PCI

PC Watchdog™

Hardware User's Manual

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NOTE: Design Update Effective August 2009

There were two versions of the PCI watchdog. The original version was PN: 1130 that was a standard size PCI card for standard +5V PCI slots. The other one was a low profile version with a universal +5V/3.3V PCI interface. It was available as PN: 1134-STD with a standard bracket or PN: 1134-LPF with a low-profile bracket.

In August of this year the two were merged into a single product in a low-profile format. All the features of both cards are now included in the new version. No features have been excluded. Customers can still order the boards using either the 1130 or the 1134-xxx part numbers.

1. Introduction

The PCI PC Watchdog board is a short PCI card that is used to monitor a PC in order to ensure maximum system availability. The board has the following features:

- Watchdog timer that can be set from 5 seconds to 1 hour via DIP switch or 1 second to 18 hours via software control.
- Eight (8) I/O ports for enhanced watchdog control and monitoring.
- Two on-board relays (DPDT - 2 form C) can be programmed to generate a 4-5 second pulse or latch on continuously after a watchdog-initiated reset.
- Four (4) general-purpose digital inputs.
- Four (4) general-purpose digital outputs.
- Single 8 bit A/D input.
- External watchdog re-trigger digital input.
- Relay contacts and digital I/O signals available on standard DB-25 connector.
- There is a non-volatile memory for saving configuration data.
- Eight bytes of non-volatile memory reserved for user data to implement simple software protection
- Over temperature circuit monitors the internal temperature of the PC.
- Two temperature trip points.
- Trip points can be modified by user software.
- Audible alarm and external digital output for the temperature trip point.
- Programmable options allow the Watchdog to hold the PC in reset after the upper trip occurs.
- Two externally visible LEDs show status of watchdog board. One LED lights after first watchdog-generated reset as a visible indication that a watchdog reset occurred.
- An I/O port allows the user to gain exclusive control of one relay from a user program.
- Programmable power-on delay to allow the PC to complete its initialization sequence.

The latest versions of all manuals and sample code can be found on our site at:

http://www.berkprod.com/

If you have any questions, corrections, or feedback about this manual please contact us at:

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2. Operation

This board is designed to monitor PCs used in critical applications such as: File Servers, Voice Mail Systems, ISP systems, industrial applications, etc. The idea is to make sure the PC is always available and running, especially systems that are not continuously monitored.

When the PC is powered up, or after a reset of the PC, the PC Watchdog will wait a preset amount of time (2.5 minutes standard) to allow the PC to complete its reset and initialization sequence. This time will be referred to as **P**ower-**O**n-**D**elay (**POD**). After this time has expired, the PC Watchdog will **Arm** itself and start a watchdog timer running (user defined time-out period) and then wait for a user program to access an I/O port or an external re-trigger signal.

If no activity is detected by the time the watchdog timer expires, the PC Watchdog will start its reset sequence on the PC.

When the PC Watchdog resets the PC it will turn on the bottom LED at the back of the board and leave it on. This provides an indication that at least one PC Watchdog reset has occurred, possibly more. There is also an I/O port that can be polled for a status bit that gets set after the PC Watchdog resets the PC. This allows an application program to determine the type of PC reset. A user program can write to a control port to clear the status bit and the LED.

The PC Watchdog will also activate the two relays to indicate the reset. The options allow pulsing the relays for 3-4 seconds after each reset or latching them on after the first reset. The relays can be reset from software. There is also a software option to allow the operation of one relay to be inverted. The contacts are **DRY** closure type.

The temperature circuit on the board will monitor the internal temperature of the PC. There are **two** standard temperature trip points available: **46°C** (115°) and **56°C (**133°F). At the first trip point the PC Watchdog board will activate one of the relays if the option is selected. It will also activate an audible alarm and an external signal that is available on the DB-25 connector. At the second trip point the PC Watchdog can optionally pull a hard reset on the PC to stop further processing.

There is an option to allow shifting the trip points higher via software control. The trip points can be increased in **1°C** increments up to **77°C (**171°F) and **87°C** (189°F).

3. DIP Switch Options

There is an eight-position DIP Switch at the top of the board to program the operation of the watchdog board for all types of operation. The switch options are:

Switch	Description
1	Relay #1 Temperature Mode
2	Relay #1 Mode
3	Relay #2 Mode
4	Temperature Reset Enable
5	Power On Delay (POD)Extend
6-8	Watchdog Delay Time

The switches are considered **ON** when the switch is **UP** or **ON**. The switch is considered **OFF** when the switch is **DOWN** or **OPEN**.

3.1 Switch #1 - Switch #1 - Relay #1 Temperature Mode (RTM)

ON - activate RELAY #1 when the temperature exceeds the lower trip point (default is 115°F). The mode of operation of RELAY #1 is determined by switch #2. If the temperature drops back below the trip point and then goes above it again, Relay #1 will generate another pulse if it is programmed by switch #2 for pulse mode.

OFF - ignore temperature.

3.2 Switch #2 - Relay #1 Mode (R1M)

ON - RELAY #1 will latch on after a watchdog trip (or a temperature trip if switch #1 is on). The PC will have to be powered down or the PC push-button reset will be needed to clear the relay state. A user program can also turn off the relay.

OFF - RELAY #1 will pulse for 4-5 seconds after a watchdog trip (or a temperature trip if switch #1 is on).

Note: The operation of this switch and Relay #1 can be inverted by a software option.

3.3 Switch #3 - Relay #2 Mode (R2M)

ON - RELAY #2 will latch on after a watchdog trip. The PC will have to be powered down or the PC push-button reset will be needed to clear the relay state. A user program can also turn off the relay.

OFF - RELAY #2 will pulse for 4-5 seconds after a watchdog trip.

Note: A user program can take exclusive control of this relay if required.

3.4 Switch #4 - Temperature Reset Enable (TRE)

ON - this will allow the PC Watchdog to reset the PC and HOLD it in reset whenever the upper temperature trip point occurs point (default is 56°C). When the PC is held in reset the CPU and other functions will stop and some disk drives will even spin down and stop. This may slow or stop the continued temperature rise. If the temperature drops to 4°C above the lower trip point then the watchdog will release the reset on the PC.

