Kvaser PCIcan Hardware Reference Manual

Last updated Thursday, 22 April 2010

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1 Table of Contents

2 Introduction

This document describes the following standard variants of the PCIcan board:

Product Name	Part Number	Description
PCIcan-S	733-0130-00082-7	1 x SJA1000, 82c251 driver
PCIcan-D	733-0130-00083-4	2 x SJA1000, 82c251 drivers
PCIcan-Q	733-0130-00084-1	4 x SJA1000, 82c251 drivers
PCIcan-SWC1	733-0130-00088-8	1 x SJA1000, 5790 drivers (Single-Wire CAN)
PCIcan-SWC2	733-0130-00089-6	2 x SJA1000, 5790 drivers (Single-Wire CAN)
PCIcan-LS1	733-0130-00085-8	1 x SJA1000, TJA1053 drivers
PCIcan-LS2	733-0130-00086-5	2 x SJA1000, TJA1053 drivers

Please note that the product names for PCIcan-S, -D, -Q changed to PCIcan-HS, -HS/HS, -4XHS during 2004/2005. This change was necessary due the introduction of PCIcan boards with low speed and single wire CAN bus drivers. In addition, the part number was shortened to the 6 last digits due practical reasons. However, both part numbers are valid. These changes affect the product name and the part number only. The product itself is identical in all other aspects.

2.1 Not recommended for new designs

NOTE: **The PCIcan devices listed in the table above are not recommended for new designs.** Instead, we recommend our PCIcanx devices, which are fully software compatible with the PCIcan devices. The PCIcanx devices are described in another document; please refer to our web site.

2.2 General Description

KVASER's PCIcan cards for CAN systems feature up to four CAN controllers.

The outputs from the CAN circuits are connected to a 25 pin DSUB (PCIcan-Q) or one or two 9-pin DSUB (all other types) via optocouplers and CAN bus driver circuits.

The bus driver circuits of type 82C251 conforms to the physical layer specified by the ISO 11898 standard and can operate up to 1 Mbit/s.

The bus driver circuits of type 5790 conforms to the physical layer specified by the SAE 2411 standard and can operate up to 25 kbit/s in normal mode and up to 80 kbit/s in high-speed mode.

The bus driver circuits of type TJA1053 are intended for automotive body electronics buses and can operate up to 125 kbit/s.

On the PCIcan-Q it is possible to connect all CAN circuits to a common CAN bus, which also is connected to the DSUB connector. A built-in terminator may be connected to the common bus if this board is at one end of the bus cable. It is necessary to have a resistor load connected between the two bus wires to make the ISO 11898 drivers work. The 25-pin connector also provides a ground point to the two bus sections of optocouplers and drive circuits.

2.3 PCIcan Features

- Up to four CAN circuits on one card.
- Optical isolation between the card and the CAN buses.
- DC/DC power supply to galvanically isolated bus drivers.

3 Specifications

General	
Size	PCI-bus PC card (135 mm)
Power consumption	PCIcan-Q: max 600 mA @ 5V.
CAN bus connector	25-pin DSUB, female, for PCIcan-Q CAN buses. (See p. 11) 2 x 9-pin DSUB, male, for PCIcan-D CAN buses. (See p. 11) 9-pin DSUB, male, for PCIcan-S CAN bus. (See p. 11)
CAN Controller(s)	
PCIcan-Q: 4 x SJA1000 PCIcan-D, PCIcan-LS2, PCIcan-SWC2: 2 x SJA1000 PCIcan-S, PCIcan-LS1, PCIcan-SWC1: 1 x SJA1000	
CAN Clock frequency: 16 MHz	
CAN Bus Driver(s)	
Drivers	PCIcan-Q, -D, -S: Philips 82C251; compliant with the ISO 11898 standard. PCIcan-LS2, -LS1: Philips TJA1053 PCIcan-SWC2, -SWC1: Philips AU5790c
Voltage feed	The drivers are galvanically separated (selectable by switches) from the power supply on the PC by on-board DC/DC converters.
Grounding	The ground of the CAN drivers is available at the DSUB connector. On the PCIcan-Q it is also possible to connect the driver ground to the PC ground by a switch on the PCIcan board.
Other Features	
• Fast optocouplers between CAN circuits and drivers. • CAN driver part fed by the PC through DC/DC-converters (the PCIcan-SWC2, and -SWC1 requires external power supply.)	

