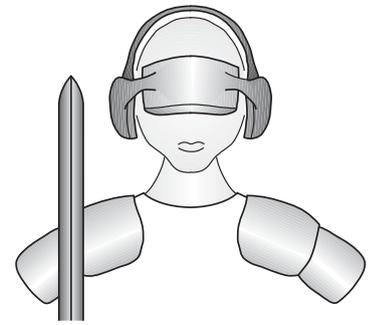


IOW24PowerVampire



IO-Warrior 24 PowerVampire USB power and generic I/O controller

This is a supplement to the IO-Warrior data sheet

Code Mercenaries

1. Features

- USB interface
- Full USB V1.1/2.0 low speed compliance
- Full USB HID 1.1 compliance
- Easy to use and standard compliant solution to draw power off the USB
- Direct control of power management chips LTC3455 or LP3947
- 12 generic I/O pins
- IIC master interface
- SPI master interface
- Minimal external component count: 1C, 1R
- Single +5V power supply
- Available in 24 pin DIL, or 24 pin SOIC

1.1 Variants

IOWarrior24PV is available in a single variant.

1.2 Custom variants

Custom adaptations are available on request. Production of chips with different product names is available for volumes of 100 or more.

2. Functional overview

IO-Warrior24 PowerVampire is designed for applications where a device needs the USB primarily to draw electric power. Examples are charging an internal battery or performing some function that needs few or no interaction with the computer (i.e. a LED light).

While the USB is somewhat tolerant about drawing up to 100mA off a USB port without a USB device being registered on that port, problems arise if a device tries to draw 500mA without registering properly. Not all USB ports can supply 500mA. Drawing 500mA from a low power port can cause the overcurrent protection to trip or it can degrade the voltage on that part of the USB which can cause problems with other devices. Also it can cause problems if a device continues to draw full power while the host computer goes to sleep, i.e. a notebooks battery gets discharged.

IO-Warrior24 PowerVampire does register as a USB device and asks for 500mA, in case it can not be configured for 500mA it will request 100mA. The power level for which it got configured as well as the suspend state is signalled on special pins. Both signals are available inverted and not inverted to reduce external circuitry.

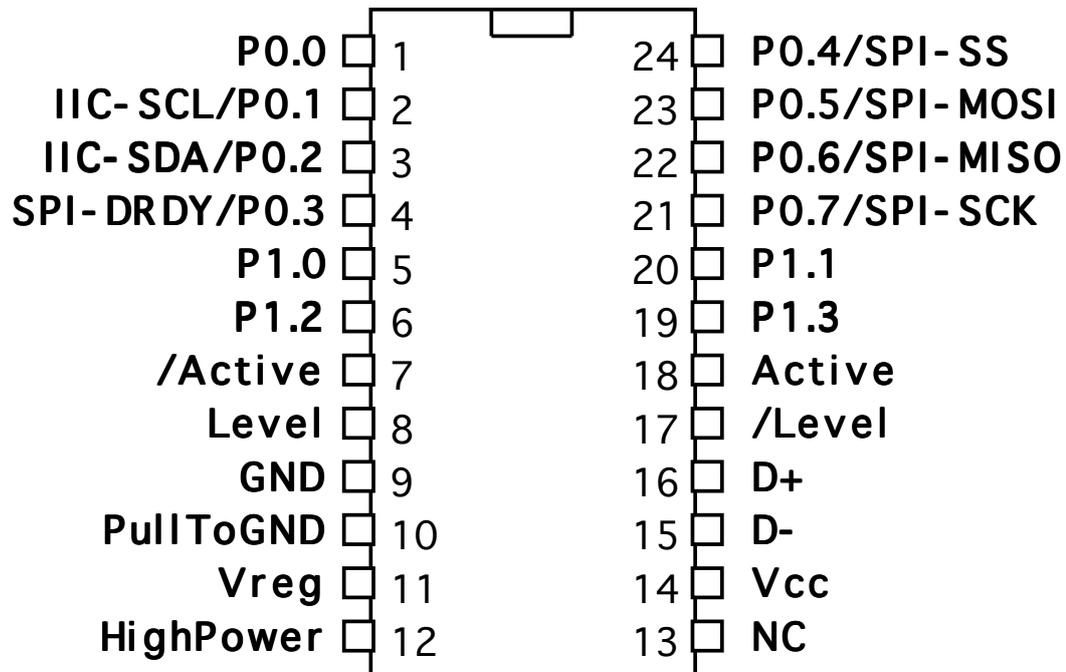
The Linear Technology LTC3455 or National Semiconductor LP3947 power manager and Li-Ion charger chips can be connected to the IOW24PV without additional hardware.

