Manual 1.0

LIH 1600

Acquisition Interface

HEKA

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1. Description of the Hardware

The `Lih 1600` is a high resolution, low-noise scientific data acquisition system. It utilizes the newest fiber optic and digital signal processing technologies, in addition to many of the exceptional features of its predecessor the `ITC-16`. The `Lih 1600` provides expandability and versatility that will satisfy both current and future needs.

The `Lih 1600` system comprises of a PCI computer interface card and one or two analog rack units connected by the fiber optic data cables. The fiber optics provide superb optical isolation, virtually eliminating ground loops, while increasing the distance between the computer and the recording set-up to at least five meters. Fiber optic cables are small, flexible, and, unlike conventional electrical cables do not emit Electro-magnetic radiation.

The `Lih 1600` rack unit has eight analog inputs, four analog outputs, sixteen digital inputs and sixteen digital output channels all sampling synchronously. In addition, two 12-bit asynchronous "telegraphing" ADC channels are available for monitoring slow changing parameters.

The eight analog input channels are separated into two banks of four. Each bank is multiplexed into one 16-bit 200 kHz A/D converter. Both A/D converters sample simultaneously and synchronously at the maximum conversion rate resulting in a total throughput of 400 kHz. This unique arrangement allows pairs of channels to be digitized without phase-shift. If the bandwidth of the experiment calls for lower sampling rates, the DSP (digital signal processor) decimates and/or filters the data. An added benefit of filtering is the reduction of noise.

The PCI Bus mastering host interface card supports one or two `Lih 1600` rack units. If two rack units are used, then all input and output channels are doubled and fully synchronized. For systems requiring even more channels, multiple PCI and `Lih 1600` units are used. Multiple PCI cards installed in the same or in separate computers can be synchronized.

2. Technical Specifications

2.1 Analog Inputs

- Eight 16-bit analog inputs
- Two A/D converters, each multiplexed into 4 inputs
- 400 kHz aggregate, 200 kHz per ADC
- Input type: differential, optically isolated
- Input Range: -10.24 to + 10.23 V
- Differential non-linearity: 0.002% of FSR
- Drift: ±2 ppm/C
- Input impedance: 1 MOhm
- Signal to noise ratio: 86 dB at DC to 160 kHz, <1 mV PP

2.2 "Telegraphing" Inputs

- Two 12-bit telegraphing inputs
- 5 kHz aggregate
- ±10 V input range

2.3 Digital Inputs

- Sixteen optically isolated inputs

- 3.3 and 5 V logic compatible
- Minimum pulse width: 150 ns

2.4 Trigger Inputs

- Four optically isolated inputs
- 3.3. and 5 V logic compatible
- BNC on front panel

2.5 Analog Outputs

- Four 16-bit analog outputs
- Four individual DA converters
- Output type: pseudo differential, optically isolated
- Settling time: <4 s
- Output Range: -10.24 to +10.23 V
- Gain error: 0.2 % of FSR
- Gain linearity: <2 dB Drift: ±4 ppm/C
- Output Impedance: 10 Ohm
- Signal to noise ratio: 116 dB

2.6 Digital Outputs

- Sixteen optically isolated outputs
- Rear panel connector

- Sink output current: 6.4 mA (front panel), 3.2 mA (rear panel)
- 4 BNC connector on front panel
- 3.3 V and TTL compatible

2.7 Connectors

- Connector for EPC 8 or TIB 14
- 2 pairs of fiber optic transmitters/receivers
- Auxiliary digital output for optional expansion panel and for synchronization of multiple PCI interfaces

2.8 Dimensions

- 475 x 44 x 250 mm
- Weight: 3.6 kg

2.9 Cable

- 1 pair of 5 meter fiber optic cable for each LIH 1600

2.10 Warranty

- One year parts and labor

3. Installation

3.1 Connecting the Lih 1600

When you receive the LIH 1600, please check the packing list to verify that you have all required parts, especially:

1. The LIH 1600 itself
2. The PCI-1600 computer interface card:
3. Two fiber optics cables which will connect the LIH 1600 to the computer interface card.