OFF - do not reset the PC at the second trip point. The buzzer will change sound to indicate the second trip.

3.5 Switch #5 - Power-On-Delay (POD) Extend

ON - In this mode the watchdog board will first wait 2.5 minutes (150 seconds) after resetting the PC, or after a power on. However, after this delay time it will then wait until it sees the first re-trigger from a temperature read or the external input. Then it will arm itself. See section 8 for changing the 2.5 minute delay.

OFF - watchdog board will wait 2.5 minutes (150 seconds) after resetting the PC, or after power on, before it Arms and starts its internal watchdog timer.

*** NOTE ** - Be Careful with this switch. If it is on and the PC locks up during reset then the board would not get "tickled" since no program would load. This would leave the PC permanently frozen. A better option is store a longer POD time in non-volatile memory. Or use configuration program to set a longer time.*

3.6 Switch #6-8 - Watchdog Delay Time

These switches set the delay time until the watchdog resets the PC. As long as the watchdog is receiving re-trigger pulses it will continue to reset the delay time. The settings and times are shown below:

Switches 6-8	Delay Time	Switches 6-8	Delay Time
OFF-OFF-OFF	5 Seconds	ON-OFF-OFF	5 Minutes
OFF-OFF-ON	10 Seconds	ON-OFF-ON	10 Minutes
OFF-ON-OFF	30 Seconds	ON-ON-OFF	30 Minutes
OFF-ON-ON	1 Minutes	ON-ON-ON	1 Hour

These times can be overridden with other delays by a user program.

4. Installation

Perform these steps to install the board in your computer:

A. Power down the computer and remove the cover.

B. Minimize static buildup by touching the frame of the PC or the power supply case to ensure all static electricity is discharged to ground.

C. Find an empty PCI slot and remove the back cover plate from the PC. Save the screw from the cover plate.

D. Make sure the board has been properly configured with the switches.

E. Pay close attention to the alignment of the board and the I/O slot of the PC as you insert the board into the slot.

F. Install the screw in the bracket on the back panel.

G. Remove the front panel reset cable from the motherboard and install it at J2 on the watchdog board. Ignore this step if your PC does not have a front panel reset cable.

H. Install the enclosed cable from J1 on the watchdog board to the reset header on the motherboard. **- OR -**

I. If you are using an ATX Reset Adaptor then connect to reset cable from J1 on the PCI board to the two (2) pin header on the ATX Adaptor.

J. Replace the cover on the PC and apply power.

K. The top LED on the watchdog board should start to flash after power has been applied.

4.1 Driver Installation

When you power up the PC you will get a found new hardware screen such as this one from Windows XP:

Make sure the CD is in the PC drive and click next to allow Windows to find the driver files.

After the files are installed you should restart the PC again. You may get another Found New Hardware Screen after the re-boot referencing a Windriver Virtual Device. Just follow the same steps again and allow Windows to find the virtual driver on the CD.

The CD has a program to tickle the Watchdog without having to write any software. See the PCI_WDog_Tickle directory on the CD for a “tickle” program that can be setup to install automatically.

5. Connectors

This section covers the internal and external connections to the board.

5.1 J1 & J2 - Reset Headers

There are two headers on the upper right corner board label **J1** and **J2**. The reset cable from the front panel reset switch should be removed from the motherboard and connected to **J2**, which is labeled **Reset Switch** for the push-button switch. The orientation of this cable on the header is not critical.

The enclosed cable that came with the board should be connected from **J1** (labeled **Reset To CPU**) to the reset header on the motherboard or the 2-Pin header on the ATX Reset Adaptor. Orientation of this cable on the headers is not critical either.

These cable connections must be done correctly for proper operation of the watchdog. From now on when you press the front panel reset button on the PC it will reset the watchdog board as well as the PC.

5.2 P1 - DB-25 Connector

The DB-25 connector provides access to the watchdog circuits. Be sure that you take appropriate anti-static precautions before making connections. The pin definitions are:

Pin	Description	Pin	Description
1	+5V	14	Relay #1 - COM-2
2	Relay #1 - COM-1	15	Relay #1 - NC-2
3	Relay #1 - NC-1	16	Relay #1 - NO-2
4	Relay #1 - NO-1	17	Relay #2 - COM-2
5	Relay #2 - COM-1	18	Relay #2 - NC-2
6	Relay #2 - NC-1	19	Relay #2 - NO-2
7	Relay #2 - NO-1	20	Temperature Trip
8	A/D Input	21	External Trigger
9	Digital Output 0	22	Digital Input 0
10	Digital Output 1	23	Digital Input 1
11	Digital Output 2	24	Digital Input 2
12	Digital Output 3	25	Digital Input 3
13	GROUND		

5.3 P1 - DB-25 Connector – (Old Low Profile PCI)

This table is included for reference for those customers with the original Low Profile version of the board. The original Low Profile PCI PC Watchdog only had a subset of the connections on the DB-25 connector. The pin definitions are:

Pin	Description	Pin	Description
1		14	
2	Relay #1 - COM	15	
3		16	
4	Relay #1 - NO-1	17	Relay #2 - COM-2
5	Relay #2 - COM-1	18	Relay #2 - NC-2
6	Relay #2 - NC-1	19	Relay #2 - NO-2
7	Relay #2 - NO-1	20	Temperature Trip
8		21	External Trigger
9	Digital Output 0	22	Digital Input 0
10	Digital Output 1	23	Digital Input 1
11		24	
12		25	
13	GROUND		

Note: Use a shielded cable to connect to this port. Connect the cable shield to pin 13. This will help attenuate any RFI from this port.

5.3.1 Power & Ground

Limited power is available on pin 1 on the standard PCI PC Watchdog. The +5V line is protected with a 100mA re-settable fuse. *Do not attempt to defeat this device.*

5.3.2 Relay Contacts

These contacts on pins 2-7 and pins 14-19 come from relays on the PCI PC Watchdog board. Do not switch more than **24 Volts** or **0.25 Amps** with these contacts!

5.3.3 Temperature Trip Output

The trip signal on pin 20 is an open collector darlington transistor output that will be in the off or high impedance state when the temperature is below the lower trip temperature. When the temperature exceeds the lower trip point, this pin will go low to about +0.8V. Do not switch more than **+5 Volts** or **100 milli-Amps** with this output!

