RAYLASE
focus on laser

Hardware Manual

SP-ICE 2 Control Card

TABLE OF CONTENTS

1 BASIC INFORMATION

The SP-ICE 2 control card contains a complete processor system for real time control of up to four scan heads and two laser units. The control card can be operated fitted into a PC or as a stand-alone unit connected through a LAN interface to a host computer. On the control card multiple jobs can be stored. These jobs can be entered separately and run consecutively. 2- and 3-axis deflection units can be used.

The control card is compatible with the RAYLASE software packages. Demanding applications and job-shop work as well can be solved and performed in a precise and quick manner.

Features

- On board embedded Linux operating system
- Interface to card via PCI-bus or LAN
- Interface to XY- and XYZ-scan heads based on XY2-100 enhanced standard
- 16 bit or 18 bit resolution in the working field
- Programmable laser control signals for commonly used lasers (e.g. Nd:YAG, Fiber, CO_2, ...)
- Two analog outputs (0 V to 10 V) or one digital output (16 bit) for diode or lamp current
- Buffered and unbuffered digital input and output signals
- Designed for stand-alone operation
- MOTF with dynamic vector processing on board
- Master-Master operation in a single PC or in a network environment
- Non-volatile storage of jobs on board or SD-card
- Real time clock and calendar with battery backup
- Real time control of scan head and laser
- DLL and .NET drivers for Windows XP, Windows Vista, Windows 7
- Java-script based command language, 1 000 000+ entries
- Scalable output of new data with sub 1 µs resolution
- Shortest possible output interval 10 µs (variable in ≤1 µs steps)
- On-board rendering of fonts and barcodes
- On-board auto serialisation function (date, time, serial number)
- Enhanced high frequency bitmap modes
- UPnP identification for network environment
- Optional interface for up to 3 stepper motors (XY table, rotary)

1.1　Delivery Scope

- SP-ICE 2 control card
- Installation CD

1.2　Warranty

The rights of the customer in respect of any defects in quality or deficiencies in title are governed by the general conditions of business of RAYLASE AG. These conditions are available for review on our website.

Before returning the product, please request an authorization number from RAYLASE. Pack the product in the original packaging or in packaging that provides equivalent protection for shipping.

RAYLASE shall not be obliged to repair defects under the following circumstances:

- If persons not authorized by RAYLASE have attempted to repair the product.
- If persons not authorized by RAYLASE have modified the product.
- If the product has been used improperly.
- If the product has been connected to incompatible devices.
- If the warranty period has expired.

Note: No implicit guarantee or warranty of suitability for specific purposes has been made. RAYLASE is not responsible for damages arising from use of the product. Individual assemblies or other assemblies manufactured by RAYLASE may be subject to separate warranty conditions. Refer to the corresponding manuals for further information.

1.3　Laser Safety

Customers assume all responsibility for maintaining a laser-safe working environment. OEM customers must assume all responsibility for CDRH (Center for Devices and Radiological Health) certification.

CAUTION:

Switch on the PC or the stand-alone SP-ICE 2 control card first, before switching on the laser system. In this way you can avoid an uncontrolled action of the laser when switching on the SP-ICE 2 control card.

Check your application carefully before using the laser system. Faulty software can lock up the complete system with no control over the laser or the scan head.

1.4　Manufacturer

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Germany

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http://www.raylase.de
E-mail: info@raylase.de

1.5   Customer Support

The RAYLASE support services are available for your problems either in respect to the product or the accompanying manual. Before calling for support, please make sure you refer to any appropriate sections in this manual and the manuals on CD that may answer your questions.

If you need further assistance call RAYLASE customer service department, Monday through Friday between 8 a.m. and 5 p.m. (Middle European Time).

The customer service personnel will be able to give you direct assistance and answers to your questions.

Germany (Wessling)

Tel.: +49 (0) 81 53 - 88 98 – 0
E-mail: support@raylase.de

... ask for the customer service department or contact us by e-mail.

