# HALdrive X20
# XY3-100 to Analogue Converter

# HALdrive N20
# NX-02 to Analogue Converter

# HALdrive L18
# Legacy XY2-100 to Analogue Converter

Users Manual

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# 1 Copyright

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# 2 History

| Date | Changes in document |
|---|---|
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| | |
| 09/2026 | Description of L18 legacy XY2-100/XY2-100E converter added |
| 10/2023 | IDC-connector pin counting clarified |
| 10/2023 | Type code description added |
| 08/2023 | Added description of NX-02 variant |
| 05/2023 | E170Xbase description added |
| 04/2023 | Connector description simplified |
| 03/2023 | Pin-names of XY3-100 interface clarified |
| 01/2023 | Added wiring for E1702S |
| 01/2023 | Extended power supply voltage range described |
| 12/2022 | Unused pinout removed |
| 10/2022 | Description of wiring with E1701D/E1803D extended/clarified |
| 08/2022 | Added diameter of holes in mechanical drawing section |
| 04/2022 | Maximum current for galvo outputs specified |
| 12/2021 | Pinout description extended, power supply wiring description added |
| 06/2021 | XY3-100 certified logo added |
| 05/2021 | Added pinout and description of HALdrive OEM |
| 04/2021 | Wiring schemes for E1701D and E1803D added |
| 10/2020 | Added description for 10V hardware variant |
| 07/2020 | Added section for initial operation |
| 06/2020 | Initial version |

# 3 Safety

The hardware described within this document is designed to control a laser scanner system. Laser radiation may effect a person's health or may otherwise cause damage. Prior to installation and operation compliance with all relevant safety regulations including additional hardware-controlled safety measures has to be secured. The client shall solely be responsible to strictly comply with all applicable and relevant safety regulations regarding installation and operation of the system at any time.

Beside of that some laser equipment can be damaged in case it is controlled with wrong signals or signals outside a given specification. Thus it is highly recommended to check the output generated by this hardware using e.g. an oscilloscope to avoid problems caused by wrong configurations. This should be done prior to putting a system into operation for the first time, whenever some parameters have been changed or whenever any kind of software update was installed.

The hardware described here is shipped without any cover and without prefabricated equipment for electric installation. It is intended to be integrated in machines or other equipment. It is not a device for use "as is", but a component which is intended to be used as part of a larger device, e.g. for integration in a machine with own housing or within an electrical cabinet. Prior to operation compliance with all relevant electric / electromagnetic safety regulations including additional hardware-controlled safety measures has to be secured. The client shall solely be responsible to strictly comply with all applicable and relevant regulations regarding installation and operation of the system at any time.

The hardware described here is an electrostatic sensitive device. This means it can be damaged by common static charges which build up on people, tools and other non-conductors or semiconductors. To avoid such a damage, it has to be handled with care and including all relevant procedures (like proper grounding of people handling the hardware, shielding/covering to not to let a person touch the hardware unwanted, proper packaging in ESD-bags, ...). For more information please refer to related regulations and standards regarding handling of ESD devices. The EMC Directive (2014/30/EU) does not apply to this hardware as it is not intended for an end user (a person without knowledge of EMC) and as it is not otherwise made available on the market.

The Low Voltage Directive (2014/35/EU) does not apply to this hardware as the voltage supply is below the 50V AC / 75V DC limit.

This control board is considered partly completed machinery in accordance with the EU Machinery Directive (2006/42/EC). It cannot operate independently and is intended to be integrated into a larger machine or system. The final integrator is responsible for ensuring that the complete machine or system complies with all applicable safety and regulatory requirements in the intended market (such as CE- certification).

This document describes the HALdrive digital XY3-100/NX-02 to analogue converter hardware but may contain errors or may be changed without further notice.

# 4 Overview

This document describes the HALdrive X20 converter board, its electrical characteristics and usage.
This board is designed to receive digital XY3-100 scanner controller signals and to convert them to 2x synchronous analogue output signals.

Furthermore it describes the HALdrive N20 converter board, its electrical characteristics and usage.
This board is designed to receive digital NX-02 scanner controller signals and to convert them to 2x synchronous analogue output signals.

So both variants act as some kind of converter between two different signal types for controlling scanning systems/scanheads.

This board is not a ready-to-use device but a component which is intended to be integrated in larger devices or to be operated with an own housing. The board itself is customisable and can be adapted to work with other transfer protocols too. In case of special requirements, contact us!