First, shut down the computer, open it, and insert the computer interface card (PCI-1600) in a free, matching slot. If there is more than one free slot, place the card away from other cards radiating heat. Close the computer.

Insert the fiber optics cable into the connectors on the card you just inserted. Connect the other end of the cables into the connector labelled "To PCI-1600" at the rear of the LIH 1600.

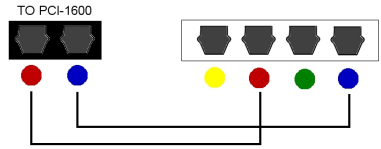


Figure 3.1: Connectors for optical cables

The LIH 1600 offers the convenience that two interfaces can be connected to and controlled by a single PCI board in the computer. All input and output channels of the two interfaces are fully synchronized. Consequently, one can connect two LIH 1600 interfaces to one PCI interface card. The new PATCHMASTER software automatically detects both interfaces.

Color coding for connecting the LIH 1600 to the LIH-1600 computer interface board:

Primary interface:	LIH 1600	PCI-1600
	Red	Red
	Blue	Blue
Secondary interface:	LIH 1600	PCI-1600
	Red	Yellow
	Blue	Green

Now connect the power cord to the LIH 1600 and connect it to the power line.

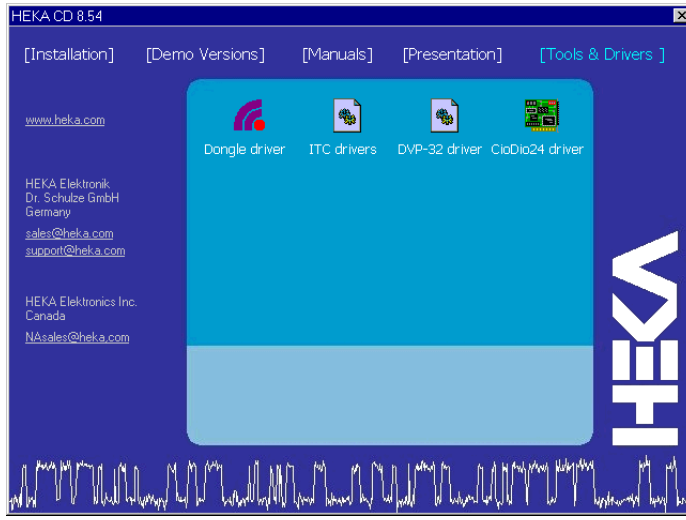
The LIH 1600 is now wired up, and you can proceed to the software installation as described in the following section.

3.2 Software Installation

3.2.1 Windows NT 4.0, Windows 2000, and Windows XP

In case of a Windows 2000 or Windows XP computer, the plug-and-play system will automatically detect the PCI-1600 board and ask for an appropriate driver. Insert the HEKA CD into the CD-ROM drive of your computer and go to the folder "Install\ITC_Drivers". Load the file `InstruTECH.inf` and then follow the instructions of the software. Finally, you should get the message, that the driver was successfully installed.

On Windows NT computers, the new hardware is not detected automatically. Please insert the HEKA CD and wait until the HEKA Installation program comes up. Switch to the `[Tools & Drivers]` section and then click on the `ITC Drivers` icon. Follow the instructions of the software.



If the HEKA installation program should not start automatically, run the driver installation software (setup.exe) in the folder "Install\ITC_Drivers" from the HEKA CD.

To be able to use our software (PATCHMASTER, PULSE, TIDA) a software protection key (Dongle) is required. Please insert the Rainbow protection key (labelled "SENTINEL SuperPro") in the parallel printer port of your computer ("LPT1" or "LPT2"). If you have a local printer connected to your computer attach the key between the parallel port and the printer cable. To install the protection key driver use the `Dongle Driver` icon in the `Tools & Drivers` section of the HEKA installation program or open the folder "Install → Rainbow" and proceed run `setup.exe`.

