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# HA2B5-S

High Voltage Amplifier ±2000V

# HA3B3-S

High Voltage Amplifier ±3000V

# HAR42-4

High Voltage Amplifier Mainframe
for 4 Channels HA2B5-S / HA3B3-S

# Operating Manual



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# 1 Warnings

**Caution! This device produces dangerous voltage above 3000V.**

**Due to capacitive charging, dangerous voltages can still be present in the set-up even after the amplifier has been switched off!**

Please respect the following rules before every activation of the high voltage amplifier:

- The device should be operated only by skilled personnel, in accordance with the local regulations and the instructions given in this manual.
- The device may only be operated as a component of an overall structure that fully complies with the regulations for working with high voltage systems.
- Before switching the unit on, the experiment setup must be checked, and safety should be assured. High voltage areas have to be blocked and secured.
- In case of suspected damage or malfunction, the device should immediately be put out of service, and it should be secured against unintentional or accidental operation.
- The safety ground must always be connected! The grounding nut on the rear panel must be connected to the grounding point of the setup and to protective earth. Local regulations about grounding should be taken into account.
- The output connectors must only be operated when the unit is switched off.
- High voltages may still exist even after the switch-off of the device due to capacitive charge! Capacitances connected to the outputs of the device can possibly remain charged to dangerous voltages, even after switching off the device
- Before removing any covers disconnect the unit from the power supply!
- Before touching the output or working on the experimental setup, disconnect the unit from the power supply!
- No wires or similar objects may project into the device through the ventilation slots
- Fuses have to be replaced by types as rated on the nameplate on the rear of the unit.

**Personal safety must be given the highest priority!**



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# 1 Warnhinweise

**Achtung! Dieses Gerät erzeugt lebensgefährliche Spannungen über 3000V.**

Vor jeder Inbetriebnahme des Hochspannungsverstärkers sind u. a. folgende Regeln zu beachten:

- Die Inbetriebnahme darf nur von einer Elektrofachkraft im Sinne der Berufsgenossenschaft der Feinmechanik und Elektrotechnik vorgenommen werden.
- Vor der Inbetriebnahme muss die Bedienungsanleitung gelesen und verstanden worden sein.
- Es sind die einschlägigen Bestimmungen und Vorschriften des Gesetzgebers, der Berufsgenossenschaft und des VDE zu beachten, insbesondere
  - DIN-VDE 104 "Errichten und Betreiben elektrischer Prüfanlagen" (s. auch BGI 891 "Errichten und Betreiben von elektrischen Prüfanlagen")
  - Unfallverhütungsvorschrift DGUV Vorschrift 3 / BGV A3 "Elektrische Anlagen und Betriebsmittel"
- Das Gerät darf nur als Bestandteil eines im Ganzen den Vorschriften für den Umgang mit Hochspannung genügenden Gesamtaufbaus betrieben werden!
- Vor jedem Einschalten des Geräts ist der Versuchsaufbau zu überprüfen und sicherzustellen, dass es zu keiner Gefährdung kommen kann. Die Hochspannung führenden Bereiche müssen vorschriftengerecht abgesperrt oder anderweitig gesichert sein!
- Sollte der Verdacht bestehen, dass das Gerät beschädigt ist oder Fehlfunktionen zeigt, ist es umgehend außer Betrieb zu setzen und gegen beabsichtigten oder unbeabsichtigten Betrieb zu sichern.
- Der Erdbolzen auf der Rückplatte des Geräts muss mit dem Zentralen Erdpunkt des Versuchsaufbaus und dem Schutzleiter verbunden werden. Die örtlichen Vorschriften über Erdung sind zu beachten.
- Die Ausgangssteckverbinder dürfen nur bei spannungsfrei geschaltetem Gerät betätigt werden!
- Bei Arbeiten am Versuchsaufbau oder bei Berühren der Ausgangsanschlüsse ist das Gerät zuvor von der Spannungsversorgung zu trennen.
- Vor dem Öffnen des Geräts ist das Gerät von der Spannungsversorgung zu trennen.
- Es dürfen keine Objekte – wie Drähte o. ä. durch die Lüftungsschlitze in das Gerät Hereinragen.
- Im angeschlossenen Versuchsaufbau können evtl. vorhandene Kapazitäten auf Hochspannung aufgeladen werden. Diese können auch nach Abschalten des Geräts noch gefährliche Spannungen führen.
- Sollte ein Ersatz der Netzsicherungen erforderlich sein, so ist sicherzustellen, dass nur Sicherungen der angegebenen Nennstromstärke und Nennspannung als Ersatz verwendet werden.

