# ZSO
# ZSO MINI

## Stepper Motor Power Stages for Bipolar Control


**Manual 2073-A003 GB**

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customized solutions *in motion*

# ZSO
# ZSO MINI

## Bipolar stepper motor power stages

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Every possible care has been taken to ensure the accuracy of this technical manual. All information contained in this manual is correct to the best of knowledge and belief but cannot be guaranteed. Furthermore we reserve the right to make improvements and enhancements to the manual and / or the devices described herein without prior notification.

We appreciate suggestions and criticisms for further improvement. Please send your comments to the following

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## Contents

# 1 Description

## 1.1 Short

ZSO and ZSO MINI power stages are used for the bipolar control of two-phase stepper motors. The "little" ZSO (width 40.3 mm) delivers phase currents between 0.5 and 6.5 $A_{rms}$. The "big" ZSO (width 70.8 mm) delivers phase currents between 1.1 and 13 $A_{rms}$.

Both models are available in the full step/half step version as well as in the MINISTEP version.

- Type ZSO for full step and half step modes with 200 and 400 steps/rev. for a 200 step/rev. motor
- Type ZSO MINI for the ministep mode with a resolution of 500 and 1000 steps/rev. (1/2.5 or 1/5 step mode) for a 200 step/rev. motor

It is also possible to connect motors having a different number of steps/rev. In this case, the resulting step resolution differs, depending of the operating mode selected.

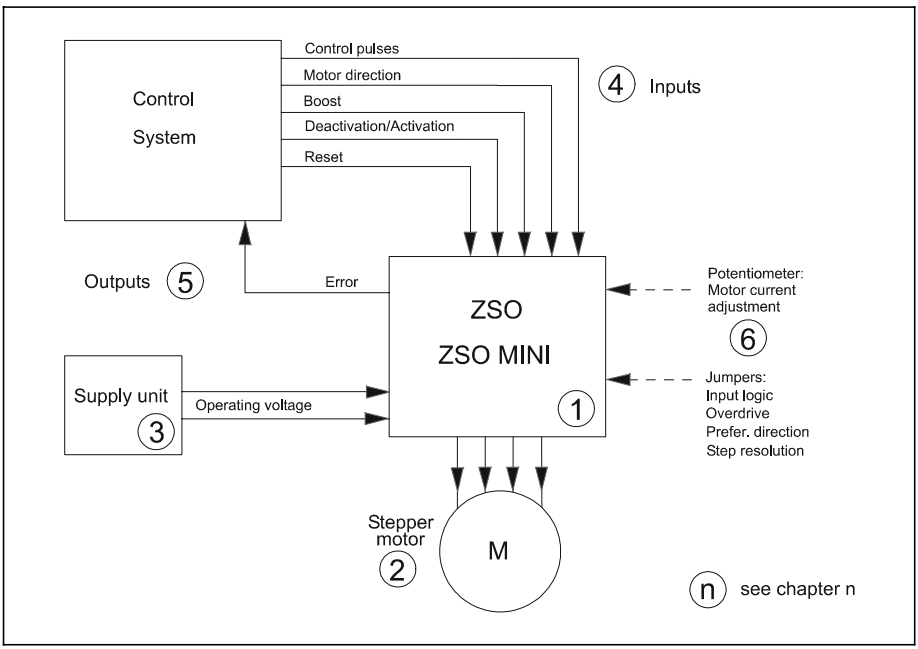



Fig. 1: Connecting diagramm for ZSO power stages

In order to drive the stepper motor, ZSO power stages require:

- a supply voltage of 40, 70 or 140 $V_{DC}$ and
- input signals from a control unit: control pulses, rotating direction, boost, deactivation and reset.

The input signal logic can be set to positive or negative logic, by means of a jumper. This enables the ZSO power stages to be driven from various control units including a stepper motor interface.

All ZSO power stages have a common error output, designed as an opening contact.

The push-pull inputs and the error output are electrically insulated by means of opto-couplers from the supply voltage.

## 1.2 Some Technical Details

- ZSO and ZSO MINI operate on the patented SYNCHROCHOP principle which enables the regulation of the motor current for both motor phases, synchronized with the rotating field. The SYNCHROCHOP principle reduces resonance and motor noise during operation.
- The run current is set by means of a scaled potentiometer. ZSO power stages automatically switch to the stop current (50 % of run current) if the control pulses are interrupted during more than 40 msec.
- For speeds over 5 rev./sec (for a 200-step motor), the chopper frequency is automatically increased from 20 KHz to 40 KHz, to avoid high motor current ripples at high speeds. High ripples may provoke torque drop and temperature increase of the motor.
- The input signal's logic can be set either positive or negative via a jumper.
- The inputs and output signals are electrically insulated from the power stage supply voltage by means of optocouplers. This confers optimum suppression of disturbances between control circuit and power circuit.
- A multi-colour LED indicates the power stage status.

## 1.3 Technical characteristics

| **Type** | ZSO 22-40<br>ZSO MINI 22-40<br>**ZSO 42-40**<br>**ZSO MINI 42-40** | ZSO 52-70<br>ZSO MINI 52-70<br>ZSO72-70<br>ZSO MINI 72-70<br>**ZSO 92-70**<br>**ZSO MINI 92-70** | ZSO 102-140<br>ZSO MINI 102-120<br>ZSO 142-140<br>ZSO MINI 142-140<br>**ZSO 182-140**<br>**ZSO MINI 182-140** |
|---|---|---|---|
| **Stepper motor** | Two-phase 4-, 6- oder 8-lead stepper motors. It is not permitted to connect 5-lead stepper motors to the unit. Minimum inductance of a motor phase: 0.5 mH. | | |
| **Phase currents** | | **ZSO/ZSO MINI 52-70**<br>0.6 – 2.8 $A_{rms}$<br>with Boost:<br>0.8 – 3.6 $A_{rms}$<br>**$I_{max}$ = 5 A** | **ZSO/ZSO MINI 102-140**<br>1.1 – 5.6 $A_{rms}$<br>with Boost:<br>1.4 – 7.3 $A_{rms}$<br>**$I_{max}$ = 10 A** |
| | **ZSO/ZSO MINI 22-40**<br>0.5 – 1.3 $A_{rms}$<br>with Boost:<br>0.7 – 1.7$A_{rms}$<br>**$I_{max}$ = 2.3 A** | **ZSO/ZSO MINI 72-70**<br>0.8 – 3.9 $A_{rms}$<br>with Boost:<br>1 – 5 $A_{rms}$<br>**$I_{max}$ = 7A** | **ZSO/ZSO MINI 142-140**<br>1.6 – 7.8 $A_{rms}$<br>with Boost:<br>2 – 10.1 $A_{rms}$<br>**$I_{max}$ = 14 A** |
| | **ZSO/ZSO MINI 42-40**<br>0.6 – 2.3 $A_{rms}$<br>with Boost:<br>0.8 – 3 $A_{rms}$<br>**$I_{max}$ = 4 A** | **ZSO/ZSO MINI 92-70**<br>1 – 5 $A_{rms}$<br>with Boost:<br>1.3 – 6.5 $A_{rms}$<br>**$I_{max}$ = 9 A** | **ZSO/ZSO MINI 182-140**<br>2 – 10 $A_{rms}$<br>with Boost:<br>2.6 – 13 $A_{rms}$<br>**$I_{max}$ = 18 A** |
| | **The run current can be set at the motor current potentiometer (behind the front plate).** Stop current: 50% of the set operating current. Minimal stop current: 0.5 A at 70 V motor voltage, 0.3 A at 40 V motor voltage ( chap. 6.1). | | |
| **Operating voltage** | filtered unregulated DC voltage | | |
| Rated voltage | +40 $V_{DC}$ | +70 $V_{DC}$ | +140 $V_{DC}$ |
| Perm. range | +24 to +80 $V_{DC}$ | +40 to +80 $V_{DC}$ | +45 to +160 $V_{DC}$ |
| Limit value | 100 $V_{DC}$ | 100 $V_{DC}$ | 200 $V_{DC}$ |
| | **Caution:** Voltages above 100 $V_{DC}$ – even for a short time (µsec range) – provoke the destruction of the power stage. | | |