4 Schematics

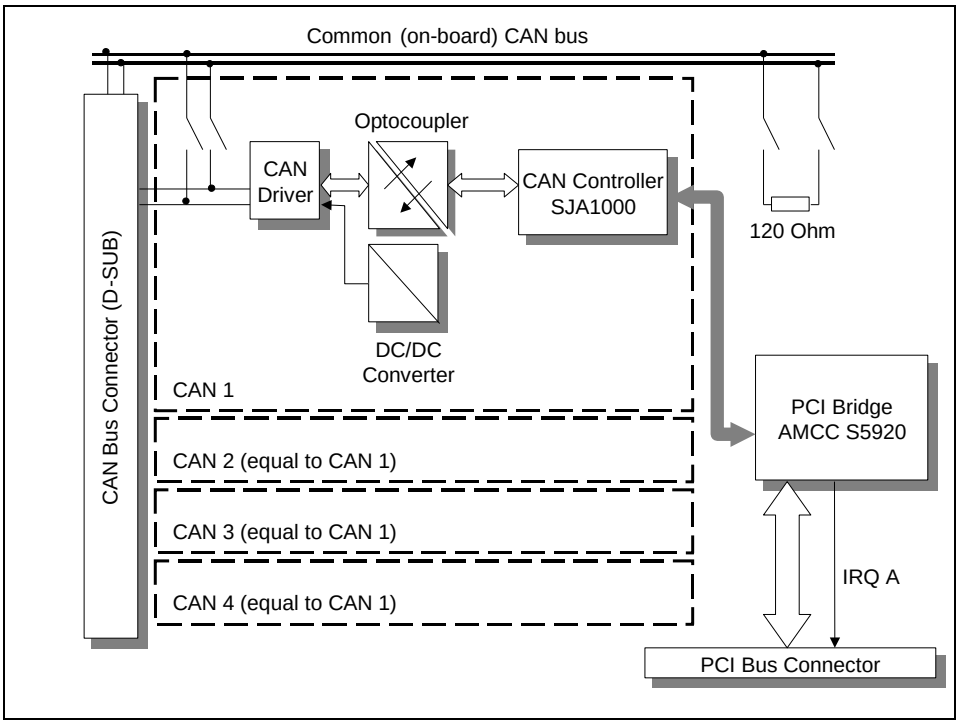

Figure 1: Block diagram for PCIcan-Q.

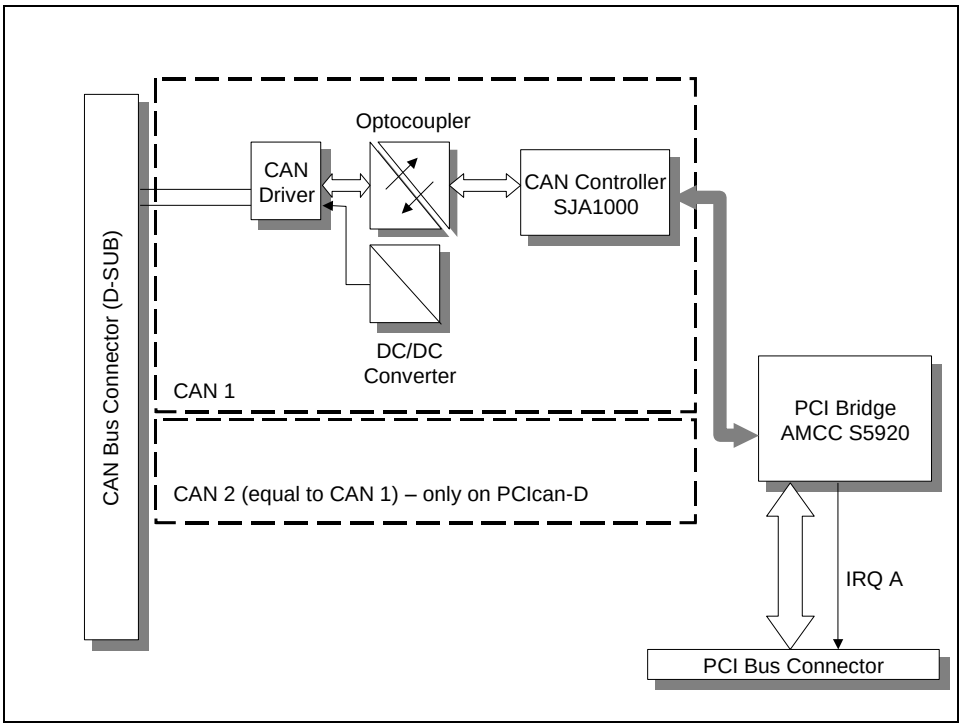

Figure 2: Block diagram for PCIcan–D, –S, –LS2, –LS1, –SWC2, and –SWC1.