5.3.4 External Trigger Input

This pin (21) expects a TTL (0-5V level) input signal. This signal should toggle faster than the watchdog timeout period. The rising edge is the active re-trigger signal. The signal should remain high and low for a minimum of 2.5 µS. This input has the same electrical characteristics as the digital inputs (section 5.3.6).

5.3.5 Digital Outputs

These signals on pins 9-12 come from open collector drivers with a 1.0K pull-up resistor. Do not switch more than **+5 Volts** or **25 milli-Amps** with these outputs! If you switch an inductive load (relay) then you must supply a protection diode as well.

5.3.6 Digital Inputs

These inputs on pins 22-25 accept TTL level inputs only. A high level should be greater than +2.0V and a low level should be less than +0.8V. Under no circumstances should inputs exceed +5.0V or drop below ground. The inputs have a 1.0K pull up resistor (to +5.0V) so you can use a dry contact switch to pull the input low.

5.3.7 A/D Input

This input is connected to the CPU via a 10K series resistor with diodes to VCC and ground for protection. It is not a high accuracy input! The A/D input level can be between ground and VCC (+5V) of the PC.

6. LEDs and Buzzer

6.1 External LEDs Standard PCI PC Watchdog

There are two LEDs on the back of the board. After the PC powers up the PC Watchdog will wait a programmed amount of time, Power-On-Delay (**POD**), before it enters its watchdog armed mode. During this time the top LED will pulse at a 1 second rate (1 second on, 1 second off). As shipped the POD time is 2.5 minutes.

When the PC Watchdog is ready and armed it will start flashing the top LED at a ½ second rate as an indication that it is running OK. When the watchdog is within 4 seconds of resetting the PC it will flash this LED at a 1/10 second rate.

If the watchdog board resets the PC, the top LED will return to its one second toggle rate while it waits again for the PC to undergo a new reset sequence. When this occurs, the bottom LED will be forced on. The LED can be cleared by cycling power on the PC, pressing the front panel reset button, or by a user program.

6.2 D1 - Watchdog Trip - Both Boards

This LED in the upper left corner of the board will emit a short pulse whenever the watchdog board receives a re-trigger pulse as the result of I/O activity or a re-trigger signal from the external input. If the I/O activity is too frequent, the LED will appear to be on continuously.

When the board powers up (or after a PC reset) the trip LED will flash for about 1 second if there are any problems detected on the board. The LED will flash once for ¼ second if the board is working correctly.

6.3 D2 – Heartbeat LED – Low Profile

This LED is also in the upper left corner of the board and is labeled: **HRTBT**. After the PC powers up the PC Watchdog will wait a programmed amount of time (set by the switch option) before it enters its watchdog armed mode. During this time the LED will pulse at a 1 second rate (1 second on, 1 second off).

When the PC Watchdog is ready and armed it will start flashing the LED at a ½ second rate as an indication that it is running OK. When the watchdog is within 4 seconds of resetting the PC it will flash this LED at a 1/10 second rate.

6.4 Buzzer

There is a buzzer installed on the board in the upper left corner. When the first temperature trip occurs the buzzer will beep. When the second trip point occurs the buzzer will be on continuously. The buzzer will sound briefly when the board resets the PC and when the board powers up. If the board has a power up problem it will emit another long 1 second beep in sync with the trip LED.

7. Watchdog Drivers, Programs and API

Please check the CD for recent updates in the readme.txt file.

The PDF manuals are in the Manuals directory on the CD.

The new DLL API and sample .cpp code is in the NEW_DLL_ConsoleTestAp directory on the CD.

There is a new "C" Console Ap provided that shows how to interface with the new DLL. There is also a new VB .Net directory with sample code for using Visual Basic to access the board through the DLL.

The Win 32 driver and .INF install file are on the WIN32_Drivers directory on the CD. When you power up the PC for the first time windows should find the card and then find the files on the CD automatically. The driver supports Win 2K/XP/Vista 32 bit only.

64 bit versions of Windows are not supported by the PCI card at this time.

There are unsupported drivers on the CD for Win 98/ME.

7.1 Web Site Downloads

The latest versions of sample code, DLL, Documents, etc can be found on our site at:

http://www.berkprod.com/

These downloads are ZIP files of the current CD image, Make sure you unzip them with the option to preserve directory structure.

8. Low-Level Programming Interface

There is now a new DLL API (PCI_WDog.DLL) for interface and access to the board. It is recommended that all new users of this board stick with this API. The functions in this DLL are in the same format and are shared by the Ether-USB-PC-Watchdog and the USB (PN: 1140) board. All the functions in the old DLL are included in the new DLL. This should make transition to the new DLL a little easier. The new DLL will work with Win 2K, XP, & Vista.

Please see the PCI_WDog_Int-ProgrammersManual.PDF on the CD for coverage of the functions in the new DLL.

The older DLL and static library files are still on the CD. The old sample programs (Console Ap & VB6) programs are still there. The functions in the old DLL and LIB files only provide a low level interface to the board. The old DLL & LIB files support Win 95/98/2000/NT/XP.

8.1 I/O Port Definitions

There is a set of registers available on the board that allows a programmer to gain control of the operation of the PC Watchdog. These descriptions are provided for users of the older API. It recommended that new users use the new API DLL on the CD since the functions in this DLL are also available in the Ether-USB-PC-Watchdog board.

In the following sections the 8 I/O ports are defined. They will be listed in order of offset from the base I/O address on the PCI bus.

In each description there will be a table that lists the Bit Name for each position, and the Reset status of the bit if defined. If the reset state of the bit is undefined it will be indicated with the letter “U”.

Each port table will also list the active bit positions for reading and writing data. If a bit position is not used it will be shown with the letter “X”.

8.1.1 Port 0 - Watchdog Re-Trigger and Temp Data

Any access of this port will also re-trigger the watchdog timer. Every time your program reads the temperature or does a dummy write, the **Watchdog Trip** LED should flash.

Port Write:

BIT	D7	D6	D5	D4	D3	D2	D1	D0
WRITE	X	X	X	X	X	X	X	X
RESET	U	U	U	U	U	U	U	U

Writing to this port does nothing other than re-triggering the watchdog.