2 TECHNICAL DATA

2.1 Dimensions and Weight

Dimensions: .... W 107 mm, L 195 mm

Weight: .... 150 g

2.2 Environmental Conditions

Working temperature: .... +15 °C to +35 °C

Storage temperature: .... -20 °C to +60 °C

Humidity rel.: .... ≤ 80%, non-condensing

2.3 Fuses

The voltage inputs and outputs of the SP-ICE 2 control card are guarded against overcurrent via a self-resetting fuse.

Voltage input / output	Current consumption
5 V laser / I/O interface	100 mA max.
with MOTF option	200 mA max.

2.4 Overview

The SP-ICE 2 control card can be easily adapted to individual requirements. For this purpose the card is equipped with connectors, jumpers and status LEDs. In the following figure these elements are shown. In the legend references to the corresponding descriptions are given.
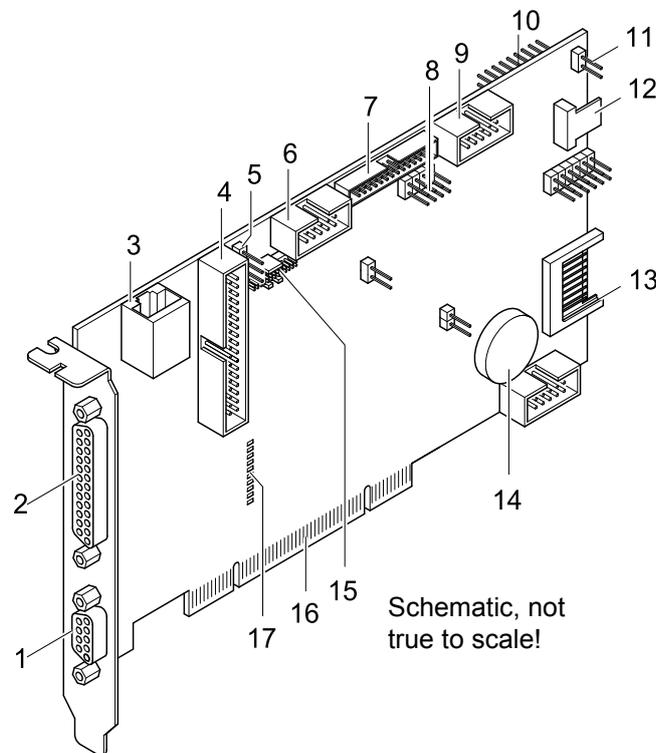

Fig. 1
SP-ICE 2
Overview

Schematic, not true to scale!

ID	Assignment	Details	ID	Assignment	Details
1	Laser IF1	⇨ page 10	10	Dig. I/O	⇨ page 17
2	XY2 100	⇨ page 11	11	RST	⇨ page 17
3	LAN	⇨ page 12	12	Ext. power supply	⇨ page 18
4	Laser IF2	⇨ page 13	13	SD card	⇨ page 18
5	LM /LM	⇨ page 14	14	Backup Battery	⇨ page 18
6	MOTF	⇨ page 15	15	Versa interface	⇨ page 18
7	Slave	⇨ page 16	16	PCI bus	
8	USB H	⇨ page 16	17	Status LEDs	⇨ page 19
9	RS232	⇨ page 17			

The case ground of the PC is connected through the board mounting bracket and the metal collar of the plug-in connectors on a parallel circuit of R1M/2kV and C10n/2kV star point with the operating voltage and signal ground of the control board. The connection is built to enable separation if necessary.

2.4.1 Laser Control Interface 1

The interface provides analogous signals to control laser power and digital signals to control laser devices such as a laser modulation driver. Further digital signals can be used for synchronizing marking with external controllers – for instance a foot switch.
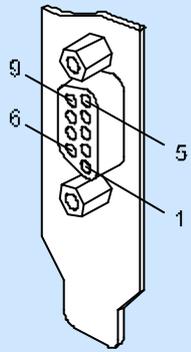
	PIN	Signal		PIN	Signal	
	1	TTL Output	LM or /LM	6	VDD Out	+5 V
	2	TTL Output	/LM_GATE	7	TTL Output	/MIP
	3	TTL Output	/FPS	8	TTL Input24V	/START_MARK
	4	Analog Output	ANA_OUT1	9	TTL Input24V	/STOP_MARK
	5	GND	Analog & Digital Return			
9 PIN D-SUB						

FPS = first pulse suppression, hc = high current, LM = laser modulation, MIP = mark in progress

Please note:

/START_MARK and /STOP_MARK are read simultaneously with the laser interface (⇨ page 13). After the input buffer, the signals will be merged with an OR function.