| **Type** | ZSO 22-40<br>ZSO MINI 22-40<br>**ZSO 42-40**<br>**ZSO MINI 42-40** | ZSO 52-70<br>ZSO MINI 52-70<br>ZSO72-70<br>ZSO MINI 72-70<br>**ZSO 92-70**<br>**ZSO MINI 92-70** | ZSO 102-140<br>ZSO MINI 102-120<br>ZSO 142-140<br>ZSO MINI 142-140<br>**ZSO 182-140**<br>**ZSO MINI 182-140** |
|---|---|---|---|
| **Chopper** | 20 kHz synchronized with the rotating field, alternately chopped. For speeds above 5 rev./sec (for a 200-step motor), the chopper frequency is increased to 40 KHz. | | |
| **Inputs** | The following input signal logic can be selected by means of a jumper: control pulses, boost, activation and reset. | | |
| | 0 – 2 V = LOW | These values are valid for the jumper position “positive logic ” (setting at delivery). | |
| | 3 – 5 V = HIGH | | |
| | If a logic voltage > 5 V is used, a series resistor must be installed to limit the optocoupler current to approx. 10 mA. (see chapter 4). | | |
| Control pulses | Maximum frequency of the drive pulses: 100 KHz<br>Minimum pulse width: 5 µsec | | |
| Motor direction of rotation | When this input is activated, the motor direction is reversed. | | |
| | **Caution:** The “Motor direction" input must only be activated when the motor is at a standstill. | | |
| Boost | When this input is activated, the phase currents are increased by 30 %. | | |
| Activation | The motor current is activated. | | |
| Reset | A reset sets the power stage to a defined initial status. | | |
| **Error output**<br>Fault | Opening contact<br>Optocoupler output with transistor<br>Rated current = 20 mA, $U_{max}$ = 30 V, $U_{CE\ sat}$ at 20 mA < 1 V<br>Common error output | | |
| **Error signal if** | motor current >14 A | motor current >25 A | |
| | operating voltage <35 V | operating voltage < 40 V | |
| | heat sink temperature > 85 °C | | |
| **Jumpers** | **Remark:**<br>Before changing the jumper positions<br>1. Switch off the supply voltages<br>2. Unscrew the module’s front panel | | |

| **Type** | ZSO 22-40<br>ZSO MINI 22-40<br>**ZSO 42-40**<br>**ZSO MINI 42-40** | ZSO 52-70<br>ZSO MINI 52-70<br>ZSO72-70<br>ZSO MINI 72-70<br>**ZSO 92-70**<br>**ZSO MINI 92-70** | ZSO 102-140<br>ZSO MINI 102-120<br>ZSO 142-140<br>ZSO MINI 142-140<br>**ZSO 182-140**<br>**ZSO MINI 182-140** |
|---|---|---|---|
| **Step resolution** | The step resolution (number of steps per revolution) can be changed by jumper. The following values apply to a 200 steps/rev. motor: | | |
| | ZSO xxx-xxx | 400 (Half step) = position on delivery | |
| | | 200 (Full step) | |
| | ZSO MINI xxx-xxx | 1000 (1/5-step) = positon on delivery | |
| | | 500 (1/2.5-step) | |
| **Preferred motor direction** | By changing the Jumper position, the preferred motor direction referred to the logic level can be reversed.<br>Position on delivery: Preferred motor direction + | | |
| **Overdrive** | The overdrive function is activated by means of the corresponding jumper.<br>Position on delivery: Overdrive ON | | |
| **Input logic** | By changing the jumper position, positive or negative input logic can be set.<br>Position on delivery: Input logic positive (active high) | | |
| **Multi-colour LED** | Green: Ready<br>Yellow: Busy<br>Red: Fault<br>LED does not light: Reset, Disabled, Power off | | |
| **Permissible ambient temperature** | 0 to 40 °C | | |
| **Permissible heat sink temperature** | 85 °C max. | | |
| | If the heat sink temperature rises above the permissible temperature, the power stage is deactivated. The LED goes red. | | |
| **Ventilation** | The power stage should be mounted to allow free air circulation. Dependend of the operating conditions (as ambient temperature, air circulation, duty cycle, phase current setting) a fan should be mounted for cooling the power stage, if necessary. | | |

| **Type** | ZSO 22-40<br>ZSO MINI 22-40<br>**ZSO 42-40**<br>**ZSO MINI 42-40** | ZSO 52-70<br>ZSO MINI 52-70<br>ZSO72-70<br>ZSO MINI 72-70<br>**ZSO 92-70**<br>**ZSO MINI 92-70** |
|---|---|---|
| **Permissible motor cable length** | 50 m max. | |
| **Recommended motor cable** | 5-lead cable with shielding mesh | |
| | Minimum cross section 1 mm² per lead | Minimum cross section 1.5 mm² per lead |
| **Connector** | 32-pin connector according to DIN 41 612, type E | |
| **Weight, front panel included** | 0.4 kg | 1 kg |
| **Front panel dimensions** | 8 F x 3 U (40.3 x 128.4 mm) | 14 F x 3 U (70.8 x 128.4 mm) |
| | 10 F x 3 U (50.5 x 128.4 mm) for combination with G-ZSO adapter plate | |

## 1.4 Connector assignment

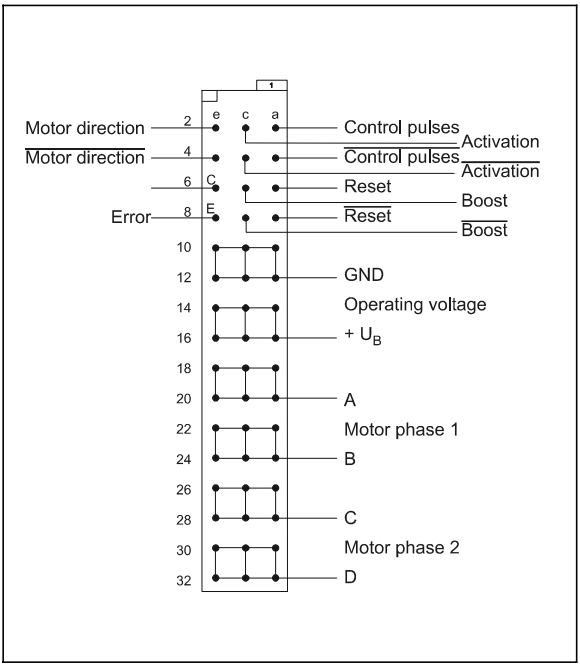



Fig. 2: Connector assignment

The connector is shown with view on the terminals.