Port Read:

BIT	D7	D6	D5	D4	D3	D2	D1	D0
READ	TD7	TD6	TD5	TD4	TD3	TD2	TD1	TD0
RESET	U	U	U	U	U	U	U	U

TD7-TD0: A read of this port will also return the temperature data in degrees Celsius. The temperature readings are updated about once per second.

8.1.2 Port 1 - Control Status #1

Port Write:

BIT	D7	D6	D5	D4	D3	D2	D1	D0
WRITE	RLY2	R2DS	X	X	X	X	X	CTRP
RESET	0	0	U	U	U	U	U	U

RLY2: Writing a one to this bit will activate Relay #2 on the board.

R2DS: Writing a one to this bit disables the on-board processor from controlling Relay #2 during a temperature trip or a reset. This allows you to have total control of the relay. If this bit is off, then the PC or the on-board processor can activate the relay.

CTRP: Writing a one to this bit will clear the **WTRP** bit and the trip (bottom) LED.

Port Read:

BIT	D7	D6	D5	D4	D3	D2	D1	D0
Read	RLY2	R2DS	X	RL1A	RL2A	TTRP	HRBT	WTRP
RESET	0	0	U	0	0	U	U	U

RLY2: Returns the status of your last write.

R2DS: Returns the status of your last write.

RL1A: If this bit is one it means Relay #1 is active or on.

RL2A: If this bit is one it means the on-board processor has tried to turn on Relay #2. If you have set the **R2DS** bit then you will have overridden the processor.

TTRP: If this bit is one it means the lower temperature trip point has been exceeded.

HRBT: This status bit is the watchdog heartbeat. It will mirror the action of the top LED on CR2. After reset it will toggle at a 1 second rate while the

watchdog is in its power-on delay. It will toggle at a ½ second rate when the watchdog arms, and it will toggle at a 1/10 second rate when the watchdog is within 4 seconds of resetting the PC.

WTRP: If this bit is set it means the watchdog has performed one (or more) resets on the PC as a result of a time-out or over-temp condition (if enabled). It also means the bottom trip LED is on. This bit is cleared whenever this port is written with **CTRP** set to one. Typically at power up you would test this bit and write to a log file indicating date and time of the reset.

If your power-up test program detects the **WTRP** bit is active, and you have enabled the watchdog to reset the PC in case of over temp as well; then also check the **TTRP** bit to see if it is set. This will let you know that the reset may have been initiated as a result of temperature, not a time-out.

8.1.3 Port 2 - Control Status #2

Port Write:

BIT	D7	D6	D5	D4	D3	D2	D1	D0
WRITE	X	X	ENTP	X	TVD3	TVD2	TVD1	TVD0
RESET	U	U	1	U	0	0	0	0

ENTP: This bit is always set to one (1) after a reset of the watchdog board to ensure compatibly with earlier versions of the board. If this bit is one **AND** the **TRE** switch on the DIP Switch is on, then the watchdog board is enabled to hold the PC in reset if the upper temperature trip point is exceeded.

TVD3-TVD0: These four (4) bits are used to change the upper and lower trip points for the temperature sensing. The value written to this port is added to the base trip points of **46°C** and **56°C**. This means if you write 0xF (decimal 15) to this register then you can shift the trip points up to **61°** and **71°** Centigrade.

Port Read:

BIT	D7	D6	D5	D4	D3	D2	D1	D0
READ	PCMD	WRSP	ENTP	WDIS	TVD3	TVD2	TVD1	TVD0
RESET	0	0	1	0	0	0	0	0

PCMD: When this bit is set it means the PC has written (sent) a command to the watchdog board via Port 6. When the watchdog reads the command the bit will clear to let the PC know it can send another command.

WRSP: When this bit is set it means the watchdog has written (sent) a response to the PC board via Port 6. When the PC reads the response the bit will clear automatically.

ENTP: This reflects the last value written.

WDIS: If this bit is set, it indicates that you have successfully disabled the watchdog board by using Port 3. *When the watchdog is disabled it will not reset the PC, it will reset its internal timer and freeze it, it will not perform*

a reset if the upper temperature trip point is exceeded, however it will continue to update the temperature register.

TVD3-TVD0: These four (4) bits return the last data written.

8.1.4 Port 3 - Switch Status / Watchdog Disable

Port Write:

BIT	D7	D6	D5	D4	D3	D2	D1	D0
WRITE	WD7	WD6	WD5	WD4	WD3	WD2	WD1	WD0
RESET	U	U	U	U	U	U	U	U

WD7-WD0: Writing to this port disables the watchdog board. In order to prevent false trips, you have to write 0xA5 to this port *TWO TIMES*. After the second write the **WDIS** bit will be set to indicate the watchdog is disabled. Writing *ANY* other data value to this port will re-enable the watchdog and the **WDIS** bit will clear.

Port Read:

BIT	D7	D6	D5	D4	D3	D2	D1	D0
WRITE	SWD7	SWD6	SWD5	SWD4	SWD3	SWD2	SWD1	SWD0
RESET	U	U	U	U	U	U	U	U

SWD7-SWD0: Reading these bits returns the settings on the DIP Switch.

8.1.5 Ports 4, 5, & 6 - Command/Response

The PC send commands to the watchdog through these three (3) eight (8) bit ports and the watchdog sends responses back through these ports. There are three types of commands:

1. Simple one byte.
2. Command with 8 bits of data.
3. Command with 16 bits (word) of data.

If a command requires data it should be written first. Commands with a single byte should be written to Port 4. Commands that require 2 bytes should be written as LSB to Port 4 and MSB to Port5. After the required data has been written then write the command to Port 6. The act of writing to Port 6 will set the **PCMD** bit in Port 2. Do not write any more data until the **PCMD** bit clears which indicates that the Watchdog has fetched the command.

The Watchdog will respond to all commands. If any response data is required it will be written to Port 4 (LSB) and Port 5 (MSB) first, then the response code will be written to Port 6. When the watchdog writes to Port 6 the **WRSP** bit will be set in Port 2 as an acknowledgement. The PC should always read Port 4 and Port 5 first if there is data to be returned and then read Port 6. Reading Port 6 automatically clears the **WRSP** bit in Port 2.

