

## 1. Application and function

### 1.1 TPA 20 Reciprocator Control for H-Series DC Reciprocators (H 13 PB / H 21 PB / H 16 PB 30)



**The reciprocator control unit should not be connected or switched on before this operation manual has been carefully read through.**

The TPA 20 Reciprocator Control was developed as the successor to the TPA 19 Reciprocator Control to control the H-Series Reciprocators with DC motors.

The TPA 20 Reciprocator Control contains the complete Hardware for Position regulation of the DC motors. The TPA 20 Reciprocator Control can be connected in Single phase to existing AC Power supplies. The power is regulated internally. A signal (Green lamp) is given when the control unit is ready for operation.

Special characteristics :

- Replacement for earlier TPA 19 Reciprocator Control units
- Simple adaptation to all Mains power supplies
- Continuous speed regulation
- Overheating protection
- EMC Concept for increased error suppression
- All electrical connections are plug-in connections
- Simple adjustment/alignment, and function control through integrated display and signalization
- Automatic activation of the brake unit at an error function
- Built into a G-V two drawer unit - IP 54 type protection
- Open Frame version for mounting in a switch cabinet
- Operation display, internal error and status display



**Before die TPA 20 Reciprocator Control is connected to the Mains the built-in power unit must be adapted to the local power supply.**

## 1.2 Function

Die TPA 20 Reciprocator Control receives its power, and control signal directly from the local Mains voltage.  
The local Mains voltage is adapted in the TPA 20.

The complete axis control system consists of a TPA 20 Control unit and an H-Reciprocator with a DC servomotor, thereby the TPA 20 Reciprocator Control takes over the Position control from the feedback from the position potentiometer.