5 The PCIcan Hardware

5.1 Installation

PCIcan-D, -S, -LS2, -LS1, -SWC2, and -SWC1 have no switches and so are plug-and-play.

PCIcan-Q has switches that allow you to
1) connect driver ground to PC ground (see “Selecting Driver Ground (PCIcan-Q only)” below),
2) connect any of the four CAN channels to a common CAN bus and possibly terminate the common bus (see “The Common CAN Bus (PCIcan-Q only)” below.)

After you have configured the switches, power down the computer, insert the board into an empty PCI slot, and power up the computer.

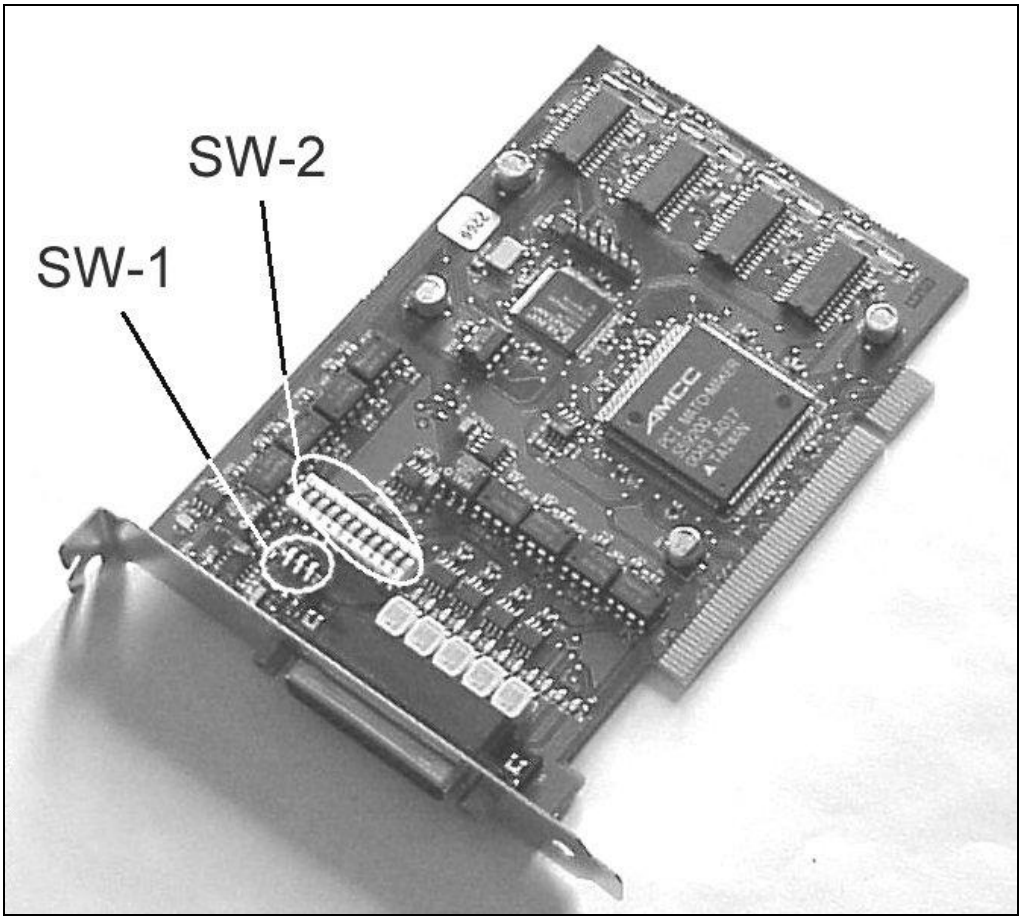

Figure 3: The switches on the PCIcan-Q board

5.2 The CAN Bus

On PCIcan-Q, -D and –S, the CAN bus drivers are 82C251 type and compliant with the ISO 11898 physical layer standard.

