5
B2	3	18	B6
B3	4	17	B7
Right	5	16	Left
Down	6	15	Up
GND	7	14	D+
PullToGND	8	13	D-
CExt	9	12	Vcc
XIn	10	11	XOut

### JoyWarrior24A8-8 24 Pin PDIP or 24 Pin SOIC

A0	1	24	YR1
A1	2	23	YR2
XR1	3	22	ZR1
XR2	4	21	ZR2
B0	5	20	B1
B2	6	19	B3
B4	7	18	B5
B6	8	17	B7
GND	9	16	D+
PullToGND	10	15	D-
VREG	11	14	Vcc
RAW	12	13	NC

### JoyWarrior20 A8-8-P/S JoyWarrior20 A10-8-P/S 20 Pin PDIP or 20 Pin SOIC

B0	1	20	B4
B1	2	19	B5
B2	3	18	B6
B3	4	17	B7
/CS	5	16	SCLK
Din	6	15	Dout
GND	7	14	D+
PullToGND	8	13	D-
CExt	9	12	Vcc
XIn	10	11	XOut

### JoyWarrior24 GP32-P/S 24 Pin DIL or 24 Pin SOIC

X0	1	24	X4
X1	2	23	X5
X2	3	22	X6
X3	4	21	X7
Right	5	20	Left
Down	6	19	Up
Y0	7	18	Y1
Y2	8	17	Y3
GND	9	16	D+
PullToGND	10	15	D-
Vreg	11	14	Vcc
Direct	12	13	NC

### JoyWarrior24A8-16 24 Pin PDIP or 24 Pin SOIC

A0	1	24	YR1
A1	2	23	YR2
XR1	3	22	ZR1
XR2	4	21	ZR2
X0	5	20	X1
X2	6	19	X3
Y0	7	18	Y1
Y2	8	17	Y3
GND	9	16	D+
PullToGND	10	15	D-
VREG	11	14	Vcc
RAW	12	13	NC

### JoyWarrior20 A8-16-P/S JoyWarrior20 A10-16-P/S 20 Pin PDIP or 20 Pin SOIC

X0	1	20	Y0
X1	2	19	Y1
X2	3	18	Y2
X3	4	17	Y3
/CS	5	16	SCLK
Din	6	15	Dout
GND	7	14	D+
PullToGND	8	13	D-
CExt	9	12	Vcc
XIn	10	11	XOut

# JoyWarrior

## 4.0 Pin Descriptions JoyWarrior20 GP 8

Name	I/O	Type	Pins	Description
D+, D-	I/O	special	14,13	USB differential data lines
B0, B1, B2, B3, B4, B5, B6, B7	I	input, internal Pull Up	1, 2, 3, 4, 20, 19, 18, 17	Button inputs, active low
Right	I	input, internal Pull Up	5	Input for right direction switch, active low
Left	I	input, internal Pull Up	16	Input for left direction switch, active low
Down	I	input, internal Pull Up	6	Input for down direction switch, active low
Up	I	input, internal Pull Up	15	Input for up direction switch, active low
CExt	I/O	special *	9	Requires external RC for periodic wake
PullToGND	I		8	Used during manufacturing, connect to GND
GND		Power supply	7	Ground
Vcc		Power supply	12	Supply voltage
XOut	O		11	On chip oscillator output
XIn	I		10	On chip oscillator input

## 4.1 Pin Descriptions JoyWarrior24 GP 32

Name	I/O	Type	Pins	Description
D+, D-	I/O	special	16,15	USB differential data lines
X0, X1, X2, X3, X4, X5, X6, X7	I	input, internal Pull Up	1, 2, 3, 4, 24, 23, 22, 21	Button row inputs, active low
Y0, Y1, Y2, Y3	O	output, open drain, internal Pull Up	7, 18, 8, 17	Button column outputs, periodically pulled low
Right	I	input, internal Pull Up	5	Input for right direction switch, active low
Left	I	input, internal Pull Up	20	Input for left direction switch, active low
Down	I	input, internal Pull Up	6	Input for down direction switch, active low
Up	I	input, internal Pull Up	19	Input for up direction switch, active low
VREG	O	special *	11	Power for USB D- pull up resistor
PullToGND	I		10	Used during manufacturing, connect to GND
GND		Power supply	9	Ground
Vcc		Power supply	14	Supply voltage
Direct	I	input, internal Pull Down	12	Pull high to enable 12 direct connected buttons.
NC		unused	13	Do not connect

\* See application circuit for external circuitry.

# JoyWarrior

## 4.2 Pin Descriptions JoyWarrior24 A 8-8

Name	I/O	Type	Pins	Description
D+, D-	I/O	special	16,15	USB differential data lines
B0, B1, B2, B3, B4, B5, B6, B7	I	input, internal Pull Up	5, 20, 6, 19, 7, 18, 8, 17	Button inputs, active low
A0, A1	I/O	special *	1, 2	Connect center taps of pots here
XR1, XR2	O	special *	3, 4	Connections for X pot
YR1, YR2	O	special *	24, 23	Connections for Y pot
ZR1, ZR2	O	special *	22, 21	Connections for Z pot
VREG	O	special *	11	Power for USB D- pull up resistor
PullToGND	I		10	Used during manufacturing, connect to GND
GND		Power supply	9	Ground
Vcc		Power supply	14	Supply voltage
RAW	I	input, internal pull down	12	Pull to Vcc to disable auto calibration and centering

## 4.3 Pin Descriptions JoyWarrior24 A 8-16

Name	I/O	Type	Pins	Description
D+, D-	I/O	special	16,15	USB differential data lines
X0, X1, X2, X3	I	input, internal Pull Up	5, 20, 6, 19	Button row inputs, active low
Y0, Y1, Y2, Y3	O	output, open drain, internal Pull Up	7, 18, 8, 17	Button column outputs, periodically pulled low
A0, A1	I/O	special *	1, 2	Connect center taps of pots here
XR1, XR2	O	special *	3, 4	Connections for X pot
YR1, YR2	O	special *	24, 23	Connections for Y pot
ZR1, ZR2	O	special *	22, 21	Connections for Z pot
VREG	O	special *	11	Power for USB D- pull up resistor
PullToGND	I		10	Used during manufacturing, connect to GND
GND		Power supply	9	Ground
Vcc		Power supply	14	Supply voltage
RAW	I	input, internal pull down	12	Pull to Vcc to disable auto calibration and centering

\* See application circuit for external circuitry.

