

HiRes IV Plus
user manual

September 2006

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Revision 1.2.1 dated 13/09/2006

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CONTENTS

introduction	3
personal computer minimum requirements	4
personal computer recommended requirements	4
scheme of the installation procedure	5
connecting the FDL interface card to the PC	6
library & fdl-pci installation	
windows xp	7
software installation procedure	10
linux	11
windriver registration	13
connecting the HiRes controller to the PC	16
connecting the HiRes head to the HiRes controller	16
description of the HiRes platform front panel	17
detail of front panel connectors	
9-pin connector	19
15-pin AD connector	19
SCSI connector	20
44-pin parallel connector	21
26-pin user port connector	22
HiRes IV Plus controller liquid filling	23
optical window cleaning	24
specifications	25
index	27

INTRODUCTION

HiRes is a cooled digital cameras series born to detect extremely faint light emissions.

There are two versions: the standard **HiRes IV** and the upgraded model **HiRes IV Plus**, both of them made of two main components: the head (with CCD, Double stage Peltier cooling system, electronics) and the controller, that includes the power supply.

This series displays KODAK and E2V Technologies sensors, either marked by high definition (small pixels: $\leq 16 \mu\text{m}$) or high sensitivity (bigger pixels: $\geq 20 \mu\text{m}$). They belong to the front-illuminated kind, with thin indium electrodes able to raise the Quantum Efficiency in the case of shorter wavelengths, or to the back-illuminated type to make the most of the latest CCD technology.

Among the main application fields: Biology, Astronomy, Spectroscopy, RAMAN Spectroscopy, Semiconductor Physics, Plasma Physics and X-Ray Physics. A line completely devoted to Spectroscopy is available.

HiRes IV also includes the former Hurricane specs.

HiRes IV (standard)

For the standard HiRes IV cameras we have appealed to sophisticated sampling and amplification techniques as well as to a 16-bit A/D Converter, to be fully exploited in their dynamics. Furthermore, the Double Stage Peltier cooling system allows to perform $T = -50 \text{ }^\circ\text{C}$. All cameras have been equipped with integrated peripherals, such as parallel ports and timers, allowing one to carry out a complete automation of one's experiment.



HiRes IV Plus

The HiRes IV Plus is the upgraded model of HiRes IV. It is equipped of three integrated peripherals, able to run an MCP, a LASER or other external devices. Moreover, it performs a better readout speed of HiRes IV, up to 1 Mpixel/second, and higher T below ambient temperature, due to two different system cooling:

- 1) Double Stage Peltier with an air exchanger, performing $T = -60 \text{ }^\circ\text{C}$;
- 2) Double Stage Peltier with a liquid exchanger (a glycol solution), performing $T = -80 \text{ }^\circ\text{C}$.



The liquid exchanger is directly connected to the freezer box, placed within the controller. The sensor cell is vacuum tight and contains a gas (Nitrogen), so that the customer doesn't need to keep a steady maintenance. The camera system consists of the HEAD, containing the CCD sensor, and the CONTROLLER, containing the power supply and the freezer box.

PERSONAL COMPUTER MINIMUM REQUIREMENTS

- CPU Pentium III 1 GHz .
- 256 Mb of RAM.
- Microsoft Windows 98, ME, 2000, XP or LINUX (we tested the SuSE LINUX 9.0 version)
- PCI bus compliant 2.1.

PERSONAL COMPUTER RECOMMENDED REQUIREMENTS

- CPU Pentium IV 2 GHz or higher.
- 512 Mb RAM.
- Colour monitor 19".

Note:

camera models mounting big dimension sensors (as KAF-16801E/LE with 4096X4096 pixels) require a very good performance computer, with a good BUS-PCI.
Moreover, each of the image acquired has a dimension of 32 Mb, involving a big memory request.

For these reasons, we suggest customers to use a computer having the following specs:

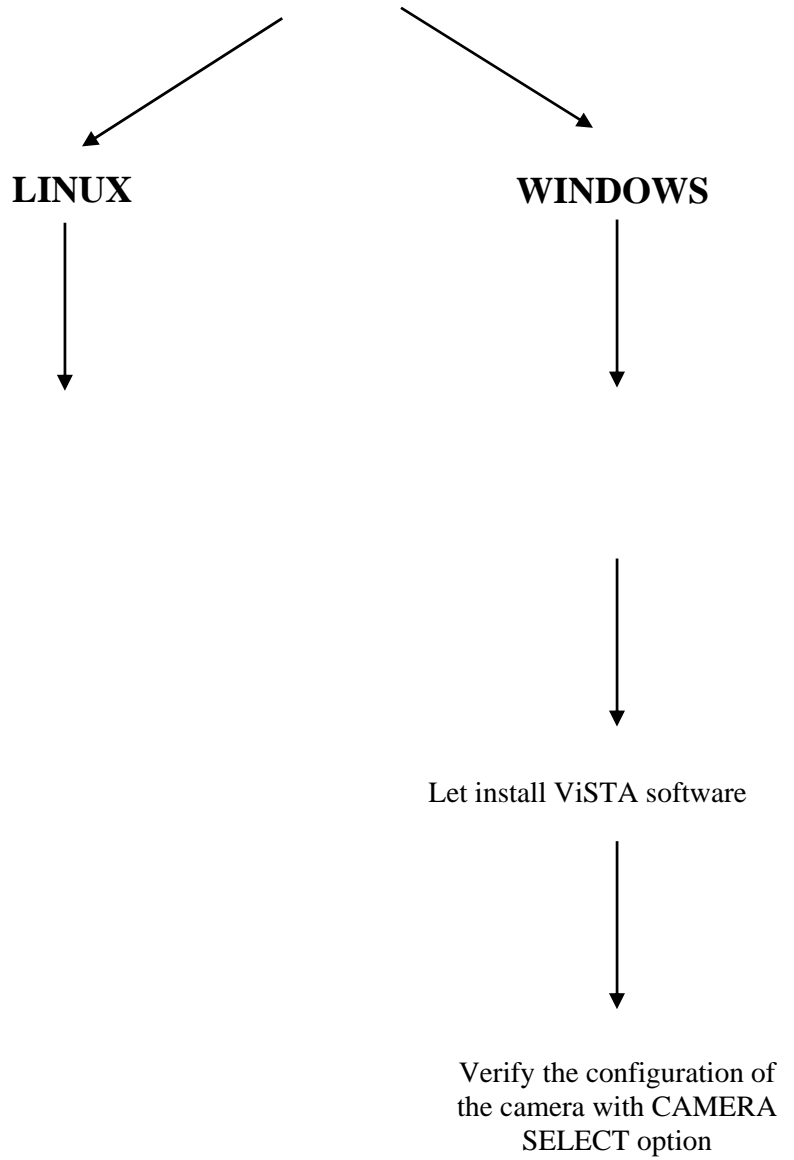
- 1) DUAL CORE of 3GHz
- 2) 1 Gb RAM
- 3) XP Professional Operative System
or better.

The combination of the specs suggested above allows customer to reach the higher performances of the CCD camera.