**Der Personensicherheit ist höchste Priorität einzuräumen!**



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# 2 Overview

This manual covers the following models:

- **HA2B5-S** single channel high voltage amplifier / 3U plug-in card
- **HA3B3-S** single channel high voltage amplifier / 3U plug-in card

- **HAR42-4** Tabletop 4U subrack for up to 4 amplifier modules HA2B5-S / HA3B3-S

# 3 Description

The single-channel high voltage amplifiers **HA2B5-S / HA3B3-S** with bipolar output voltage are designed to drive capacitive and resistive-capacitive loads.
The amplifiers are characterized by high speed, good stability and low noise. Piezo elements, electroactive polymers, electrorheological fluids, electrostatic deflecting electrodes and many other loads can be driven by this amplifier easily.

For **HA2B5-S** output voltages of -2000V to +2000V at load currents of up to ±5mA and >7mA$_P$ are provided. The signal gain is 200, the input voltage range is -10V...+10V.
For **HA3B3-S** output voltages of -3000V to +3000V at load currents of up to ±3mA and >5mA$_P$ are provided. The signal gain is 300, the input voltage range is -10V...+10V.
The output voltage can be monitored by a high-speed voltage monitor; a current monitor provides a representation of the output current.

**HA2B5-S** and **HA3B3-S** are 3U plug-in cards intended to be mounted in a suitable subrack.
The deviced incorporate the high voltage amplifier itself, high voltage sources for the output stage, measuring functions as well as monitoring and protective functions.

The amplifier's output is protected against overload, short circuit, overtemperature, transient overvoltage and high voltage flashover. LEDs on the front panel indicate operation and error statuses.

The **HAR42-4** is a tabletop subrack to accommodate up to 4 high voltage amplifier modules **HA2B5-S** or **HA3B3-S**. Both models can be combined in a single subrack.
It features internal power supplies, cooling fans, a common Interlock input for all channels and a HV OFF button. Customized and full custom models are available on request.

## 3.1 Block Diagram



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## 3.2 Control Voltage Input

The BNC control voltage input **In** is connected to a differential amplifier to suppress common mode voltages between the external signal source and the amplifier (ground loops). Two jumpers (W2, W5) are provided on each amplifier module in order to adapt the control voltage input to the signal source. W5 connects the input signal reference via 100Ω to the amplifier signal ground. W2 adjusts the amplifier gain to the output impedance of the signal source.


W5

| | | |
|---|---|---|
| 1-2 | Floating signal source<br>Common mode voltage <1$V_{RMS}$ | Default |
| 2-3 | Grounded signal source (connected to PE)<br>Common mode voltage <5$V_{RMS}$ | |

W2

| | | |
|---|---|---|
| 1-2 | Output impedance of signal source <1 Ω | Default |
| 2-3 | Output impedance of signal source 50 Ω | |

## 3.3 Monitor Outputs

Two BNC monitor outputs provide actual values of output voltage and output current, both of which are normalized to ±10 V.
The voltage monitor output **V Mon** receives its signal via a compensated voltage divider and provides a scaled image of the output voltages. The frequency response is linear up to well above the upper cut-off frequency of the amplifiers. The frequency response of the **I Mon** current monitor output is limited to about 9kHz in order to filter out the common mode ripple of the internal high voltage sources.

The monitor outputs are buffered (output impedance: 2kΩ) and short-circuit-proof. They are able to drive capacitive loads (coaxial cables), but are not designed to drive cables with a low-impedance termination.

## 3.4 Differential Output Mode

Two amplifier modules can be configured to operate in a differential output mode. In this configuration, only amplifier 1 (Master) receives the input signal from the signal source. Amplifier 2 (Slave) receives the input signal through the backplane of the subrack. The signal to amplifier 2 is inverted (180° phase shift in respect to amplifier 1).
This mode can be used e. g. to differentially drive two deflection plates or to drive a floating load with up to 8000$V_{PP}$.