On PCIcan-LS2 and –LS1, the CAN bus drivers are of TJA1053 or TJA1054 type.

On PCIcan-SWC2 and –SWC1 the CAN bus drivers are of AU5790c type**. The bus driver requires an external power source.**

The CAN bus is galvanically isolated from the card by means of fast optocouplers. These optocouplers introduce a small signal delay and decreases the maximum allowed bus length somewhat.

For PCIcan-S, PCIcan-D, and PCIcan-Q, the optocouplers allow for a CAN bus speed up to 1 Mbit/s.

5.3 Selecting Driver Ground (PCIcan-Q only)

Using switch pack SW1 you can connect the grounds at the driver part to the ground of the PC. This is normally not necessary but it may sometimes be advantageous.

Switch pack SW1 is the small switch pack located near the 25-pin DSUB connector.

Table 1. Switch Pack 1.

SW3	Function
1	ON: PC ground and the ground of CAN driver #1 and #2 are connected. OFF: PC ground and the ground of CAN driver #1 and #2 are **not** connected. Default is OFF.
2	ON: PC ground and the ground of CAN driver #3 and #4 are connected. OFF: PC ground and the ground of CAN driver #3 and #4 are **not** connected. Default is OFF.
3	Not used. Default is OFF.

Factory settings are: all switches OFF, meaning that the PC, and the CAN controller circuits, are galvanically isolated from the CAN bus.

5.4 The Common CAN Bus (PCIcan-Q only)

Using switch pack SW2, you can connect the four different CAN buses to one single bus on the board. This common CAN bus is also accessible at the DSUB connector. This allows communication between two or more of the circuits on the card without having to connect any cables.

Switch pack SW2 is the large switch pack near the 25-pin DSUB connector.

Table 2. Switch Pack 2.

SW2-	When set to ON, it connects...
1	On-board terminating resistance to common CAN-L.
2	On-board terminating resistance to common CAN-H.
3	CAN-L of SJA1000 #1 to common CAN-L.
4	CAN-H of SJA1000 #1 to common CAN-H.
5	CAN-L of SJA1000 #2 to common CAN-L.
6	CAN-H of SJA1000 #2 to common CAN-H.

SW2-	When set to ON, it connects...
7	CAN-L of SJA1000 #3 to common CAN-L.
8	CAN-H of SJA1000 #3 to common CAN-H.
9	CAN-L of SJA1000 #4 to common CAN-L.
10	CAN-H of SJA1000 #4 to common CAN-H.

All switches are set to ON when the product is delivered. This means that all CAN buses and the terminator are connected to the common bus.

5.5 External power supply (PCIcan–SWC2 and –SWC1)

The PCIcan–SWC2 and –SWC1 have a type of CAN bus driver that under certain circumstances can consume a lot of power. For this reason the bus drivers in these cards are not powered from the PC. You must supply power to the bus driver from an external source.

The power shall be supplied to pin 9 on the D-SUB connector (s). For PCIcan-SWC2 you need to supply power to **both** connectors.

The voltage is nominal +12V DC (min 5.5V, max 26.5V.) Current consumption may go up to 200 mA per bus under certain circumstances.

5.6 CAN Bus Termination (PCIcan-Q)

A selectable CAN bus termination is built-in on the PCIcan-Q boards. You activate it by setting switches 1 and 2 on switch pack 1 to ON. *The termination works only on the common CAN bus.* The four individual CAN busses are not affected by the built-in termination.

To avoid signal reflections at the bus ends, terminating resistors must be mounted *at both ends* of the CAN bus. The on-board terminating resistor is 120Ω, which is the standard for CAN buses, and should work fine for most cables. Please observe that this internal resistor can only be used if the board is placed at one of the ends of the CAN-bus. The terminating resistor is only available from the on-board *common* CAN-bus.

The terminating resistors also serves as a load between the CAN bus wires; this is needed for the ISO 11898 compliant bus drivers to work properly.

5.7 CAN Bus Termination (PCIcan-D, -S)

The PCIcan-S and PCIcan-D do not have built-in termination as standard. There is room for mounting terminating resistors (R1, R3) which are located very close to the 9-pin DSUB connector(s).