# JoyWarrior

## 4.4 Pin Descriptions JoyWarrior20 A8-8 and JoyWarrior20 A10-8

Name	I/O	Type	Pins	Description
D+, D-	I/O	special	14,13	USB differential data lines
B0, B1, B2, B3, B4, B5, B6, B7	I	input, internal Pull Up	1, 2, 3, 4, 20, 19, 18, 17	Button inputs, active low
/CS	O	OD, internal Pull Up	5	/CS signal to external A/D converter
SCLK	O	OD, internal Pull Up	16	SCLK signal to external A/D converter
Din	O	OD, internal Pull Up	6	Din signal to external A/D converter
Dout	I	input, internal Pull Up	15	Dout signal from external A/D converter
CExt	I/O	special *	9	Requires external RC for periodic wake
PullToGND	I		8	Used during manufacturing, connect to GND
GND		Power supply	7	Ground
Vcc		Power supply	12	Supply voltage
XOut	O		11	On chip oscillator output
XIn	I		10	On chip oscillator input

## 4.5 Pin Descriptions JoyWarrior20 A8-16 and JoyWarrior20 A10-16

Name	I/O	Type	Pins	Description
D+, D-	I/O	special	14,13	USB differential data lines
X0, X1, X2, X3	I	input, internal Pull Up	1, 2, 3, 4	Button row inputs, active low
Y0, Y1, Y2, Y3	O	output, open drain	20, 19, 18, 17	Button column outputs, periodically pulled low
/CS	O	OD, internal Pull Up	5	/CS signal to external A/D converter
SCLK	O	OD, internal Pull Up	16	SCLK signal to external A/D converter
Din	O	OD, internal Pull Up	6	Din signal to external A/D converter
Dout	I	input, internal Pull Up	15	Dout signal from external A/D converter
CExt	I/O	special *	9	Requires external RC for periodic wake
PullToGND	I		8	Used during manufacturing, connect to GND
GND		Power supply	7	Ground
Vcc		Power supply	12	Supply voltage
XOut	O		11	On chip oscillator output
XIn	I		10	On chip oscillator input

\* See application circuit for external circuitry.

# JoyWarrior

## 4.4 Pin descriptions

### **D+, D-**

Differential data lines of USB. Connect these signals direct to a USB cable. D- requires a pull up resistor, see application circuits for details.

### **B0..B7 (non matrix chips)**

Inputs for the buttons. Connect contacts closing to ground.

Internal pull up resistors.

### **X0..X3 or X0..X7 (matrix chips)**

Matrix row inputs for the buttons. These pins are read by JoyWarrior to determine the status of the buttons.

Internal pull up resistors.

### **Y0..Y3 (matrix chips)**

Matrix column outputs. These pins are periodically pulled low to determine the status of the buttons.

All buttons must be decoupled with diodes, see application circuit for details.

Open drain outputs.

### **Left, Right, Up, Down (JoyWarrior GP)**

Inputs for the direction pad. Connect contacts closing to ground.

Internal pull up resistors.

### **/CS, SCLK, Din, Dout (JoyWarrior20 A8/A10)**

Signals to connect to the external A/D converter.

The JoyWarrior 20A10 chips are designed to work with Maxim MAX 1249 A/D converters.

Internal pull up resistors.

### **CExt (except JoyWarrior24)**

This input is used to periodically wake the processor during USB suspend to check for a wakeup condition. An external RC combination is required. See application circuit for details.

If remote wakeup is not desired this pin should be pulled to GND. However this is not very clean according to USB specs as the chip will still report to be remote wakeup capable.

### **/Pull to GND**

This pin is used during production of the JoyWarrior chips, connect to GND.

### **VREG (JoyWarrior24)**

Supplies 3.3V for the USB D- pull up resistor. Don't use this pin to supply power to external circuitry, it does only supply sufficient current for the pull up resistor.

### **A0, A1 (JoyWarrior24A8)**

The center taps of the pots and a capacitor are connected to these two pins. The pins are used to charge the capacitor and measure the time it takes to discharge the capacitor via the pots.

See application circuits for details.

### **XR1, XR2, YR1, YR2, ZR1, ZR2 (JoyWarrior24A8)**

These outputs connect to the outer taps of the pots. One of them is pulled low at a time to measure how long it takes to discharge the capacitor via the pot.

Axis values get smaller when the pot center tap gets closer to the tap connected to the nR1 pin, i.e. resistance between nR1 and A0, A1 gets smaller.

### **RAW (JoyWarrior24A8)**

Pulling this pin to Vcc disables the autocalibration and autocentering function. The chip will then report the raw axis data. This can be useful during design test or for applications that can't accept the autocalibration or autocentering feature.

Internal weak pull down resistor.

### **XOut, XIn (except JoyWarrior24)**

Connection for external oscillator. A 6MHz ceramic resonator should be connected here, no additional components necessary.

Using a crystal results in unstable operation as the oscillator is optimized for use with ceramic resonators.

An external 6MHz clock may be connected to XIn, XOut has to be left floating in this case.

### **Direct (JoyWarrior24GP32)**

Pulling this pin high disables the matrix scanning for the buttons and instead uses X0..7 and Y0..3 as direct button inputs for up to 12 buttons pulling to GND. X0..7 will be buttons 1..8 and Y0..Y3 buttons 9..12. All button input pins have internal pull ups.

### **GND**

Power supply ground.

### **Vcc**

Supply voltage.

# JoyWarrior

## 5. Device Operation

By following the USB HID specifications JoyWarrior chips are able to work with most operating systems without the need to supply special drivers. Any operating system with support for USB HID game controllers will have the necessary drivers already in place.

### 5.1 Operation with Windows

Any Windows versions 98 and newer and 2000 and newer will work with JoyWarrior. Older versions of Windows do not support USB.

JoyWarrior 20A10-16 is not properly supported by Windows 98 original release.

Upon connecting a JoyWarrior based device for the first time you will be asked to perform the standard driver install. The same happens if you connect the device to a different USB port on the same computer.

After the driver installation has completed you should be able to see the device in the "Game Controllers" control panel and be able to access it via DirectInput.

### 5.2 Operation with MacOS

MacOS 9.0 and up and MacOS X do support JoyWarrior direct. Some versions of MacOS 8.x do support USB as well, though their use is not recommended.

With MacOS 9.x you will be able to use JoyWarrior based devices via InputSprocket or with 3rd party software like USB Overdrive.

On MacOS X access is available via the HIDManager.

There will be no warnings or dialogs when a properly functioning JoyWarrior based device is connected under MacOS, it will simply start to work.

### 5.3 Protocol Specifics: JoyWarrior GP

Even though JoyWarrior GP is a gamepad style device it does report the directional data in two itmes of 8 bits each. For left and up directions 0 is reported, for neutral 127 and for right and down 255.