IOW24PV is based on the IO-Warrior24 chip. For some details of the chip operation this data sheet refers to the IO-Warrior data sheet.

IOW24PV

3. Pin Configurations

IOWarrior24PowerVampire-P/S 24 Pin PDIP or 24 Pin SOIC



Drawing: TOP VIEW!

4. Pin Descriptions IO-Warrior24PowerVampire

Name	I/O	Type	Pins	Description
D+, D-	I/O	special	16, 15	USB differential data lines
P0.0, P0.1, P0.2, P0.3, P0.4, P0.5, P0.6, P0.7	I/O	I/O open drain, internal pullup	1, 2, 3, 4, 24, 23, 22, 21	First I/O Port
P1.0, P1.1, P1.2, P1.3	I/O	I/O open drain, internal pullup	5, 20, 6, 19	Second I/O Port
Active	O	open drain, internal pull up	18	Goes high when it is OK to draw power off USB
/Active	O	open drain, internal pull up	7	Goes low when it is OK to draw power off USB
Level	O	open drain, internal pull up	8	Goes high if 500mA available, low for 100mA Only valid if Active signal is true
/Level	O	open drain, internal pull up	17	Goes low if 500mA available, high for 100mA Only valid if Active signal is true
HighPower	I	Input internal pull down	12	Connect to Vcc to set high power only mode
PullToGND	I		10	Used during manufacturing, connect to GND
GND		Power supply	9	Ground
Vcc		Power supply	14	Supply voltage
Vreg	O	Regulated 3V out	11	Power for D- pullup resistor
NC	-		13	do not connect

IOW24PV

4.1 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.

P0.0..P0.7

First I/O port of the chip. These pins correspond with the lowest 8 bits of the input or output (bits 0..7).

P1.0..P1.3

Second I/O Port. Corresponds to the bits 8..11.

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.

Active, /Active

When these outputs go active the external circuit may use power off the USB up to what the Level pin indicates. For simplicity of external circuit the signal is provided inverted and not inverted. So when Active is high /Active will be low, indicating that power may be drawn off the USB.

If the USB enters the suspended state both signals will be deasserted.

Level, /Level

These outputs signal how much current is available. If Level is high (/Level low) then 500mA are available if the Active signal is asserted.

HighPower

Pulling this pin to Vcc disables the 100mA configuration. The chip will then assert the Active signal only if it gets configured for using 500mA. This is intended for devices that need the 500mA and can not operate with 100mA or less.

Internal weak pull down resistor.

PulltoGND

This pin is used during production of the IO-Warrior chips, connect to GND.

GND

Power supply ground.

Vcc

Supply voltage.

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5. Device Operation

IOW24PV declares itself as a HID class device. On most operating systems this allows to use the device without software installation.

5.1 USB Power

As far as available power is concerned there are two types of USB ports: Those on self powered hubs and those on bus powered hubs.

A self powered hub is a hub that has its own power supply, like the root hub on the motherboard, an external hub with a power supply, or a hub in a display. Self powered hubs supply up to 500mA on each of their downstream ports.

Bus powered hubs are hubs that get their power off the USB like a hub in a keyboard. They can supply only 100mA for each of their downstream ports and they can have no more than 4 ports. Bus powered hubs can operate only if they are plugged into a port of a self powered hub since they need more than 100mA.

IOW24PV does make the best effort to get as much power from the USB port it gets connected to. However the results may depend on the operating system running on the system it gets connected to.