> ***Important note:*** *Windows does not allow you to install a driver, if you do not have administrative rights. Make sure to login as "Administrator" before performing any driver installation!*

Now, you can install and run the acquisition software (PATCHMASTER, PULSE, or TIDA).

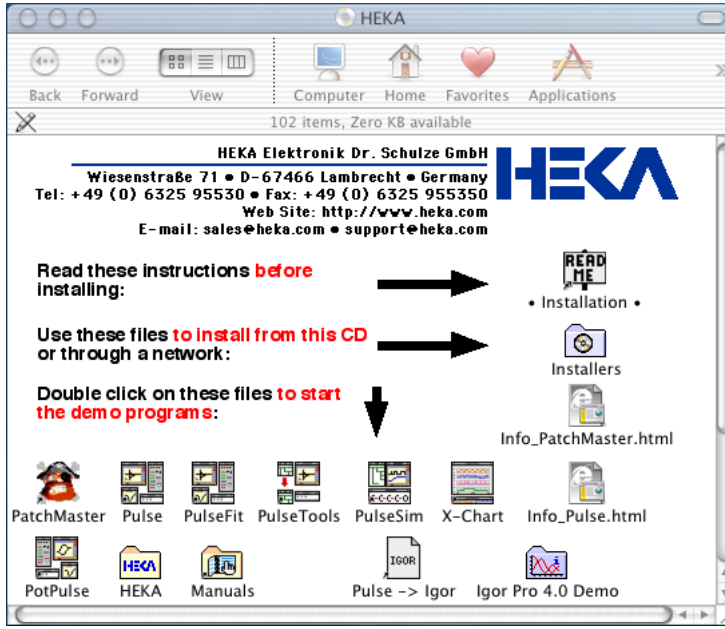
3.2.2 Windows 98

In case of a Windows 98 computer, the plug-and-play system will automatically detect the PCI-1600 board and ask for an appropriate driver. Insert the HEKA CD into the CD-ROM drive of your computer and go to the folder "Install\ITC_Drivers". Load the file "`InstruTECH.inf`" and then follow the instructions of the software. Finally, you should get the message, that the driver was successfully installed.

3.2.3 MacOS 9.x

Please open the "Installers" folder from the HEKA installation screen and run the PATCHMASTER or PULSE installer. The driver for the hardware protection key ("dongle") is automatically installed with the software. PATCHMASTER users should make sure, that the `Carbon.lib` on the computer is v1.6 or higher (information on the installed `Carbon.lib` can be found in the APPLE SYSTEM PROFILER). We tested the program using CarbonLib version 1.6, dated 16-Dec-2002. That file can be freely downloaded from Apple's web site.

3.2.4 Mac OS X



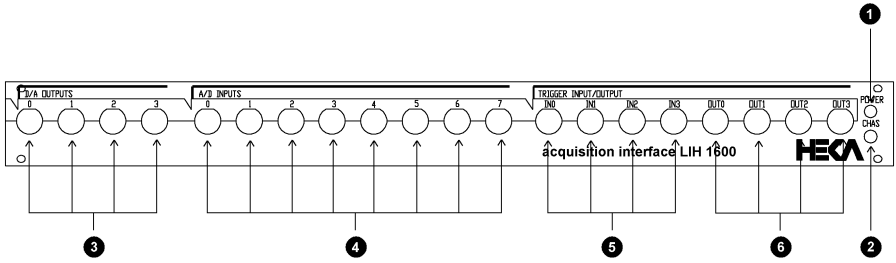
On the MacOS X operating systems, drivers for the hardware protection key ("dongle") and for the LIH 1600 need to be installed. The installer for the LIH 1600 interface can be found in the `Driver Installers/Drivers_MacOSX/Installer for ITC drivers` folder. Please double-click on the installer icon to run the program.