This method was chosen since the more logical report format with two bit items does cause problems with several OS variants (Mac and PC) and some games.

### 5.4 Jitter Filter in JoyWarrior24A8

The jitter filter is no longer present in JW20A8 and JW20A10, it was removed with the release of V1.0.3.3.

Since any A/D converter generates quantisation noise (the least significant bit jittering at voltages close to the threshold between two values) JoyWarrior24A8 variants use a simple but efficient jitter filter. Only if the axis values change more than  $\pm 1$  digit the data is actually send to the host. This efficiently eliminates quantisation noise but retains full resolution and reaction speed. If there is still noise on the axis data you should check your circuit for the cause.

If the RAW pin on the JoyWarrior24A8 is pulled high this will also disable the jitter filter.

### 5.5 Autocalibration and autocentering - JoyWarrior24A8

The JoyWarrior24A8 chips do have a autocentering and autocalibration function that compensates mechanical tolerances in the joystick. When autocalibration and centering is activated (i.e. RAW pin is unconnected or pulled to Gnd) upon power up the JoyWarrior24A8 will sample axis data for about 200msec and then use the stick position as center. The chip then assumes that each pot will reach 60% of its total range and will scale all axis data accordingly to cover the value range of 0 to 255. If any axis is moved beyond the assumed 60% the scaling will be adjusted.

To calibrate a joystick with the autocentering feature activated it is sufficient to place the stick to about center before plugging it in and then move the stick to all maximum positions. The JoyWarrior24A8 will optimize the value scaling for best resolution.

Pulling the RAW pin high for more than 20msec and then let it go low again triggers a recalibration.

### 5.6 Pot and capacitor values for JW24A8

The JoyWarrior24A8 is optimized to be used with a 4.7nF capacitor and 100k $\Omega$  pots. A ceramic multi layer capacitor may be used as the measuring capacity. It is not recommended to use ceramic disk type capacitors because of their microphony effect.

Varying the pot or capacitor values may result in sub optimal performance. Larger capacitors may not sufficiently charge or discharge, while smaller values may introduce more noise.

To optimize the setup it is recommended to check out the axis values in RAW mode. Ideally the values in raw mode should range from 0 at one end of the pot position to 255 at the other end.

# JoyWarrior

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## 5.7 Remote Wakeup

All JoyWarrior chips support the remote wakeup feature. They are able to wake the host computer from sleep state if the host operating system does enable this feature.

Remote wakeup is initiated by JoyWarrior if any button is pressed or if any switch of the direction pad closes. Changes on the analog axes are not detected.

For remote wakeup to be functional on the JoyWarrior20 chips the RC combination on the CExt pin as specified in the application circuits is required.

When remote wakeup is active and the USB is in suspend state JoyWarrior20 will wake periodically and check if any switches are closed, if not it will immediately return to suspend mode.

JoyWarrior24 chips go to full sleep and do not wake periodically, the pressing of any button will get them out of suspend immediately.

## 5.8 Joystick axis orientation

USB specifies the axis orientation as follows:

For the X axis values should increase for left to right movement, Y axis values increase for far to near movements (i.e. pulling the stick gets you larger values), Z axis values should increase for high to low movement.

## 5.9 Non Joystick Applications

USB does allow a Human Interface Device controller to very detailed specify the function of axes and buttons. This gives a game controller device the option to specify a certain axis to be a throttle or break or something else.

The standard JoyWarrior chips are for general use, so the analog axes variants just specify X, Y, Z and the switch inputs are defined as being just buttons. We can modify the controllers to define axes as other inputs, like gas or rudder pedals or support hat switches etc.

However not all available usages are supported by all operating systems and programs. Windows for instance supports only a small subset of the simulation controls page.

If you have special requirements, please contact us about modifications.

# JoyWarrior

## 6. DC Characteristics

	Parameter	Min	Max	Units	Remarks
V <sub>cc</sub>	Operating Voltage	4.35	5.25	V	
I <sub>cc</sub>	Operating Supply Current		25	mA	
I <sub>sb</sub>	Suspend mode current		20	μA	Oscillator off
I <sub>ol</sub>	Sink current on output pins	8**	24**	mA	V <sub>out</sub> = 2.0V
R <sub>up</sub>	Pull-up Resistance	8	24	kΩ	
V <sub>ith</sub>	Input Threshold Voltage	45%	65%	V <sub>cc</sub>	
	<b>USB Interface</b>				
V <sub>oh</sub>	Static output high	2.8	3.6	V	15kΩ±5% to GND
V <sub>ol</sub>	Static output low		0.3	V	
V <sub>di</sub>	Differential Input sensitivity	0.2		V	$(D+) - (D-)$
V <sub>cm</sub>	Differential Input common Mode Range	0.8	2.5	V	
V <sub>se</sub>	Single Ended Transceiver Threshold	0.8	2.0	V	
C <sub>in</sub>	Transceiver capacitance		20	pF	
I <sub>io</sub>	Hi-Z State Data Line Leakage	-10	10	μA	0V < V <sub>in</sub> < 3.3V, Hi-Z State
R <sub>pu</sub>	Bus Pull-up resistance	7.35 *	7.65 *	kΩ	7.5kΩ±2% to V <sub>cc</sub> *
R <sub>pd</sub>	Bus Pull-down resistance	14.25	15.75	kΩ	15kΩ±5%

\*) For JW24A8: 1.274kΩ to 1.326kΩ, 1.3kΩ resistor to VREG

\*\*\*) 2mA max for JoyWarrior24

## 6.1 AC Characteristics

	Parameter	Min	Max	Units	Remarks
t <sub>cyc</sub>	input clock cycle time	165.0	168.3	ns	no external clock on JW24A8
t <sub>ch</sub>	Clock high time	0.45tcyc		ns	no external clock on JW24A8
t <sub>cl</sub>	Clock low time	0.45tcyc		ns	no external clock on JW24A8
	<b>USB Driver Characteristics</b>				
t <sub>r</sub>	Transition rise time	75		ns	C <sub>Load</sub> = 50pF
t <sub>r</sub>	Transition rise time		300	ns	C <sub>Load</sub> = 350pF
t <sub>f</sub>	Transition fall time	75		ns	C <sub>Load</sub> = 50pF
t <sub>f</sub>	Transition fall time		300	ns	C <sub>Load</sub> = 350pF
t <sub>r/m</sub>	Rise/Fall Time matching	80	120	%	
V <sub>crs</sub>	Output signal crossover voltage	1.3	2.0	V	
	<b>USB Data Timing</b>				
t <sub>drate</sub>	Low Speed Data Rate	1.4777	1.5225	MBit/s	
t <sub>djr1</sub>	Receiver data jitter tolerance	-75	75	ns	To next transition
t <sub>djr2</sub>	Receiver data jitter tolerance	-45	45	ns	For paired transitions
t <sub>deop</sub>	Differential to EOP transition skew	-40	100	ns	
t <sub>eoпр1</sub>	EOP width at receiver	165		ns	Rejects as EOP
t <sub>eoпр2</sub>	EOP width at receiver	675		ns	Accepts as EOP
t <sub>eoпрt</sub>	Source EOP width	1.25	1.50	μs	
t <sub>udj1</sub>	Differential driver jitter	-95	95	ns	To next transition
t <sub>udj2</sub>	Differential driver jitter	-150	150	ns	To paired transition