5.1.1 Power request from IOW24PV

Normally IOW24PV registers with two configurations, the first one requiring 500mA, the second 100mA. If the HighPower pin is pulled high IOW24PV specifies 500mA only.

Once the operating system has selected one of the configurations IOW24PV will signal which one got activated.

If the operating system does not configure IOW24PV within approximately 5sec IOW24PV will disconnect itself from the USB, change its descriptors including its ProductID and reconnect. Disconnecting and reconnecting can happen twice in the effort to get the highest possible current assigned.

The disconnect and reconnect will not happen if the HighPower pin is pulled high.

5.2 Operation with Windows

Any Windows versions 98 and newer and 2000 and newer will work with IOW24PV. Older versions of Windows do not support USB.

Upon connecting a IOW24PV based device for the first time you may be asked to perform the standard driver install. Allow Windows to install the standard drivers it recommends.

On some Windows systems you will probably see

a warning that the installed device does not work properly and that you should restart the machine, ignore this warning.

ATTENTION! When using IOW24PV with Windows you have to be aware that IOW24PV can show up under two different ProductIDs. This is necessary since Windows sometimes has problems with generating the necessary registry entries for IOW24PV if it tries to register with two configurations.

5.2.1 Power with Windows

Windows does always check only the first available configuration of a device and some versions of Windows do not work with a HID class device that offers two configurations. So Windows will in some situations not configure IOW24PV until it has done the disconnect and changed the descriptors.

Depending on the specific Windows version and processor speed you may or may not see an overcurrent warning in this case.

On some system configurations it can happen that a IOW24PV that is already connected during system startup gets configured only for 100mA even though it is connected to a self powered hub. For those situations a program is available that causes all IOW24PV to retry for high power.

5.3 Operation with MacOS 9

MacOS 9.0 and up do support IOW24PV direct. Some versions of MacOS 8.x do support USB as well, though their use is not recommended.

There will be no warnings or dialogs when a properly functioning IOW24PV based device is connected under MacOS 9, it will simply start to work.

5.3.1 Power with MacOS 9

MacOS 9 checks for the first configuration of a USB device that can be used. So it automatically selects the best possible power setting for IOW24PV.

If the HighPower option is set and IOW24PV gets connected to a bus powered hub it will not get enabled, some MacOS 9 versions may display a dialog telling that there is insufficient power to operate the device.

IOW24PV

5.4 Operation with MacOS X

All releases of MacOS X support IOW24PV direct. There will be no warnings or dialogs when a properly functioning IOW24PV based device is connected under MacOS X, it will simply start to work.

5.4.1 Power with MacOS X

MacOS X checks all configurations of a USB device and enables the best possible (highest power) configuration.

If the HighPower option is set and IOW24PV gets connected to a bus powered hub it will simply not get enabled, some MacOS X versions may display a dialog telling that there is insufficient power to operate the device.

5.5 Operation with Linux

Linux as of now has a faulty USB implementation. It just enables the first configuration of a USB device without checking if sufficient current is available.

Until there is a better implementation of the Linux USB protocol IOW24PV must be plugged only into self powered hub ports when using Linux.

The next kernal version of Linux will have much better USB support.

5.6 Remote Wakeup

IOW24PV does support Remote Wakeup of a sleeping host. The wakeup can take place when any port pin is pulled low while the host is sleeping. Remote wakeup has to be enabled by the operating system.

5.7 I/O functions of IOW24PV

IOW24PV offers a subset of the functions of IO-Warrior 24. For the detailed description of these functions please refer to the IO-Warrior data sheet. Accessing the 12 generic I/O pins of IOW24PV works identical to IOW24, except that there are only 12 I/O pins versus the 16 I/O pins of IOW24. Refer to sections 5 to 5.6 of the IO-Warrior data sheet for the details of the I/O pin operation.

5.7.1 IIC function

See sections 4.2.1, 5.10, and 5.10.1 of the IO-Warrior data sheet for a description of the IIC function.

5.7.2 SPI function

See sections 4.2.3, 5.10, and 5.10.3 of the IO-Warrior data sheet.