## 4.1 Features

The HALdrive converter boards provides the following features:

- accept 2D input signals in XY3-100, NX-02, XY2-100, XY2-100E format (X and Y position data, Z is ignored if available)
- synchronous output of analogue X and Y position data in +-5V.. +-10V range (values in between are available on request)
- 20 bit output resolution (16 or 18 bit effective in case of XY2-100/XY2-100E input data)
- 100 kHz sampling/output frequency
- XY3-100 or NX-02 backchannel
- instant-on, so there is no boot-up time until the device is available
- input voltage range of +-15..+-24V, wider voltage range available on request

## 4.2 Type Code

Converter boards of type “HALdrive” make use of a defined name scheme which can be interpreted as follows:

**`HALdrive Irr`**

**`HALdrive`** – the general name of the converter board
**`I`** – interface to scanner controller card:
“ **`.`** ” or “**`X`**” – XY3-100 interface
“**`N`**” – NX-02 interface
“**`L`**” – XY2-100 / XY2-100E interface
**`rr`** – digital resolution of the output

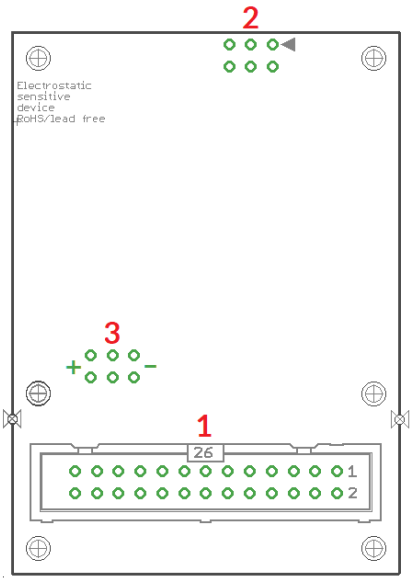
## 4.3 Comparison

Following differences in functions and features of the different HALdrive variants are compared:

| | HALdrive L18 | HALDrive X20 | HALdrive N20 |
|---|---|---|---|
| **Supported protocol(s)** | XY2-100<br>XY2-100E | XY3-100 | NX-02<br>SL2-100 |
| **Maximum output resolution** | 16 bit / 65535 steps<br>18 bit / 262144 steps | 20 bit / 1048576 steps | 20 bit / 1048576 steps<br>20 bit / 1048576 steps |
| **Backchannel** | No | XY3-100 | NX-02 position feedback |
| **Type code** | L | X | N |
| **Remarks** | Not recommended to be used with E1803D or E170X scanner controller series due to the low resolution of the XY2-100 protocols | | |

# 5 HALdrive X20 Board And Connectors

The XY3-100 board variant provides the following connectors:




1. XY3-100 interface for power supply and scanner input signals (as described below)
2. 2,54mm 6pin connector for Galvo-X and Galvo Y analogue output signals
3. Optional separate power supply input pin, when not already provided via connector (1)

## 5.1 Scanner Signals

The (optionally white) 26 pin connector expects the XY3-100 position signals and the power supply for the HALdrive board:

| Upper Row Of Pins | Signal | Voltage | Remarks | Lower Row Of Pins | Signal | Voltage | Remarks |
|---|---|---|---|---|---|---|---|
| **1** | SYNC- | | XY3-100-compatible signals | **2** | SYNC+ | | XY3-100-compatible signals |
| **3** | CLK- | | | **4** | CLK+ | | |
| **5** | X- | | | **6** | X+ | | |
| **7** | Y- | | | **8** | Y+ | | |
| 9 | | | | 10 | | | |
| **11** | BACK- | | | **12** | BACK+ | | |
| 13 | | | | 14 | | | |
| 15 | | | | 16 | | | |
| **17** | +V | +15..24V | Power supply from scanner card | **18** | +V | +15..24V | Power supply from scanner card |
| **19** | +V | +15..24V | | **20** | GND | GND | |
| **21** | GND | GND | | **22** | GND | GND | |
| **23** | -V | -15..24V | | **24** | -V | -15..24V | |
| **25** | -V | -15..24V | | 26 | | | |

When the HALdrive is used together with the E1803D scanner controller card, a direct 1:1 connection can be established between the 26 pin scanner signal connector of the E1803D controller and this connector. Then power has to be supplied via the three screw-connectors of the E1803D (for details please refer to manual of E1803D scanner controller card).
For all other scanner controller cards, wring has to be done according to their pinout. For further information

please refer to appendices below.