48-pin connector according to DIN 41612,Version E

## 1.5 Dimensions

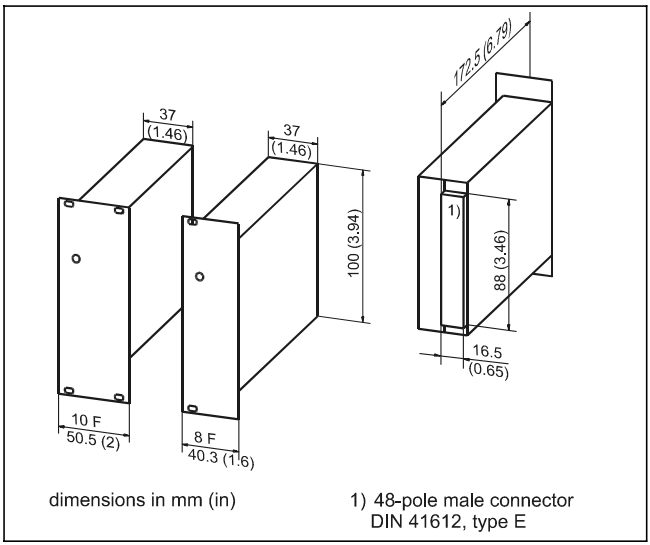



Fig. 3: Dimensions ZSO/ZSO MINI 22-20 to 92-70

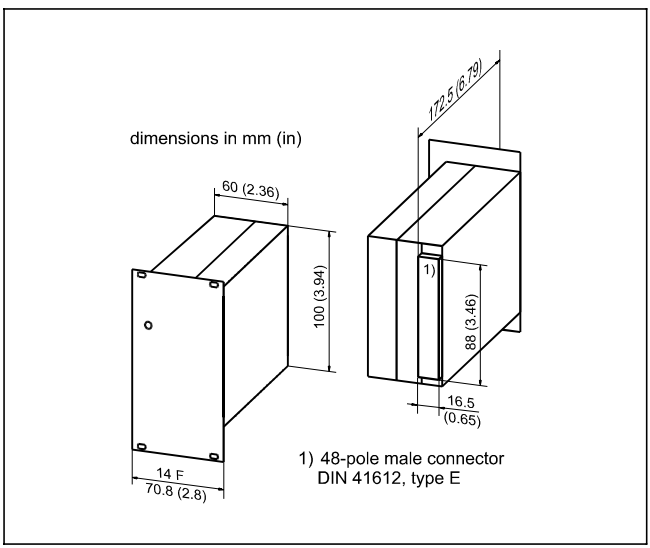



Fig. 4: Dimensions ZSO/ ZSO MINI 102-140 to 182-140

## 1.6 Block diagram

The block diagram below shows the ZSO operating principle:

- A special multifunction chip integrates the input logic, the ring counter for the different step resolution modes as well as the current regulation circuits. This subassembly also includes the current adjustment and monitoring circuits.
- Both output power stages contain bridge circuits, equipped with POWER-MOSFET transistors, various drivers, protective diodes and current sensors.
- The supply unit generates all operating voltages for the logic circuits from the unstabilized motor voltage.
  ZSO/ZSO MINI 22-40 to 92-70 power stages include a linear supply module. Due to the higher supply voltage, versions 102-140 to 182-140 include a switching type supply module.

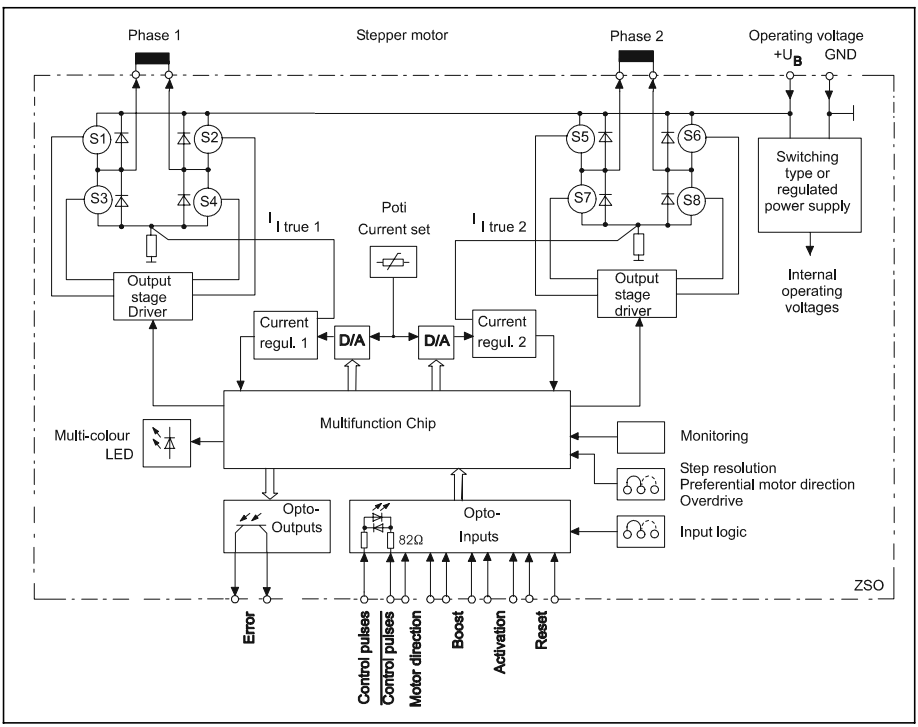



Fig. 5: Block diagram

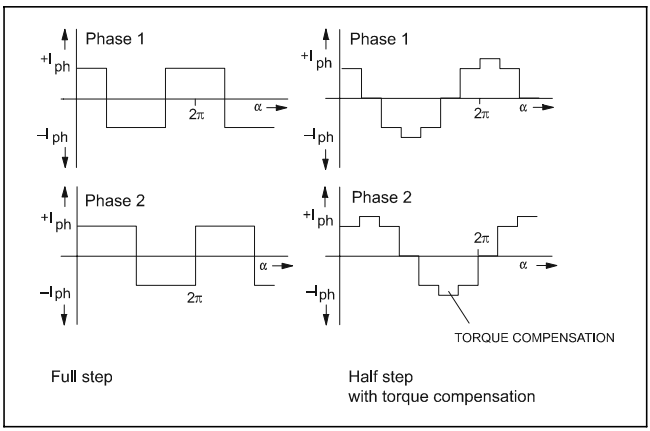
## 1.7 Full step / Half step mode

The "full step" mode is the operating mode in which a 200-step motor, for example, drives 200 steps per revolution. Therefore, a 500-step motor drives 500 steps per revolution in the full step mode. In the full step mode, both stepper motor phases are permanently energized.

The motor step resolution can be electronically multiplied by 2 by alternately energizing the stepper motor's phases 1, 1+2, 2 etc.: this is the "half step" mode. This means that a 200-step motor executes 400 true steps per revolution and a 500-step motor, executes 1,000 true steps per revolution.

Compared to the full step mode, the half step mode reduces the output torque by a factor of approximately 1/√2, since all motor phases are not permanently energized.To compensate this lack of torque, ZSO power stages use the "half step mode with torque compensation": as long as only one motor phase is energized, the current is increased by √2. Compared to the full step mode, the torque delivered is almost the same, however, most of the resonance of the full step mode is suppressed.

**Remark:**
In general, the current and loss values on the motor data sheets apply to a stepper motor with both phases energized.




The figure shows the phase currents for the full step mode and those of the half step mode with torque compensation.

Fig. 6: Phase currents in the full step and the half step mode

ZSO power stages are set to the half step mode on delivery. The jumper "step resolution" switches the unit to the full step mode.

**Caution:**

It is not permitted to change the step resolution during operation.

## 1.8 MINISTEP mode

ZSO MINI power stages increase the step resolution by a factor 5 or 2.5: this is the ministep mode.

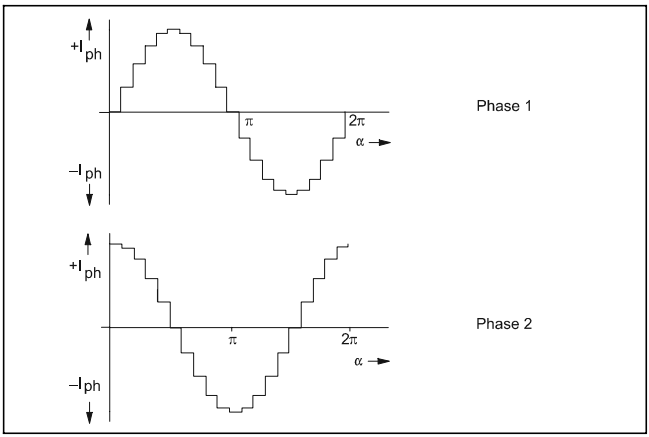



Fig. 7: Phase current in the ministep mode 1/5-step

Various advantages are obtained by the almost sine-shaped ministep mode current:

- The torque undulation decreases when the number of ministeps is increased.
- Resonance and overshoot are greatly reduced.
- The motor noise also drops when the number of ministeps is increased.