SCHEME OF THE INSTALLATION PROCEDURE

When you use the camera for the first time, you must install the library and the FDL-PCI interface. For this purpose, please follow the procedure described in the next pages and schematized in the diagram below:

Turn off the PC
Insert the FDL-PCI card interface in
the proper slot
Turn on the PC



CONNECTING THE FDL INTERFACE CARD TO THE PC

To install your FDL interface card, do as follow :

⇒ Turn your PC off, including any peripheral.

⇒ Remove the external case of the PC (please see the relevant instructions in the PC Handbook).

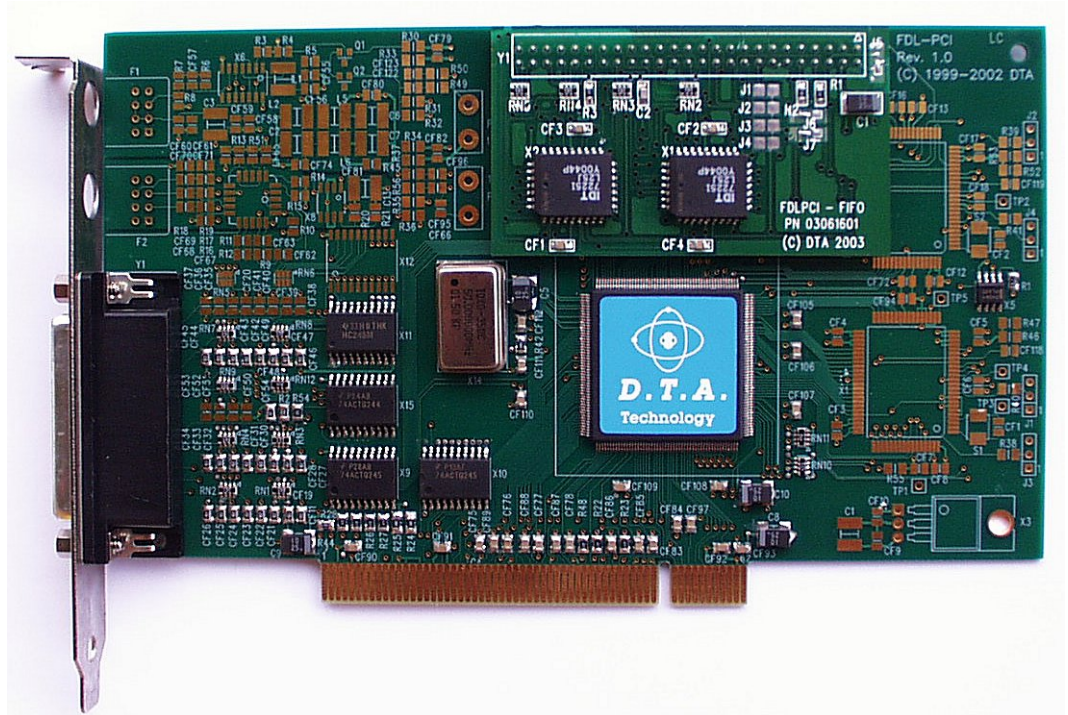
⇒ Choose a free PCI expansion slot. Remove the relevant back cover by means of a screwdriver.

⇒ Insert the camera interface card into the expansion slot. Please make sure that the card is properly and fast inserted. Fix the card by screwing the relevant screw again.

⇒ Reassemble the PC case.

Turn the PC on once again. The interface card installation has been completed.

In case of a fiber optic link connection, a dedicated FDL-PCI is provided with the proper connectors.



LIBRARY & FDL-PCI INSTALLATION

The installation of the library is always linked to the installation of the camera, of course. For this purpose you just need to install the PCI interface as well.

Let's analyse the sequence of operations to be carried out. It will be shown the example with WINDOWS XP Operating System. The operations are similar for the other Operating Systems.

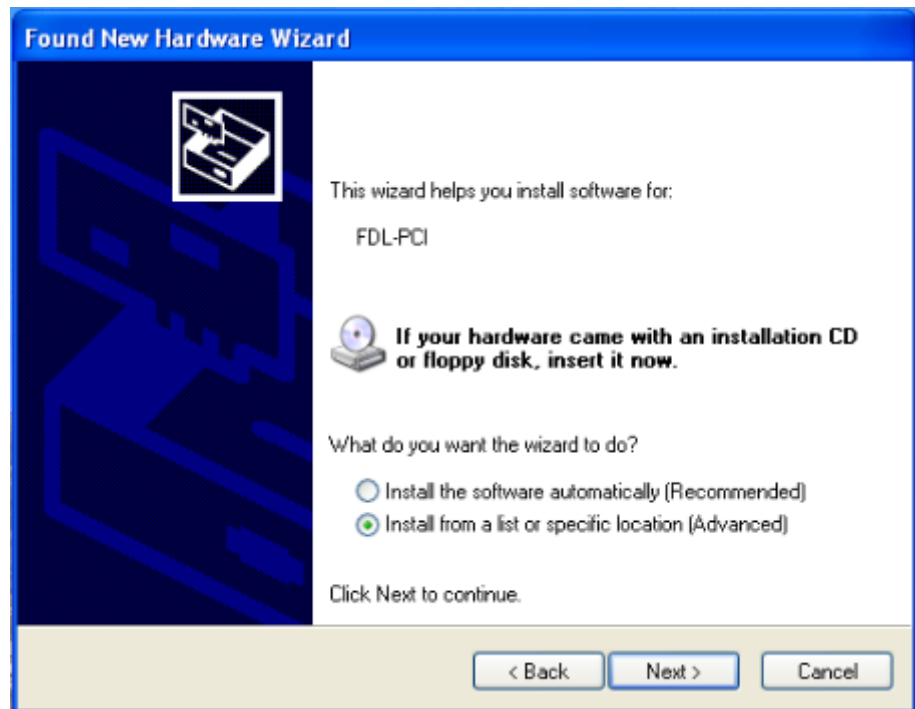
Once you turn the system on for the first time with the FDL-PCI interface on, you will be asked to specify where the available drivers are. Follow the steps on the basis of your Operative System.