5.7.3 Getting current pin status

See sections 5.10 and 5.10.4 of the IO-Warrior data sheet.

5.7.4 Power status functions

IOW24PV has a function to read back the power mode it has been configured for.

To read the power mode a report with ID \$20 is sent to interface 1:

ReportID	1	2	3	4	5	6	7
\$20 out	\$00	\$00	\$00	\$00	\$00	\$00	\$00

This will return a report with ID \$20 containing the power mode:

ReportID	1	2	3	4	5	6	7
\$20 in	mode	\$00	\$00	\$00	\$00	\$00	\$00

mode = 1 is 100mA

mode = 2 is 500mA

To trigger a retry for getting configured for 500mA a report with ID \$21 is sent to interface 1:

ReportID	1	2	3	4	5	6	7
\$21 out	\$00	\$00	\$00	\$00	\$00	\$00	\$00

This will cause IOW24PV to disconnect from the USB, then revert to sending the 500mA configuration as the first descriptor and then doing a reconnect.

Use this function only if IOW24PV has been configured for 100mA, otherwise it will just cause a lot of system activity without any better result.

IOW24PV

6. DC Characteristics

	Parameter	Min	Max	Units	Remarks
V _{cc}	Operating Voltage	4.35	5.25	V	
I _{cc}	Operating Supply Current		20	mA	
I _{sb}	Suspend mode current		25	μA	Oscillator off
I _{ol}	Sink current on output pins		70	mA	V _{out} = 0.4V
R _{up}	Pull-up Resistance	8	24	kΩ	
V _{ith}	Input Threshold Voltage	40%	60%	V _{cc}	
	USB Interface				
V _{oh}	Static output high	2.8	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 _{reg}
R _{pd}	Bus Pull-down resistance	14.25	15.75	kΩ	15kΩ±5%

6.1 AC Characteristics

	Parameter	Min	Max	Units	Remarks
F _{icl} k2	Internal clock frequency	5.91	6.09	MHz	Clock synchronized to USB
	USB Driver Characteristics				
t _r	Transition rise time	75		ns	C _{Load} = 50pF
t _r	Transition rise time		300	ns	C _{Load} = 350pF
t _f	Transition fall time	75		ns	C _{Load} = 50pF
t _f	Transition fall time		300	ns	C _{Load} = 350pF
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 _{eopr1}	EOP width at receiver	165		ns	Rejects as EOP
t _{eopr2}	EOP width at receiver	675		ns	Accepts as EOP
t _{eopt}	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

See IO-Warrior main data sheet for absolute maximum ratings.

IOW24PV

7. Ordering information

Partname	Order Code	Description	Package
IO-Warrior24PV	IOW24PV-P	Power controller and generic I/O	PDIP24
IO-Warrior24PV	IOW24PV-S	Power controller and generic I/O	SOIC24

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

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. Custom chips are produced in multiples of full tubes only.

7.2 USB VendorID and ProductID

By default all IO-Warrior 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.

Following are the ProductIDs for the IO-Warrior controllers:

IO-Warrior24 PV \$1511 and \$1512

IOW24PV will use either ProductID depending on how it was configured by the host computer.

ProductIDs are independent of the package type.

See the IO-Warrior data sheet for version information.

IOW24PV

8. Application scenarios

Following are a couple examples for how to use take the best advantage of IOW24PV.

8.1 Application needs max. 80mA

If your application needs no more than about 80mA for its operation (allow 20mA for worst case IOW24PV current) you can just use the /Active or Active signal to enable your circuit. Leave the HighPower pin floating.

8.2 Application wants maximum available current

In case your application can run with less than 100mA but preferably uses up to 500mA you will need to use the Active and the Level pins to determine how much current is available.

Any time the Active pins are not asserted (i.e. Active = 0, /Active = 1) you may not draw power off the USB. The USB specification allows no more than 500 μ A to be drawn off the bus while it is in suspend mode. IOW24PV uses 25 μ A in suspend mode, the remaining current may be used by your circuit while Active is not asserted.