ZSO MINI power stages are set to the 1/5 step mode on delivery. The jumper “step resolution” switches the unit to the 1/2.5 step mode.

**Caution:** It is not permitted to change the step resolution during operation.

## 1.9 Boost

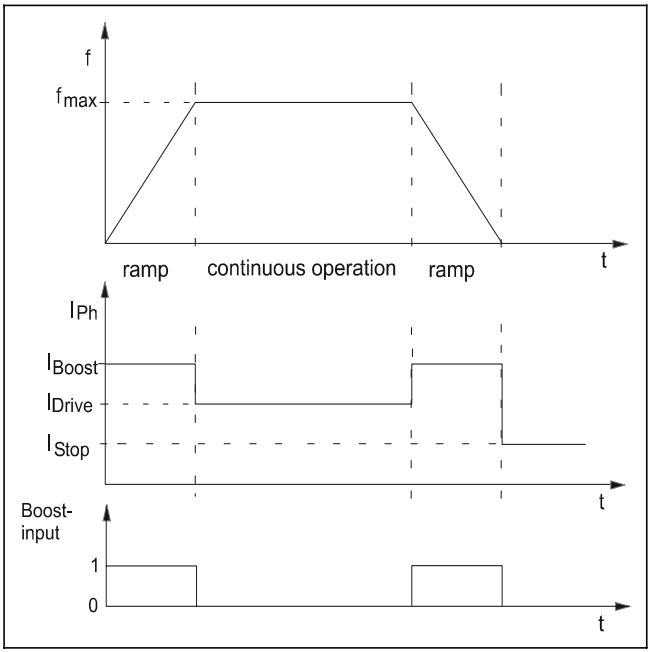



Fig. 8: Boost

The "Boost" function, which increases the motor current approx. by 30 %, can be switched on or off as requested.

**The "Boost" function is switched on by activation of the "Boost" input.**

**How to use the ”Boost” ?**

The motor torque required during acceleration and deceleration (ramps) is higher than that required during continuous motor operation ($f_{max}$). During continuous operation at $f_{max}$, the motor current can be reduced to avoid unnecessary heating of the motor.

In order to get the maximum available torque during the ramps, you can increase the motor current by switching on the "Boost" function.

## 1.10 Overdrive

In addition to the standard Boost function, the ZSO power stages include a dynamic Boost function: "Overdrive".

The "Overdrive" function compensates the current/time area in the higher frequencies which is due to motor inductivity and the increasing generator effect. To increase the torque, the r.m.s. phase current is automatically increased by a factor of 1.4 for speeds above 5 rps (for a 200-step motor). This function is simplifying the current shape, too.

The "Overdrive" function is activated or deactivated by a jumper.

**Caution:** It is not permitted to change the setting during operation.

# 2 Motor connection

## 2.1 Different types of motors

Type ZSO power stages can be used to drive various types of two-phase stepper motors. For 8-lead stepper motors, two types of connections can be used: parallel (1) or series (2) winding connection of the motors.

For 6-lead stepper motors, we recommend connection (3) with the motor windings in series. If the motor cannot be connected as per figure (3), it can be be used by connecting only 2 windings, as shown in (4).

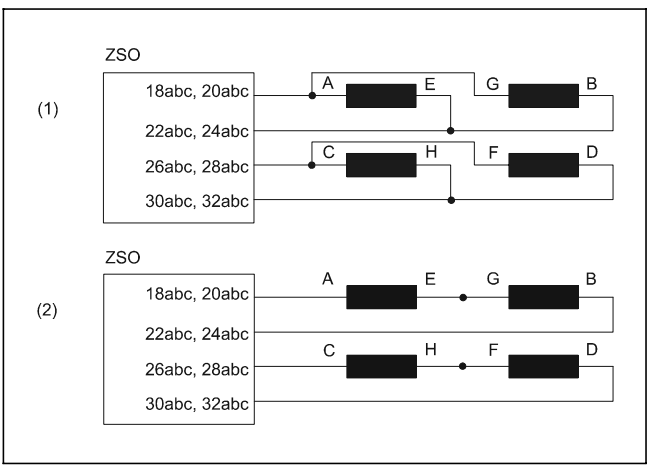
**Caution:** It is not permitted to connect 5-lead stepper motors to ZSO power stages.

**The power stage might be destroyed if 5-lead stepper motors are connected.**

The figures on the following pages show the connection of various types of stepper motors to the ZSO power stages. Letters A to H refer to the connecting diagrams in the motor data sheets for stepper motors types ZSS, ZSH, RSS and RSH.

**Caution:**

The stepper motor leads may be marked differently, depending of the type of motor used. **Before connecting the motor, please check the motor plate (voltage/current values) and the motor connecting diagram.**



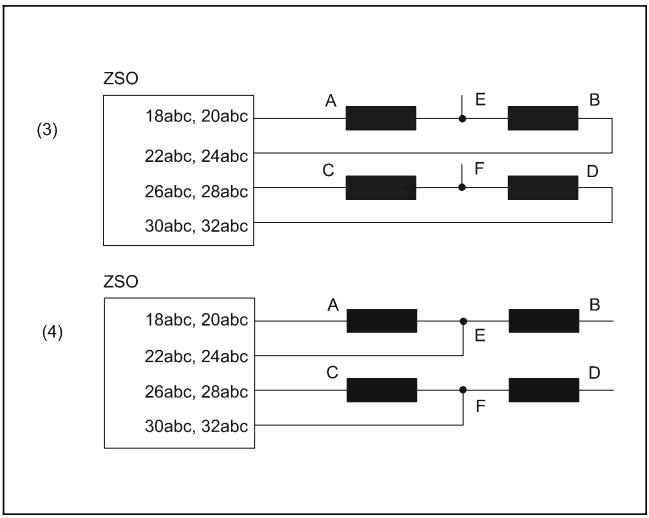

(1) 8-lead stepper motor connected as a 4-lead stepper motor

Windings connected in parallel (standard)

(2) 8-lead stepper motor connected as a 4-lead stepper motor

Windings connected in series

Fig. 9: 8-lead motor connection



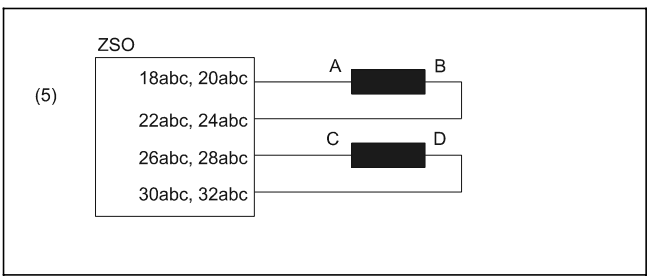

(3) 6-lead stepper motor

Windings connected in series

(4) 6-lead stepper motor

Used with 2 windings if connection (3) can not be effected

Fig. 10: 6-lead motor connection




(5) 4-lead stepper motor

Fig. 11: 4-lead motor connection

## 2.2 Motor cables

| | Minimum cable cross section | Maximum cable length |
|---|---|---|
| ZSO 22-40 – 92-70 | 1 mm² | 50 m |
| ZSO 102-140 – 182-140 | 1.5 mm² | |

**Caution:**

- We recommend to use a 5-lead cable with shielding mesh for connecting the motor!
- The cable shield should be connected with the motor housing (EMC type conduit fitting).
- All unused motor wires must be insulated individually (motor connections (3) and (4)).

