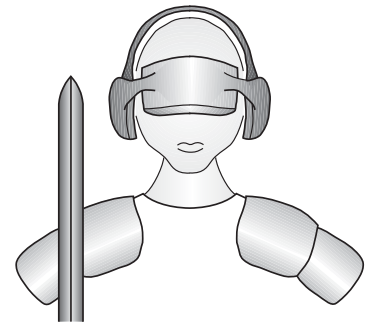


JoyWarrior

Universal joystick and gamepad controller chips



Code Mercenaries

1.0 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
- Digital outputs available on some models
- Single +5V power supply
- Available in 24 pin DIL, or 24 pin SOIC

1.1 Variants

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

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)

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)
- Low cost yet high quality solution
- 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)
- Low cost yet high quality solution
- Fully assembled modules available

JoyWarrior24A8L

- Four analog axes with 8 bit resolution each via external A/D
- Supports 8 direct connected buttons or 16 buttons in a 4x4 matrix (pin selectable)
- Four auxiliary outputs capable of direct driving LEDs, supporting flashing modes

JoyWarrior24A10L

- Three analog axes with 10 bit resolution each via external A/D
- Supports 8 direct connected buttons or 16 buttons in a 4x4 matrix (pin selectable)
- Four auxiliary outputs capable of direct driving LEDs, supporting flashing modes

JoyWarrior24 RC

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

MouseWarrior24J8

- Mouse/Joystick hybrid low cost controller
- See separate data sheet supplement for details

MouseWarrior24H8

- Mouse/Joystick hybrid controller
- Compatible with hall sensors
- See separate data sheet supplement for details

JoyWarrior24F8/F14

- Three axis acceleration sensor
- See separate data sheet supplement for details

MouseWarrior24F8

- Acceleration sensor based mouse controller
- See separate data sheet supplement for details

1.2 Custom variants

Custom adaptations are available on request. Special function modifications, like controllers for pedals, steering wheels etc. are available on request.

1.3 Obsolete variants

The JoyWarrior20 variants have been discontinued. To replace the JW20 chips use the following active products:

JW20GP8	- use JW24GP32
JW20A8-8	- use JW24A8L
JW20A8-16	- use JW24A8L
JW20A10-8	- use JW24A10L
JW20A10-16	- use JW24A10L

For details on the JW20 chips please refer to the data sheet V1.0.8.

JoyWarrior

2.0 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.

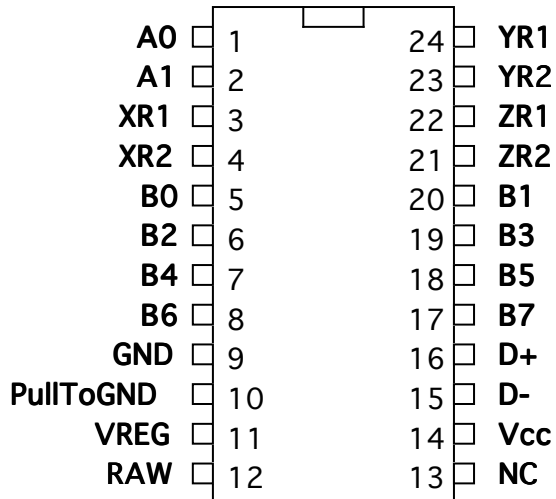
2.1 Product selection matrix

Type	Analog	Digital	A/D	Axes	Bit/Axis	Buttons	Matrix	Outputs	DIL24	SOIC24
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 24 A8L	√	-	MAX1113	4	8	8 or 16	4x4 or 8	4	√	√
JoyWarrior 24 A10L	√	-	MAX1249	3	10	8 or 16	4x4 or 8	4	√	√

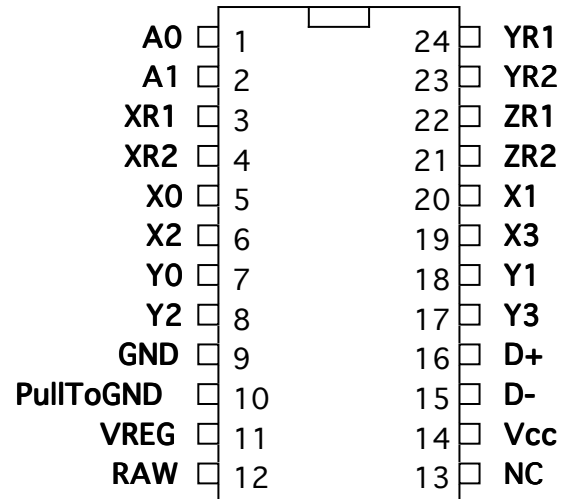
JoyWarrior

3.0 Pin Configurations (TOP VIEW!)

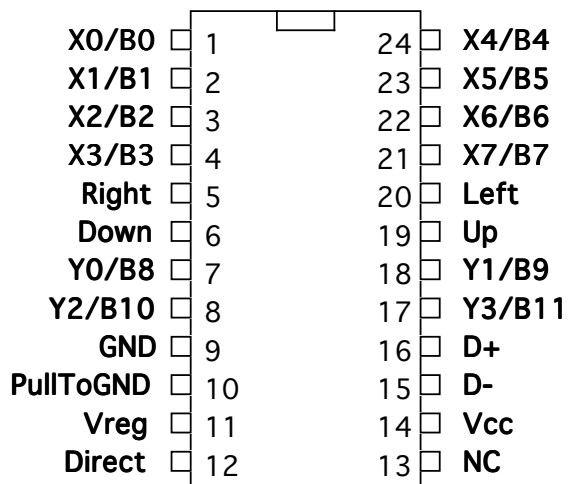
JoyWarrior24A8-8
24 Pin PDIP or 24 Pin SOIC