The LM signal can be inverted via a jumper (⇨ page 14). The inversion of the signals FPS, LM-GATE and MIP can be set via software.

Analog output

The analog output ANA_OUT1 is dedicated to control the diode or lamp current of a Nd:YAG laser. The output voltage range can be adjusted via software.
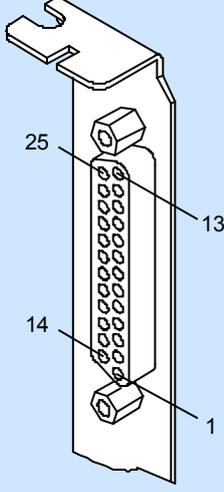
Specifications

TTL Input 24 V	
Input low	max. 1.3 V
Input high	1.6 V to 24.0 V
Hysteresis	typ. 1.1 V
Input impedance	approx. 3 kΩ
ESD protection	± 10kV

TTL Outputs		
TTL low	0.26 V max.	6 mA max.
TTL high	3.84 to 5.0 V	6 mA max.

Analog output	
Amplitude	0 V to +10 V ± 1%
Output current	5 mA max.
Bandwidth	1 kHz
DAC resolution	16 Bit
Noise ratio (≤1 GHz)	60 dB min.

2.4.2 Scan Head Interface

At the 25-pin D-SUB connector, a RAYLASE XY(Z) scan head can be connected. All signals are compatible with the XY2-100 standard interface with RAYLASE functional extensions.

XY2-100	PIN	Signal		PIN	Signal	
	1	Diff.Output-	SENDCLOCK	14	Diff.Output+	SENDCLOCK
	2	Diff.Output-	SYNC	15	Diff.Output+	SYNC
	3	Diff.Output-	X- CHANNEL	16	Diff.Output+	X- CHANNEL
	4	Diff.Output-	Y- CHANNEL	17	Diff.Output+	Y- CHANNEL
	5	Diff.Output-	Z- CHANNEL	18	Diff.Output+	Z- CHANNEL
	6	Diff.Input-	STATUS X	19	Diff.Input+	STATUS X
	7	Diff.Input-	STATUS Z	20	Diff.Input+	STATUS Z
	8	Diff.Input-	STATUS Y	21	Diff.Input+	STATUS Y
	9	nc		22	nc	
	10	nc		23	GND	
	11	GND		24	GND	
	12	nc		25	nc	
	13	nc		---	---	
25 PIN D-SUB						

nc = not connected

Specifications

Diff.Input-, Diff.Input+	
Input voltage	± 10.0 V max.
Input threshold	200 mV max.
Hysteresis	70 mV typ.

Diff.Output-, Diff.Output+		
Output low	0.5 V max.	40 mA max.
Output high	2.0 V min.	40 mA max.

ESD protection
≥ 6.5 kV

The following figure shows the typical scheme of a RAYLASE MINISCAN scan head with Dig.1 interface. Customer-specific modules are shown dashed. Other connection schemes can be found in the manual of the respective scan head.