5.8 CAN Bus Termination (PCIcan-LS2, -LS1, -SWC2, -SWC1)

No separate bus termination is needed for these boards.

5.9 The D-SUB connector(s)

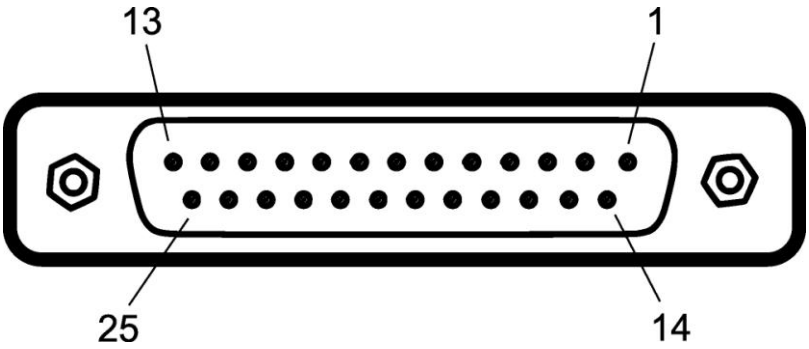

Table 3. The 25-pin DSUB connector on the PCIcan-Q.

Pin	Function
1, 2	Ground to CAN drivers #1 and #2.
14, 15	Ground to CAN drivers #3 and #4.
4	CAN-L for the common CAN bus.
16	CAN-H for the common CAN bus.
5	CAN-L for CAN #1
19	CAN-H for CAN #1
7	CAN-L for CAN #2
21	CAN-H for CAN #2
9	CAN-L for CAN #3
23	CAN-H for CAN #3
11	CAN-L for CAN #4
25	CAN-H for CAN #4

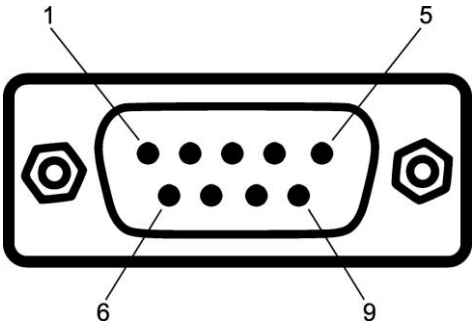

Table 4. The 9-pin DSUB connector(s) on PCIcan-S, -D, -LS2 and -LS1.

Pin	Function
2	CAN-L
7	CAN-H
3	Signal ground.

Table 5. The 9-pin DSUB connector(s) on PCIcan-SWC2 and –SWC1.

Pin	Function
7	CAN-H
3	Signal ground.
9	Vcc for the SWC driver. You need to supply +12V DC on this pin.