WINDOWS XP

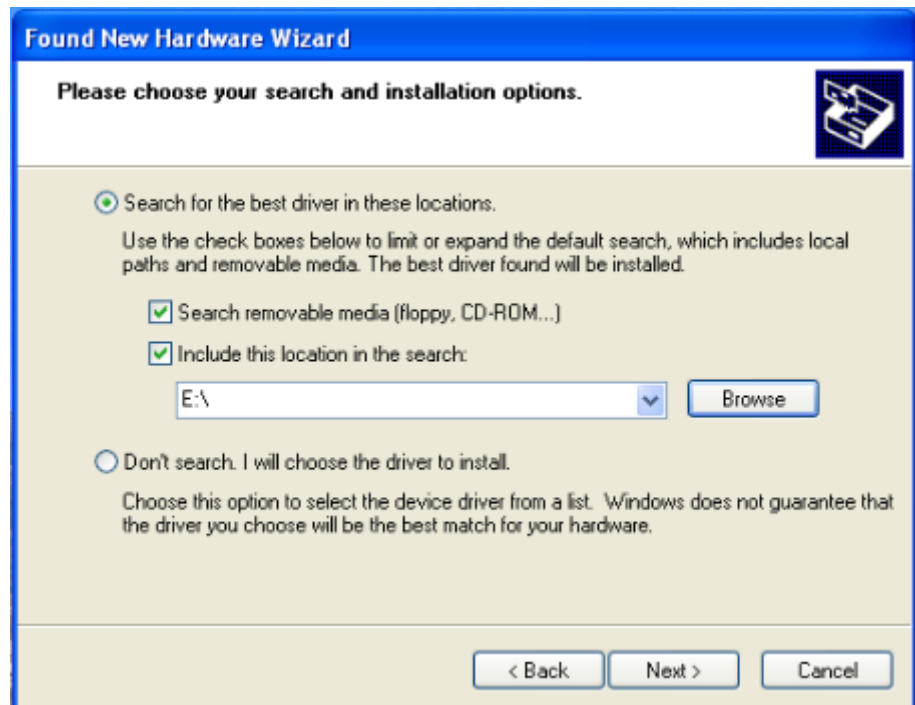
Insert the FDL-PCI card into the slot of the motherboard and turn the PC on. As soon as the system gets started, a window (like the one shown below) will appear, noticing you a new hardware was found. You'll be requested to connect for Windows update, let select: "No, not at this time".



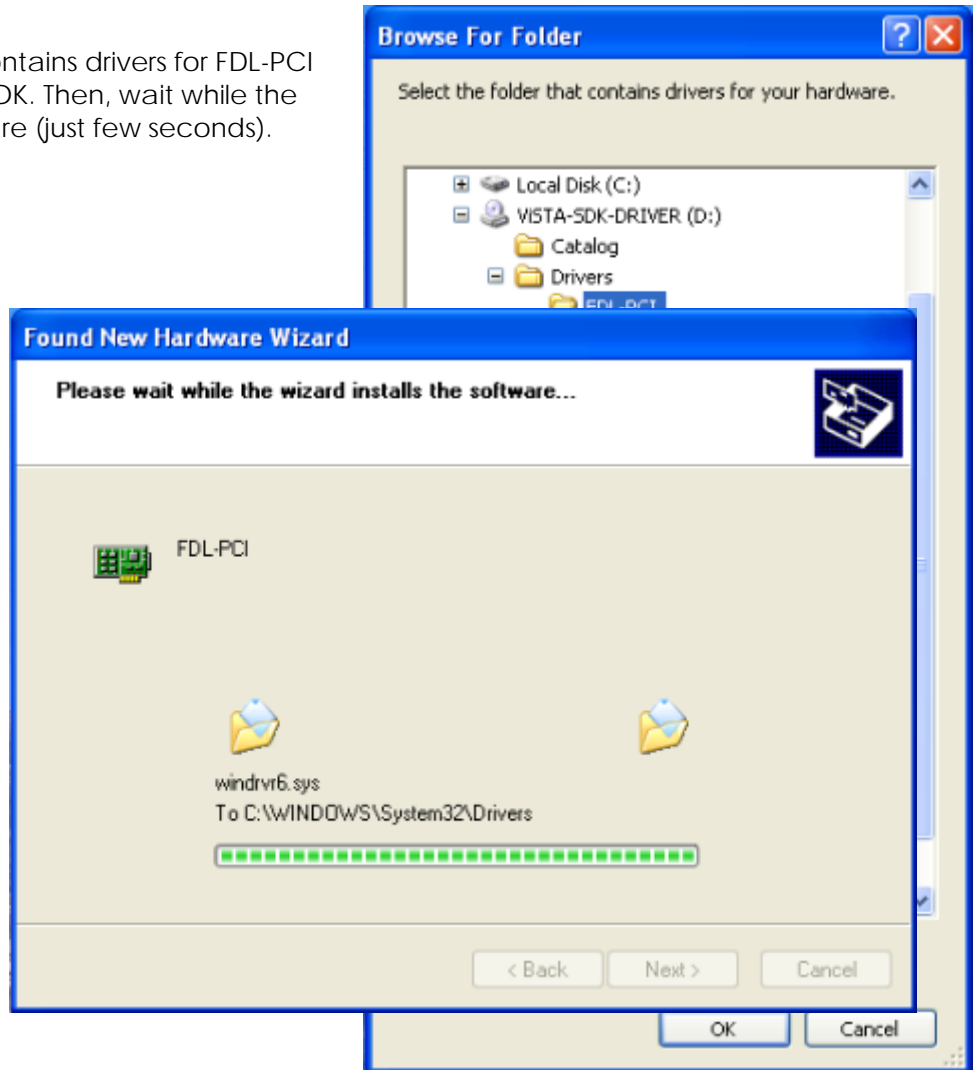
Insert the "VISTA" CD into the CD-ROM reader, close the "Quick Install" (it may open due to the CD autorun). Select the option "Install from a list or specific location (Advanced)" (recommended choice). Then click on "Next" to continue the installation.



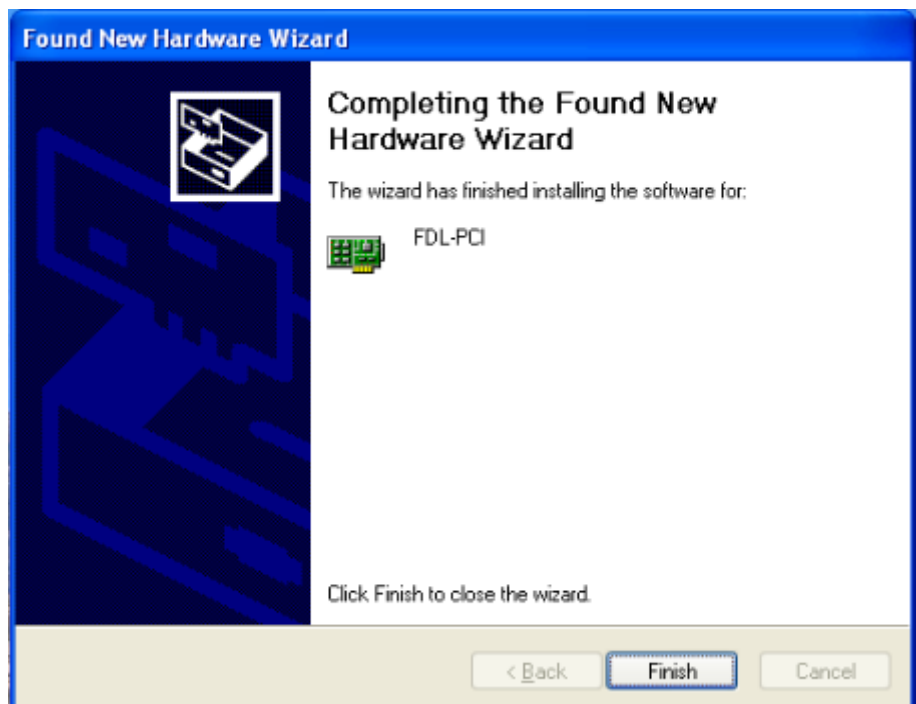
Check the function selected in the window (recommended choice) below (in this case, E:\ indicates the CD-ROM drive) and click on next to continue. The PC will start to search for the most suitable driver to the peripheral.