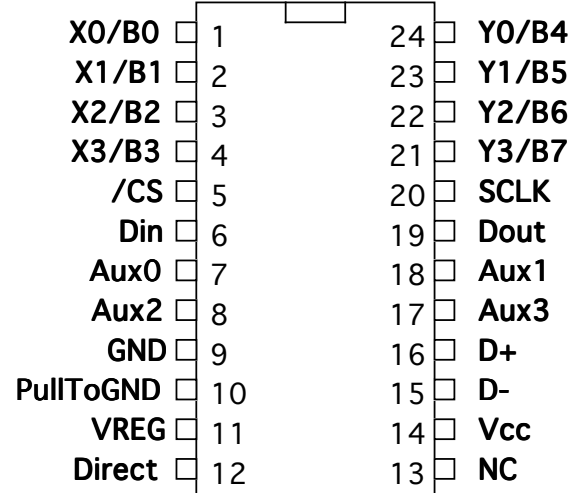
JoyWarrior24A8-16
24 Pin PDIP or 24 Pin SOIC



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



JoyWarrior24A8L-P/S
JoyWarrior24A10L-P/S
24 Pin DIL or 24 Pin SOIC



JoyWarrior

4.0 Pin Descriptions JoyWarrior24 GP 32

Name	I/O	Type	Pins	Description
D+, D-	I/O	special	16,15	USB differential data lines
X0/B0, X1/B1, X2/B2, X3/B3, X4/B4, X5/B5, X6/B6, X7/B7	I	input, internal pull up	1, 2, 3, 4, 24, 23, 22, 21	Button row inputs, active low for matrix mode, direct button inputs 0..7 for direct connection, active low
Y0/B8, Y1/B9, Y2/B10, Y3/ B11	I or O	output, open drain, or input, internal pull up	7, 18, 8, 17	Button column outputs, periodically pulled low for matrix mode, direct button inputs 8..11 for direction connection mode, active 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 instead of 4x8 matrix
NC		unused	13	Do not connect

* See application circuit for external circuitry.

4.1 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
NC		unused	13	Do not connect

* See application circuit for external circuitry.

JoyWarrior

4.2 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
NC		unused	13	Do not connect

* See application circuit for external circuitry.

4.3 Pin Descriptions JoyWarrior24A8L and JoyWarrior24A10L

Name	I/O	Type	Pins	Description
D+, D-	I/O	special	16,15	USB differential data lines
X0/B0, X1/B1, X2/B2, X3/B3, Y0/B4, Y1/B5, Y2/B6, Y3/B7	I or O	input or output, internal pull up	1, 2, 3, 4, 24, 23, 22, 21	Button inputs, active low for direct connection mode, row and column lines for matrix mode
/CS, Din, Dout, SCLK	I/O	input or output	5, 6, 19, 20	Connect to external A/D converter
Aux0, Aux1, Aux2, Aux3	O	output, high and low drive	7, 18, 8, 17	Auxiliary outputs, capable of sinking up to 50mA (70ma total for all combined)
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 to Vcc to enable direct connected buttons
NC		unused	13	Do not connect

* 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 connecting to VREG, see application circuits for details.

VREG

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.

B0..B7 (JoyWarrior24A8-8)

Inputs for the buttons. Connect contacts closing to ground.

Internal pull up resistors.

X0/B0..X3/B3 or X0/B0..X7/B7

Matrix row inputs for the buttons. In direct mode these pins work as direct button inputs, active low, use contacts closing to ground.

Internal pull up resistors.

Y0/B4..Y3/B7 or Y0/B8..Y3/B11

Matrix column outputs or button inputs for direct mode. In matrix mode these pins are periodically pulled low to determine the status of the buttons.

In matrix mode all buttons must be decoupled with diodes, see application circuit for details.

In direct mode these pins act as active low inputs, connect contacts closing to ground.

Open drain outputs or inputs with internal pull up resistor.

Left, Right, Up, Down (JoyWarrior24GP32)

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

Internal pull up resistors.

/CS, SCLK, Din, Dout (JoyWarrior24A8L/A10L)

Signals to connect to the external A/D converter.

JoyWarrior 24A10L requires an external Maxim MAX1249 A/D converter, JoyWarrior24A8L requires a Maxim MAX1113.

Internal pull up resistors.

/Pull to GND

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

A0, A1 (JoyWarrior24A8-x)

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-x)

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-x)

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.

Direct (all except JoyWarrior24A8-x)

Pulling this pin high disables the matrix scanning for the buttons and instead uses all button pins as direct button inputs for up to 8 or 12 (JW24GP32) buttons pulling to GND.

All button input pins have internal pull ups.

Aux0..Aux3 (JoyWarrior24A8L/A10L)

Auxiliary outputs, active low. Each pin is capable to sink up to 50mA (70mA combined for all pins). Push-Pull outputs.

GND

Power supply ground.

Vcc

Supply voltage.

JoyWarrior

5.0 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 newer than 98 will work with JoyWarrior. Older versions of Windows do not support USB or support only a subset of the functionality.

Upon connecting a JoyWarrior based device for the first time you may be asked to perform the standard driver install. The same may happen if you connect the device to a different USB port on the same computer. In this case let the system install the default drivers.

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. Some versions of MacOS 8.x do support USB as well, though their use is not recommended.