8.1.6 Port 7 - Digital Input/Output

Port Write:

BIT	D7	D6	D5	D4	D3	D2	D1	D0
WRITE	X	X	X	X	DO-3	DO-2	DO-1	DO-0
RESET	U	U	U	U	0	0	0	0

DO-3 - DO-0: When these bits are written as one (1) the corresponding digital outputs will be low or less than +0.8V. The CPU on the watchdog board can also set these outputs under special circumstances. The outputs are open collector transistors with 1.0K pull-up resistors. The maximum sink current is 25mA. *Currents higher than this may cause the output voltage to be higher than +0.8V and could permanently damage the output transistors!*

*Note: The Low Profile board only has **DO-0 & DO-1**.*

Port Read:

BIT	D7	D6	D5	D4	D3	D2	D1	D0
WRITE	DI-3	DI-2	DI-1	DI-0	DO-3	DO-2	DO-1	DO-0
RESET	U	U	U	U	0	0	0	0

DI-3 - DI-0: When the digital inputs on the board are higher than +2.0V then these bits will read as zero (0). If the inputs are less than +0.8V then these bits will read as one (1). Voltages between these two levels are indeterminate. The input pins are pulled high with 1.0K pull-up resistors on the board so unconnected pins will read as a zero (0).

*Note: The Low Profile board only has **DI-0 & DI-1**.*

DO-3 - DO-0: These bits reflect the last value written to the output pins. The CPU on the watchdog could have also set these outputs under special circumstances.

9. Command Mode - Commands

This section covers sending commands to the Watchdog board and getting responses. See the coverage of Ports 2 and 4-6 in the prior section. The two status bits: **PCMD & WRSP** in Port 2 are the handshaking mechanism used to regulate data flow between the PC and the board. The APIs provided will handle this low level protocol for you.

9.1 Command Summary

This tables summarizes the commands that can be sent:

Command	Description	NV	Ver
0x04	Get Status Information	No	1.06
0x08	Get Firmware Version	No	1.06
0x10	Read Current POD Time	No	1.06
0x11	Write Current POD Time	No	1.06
0x14	Read Non-Volatile POD Time	No	1.06
0x15	Write Non-Volatile POD Time	Yes	1.06
0x18	Read Current Watchdog Time	No	1.06
0x19	Write Current Watchdog Time	No	1.06
0x1A	Read Hold Register Watchdog Time	No	**1.72**
0x1C	Read Non-Volatile Watchdog Time	No	1.06
0x1D	Write Non-Volatile Watchdog Time	Yes	1.06
0x20	Read Re-trigger Count	No	1.06
0x22	Read External Re-trigger Count	No	1.06
0x50	Read Relay Control	No	1.06
0x51	Write Relay Control	Yes	1.06
0x58	Read Temperature Offset	No	1.06
0x59	Write Temperature Offset	Yes	1.06
0x5C	Read Buzzer Control	No	1.60
0x5D	Write Buzzer Control	Yes	1.60
0x60	Read A/D Input	No	1.32
0x80	Reset PC	No	1.06
0x84	Get/Clear Reset Count	No	1.06
0x88	Read Reset Relay Pulse Width	No	1.32
0x89	Write Reset Relay Pulse Width	Yes	1.32
0xC0	Read User ID Data	No	1.32
0xC1	Write User ID Data	Yes	1.32

The NV column tells you if the command will write data to the non-volatile memory and thus will take longer to execute. Allow 10mS (milli-seconds) for the board to

process a normal command and allow up to 100mS for a non-volatile memory write command.

The Version (Ver) column tells you what firmware version your board should have to support the command. Items in bold type are new since last manual.

*Do not use commands higher than **0xE0**. They are for testing purposes only and will produce undesirable results.*

9.2 Command: 0x04 - Get Status Information

This command will return the status of the board. It is recommended that this command be used every once in a while. The non-volatile memory chip employs hardware circuits and software features to prevent inadvertent data corruption. However no method is always perfect.

Send Command:

Port 6 CMD	**Port 5** MSB	**Port 4** LSB
0x04	Not Used	Not Used

WDog Response:

Port 6 RESP	**Port 5** MSB	**Port 4** LSB
0x04	Not Used	Bits

Notes:

The response data byte is a bit field defined as:

- **D0:** Set to one (1) if non-volatile memory OK. If zero (0) then all data was cleared.
- **D1:** Set to one (1) if temperature sensor is OK.
- **D2:** *Set to one for Low Profile PCI PC Watchdog.*
- **D3:** Set to one (1) to indicate **ENTP** bit in Hardware I/O Port #2
- **D4:** Set to one (1) to indicate **WDIS** bit in Hardware I/O Port #2.
- **D5:** Set to one (1) to indicate **TTRP** bit in Hardware I/O Port #2.
- **D6:** Set to one (1) to indicate **WTRP** bit in Hardware I/O Port #2.
- **D7:** Set to one (1) when the board has completed its power-on delay and is armed.

9.3 Command: 0x08 - Get Firmware Version Number

This command will return the numeric version of the firmware on the board.

Send Command:

Port 6 CMD	**Port 5** MSB	**Port 4** LSB
0x08	Not Used	Not Used

WDog Response:

Port 6 RESP	**Port 5** MSB	**Port 4** LSB
0x08	Whole#	Fraction

Notes:

The response data will be two bytes. The MSB is the whole number portion of the version and the LSB is the fraction.
EX: 0x01 0x09 = Version 1.09

9.4 Commands: 0x10 & 0x11 - Read / Write Current POD Time

When you use the Watchdog for the first time it will wait 2.5 minutes, or it may use a programmed value, after a power-up or a reset before it arms itself. This **P**ower-**O**n-**D**elay (**POD**) time allows the PC additional time to complete a reboot sequence. These commands allow you to check and shorten / lengthen the current delay. See the next section for storing a new wait time.