Select the folder that contains drivers for FDL-PCI hardware and click on OK. Then, wait while the wizard installs the software (just few seconds).



When the installation has been completed, a window like the one below will appear. Click on finish to close the wizard and restart the PC (recommended choice).



SOFTWARE INSTALLATION PROCEDURE:

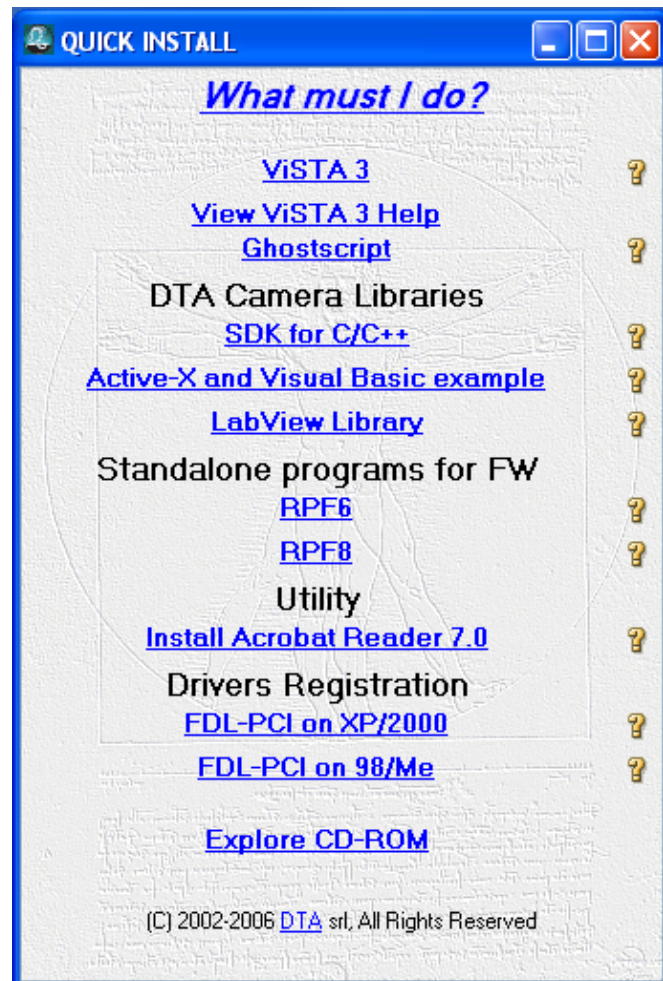
When you use the camera for the first time, you must install the ViSTA software.

Insert the ViSTA 3 CD-ROM, provided with the camera, into the CD-ROM reader, wait a few seconds so as to allow the PC to load the "QUICK INSTALL" menu.

Let click on ViSTA 3 and QUICK INSTALL will start and take you through the process of installing the software.

The default settings will install the full software package and all options.

You may be asked to reboot the PC if certain files in use by Windows needs to be updated.



System Requirements

- Linux 2.0.31 or higher (can be embedded Linux or Linux 2.4x)
- An x86 processor.
- Any 32-bit development environment supporting C (such as GCC).

Preparing the system for installation

In Linux, kernel modules must be compiled with the same header files that the kernel itself was compiled with. Since WinDriver installs the kernel module **windr6.o**, it must compile with the header files of the Linux kernel during the installation process.

Therefore, before you install WinDriver for Linux, verify that the Linux source code and the file **versions.h** are installed on your machine:

Install linux kernel source code

- If you have yet to install Linux, please choose **Custom** installation when performing the installation and then choose to install the source code.
- If Linux is already installed on the machine, you must check to see if the Linux source code was installed. You can do this by looking for linux in the **/usr/src** directory. If the source code is not installed, you can either reinstall Linux with the source code, as described above, or you can install the source code by following these steps:

1. Login as super user.
2. Type:

```
/$ rpm -i /<source location>/ <Linux distributor>/RPMS/kernel-source-<version number>
```

 (For example: to install the source code from the Linux installation CD-ROM, for RedHat 7.1, type:

```
/$ rpm -i /mnt/cdrom/RedHat/RPMS/kernel-source-2.4.2.-2.i386rpm)
```

TIP!

If you do not have an RPM with the source code, you may download it from:
<http://rpmfind.net/linux/RPM/>.

Install version.h

- The file **version.h** is created when you first compile the Linux kernel source code. Some distributions provide a compiled kernel without the file **version.h**. Look under **/usr/src/linux/include/linux/** to see if you have this file. If you do not, please follow these steps:
 1. Type:

```
/$ make xconfig
```
 2. Save the configuration by choosing **Save and Exit**.
 3. Type:

```
/$ make dep.
```

Before proceeding with the installation, you must also make sure that you have a linux symbolic link. If you do not, please create one by typing:

```
/usr/src$ ln -s <target kernel>/ linux
```

(For example: for Linux 2.4 kernel type:

```
/usr/src$ ln -s linux-2.4/ linux)
```

Installation

1. Insert the **DTA SDK CD** into your Linux machine CD drive or copy the downloaded file to your preferred directory.
2. Change directory to your preferred installation directory (your home directory, for example):
/\$ **cd ~**
3. Extract the file **WDxxxLN.tgz** (where xxx is the version number):
~\$ **tar xvzf /<file location>/WDxxxLN.tgz**
For example:
 - o From a CD:
~\$ **tar xvzf /mnt/cdrom/LINUX/WDxxxLN.tgz**
 - o From a downloaded file:
~\$ **tar xvzf /home/username/WDxxxLN.tgz**
4. Change directory to WinDriver (this directory gets created by tar):
~\$ **cd WinDriver/**

NOTE:

From version 5.x and above this directory gets created by tar, but in versions preceding 5.x the WinDriver directory does not get created by the extraction. Therefore, when working with versions preceding 5.x (version 4.33, for example) first create a directory (e.g., WinDriver) before proceeding with the installation.

(/\$ **mkdir ~/WinDriver**)

5. Install WinDriver:
 - a. ~/WinDriver\$ **make**
 - b. Become super user:
~/WinDriver\$ **su**
 - c. Install the driver:
~/WinDriver# **make install**
6. Create a symbolic link so that you can easily launch the DriverWizard GUI
~/WinDriver\$ **ln -s ~/WinDriver/wizard/wdwizard/ usr/bin/wdwizard**
7. Change the read and execute permissions on the file **wdwizard** so that ordinary users can access this program.
8. Change the user and group ids and give read/write permissions to the device file **/dev/windrvr6** depending on how you wish to allow users to access hardware through the device.
9. You can now start using WinDriver to access your hardware and generate your driver code!

Restricting Hardware Access on Linux

CAUTION:

Since **/dev/windrvr6** gives direct hardware access to user programs, it may compromise kernel stability on multi-user Linux systems. Please restrict access to the DriverWizard and the device file **/dev/windrvr6** to trusted users.