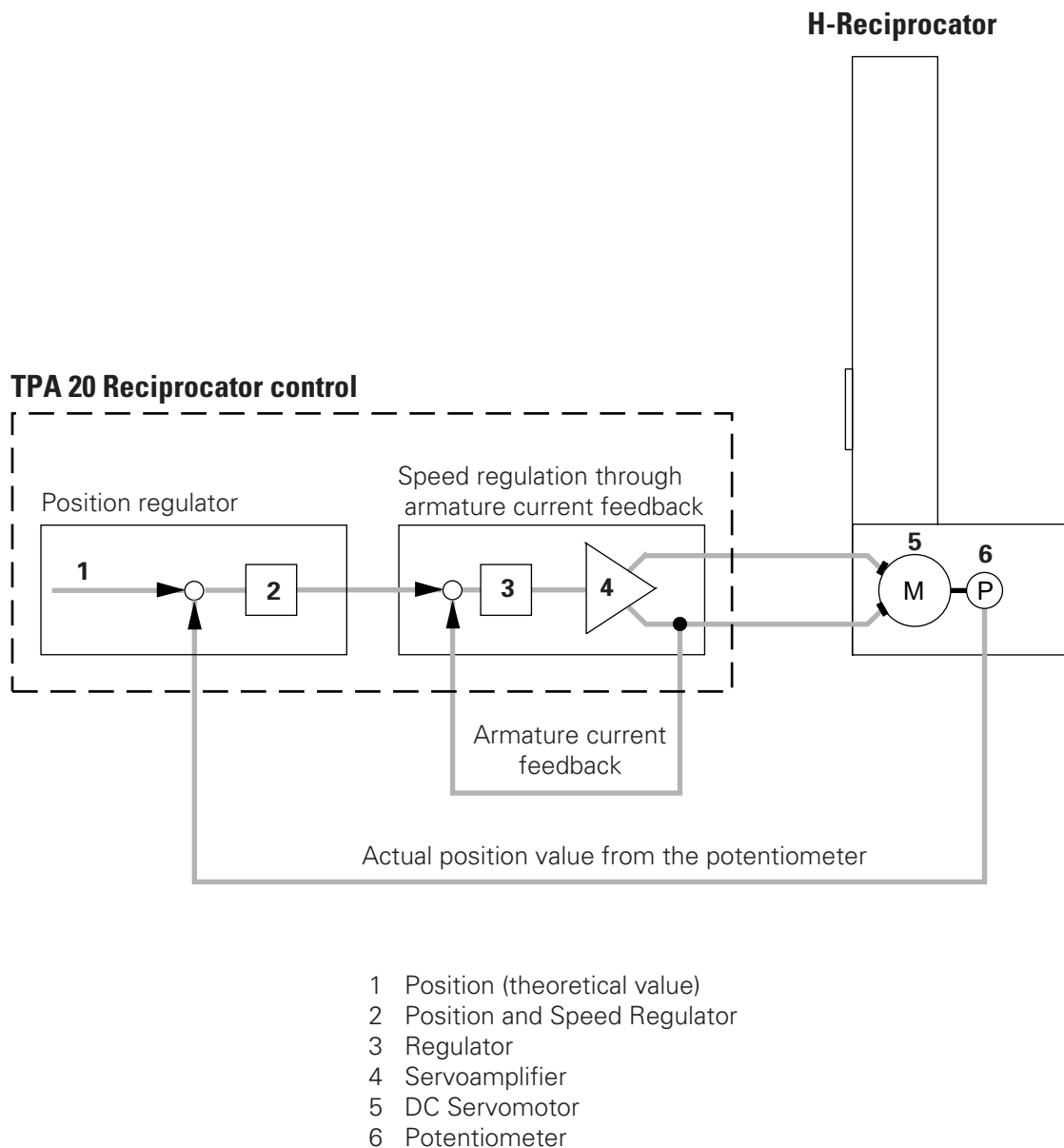


Figure 1

### 1.3 Mechanical construction

The TPA 20 is built into an enclosed housing in a G-V two drawer unit design. The enclosed housing contains all the necessary pluggable connections on the rear of the housing. The drawer housing is fitted with a built-in fan, and temperature monitoring.

### 1.4 Electronic design

Die TPA 20 Reciprocator Control consists principally of four different function blocks:

- Power supply
- DC drive control board
- AXODYN RPM control board
- PSCB - Position and speed control board

TPA 20 Reciprocator Control			
Power supply: with voltages of 100 V...240 V	DC control board: - Braking control - Brake Chopper - Interface function	AXODYN motor board - Power output stage - Speed regulation	PSCB - Position control - Speed control

A more detailed description of the special characteristics of the four function blocks is made in Chapter 2 of this operating manual.

## 2. Preparation for start-up

### 2.1 Selecting the correct voltage

Before die TPA 20 Reciprocator Control is connected to the Mains the built-in power unit must be adapted to the local power supply.



#### NOTICE

**If the voltage has a variation of > 10 % this could lead to damage to the electronic controls.**

Selectable voltages : 100 V, 110 V, 120 V, 220 V, 230 V, and 240 V.

Setting the input voltage of the TPA 20 should be done as follows :

1. Disconnect all electrical connections at the rear of the drawer unit and pull the drawer out of the housing.
2. Remove the screws on the rear of the drawer unit and remove the mounting plate.
3. The connections, and bridges must be set to the desired voltage on the contacts of the transformer.

Mains voltages	Connect Neutral conductor to contact	Connect Phase to contact	Bridge(s) from - to
100 V	1	2	1 - 5 and 2 - 6
110 V	1	3	1 - 5 and 3 - 7
120 V	1	4	1 - 5 and 4 - 8
200 V	1	6	2 - 5
220 V	1	7	3 - 5
230 V	1	7	4 - 5
240 V	1	8	4 - 5

The numbers in the table represent the contacts on the transformer (see below)

0 V	100 V	110 V	120 V
1	2	3	4

0 V	100 V	110 V	120 V
5	6	7	8

Example:

for 120 V

... connect the neutral conductor to contact 1, and Phase to contact 4. A wire bridge joins contact 1 to contact 5, a second wire bridge joins contact 4 to contact 8.

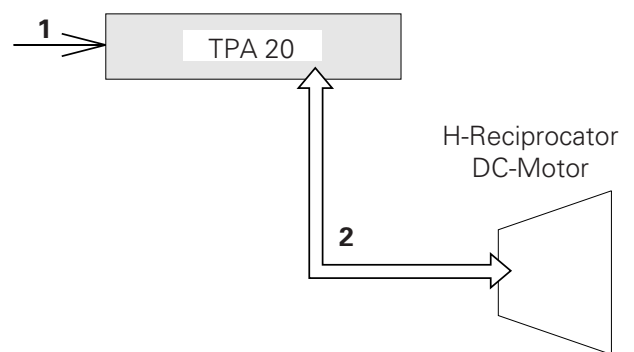
for 240 V

... connect the neutral conductor to contact 1, and Phase to contact 8. A wire bridge joins contact 4 to contact 5.

## 2.2 Connecting the TPA 20 Reciprocator Control

The H-Series reciprocator is connected to the TPA 20 Reciprocator Control by the „Axis 2“ connecting cable.