# JoyWarrior

## 7. Ordering information

Partname	Order Code	Description	Package
JoyWarrior20 GP 8	JW20GP8-P	Gamepad controller supports up to 8 buttons	PDIP20
JoyWarrior20 GP 8	JW20GP8-S	Gamepad controller supports up to 8 buttons	SOIC20
JoyWarrior24 GP 32	JW20GP32-P	Gamepad controller supports up to 32 buttons, 8x4 matrix	PDIP24
JoyWarrior24 GP 32	JW20GP32-S	Gamepad controller supports up to 32 buttons, 8x4 matrix	SOIC24
JoyWarrior24 A8-8	JW24A8-8-P	Joystick controller, 3 axis, 8 bit, autocenter/cal, up to 8 buttons	PDIP24
JoyWarrior24 A8-8	JW24A8-8-S	Joystick controller, 3 axis, 8 bit, autocenter/cal, up to 8 buttons	SOIC24
JoyWarrior24 A8-16	JW24A8-16-P	Joystick controller, 3 axis, 8 bit, autocenter/cal, up to 16 buttons	PDIP24
JoyWarrior24 A8-16	JW24A8-16-S	Joystick controller, 3 axis, 8 bit, autocenter/cal, up to 16 buttons	SOIC24
JoyWarrior20 A8-8	JW20A8-8-P	Joystick controller, 4 axis, 8 bit, up to 8 buttons	PDIP20
JoyWarrior20 A8-8	JW20A8-8-S	Joystick controller, 4 axis, 8 bit, up to 8 buttons	SOIC20
JoyWarrior20 A8-16	JW20A8-16-P	Joystick controller, 4 axis, 8 bit, up to 16 buttons, 4x4 matrix	PDIP20
JoyWarrior20 A8-16	JW20A8-16-S	Joystick controller, 4 axis, 8 bit, up to 16 buttons, 4x4 matrix	SOIC20
JoyWarrior20 A10-8	JW20A10-8-P	Joystick controller, 3 axis, 10 bit, up to 8 buttons	PDIP20
JoyWarrior20 A10-8	JW20A10-8-S	Joystick controller, 3 axis, 10 bit, up to 8 buttons	SOIC20
JoyWarrior20 A10-16	JW20A10-16-P	Joystick controller, 3 axis, 10 bit, up to 16 buttons, 4x4 matrix	PDIP20
JoyWarrior20 A10-16	JW20A10-16-S	Joystick controller, 3 axis, 10 bit, up to 16 buttons, 4x4 matrix	SOIC20

The chips listed here are standard products. Customized chips are available on request.

### 7.1 Packaging info

PDIP20 chips come in tubes with 20 chips each.  
 PDIP24 chips come in tubes with 16 chips each.  
 SOIC20 chips come in tubes with 37 chips each.  
 SOIC24 chips come in tubes with 31 chips each.  
 To assure best handling and shipping safety please order the chips in full tubes.

### 7.2 USB VendorID and ProductID

By default all JoyWarrior chips are shipped with the USB VendorID of Code Mercenaries (\$7C0 or decimal 1984) and a fixed ProductID.

On request chips can be equipped with the customers VendorID and ProductID. VendorIDs can be obtained from the USB Implementers Forum <[www.usb.org](http://www.usb.org)>

Customized chips are subject to minimum order quantities, contact <[sales@codemercs.com](mailto:sales@codemercs.com)> for details.

Following are the ProductIDs for the JoyWarrior controllers:

JoyWarrior20 GP8	\$1100
JoyWarrior24 GP32	\$1101
JoyWarrior24 A8-8	\$1104
JoyWarrior24 A8-16	\$1105
JoyWarrior20 A10-8	\$1108
JoyWarrior20 A10-16	\$1109
JoyWarrior20 A8-8	\$110A
JoyWarrior20 A8-16	\$110B

ProductIDs are independent of the package type.

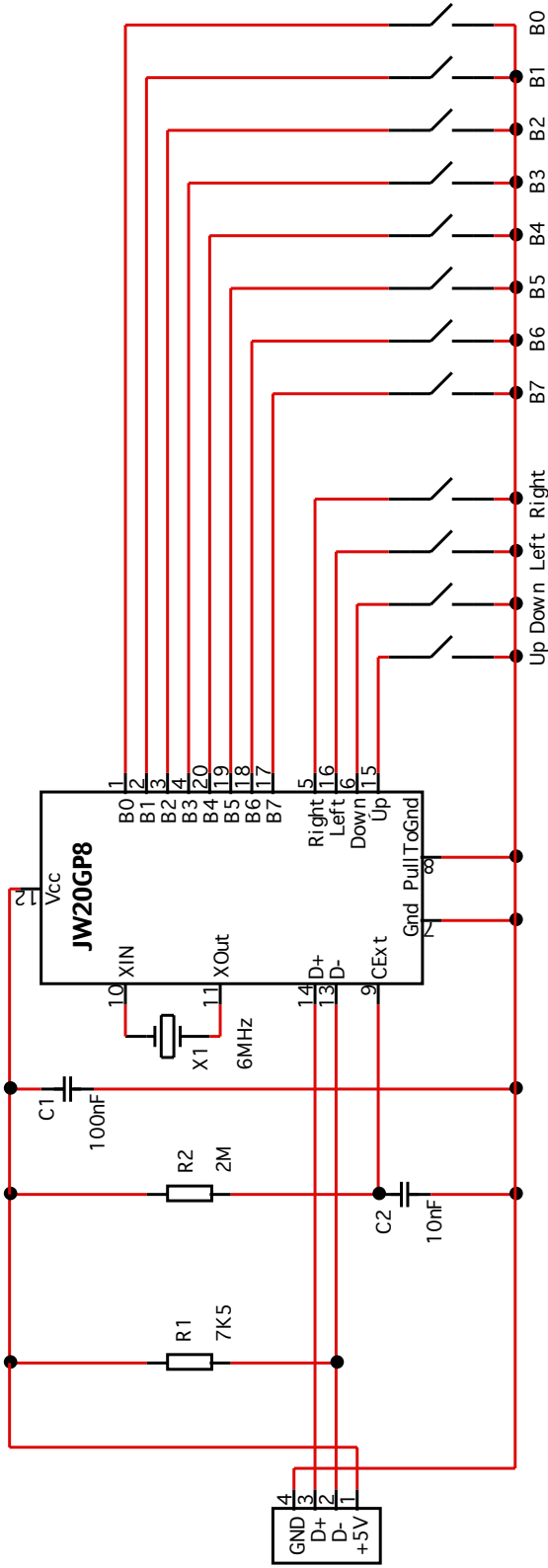
### 7.3 Currently shipping versions

Following are the currently shipping versions for the chips:

JoyWarrior20 GP8	V1.0.3.0
JoyWarrior24 GP32	V1.0.3.3
JoyWarrior24 A8-8	V1.0.3.0
JoyWarrior24 A8-16	V1.0.3.0
JoyWarrior20 A10-8	V1.0.3.3
JoyWarrior20 A10-16	V1.0.3.3
JoyWarrior20 A8-8	V1.0.3.3
JoyWarrior20 A8-16	V1.0.3.3
JoyWarrior24RC	V1.0.3.1
MouseWarrior24J8	V1.0.3.3

# JoyWarrior

## 8. Typical application for JoyWarrior20 GP8

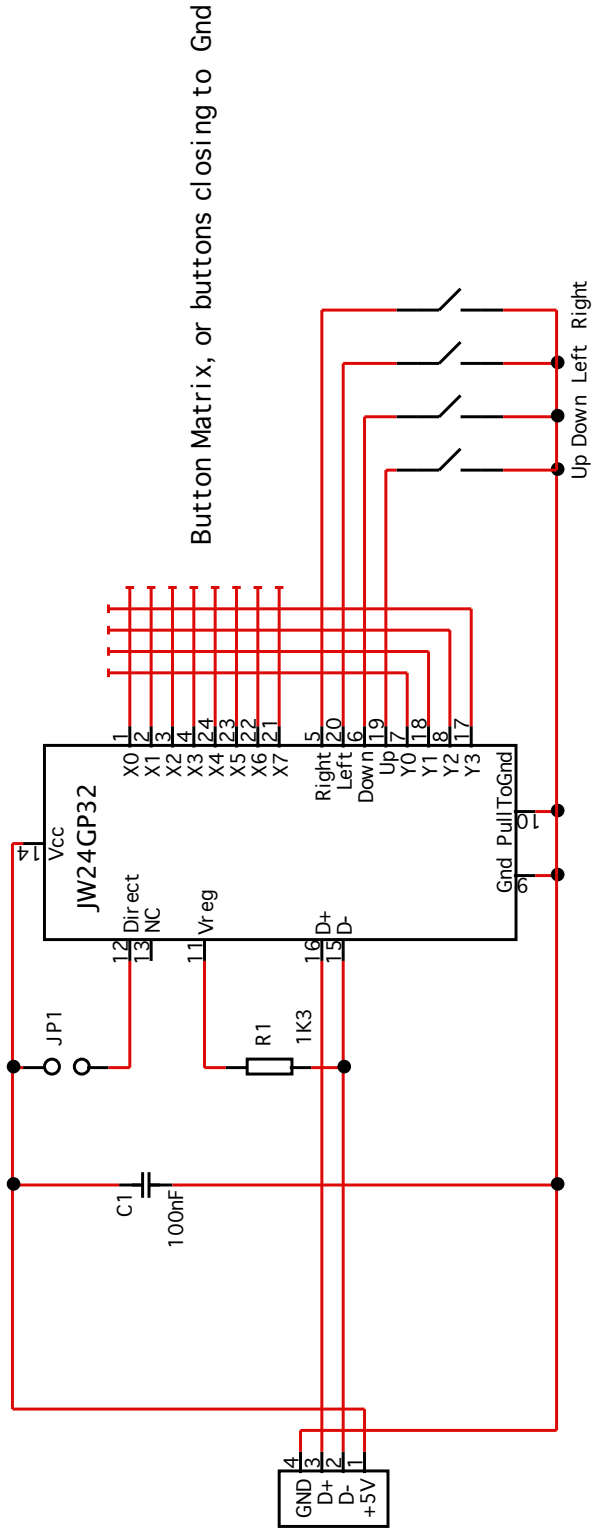


X1 = Ceramic resonator, crystal will not work!

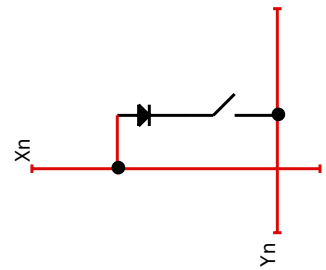
		Rev.	Date	By	Change	Sign.
<b>Circuit:</b> JoyWarrior20GP8 <b>Version:</b> 1.0 <b>Date:</b> July 19th 2002 <b>Drawn by:</b> <b>Function:</b> <b>Page:</b>						

# JoyWarrior

## 8.1 Typical application for JoyWarrior24 GP32



Button Matrix needs decoupling diodes at every switch:



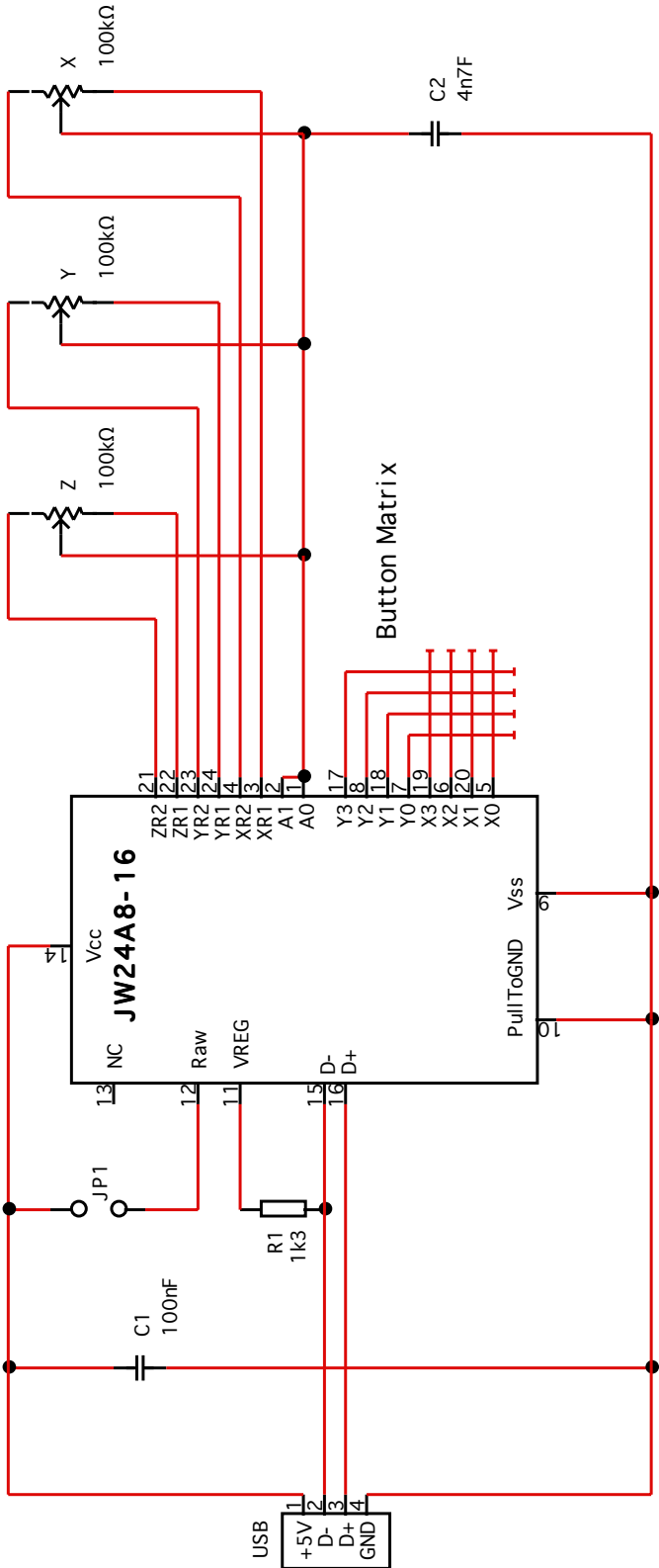
Close JP1 for 12 direct connected buttons

Circuit: JoyWarrior24GP32				
Version: 2.2				
Date: July 25th 2005				
Drawn by:				
Function:				
Pane:				
Rev.	Date	By	Change	Sign.

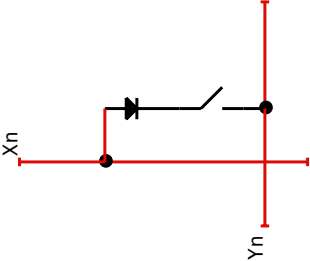


# JoyWarrior

## 8.3 Typical application for JoyWarrior24 A8-16



Button Matrix needs decoupling diodes at every switch:



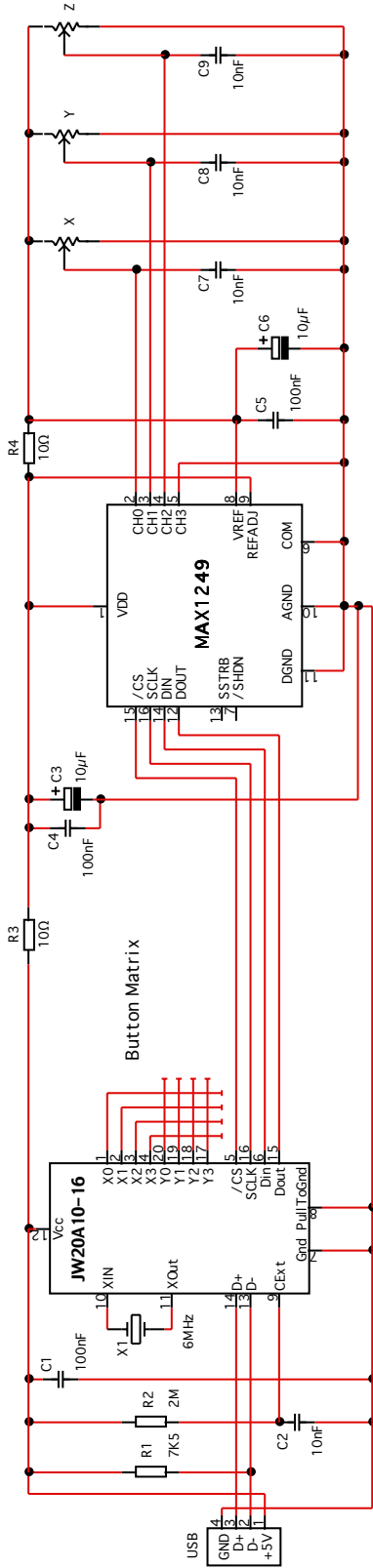
Close JP1 to disable auto centering and auto calibration

Circuit: JoyWarrior 24A8-16			
Version: V1.0			
Date: 30.9.2002			
Drawn by:			
Function:			
Page:		Change	
Rev.	Date	By	Sign.



# JoyWarrior

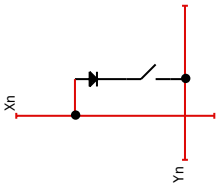
## 8.5 Typical application for JoyWarrior20 A10-16



X1 = ceramic resonator, crystal will not work

AGND is the reference point for a star ground for all analog parts  
Potentiometers must be 50kΩ to 200kΩ || near

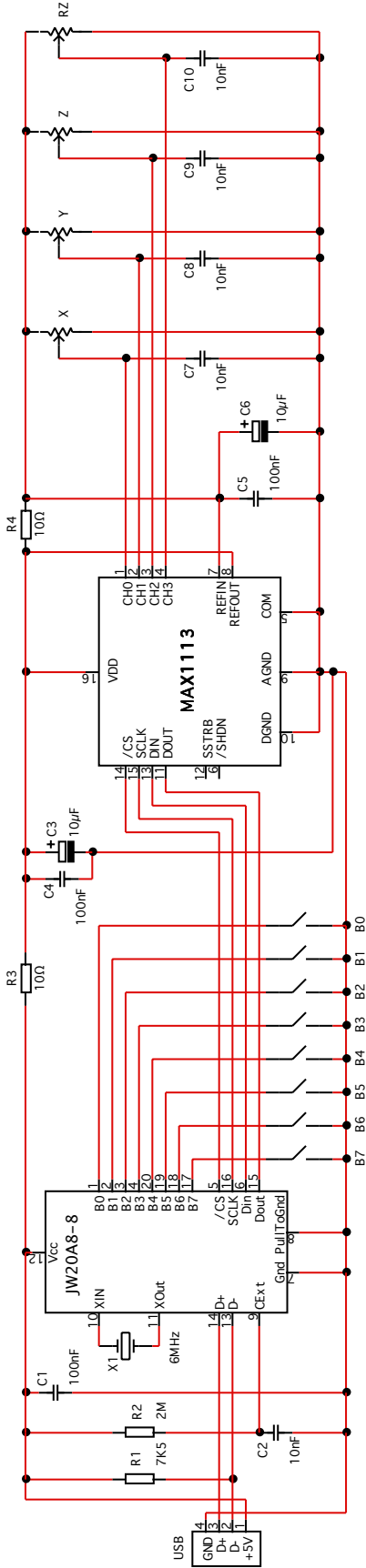
Button Matrix needs decoupling diodes at every switch:



Circuit: JoyWarrior20A10-16		 Code Mercenaries	
Version: 1.0			
Date: Jul 19th 2002			
Drawn by:			
Function:			
Rev.	Date	By	Change


# JoyWarrior

## 8.6 Typical application for JoyWarrior20 A8-8



X1 = ceramic resonator, crystal will not work

AGND is the reference point for a star ground for all analog parts  
 Potentiometers should be 50kΩ to 200kΩ linear

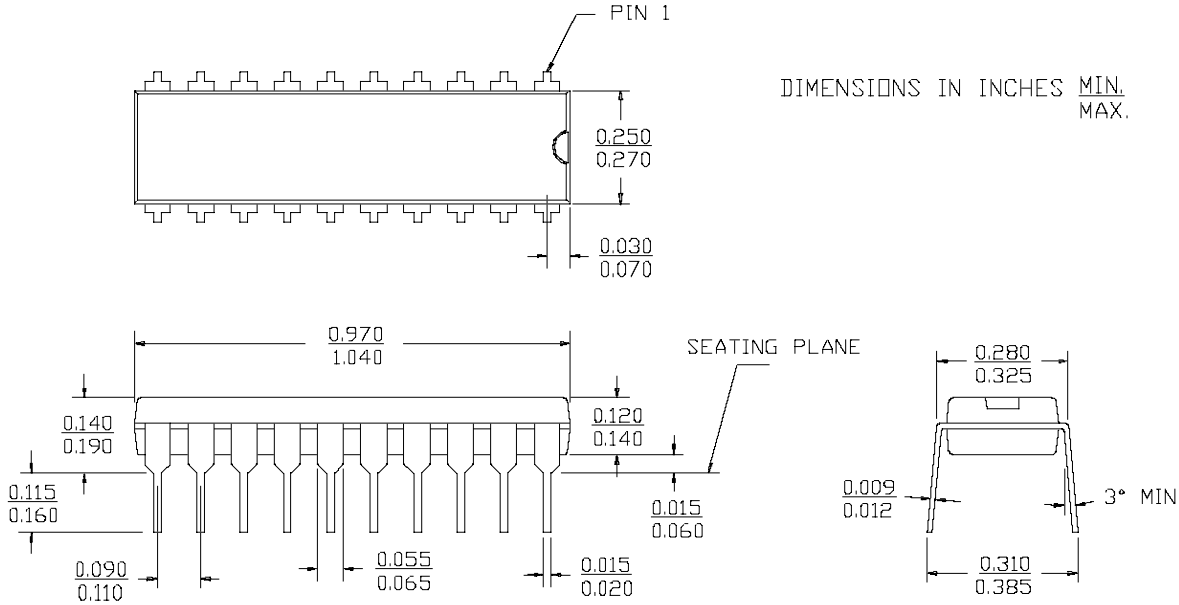
				
<b>Circuit:</b> JoyWarrior20A8-8				
<b>Version:</b> 1.0				
<b>Date:</b> June 2nd 2004				
<b>Drawn by:</b>				
<b>Function:</b>				
<b>Page:</b>				
<b>Rev.</b>	<b>Date</b>	<b>By</b>	<b>Change</b>	<b>Sign.</b>