Fig. 2
Connection
example:
MINISCAN
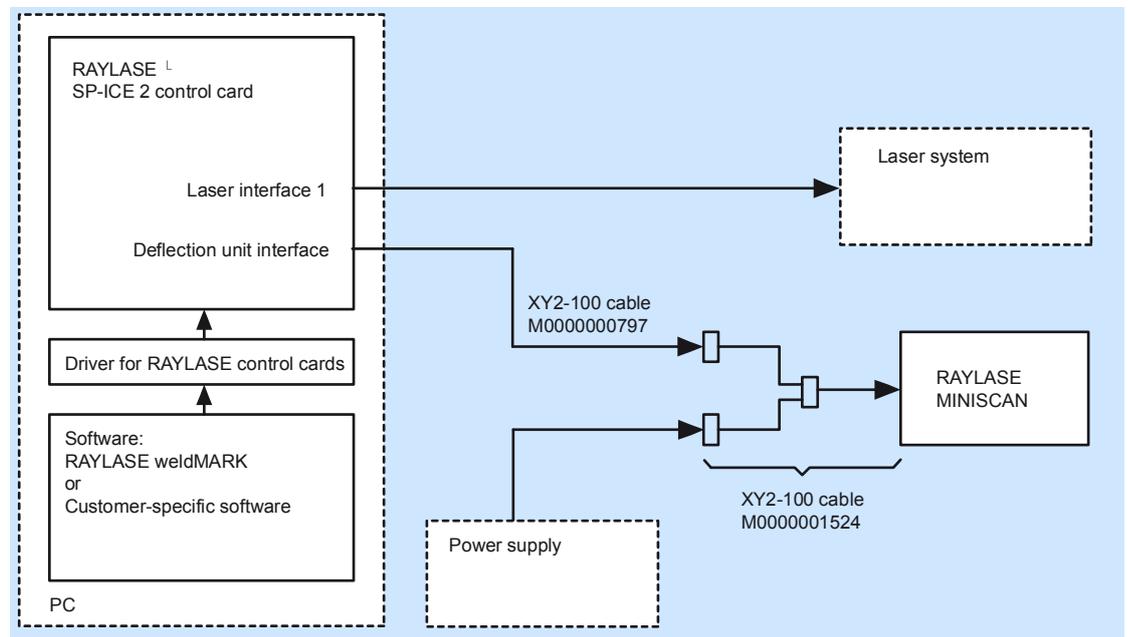
2.4.3   LAN Interface

The SP-ICE 2 control card is designed as LAN component. Via PCI-bus it can be controlled from the PC, in which it is installed. Connected to a LAN, it can be controlled from every other PC within the same network. Normally the total communication with the connected PCs is performed via the LAN interface. For stand-alone operation the SP-ICE 2 control card is equipped with an external LAN connector. The data transmission rate can be 10 Mbit/s or 100 Mbit/s.

2.4.4   Laser Interface 2

At the 34-pin male connector add-on cards can be connected. With the additional cards, specific laser interfaces can be realised. Please contact RAYLASE in case of interest.
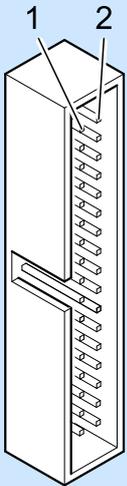
PIN	Signal	PIN	Signal
1	TTL Output /PB0	2	TTL Output /PB1
3	TTL Output /PB2	4	TTL Output /PB3
5	TTL Output /PB4	6	TTL Output /PB5
7	TTL Output /PB6	8	TTL Output /PB7
9	TTL Input /PA0	10	TTL Input /PA1
11	TTL Input /PA2	12	TTL Input /PA3
13	TTL Input /PA4	14	TTL Input /PA5
15	TTL Input /STATUS A	16	TTL Input /STATUS B
17	TTL Input /Start Mark2	18	TTL Input /Stop Mark2
19	TTL Output /LM2	20	TTL Output /LM1
21	TTL Output /LMGate2	22	TTL Output /FPS2
23	TTL Output /Mark in Progr.	24	TTL Output /Rem.Exe.2
25	TTL Output /Rem.Exe.1	26	TTL Input /STATUS C
27	TTL Output /Soft Reset	28	TTL Input/Laser Select 1
29	TTL Input Laser Select 2	30	Analog Output/ Ana.Out 2
31	GND	32	GND
33	VDD Out +5 V	34	Analog Output/Ana.Out 1

Specifications

TTL Inputs 3,3V*		
Input low	≤ 0.8 V	-
Input high	≥ 2.0 V	

*) 5V compatible with 10k pull up to 3.3 V

TTL Outputs 3,3V		
TTL low	≤ 0.4 V	max. 6mA per output
TTL high	≥ 2.4 V	

Analog Output	
Amplitude	0 bis + 10 V ± 1 %
Output current	max. 5 mA
Bandwidth	1 kHz
DAC resolution	16 Bit
Noise ratio (≤ 1 GHz)	min. 60 dB