## 5.2 Galvo X and Y Signals

A standard 6 pin 2,54 mm header, to be used with an IDC connector:

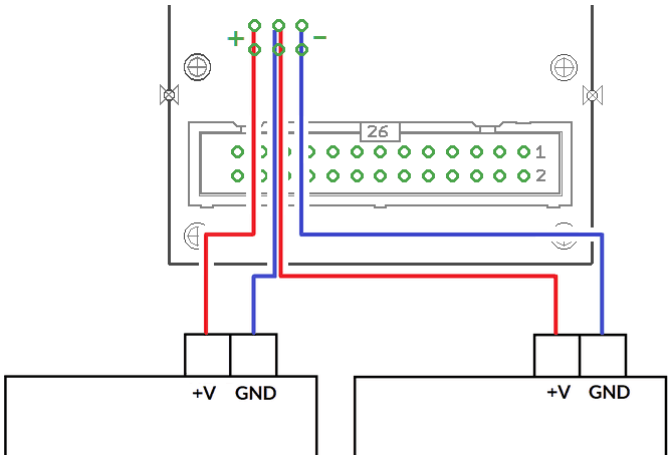
| Pin | Signal | Description |
|---|---|---|
| 1 | NC | Unused and reserved for future use, do not connect! |
| 2 | NC | Unused and reserved for future use, do not connect! |
| 3 | Galvo-Y | analogue output with voltage possible in range +-5V..+-10V |
| 4 | Galvo-X | analogue output with voltage possible in range +-5V..+-10V |
| 5 | GND | Common ground for Galvo-X |
| 6 | GND | Common ground for Galvo-Y |

Pins 3 and 4 typically work in range -5V..+5V. For the +-10V hardware variant the Pins 3 and 4 work in range -10V..+10V. Pins 5 and 6 is connected to GND.

The maximum current to be pulled out of each of the outputs should never exceed 20 mA. Lower currents are recommended to avoid unnecessary heating of the whole board.

## 5.3 Optional Power Supply Input

These are optional separate power supply input pins which can be used when power is not or can not provided via connector (1). Here a symmetric voltage in range +-15V..+-24V can be fed in. The two outer pins marked with "-" are for -15V..-24V, the two middle pins are for GND and the two other outer pins marked with "+" are for +15V..+24V power input.
When no power supply with symmetric/bipolar outputs is available, it is possible to combine two standard power supplies, here GND of the first power supply has to be connected with +V of the second power supply and with the GND-pins of the HALdrive:



## 5.4 Initial Operation

After the HALdrive does not have a nameable boot-up time, putting it into operation consists of a few steps only:

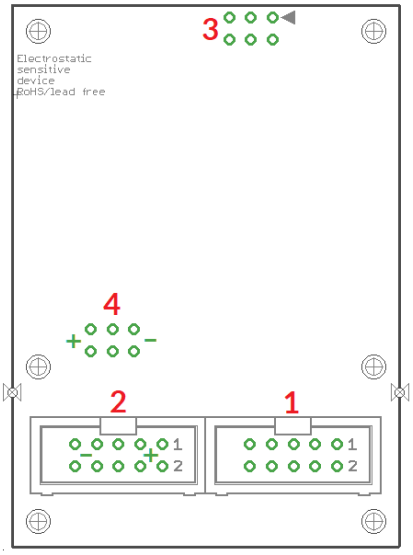
1. power up HALdrive and if necessary the connected scanner controller card
2. power-up connected galvo drivers (can be done together with powering the HALdrive)
3. start sending data from the scanner controller card to the HALdrive board

For security reasons it is recommended to not to send any data to the HALdrive while it is still turned off, so that it may start up in the middle of an already running data transmission. This may lead to a situation where the first valid position command received is at an extreme and unexpected position causing damage to the connected scanhead as it jumps to this extreme position too fast.

For the same reason also the galvo driver should be powered and be ready to use before the scanner controller sends any data, elsewhere when the connected galvos jump to an extreme position immediately, this may cause damage to the galvos and/or mirrors.

# 6 HALdrive N20 Board And Connectors

The NX-02 board variant provides the following connectors:




1. NX-02 interface for scanner input signals (as described below), this connector can be used together with a single 26 pin plug that covers both, connectors (1) and (2) at the same time

2. Main power interface for power input, this connector can be used together with a single 26 pin plug that covers both, connectors (1) and (2) at the same time

3. 2,54mm 6pin connector for Galvo-X and Galvo Y analogue output signals and Galvo X and Galvo Y analogue feedback signals (optional)

4. Optional separate power supply input pin, when not already provided via connector (2)

## 6.1 Scanner Signals

| Upper Row Of Pins | Signal | Voltage | Remarks | Lower Row Of Pins | Signal | Voltage | Remarks |
|---|---|---|---|---|---|---|---|
| **1** | DATA+ | | NX-02 signal | **2** | DATA- | | NX-02 signal |
| 3 | | | | 4 | | | |
| 5 | | | | 6 | | | |
| 7 | | | | **8** | BACK- | | NX-02 signal |
| **9** | BACK+ | | NX-02 signal | 10 | | | |

The board accepts 2D and 3D input data.

