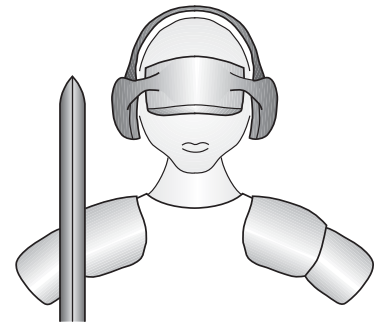


MouseWarrior28



Code Mercenaries

MouseWarrior28Wheel Universal mouse controller chips

1. Features

- USB full speed interface
- Up to six buttons
- USB V2.0 compliant
- USB HID 1.1 compliant
- Uses optical quadrature encoders
- Supports quadrature encoder wheel or two buttons for scrolling
- Scrolling with full or quadrant pulses selectable
- Pull up or down or no pull resistors selectable
- Compatible with standard system drivers, no special drivers necessary
- Low external component count
- Single +3.3V power supply (5V for some modules)
- Available in 28QFN or as modules

1.1 Variants

MouseWarrior is available in a couple standard variants with multiple package options as chip or module.

For the mouse/joystick hybrid controllers please refer to the JoyWarrior data sheet.

MouseWarrior28Wheel

- Standard mouse controller with scroll wheel
- USB interface
- Supports up to six buttons
- Uses quadrature encoding hardware
- Scrolling by quadrature encoded wheel or two buttons

MouseWarrior28H8L (see JoyWarrior data sheet)

- Mouse/Joystick hybrid controller
- Compatible with hall sensors
- Three analog axes with 8 bit resolution each
- Up to six buttons direct connected
- Autocalibration and auto-centering pin selectable
- Dynamic recentering for drift compensation pin selectable
- Four auxiliary outputs i.e. to control LEDs, supporting flashing modes
- Enable output to signal suspend mode to external circuitry

1.2 Custom variants

Custom adaptations are available on request.

1.3 Obsolete variants

The MouseWarrior24 family is replaced by the MouseWarrior28 family.

Support for the PS/2 interface has been dropped for the MouseWarrior28.

Use the following chips to replace the obsolete MouseWarrior24 chips:

MW24EyeIII	- discontinued
MW24WII	- use MW28W
MW24J8	- use MW28H8L
MW24H8	- use MW28H8L

2. Functional overview

The MouseWarrior family supports cursor control. It allows to build USB compatible input devices without the need to acquire much USB know how. Mostly only electro-mechanical components need to be added to the MouseWarrior chips.

MouseWarrior28

2.1 Product selection matrix

Type	Sensor type	Buttons	Wheel	QFN28	DIL Module	SO24 Module
MouseWarrior28Wheel	Quadrature	6	√	√	√	√
MouseWarrior28H8L	8 bit analog	6	3rd axis	√	√	-

2.2 Package types

The standard package for MouseWarrior28 is a QFN28 SMD package. For simpler handling in small volumes a DIL28 module is available too. MouseWarrior28Wheel is also available as a SOIC24 module to directly replace MouseWarrior24WII-S.

2.3 DIL28 module

The DIL28 package is intended for easier handling in small volumes. Mechanically it fits on the same footprint as a DIL28 chip package with 300 mil row spacing.

In addition to the MouseWarrior28 chip the module already contains the 100 nF power filter capacitors for the supply power. Aside from that no additional circuitry is on the module. The electrical properties are identical with the QFN28 chips.

The DIL28 module must not be soldered in a reflow process as components may desolder and fall off the module.

2.4 SOIC24 module (MW28W only)

A module that fits on the SOIC24 footprint is available to simplify the transition of designs from the old chips. Due to the functional differences of the other chips this is only possible for the MouseWarrior28Wheel.

The MW28W-S24 module replicates the function of the MW24WII-S as close as possible.

A 3.3 V regulator is contained on the module so it can accept 5 V power. No changes to the board should be necessary in most cases.