2.4.5   Signal Polarity of Laser Modulation (LM)

With a 2-pin bridge plug the polarity of the LM-signal may be inverted. The LM signal is emitted at laser interface 1 (⇨ page 10).
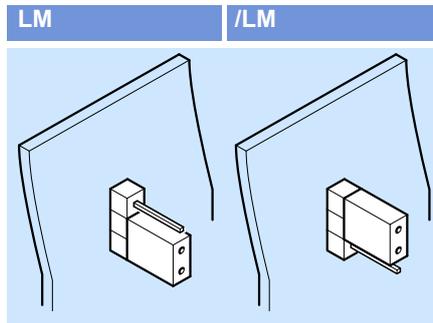
LM = laser modulation

2.4.6   Interface for Marking-On-The-Fly-Option

With the option Marking-On-The-Fly objects can be marked in motion, for example when moving along a conveyor. The movement is measured via up to three position encoders. Based on these moving informations, the SP-ICE 2 control card is able to adapt the marking process to the actual motion.

The MOTF signals are transferred to a 9 pin Sub-D male connector on a slot bracket via ribbon cable. This enables the connection of the position encoders at the rear panel of a PC.

	PIN	Signal		PIN	Signal	
	1	Diff. IN	A-	2	Diff. IN	A+
	3	Diff. IN	B-	4	Diff. IN	B+
	5	Diff. IN	C-	6	Diff. IN	C+
	7	GND		8	GND	
	9	VDD	+5 V	10	VDD	+5 V

Diff. IN = differential TTL signal, O = output

The MOTF interface of the SP-ICE 2 control card is equipped with differential inputs. It provides the option to use the input signals differential as well as single-ended. The internal circuit keeps the inputs –A, –B and –C at +2.5 Volts, if they are unused.
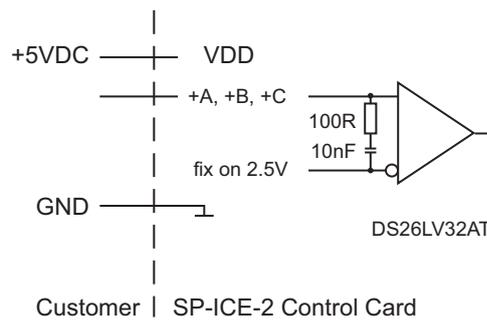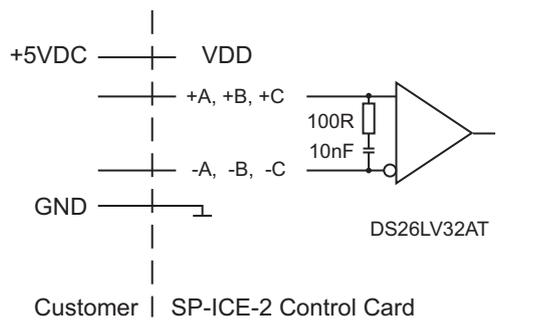

Fig. 3
Input signals
(differential,
single-ended)

Specifications

Input low	0.8 V max.
Input high	2.5 V min. to 24 V max.
Hysterese	45 mV typ.
Input impedance	120 Ω
Inputs, ESD protection	≥ 6.5 kV
Output current	VDD + 5 V for position encoder can supply 0.2 A max.

2.4.7 Interface for Slave Control

At this 26-pin D-SUB female connector, up to three RAYLASE SP-ICE2 slave boards can be connected. This makes it possible to operate up to four laser beam scan units with one SP-ICE 2 control card in parallel. For further information please contact RAYLASE.
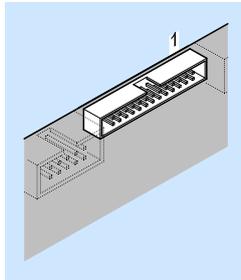
**This option is reserved for future use.**
2.4.8 USB H Interface

Via this connector an USB adapter can be connected. The adapter is fitted at a free slot bracket at the rear panel of the PC.