## 6.2 Power Supply

| Upper Row Of Pins | Signal | Voltage | Remarks | Lower Row Of Pins | Signal | Voltage | Remarks |
|---|---|---|---|---|---|---|---|
| **1** | +V | +15..24V | Power supply from scanner card | **2** | +V | +15..24V | Power supply from scanner card |
| **3** | +V | +15..24V | | **4** | GND | GND | |
| **5** | GND | GND | | **6** | GND | GND | |
| **7** | -V | -15..24V | | **8** | -V | -15..24V | |
| **9** | -V | -15..24V | | 10 | | | |

## 6.3 Galvo X and Y Signals

A standard 6 pin 2,54 mm header, to be used with an IDC connector:

| Pin | Signal | Description |
|---|---|---|
| 1 | FeedbackY | analogue input for current galvo position |
| 2 | FeedbackX | analogue input for current galvo position |
| 3 | Galvo-Y | analogue output with voltage possible in range +-5V..+-10V |
| 4 | Galvo-X | analogue output with voltage possible in range +-5V..+-10V |
| 5 | GND | Common ground for Galvo-X |
| 6 | GND | Common ground for Galvo-Y |

The galvo signal output pins 3 and 4 typically work in range -5V..+5V. For the +-10V hardware variant the Pins 3 and 4 work in range -10V..+10V. Pins 5 and 6 are connected to GND.

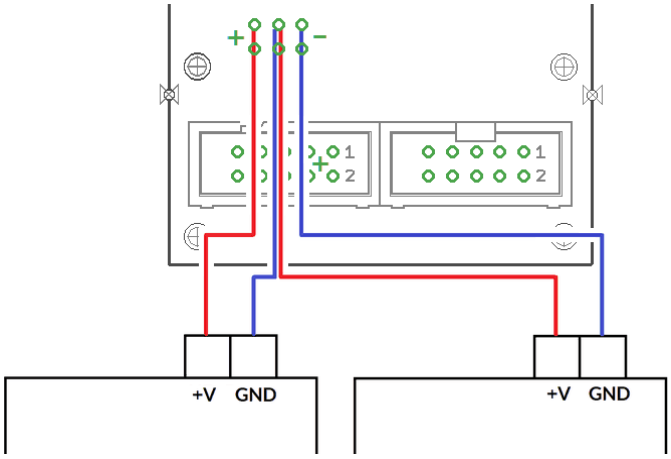
The maximum current to be pulled out of each of the outputs should never exceed 20 mA. Lower currents are recommended to avoid unnecessary heating of the whole board.

Pins 1 and 2 can be used to feed in a -5V..+5V analogue signal which corresponds to the actual galvo position. This value is converted to a NX-02 feedback signal which reports the current galvo position and movement back to the scanner controller card. Here the feedback voltage has to correspond to the input positions/command voltage for the galvo:

- minimum position / nominal galvo voltage of -5V/-10V has to correspond to an actual input voltage close to -5V
- central position / nominal galvo voltage of 0V has to correspond to an actual input voltage close to 0V
- maximum position / nominal galvo voltage of 5V/10V has to correspond to an actual input voltage close to +5V

## 6.4 Optional Power Supply Input

These are optional separate power supply input pins which can be used when power is not or can not provided via connector (2). Here a symmetric voltage in range +-15V..+-24V can be fed in. The two outer pins marked with “-” are for -15V..-24V, the two middle pins are for GND and the two other outer pins marked with “+” are for +15V..+24V power input.
When no power supply with symmetric/bipolar outputs is available, it is possible to combine two standard power supplies, here GND of the first power supply has to be connected with +V of the second power supply and with the GND-pins of the HALdrive:


+
–
1
2
1
2
+V
GND
+V
GND

## 6.5 Initial Operation

Putting the N20 board into operation consists of a few steps only:

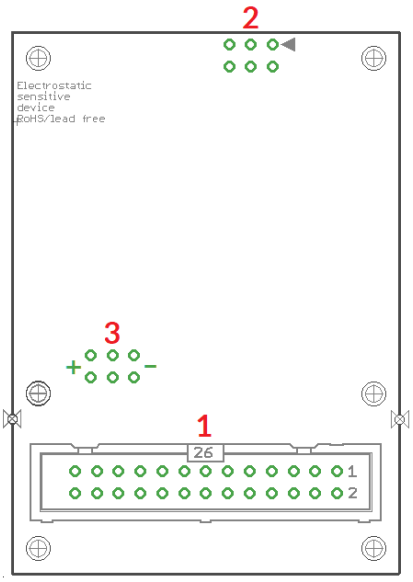
1. power-up connected galvo drivers
2. power up the board and if necessary the connected scanner controller card (can be done together with powering the galvo drivers)
3. wait until the calibration sequence has been completed: here the board performs a movement with both mirrors to the outer position (+5V / +10V) and then moves back to the centre position (0V); during this time the analogue feedback channels (if used) are measured and calibrated
4. start sending data from the scanner controller card to the board

For security reasons it is recommended to not to send any data to the board while it is still turned off, so that it may start up in the middle of an already running data transmission. This may lead to a situation where the first valid position command received is at an extreme and unexpected position causing damage to the connected scanhead as it jumps to this extreme position too fast.