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Two jumpers (W3, W4) are provided on each amplifier module to configure differential output mode:

W3

| | | |
|---|---|---|
| 1-2 | Master | Default |
| 2-3 | Slave | |

W4

| | | |
|---|---|---|
| 1-2 | Master | Default |
| 2-3 | Slave | |

## 3.5 DISABLE

The high voltage amplifier channels can be remotely switched off through the **DISABLE** input. The signal is available through connector **X1 INTERLOCK** on the HAR42-4 rear panel. It is TTL-compatible. A LOW-signal turns on all amplifier outputs. In case of open input or HIGH signal, the amplifier outputs are forced to 0V. During disable the internal high voltage sources are not turned off. The **DISABLE** input can be used to turn on and off the amplifier outputs relatively fast.
If the **DISABLE** input is not needed, a wire jumper can be installed between **DISABLE (X1.4)** and **GND (X1.5)** to turn on the amplifiers permanently.

The **DISABLE** input is not suitable to achieve a safe state at the amplifier output. It must not be used for safety relevant purposes.

## 3.6 Loading Conditions

The amplifiers are designed to drive capacitive and resistive-capacitive loads. The output is stable even with large capacitive loads. In case of larger load capacitances overshoot of the output may occur.

The slew rate that can be achieved on the output depends on the load capacitance. The effective load capacitance $C_L$ consists of the amplifier's internal output capacitance (ca. 80pF), capacitance of the output cable (a typical coaxial cable: ca. 100pF/m) and capacitance of the connected load.
The output stage can provide peak currents ($I_{OP}$) of > ±7.5mA$_P$ for ca. 1s. The maximum static output current is +5mA and -5mA.
Achievable slew rate: **$SR = I_o / C_L$ [V/s]**.

If the average positive or negative output current exceeds 5mA (HA2B5-S) or 3mA (HA3B3-S) the amplifier shuts down with **Overload**.

If the maximum slew rate is exceeded, distortions occur in the output signals. In principle, the amplifier should thus only be controlled by input signals that satisfy the achievable slew rate for a given load. However, dynamic override of the inputs (e.g. control by square wave signals) is harmless. The edges of the output waveform are nearly linear then with a slight overshoot.
Large capacitive loads driven by high frequency signals may result in a DC-offset superimposed on the output voltage. This occurs if the final value of the desired output voltage can not be reached periodically.



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## 3.7 Protection

During operation, the internal auxiliary supplies, overload of the high voltage sources, overtemperature and interlock are monitored. In the event of a fault, the high voltage supplies are switched **off**; the shutdown state is latched and displayed on LEDs.
A shutdown state can only be exited by means of a shutdown reset (push button **SDN Reset** on the HAR42-4 front panel or signal **SDR (X1.1)** on connector **X1 INTERLOCK** set to +24V).
After power on the unit will be in shutdown state.

| **LED** | **Function** | |
|---|---|---|
| **Enable** | on: | output stage is enabled by signal DISABLE=low |
| **HV ok** | on: | internal HV sources on, no overload |
| **Interlock** | on: | shutdown: interlock circuit open |
| | blink: | shutdown after interlock |
| **Overload** | on: | overload |
| | blink: | shutdown due to overload |
| **Overtemp** | on: | overtemperature |
| | blink: | shutdown due to overtemperature |

## 3.8 Interlock / HV Off

The amplifier modules incorporate an interlock circuit through which the supply voltage of the high voltage sources is switched.
The interlock signal is available via the rear connector **X1 INTERLOCK** on the subrack. The **HV off** palm button is looped into the interlock circuit. It is a closed circuit (break contacts). Its source voltage is 24V$_{DC}$.
To enable the high voltage generators **+24V_IL (X1.2)** and **IL (X1.3)** must be connected by a jumper or a contact. The contact can be part of an external interlock circuit. The quiescent current is 30mA typ.
When the interlock circuit is closed and the **HV off** palm button is released, the palm button will be lit to indicate that the high voltage sources are switched on.
The high voltage generation is not in operation until the **Interlock** shutdown state is cleared by shutdown reset.

The device must be disconnected from the power supply before carrying out any operations on the test setup or before touching the output terminals.




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# 4 Technical Data

**Mainframe HAR42-4**

| Parameter | Conditions | |
|---|---|---|
| Mains voltage | | 95 – 265VAC |
| Mains frequency | | 47 – 63Hz |
| Input current | $V_{Line}$=115$V_{AC}$, full load | 1.0$A_{RMS}$ maximum |
| | $V_{Line}$=230$V_{AC}$, full load | 0.5$A_{RMS}$ maximum |
| Mains Fuses | F1, F2 | T6.3A, 250V, IEC127-2/V |
| External Fusing | | 16A |
| Protection Category | | I |

- Fuses F1, F2 are located within the mains connector unit on the rear.
- Signal ground and high voltage ground are connected to chassis ground / protective earth and the earth connector (M4 nut).
- The appliance conforms to protection category I. It must only be used on mains power sockets with a ground connection.