For security reasons the WinDriver installation script does not automatically perform the steps of changing the permissions on **/dev/windrvr6** and the DriverWizard executable (**wdwizard**).

After the installation of the drivers for the FDL-PCI card, we need to record the files to make them work properly. Insert the "VISTA 3" CD into the CD-ROM reader, wait a few seconds so as to allow the PC to load the "QUICK INSTALL" menu.

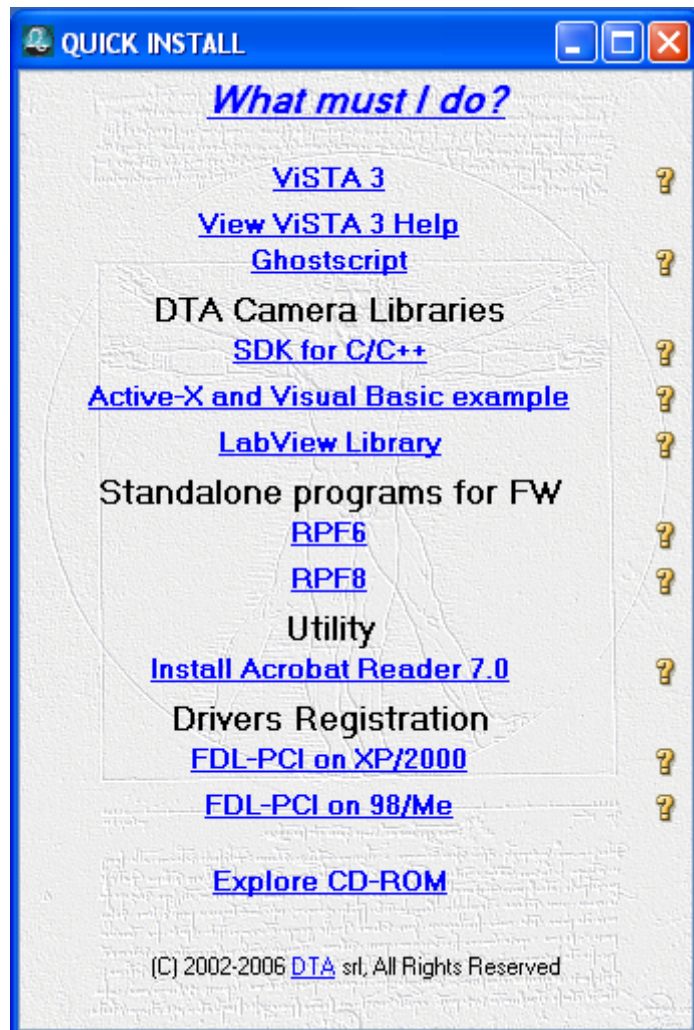
Once the PC has loaded the "QUICK INSTALL" menu, follow the steps below:

- Register the drivers according to your Operating System, clicking on the proper **Drivers Registration** field:

FDL-PCI on XP/2000 (for WINDOWS XP/2000)

FDL-PCI on 98/Me (for WINDOWS 98/Me)

- Install VISTA 3 just clicking on the proper field

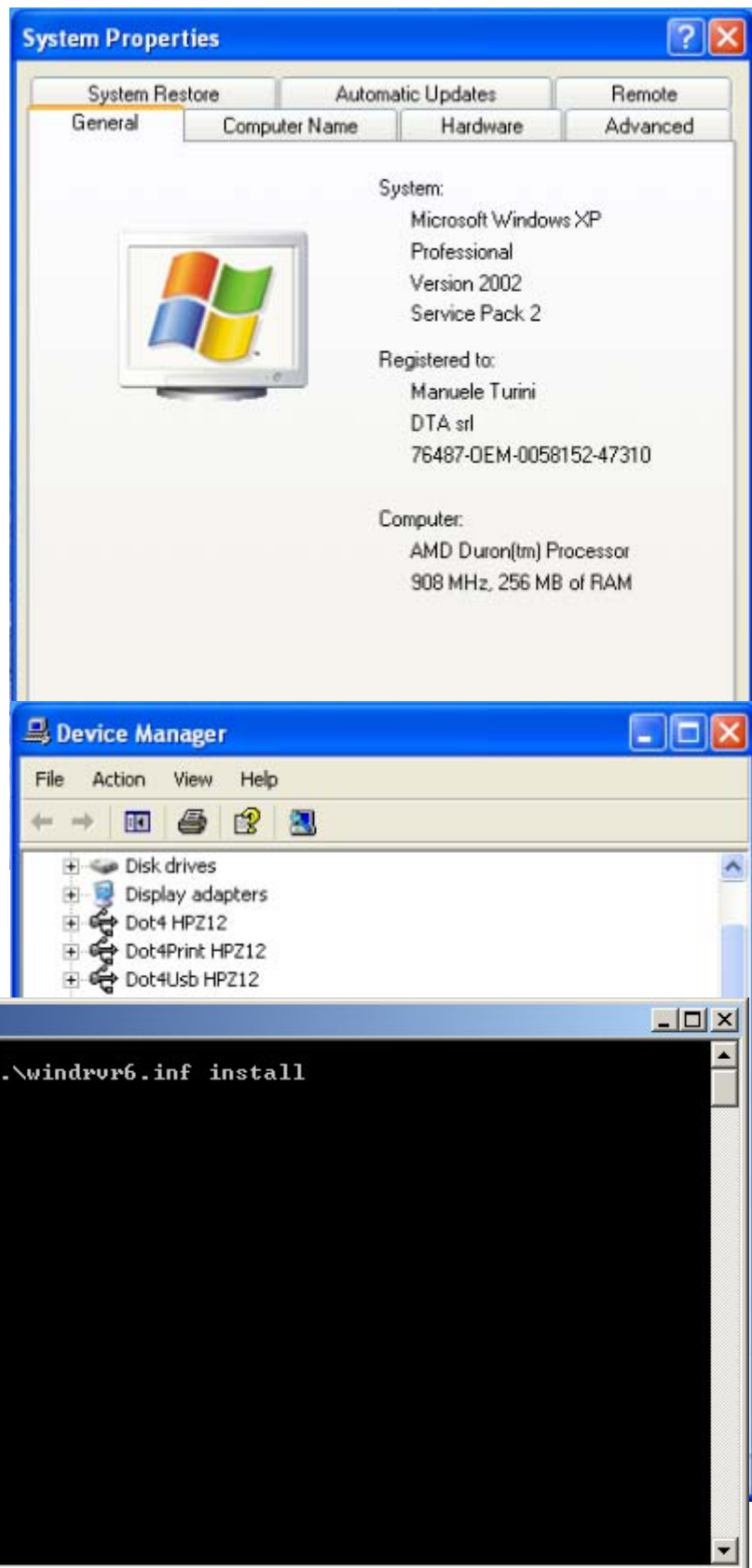


Once you have installed the drivers and the "ViSTA 3" software, restart the PC.

When you restart the PC, it is suggested to check the correct installation of the peripheral, that is if the installation of the necessary drivers for the FDL-PCI card and WINDRIVER has been carried out good.