For the same reason also the galvo driver should be powered and be ready to use before the scanner controller sends any data, elsewhere when the connected galvos jump to an extreme position immediately, this may cause damage to the galvos and/or mirrors.

# 7 HALdrive L18 Legacy Board And Connectors

The XY2-100/XY2-100E board variant provides the following connectors:




4. XY2-100 interface for power supply and scanner input signals (as described below)
5. 2,54mm 6pin connector for Galvo-X and Galvo Y analogue output signals
6. Optional separate power supply input pin, when not already provided via connector (1)

## 7.1 Scanner Signals

The (optionally white) 26 pin connector expects the XY2-100/XY2-100E position signals and the power supply for the HALdrive board:

| Upper Row Of Pins | Signal | Voltage | Remarks | Lower Row Of Pins | Signal | Voltage | Remarks |
|---|---|---|---|---|---|---|---|
| **1** | CLK- | | XY2-100- / XY2-100E-compatible signals | **2** | CLK+ | | XY2-100- / XY2-100E-compatible signals |
| **3** | SYNC- | | | **4** | SYNC+ | | |
| **5** | X- | | | **6** | X+ | | |
| **7** | Y- | | | **8** | Y+ | | |
| 9 | | | | 10 | | | |
| **11** | BACK- | | | **12** | BACK+ | | |
| 13 | | | | 14 | | | |
| 15 | | | | 16 | | | |
| **17** | +V | +15..24V | Power supply | **18** | +V | +15..24V | Power supply |
| **19** | +V | +15..24V | | **20** | GND | GND | |
| **21** | GND | GND | | **22** | GND | GND | |
| **23** | -V | -15..24V | | **24** | -V | -15..24V | |
| **25** | -V | -15..24V | | 26 | | | |

The XY2-100 legacy variant of the HALdrive is not recommended to be used together with an E1803D or E170X scanner controller card. These scanner card series provide a higher resolution than XY2-100 or XY2-100E can offer, so operating them with the HALdrive L18 would result in an unnecessary loss of accuracy. The HALdrive L18 is intended to be used with scanner controller cards that offer the outdated and low resolution XY2-100 protocol only. For modern controller cards that work with higher resolutions, please always use the

HALdrive X20 or N20 as described above.

For wiring between a legacy scanner controllers interface and the HALdrive L18, please refer to the manual of the related controller card.

## 7.2 Galvo X and Y Signals

A standard 6 pin 2,54 mm header, to be used with an IDC connector:

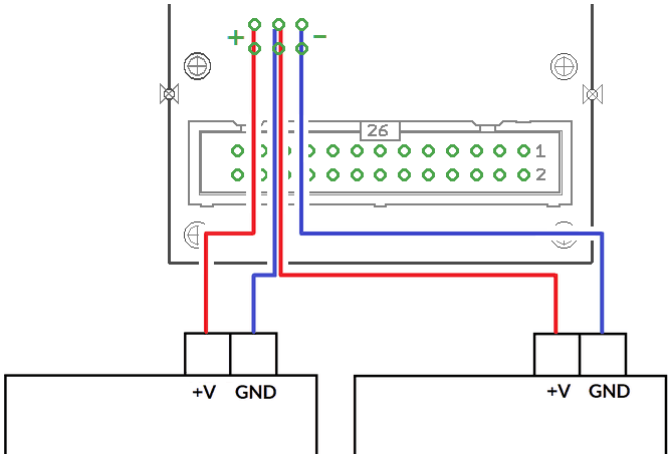
| Pin | Signal | Description |
|---|---|---|
| 1 | NC | Unused and reserved for future use, do not connect! |
| 2 | NC | Unused and reserved for future use, do not connect! |
| 3 | Galvo-Y | analogue output with voltage possible in range +-5V..+-10V |
| 4 | Galvo-X | analogue output with voltage possible in range +-5V..+-10V |
| 5 | GND | Common ground for Galvo-X |
| 6 | GND | Common ground for Galvo-Y |

Pins 3 and 4 typically work in range -5V..+5V. For the +-10V hardware variant the Pins 3 and 4 work in range -10V..+10V. Pins 5 and 6 is connected to GND.

The maximum current to be pulled out of each of the outputs should never exceed 20 mA. Lower currents are recommended to avoid unnecessary heating of the whole board.