On MacOS X access to the joystick data 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: JoyWarrior24GP32

Even though JoyWarrior24GP32 is a gamepad style device it does report the directional data as a joystick with two axes of 8 bit each. For left and up directions 0 is reported, for neutral 127 and for right and down 255.

This method was chosen since the gamepad data format does cause problems with several older OS variants (Mac and PC) and some games.

5.4 Jitter Filter in JoyWarrior24A8-x

Since any A/D converter generates quantisation noise (the least significant bit jittering at voltages close to the threshold between two values) JoyWarrior24A8-x variants (not JW24A8L) use a simple but efficient jitter filter. Only if the axis values change more than ± 1 digit the data is actually sent 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-x is pulled high this will also disable the jitter filter.

5.5 Autocalibration and autocentering - JoyWarrior24A8-x

The JoyWarrior24A8-x chips do have a autocentering and autocalibration function that compensates mechanical tolerances of the joystick. When autocalibration and autocentering is activated (i.e. RAW pin is unconnected or pulled to Gnd) upon power up the JoyWarrior24A8-x will sample axis data for about 200msec and then use the current 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 range 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-x 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-x

The JoyWarrior24A8 is optimized to be used with a 4.7nF capacitor and 100k Ω 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 microphone 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.

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.

JoyWarrior

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.

5.10 Auxiliary outputs on JW24A8L/A10L

The JoyWarrior24A8L and JoyWarrior24A10L chips have four auxiliary outputs that may be used to drive LED indicators or for other applications. Due to the significant current sinking capability of the outputs they are defined as being active low.

Setting the outputs is done by sending a four byte Feature report to the joystick device. In most cases this can be done via standard file I/O functions.

The outputs are set by one byte each, the first byte sets Aux0, second Aux1 etc.

The bits in the bytes do have the following meaning:

- 7 - reserved, write 0
- 6 - reserved, write 0
- 5 - reserved, write 0
- 4 - reserved, write 0
- 3 - Invert blink mode
- 2 - reserved, write 0
- 1 - Mode MSB
- 0 - Mode LSB

The mode bits determine the behaviour of the output. Following are the combinations (MSB/LSB):

- 00 - Output idle (high)
- 01 - Output static on (low)
- 02 - Fast blink mode (1/8th second on/off)
- 03 - Heart beat blink mode

Heart beat mode switches the output low for 1/16th second, then high for 1/16th, again low for 1/16th and then idles high for 13/16th seconds.

The invert bit reverts the output status for the blink modes (no effect on static on/off), this allows to have two indicators blink in an exactly alternating pattern.

The output status and blinking is maintained by the JoyWarrior without further host interaction until a new configuration is send. All outputs go to idle when the JoyWarrior enters suspend mode.

JoyWarrior

6.0 Absolute Maximum Ratings

Storage Temperature	-65°C to +150°C
Ambient Temperature with power applied.....	-0°C to +70°C
Supply voltage on Vcc relative to Gnd	-0.5V to +7V
DC input voltage.....	-0.5V to Vcc+0.5V
Maximum current into all ports.....	70mA
Power Dissipation.....	300mW
Static discharge voltage.....	>2000V
Latch-up current.....	>200mA

6.1 DC Characteristics

	Parameter	Min	Max	Units	Remarks
V _{cc}	Operating Voltage	4.35	5.25	V	
I _{cc}	Operating Supply Current (no loading)		20	mA	
I _{sb}	Suspend mode current		25	μA	Oscillator off
I _{ol}	Sink current on output pins		2	mA	V _{out} = 0.4V
R _{up}	Pull-up Resistance	8	24	kΩ	
I _{olaux}	Sink current into Aux pins		50	mA	V _{out} = 0.8V
I _{ohaux}	Source current from Aux pins		2	mA	V _{out} > V _{cc} -2V
I _{snk}	Combined sink current into all pins		70	mA	Cummulative across all ports
V _{ith}	Input Threshold Voltage	40%	60%	V _{cc}	
	USB Interface				
V _{oh}	Static output high	2.7	3.6	V	15kΩ±5% to GND
V _{ol}	Static output low		0.3	V	
V _{di}	Differential Input sensitivity	0.2		V	$(D+) - (D-)$
V _{cm}	Differential Input common Mode Range	0.8	2.5	V	
V _{se}	Single Ended Transceiver Threshold	0.8	2.0	V	
C _{in}	Transceiver capacitance		20	pF	
I _{io}	Hi-Z State Data Line Leakage	-10	10	μA	0V < V _{in} < 3.3V, Hi-Z State
R _{pu}	Bus Pull-up resistance	1.274	1.326	kΩ	1.3kΩ±2% to V _{cc} *
R _{pd}	Bus Pull-down resistance	14.25	15.75	kΩ	15kΩ±5%

JoyWarrior

6.2 AC Characteristics

	Parameter	Min	Max	Units	Remarks
USB Driver Characteristics					
t _r	Transition rise time	75		ns	C _{Load} = 200pF
t _r	Transition rise time		300	ns	C _{Load} = 600pF
t _f	Transition fall time	75		ns	C _{Load} = 200pF
t _f	Transition fall time		300	ns	C _{Load} = 600pF
t _{rfm}	Rise/Fall Time matching	80	125	%	
V _{crs}	Output signal crossover voltage	1.3	2.0	V	
USB Data Timing					
t _{drate}	Low Speed Data Rate	1.4775	1.5225	MBit/s	
t _{djr1}	Receiver data jitter tolerance	-75	75	ns	To next transition
t _{djr2}	Receiver data jitter tolerance	-45	45	ns	For paired transitions
t _{deop}	Differential to EOP transition skew	-40	100	ns	
t _{eoпр2}	EOP width at receiver	670		ns	Accepts as EOP
t _{eoпрt}	Source EOP width	1.25	1.50	μs	
t _{udj1}	Differential driver jitter	-95	95	ns	To next transition
t _{udj2}	Differential driver jitter	-150	150	ns	To paired transition