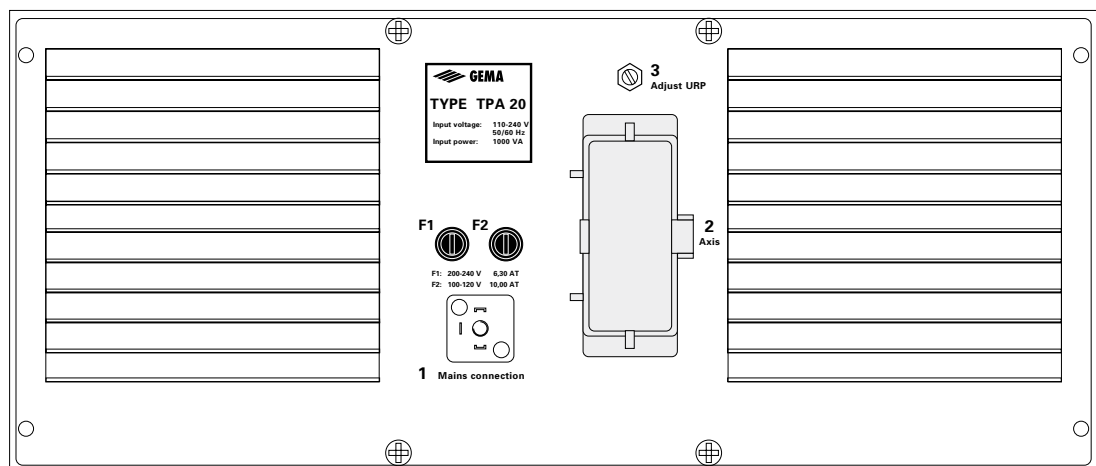
Power supply of the TPA 20 is through the „Mains connection 1“ connection cable.



- 1 Mains connection
- 2 H-Reciprocator (motor) signal from Position potentiometer

Figure 2

*Connections on the rear of the TPA 20 Reciprocator Control*



- 1 Power supply input for the TPA 20 Reciprocator Control
- 2 Multi-cable connection to and from the reciprocator
- 3 URP Potentiometer (Upper stroke limit)

Figure 3

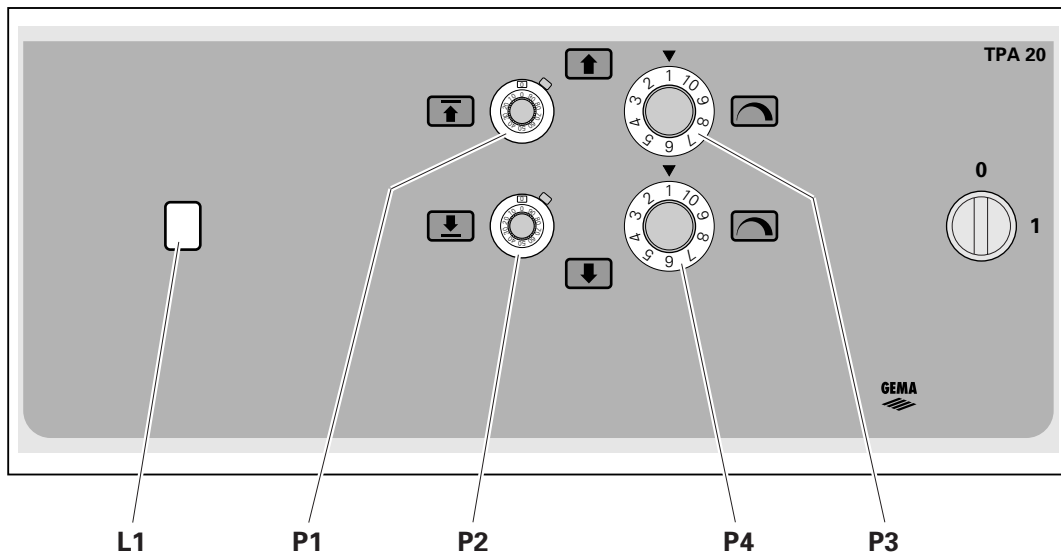
## 2.3 Operation

The TPA 20 Reciprocator Control makes very simple setting of the individual movement sequences possible. The reciprocator stroke movements can be set with the aid of 4 potentiometers.

P1 and P2 (10-turn potentiometers) serve to set the upper, and lower reversing points.

P3 and P4 (1-t-turn potentiometers) serve to set the individual speed of the up, and down movements.