## 7.3 Optional Power Supply Input

These are optional separate power supply input pins which can be used when power is not or can not provided via connector (1). Here a symmetric voltage in range +-15V..+-24V can be fed in. The two outer pins marked with "-" are for -15V..-24V, the two middle pins are for GND and the two other outer pins marked with "+" are for +15V..+24V power input.
When no power supply with symmetric/bipolar outputs is available, it is possible to combine two standard power supplies, here GND of the first power supply has to be connected with +V of the second power supply and with the GND-pins of the HALdrive:



## 7.4 Initial Operation

After the HALdrive does not have a nameable boot-up time, putting it into operation consists of a few steps only:

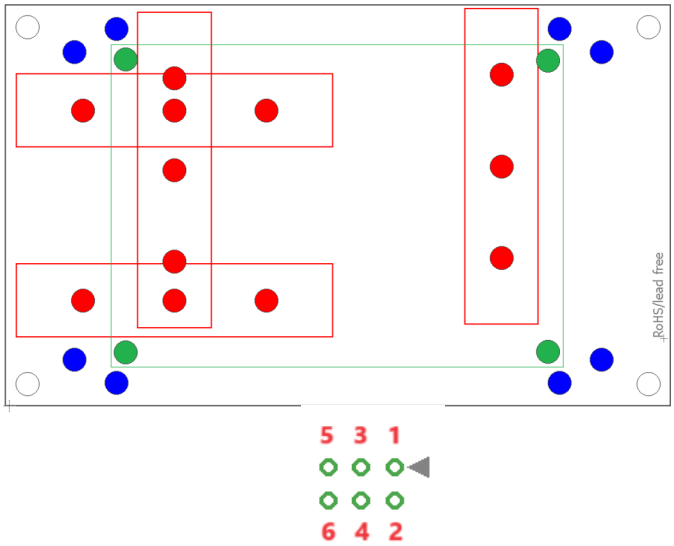
1. power up HALdrive and if necessary the connected scanner controller card
2. power-up connected galvo drivers (can be done together with powering the HALdrive)
3. start sending data from the scanner controller card to the HALdrive board

For security reasons it is recommended to not to send any data to the HALdrive while it is still turned off, so that it may start up in the middle of an already running data transmission. This may lead to a situation where the first valid position command received is at an extreme and unexpected position causing damage to the connected scanhead as it jumps to this extreme position too fast.

For the same reason also the galvo driver should be powered and be ready to use before the scanner controller sends any data, elsewhere when the connected galvos jump to an extreme position immediately, this may cause damage to the galvos and/or mirrors.

# 8 E170Xbase

The E170Xbase extension is a mounting help for easy installation on DIN rails/C45 rails and other possibilities of mechanical integration into machines:




**RED** – mounting positions for DIN/C45 rail locks/DIN/C45 rail adapters (bottom side). Pairs of locks can be mounted in one of 2 possible orientations. Here locks of type Phoenix Contact 1201578 or similar can be used. With these locks the board then can be clamped on a DIN/C45 rail.

**BLUE** – optional; mounting holes for a E170X scanner controller card on top of the E170Xbase in one of two possible orientations. These holes are symmetrically arranged so that the board can be mounted by 180 degrees rotated. Here Hex stands/distance bolts with M3 threads (or similar) can be screwed in where the controller card is mounted on top.

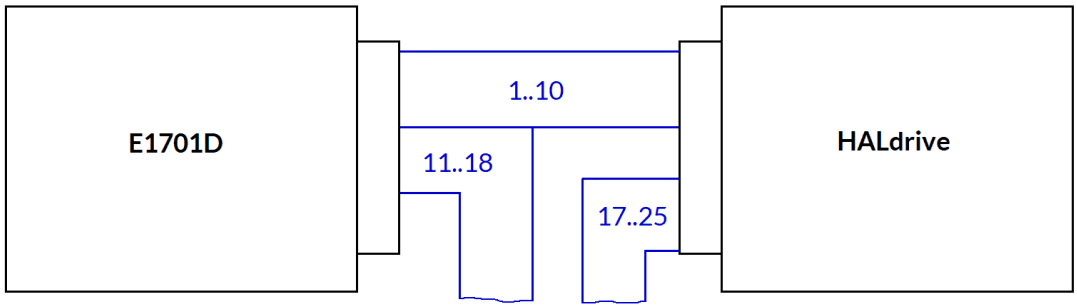
**GREEN** – mounting holes for a HALdrive converter board (top side), here Hex stands/distance bolts with M2 threads (or similar) can be screwed in where the HALdrive is mounted on top.