## 2.3 Shielding

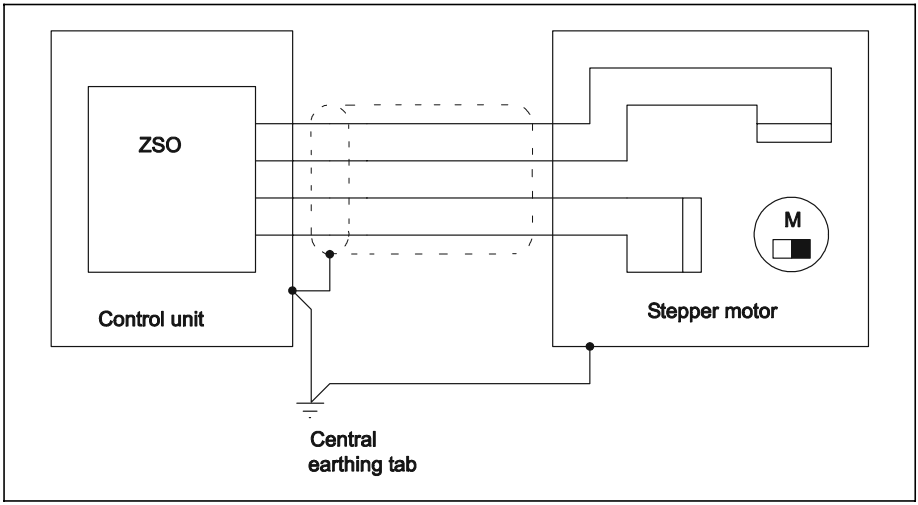



Fig. 12: Motor lead shielding

To avoid disturbances affecting the wires and instruments installed close to the drive system, we recommend to use shielded cables.

The cable shielding should be connected at one end to the ground (PE) of the control unit.

The motor and/or the mechanical system should be connected to the ground by a central earthing tab.

# 3 Supply unit

## 3.1 Mains supply

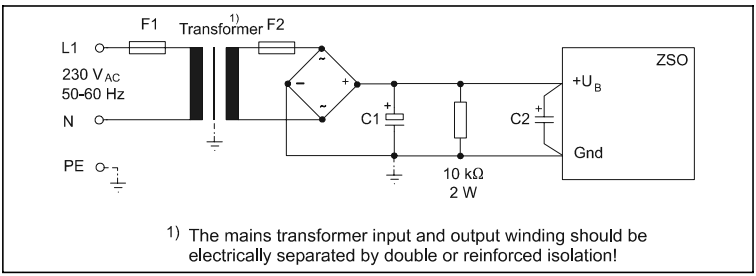



Fig. 13: Example of supply unit

| Operating voltages for power stages ZSO/ZSO MINI | | | |
|---|---|---|---|
| Power stage | Rated voltage [1] | Permissible range | Limit value [2] |
| ZSO 22-40<br>ZSO MINI 22-40<br>ZSO 42-40<br>ZSO MINI 42-40 | +40 $V_{DC}$ | +24 to +80 $V_{DC}$ | +100 $V_{DC}$ |
| ZSO 52-70<br>ZSO MINI 52-70<br>ZSO 72-70<br>ZSO MINI 72-70<br>ZSO 92-70<br>ZSO MINI 92-70 | +70 $V_{DC}$ | +40 to +80 $V_{DC}$ | |
| ZSO 102-120<br>ZSO MINI 102-140<br>ZSO 142-140<br>ZSO MINI 142-140<br>ZSO 182-140<br>ZSO MINI 182-140 | +140 $V_{DC}$ | +45 to +160 $V_{DC}$ | +200 $V_{DC}$ |

1) **Caution:**
Voltages above the limit value - even for a short time (µsec range) - provoke the destruction of the power stage.

2) The ZSO and the motor can be supplied by means of an unregulated filtered DC voltage. The following chapter concerns the calculation and the connection of the supply unit.

## 3.2 Calculation and Connection

1. **All** mating connector terminals indicated in the connecting diagram must be connected to the cable. Example: + $U_B$ must be connected to terminal 14a, 14b, 14c, 16a, 16b and 16c.
2. The cable cross section of the supply wires should be at least under 1 $mm^2$. If possible, twist into pairs the mains supply leads and the phase leads.
3. If you connect several ZSO power stages to a single supply unit, the wire cross section should be calculated so that the current in the wire never exceeds a load of 10 A per $mm^2$.
4. If the supply leads between the mains and the ZSO module are longer than 500 mm, connect a capacitor (C2, approx. 47 µF/200 V - refer to figure 13) as close as possible to the connector. This capacitor should be adapted for switching applications and have a low ESR factor (e.g.: Roederstein type EKM 47 µF/200 V).

   By this measure perturbations fed through the supply leads are avoided, which might cause a "Supply error" message.
5. Transformer, load capacitor
   The mains transformer should be designed acc. to the VDE 0551/EN 60742 standard.

   **The mains transformer input and output windings should be electrically separated by double or reinforced isolation!**

| | ZSO 22-40 to 92-70 | ZSO 102-140 to 182-140 |
|---|---|---|
| Transformer<br>U<br>I | <br>50 $V_{AC}$<br>5.5A | <br>100 $V_{AC}$<br>11 A |
| Load capacitor<br>C1 | 4,700 µF | 10,000 µF |

   The power indications for the transfomer and the load capacitor are "worst-case" values:maximum motor power, permanent "Boost" activation and a 100 % load factor.

   For the load capacitor, a value of 1,000 µF per Amp of motor current can be used. The thermal limit values of the transformer must never be exceeded.

   The supply module must be designed to avoid that the DC voltage drops more than 15 % below the peak value, at maximum load.
6. Rectifier
   The rectifier must be adapted to dissipation losses up to 2 Watts per Amp. If necessary, mount a heat sink.

## 4 Inputs

The push-pull inputs are electrically insulated from the power stage supply voltage by means of optocouplers. This confers optimum suppression of disturbances between control circuit and power circuit.

The input signal's logic “Control Pulses”, “Boost”, “Activation” and “Reset” can be reversed by a jumper (refer to chapter 6).

**On delivery, the power stage is preset to positive logic (input signals active at high level).**

**Caution:** It is not permitted to change the jumper positions during operation!

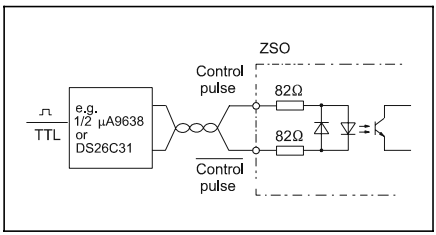



Fig. 14: Push-pull input connection

High immunity is obtained when driving the module with RS 422 control signals, as these lines are permanently supplied. This type of control signal is particularly recommended for connections over long distances.

Alternately, the control signals can be of the open collector type:

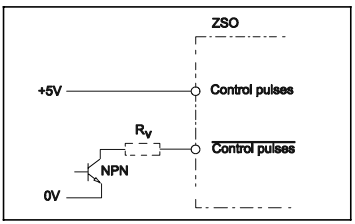



Fig. 15: Input connection NPN-transistor

or

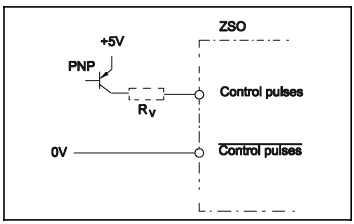



Fig. 16: Input connection PNP-transistor

If a logic voltage > 5 V is used, a series resistor $R_V$ must be installed to limit the optocoupler current to approx. 10 mA:

| U | $R_V$ |
|---|---|
| 5 V | - |
| 12 V | 620 Ω |
| 24 V | 1.8 kΩ |

## 4.1 Control pulses

One >5 µs pulse triggers one motor step. The first control pulse switches the motor from the stop to the run current and the step is executed. If the time lapse between pulses is above 40 ms, the motor automatically switches back to the stop current.