According to the different Operating Systems, you have to click on "System Properties" by means of the right key of the mouse. The images below refer to the case you use Windows XP as OS.

A menu with different options will open; click on "Hardware" by means of the left key of the mouse and on "Device Manager". Then check if the FDL-PCI peripheral has been installed correctly (see the images sideways).



The tests have been carried out with the following OS's:

WINDOWS 98 SECOND EDITION

WINDOWS 2000 WITHOUT SERVICE PACK

WINDOWS 2000 WITH SERVICE PACK 3/4/5

WINDOWS ME

WINDOWS XP WITHOUT SERVICE PACK

WINDOWS XP WITH SERVICE PACK 1/2

CONNECTING THE HiRes CONTROLLER TO THE PC

The connection procedure is common both for the standard HR IV and the HR IV Plus cameras.

To install your hardware platform on the PC interface, follow the following steps:

Before making any connection, **make sure that the PC and every peripheral are switched OFF and the HR IV is not powered!**

⇒ Connect the parallel cable (supplied with a standard length of 2,5 mt) to the "parallel" port on the HR IV front panel and to the interface card **FDL-PCI** previously mounted on PC.

⇒ In case you have purchased the model with FOL connectors for the serial connection on optic fiber, insert an end of an optic fiber cable into the TX connector of the HR IV and the other one into the RX connector of the FDL-PCI, then insert an end of an optic fiber cable into the RX connector of the HR IV and the other one into the TX connector of the FDL-PCI.

NOTE: the two vitric optic fiber cables, mod. 62/125, are optional and a length up to 4 Km is available upon request.

Warning: once the platform has been installed, make sure there are at least 2 cm of clear space behind the cooling fan (showed by the red arrow in the figure on the right), so that this can efficiently work.



CONNECTING THE HIRES HEAD TO THE HIRES CONTROLLER

Before making any connection, make sure that the **HR IV is not powered!**

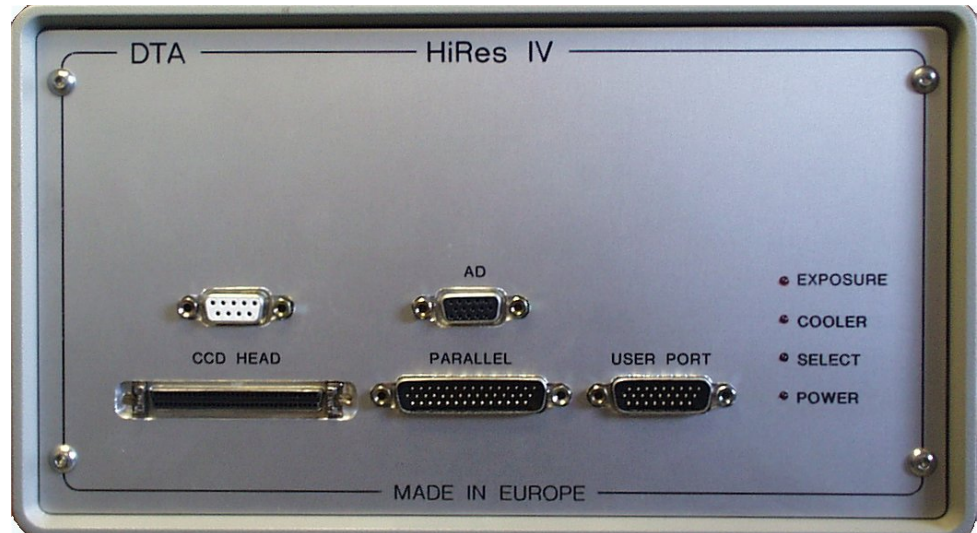
⇒ Connect an end of the SCSI cable (supplied with the CCD camera) to the relevant connector on the HRIV front panel, then connect the other end to the SCSI connector of the CCD camera.

NOTE: the 64-pin connectors are only SCSI type, **the communication protocol being used is not SCSI!**

⇒ Connect an end of the 9-pole cable (supplied with the CCD camera) to the relevant connector above the SCSI port of the HR IV front panel, then connect the other end to the relevant connector on the CCD camera.

DESCRIPTION OF THE HIRES PLATFORM FRONT PANEL

On the HR IV and HR IV Plus platform front panel are the connectors for its connection to the CCD Camera and the PC. Also, there are 4 red LED's that allow you to read the device status at any moment.



HR IV Front Panel



HR IVPlus Front Panel

NOTE:

On the HR IV Plus platform front panel there are even the cooling system input/output gumples (IN/OUT) and the fiber optic link connectors (TO-PARALLEL, TX, RX), described in a proper manual

Here below the description of the connectors common to the HR IV and HR IV Plus platform front panel. Starting from the top part on the left, you can see the following connectors:

- 9-pin connector for the control of the Peltier, the shutter and the cooling fans of the CCD Camera.
- AD: high density 15-pin connector for the connection and the communication with the auxiliary devices such as *filter wheel, image intensifier, focuser*, and so on, manufactured by **DTA**.
- SCSI type connector for the power supply and the data transfer from the CCD Camera to the platform.
- PARALLEL: high density 44-pin connector for the parallel communication at 32 bits (Hurricane) or 16 bits (HiRes) with the PC.
- USER PORT: 26-pin connector which is a programmable bidirectional parallel communication port.

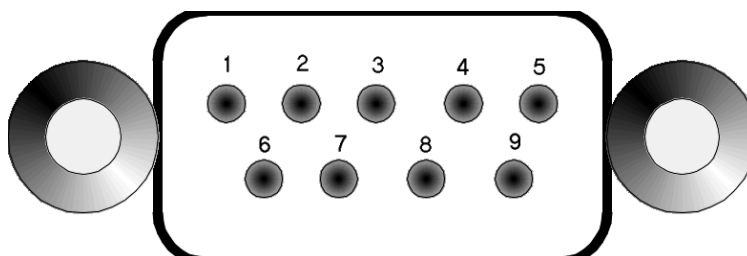
In the top part on the right, there are 4 red LED's whose function is to indicate the platform status. Starting from the LED on the left, they are:

- POWER: if ON, this LED indicates the presence of the power supply voltage.
- SELECT: if ON, indicates that the HR IV is active.
- COOLER: if ON, indicates that the cooling system has been enabled.
- EXPOSURE: if ON, this LED indicates that the CCD camera imaging is in progress.

DETAIL OF THE FRONT PANEL CONNECTORS

In the following paragraph, we will list the signals on the connectors' pins of the HR IV platform front panel.