The dongle driver is installed by copying the "Eve3.framwork" (in the `Rainbow drivers` folder) into the `/Library/Frameworks` folder on your computer.

Finally copy the "HEKA" folder and its content to your hard disk and re-boot your computer.

4. Controls and Functions

4.1 Front panel controls



1. **Power Indicator:** The power indicator will be illuminated when the LIH 1600 is switched on and connected to the power line.

2. **Chassis Ground Connector:** A 4 mm banana receptacle provides connection to the chassis ground of the LIH 16000 interface.

3. **DAC Ouputs:** Four BNC connectors provide access to the four individual 16-bit digital to analog converter outputs. The acquisition software controls the digital to analog converter voltages and timings. The DAC channels have an output range of ±10.24 volts. These channels are optically isolated from the computer.

4. **ADC Inputs:** Eight BNC connectors provide access to the 16-bit analog to digital converter input channels. The eight analog input channels are separated into two banks of four. Each bank is multiplexed into one 16-bit 200 kHz A/D converter. The acquisition software controls analog to digital converter channel selection and sampling interval timing. The ADC channels have an input range of

10.24 volts. These channels are optically isolated from the computer. Make sure that the cables that are used to connect to these channels have a very good shield, and that it is continuous to both ends of the cable. The shield of the BNC connector must have a reference connected to it. If the BNC connector shield is left unconnected un-expected results can occur.

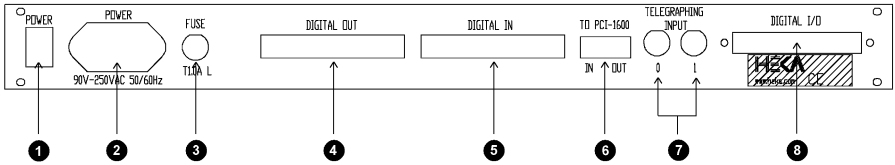
> ***Important note:*** *Do not under any circumstances exceed the maximum input allowed voltage of 15 volts peak.*

5. **Trigger Inputs:** Four BNC connectors provide access to the four fast trigger input channels. These digital input channels accept standard TTL levels (5 volts and 0 volts).

   Please note: At the moment, the acquisition software supports only the first trigger input (IN-0).

6. **Trigger Outputs:** Four BNC connectors provide access to four out of the sixteen digital output channels. The acquisition software controls the state of the digital output channels. These digital channels output standard TTL levels (5 volts and 0 volts). These channels are optically isolated from the computer.

4.2 Rear panel controls



1. **Power Switch:** If the power is switched on, the green LED at the front panel should be illuminated.

2. **Power Connector:** Accepts standard three wire IEC female type power cords. The appropriate power cord has been provided with the LIH 1600. The LIH 1600 will function with a line voltage of 100 volts AC to 120 volts AC or 200 volts AC to 240 volts AC.

3. **Fuse:** Replace fuse with 20 mm type F2A fuse only

4. **Digital Out Connector:** The LIH 1600 interface provides sixteen digital output lines. Four out of the sixteen output channels are brought out on the front panel (Out-0 to Out-3). All of the digital channels are available on this connector. The state of the digital lines can be set from the acquisition software.

5. **Digital In Connector:** The LIH 1600 interface provides sixteen digital input lines. All of the digital channels are available on this connector. The state of the digital lines can be read from the acquisition software.

6. **Computer Connector:** Connection to the PCI host interface card. The fiber optics provide superb optical isolation, virtually eliminating ground loops, while increasing the distance between the computer and the recording set-up to at least five meters. Fiber optic cables are small, flexible, and, unlike conventional electrical cables do not emit electro-magnetic radiation.

7. **Telegraphing Input:** Two 12-bit asynchronous "telegraphing" ADC channels can be used for monitoring slow changing parameters. If a so called "telegraphing" amplifier is connected to the LIH 1600, these inputs can be used to determine the encoded amplifier gain and filter bandwidth settings.