JoyWarrior

7. Ordering information

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

Partname	Order Code	Description	Package
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
JoyWarrior24A8L	JW24A8L-P	Joystick controller, four axes 8 bit, auxiliary outputs	PDIP24
JoyWarrior24A8L	JW24A8L-S	Joystick controller, four axes 8 bit, auxiliary outputs	SOIC24
JoyWarrior24A10L	JW24A10L-P	Joystick controller, three axes 10 bit, auxiliary outputs	PDIP24
JoyWarrior24A10L	JW24A10L-S	Joystick controller, three axes 10 bit, auxiliary outputs	SOIC24
JoyWarrior20 GP 8	end-of-life	don't use for new designs	
JoyWarrior20 A8-8	end-of-life	don't use for new designs	
JoyWarrior20 A8-16	end-of-life	don't use for new designs	
JoyWarrior20 A10-8	end-of-life	don't use for new designs	
JoyWarrior20 A10-16	end-of-life	don't use for new designs	

7.1 Packaging info

PDIP24 chips come in tubes with 16 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>

Customized chips are subject to minimum order quantities, contact <sales@codemercs.com> for details.

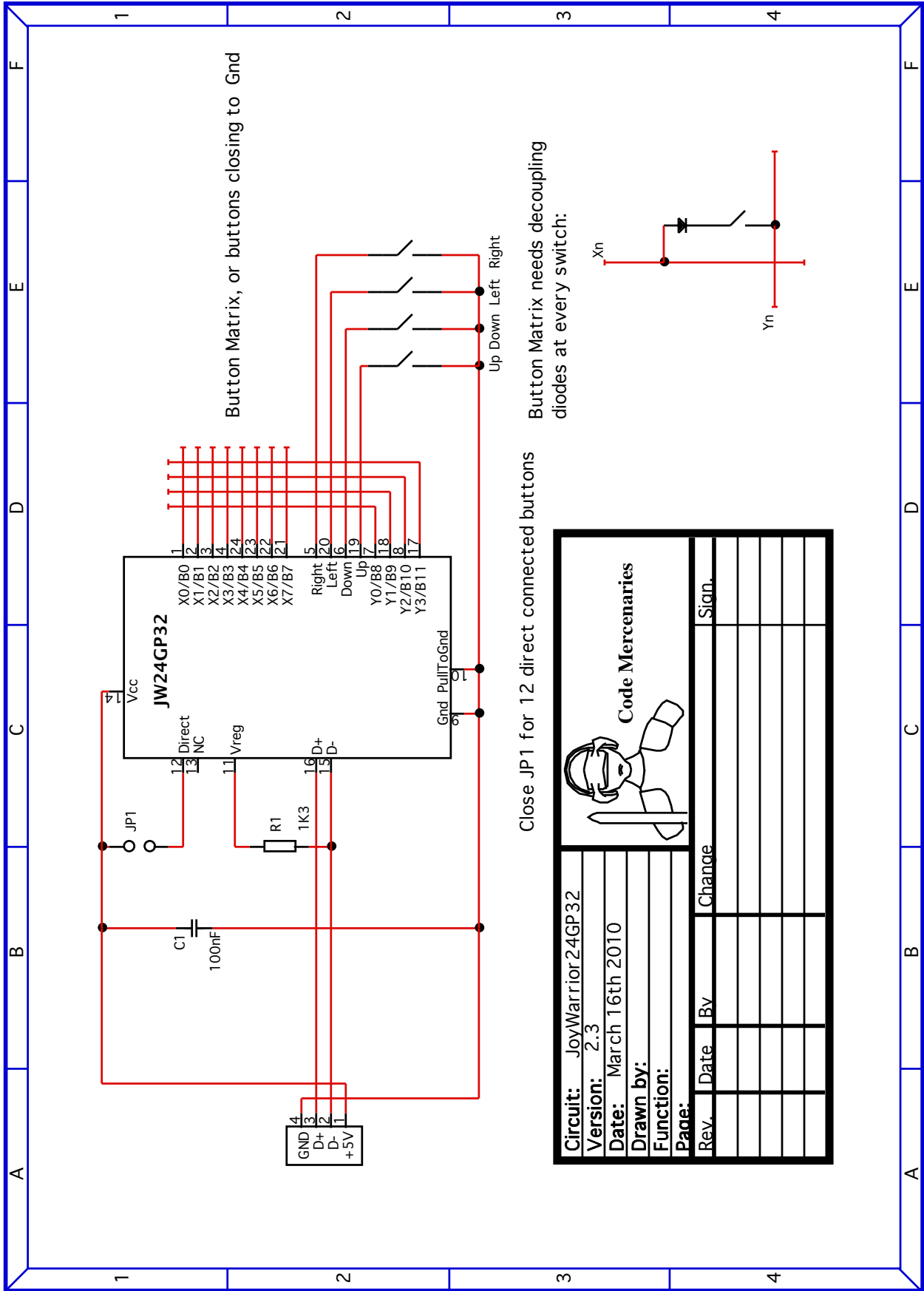
7.3 Product IDs, Versions and Production Status

Following is the current status for all JoyWarrior variants and the Product ID information. ProductIDs are independent of the package type. The MouseWarrior chips listed are based on the JoyWarrior core.