	PIN	Signal	PIN	Signal
	1	+ 5 V, 500mA Output (Host)	2	+5 V
	3	D+ (Host)	4	D+ (Client)
	5	D- (Host)	6	D- (Client)
	7	GND	8	GND

Specifications

Standard	USB 2.0 (12 Mbit/s)
ESD protection	± 10 kV

For RAYLASE internal use only
2.4.9   RS-232 Interface
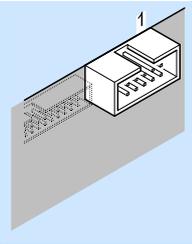
	PIN	Signal	PIN	Signal
	1	nc	2	nc
	3	RxD	4	RTS
	5	TxD	6	CTS
	7	nc	8	nc
	9	GND	10	GND

nc = not connected

Note:

When using a 9-pin D-Sub connector it is a DCE port 1:1 cable.

For further information regarding the usage of the RS-232 interface in combination with your application software please contact RAYLASE.

Specifications

Baud rate	9600 to 115200 Baud
ESD protection	10 kV (air discharge)

2.4.10   Dig. I/O Interface

An additional card can be connected at the male connector (see Fig.1 pos.10). The additional card PCIDIOEX provides a set of optically isolated inputs and outputs. It is dedicated to a signal voltage of 24V.

With this additional card, up to 32 I/O ports can be read and written. This enables multiple control options of external components while marking from SP-ICE 2 control card.

If required, please contact RAYLASE.

2.4.11   RST
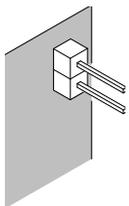
Via a 2-pin shorting plug the SP-ICE 2 control card can be resetted. After a reset, the jumper has to be removed.

2.4.12 External Power Supply

Instead of using the PCI bus, the control card can be supplied with power via the connector shown below. This is necessary when operating the card stand-alone.

If the control card is supplied via the external power supply, it may not be plugged into PCI bus.

CAUTION:
The simultaneous power supply of the control card via the PCI bus and via the "Ext Power" can destroy the control card.
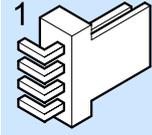
PIN	Signal
1	12 V
2	GND
3	GND
4	+ 5 V

2.4.13 SD Card Connector

Via this plug SD cards with a capacity of up to 2 GB can be inserted. SD cards can be used to store jobs.

The plug is provided with a switch for write protection and card detection.
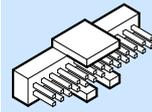
2.4.14 Backup Battery

Via the battery, time and date is buffered. The buffer time is approximately 60 days, after the control board was been connected to a power supply or plugged in a PCI bus.

For RAYLASE internal use only
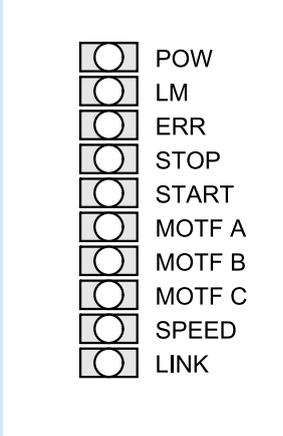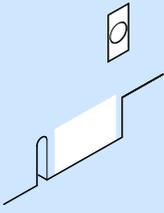### 2.4.15 Versa-Interface (for internal use only)

The Versa-Interface is based on a SPI-interface which can be adopted to specific needs. Through the 26-pin male connector the optional stepper motor interface is connected.