Front view



- P1 : Upper stroke setting
- P2 : Lower stroke setting
- P3 : Speed setting - upwards
- P4 : Speed setting - downwards
- L1 : Operation indicator (green)

Figure 4

## 2.4 Starting up

### 2.4.1 Checking the Position determination Potentiometer in the reciprocator before the Start Up

1. Remove the motor cable from the socket on the reciprocator.
2. Move the reciprocator carriage down onto the rubber buffer.
3. Measure the resistance between Pin 3 and Pin 8 of the motor cable socket with an Ohm meter.

The measured resistance must be between  $0\ \Omega$  and  $20\ \Omega$ . If the value is higher, then the Position potentiometer in the reciprocator must be reset (see „GEMA H 13 PB / H 21 PB / H 16 PB 30 Reciprocators Operating Instructions“).

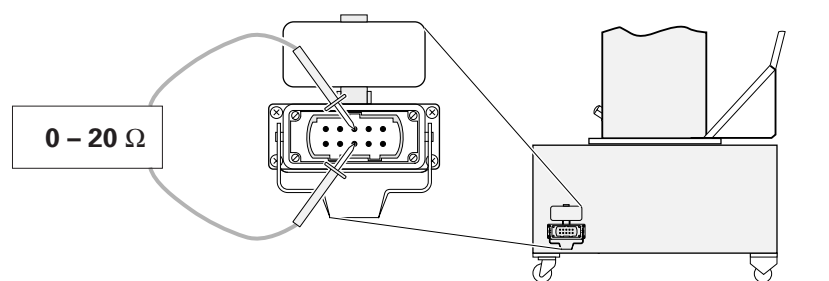


Figure 5

### 2.4.2 Setting the upper stroke limit

1. Set 10-turn Potentiometer **P1** to the value - **10.0**, and the **P2** to **5.0**.
2. Set both Speed Potentiometer (**P3** and **P4**) to the value - **2.0**
3. Turn the „ADJUST URP“ potentiometer on the rear of the TPA 20 Reciprocator Control to the stop in the counter-clockwise direction. For safety, the upper stroke limit will be moved approximately to the middle of the reciprocator.

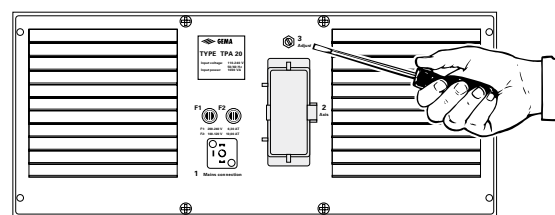


Figure 6

4. Switch on the TPA 20 Reciprocator Control with the Mains switch. The reciprocator carriage starts to reciprocate.
5. Turn the URP potentiometer slowly in the clockwise direction. The upper stroke limit of the reciprocator is thereby displaced upwards. Wait each time until the carriage has reached its newly set position.



**The upper stroke limit must always be set according to the height of the reciprocator or to the height of the gun slots in the booth. If an incorrect stroke height is set (too high) this can lead to damage to the reciprocator and / or the booth.**

6. After the upper stroke limit is set the required stroke range can be set with potentiometers P1 and P2.

### 3. Function blocks

#### 3.1 DDC 1 DC drive control board

The DDC 1 board takes over various functions necessary for the operation of the Power pack :

- Preparation of the signal for the AXODYN Speed control board
- Brake chopper
- Monitoring of the brake chopper
- Brake functions
- Power supply monitoring for the Brake
- EMC protection

The AXODYN® Speed control board can be directly connected to the DDC 1 through a DIN multipin connector. All connections to and from the DDC 1 are carried out through pluggable contacts with screw connections. Because of the pluggable connections the Power pack can be easily removed without opening the clamp connections.

#### Display on the DDC 1 DC drive control board

The following operation conditions and error messages are displayed directly on the DCC 1 board through LEDs :

Recup :	(H1, red)	Brake chopper is switched (only short pulse)
Run :	(H2, yellow)	RPM control is activated through the control unit
E1 : Direction of rotation release	(H3, yellow)	Negative direction of rotation is released
E2 : Direction of rotation release	(H4, yellow)	Positive direction of rotation is released
24 VDC :	(H5, green)	24 V supply voltage is available
Fuse F2 :	(H6, red)	Fuse for the 24 V supply has blown.

### **Fuses on the DDC 1 drive control board**

Fuse F1 : Brake chopper and Control  
Type : 2.0 A-Slow (5 x 20 mm)

Fuse F2 : Internal 24 VDC for Brake,  
Safety limiting switch and interface function  
Type : 2.0 A-Slow (5 x 20 mm).