Partname	Product ID	Current Shipping Version	Status
JoyWarrior20 GP 8	\$1100	V1.0.3.B	end of life
JoyWarrior24 GP 32	\$1101	V1.0.3.3	active
JoyWarrior24 A8-8	\$1104	V1.0.3.0	active
JoyWarrior24 A8-16	\$1105	V1.0.3.0	active
JoyWarrior20 A10-8	\$1108	V1.0.3.B	end of life
JoyWarrior20 A10-16	\$1109	V1.0.3.B	end of life
JoyWarrior20 A8-8	\$110A	V1.0.3.B	end of life
JoyWarrior20 A8-16	\$110B	V1.0.3.B	end of life
JoyWarrior24RC	\$1110	V1.0.3.5	active
MouseWarrior24J8	\$1112	V1.0.3.3	active
JoyWarrior24F8	\$1113	V1.0.3.8	active
MouseWarrior24F8	\$1114	V1.0.3.8	active
MouseWarrior24H8	\$1115	V1.0.3.7	active
JoyWarrior24F14	\$1116	V1.0.4.0	active
JoyWarrior24A8L	\$1117	V1.0.4.1	active
JoyWarrior24A10L	\$1118	V1.0.4.1	active

JoyWarrior

8 Typical application for JoyWarrior24 GP32

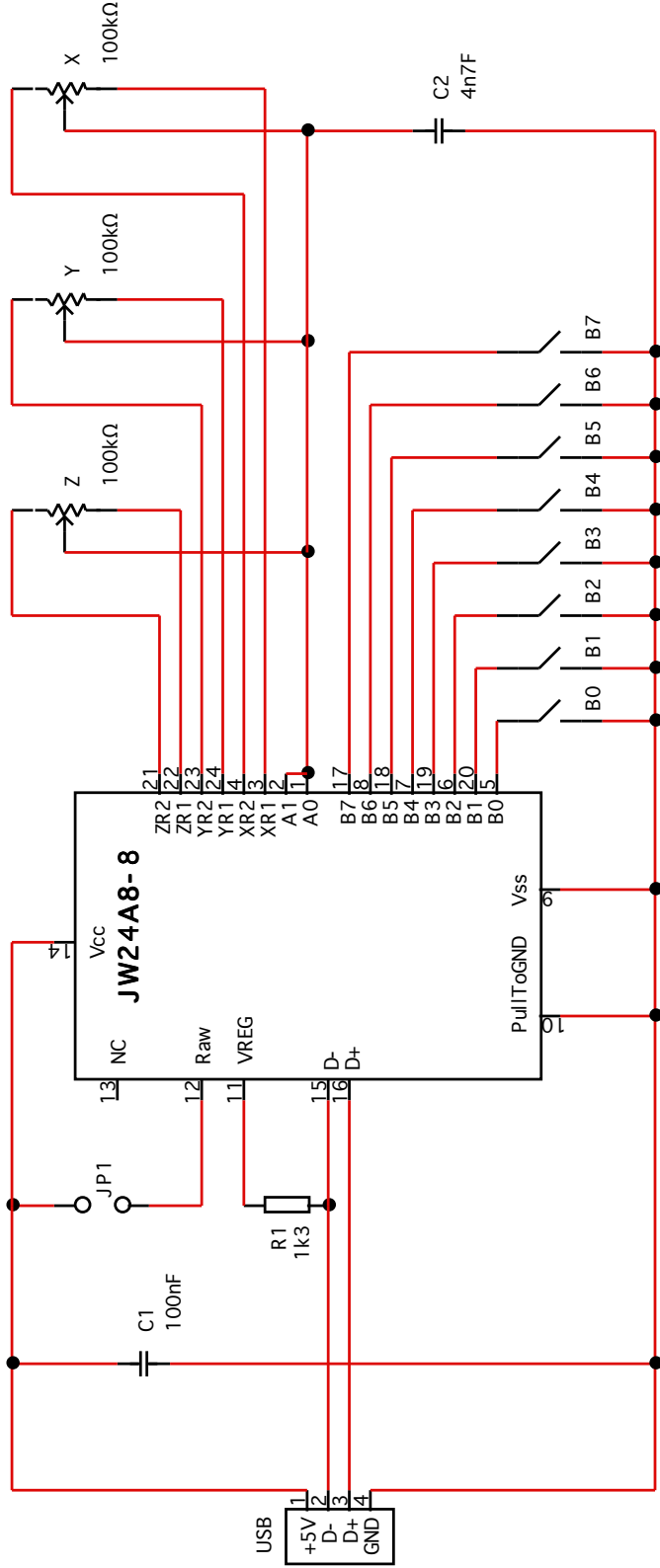


Code Mercenaries

Circuit: JoyWarrior24GP32		Sign.
Version: 2.3		
Date: March 16th 2010		
Drawn by:		
Function:		
Page:		
Rev.	Date	By
		Change