Differences are as follows:

USB is running at full speed instead of low speed.
 The Vreg pin, which drives the USB pull up resistor for MW24WII, is not connected. MW28W has an internal pull up resistor on the USB and does not need the external resistor. There is no need to remove the resistor on your legacy board.
 All pins aside from the /PullOff pin are only 3.3 V tolerant. This has to be taken into account when connecting the encoders.
 Since the /PullOff pin is 5 V tolerant it may be pulled up to 5 V for direct connected pins.

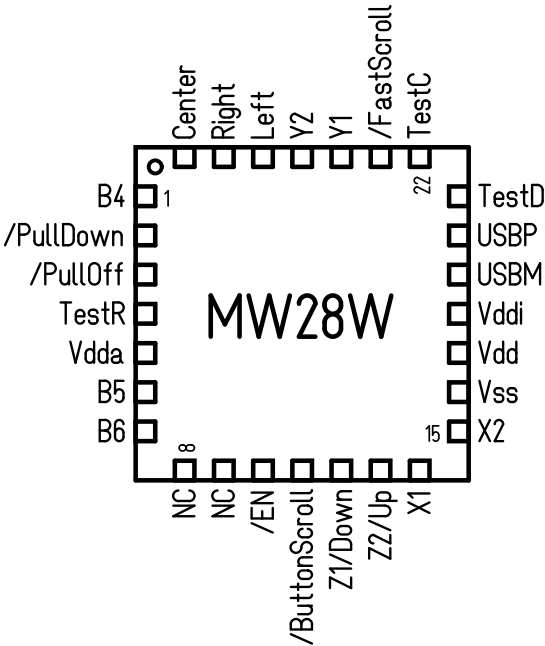
The /PullDown and /FastScroll options are not accessible on the SOIC24 module.

Since MW28W does not support PS/2 any more the PS2Data and PS2Clock pins have no function. Though they are physically connected to the chip and may not be exposed to voltages above 3.3 V.

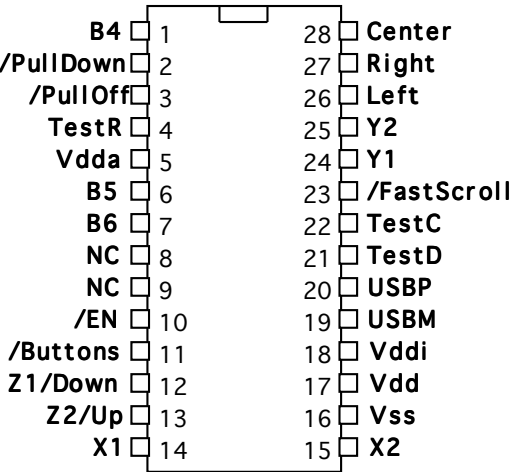
MouseWarrior28

3. Pin Configurations

**MouseWarrior28Wheel
28 Pin QFN**

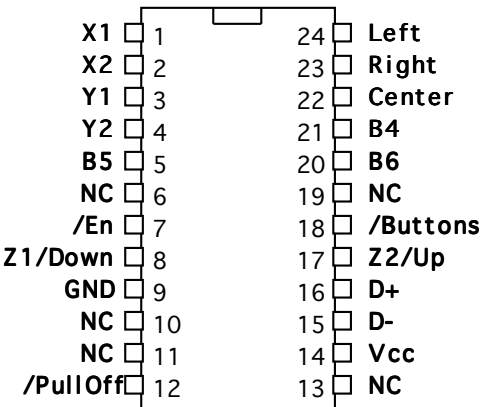


**MouseWarrior28W-DIL28
28 Pin DIL module**



All drawings: TOP VIEW!