Also you have to make sure your circuit limits its current consumption to the indicated level. If the Level pin is low (/Level = 1) you may not use more than 100mA minus the 20mA worst case current for the IOW24PV. Only if the Level pin is high (/Level = 0) you may use up to 500mA minus the 20mA for IOW24PV.

Using the LTC3455 or LP3947 power management chips does simplify this task as these chips contain the necessary current limiting circuits and they can be controlled direct with the IOW24PV Level and Active pins.

See 8.6 for a circuit example showing how to connect the LTC3455 to the IOW24PV.

8.3 Application needs 500mA

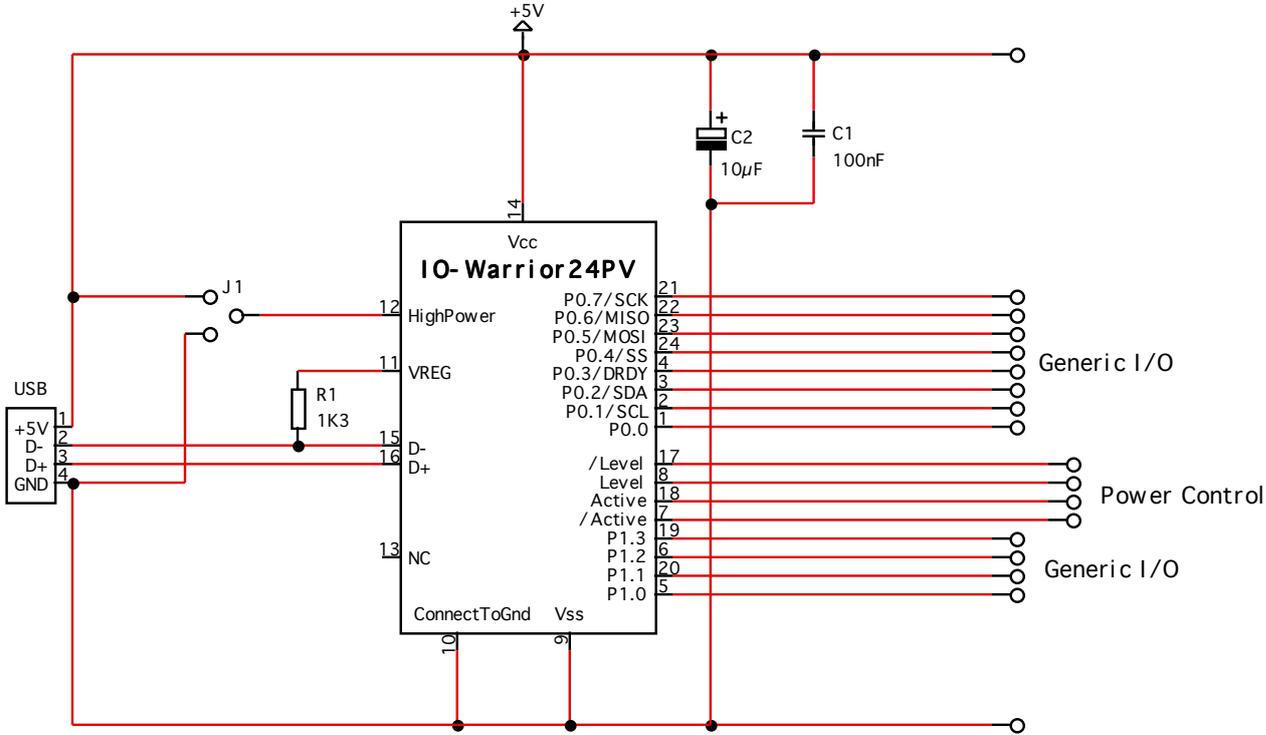
If your application always requires 500mA (less current for IOW24PV) you have to pull the HighPower pin to +5V. Then you can use the /Active, Active pins to enable power to your circuit.

8.4 Application examples

Following are a couple circuit schematics showing how IOW24PV can be used with power switching and management chips.