JoyWarrior

8.1 Typical application for JoyWarrior24 A8-8

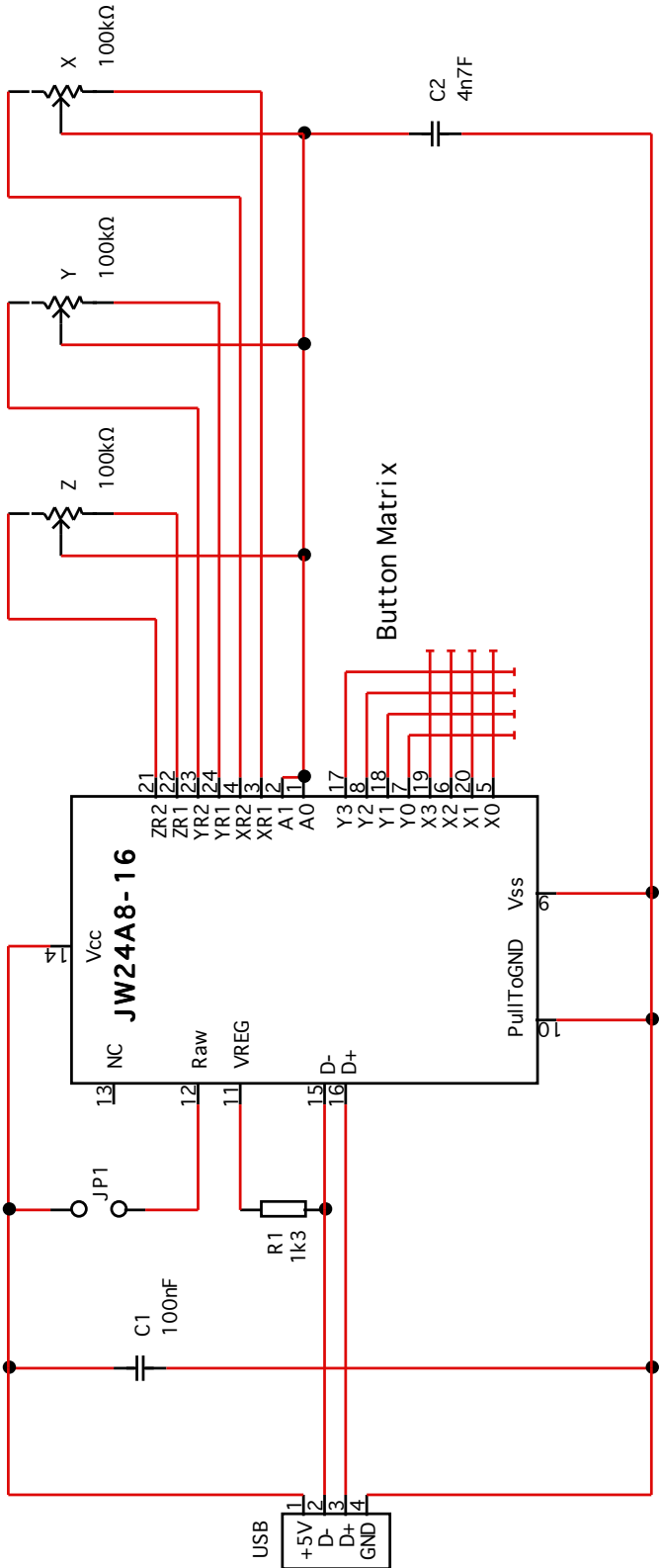


Close JP1 to disable auto centering and auto calibration

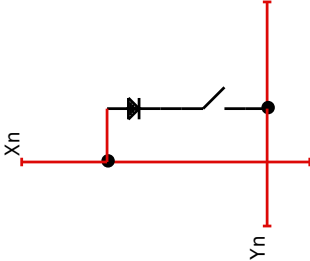
Circuit: JoyWarrior 24A8-8				
Version: V1.0				
Date: 30.9.2002				
Drawn by:				
Function:				
Page:				
Rev.	Date	By	Change	Sign.

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8.2 Typical application for JoyWarrior24 A8-16



Button Matrix needs decoupling diodes at every switch:

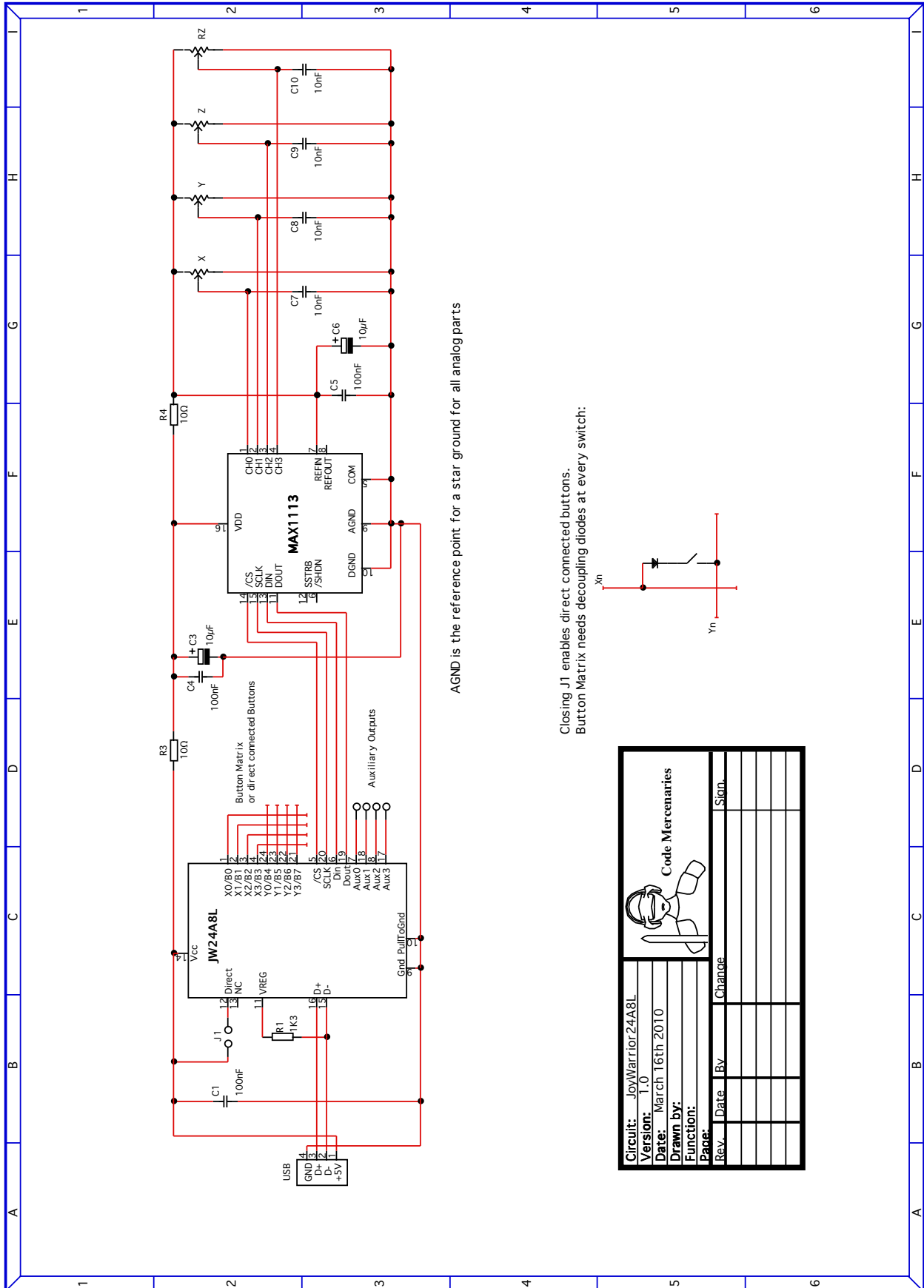



Close JP1 to disable auto centering and auto calibration

Circuit: JoyWarrior 24A8-16		<p>Code Mercenaries</p>			
Version: V1.0				Change	Sign.
Date: 30.9.2002					
Drawn by:					
Function:					
Page:					
Rev.	Date	By			

JoyWarrior

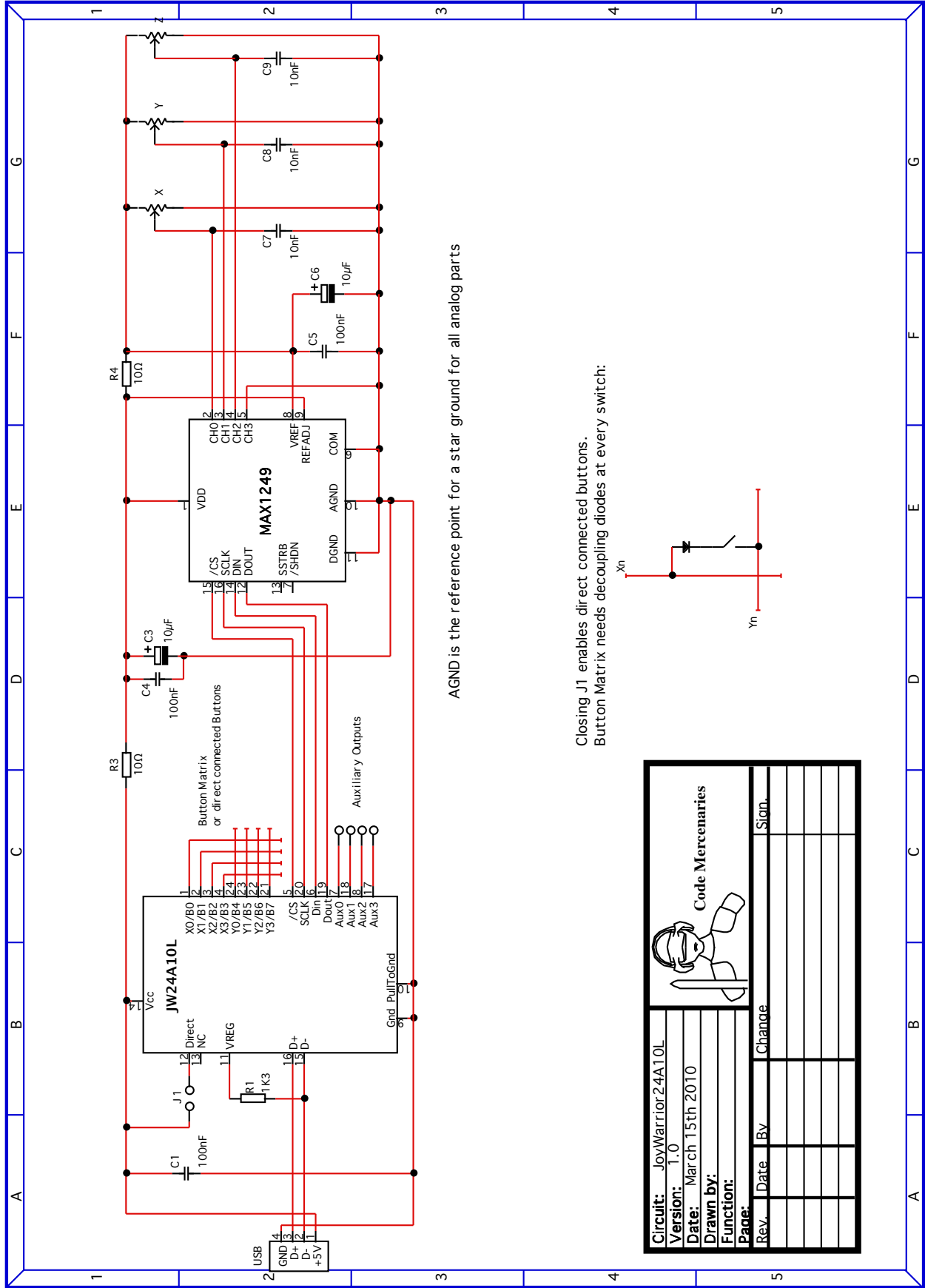
8.3 Typical application for JoyWarrior24A8L