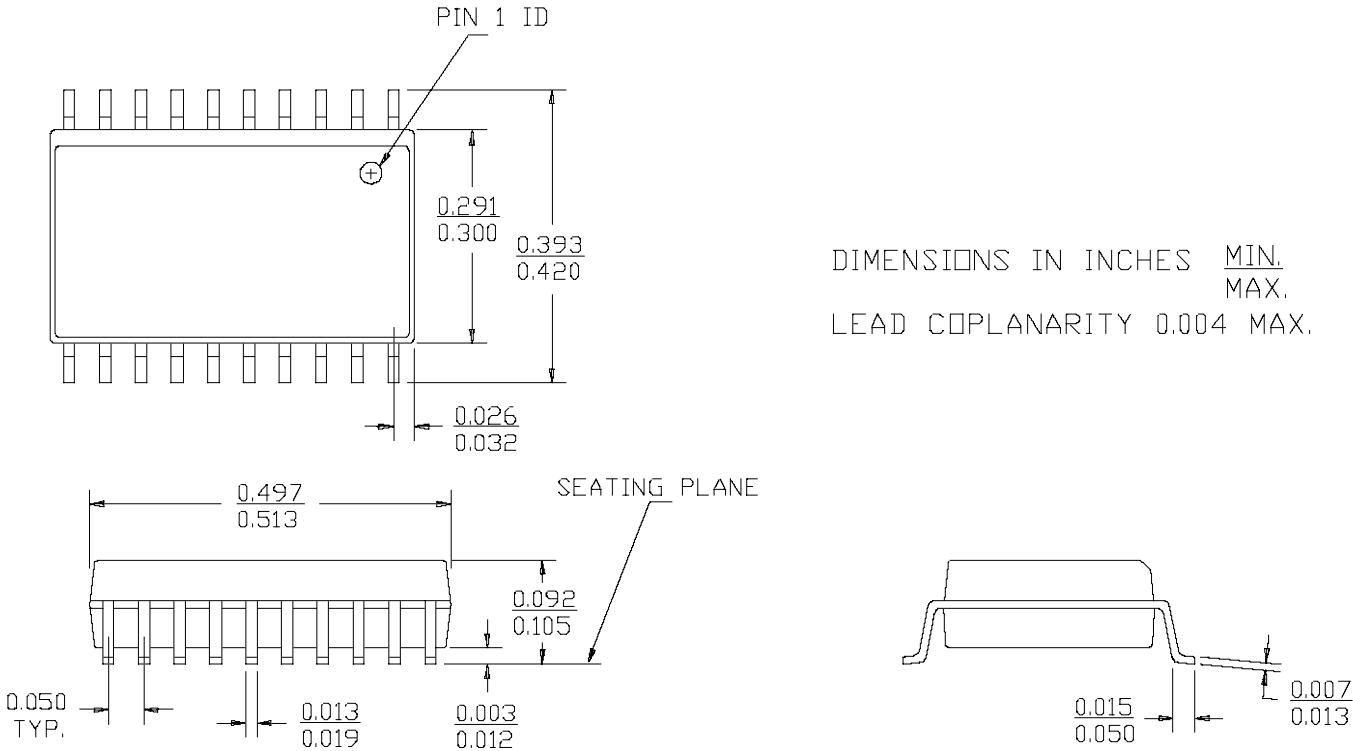
# JoyWarrior

## 9. Package Dimensions

### 20 Pin DIP



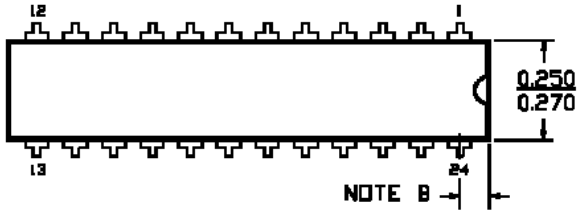
### 20 Pin SOIC



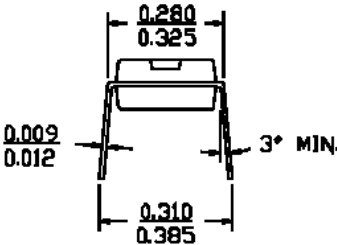
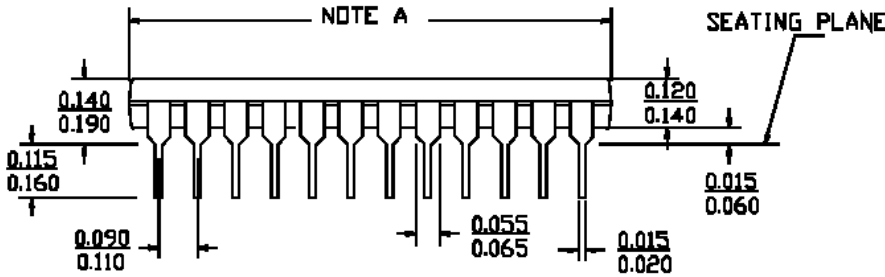
# JoyWarrior

## 24 Pin PDIP

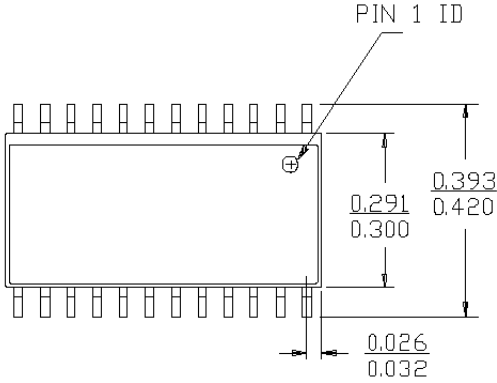
DIMENSIONS IN INCHES MIN.  
MAX.



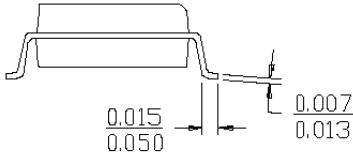
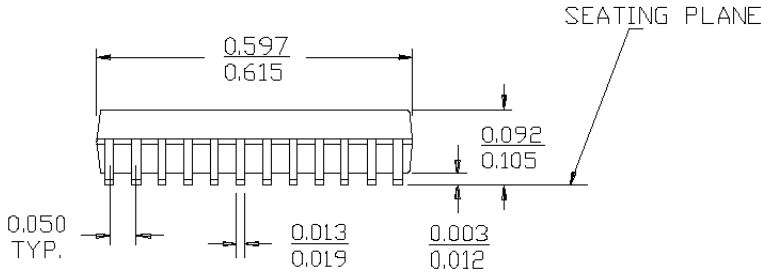
	P 13	P 13A
NOTE A	1.170 1.200	1.230 1.260
NOTE B	0.030 0.050	0.060 0.080



## 24 Pin SOIC



DIMENSIONS IN INCHES MIN.  
MAX.  
LEAD COPLANARITY 0.004 MAX.



# JoyWarrior

## 10. ESD Considerations

JoyWarrior has an internal ESD protection to withstand discharges of more than 2000V without permanent damage. However ESD may disrupt normal operation of the chip and cause it to exhibit erratic behaviour.

For the typical office environment the 2000V protection is normally sufficient. Though for industrial use additional measures may be necessary.

When adding ESD protection to the signals special care must be taken on the USB signal lines. The USB has very low tolerance for additional resistance or capacitance introduced on the USB differential signals.

Series resistors of  $27\Omega$  may be used alone or in addition to some kind of suppressor device. In any case the USB 2.0 specification chapter 6 and 7 should be read for detailed specification of the electrical properties.

### 10.1 EMC Considerations

JoyWarrior uses relatively low power levels and so it causes few EMC problems.

To avoid any EMC problems the following rules should followed:

- Keep the PCB traces from the resonator to the chip pins as short as possible.
- Put the 100nF ceramic capacitor right next to the power supply pins of the chip and make sure the PCB traces between the chips power pins and the capacitor are as short as possible.
- Run the power supply lines first to the capacitor, then to the chip.
- Make the matrix lines only as long as absolutely necessary.
- Keep the two USB signal lines close to each other, route no other signal between them. USB uses differential signalling so the best signal quality with lowest RF emission is achieved by putting these lines very close to each other.
- Adding a ferrite bead to the +5V power supply line is advisable.

## 11. Revision History

The initial release version of JoyWarrior is V1.0.2.0, earlier versions were custom designs not available for general use.

### V1.0.3.3

- Added MouseWarrior24J8.
- Removed jitter filter on JW20A8 and JW20A10.
- Relaxed timing of matrix scan function of JW20A8-16 and JW20A10-16.

- Added direct connected button mode on JW24GP32 allowing 12 buttons connected pulling to ground instead of using a matrix.

### V1.0.3.2

- Release for customer specific chips, not generally available.

### V1.0.3.1

- Fixed a problem in JW24RC that could cause it not to detect the correct signal polarity of the PPM signal.

### V1.0.3.0

- Added JoyWarrior20A8-8, JoyWarrior20A8-16, and JoyWarrior24RC variants.
- Moved JoyWarrior24GP32 to new silicon reducing external circuitry and adding the option for a DIL24 package.
- Improved auto-calibration and -centering on JoyWarrior24A8 so unused axes with no pots connected no longer block operation.

### V1.0.2.1

- Added JoyWarrior24A8-8 and JoyWarrior24A8-16 variants.

# JoyWarrior

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