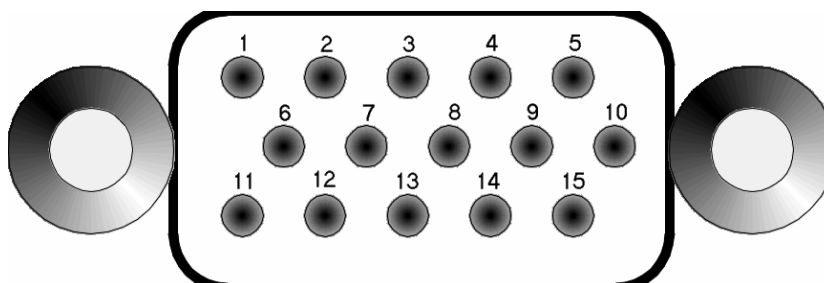
9-PIN CONNECTOR



1	S1 (+)	2	S2 (-)	3	-	4	P1(-)	5	P2(+)
6	F1(-)	7	F2(+)	8	-	9	-	-	-

- **1-S2:** Shutter control. **CAUTION 65 Volts !**
- **P1-P2:** Peltier cell control, 3.15A Max.
- **F1-F2:** Cooling fan control, 12V 500Ma Max.

15-PIN AD CONNECTOR

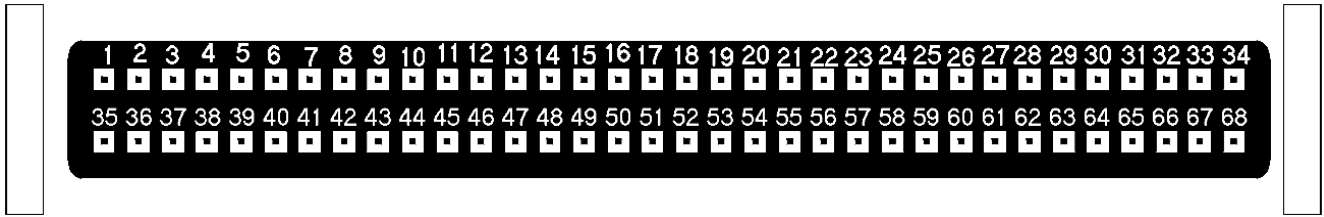


1	BD7	2	BD6	3	BD5	4	BD4	5	BD3
6	BD2	7	BD1	8	BD0	9	IN 0	10	OUT 0
11	OUT 1	12	OUT 2	13	OUT 3	14	VDC(+12V)	15	OUT 5

- **BD7-BD0:** bidirectional port reserved for the manufacturer's own use.
- **IN0:** input from the aux device necessary for the handshake.
- **OUT3-OUT0:** handshake outputs towards the aux device.

NOTE: the pins from 2 to 13 are TTL compatible.

SCSI CONNECTOR



1	CK-GND	2	CK-GND	3	CK-GND	4	CK-GND
5	CLAMP	6	SIGNAL	7	STC	8	AD-RES
9	AD-CLK	10	CCD-CLK	11	CCD-CLK	12	CCD-CLK
13	CCD-CLK	14	GAIN-CCD	15	CCD-CLK	16	CCD-CLK
17	CCD-CLK	18	CCD-CLK	19	CCD-CLK	20	CCD-CLK
21	CCD-CLK	22	CCD-CLK	23	CCD-CLK	24	L/H
25	SIN0	26	SIN1	27	D0	28	D1
29	GND	30	GND	31	GND	32	GND
33	GND	34	GND	35	D15 *	36	D14 *
37	D13 *	38	D12 *	39	D2	D	D3
41	D4	42	D5	43	D6	44	D7
45	S0	46	S1	47	VDD	48	VDD
49	VDD	50	VDD	51	VDD	52	VSS
53	VSS	54	VSS	55	VSS	56	VSS
57	HIV	58	HIV	59	HIV	60	HIV
61	HIV	62	D8 #	63	D9 #	64	D10 #
65	D11 #	66	GND	67	GND	68	GND

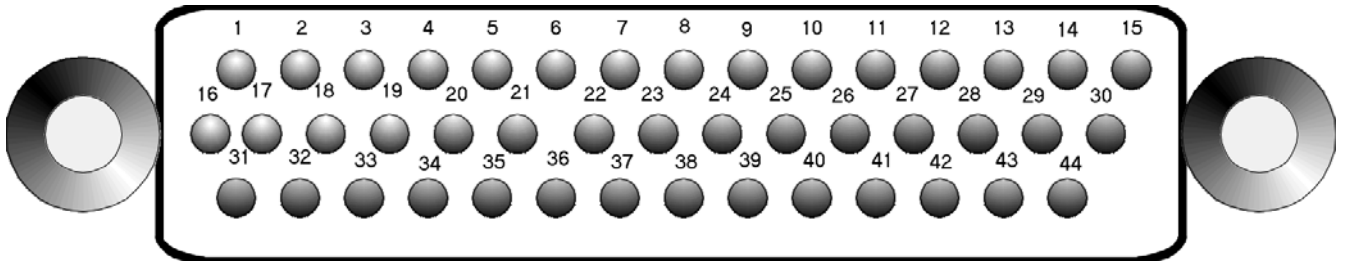
- **CK-GND**: clock ground (digital).
- **CLAMP – SIGNAL**: CDS signals.
- **STC**: signals that instruct the AD the start of the conversion.
- **AD-RES**: AD reset.
- **AD-CLK**: AD clock signal.
- **CCD-CLK**: CCD general clocks.
- **L/H**: instructs the reading of the low (less significant 8 bits) or high part (most significant 8 bits) of the 16 bit parallel bus.
- **SIN0 – SIN1**: selects the input to the AD.
- **D0 – D15**: parallel data.
- **GND**: analog ground.
- **S0**: serial clock.
- **S1**: serial data.
- **VDD**: +15V (*according to the CCD sensor, this value can be modified*).
- **VSS**: -15V (*according to the CCD sensor, this value can be modified*).
- **HIV**: +27V (*according to the CCD sensor, this value can be modified*).

NOTE

The parallel data bus is at 16 bits if the camera being mounted is a Hurricane. If the camera connected to the HR IV platform is a HiRes, the parallel data bus is at 8 bits, therefore in this case the **D_i** pins marked with the * are connected to the digital ground, while those marked with the # are connected to the analog ground.

NOTE: the 5-28, 35-46 and 62-65 pins are TTL compatible.

44-PIN PARALLEL CONNECTOR



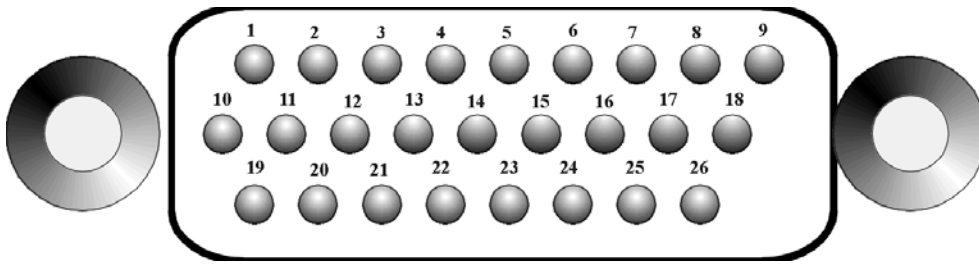
1	D0	2	D3	3	D6	4	D9	5	D12
6	D15	7	ACK	8	R/W	9	GND	10	GND
11	D18	12	D21	13	D24	14	D27	15	D30
16	D1	17	D4	18	D7	19	D10	20	D13
21	VCC	22	REQ	23	STB	24	GND	25	D16
26	D19	27	D22	28	D25	29	D28	30	D31
31	D2	32	D5	33	D8	34	D11	35	D14
36	VCC	37	A/D	38	GND	39	GND	40	D17
41	D20	42	D23	43	D26	44	D29	-	-

- **D0 – D31**: data, if the camera being controlled by the HR IV is a Hurricane, all the 32 given bits are significant, otherwise in case of a HiRes only the less significant 16 bits are significant.
- **REQ**: by means of this pin, the platform starts the transfer request to the PC.
- **ACK**: response signal to the REQ signal from the PC.
- **A/D**: by means of this pin, it is indicated the presence of addresses or data on the bus.
- **R/W**: indicates whether the operation to execute is a reading or a writing.
- **STB**: STROBE signal.
- **GND**: ground.
- **VCC**: +5V.