IOW24PV

8.5 Typical application for IO-Warrior24 PV

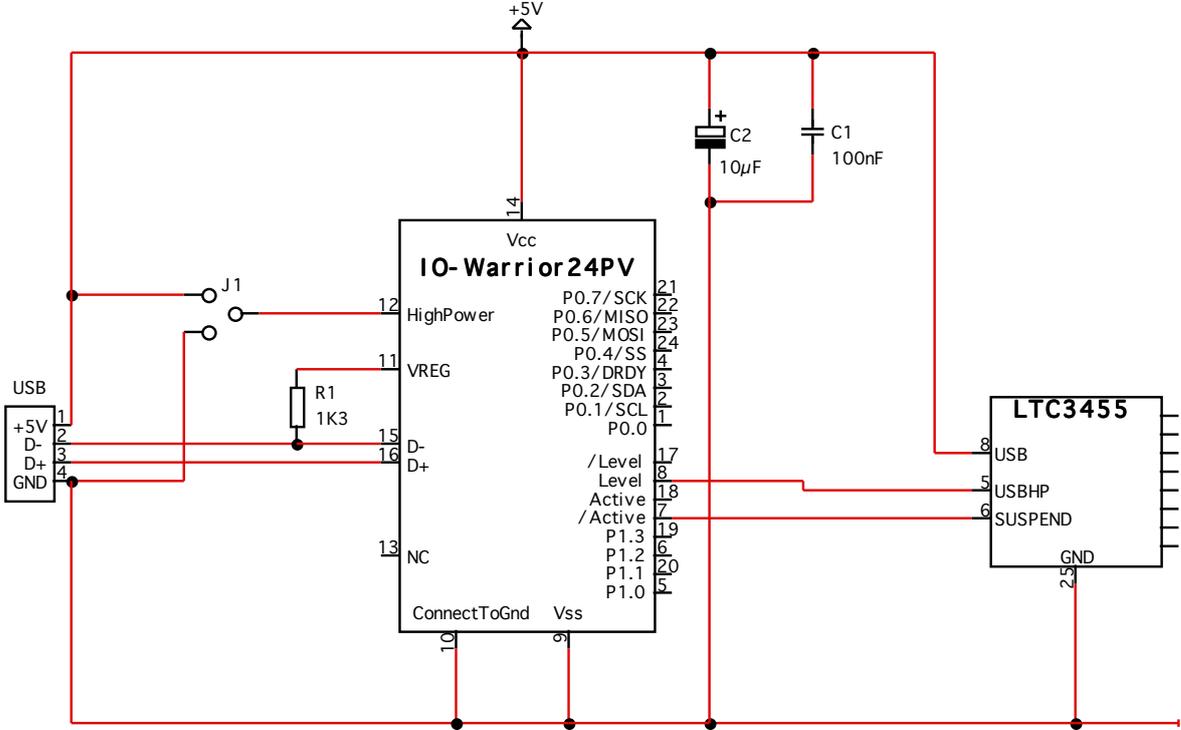


J1 pulling high forces high power mode (500mA)
 J1 pulling low allows auto power mode (100mA or 500mA)

Circuit: IO-Warrior24 PV		 Code Mercenaries		
Version: 1.0				
Date: 23.8.2005				
Drawn by:				
Function:				
Page:				
Rev.	Date	By	Change	Sign.