Send Commands:

Port 6 CMD	**Port 5** MSB	**Port 4** LSB
0x10	Not Used	Not Used
0x11	Delay Time	Delay Time

WDog Responses:

Port 6 RESP	**Port 5** MSB	**Port 4** LSB
0x10	Delay Time	Delay Time
0x11	Not Used	Flag

Notes:

The delay time sent can range from 0x0000 to 0xFFFF seconds. If the time is less than the current remaining wait time then the arming will occur sooner. The board will return a flag byte after a write operation. The flag will be zero if the board is already passed the power-on delay and is armed A read return value of 0x0000 means the board is already armed. This command is only active for the current session and the board will revert to its 2.5 minute or non-volatile memory programmed delay at the next reboot.

9.5 Commands: 0x14 & 0x15 - Read / Save Non-Volatile POD Time

This command allows you to shorten or lengthen the POD time after every reboot by saving the value in non-volatile memory.

Send Commands:

Port 6 CMD	**Port 5** MSB	**Port 4** LSB
0x14	Not Used	Not Used
0x15	Delay Time	Delay Time

WDog Responses:

Port 6 RESP	**Port 5** MSB	**Port 4** LSB
0x14	Delay Time	Delay Time
0x15	Not Used	Not Used

Notes:

If the time read is 0x0000 using command 0x14 then there is not a new Arm time in the non-volatile memory. The new Arm time can range from 0x0001 to 0xFFFF seconds. If the value is set to zero (0x0000) on command 0x15 (write) then any Arm time in non-volatile memory will be erased and the board will go back to using the 2.5-minute delay. A non-zero value will be stored and then used as the Arm time on future resets and power-on. *Be careful not to make it too short.*

9.6 Commands: 0x18 & 0x19 - Read / Write Current Watchdog Time

When you use the Watchdog for the first time it will use a countdown time set by the DIP switches (section3.6) or it will use a stored value if programmed in non-volatile memory. This command allows you override the switch or stored setting to shorten or lengthen the delay. See the next section for storing a new delay time.

Send Commands:

Port 6 CMD	**Port 5** MSB	**Port 4** LSB
0x18	Not Used	Not Used
0x19	Delay Time	Delay Time

WDog Responses:

Port 6 RESP	**Port 5** MSB	**Port 4** LSB
0x18	Delay Time	Delay Time
0x19	Not Used	Not Used

Notes:

The delay time can range from 0x0001 to 0xFFFF seconds. A value written of zero (0x0000) allows you to return to the time set on the DIP switch or the stored value in non-volatile memory if it exists. The new time will be activated at the next re-trigger of the Watchdog. A read will return 0xFFFF if the board is not yet armed.

Be careful using low times (1 or 2 seconds) if your application runs as a low priority task.

9.7 Command: 0x1A - Read Holding Register Watchdog Time

This command only works on boards with firmware version 1.72 or higher.

The PCI PC Watchdog uses an internal register to store the watchdog time that will be reloaded into the countdown timer every time the board it "tickled"

Typically this value will be determined by the DIP Switch setting. It can be replaced by using the Write Current Watchdog Time (0x19 in the prior section) or it can be replaced with a value from the non-volatile memory which overrides the DIP Switch values at power up.

Send Command:

Port 6 CMD	**Port 5** MSB	**Port 4** LSB
0x1A	Not Used	Not Used

WDog Response:

Port 6 RESP	**Port 5** MSB	**Port 4** LSB
0x1A	Hold Time	Hold Time

9.8 Commands: 0x1C & 0x1D - Read / Save Non-Volatile Watchdog Time

These commands allow you to check and shorten / lengthen the watchdog time for every reboot by saving the value in non-volatile memory.

Send Commands:

Port 6 CMD	**Port 5** MSB	**Port 4** LSB
0x1C	Not Used	Not Used
0x1D	Delay Time	Delay Time

WDog Responses:

Port 6 RESP	**Port 5** MSB	**Port 4** LSB
0x1C	Delay Time	Delay Time
0x1D	Not Used	Not Used

Notes:

If the time read is 0x0000 using command 0x1C then there is not a new watchdog time in the non-volatile memory. The new watchdog time can range from 0x0001 to 0xFFFF seconds. If the value is zero (0x0000) on command 0x1D then any watchdog time in non-volatile memory will be erased and the board will go back to using the DIP switch settings. A non-zero value will be stored and then used as the watchdog time on future resets and power-ups. The new time will also be activated next time the watchdog board is re-triggered.

9.9 Commands: 0x20 & 0x22 - Read Re-trigger Counts

Every time the watchdog gets re-triggered by reading the temperature port or from the external input pin it will increment a 16 bit counter. These commands allow to you to read these counters. If you set the flags in the LSB to a non-zero value then the counter will be cleared after the value has been returned.

Send Command:

Port 6 CMD	**Port 5** MSB	**Port 4** LSB
0x20	Not Used	Flag
0x22	Not Used	Flag

WDog Response:

Port 6 RESP	**Port 5** MSB	**Port 4** LSB
0x20	Count MSB	Count LSB
0x22	Count MSB	Count LSB

Notes:

Command 0x20 gets the count from the I/O (temperature) port re-trigger and command 0x22 gets the count from external pin re-trigger.

9.10 Commands: 0x50 & 0x51 - Read / Write Relay Control

This command provides an alternate method to control the relays on the board. You can also invert the operation of relay #1 and optionally save the setting. When relay #1 is inverted it will be turned on within a few hundred milli-seconds of the PC being powered on. From then on, **all** relay #1 operations described in the manual will be inverted.

Send Commands:

Port 6 CMD	**Port 5** MSB	**Port 4** LSB
0x50	Not Used	Not Used
0x51	Not Used	Bits

WDog Responses:

Port 6 RESP	**Port 5** MSB	**Port 4** LSB
0x50	Not Used	Bits
0x51	Not Used	Bits

Notes:

The data byte in the send command (0x51) is a bit field defined as:

D0: Set to one (1) to turn relay #1 on (evaluated first).
D1: Set to one (1) to turn relay #2 on (evaluated first).
D2: Set to one (1) to turn relay #1 off (evaluated second).
D3: Set to one (1) to turn relay #2 off (evaluated second).
D4: Set to one (1) to invert relay #1 operation. Set to zero (0) for normal operation. Writing a zero (0) will override the non-volatile setting for the duration of the current session.
D5-6: Not used - write zeros for future compatibility.
D7: Set to one (1) to store relay #1 inversion setting in non-volatile memory.