**MouseWarrior28W-S24
24 Pin SOIC replacement module**



MouseWarrior28

4. Pin Descriptions MouseWarrior28Wheel-Q28/-DIL28

Name	I/O	Type	Pins	Description
USBP, USBM	I/O	special	20, 19	USB differential data lines
X1	I	input, optional pull	14	Encoder X1 input
X2	I	input, optional pull	15	Encoder X2 input
Y1	I	input, optional pull	24	Encoder Y1 input
Y2	I	input, optional pull	25	Encoder Y2 input
Z1/Down	I	input, optional pull (*)	12	Encoder Z1 input for wheel or scroll down button
Z2/Up	I	input, optional pull (*)	13	Encoder Z2 input for wheel or scroll up button
Left	I	input, internal Pull Up	26	Input for left mouse button
Right	I	input, internal Pull Up	27	Input for right mouse button
Center	I	input, internal Pull Up	28	Input for center mouse button
B4	I	input, internal Pull Up	1	Input for 4th mouse button
B5	I	input, internal Pull Up	6	Input for 5th mouse button
B6	I	input, internal Pull Up	7	Input for 6th mouse button
/Buttons	I	input, internal Pull Up	11	Selects wheel or buttons for scrolling
/En	O	open drain w. Pull Up	10	Output to enable external hardware
/FastScroll	I	input, internal Pull Up	23	Enables quadrant mode for wheel
/PullDown	I	input, internal Pull Up	2	Selects pull down resistors
/PullOff	I	input, internal Pull Up	3	Deactivates pull resistors on X1, X2, Y1, Y2, Z1, Z2
Vss		power supply	16	Ground
Vdd, Vdda, Vddi		power supply	17, 5, 18	Supply voltage, connect to 3.3 V
NC		unused	8, 9	Unused, do not connect

4.1 Pin Descriptions MouseWarrior28Wheel-SO24

Name	I/O	Type	Pins	Description
D+, D-	I/O	special	16, 15	USB differential data lines
X1	I	input, optional pull	1	Encoder X1 input
X2	I	input, optional pull	2	Encoder X2 input
Y1	I	input, optional pull	3	Encoder Y1 input
Y2	I	input, optional pull	4	Encoder Y2 input
Z1/Down	I	input, optional pull (*)	8	Encoder Z1 input for wheel or scroll down button
Z2/Up	I	input, optional pull (*)	17	Encoder Z2 input for wheel or scroll up button
Left	I	input, internal Pull Up	24	Input for left mouse button
Right	I	input, internal Pull Up	23	Input for right mouse button
Center	I	input, internal Pull Up	22	Input for center mouse button
B4	I	input, internal Pull Up	21	Input for 4th mouse button
B5	I	input, internal Pull Up	5	Input for 5th mouse button
B6	I	input, internal Pull Up	20	Input for 6th mouse button
/Buttons	I	input, internal Pull Up	18	Selects wheel or buttons for scrolling
/En	O	open drain w. Pull Up	7	Output to enable external hardware
/PullOff	I	input, internal Pull Up	12	Deactivates pull resistors on X1, X2, Y1, Y2, Z1, Z2
GND		power supply	9	Ground
Vcc		power supply	14	Supply voltage, connect to max. 5 V
NC		unused	6, 10, 11, 13, 19	Unused, do not connect

MouseWarrior28

4.2 Pin descriptions

USBP, USBM

Differential data lines of USB. Connect these signals direct to a USB cable. ESD protection may be added.

X1, X2, Y1, Y2

Inputs for optical quadrature encoded trackball or mouse mechanism. X1 falling edge leads X2 falling edge for right movement. Y1 falling edge leads Y2 falling edge for up movement. Internal pull up/down resistors are determined at controller power up via the /PullDown and /PullOff pins.

Z1/Down, Z2/Up

Inputs for quadrature encoded scroll wheel or scroll buttons. The function of these pins is selected by /ButtonScroll pin.

Z1 falling edge leads Z2 falling edge for downward scrolling. Scrolling speed can be selected to full clocks or quarter clocks.

The pins have internal pull up, pull down, or no resistors, depending on the option pins. Internal pull up resistors are always active if /ButtonScroll is low.