Circuit: JoyWarrior24A8L		 Code Mercenaries			
Version:	1.0			Date:	March 16th 2010
Date:	March 16th 2010			Function:	
Function:				Page:	
Page:				Rev:	Date
Rev:	Date	By:	Change		
			Sign:		

JoyWarrior

8.4 Typical application for JoyWarrior24A10L

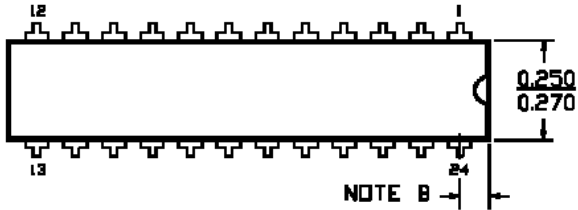


JoyWarrior

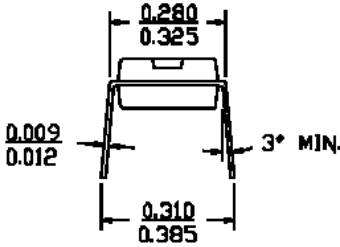
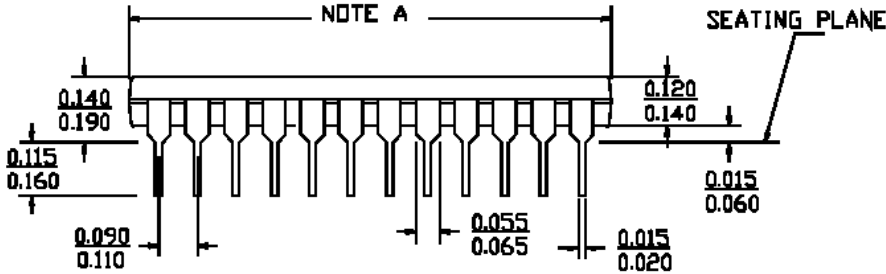
9. Package Dimensions

24 Pin PDIP

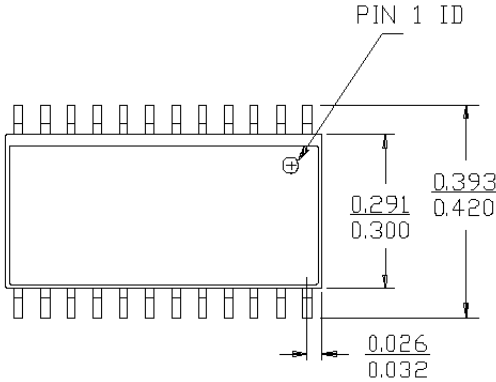
DIMENSIONS IN INCHES MIN. MAX.



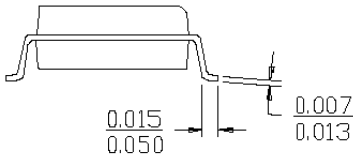
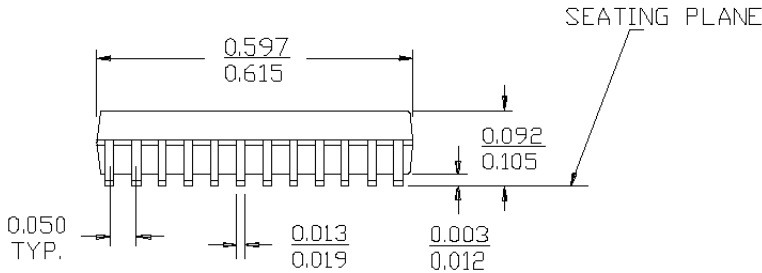
	P 13	P 13A
NOTE A	1.170 1.200	1.230 1.260
NOTE B	0.030 0.050	0.060 0.080



24 Pin SOIC



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



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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 27Ω 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:

- 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.

V1.0.4.1

- First shipping version of JW24A8L and JW24A10L

V1.0.4.0

- Discontinued JW20 branch of chips.
- Added JW24A8L and JW24A10L
- Added JW24F14 (aka Tomcat) acceleration

sensor.

V1.0.3.B

- Fixed a spurious enumeration problem with JW20 variants on Linux. JW24 chips are not affected. On UHCI hosts it was possible that reading the device descriptors could fail. Windows and MacOS were not affected due to a different error recovery method of their system drivers.

V1.0.3.A

- Customer specific chips, no general release

V1.0.3.9

- Customer specific chips, no general release

V1.0.3.8

- Added MW24F8 variant
- Fixed a race condition in JW24F8 that could lead to wrong data when values were jittering around a 256 boundary.

V1.0.3.7

- Added MW24H8 variant

V1.0.3.6

- Added JW24F8 variant

V1.0.3.5

- Added Zhen Hua protocol to JW24RC

V1.0.3.4

- Added customer specific chips
- Changed reset timing for JW20 variants.
- Not a general release!

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.

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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.

V1.0.2.0

- Initial general release.

JoyWarrior

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