The data byte in the command response (0x50 or 0x51) is also a bit field defined as:

D0: Set to one (1) means relay #1 is/was on.
D1: Set to one (1) means relay #2 is/was on.
D2-3: Not used - read zeros for future compatibility.
D4: Set to one (1) to means relay #1 is/was inverted.
D5-6: Not used - read zeros for future compatibility.
D7: Set to one (1) means non-volatile inversion setting is/was active.

Using the read command (0x50) will tell you what **IS** the current state. After using the write command (0x51), the response will be what **WAS** the prior state before your new changes.

Important Note:

If you set bit **D0** to turn on Relay #1 or set **D2** to turn off Relay #1 then inversion will be overridden. On a read if **D0** is set then it means that Relay #1 is actually on or energized.

9.11 Commands: 0x58 & 0x59 - Read / Write Temperature Offset

There are two ways to increase the temperature trip points on the watchdog board. The first is to use the **TVDx** bits in hardware Port #2. These bits have to be rewritten after each reset of the PC and they only allow offsets up to 15. These commands allow you to set the offsets up to 31 (0x1f). If the offset is used then it will be active every time the PC powers up and it will override any data present in hardware Port #2.

Send Commands:

Port 6 CMD	**Port 5** MSB	**Port 4** LSB
0x58	Not Used	Not Used
0x59	Not Used	Offset

WDog Responses:

Port 6 RESP	**Port 5** MSB	**Port 4** LSB
0x58	Not Used	Offset
0x59	Not Used	Not Used

Notes:

The offset here is in degrees C and can range from 0x00 to 0x1F. Values higher will be corrected modulo 32. A value of zero causes the board to go back to using the value in the **TVDx** bits.

9.12 Commands: 0x5C & 0x5D - Read / Write Buzzer Control

This command provides a method to control the buzzer on the board. Normally the buzzer sounds at power up and after each reset of the PC. It only emits a beep that lasts about 600mS (0.6 seconds). This command provides additional control via bit field parameter. This command added at Version 1.50 firmware.

Send Commands:

Port 6 CMD	**Port 5** MSB	**Port 4** LSB
0x5C	Not Used	Not Used
0x5D	Not Used	Bits

WDog Responses:

Port 6 RESP	**Port 5** MSB	**Port 4** LSB
0x5C	Not Used	Bits
0x5D	Not Used	Bits

Notes:

The data byte in the send command (0x5D) is a bit field defined as:

- **D0:** Set to one (1) for a 2.5 second beep after each reset (evaluated first).
- **D1:** Set to one (1) for a continuous buzzer after the first reset. *Note that this could be very annoying.*
- **D2:** Set to one (1) to turn on the buzzer. Method for user application to sound buzzer.
- **D3:** Set to one (1) to turn off the buzzer (evaluated last). Also for a user ap to turn off the buzzer.
- **D4:** Not used - write zeros for future compatibility.
- **D5:** ***Firmware 1.60.*** If this bit is set to one it will disable ALL buzzer activity.
- **D6:** ***Firmware 1.60.*** Set this bit to one to store the disable buzzer status in non-volatile memory.
- **D7:** Set to one (1) to store in non-volatile memory the beep time set in D0 or D1. This will be effect every time the board powers up. If D0 and D1 are clear the non-volatile memory will be cleared.

Bits are evaluated starting with D0 first. Example: if you set both D2 and D3 the result will be that the buzzer is off.

The data byte in the command response (0x5C or 0x5D) is also a bit field defined as:

D0: Set to one (1) means buzzer is/was set for 2.5 second beep.
D1: Set to one (1) means buzzer is/was set for continuous beep.
D2: Set to one means buzzer is/was on.
D3: Set to one means buzzer is/was off.
D4: Not used - read zeros for future compatibility.
D5: ***Firmware 1.60.*** Set to one (1) means buzzer is/was disabled.
D6: ***Firmware 1.60.*** Set to one (1) means non-volatile buzzer disable is/was active.
D7: Set to one (1) means a non-volatile buzzer time setting is/was active.

Using the read command (0x5C) will tell you what **IS** the current state. After using the write command (0x5D), the response will be what **WAS** the prior state before your new changes.

9.13 Command: 0x60 – Read A/D Input

This command will return a value that represents the voltage level on the A/D input pin. The accuracy of this data is ±2 LSB. The span range of the A/D is ground to VCC (+5V) of the PC. The input should never exceed these limits.

Send Command:

Port 6 CMD	**Port 5** MSB	**Port 4** LSB
0x60	Not Used	Not Used

WDog Response:

Port 6 RESP	**Port 5** MSB	**Port 4** LSB
0x60	Not Used	A/D Data

Notes:

The data ranges from 0x00 to 0xFF (255).

Example: Data returned = 0xB3. VCC on PC = 5.06V
0xB3 = 179 => (179 * 5.06) / 255 = 3.55V

Not available on Low Profile board. This command will always return a value between 0xFD to 0xFF.

9.14 Command: 0x80 - Reset PC

Use this command carefully. It will reset your PC.

Send Command:

Port 6 CMD	**Port 5** MSB	**Port 4** LSB
0x80	0xA5	Delay Time

WDog Response:

Port 6 RESP	**Port 5** MSB	**Port 4** LSB
0x80	Not Used	Flag

Notes:

If the delay time is set to zero the reset will occur immediately. The delay time can be as high as 255 (0xFF) seconds. If the board is not armed it will return a flag byte set to zero. In this case you will need to shorten the arm time to get the board armed. If the reset time is not zero and the board is armed then the flag will be non-zero. The MSB must be set to 0xA5 as a safety feature; if it is not 0xA5 then the flag returned will be zero.

Once this command has been sent it cannot be disabled! The board will enter a mode where it will no longer communicate with the PC until the reset has been done.

Even if the Watchdog board has been disabled via port 3, this command will still work!

9.15 Command: 0x84 - Get / Clear Reset Count

When the watchdog board powers up it will set a counter to zero. Every time it resets the PC this count will increase by one. Use this command to get the count. If the Clear Flag is non-zero then the board will clear the count after it has been returned.