/ButtonScroll

This pin is checked only on power up of the MouseWarrior. If /ButtonScroll is high an optical encoder is assumed for the scroll function, Z1/Z2 will accept quadrature signals.

The internal pull resistors are determined by the /PullDown and /PullOff pins.

If /ButtonScroll is low scrolling via up/down buttons is enabled. The buttons have to close to ground, internal pull up resistors are always on.

The pin has an internal pull up resistor.

/FastScroll

If /FastScroll is high, full clock mode is used for scrolling. A falling edge on Z1 does generate a scrolling pulse, Z2 determines the direction. Pulling /FastScroll low enables quadrant mode for the scroll wheel encoder.

The pin has an internal pull up resistor.

/PullOff

This pin is checked only on power up of the MouseWarrior. If /PullOff is pulled low the pull resistors on X1, X2, Y1, Y2 will be disabled. If scrolling is in wheel mode, resistors on Z1, Z2 will also be disabled.

The pin has an internal pull up resistor.

/PullDown

This pin is checked only on power up of the MouseWarrior. The /PullDown pin determines whether pull up or pull down resistors are used on the X1, X2, Y1, Y2, Z1, Z2 inputs. If the pin is high pull up resistors will be used, if it is pulled low pull down resistors will be used.

The pin has an internal pull up resistor.

/En

Enable signal to enable the LEDs of the optical quadrature encoder. Open drain output with internal pull up resistor

Left, Right, Center

Inputs for three mouse buttons. Internal pull up resistors, contacts must close to ground.

B4, B5, B6

Input for 4th, 5th, and 6th mouse button. Internal pull up resistor, contact must close to ground.

Vss

Power supply ground.

Vdd, Vddi, Vdda

Supply voltage. Requires 3.3 V

Vcc, GND (MW28W-S24)

Power supply pins for SOIC24 replacement module. Vcc is 5 V.

TestC, TestD, TestR

These pins are used during production of the JoyWarrior chips, do not connect.

5. Device Operation

MouseWarrior does work with very few external components.

5.1 Power Up

Every time the supply voltage is applied MouseWarrior executes an internal reset sequence. All internal pull up resistors are disabled upon power up and will be activated during the internal reset sequence.

5.2 Protocol details: USB

MouseWarrior works as a HID compliant pointing device using boot protocol. The country code is 0 for not localized hardware. MouseWarrior defines six buttons and a scroll wheel.

MouseWarrior works with standard system drivers and does not require any software installation.

MouseWarrior28

6. Absolute Maximum Ratings

Storage Temperature	-65°C to +150°C
Ambient Temperature, operating.....	-40°C to +85°C
Supply voltage on Vdd relative to Gnd.....	-0.3V to +4V
DC input voltage	-0.3V to +4V
Maximum current into all ports.....	80mA
Power Dissipation.....	max. 170mW
Static discharge voltage.....	>2000V
Latch-up current.....	>200mA

6.1 DC Characteristics

	Parameter	Min	Max	Units	Remarks
V _{cc}	Operating Voltage	2.0	3.6	V	typ. 3.3 V
I _{cc}	Operating Supply Current		25	mA	
I _{sb}	Suspend mode current		350	μA	internally active
I _{ol}	Sink current on interface pins		25	mA	max. combined all pins 80 mA
I _{olen}	Sink current on /En pin		25	mA	max. combined all pins 80 mA
V _{ol8}	Output low voltage		0.4	V	I = 8 mA
V _{oh8}	Output high voltage	V _{ddi} -0.4		V	I = 8 mA
V _{ol20}	Output low voltage		1.3	V	I =20 mA
V _{oh20}	Output high voltage	V _{ddi} -1.3		V	I =20 mA
R _{up}	Pull up/down resistors	25	55	kΩ	typ. 40 kΩ
V _{ith}	Input Threshold Voltage	0.7 x V _{ddi}		V	