IOW24PV

8.6 Using IO-Warrior24 PV with LTC3455



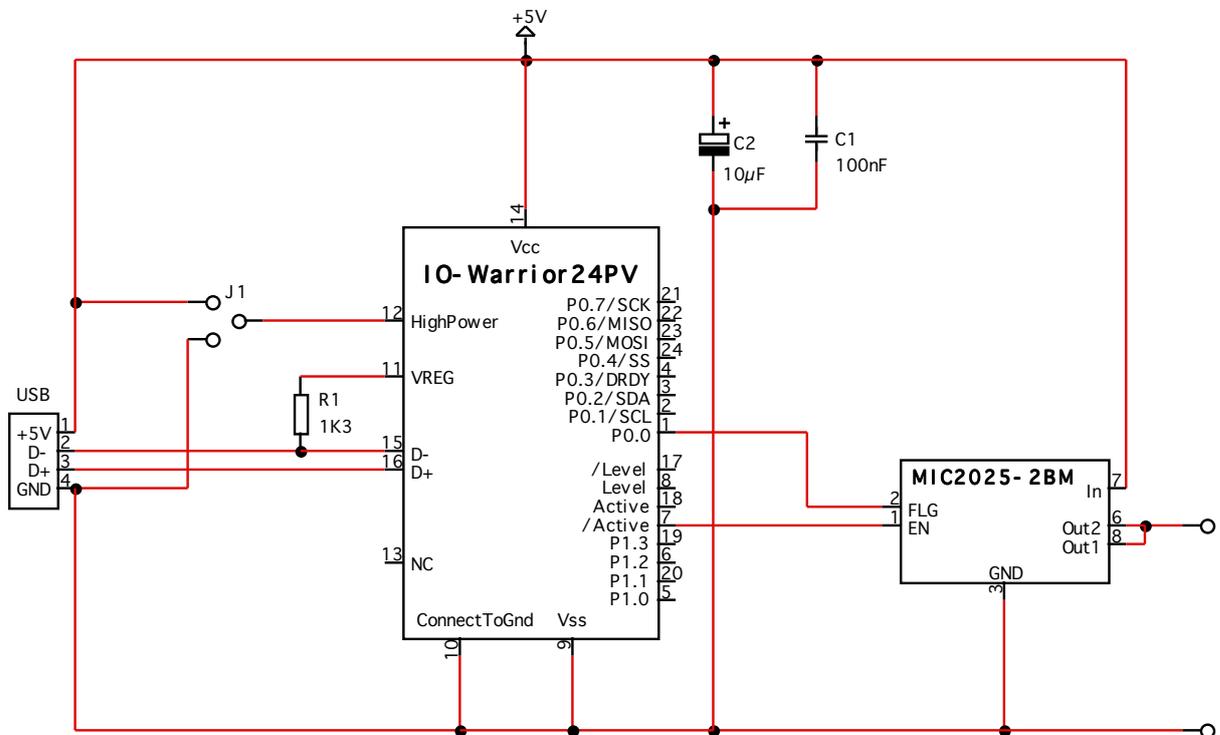
J1 pulling high forces high power mode (500mA)
 J1 pulling low allows auto power mode (100mA or 500mA)

Circuit: IO-Warrior24 PV		 Code Mercenaries		
Version: 1.0				
Date: 23.8.2005				
Drawn by:				
Function:				
Page:				
Rev.	Date	By	Change	Sign.

This schematic shows how to connect a LTC3455 with a IOW24PV. Only the IOW24PV specific part of the circuit is shown, refer to the LTC3455 data sheet for more details. The LTC3455 provides current limiting to 100mA or 500mA for drawing power off the USB and it contains two switch mode voltage regulators, a Li-Ion battery charger, a hot swap power switch, and monitoring functions. Combined with the IOW24PV it provides a complete power supply solution for USB including a wall plug option. Additional control lines of the LTC3455 may be connected to IOW24PV generic I/O pins for further control.

IOW24PV

8.7 Using IO-Warrior24 PV with a high side switch



J1 pulling high forces high power mode (500mA)
 J1 pulling low allows auto power mode (100mA or 500mA)

Circuit: IOW24PV with switch		 Code Mercenaries		
Version: 1.1				
Date: 22.9.2005				
Drawn by:				
Function:				
Page:				
Rev.	Date	By	Change	Sign.

This example shows how IOW24PV can control a high side power switch. This high side switch does include an over current protection. If the load does draw more than 500mA the switch will cut off and signal an over current condition. The overcurrent signal can be connected to any available I/O pin of the IOW24PV.