PIN		Funktion / Signal		PIN		Funktion / Signal	
1	SCK	SPI-Clock	IN	2	MOSI	SPI-In	IN
3	MISCO	SPI-Out	OUT	4	nCS	Chip select	IN
5	SW 1	ext. SW	OUT	6	SW 2	ext. SW	OUT
7	SW 3	ext. SW	OUT	8	SW 2	ext. SW	OUT
9	SW 5	ext. SW	OUT	10	SW 2	ext. SW	OUT
11	SW 7	ext. SW	OUT	12	SW 2	ext. SW	OUT
13	SW 9	ext. SW	OUT	14	nc		
15	nc			16	nc		
17	ID0	HW-ID	IN	18	ID1	HW-ID	IN
19	+3.3V			20	+3.3V		
21	+3.3V			22	+3.3V		
23	GND			24	GND		
25	GND			26	GND		

2.4.16 Status LEDs

After switching on the scan head, an internal function test starts; all status LEDs blink. The LEDs "POW" and "ERR" flash until the PCI connection is established to the PC. Then, the following informations are displayed.

LEDs	Name	Color	Meaning
POW LM ERR STOP START MOTF A MOTF B MOTF C SPEED LINK	POW	green	Operating voltage on
	LM	red	Laser control active
	ERR	red	Not ready (scan head is not responding)
	STOP	yellow	STOP_MARK active
	START	yellow	START_MARK active
	MOTF A	yellow	Input A active
	MOTF B	yellow	Input B active
	MOTF C	yellow	Input C active
	SPEED	yellow	100 Mbit mode
	LINK	yellow	Data transfer on LAN interface
	CPU	yellow	Is switched on when CPU is active.

3   INSTALLATION

Make sure that all requirements for laser safety, as described in the scan head manuals, are fulfilled. It is the users responsibility to follow the regulations on laser safety.

CAUTION: There are components on the SP-ICE 2 control card and within the PC which can be destroyed by electrostatic discharge. Please ask a specialist for the installation of the board, if you are not familiar with the necessary protective measures.

The SP-ICE 2 can be installed as an autonomous Card, as external device connected to a network or directly connected inside the PC. The according preparations for each operation are described consecutively.

3.1   Internal Installation

The SP-ICE 2 runs with the 32-Bit versions of Windows™ XP, Windows™ Vista and Windows™ 7. The 64-Bit versions of these operating systems are not currently supported.

3.1.1   Installing Drivers

The SP-ICE 2 is delivered with a Driver-CD. For a smooth installation install the drivers before inserting the control card in the PC.

○ Switch on the PC and log in with administrator rights

○ Insert the RAYLASE Driver-CD.

○ Choose the SP-ICE 2 driver installation.

○ Check if the following folder has been created after the installation:

> C:\Program Files\RAYLASE\SP-ICE2\Drivers\SPICE2PCIWinDriver

The part „C:\Program Files" depends on your regional settings.

3.1.2   Inserting Control Card

○ Switch off the PC and unplug the power cable.

○ Open the PC casing.

○ Insert the SP-ICE 2 in a free PCI-Slot and lock it safely.

○ Close the PC casing.

3.1.3   Assigning Drivers

○ Switch on the PC and log in with administrator rights.

○ Start the hardware-manager.
  Since the drivers are not detected automatically, the control card will be displayed as unknown Ethernet-Controller.

○ Assign the drivers manually:
  Enter the RAYLASE driver path (⇨ paragraph 3.1.1.)
  If the maker of the drivers cannot be verified during the assignation, instruct Windows to install them anyway.

After a successful driver installation, the control card will be displayed as network adapter named „RAYLASE AG SP-ICE 2 PCI Adapter" in the hardware manager.

3.2   External Installation

The SP-ICE 2 can be installed as autonomous device (Stand-alone-operating). The Control Card can be connected to an existing network or directly to a PC.

3.2.1   Ethernet LAN with automatically assigned IP-Address (DHCP)

The following procedure describes how to connect the SP-ICE 2 in a LAN that uses a DHCP-Server to automatically assign network addresses. This is the default configuration as shipped. The steps have to be performed only when to return to the DHCP mode.

○ Connect the Control Card via patch cable to the network.

○ Connect the Control Card to a suitable power supply (⇨ page 18) and switch it on.

○ Switch on the PC and log in with administrator rights.

○ Go to the Network Neighborhood folder.[1]

○ Double-Click on the control card icon. The control cards' web interface will be opened in browser.[2]

○ Access the menu item "Configure the Spice2card".