A red LED (H6) illuminates on the DDC 1 board when this fuse blows.

Fuse F3 : 110 VAC for the mains motor and fan supply  
Type : 315 mA-Slow (5 x 20 mm)

### 3.2 AXODYN® Speed control board

The AXODYN DC Speed control board regulates and supplies the DC servomotor, as is built into the H-Reciprocators. The AXODYN® Speed control board can be directly connected to the DDC 1 through a DIN multipin connector.

The AXODYN® has a multi LED display on the front panel through which the regulation settings, and processing data are displayed. Selection of the desired display functions is made with the yellow key - DISPLAY UP. The actual type of display is shown on a separate display - DISPLAY TYPE.

The settings were made before delivery and must not be changed without exact instructions.

*Important elements of the AXODYN®*

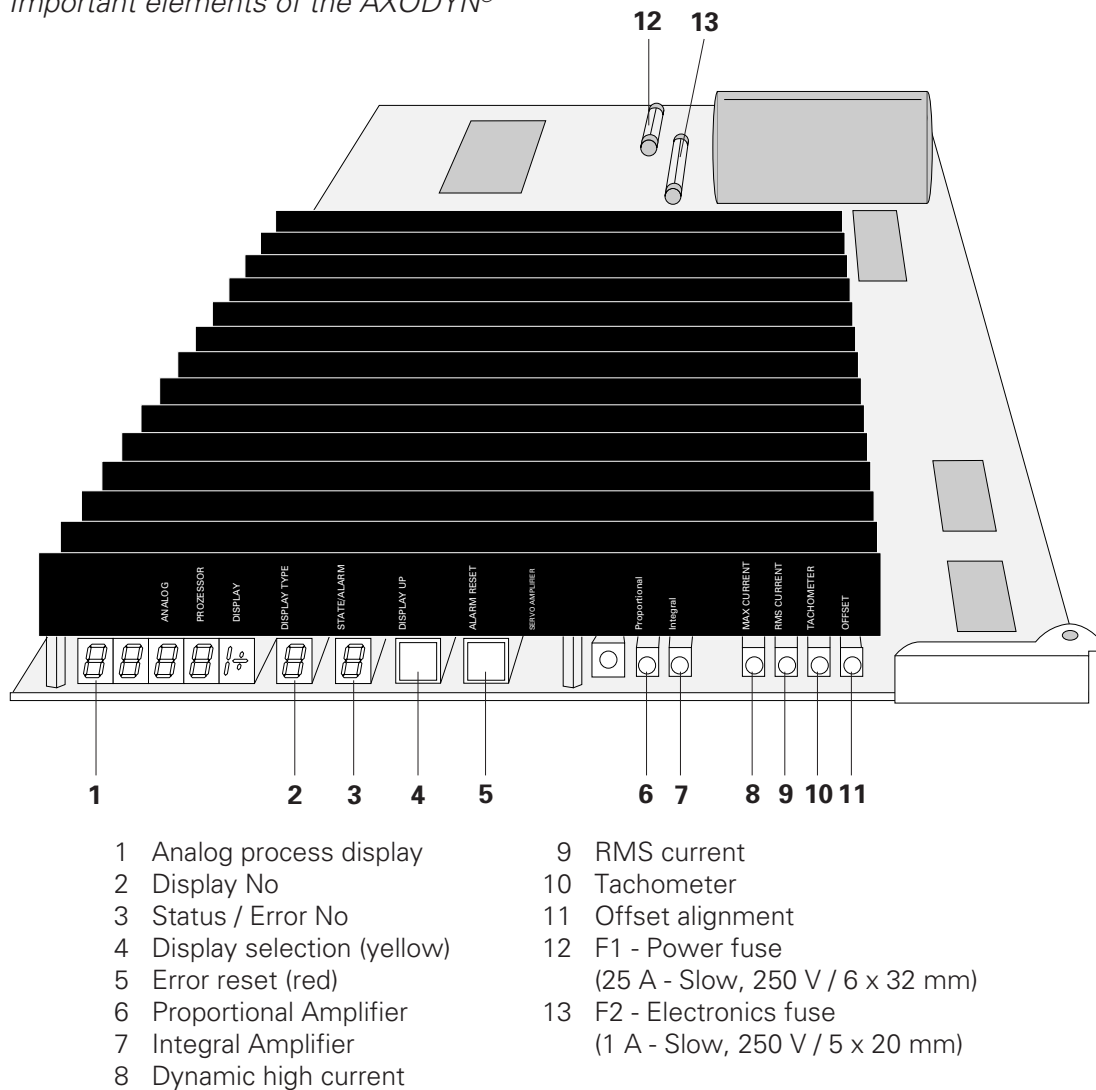


Figure 7

The displays on the AXODYN® are only visible when the housing is open.