**Amplifier modules HA2B5-S / HA3B3-S**

| Parameter | Conditions | | |
|---|---|---|---|
| Supply voltage, $V_S$ | | | 24$V_{DC}$ ±10% |
| Supply current, $I_S$ | $V_S$ = 24V | | <1.6$A_{DC}$ |
| | | | |
| Input voltage range | Control input | | -10.0V – +10.0V |
| Max. input voltage | | | ±18V |
| Input resistance | | | 25kΩ typ. |
| DC Gain | | HA2B5-S | 200 ±0.1% |
| | | HA3B3-S | 300 ±0.1% |
| Offset | | | ≤ 100mV |
| Output voltage range | | HA2B5-S | -2000V – +2000V |
| | | HA3B3-S | -3000V – +3000V |
| Load current range | static | HA2B5-S | -5mA – +5mA |
| | | HA3B3-S | -3mA – +3mA |
| Load current range | dynamic, t < 1ms | HA2B5-S | -7mA – +7mA |
| | | HA3B3-S | -5mA – +5mA |
| Power bandwidth | $C_L$ = 0pF, THD ≤ 1% | | |
| | VO = 4000$V_{PP}$ | HA2B5-S | DC – ≥ 5kHz |
| | VO = 6000$V_{PP}$ | HA3B3-S | DC – ≥ 2.5kHz |
| Power bandwidth | $C_L$ = 100pF, THD ≤ 1% | | |
| | VO = 4000$V_{PP}$ | HA2B5-S | DC – ≥ 2.5kHz |
| | VO = 6000$V_{PP}$ | HA3B3-S | DC – ≥ 1.3kHz |
| Small Signal Bandwidth | $C_L$ = 100pF, $V_I$ = 2$V_{PP}$, $V_O$ -3dB | | DC – ≥ 20kHz |
| Slew-Rate | $C_L$ = 100pF | HA2B5-S | ≥ 40V/µs |
| | | HA3B3-S | ≥ 25V/µs |
| Internal output capacitance | | | ca. 80pF |
| Ripple, Noise | $C_L$ = 100pF, | HA2B5-S | ≤ 20m$V_{RMS}$ |
| | 1Hz – 20kHz | HA3B3-S | ≤ 20m$V_{RMS}$ |



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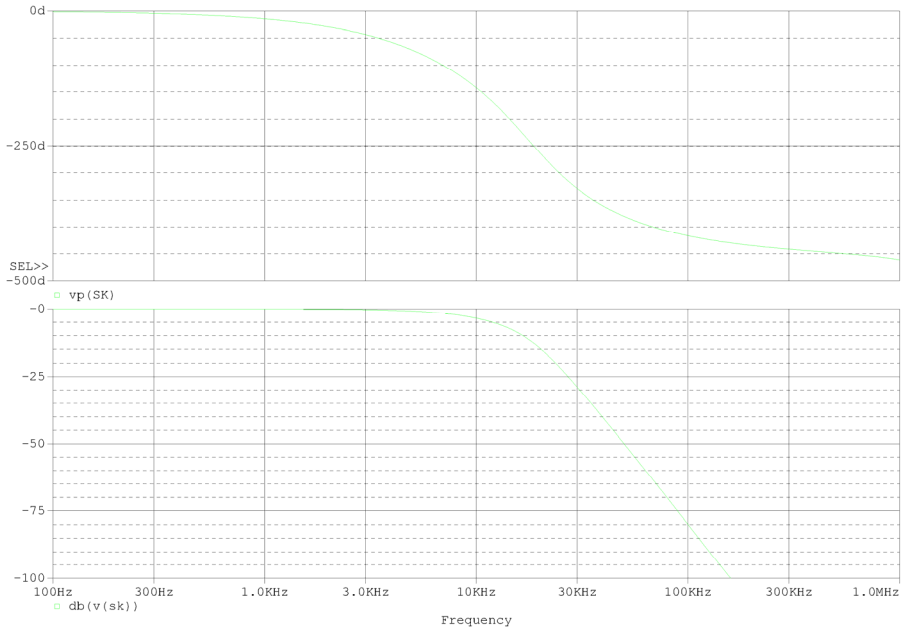
| | | |
|---|---|---|
| Scaling monitor output V | HA2B5-S<br>HA3B3-S | 10V ≙ 2000V ±0.2%<br>10V ≙ 3000V ±0.2% |
| Bandwidth monitor output V | | DC – ≥ 50kHz |
| Scaling monitor output I | | 10V ≙ 10mA ±1% |
| Bandwidth monitor output I | | DC – ≥ 9kHz |