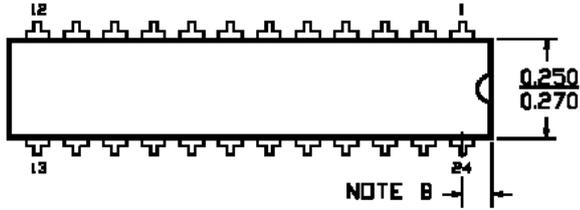
Use this circuit only if you either can guarantee that your application will stay within the 100mA current budget, or if you set the HighPower pin high to always request 500mA from the system.

The Micrel MIC2025 is just one example, there are several equivalent chips providing the same function (i.e. AIC1525, LM3525).

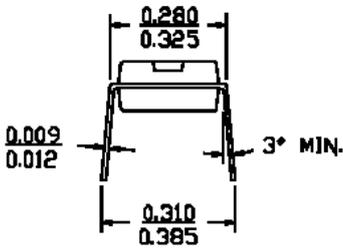
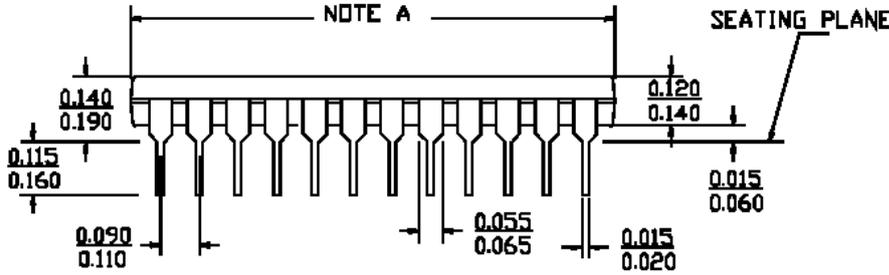
IOW24PV

9. Package Dimensions 24 Pin PDIP

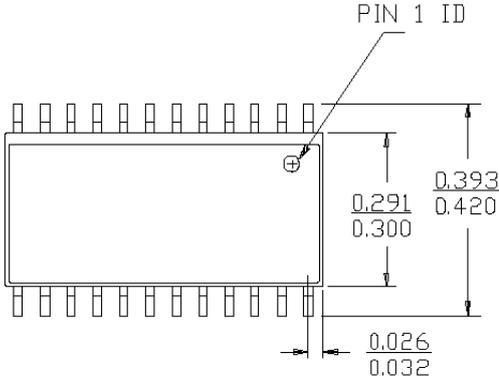
DIMENSIONS IN INCHES MIN.
MAX.



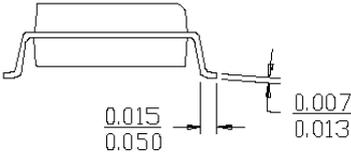
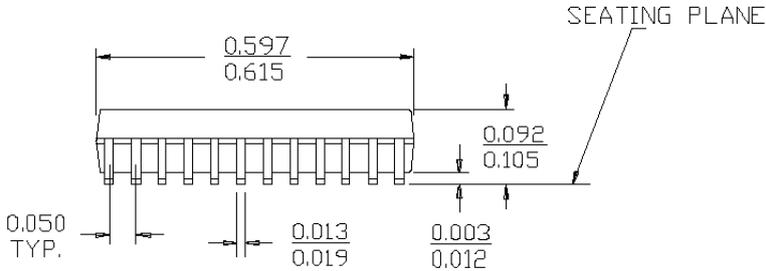
	P 13	P 13A
NOTE A	1.170 1.200	1.230 1.260
NOTE B	0.030 0.050	0.060 0.080



24 Pin SOIC



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



IOW24PV

10. ESD Considerations

IO-Warrior 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

IO-Warrior 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.
- Adding a ferrite bead to the +5V power supply line is advisable.

11. Revision History

Please refer to the IO-Warrior main data sheet for the revision history.

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Code Mercenaries
 Hard- und Software GmbH
 Karl-Marx-Str. 147a
 12529 Schönefeld OT Grossziethen
 Germany
 Tel: x49-3379-20509-20
 Fax: x49-33790-20509-30
 Mail: support@codemercs.com
 Web: www.codemercs.com

HRB 9868 CB
 Geschäftsführer: Guido Körber, Christian Lucht