The maximum control pulse frequency is 100 KHz.

**Remark:**

There must be no sudden interruption of the control pulses for frequencies above the start-stop frequency. This would cause mispositioning of the motor and/or an error signal.

**Start-stop frequency:**

The start-stop frequency corresponds to the maximum frequency at which a stepper motor at standstill can be started without mispositioning.

The start-stop frequency mainly depends on the entire mass inertia of the system, that means the rotor mass and the load to be moved. For example, in case of a relative big motor and a heavy load the start-stop frequency is lower.

**Normally the start-stop frequency is approx. in a range of 200 to 2000 Hz.**

In case of a step frequency above the start-stop frequency, the motor should be accelerated to the maximum speed and also decelerated with a frequency ramp.

## 4.2 Motor direction

This signal sets the direction of rotation of the motor.

If the input optocoupler is powered, the motor runs inverse to the preferred motor direction, at jumper position “positive input logic” .

The "preferential motor direction" jumper changes the initial motor direction, as compared to the logic signal level.

**Caution:**

1. This signal must only be modified when the motor is at a standstill. Changing the motor direction when the motor is running will cause step losses and/or stop the motor.
2. The rotating direction must not be changed 5 µs before and after the control pulse.

## 4.3 Boost

The "Boost" function increases the motor current by approximately 30 %. The resulting torque increase is used, for example, during motor acceleration (please refer to the "Boost" description on page 15).

There is no time limit for the use of the Boost function.

If the input optocoupler is powered, the boost function is switched on, at jumper position “positive input logic”.

## 4.4 Activation

This input activates and deactivates the motor current. This input is useful, for instance, during maintenance operations to switch the power stage off, without having to disconnect it physically from the mains.

It is then possible to **slowly** rotate the motor by hand. Never try to rotate the motor externally at high speed. In this case, it operates as a generator and returns energy to the ZSO power stage.

The deactivation input is also useful when highly sensitive instruments are installed close to the drive system. The magnetic disturbances generated by the power stage can thus be suppressed during measurements.

If the input optocoupler is powered, the motor current is switched on, at jumper position “positive input logic” .

**Caution:** The "Deactivation" input must only be activated when the motor axis is at a standstill.

**Warning:** The "Deactivation" input is not in conformance with professional emergency stop circuit requirements.

## 4.5 Reset

The Reset function sets the power stage to a given initial status.

The activation of this input initializes the monitoring circuits and the internal ring counter is set to zero. When the Reset signal is suppressed, a time lapse of approx. 500 ms is necessary before the power stage returns to the "Ready" status.

If the input optocoupler is powered, a Reset is activated, at jumper position “positive input logic” .

## 5 Error Output

"Error" is a common output for all error signals generated by the ZSO power stage.The error output is an optocoupler, open collector Darlington transistor output:

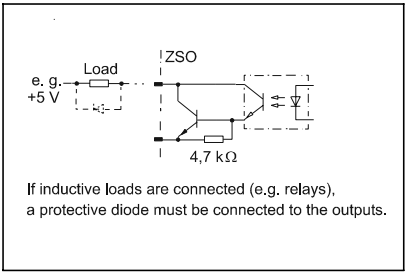



Fig. 17: Output connection

Rated current = 20 mA

$U_{max}$ = 30 V

$U_{CE\ sat}$ at 20 mA < 1 V

The Error output is active at low level if the power stage is operating correctly. The setting to "Opening contact" has the advantage of detecting a power interruption or cable breakage.

This output is activated if certain thresholds are exceeded. To avoid damaging the motor, the latter is deactivated. The front panel multi-colour LED turns red.

To reset the error signal, you must activate the Reset input or switch the mains off for a short lapse of time. If the Error message has been caused by overheat, the unit must be switched on again only after cooling.

Applicable thresholds for the “Error” signal.

| | ZSO 22-40 to 92-70 | ZSO 102-140 to 182-140 |
|---|---|---|
| Motor current | > 14 A | > 25 A |
| Operating voltage [1)] | < 35 V | < 60 V |
| Heat sink temperature | > 85 °C | |

The "Error" signal can also be due to the following causes:

- Short-circuit in the motor
- Deceleration ramp too high
- Incorrect layout or connection of the supply unit. Please, refer to page 30.

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1) **Remark:** In special cases, ZSO special versions with deactivated voltage monitoring on request.

## 6 Front panel controls

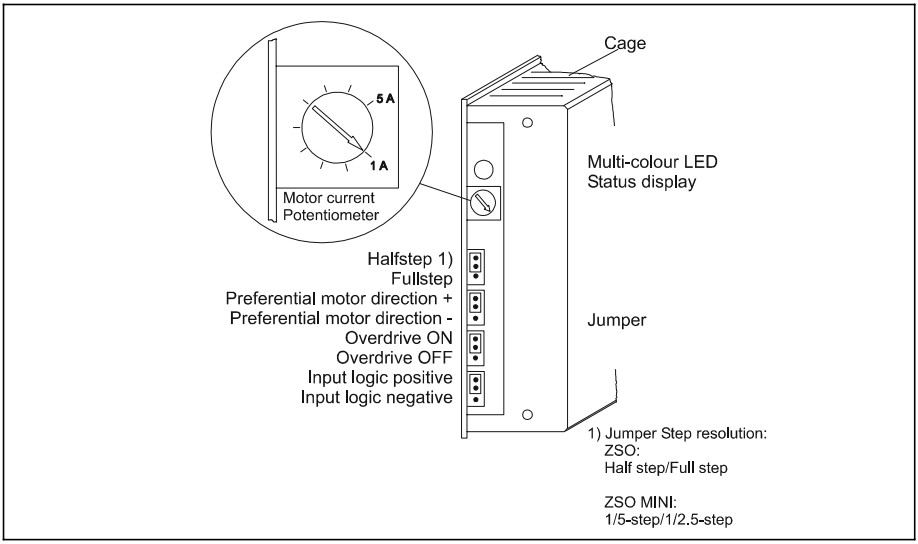



Fig. 18: Front view - front panel removed (ZSO 22-40 to 92-70)

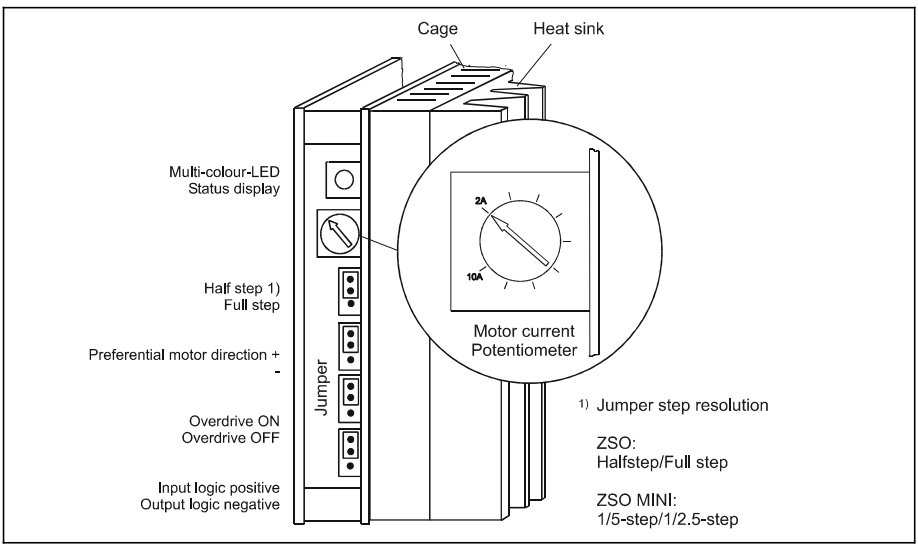



Fig. 19: Front view - front panel removed (ZSO 102-140 to 182-140)

## 6.1 Current adjustment

The motor run current is set by means of a scaled potentiometer which can be accessed after removal of the ZSO module's front panel.