- Signal ground and high voltage ground are connected to the chassis ground / earth terminal.

## 4.1 Frequency Response of Current Monitor




## 4.2 Ambient Conditions

| Parameter | Conditions | Min. | Max. | Unit |
|---|---|---|---|---|
| Ambient temperature<br>- Operation<br>- Storage and Transportation | | <br>-20<br>-25 | <br>+50<br>+70 | <br>°C<br>°C |
| Relative humidity<br>- Operation<br>- Storage and Transportation | Not condensing | <br>5<br>5 | <br>80<br>95 | <br>%<br>% |

- Depending on the ambient temperature, modulation amplitude and load capacitance, the maximum output power may need to be derated.



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## 4.3 Mechanical Specifications

**Mainframe HAR42-4**

| Parameter | | Unit |
|---|---|---|
| Depth overall | 490 | mm |
| Depth case | 420 | mm |
| Width overall | 250 | mm |
| Width case | 235 | mm |
| Height | 185 | mm |
| Weight without amplifier modules | 4.0 | kg |

**Amplifier module HA2B5-S / HA3B3-S**

| Parameter | | Unit |
|---|---|---|
| Depth overall | 255 | mm |
| Depth module | 235 | mm |
| Width | 40 | mm |
| Height | 128 | mm |
| Weight | 0.51 | kg |



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# 5 Operation

## 5.1 Initial Check

Once the product is delivered, please check the packaging and the device for possible transport damage. Please check the device taken out of the packaging for any mechanical defects before the unit is put into operation.
If the device has any signs of damage caused by transport, please immediately inform the shipping company so that damages can be claimed.

## 5.2 Warning Notices

- For safe operation of this device it should be put into operation by a qualified electrician according to this Operating Manual.
- The device may only be operated as a component of an overall setup that fully complies with the regulations for working with high voltage systems.
- Output connectors may only be touched when the device is disconnected from the power supply! Otherwise, there is a risk of electric shock.
- The test setup must be fully wired and protected against any contact before the device is put into operation.
- The test setup must be checked each time before the device is put into operation to ensure that it is not potentially dangerous. It should be checked that the high voltage connections are faultless and the insulation of the wires is not damaged.
- The high-voltage areas must be blocked in accordance with regulations or secured by other means.
- Once the test setup is connected, any existing capacitances can be charged to high voltage. They may carry dangerous voltages even after the device is switched off.
- The ground bolt on the rear panel of the device must be connected to the central grounding point of the test setup and to protective earth. Local regulations on grounding must be observed.
- No wires or similar objects may project into the device through the ventilation slots
- If it is suspected that safe operation is no longer possible, the device has to be taken out of operation and secured against unintentional operation.

This symbol on the output terminals warns of the risk of electric shock.

## 5.3 Temperature Compensation

To avoid condensation within the device, it should be allowed to reach the room temperature. Please unpack the product at least two hours prior to power-up.



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## 5.4 Power Supply

The **HAR42-4** subrack provides the 24V supply voltage for the amplifier modules.
The mainframe is fed by mains voltage.

## 5.5 Ventilation

The **HAR42-4** subrack is equipped with fans on the rear panel. Air intake is below the front panels. Sufficient space must be allowed for cooling air to reach the ventilation inputs and for the fan exhaust air to exit from the rear of the unit.

The speed of the fans is controlled automatically by the temperature of the amplifier modules.

## 5.6 Functional Test

Before the device is finally put into operation in a setup, a short functional test is to be carried out.
It is necessary that the interlock circuit is closed.