## Display functions of the AXODYN®

The following parameter or process data are shown on the analog display (**1** - Fig. 7). The desired type of display is selected with the yellow key - DISPLAY UP. The type of the actual display value is shown on a separate display - DISPLAY TYPE.

Display Type	Displayed parameter or process value (Select with key - DISPLAY UP)	Default value
1	Proportional part of the regulator (Setting with the proportional potentiometer)	1000
2	Integral part of the regulator (Setting with the integral potentiometer)	1000
3	Differential part of the regulator (Standard switch off)	
4	Maximum dynamic high current Maximum Pulse voltage $I_{max}$ Setting on the potentiometer MAX CURRENT ( <b>8</b> - Fig. 7)	10.00
5	Maximum RMS CURRENT Permissible continuous power of the motor $I_{rms}$ Setting on the potentiometer RMS CURRENT ( <b>9</b> - Fig. 7)	9.0
6	Display of the momentary actual power value in Amperes (Momentary power of the motor with preceding sign)	
7	Display of the actual power value in Amperes linearly averaged over a 30 second period.	
8	Display the actual Tacho voltage	
9	Display of the actual theoretical value (-10 V ...+10 V)	



**NOTICE**

**The settings were made before delivery and must not be changed without exact instructions.**

## Status, and alarm messages of the AXODYN®

Status, and alarm messages are shown on the display element STATE / ALARM.

STATE/ ALARM	Definition of the Status or Alarm message	Error acknowledgement method
0	The drive is active (Stand-by / <b>Run</b> ) and no error is indicated. -> Normal operation	<i>Status display</i>
1	The servo amplifier is blocked <b>(Stand-by / Run)</b> -> Output stage blocking	<i>Status display</i>
2	RMS power $I_{EFF}$ reached -> Servo amplifier runs at the power limit at constant voltage operation	<i>Status display</i>
3	Maximum operating time at the power limit with $I_{EFF}$ reached.	<i>Press Reset key or Mains ON/OFF</i>
4	Tachogenerator No tacho signal or incorrect polarity -> Motor switches off, Carriage moves to the lower buffer	<i>Press Reset key or Mains ON/OFF</i>
5	Overheating in the power stage. Temperature on the heat sink > 90 °C. -> Motor switches off, Carriage moves to the lower buffer	<i>Press Reset key or Mains ON/OFF</i>
6	Short circuit or short to ground -> Motor switches off, Carriage moves at the lower buffer	<i>Press Reset key or Mains ON/OFF</i>
7	Alarm from Brake Chopper or Over / Under power in the intermediate circuit. -> Motor switches off, Carriage moves to the lower buffer	

### 3.3 Input and Output connections on the DDC 1 board

Connection	Description	Signal function	Pin function
<b>X1</b> 1 2 3 4 5 6 7 8	+ 24 V E1 E2 GND		
<b>X2</b> 1 2 3 4 5 6 7 8 9 10	Theoretical+ Theoretical- Run +24 V HF-Gnd +24 V GND  READY	Theor. speed value (Signal) Theor. speed value (GND)  Shield connection +24 V GND	Signals from PSCB are fed to the Servo amplifier through X2: -Theoretical R.P.M. value -Position control
<b>X3</b> 1 2	19 V AC 19 V AC	Supply for creating the internal 24 VDC	The system's power is supplied through X3, X4, and X5.
<b>X4</b> 1 2 3	+S -S PE	Supply 110 V DC from DC circuit Gnd connection	
<b>X5</b> 1 2 3	110 V AC 110 V AC PE	Power for the fan, circuit monitor Gnd connection	
<b>X6</b> 1 2 3 4	M+ M- PE S	Positive pole - DC motor Negative pole - DC motor Gnd for motor Shield - motor cable	The DC servomotor is connected to X6
<b>X7</b> 1 2 3	B+ B- PE	Positive pole - Brake Negative pole - Brake Gnd for Brake	The Brake is connected to X7.
<b>X8</b> 1 2	R EXT. R EXT.	External resistor External resistor	Optional connection for an external Brake resistor
<b>X9</b> 1 2 3	110 V AC 110 V AC PE	Output 110 V AC for the cooling fan Gnd connection	Cooling fan connected to X9.
<b>X11</b> 1 2 3 4 5 6	$U_{mot}$ Theoret. int. $F_{AVG}$ $I_{AVG}$ $U_{Tacho}$ GND	Motor power Theoretical value intern. Average motor current Momentary value motor curr. Tacho power (negative) Gnd for measurement	X11 is occupied by the monitoring signal for Test and Service purposes. (under certain circumstances X11 has no components).
<b>X12</b>		X12 Operation display	

### 3.4 Input and Output connections of the PSCB board

The PSCB board („Position Speed Control Board“) contains the Position and Speed Detection determination components.