Mounting procedure for E170Xbase:

1. Identify suitable positions (RED) for two DIN/C45 rail locks and mount them on bottom side (two or three screws from top side into the lock on bottom)
2. Mount hex-stands or distance bolts in at least four of the given mounting holes (GREEN).
3. Mount HALdrive on top of these hex-stands/distance bolts
4. Clamp the board on your DIN/C45 rail

# APPENDIX A – Wiring between HALdrive X20 and E1701D

To connect an E1701D scanner controller card with the HALdrive X20, a split cable is needed between the white laser/scanner interface connector of E1701D and the 26-pin connector of the HALdrive X20 board:

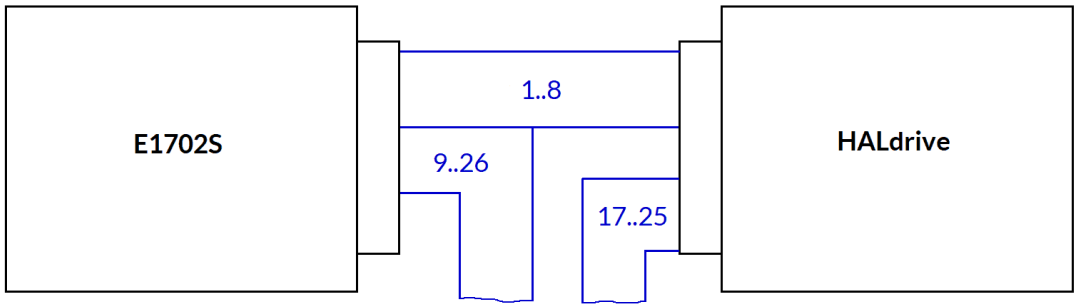



| E1701D pin | | Description of signals from E1701D | Description of signals to HALdrive | | HALdrive pin |
|---|---|---|---|---|---|
| 1 | - | XY3-100 signal lines | | - | 1 |
| 2 | - | | | - | 2 |
| 3 | - | | | - | 3 |
| 4 | - | | | - | 4 |
| 5 | - | | | - | 5 |
| 6 | - | | | - | 6 |
| 7 | - | | | - | 7 |
| 8 | - | | | - | 8 |
| 9 | - | | | - | 9 |
| 10 | - | | | - | 10 |
| 11 | o | Laser and control signals | Back-channel, optionally connect with pins 25/26 of E1701D | - | 11 |
| 12 | o | | | - | 12 |
| 13 | o | | | X | 13 |
| 14 | o | | | X | 14 |
| 15 | o | | | X | 15 |
| 16 | o | | | X | 16 |
| 17 | o | | +15..+24V (from power supply) | o | 17 |
| 18 | o | | | o | 18 |
| 19 | X | | | o | 19 |
| 20 | X | | GND (from power supply) | o | 20 |
| 21 | X | | | o | 21 |
| 22 | X | | | o | 22 |
| 23 | X | | -15..-24V (from power supply) | o | 23 |
| 24 | X | | | o | 24 |
| 25 | - | Back-channel, optionally connect with F-/F+ of HALdrive | | o | 25 |
| 26 | - | | | X | 26 |

"-" – connection to be established between E1701D and HALdrive
"o" – connection to external equipment but not between E1701D and HALdrive
"X" – no connection allowed here

# APPENDIX B – Wiring between HALdrive X20 and E1702S

To connect an E1702S scanner controller card with the HALdrive X20, a split cable is needed between the white laser/scanner interface connector of E1702S and the 26-pin connector of the HALdrive X20 board:




| E1702S pin | | Description of signals from E1701D | Description of signals to HALdrive | | HALdrive pin |
|---|---|---|---|---|---|
| 1 | - | XY3-100 signal lines | | - | 1 |
| 2 | - | | | - | 2 |
| 3 | - | | | - | 3 |
| 4 | - | | | - | 4 |
| 5 | - | | | - | 5 |
| 6 | - | | | - | 6 |
| 7 | - | | | - | 7 |
| 8 | - | | | - | 8 |
| 9 | o | | | X | 9 |
| 10 | o | | | X | 10 |
| 11 | o | Laser and control signals | | X | 11 |
| 12 | o | | | X | 12 |
| 13 | o | | | X | 13 |
| 14 | o | | | X | 14 |
| 15 | o | | | X | 15 |
| 16 | o | | | X | 16 |
| 17 | o | | +15..+24V (from power supply) | o | 17 |
| 18 | o | | | o | 18 |
| 19 | o | | | o | 19 |
| 20 | o | | GND (from power supply) | o | 20 |
| 21 | o | | | o | 21 |
| 22 | o | | | o | 22 |
| 23 | o | | -15..-24V (from power supply) | o | 23 |
| 24 | o | | | o | 24 |
| 25 | o | | | o | 25 |
| 26 | o | | | X | 26 |

"-" – connection to be established between E1702S and HALdrive X20
"o" – connection to external equipment such as Laser but not between E1702S and HALdrive X20
"X" – no connection allowed here

# APPENDIX C – Wiring between HALdrive X20 and E1803D

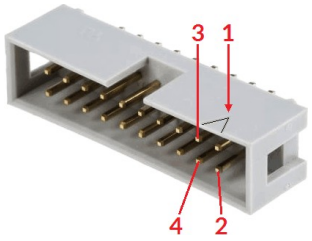
For connection between E1803D and HALdrive X20 a simple 1:1 wire is needed between the 26-pin IDC connector of the E1803D and the (optionally white) IDC connector of the HALdrive X20 board.