1. Make sure that the supply voltage is disconnected.
2. Remove all input signal cables and the output cable from the device.
3. Connect the terminals **+24V_IL (X1.2)** and **IL (X1.3)** by means of a wire link.
4. Connect the terminals **DISABLE (X1.4)** and **GND (X1.5)** by means of a wire link.
5. Connect the mains supply voltage.
6. Switch on the **Power** switch.
7. Release the **HV off** palm button.
8. The **Power** switch and **HV off** button will light up, **Enable** LEDs will light up, **IL, Overload** and **Overtemp** LEDs will flash.
9. Push the **SDN Reset** push button.
10. The **IL, Overload** and **Overtemp** LEDs will turn off, the **HV ok** LEDs will light up.
11. Push in the **HV off** palm button.
12. The **HV off** button and **HV ok** LEDs will turn off, the **IL** LEDs will light up.
13. Open the interlock bridge at **X1**.
14. Release the **HV off** palm button.
15. The **Interlock** LEDs will light up continuously.
16. Press the **SDN Reset** push button.
17. The interlock status remains unchanged and the high voltage cannot be switched on.
18. Turn off the supply voltage.



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## 5.7 Connector X1 INTERLOCK

Connector type: Phoenix Mini-Combicon, 5-pin
Mating connector: Phoenix Mini-Combicon, 5 circuits, FK-MCP1.5_ 5-ST-3.81

| Pin | Signal | Direction | Function |
|---|---|---|---|
| 1 | SDR | I | Control signal: 24V for 0.2s => Shutdown Reset;<br>Caution: This reactivates the HV output after a shutdown! |
| 2 | +24V_IL | O | 24V output for interlock circuit and SDR signal;<br>protected against overload |
| 3 | IL | I | Interlock / bridge to X1.+24V_IL |
| 4 | DISABLE | I | Control signal: TTL compatible; 2.5kΩ internal pull-up resistor;<br>LOW == enable amplifier outputs |
| 5 | GND | - | Supply voltage GND |

## 5.8 Output Connector X7

Connector type: SHV

The high voltage connector may only be mated or unmated when the supply voltage is switched off! Otherwise, there is a risk of an electric shock.

## 5.9 Grounding

The M4 ground nut on the back panel of the device must be connected to the central grounding point of the test setup and to protective earth.

## 5.10 DIP Switch S1

| Switch | Function | Default |
|---|---|---|
| S1-1 | Disable Interlock shutdown latch | OFF |
| S1-2 | Disable Overload shutdown latch | OFF |
| S1-3 | Disable Overtemperature shutdown latch | OFF |
| S1-4 | not used | |

For safety reasons it is not recommended to disable the shutdown latches. In case of disabled shutdown latches high voltage will reappear at the outputs after a shutdown condition (Interlock, Overload, Overtemperature) is no longer pending.
It is recommended to operate the unit with shutdown latches enabled and actively reset any shutdown condition via the **SDN Reset** push button or the **SDN** signal on X1.



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## 5.11 Internal Connectors

Internal connector X1 of HA2B5-S / HA3B3-S plug-in modules (DIN41612, Type F)

| Pins | | | Signal | Dir | Function |
|---|---|---|---|---|---|
| D2 | B2 | Z2 | n.c. | | |
| D4 | B4 | Z4 | n.c. | | |
| D6 | B6 | Z6 | n.c. | | |
| D8 | B8 | Z8 | n.c. | | |
| D10 | B10 | Z10 | n.c. | | |
| D12 | B12 | Z12 | GND | - | GND |
| D14 | B14 | Z14 | n.c. | | |
| D16 | B16 | Z16 | n.c. | | |
| D18 | | | HVON_BP | I | HV enable input; used for interlock or general high voltage ON; approx. 10mA @ 24V |
| | B18 | | SDNRST_BP | I | Shutdown reset input; clear latched shutdown conditions; $t_P$>200ms @ 24V; approx. 2.5mA @ 24V |
| | | Z18 | DISABLE_BP | I | Disable input; TTL compatible; 10kΩ internal pull-up resistor to +5V; LOW == enable amplifier outputs; $t_D$≈50ms; see 3.5 |
| D20 | | | STAT_BP | O | Status output; 5V; HIGH == high voltage generation enabled |
| | B20 | | VFCON | O | Fan control output; 100mV/°C; 9.3V == 100°C; min. load: 10kΩ; DO NOT OVERLOAD OR SHORT TO GND |
| | | Z20 | CHA_SEL_BP | I | Channel select input; TTL compatible; 10kΩ input resistance; HIGH == activate backpanel monitor outputs IOAV_BP and VOAV_BP |
| D22 | | | VOAV_BP | O | Output voltage monitor output; ±10V; must be activated via CHA_SEL_BP; high impedance if disabled; see 3.3 |
| | B22 | | IOAV_BP | O | Output current monitor output; ±10V; must be activated via CHA_SEL_BP; high impedance if disabled; see 3.3 |
| | | Z22 | AV_RTN | - | Monitor output reference point; connected to analog GND |
| D24 | | | INP_S | I | Slave unit pos. differential input; ±10V; see 3.4 |
| | B24 | | INP_S | I | connected to D24 |
| | | Z24 | INN_S | I | Slave unit neg. differential input; ±10V; see 3.4 |
| D26 | | | VONV_BP | O | Inverted input signal output; ±10V; used to drive 2nd channel module in differential mode; see 3.4 |
| | B26 | | VONV_BP | O | connected to D26 |
| | | Z26 | INN_S | I | connected to Z24 |
| D28 | | | VONV_RTN | - | VONV_BP output reference point; connected to analog GND |
| | B28 | | VONV_RTN | - | connected to D28 |
| | | Z28 | VT_MAX | O | Temperature monitor output; 100mV/°C; 10V == 100°C; min. load: 10kΩ; DO NOT OVERLOAD OR SHORT TO GND |
| D30 | B30 | Z30 | +24V | I | +24$V_{DC}$ supply voltage input |
| D32 | B32 | Z32 | GND | - | GND |