Connection	Signal function
<b>X1</b>	1 GND (24 VDC) 2 +24 VDC 3 Theoretical - (RPM theor. value GND) 4 Theoretical + (RPM theor. value Signal) 5 Position determination potentiometer 6 Position determination potentiometer 7 Position determination potentiometer 8 GND (not used)
<b>X2</b>	1 Theoretical value - upper position (Potentiometer connection 1) 2 Theoretical value - upper position (Potentiometer connection 2) 3 Theoretical value - upper position (Potentiometer connection 3) 4 Theoretical value - lower position (Potentiometer connection 3) 5 Theoretical value - lower position (Potentiometer connection 2) 6 Theoretical value - lower position (Potentiometer connection 1)
<b>X3</b>	1 Theoretical value - speed downwards (Potentiometer connection 3) 2 Theoretical value - speed downwards (Potentiometer connection 2) 3 Theoretical value - speed downwards (Potentiometer connection 1) 4 Theoretical value - speed upwards (Potentiometer connection 3) 5 Theoretical value - speed upwards (Potentiometer connection 2) 6 Theoretical value - speed upwards (Potentiometer connection 1)
<b>X4</b>	1 Potentiometer URP (Potentiometer connection 1) 2 Potentiometer URP (Potentiometer connection 2) 3 Potentiometer URP (Potentiometer connection 3)

### 3.5 Pin allocation - Motor Cable

The Socket connection for the Motor Cable „2 Axis“ has the following signal allocations :

PIN	1	Motor +
	2	Position determination potentiometer
	3	Position determination potentiometer
	4	—
	5	—
	6	Motor –
	7	—
	8	Position determination potentiometer (sliding contact)
	9	—
	10	—
		Ground

#### **4. Connection Control Position Determination Pot**

Move the carriage down onto the lower reciprocator buffer. Measure the resistance between Pin 3 and Pin 8 of the motor cable socket with an Ohm meter. The measured resistance must be between 0  $\Omega$  and 20  $\Omega$ .

## 5. Maintenance and Cleaning



**The plug must be removed from the Mains socket before any repairs on the electrical section are made or when changing a fuse.**

### 5.1 Replacing the bulb in the main switch

1. Turn the main switch *off* and disconnect the Mains cable of the control module.
2. Unscrew the black retaining ring (1) of the main switch on the front of the control module and remove the green switch grip.
3. Push the special rubber bulb extractor (supplied) against the defect bulb and turn counter-clockwise to the stop (Bayonet connection). The bulb can now be removed easily.
4. Replace the new bulb (24 V / 2 W) so that the pins on the bulb fit into the slots of the bulb holder. Push the bulb carefully down with the rubber pad as far as it will go and turn clockwise.
5. Check that the bulb is seated correctly.
6. Replace the green switch grip and screw on the retaining ring (1). Make sure the white stripe on the switch grip is pointing upwards.
7. Reconnect the Mains cable of the control module.

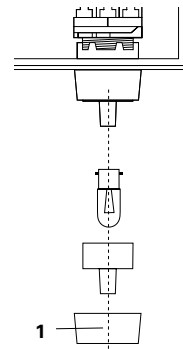


Figure 8

### 5.2 Replacing the fuse - F1

1. Unscrew the fuse holder cap to the left, remove the defective fuse and replace with a new one. Screw the fuse holder cap onto the fuse holder.

### 5.3 Replacing a potentiometer

#### 5.3.1 Replacing the speed potentiometer

1. Remove all electrical connections from the rear of the control module.
2. Unscrew the retaining screws and pull the mounting plate out to the stop
3. Carefully remove plugs X2 and X3 on the PSCB board (*Never pull on the cables*). The plugs are marked with X2 or X3 and **should not be connected to the wrong socket on assembly!**
4. Unlock the lamp and contact element block, to the left, on the inside of the control housing with an index finger and remove.
5. Gently lift the mounting plate and remove.
6. Release the cable strain relief from the Housing plate.
7. Remove the Adjusting knob cap with a thin screwdriver.