| **E1803D pin** | | **Description** | | | **HALdrive pin** |
|---|---|---|---|---|---|
| 1 | - | XY3-100 signal lines | | - | 1 |
| 2 | - | | | - | 2 |
| 3 | - | | | - | 3 |
| 4 | - | | | - | 4 |
| 5 | - | | | - | 5 |
| 6 | - | | | - | 6 |
| 7 | - | | | - | 7 |
| 8 | - | | | - | 8 |
| 9 | - | | | - | 9 |
| 10 | - | | | - | 10 |
| 11 | O | | | O | 11 |
| 12 | O | | | O | 12 |
| 13 | O | | | O | 13 |
| 14 | O | | | O | 14 |
| 15 | O | | | O | 15 |
| 16 | O | | | O | 16 |
| 17 | - | +15V..+24V (via E1803D screw terminal) | | - | 17 |
| 18 | - | | | - | 18 |
| 19 | - | | | - | 19 |
| 20 | - | GND (via E1803D screw terminal) | | - | 20 |
| 21 | - | | | - | 21 |
| 22 | - | | | - | 22 |
| 23 | - | -15V..-24V (via E1803D screw terminal) | | - | 23 |
| 24 | - | | | - | 24 |
| 25 | - | | | - | 25 |
| 26 | O | | | O | 26 |

“-” connection to be established between E1803D and HALdrive X20
“O” currently unused signal but can be connected

# APPENDIX D – IDC connector pin numbering

Pin numbering of the, 2,54 mm 26 pin IDC connector (according to pinout-tables shown in hardware description sections above) can be seen in below's images:




*IDC-connector socket, side view*

*IDC-connector socket, top view on PCB mounting side*

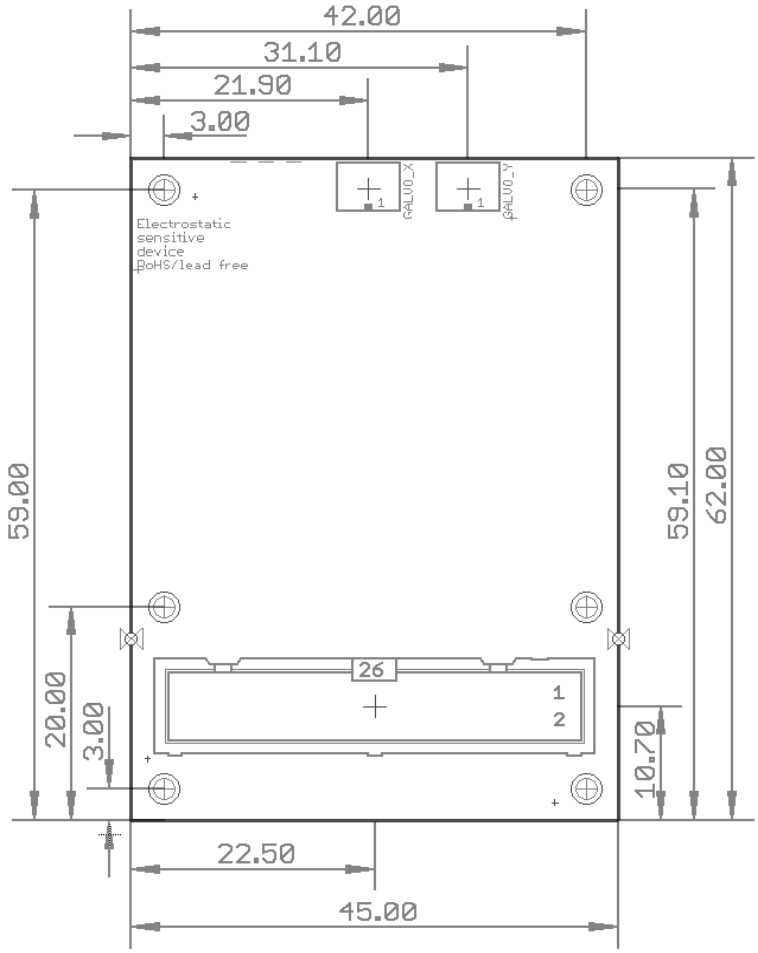
Pin 1 is marked by a small arrow either on the connector itself or directly on the PCB. Second pin is located below of it, counting continues column-wise.

# APPENDIX E – XY3-100 protocol description

For details about the XY3-100 protocol, please refer to https://lasia.org/documents.php

# APPENDIX F – Board dimensions

Board dimension drawing, all values are given in unit mm.




The six holes at the outer corners/edges have a diameter of 2,8 mm each.

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