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# 6 Operation / Maintenance

## 6.1 Troubleshooting

If the device behaves unusual or erratic, please switch off the supply voltage and check the wiring of the load and that of the control and monitoring signals. Check the connected load and the signal source. Check the interlock circuit.

During operation various parameters are monitored and analyzed. In case of a fault the error is reported via error LEDs on the front panel of the amplifier module. Press the **SDN Reset** push button to reset the error condition.

Do not attempt to locate any faults within the device. This can be dangerous to life due to the high voltage used in the device. In such a case, please return the device to the manufacturer after consultation.

| **Symptom** | **Possible causes** |
|---|---|
| Device will not turn on; **Power** LED will not light up | - No supply voltage present<br>- Fuses F1, F2 in the IEC inlet defective |
| **HV off** palm button will not light up | - **HV off** palm button is in **off** position (pushed in)<br>- Interlock circuit is open |
| Output signal is distorted | - Load capacitance too large for the desired slew rate (see section 3.6 for load conditions) |
| Amplifier switches off, the **OVERLOAD** indicator lights up | - Dynamic load current exceeded (see section 3.6 for load conditions)<br>- Static load current exceeded (see section 3.6 for load conditions) |
| Amplifier switches off, the **OVERTEMP** indicator lights up | - Poor ventilation<br>- Total load too large (see section 3.6 for load conditions) |

## 6.2 Maintenance

Depending on the cleanliness of the ambient air dust may accumulate within the unit possibly blocking the airflow. In that case the accumulated dust has to be removed by blowing out the unit cautiously. The manufacturer specified lifetime of the fans is >50000h. After about 6 years of continuous operation the fans might be replaced.
Type: Papst 8314H (HAR42-4).

**Caution:** disconnect the unit from the power supply before removing any modules or opening any covers.

Further regular maintenance is not required.

## 6.3 Cleaning

If necessary, wipe the device with a slightly damp cloth. Do not use abrasive detergents or solvents.



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As of 03/2021

**Document History:**

| Version | Date | Name | Changes |
|---|---|---|---|
| 1.0 | 2019-09-03 | WM | Created |
| 1.1 | 2020-10-19 | WM | extended description of internal connector X1 |
| 1.2 | 2021-03-09 | WM | HA3B3-S added |
| 1.3 | 2021-07-16 | WM | pin-assignment X1 IOAV_BP, VOAV_BP corrected |



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# 7 Declaration of Conformity

We declare under sole responsibility that the products

| | |
|---|---|
| Device: | **High Voltage Amplifiers** |
| Series: | **HA2B5-S, HA3B3-S** |
| Subrack | **HAR42-4** |

are in accordance with the following European directives:

| | |
|---|---|
| Low Voltage Directive | 2014/35/EU |
| EMC Directive | 2014/30/EU |

and comply with the following European standards:

| | |
|---|---|
| EN 61010-1:2010 | Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements |
| EN 61326-1:2013 | Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements<br><br>Classification: Group 1, Class B |

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