Send Command:

Port 6 CMD	**Port 5** MSB	**Port 4** LSB
0x84	Not Used	Clear Flag

WDog Response:

Port 6 RESP	**Port 5** MSB	**Port 4** LSB
0x84	Not Used	Count

Notes:

The count ranges from 0x00 to 0xFF (255). When the counter hits the upper limit it will stop rather than rollover.

9.16 Commands: 0x88 & 0x89 - Read / Write Reset Relay Pulse

The default mode for the Watchdog is to pulse a reset relay (which simulates pushing the reset button) for 3 seconds. This value works for most computers, however some machines may require longer or shorter values. This command allows you to tailor the pulse time by selecting a delay in 50mS tics.

Send Commands:

Port 6 CMD	**Port 5** MSB	**Port 4** LSB
0x88	Not Used	Not Used
0x89	Not Used	Delay Tics

WDog Responses:

Port 6 RESP	**Port 5** MSB	**Port 4** LSB
0x88	Not Used	Delay Tics
0x89	Not Used	Not Used

Notes:

The delay time can range from 0x01 to 0xFF tics. A value of zero (0x00) allows you to return to the default 3 second pulse. The new time will be activated at the next re-boot of the PC.

Be careful using low times (1 or 2 tics) since these may be too short to generate valid resets on the PC.

9.17 Commands: 0xC0 & 0xC1 - Read / Write User ID Data

Eight (8) bytes of the non-volatile memory have been reserved for the user to store their own ID data. These bytes could have many uses with one of them being a software security mechanism. A user could make their software refuse to run unless there was a watchdog board in the system with the correct code in the memory.

Send Commands:

Port 6 CMD	**Port 5** MSB	**Port 4** LSB
0xC0	Offset	Not Used
0xC1	Offset	User Data

WDog Responses:

Port 6 RESP	**Port 5** MSB	**Port 4** LSB
0xC0	Not Used	NV Data
0xC1	Not Used	Not Used

Notes:

The offset should be a number between 0 and 7. Higher values will be corrected to modulo 8. Data can be any value from 0x00 to 0xFF.

9.18 Invalid Commands

If you send a command is not implemented in the firmware on the board then the board will respond with zeros in all three response bytes.

9.19 Special Diagnostics - 0xE0 to 0xFF (Do Not Use)

These commands are used for internal testing purposes.

*Do not use commands higher than **0xE0**. They are for testing purposes only and will very likely produce undesirable results.*

10. Appendix A - Specifications

Bus Type:	32 Bit +5V PCI *32 Bit Universal +3.3/5.0V on Low Profile PCI*
Power:	+5V - 350mA Max.
Environmental:	-25 - 70°C Operating -25 - 80°C Storage 5-95% Relative Humidity - Non Condensing
MTBF:	500,000 Hours
Relays:	24 Volts @ 0.25 Amp Max.[1] 250,000 Closures Minimum
Temperature:	Basic Accuracy = ±2.5°C Trip Point Accuracy = ±3.0°C

1. The Relays should not switch more than +24V. The creepage limits imposed by trace spacing on the board will not allow higher voltages. Switching higher voltages could result in damage to the board, damage to the PC, or risk electrical shock.

11. Appendix B - Warranty

Berkshire Products, Inc. warrants to the original consumer or other end user purchaser that this product is free from defects in materials or workmanship for a period of one (1) year from the date of purchase. During the warranty period, and upon proof of purchase, the product will be repaired or replaced (with the same or functionally equivalent model) at our option, without charge for either parts or labor.

This warranty does not apply to defects due directly or indirectly to misuse, abuse, negligence, accident, repairs or alterations made by the customer or another party.

UNDER NO CIRCUMSTANCES WILL BERKSHIRE PRODUCTS, Inc. BE LIABLE IN ANY WAY TO ANY PURCHASER FOR DAMAGES, LOST REVENUE, LOST WAGES, OR ANY OTHER INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THIS PRODUCT.

Berkshire Products, Inc. reserves the right to make modifications in this product without prior notification.

12. Appendix C - Service and Tech Support

We are available to help you with your questions and problems that you may have with our product. Our technical support is available:

Monday through Friday (except holidays)
8:30 AM to 5:00 PM (Eastern Time)
770-271-0088

Email: support@berkprod.com

12.1 Calling Tech Support

To help our tech support personnel with your problem, please try to have the following information ready:

- Type of PC
- Type of operating system and version
- Other peripheral boards in the PC
- Clear description of the problem

12.2 Product Returns

Please call our tech support personnel before returning a product. Many times the problem can be corrected over the phone. If the tech support representative determines that your product must be returned, they will assign you a **RMA #.**

Package the product in a secure container and return it to us freight prepaid. We will not accept COD freight charges! Indicate the **RMA #** on the package or shipping label.

If the repairs are done under warranty the unit will be returned FedEx ground rate and we will pay the freight charges. If you prefer faster a Federal Express service, please provide your Federal Express account number.

If your unit is out of warranty, repairs and shipping will be charged COD or other method established in advance.

13. Appendix D - Agency Approvals

The PC Watchdog meets the following agency approvals.

13.1 FCC - Class A

This equipment generates and uses radio frequency energy and if not installed and used properly, that is in strict adherence with the manufacturer's instructions, may cause interference to radio and television reception. It has been tested and found to comply with the limits for a Class A computing device in accordance with the specifications in Subpart J of Part 15 of FCC rules, which are designed to provide reasonable protection against such interference in a commercial installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient the receiving antenna.
- Relocate the computer with respect to the receiver.
- Move the computer away from the receiver.
- Plug the computer into a different outlet so that the computer and receiver are on different branch circuits.
- Consult the dealer or an experienced radio/TV technician for help.

13.2 CE

The PC Watchdog has successfully passed all appropriate tests that are necessary for its certification under EMC directive 89/336/EEC. The following tests were done:

EN 50881-1:92	Generic emission requirements
EN 55022	Radiated and conducted emissions
EN 50082-1:97	Generic immunity requirements
EN 61000-4-2	Electrostatic discharge (ESD)
EN 61000-4-3	Electronic fast transient / burst
EN 61000-4-5	Surge
EN 61000-4-6	Conducted RF
EN 61000-4-8	Magnetic field
EN 61000-4-11	Voltage dips