MouseWarrior28

7. Ordering information

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

Partname	Order Code	Description	Package
MouseWarrior28Wheel	MW28W-Q28	Mouse controller for optical encoders with scroll support, 6 buttons	QFN28
MouseWarrior28Wheel	MW28W-DIL28	Mouse controller for optical encoders with scroll support, 6 buttons	DIL28 Mod
MouseWarrior28Wheel	MW28W-S24	Mouse controller for optical encoders with scroll support, 6 buttons	SOIC24 Mod

7.1 Packaging info

QFN28 chips come in trays - TBD

DIP28 modules - TBD

SOIC24 replacement module - TBD

7.2 USB VendorID and ProductID

By default all MouseWarrior 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

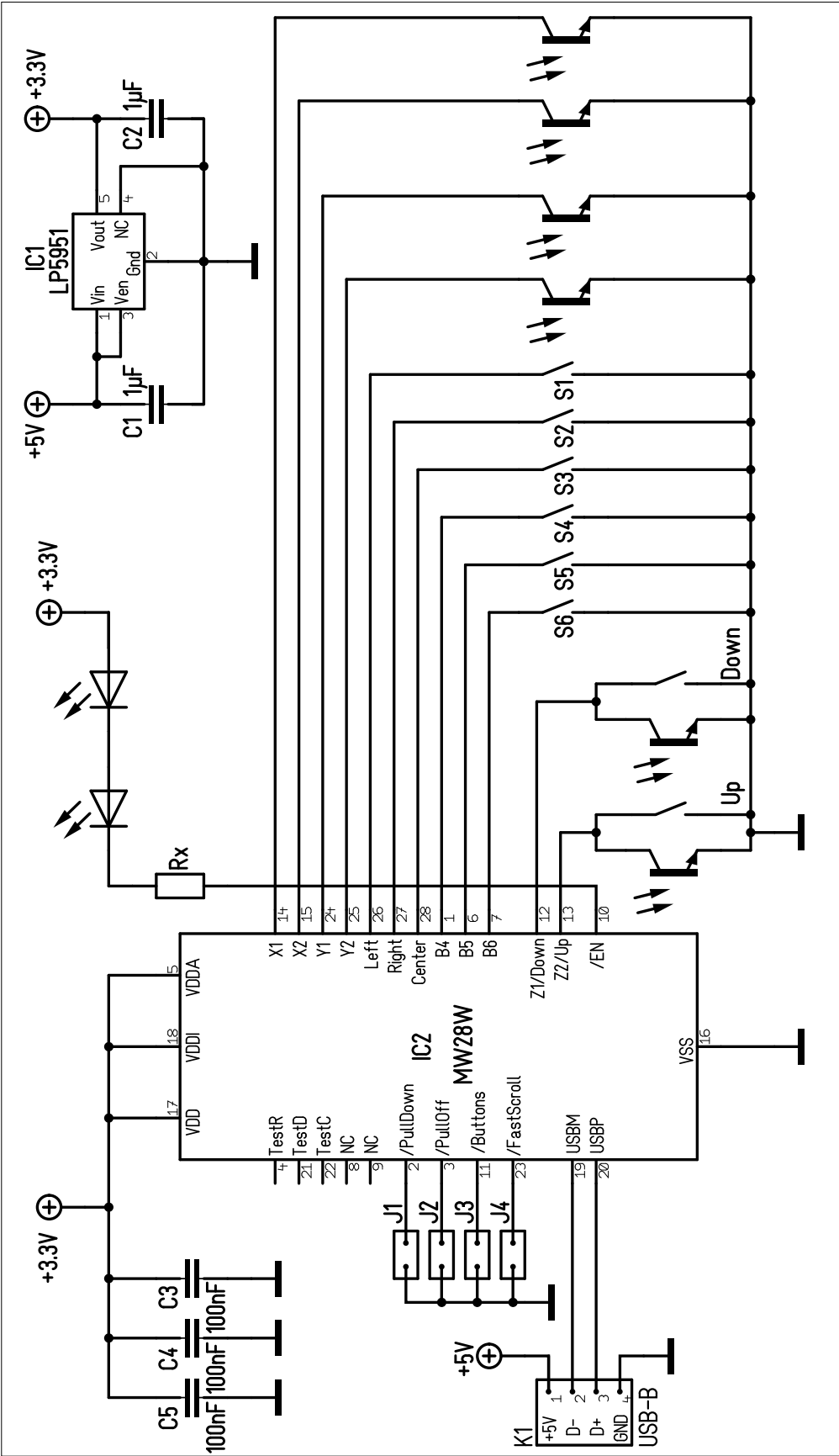
Following is the current status for all MouseWarrior variants and the Product ID information. ProductIDs are independent of the package type.