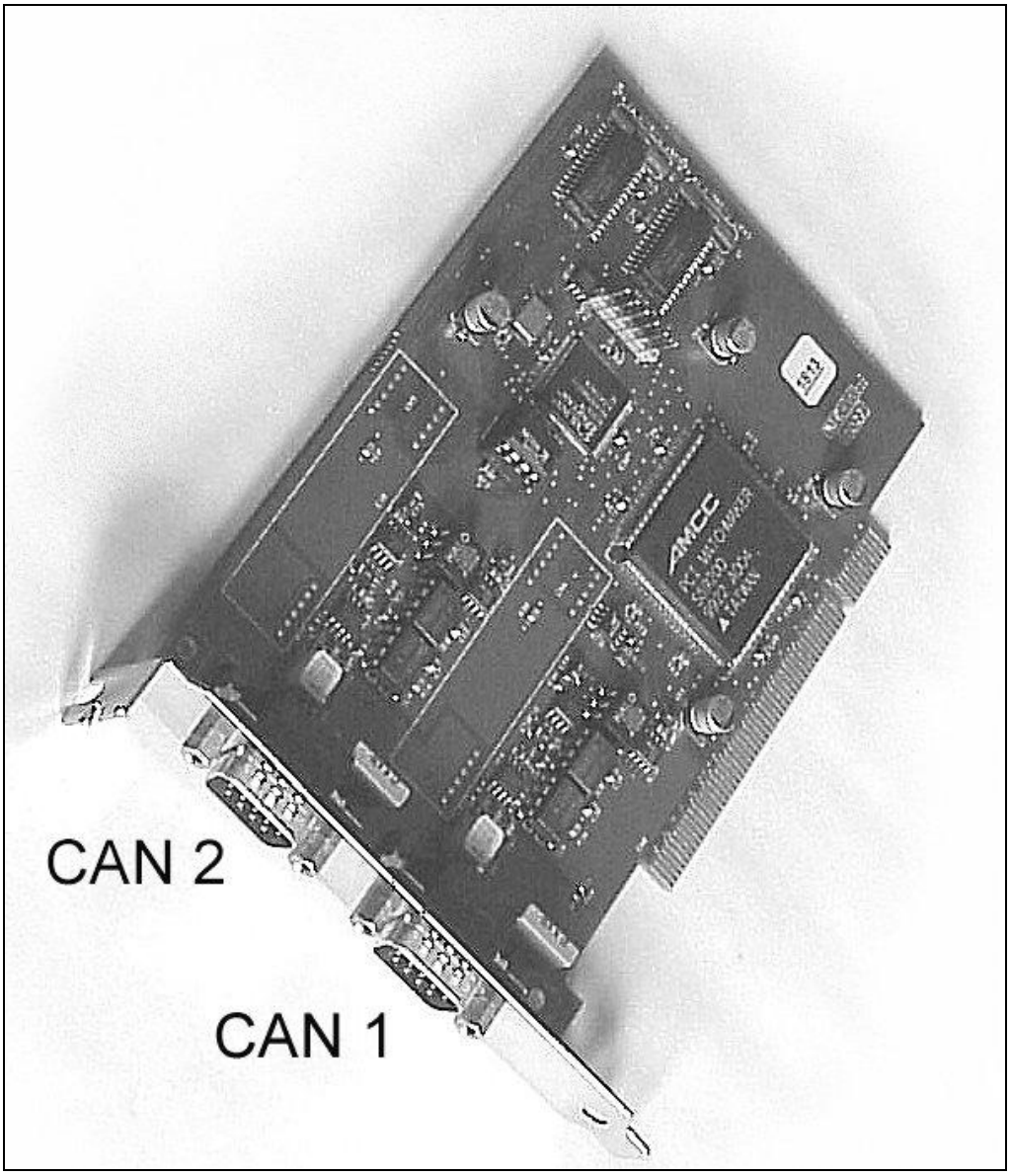

Figure 4: The CAN buses on the PCIcan-D, -LS2, and –SWC2. On the –S, LS1, and –SWC1, the "CAN2" connector is not present.Software Development Information

5.10 Intended Audience

This section is intended for those who want to program the PCIcan card directly. Normally, you would choose to use the supporting device drivers available for the PCIcan card. Refer to the "CANLIB Software Development Kit" documentation for further information on these device drivers from a programmer's point of view.

5.11 Additional Documentation

This document includes all information you need to use the circuits on the card. However, the circuits themselves are not described here so information about these must be obtained from the suppliers. See the list of references on page 18.

General knowledge about the PCI bus is also assumed.

5.12 A note on the different PCIcan versions

PCIcan-Q has four CAN controllers. PCIcan-D has two CAN controllers and PCIcan-S has just one controller. This chapter describes primarily PCIcan-Q; if you have one of the other cards, just disregard the circuits and switches that are not on your card. Differences between the different members of the PCIcan family are explicitly noted wherever they occur.

5.13 The PCI bus controller

All PCIcan boards use the same PCI controller, which is an S5920 from AMCC. The PCI controller is responsible for address decoding and interrupt steering.

The initialization of the PCI controller is outside the scope of this manual. Typically, it is carried out by the operating system and/or the BIOS. There are a few registers you have to set up in the driver; these are described below.

5.14 Address decoding

The PCI controller can decode up to 5 different address areas, three of which are used by the PCIcan.

Address area #	Type	Size (bytes)	Used for
0	I/O	128	AMCC registers. Described in the S5920 manual.
1	I/O	128	SJA1000 circuits
			0 – 0x1f: SJA1000 #1
			0x20 – 0x3F: SJA1000 #2
			0x40 – 0x5F: SJA1000 #3
			0x60 – 0x7F: SJA1000 #4
2	I/O	8	Xilinx registers

Address area number 1, the one used for the SJA1000's, is further subdivided into four areas of 32 bytes each; one for each (possible) SJA1000.