○ Enter DHCP in the field "IP Address". Be sure to check the accuracy of the input, since a mistake can lead to non-availability of the board.The field "IP Netmask" can be left empty.

Additional settings and first functional tests can be made via the web interface.

3.2.2   Ethernet LAN with manually assigned IP-Address

The following procedure describes how to connect the SP-ICE 2 in a LAN that assigns network addresses manually.

The card's own network address can be set via its web interface. However, access to the web interface itself requires a network connection, so it is necessary with the first of the following steps to set up a temporary direct connection.

○ Set up a temporary direct connection between the card and a PC, using the procedure described in paragraph 3.2.3.

○ Access the menu item "Configure the Spice2card".

○ Enter the reserved IP address for the control card in the field "IP Address". The field "IP Netmask" is entered with 255.255.0.0.

○ Save the new settings.

○ Switch off the card and disconnect it from the PC.

○ Use a standard patch cable (not cross-over) to connect the card to the network.

○ Connect the Control Card to a suitable power supply (⇨ page 18) and switch it on.

○ Switch on the PC and log in with administrator rights.

○ Go to the Network Neighborhood folder.

○ Double-Click on the control card icon. The control cards' web interface will be opened in the browser.

Additional settings and first functional tests can be made via the web interface.

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1. If you are using Windows™ XP assure that the display of UPnP-devices is enabled. Windows™ Vista and Windows™ 7 will show UPnP-devices automatically.

2. If necessary the firewall settings have to be configured so the browser can communicate with the control card.

3.2.3 Direct connection with automatically assigned IP-Address (APIPA)

The following procedure describes how to connect the SP-ICE 2 directly to a PC. Thereby the network addresses for the PC and the control card will be assigned automatically in the range of the APIPA (Automatic Private IP Addressing).

○ Connect the control card via Ethernet <u>crossover cable</u> to a PC.

○ Connect the Control Card to a suitable power supply (⇨ page 18) and switch it on.

○ Switch on the PC and log in with administrator rights.

○ Go to the Network Connections.

○ Set the connection to the control card, so that the IP address assigned automatically.

○ Go to the Network Neighborhood folder. It may take several minutes for the control card to be displayed.[1, 2, 3]

○ Double-Click on the control card icon. The control cards' web interface will be opened in the browser.[4]

Additional settings and first functional tests can be made via the web interface.

3.2.4 Direct connection with manually assigned IP-Address

The following procedure describes how to connect the SP-ICE 2 directly to a PC. Thereby the network addresses for the PC and the control card will be assigned manually in the range of the APIPA (Automatic Private IP Addressing). Through this fixed connection future connections can be established quickly.

○ Switch on the PC and log in with administrator rights.

○ Go to the Network Connections.

○ Set the connection to the control card, so that it has a fixed network address between 169.245.1.10 and 169.254.255.255. The Subnet mask is entered with 255.255.0.0.

○ Connect the control card via Ethernet <u>crossover cable</u> to a PC.

○ Connect the Control Card to a suitable power supply (⇨ page 18) and switch it on.

○ Go to the Network Neighborhood folder. It may take several minutes for the control card to be displayed.

○ Double-Click on the control card icon. The control cards' web interface will be opened in the browser.

○ Access the menu item "Configure the Spice2card".

○ Enter an IP address between 169.245.1.1 and 169.245.1.9 the field "IP Address". The field "IP Netmask" is entered with 255.255.0.0.

Additional settings and first functional tests can be made via the web interface.

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1. The card will first try to obtain an address from a DHCP server. If none becomes available within about 3 minutes, the card will create an address for itself between 169.254.1.1 and 169.254.1.9 (APIPA).

2. The PC will first try to obtain an address from a DHCP server. If none becomes available within about 3 minutes, the PC will create an address for itself between 169.254.1.10 and 169.254.255.255 (APIPA) and will show all connected devices in the network neighborhood.

3. If you are using Windows™ XP assure that the display of UPnP-devices is enabled. Windows™ Vista and Windows™ 7 will show UPnP-devices automatically.

4. If necessary the firewall settings have to be configured so the browser can communicate with the control card.

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