**The potentiometer always sets the run current.**

If the control pulses are interrupted for a lapse of time >40 ms [1)], the power stage automatically switches to the stop current. The stop current is set to 50 % [1)] of the adjusted run current.

| **Range of motor currents** | | |
|---|---|---|
| | **ZSO 52-70**<br>0.6 – 2.8 $A_{rms}$<br>with Boost: 0.8 – 3.6$A_{rms}$<br>**$I_{max}$ = 5 A** | **ZSO 102-140**<br>1.1 – 5.6 $A_{rms}$<br>with Boost: 1.4 – 7.3 $A_{rms}$<br>**$I_{max}$ = 10 A** |
| **ZSO 22-40**<br>0.5 – 1.3 $A_{rms}$<br>with Boost: 0.7 – 1.7 $A_{rms}$<br>**$I_{max}$ = 2,3 A** | **ZSO 72-70**<br>0.8 – 3.9 $A_{rms}$<br>with Boost: 1 – 5 $A_{rms}$<br>**$I_{max}$ = 7A** | **ZSO 142-140**<br>1.6 – 7.8 $A_{rms}$<br>with Boost: 2 – 10.1 $A_{rms}$<br>**$I_{max}$ = 14 A** |
| **ZSO 42-40**<br>0.6 – 2.3 $A_{rms}$<br>with Boost:<br>0.8 – 3 $A_{rms}$<br>**$I_{max}$ = 4 A** | **ZSO 92-70**<br>1 – 5 $A_{rms}$<br>with Boost:<br>1.3 – 6.5 $A_{rms}$<br>**$I_{max}$ = 9 A** | **ZSO 182-140**<br>2 – 10 $A_{rms}$<br>with Boost: 2.6 – 13 $A_{rms}$<br>**$I_{max}$ = 18 A** |

The maximum phase current $I_{max}$ circulates if only one phase is activated in the half step mode or in the ministep mode (refer to chapter 1.7, phase current diagram).

1) **Remark**: Special versions with modified recovery time on demand !

## 6.2 Jumpers

The jumpers can be accessed after removal of the front panel:

| Jumper | | Position on delivery |
|---|---|---|
| Input logic | positive<br>negative | Positive Logic |
| Overdrive | ON<br>OFF | ON |
| Prefer. motor direction | +<br>– | + |
| Step resolution<br>(see p.8) | ZSO: Half step/Full step | ZSO: Half step |
| | ZSO MINI:<br>1/5-Step/1/2.5-Step | ZSO MINI: 1/5-Step |

**Caution:** The jumpers must only be set when the operating voltage is off.

## 6.3 LED

The multi-colour LED changes colour to indicate the status of the power stage:

| | | |
|---|---|---|
| Green | Ready | The power stage is ready to operate. |
| Yellow | Busy | The power stage receives pulses from the control system. |
| Red | Fault | One of the monitoring circuits has sent an error signal. |
| LED off | Reset<br>Disabled<br>Power Off | A “Reset” is active or the input "Activation" is switched off or the supply voltage is interrupted. |

## 7 To Consider before Installation

Read this manual very carefully before installing and operating the ZSO. Observe the safety instructions in the following chapter!

### 7.1 Qualified Personel

Design, installation and operation of systems using the ZSO may only be performed by qualified and trained personnel.

Qualified personnel should be able to recognize and handle risks emerging from electrical, mechanical or electronical system parts.

***WARNING !***

By persons without the proper training and qualification damages to devices and persons might result!

### 7.2 Safety Instructions

If you need to open the ZSO:

**Up to 3 minutes after turning off the supply voltage, dangerous voltages may still exist within the device.**

**Be careful handling the connectors “Motor” at the ZSO and any motor cable coupling.**

As long as the ZSO is connected to supply voltage, a hazardous voltage level is present at motor connector and motor cable, even if the motor is not wired.

**Up to 3 minutes after turning off the supply voltage, dangerous voltages my still exist at the ZSO connectors.**

**Do not disconnect the motor while powered.**

Danger of electric arcing.

## 7.3 Putting-Into-Service

1.  **Please read the safety instructions in chapter 7.2.**

2. Check the supply unit's output voltage.
3. Switch off the supply before insertion or removal of the ZSO board.
4. Never disconnect the board from the connector as long as the LED is not off.
5. The jumpers must only be inserted or removed after having switched off the supply voltage.
6. If the motor stops during acceleration, reduce the acceleration and/or maximum frequency values. This problem may also be caused by incorrect setting of the motor's rated current.
7. If the motor gets too hot, the motor current has probably been adjusted too high. Excessive motor heating may also be caused by continuous use of the "Boost" function.
8. If the motor shows high resonances, select a higher step resolution or modify the control pulse frequency and/or the acceleration.

   Resonances can also be generated if the motor rotates with **too high** current. Reduce the motor current, if necessary.
9. If the motor does not position correctly, it is possible that there are disturbances on the control pulse input. Also check that the acceleration and deceleration ramps are not programmed too high. Please refer to the remark on page 23.

   Too high deceleration may cause mispositioning of the motor by multiples of 4 or 8 steps, or by multiples of 5 or 10 steps for the ZSO MINI power stage (desynchronisation effect).
10. The use of a regulated transformer whose voltage rises too slowly may cause an error signal, such as the use of a regulated power supply module with a current limiter.

## 8 ESD protective measures

All the products which we deliver have been carefully checked and submitted to a long-term test. To avoid the failure of components sensitive to electrostatic discharge (ESD), we apply a great number of protective measures during manufacturing, from the component input check until the delivery of the finished products.

**Caution:**

Manipulation of ESD modules must be effected by respecting special protective measures (e.g. CECC 00 015 Version 1). Only return the modules or boards in adapted packaging.

**Phytron's warranty is cancelled in case of damages arising from improper manipulation or transportation of ESD modules and components.**

## 9 Quality assurance system

Phytron-Elektronik GmbH has received the EQ-ZERT certificate on 30/11/94 from the European Institute of Certification of Quality Management Systems.

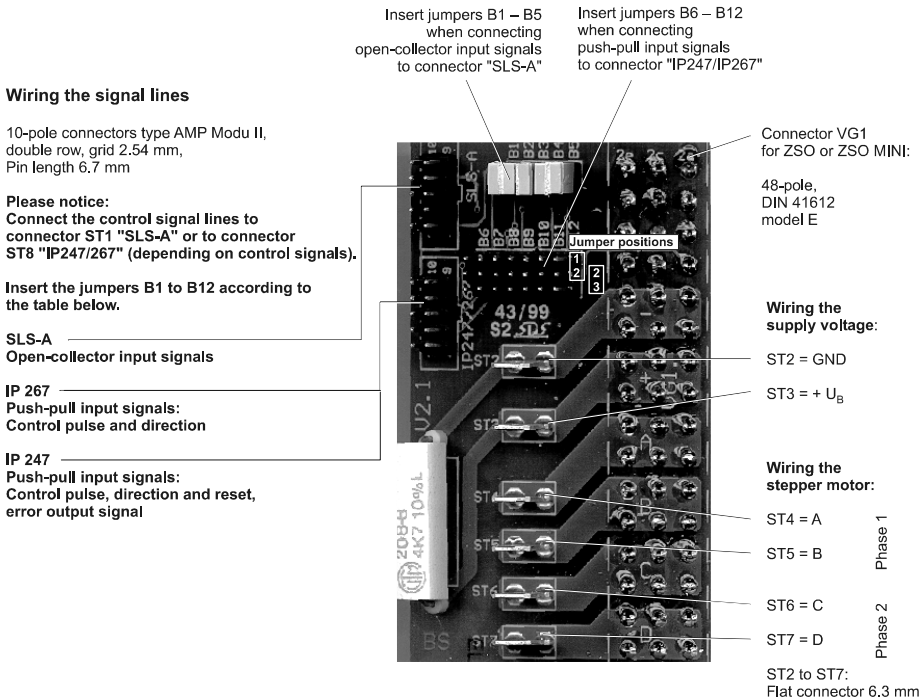
This certificate confirms the efficacy of our quality management system (according to DIN/ISO 9001), as far as design, development, production, mounting and after-sales-service are concerned.