NOTE: all signals are TTL compatible.

By means of this port, it is possible to carry out a parallel connection between the CCD Camera and the PC.

26-PIN USER PORT CONNECTOR



1	GND	2	SYNO	3	STC
4	TACK	5	BD2	6	BD5
7	RL00	8	RL11	9	RL30
10	GND	11	SYN1	12	EXTSHUT
13	BD0	14	BD3	15	BD6
16	RL01	17	RL20	18	RL31
19	SHUTTER	20	SYN2	21	TRG
22	BD1	23	BD4	24	BD7
25	RL10	26	RL21	-	-

- **BD0 – BD7:** bidirectional parallel port.
- **SHUTTER:** shutter TTL output, for the control of a second external shutter.
- **SYNO – SYN2:** synchronism signals for external use.
- **STC:** signal that instructs the AD the start of the conversion.
- **EXTSHUT:** by means of this signal, the user can directly control the shutter (by keeping it at 1 the shutter stays open, otherwise it is closed).
- **TRG:** bidirectional pin for the trigger signals transmission from and to the camera.
- **TACK:** input from the camera that indicates that this has seen an input trigger signal.
- **GND:** ground.
- **RL00 – RL31:** by means of these pins, it is possible to control some external relays. 24 VDC, 1A Max.

NOTE: the 2-6, 11-15 and 20-24 pins are TTL compatible.

HiRes IV PLUS CONTROLLER LIQUID FILLING:

We provide the cooling system already filled with the cooling liquid, both for the head and the controller.

There are two silicone tubes connecting the head and the controller of the HiRes camera, for the *in* and *out* liquid circulation. Each tube consists of two parts: a short part coming out from the head, closed by a plug and a long part coming out from the controller, closed by a tap.

First employment:

With the camera system turned off, remove the plug of one head tube and quickly insert it on the relative controller tap.

Repeat the operation for the other couple of tubes.

Open the two taps.

Open the expansion tank placed on the right external side of the controller, and press the START button, taken pressed it until the flow of the circulating liquid maintain itself.

Let gurgle the water on the task for some minutes, in order to eliminate some possible air bubbles in the tubes and add some liquid if necessary.

Close the expansion tank.

Now, the pump remain working, because of the constant internal pressure on the silicon tube and the system is ready to be used.

The expansion tank is fixed external with two screws (M3 type), but it can be freely moved, if necessary. To avoid inconveniences (such as liquid leakage), let move the expansion tank only before filling it.

Next applications:

Push the START button to start up the pump. The START button is connected with a manostat blocking the liquid flow in case of pressure leak.

Cooling liquid composition:

The cooling liquid for the HiRes IV Plus cooling is composed by:

- 100 % distilled water.

ATTENTION:

Do not use silicone liquid.

OPTICAL WINDOW CLEANING

Both the optical window and the CCD cleaning are carried out in the clean room by means of a 30-magnifying power microscope. This procedure removes any dust which can otherwise bring about unmistakable marks on the image you have taken. In particular such spots increase as the focal ratio gets wider. In other words an image may not show any mark at f/5.6 but it can be clearly noted at f/32 because of an obvious geometrical problem of projection. Due to the shutter or elapsed time, the external surface of the optical window may gather dirty particles that may be easily removed.

To perform such task we use a compressed air cylinder specifically designed for optical cleaning.

*Be careful !!! There are similar products that, instead of using compressed air, use a liquefiable gas : at ambient pressure it quickly gassifies, thus "triggering" an air-compressed-effect. You do **not** absolutely have to use these products : they may give rise to heavy marks or rings on the windows itself.*



A product we can recommend is DUST-OFF provided by EDMUND-OPTICS. Thanks to DUST-OFF (or any other similar product) it is very easy to get rid of any microparticles : keep the shutter open for a few seconds (by the camera control program) and spray some air blast. We kindly advise you against using cloths, optical paper and cleaning liquids because the dirt will be only mixed up or, even worse, increased. The risk is to finally damage the coating of the optical window itself !

SPECIFICATIONS

SHUTTER:

Electromechanical . Exposure time: from 0.01 s to 9999 s

A/D CONVERTER:

16 bit for HR IV
Selectable: 12, 14, 16 bit for HR IV Plus

SETTABLE GAINS:

2 for HR IV
64 for HR IV Plus

READ OUT SPEED:

up to 100 kpixel/s for HR IV
≥ 1 Mpixe/s for C3P

INTERFACE:

FDL-PCI 8, 16, 32 bit.

COOLING:

- HR IV
- Double stage PELTIER (-50°C below ambient)
- HR IV Plus
- Double stage Peltier + air stage (-60°C below ambient)
 - Double stage Peltier + liquid stage (-80°C below ambient)

CCD TEMPERATURE CONTROL:

± 0.1 °C

OPTICAL WINDOW:

Fused Silica

FILTER WHEEL:

External

BACKFOCUS:

17.5 mm

MAX TOTAL NOISE:

10 e⁻

MOUNT:

According to different sensors

BINNING:

From 1 x 1 to 8 x 8 or arbitrary

POWER SUPPLY:

230V 50Hz.

MAX ABSORPTION:

250 W for HR IV
700 W for HR IV Plus (cooling system included)

WEIGHT:**HEAD**

1.7 kg both of cameras

CONTROLLER

8 kg for HR IV

17.5 kg for HR IV Plus

DIMENSIONS:**HEAD**

130x130x160 mm³ for HR IV

130x130x103 mm³ for HR IV Plus

CONTROLLER

250x150x308 mm³ for HR IV

483x187x345 mm³ for HR IV Plus

INDEX

	9
9-pin connector	19
	15
15-pin connector	19
	26
26-pin user port connector	22
	44
44-pin parallel connector	21
c	
connecting the fdl interface card to the pc	6
connecting the HiRes controller to the pc	16
connecting the HiRes head to the HiRes controller	16
d	
description of the HiRes platform front panel	17
detail of front panel connectors	19
h	
HiRes IV plus controller liquid filling	23
i	
introduction	3
l	
library & fdl-pci installation	7
linux	11
o	
optical window cleaning	24
p	
personal computer minimum requirements	4
personal computer recommended requirements	4
s	
scheme of the installation procedure	5
scsi connector	20
software installation procedure	10
specifications	25
w	
windows xp	7
windriver registration	13