8. **Digital I/O Connector:** In this connector the digital output lines of the `Digital Out` connector and the digital input lines of the `Digital In` connector are brought together. This connector can be used to control other HEKA devices, such as the EPC 8 patch clamp amplifier or the TIB 14 trigger interface.

5. Appendix I: Technical Data

5.1 Digital I/O Connector

The digital IN and OUT lines of this connector carry TTL-compatible signals. The connector is intended to connect other HEKA devices, such as EPC 8 or TIB 14 to the EPC 10 amplifier. For other purposes the Digital In connector and the Digital Out connector should be used.

PIN 1 of the 40-pin connector is labelled with a small arrow:

Pin number	EPC 10	Pin number	EPC 10
1	IN-0	2	OUT-14
3	Not connected	4	OUT-15
5	IN-2	6	IN-10
7	IN-3	8	IN-11
9	IN-4	10	IN-12
11	IN-5	12	IN-13
13	IN-6	14	IN-14
15	IN-7	16	IN-9
17	IN-1	18	Not connected
19	GND	20	GND
21	GND	22	GND
23	Not connected	24	STROBE
25	OUT-0	26	OUT-8
27	OUT-1	28	OUT-9
29	OUT-2	30	OUT-10
31	OUT-3	32	OUT-11
33	OUT-4	34	OUT-12
35	OUT-5	36	OUT-13
37	OUT-6	38	IN-8
39	OUT-7	40	Not connected

Figure 5.1: Digital I/O connector

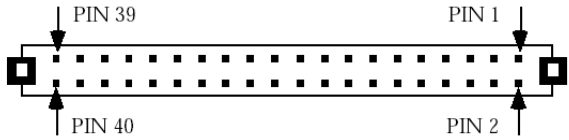
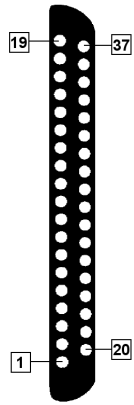


Figure 5.2: Digital I/O connector

5.2 Digital In Connector

The Digital In connector at the rear panel can be used to read TTL trigger signals from external devices.



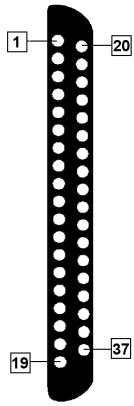
PIN	Signal	Pin	Signal
1	GND	20	GND
2	GND	21	In 0
3	GND	22	In 1
4	GND	23	In 2
5	GND	24	In 3
6	GND	25	In 4
7	GND	26	In 5
8	GND	27	In 6
9	GND	28	In 7
10	GND	29	In 8
11	GND	30	In 9
12	GND	31	In 10
13	GND	32	In 11
14	GND	33	In 12
15	GND	34	In 13
16	GND	35	In 14
17	GND	36	In 15
18	GND	37	GND
19	GND		

Figure 5.3: Digital In connector

5.3 Digital Out Connector

The Digital Out connector at the rear panel of the EPC 10 amplifiers can be used to trigger external devices, which require TTL inputs. The signals of pin 21 (OUT-0) to 23 (OUT-2) can also be accessed from the BNC trigger

outputs at the front panel of the amplifier.



PIN	Signal	Pin	Signal
1	GND	20	GND
2	GND	21	Out 0
3	GND	22	Out 1
4	GND	23	Out 2
5	GND	24	Out 3
6	GND	25	Out 4
7	GND	26	Out 5
8	GND	27	Out 6
9	GND	28	Out 7
10	GND	29	Out 8
11	GND	30	Out 9
12	GND	31	Out 10
13	GND	32	Out 11
14	GND	33	Out 12
15	GND	34	Out 13
16	GND	35	Out 14
17	GND	36	Out 15
18	GND	37	GND
19	GND		

Figure 5.4: Digital Out connector