QS 1/95

## 10 Adapter Plate G-ZSO (option)

The ZSO or ZSO MINI power stage can be directly plugged to the G-ZSO adapter plate. The adapter plate includes the connectors for the motor cable, signal lines and voltage supply.

The adapter plate G-ZSO was designed for use in Phytron control units. But it can also be used for connecting ZSO power stages to other controllers or PLC stepper motor interfaces. For connecting the control leads, please select signal line connector ST1 ot ST8 depending on the type of controller outputs – open collector or push-pull. The jumpers are also to be set suitable to the controller outputs (see table next page).



### Jumper

| Jumper | open-collector-signals | push-pull signals | |
|---|---|---|---|
| | signal line connector ST1 | signal line connector ST8 | |
| | SLS-A | IP247 | IP267 |
| B1 to B5 | inserted | not inserted | not inserted |
| B6 to B12 | not inserted | inserted at 1–2 | inserted at 2–3 |

### Signal line connector ST1 "SLS-A" for open collector signals

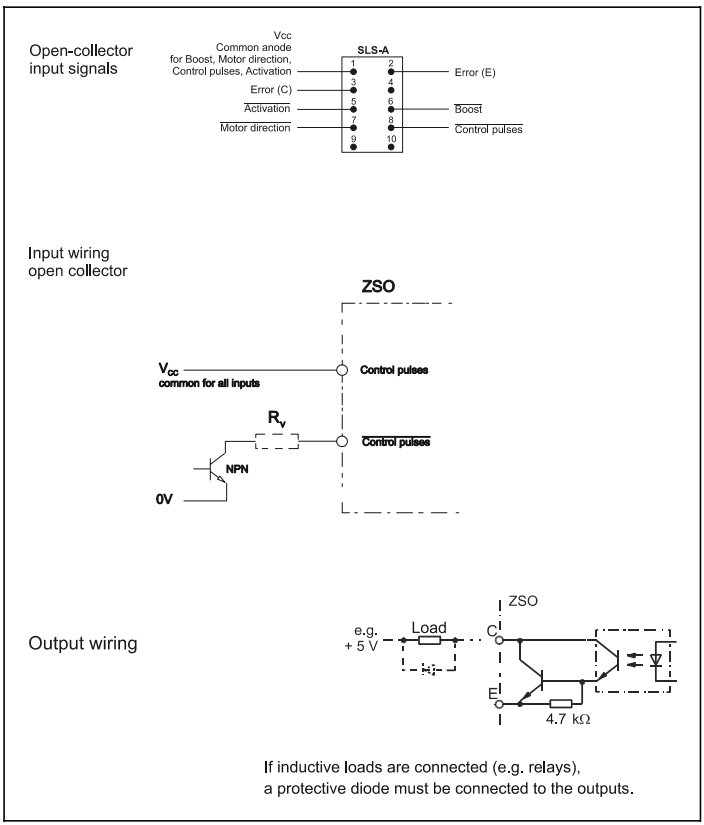



Fig. 27: Adapter plate G-ZSO / ST1

## Signal line connector ST8 "IP247/IP267" for push-pull signals

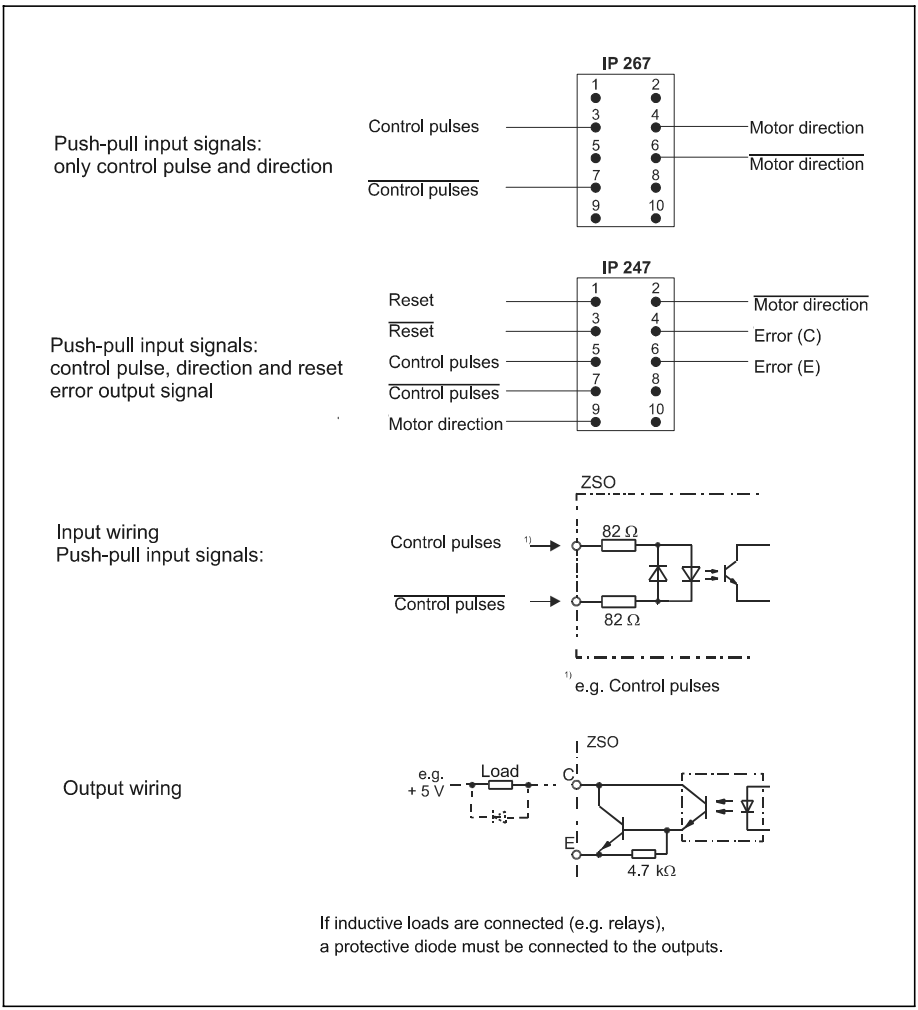



Fig. 28: Adapter plate G-ZSO / ST8

**Safety Recommendations:**

1. The G-ZSO adapter plate must only be wired and put into operation by qualified personnel.
2. Switch off the supply voltage before inserting or removing the power stage.

   **Danger of damages by electric arcs.**
3. Mount the G-ZSO adaptor plate inside a closed housing with protection against accidental contact to the adapter plate.

   **Danger of electric shock in case of contact to not isolated energized areas**.
4. When mounting the adapter plate, you should care for at least 6 mm distance between other components or housings and the adapter plate (welding and components side). The minimum distance at the left and right side and above and below the plate is1.6 mm.

## 11 Index

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