The S5920 is operated in pass-thru operation, passive mode.

To configure the address areas, the value 0x80808080 should be written into the PCI PASS-THRU CONFIGURATION REGISTER (PTCR) register. This sets all regions to use 0 wait states and to use the PTADR signal.

5.15 Interrupts

The PCIcan uses one PCI bus interrupt, INTA#. It is asserted whenever one or more SJA1000's have their interrupts active. To reset an active interrupt, read the interrupt status register in all present SJA1000s – the interrupt of the corresponding SJA1000 will then automatically clear.

To check the status of the interrupt line, test the INTERRUPT ASSERTED bit (number 23) in the INTCSR register in the S5920.

To enable or disable interrupts from the PCIcan, use the ADD-ON INTERRUPT PIN ENABLE (bit 13) in the INTCSR register in the S5920.

5.16 Registers in the Xilinx

The Xilinx FPGA implements a few registers.

Address offset	Register	Usage
0 – 6		Reserved, do not use
7	VERINT	Bit 7 - 4 contains the revision number of the FPGA configuration. 15 is the first revision, 14 is the next, and so on.

The current FPGA revision number is 14 (which is read from the VERINT register as 1110xxxx). Future revisions (13, 12, 11, …) will remain compatible with revision 14.

5.17 PCI Configuration Data

The following data are configured automatically into the S5920 PCI controller when power is applied to the card.

Item	Value
Vendor Id	0x10e8
Device Id	0x8406 (for all PCIcan boards)
Revision Id	0
Class Code	0xffff00 (means: no base class code defined for device)
Subsystem Vendor Id	0
Subsystem Device Id	0

5.18 Configuration of the SJA1000

Refer to the SJA1000 data sheet for all details on how to program the SJA1000. You need to know the following:

- RX1 is connected to ground.
- TX1 is not connected.
- CLKO is not connected.
- Setting the OCR register to 0xDA is a good idea. This means “normal output mode”, push-pull and the correct polarity.
- In the CDR register, you should set CBP to 1. You will probably also want to set the clock divider value to 0 (meaning divide-by-2), the Pelican bit, and the clock-off bit (you have no need for CLKOUT anyway.)

6 Support

The PCIcan boards are supported by driver routines and program examples for Windows 95/98/ME and Windows NT/2000/XP.

The software is distributed separately and is not further documented here. Please refer to the documentation that is packaged with the software. The software and its documentation are available from our web site, http://www.kvaser.com. In addition, online support is available from our web site, http://www.kvaser.com.

7 References

7.1.1.1 AMCC	PCI Products Data Book S5920 / S5933 (1998) Also available on the web (www.amcc.com) in the file **pciprod.pdf.**
Philips	SJA1000 Stand-Alone CAN Controller. Preliminary Specification. 1997 Nov 04. Also available on the web.
Shanley, T., and Anderson, D.	*PCI system architecture*, fourth edition. MindShare, Inc. ISBN 0-201-30974-2. Available from e.g. Annabooks, www.annabooks.com.

http://www.kvaser.com contains much information on CAN and has many links to other sites with CAN information. You can also download new versions of the software for PCIcan here.

8 Legal Information

8.1 RoHS Directive

This line of products will never comply with the RoHS (Restriction of Hazardous Substances) directive when it becomes effective 1 of July 2006. However, the complete line of Kvaser PCIcanx boards will achieve full conformance to the RoHS directive when it becomes effective 1 of July 2006. Kvaser PCIcan and Kvaser PCIcanx is fully software compatible with each other.

8.2 Copyright

We believe that the information contained herein was accurate in all respects at the time of printing. Kvaser AB cannot, however, assume any responsibility for errors or omissions in this text. Please also note that the information in this document is subject to change without notice and should not be construed as a commitment on the part of Kvaser AB.

8.3 CE Marking Directive

This line of products has been CE marked. We will be pleased to inform you on which standards this equipment has been tested for compliance.

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

8.4 Trademarks and patents

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9 Document revision history

Revision	Date	Changes
1	2006-02	Original revision
2	2006-11-10	Reviewed – New layout, new dsub connector pics.
3	2008-12-01	Updated legal information. Added paragraph stating that the PCIcan devices are no longer recommended for new designs; use the PCIcanx instead.