Obsolete versions are listed for information purposes only.

Partname	Product ID	Current Shipping Version	Status
MouseWarrior28W	\$000B	V1.0.0.1	shipping
MouseWarrior20O	\$0001	V1.0.6.3	discontinued, available for maintenance only
MouseWarrior20V	\$0002	V1.0.6.3	discontinued, available for maintenance only
MouseWarrior24Wheel	\$0003	-	discontinued, no remaining stock
MouseWarrior24Eye	\$0004	-	discontinued, no remaining stock
MouseWarrior24EyeII	\$0005	-	discontinued, no remaining stock
MouseWarrior24EyeIII	\$0009	V1.0.6.4	discontinued, available for maintenance only
MouseWarrior24WheellII	\$000A	V1.0.6.3	discontinued, available for maintenance only

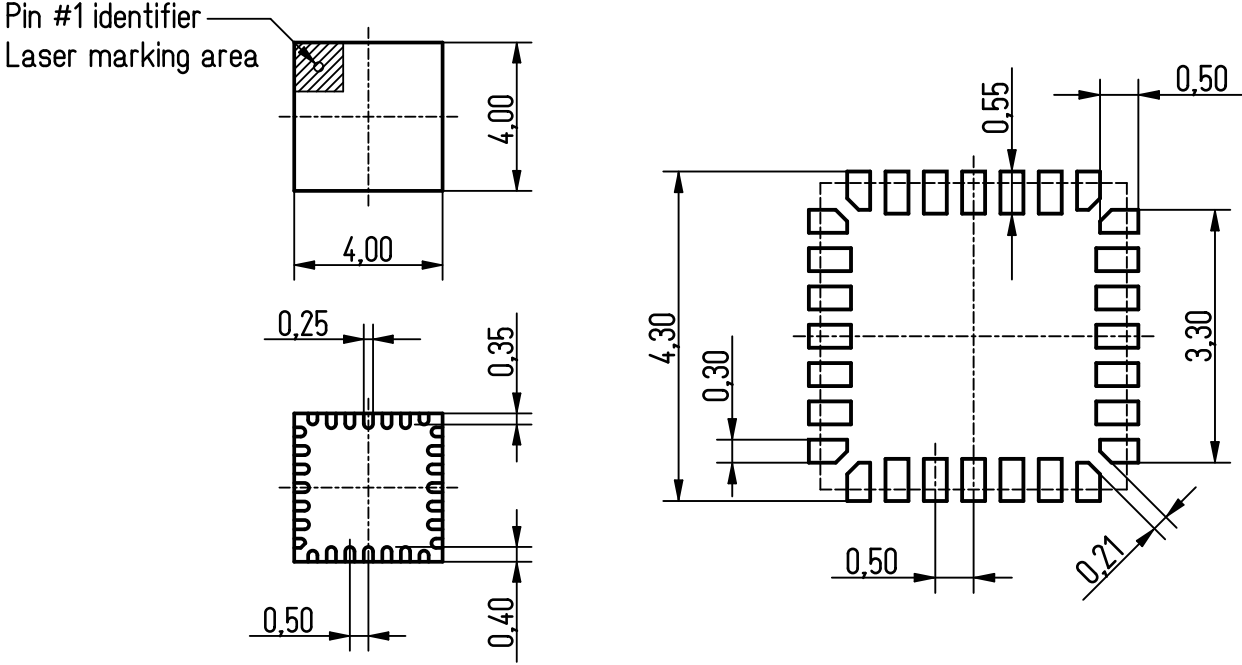
MouseWarrior28

8. Typical application for MouseWarrior28Wheel



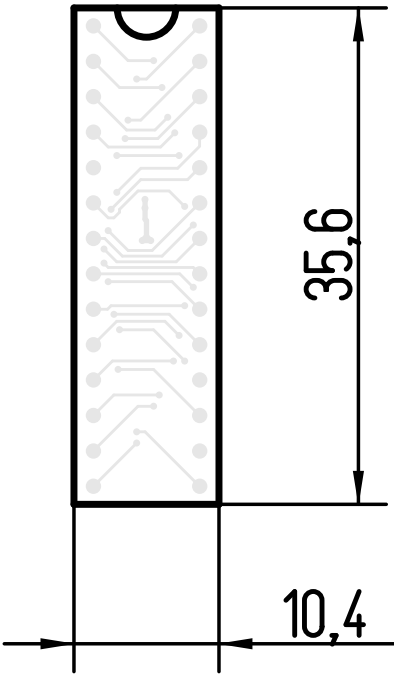
MouseWarrior28

9. Package Dimensions 28 Pin QFN - UQFPN28 - 4x4 mm with 0.5 mm pitch and recommended footprint



Package thickness: 0.55 mm ±0.05 mm
Outer contour tolerance: ±0.1 mm

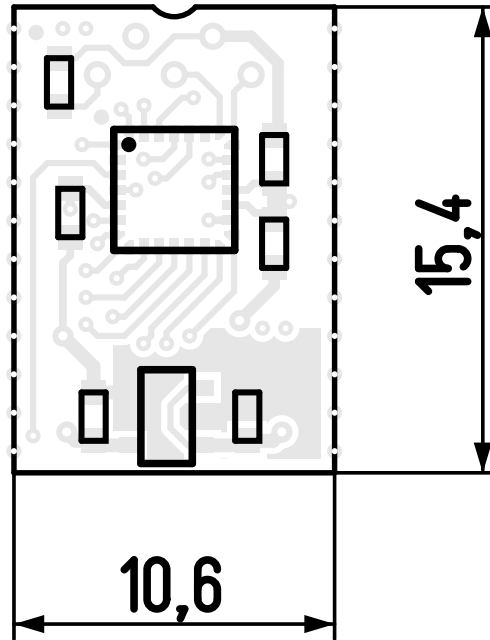
28 Pin DIL module



All dimensions: mm

MouseWarrior28

24 Pin SO24 Replacement Module



Height at thickest point: max. 2.2 mm

MouseWarrior28

10. ESD Considerations

MouseWarrior 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.

10.1 EMC Considerations

MouseWarrior 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.
- 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.

11. Revision history

The current shipping version of MouseWarrior28 is V1.0.0.3

V1.0.0.3 - Fixed a problem that could cause an error leading to an "unknown device" on Windows system start.

V1.0.0.2 - Did not affect MouseWarrior28

V1.0.0.1 - Fixed direction of Y and Z axis to be identical with MouseWarrior24

V1.0.0.0 - initial release version

11.1 Document Revision History

12.10.2018 - Added versions notes for V1.0.0.1 and V1.0.0.2

02.10.2018 - Added version note for V1.0.0.1
 - fixed pin number for /En-pin in table 4 on page 4
 - added package thickness and contour tolerances to QFN package drawing on page 9
 - fixed info for direction of Z-axis
 - fixed listing of variants in chapter 7.3

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