8. Unscrew the grub screw of the potentiometer knob with an Allen key and pull the knob off the spindle. Notice: The grub screw can easily be lost!
9. Remove the locking nut (with the correct sized spanner) and washer, pull the potentiometer out (to the inside of the housing).
10. Unsolder the connecting wire from the defect potentiometer and resolder onto the new one.

**⚠ IMPORTANT**

**The contacts are not numbered, therefore, the potentiometer should only be replaced by a specialist!**

11. Reassemble in the reverse order.
12. Turn the new potentiometer counter-clockwise to the stop.
13. Fit the Setting knob - it must display „1“.
14. Fix the Setting knob with the screw and fit the cap.

### 5.3.2 Replacing the Positioning potentiometer

1. - 6. See above
7. Unscrew the set screw of the multial with an Allen key and pull the multial off the spindle.
8. Remove the locking nut (with the correct sized spanner) and washer, pull the potentiometer out (to the inside of the housing).
9. Unsolder the connecting wire from the defect potentiometer and resolder onto the new one.

**⚠ IMPORTANT**

**The contacts are not numbered, therefore, the potentiometer should only be replaced by a specialist!**

10. Reassemble in the reverse order.
11. Turn the shaft of the potentiometer against its counterclockwise stop.
12. Turn the inner scale of the multial so that "0" appears in the viewing window.
13. Slip the multial over the potentiometer shaft.  
The locating lug on the multial should enter the hole drilled in the panel.
14. Tighten the set screw firmly on the potentiometer shaft.

## 5.4 Cleaning the air filter mats

1. Carefully remove the filter mat grill on the rear of the TPA 20 Reciprocator Control.
2. Remove and clean the air filter mat(s).
  - Rinse in warm water (up to approximately 40 °C = 104 °F, wash with a household detergent, if necessary;
  - Dusting off, vacuuming or blowing off with compressed air is also possible.



**Do not wring out!**  
**When spraying with water, do not use a sharp jet!**

## Spare Parts List

### Ordering Spare Parts

When ordering spare parts for powder coating equipment, please indicate the following specifications :

1. Type, and serial number of your powder coating equipment.
2. Order number, quantity, and description of each spare part.

*Example :*

**1. Type :** TPA 20      **Serial no :** XXXX XXXX  
**2. Order no :** 235 954    1 piece,    Bulb 24 V / 2 W

When ordering cable or hose material the length required must also be given.  
The spare part numbers of this yard/metre ware is always marked with an \*.

The spare part number of yard/metre ware always begins with 1.. ... .

All wear parts are marked with a #.

All dimensions of plastic hoses are given as external and internal diameters :  
e.g.  $\varnothing 8 / 6$  mm = 8 mm outside diameter (o/d) / 6 mm inside diameter (I/d).

## Spare Parts List for TPA 20 Reciprocator Control



**Before opening the housing of the TPA 20 Reciprocator Control it must be disconnected from the Mains!! Wait at least one minute until the electronics have fully discharged themselves.**

1	AXODYN Speed regulating board - complete	371 645
2	DDC-DC Drive control board	343 390
2.1	Fuse for DDC board - 0.315 AT	211 753
2.2	Fuse for DDC board - 2.00 AT	221 872
2.3	Fuse for DDC board - 2.50 AT	206 571
3	LED Display	343 480
3.1	LED mounting frame	239 968
4	Exhaust filter complete (incl. item 4.1 and 4.3)	234 281
4.1	Filter	234 303
4.2	Fine filter	234 273
4.3	Filter sealing frame	234 290
5	Socket housing	201 430
5.1	Socket insert 10 pole + PE	211 532
6	Fine wire fuse 6.3 AT - for 200 V - 240 V	201 570
7	Fine wire fuse 10 AT - for 100 V - 120 V	200 174
8	Fixed plug, with gasket (for Mains connection)	200 409
9	Trim Potentiometer complete	361 550
10	Contactor - 24 DC	241 555
11	Axial Fan - 115 V	241 172
12	Contact unit	235 938
13	Lamp unit	235 946
14	Adapter fixture	235 920
15	Bulb 24 V / 2 W	235 954#
16	Switch	235 911
17	PSCB board complete	361 658
18	1-turn potentiometer for speed	251 887
19	10-turn potentiometer for position	210 811
19.1	Counter multidial	251 895

### TPA 20 Reciprocator Control

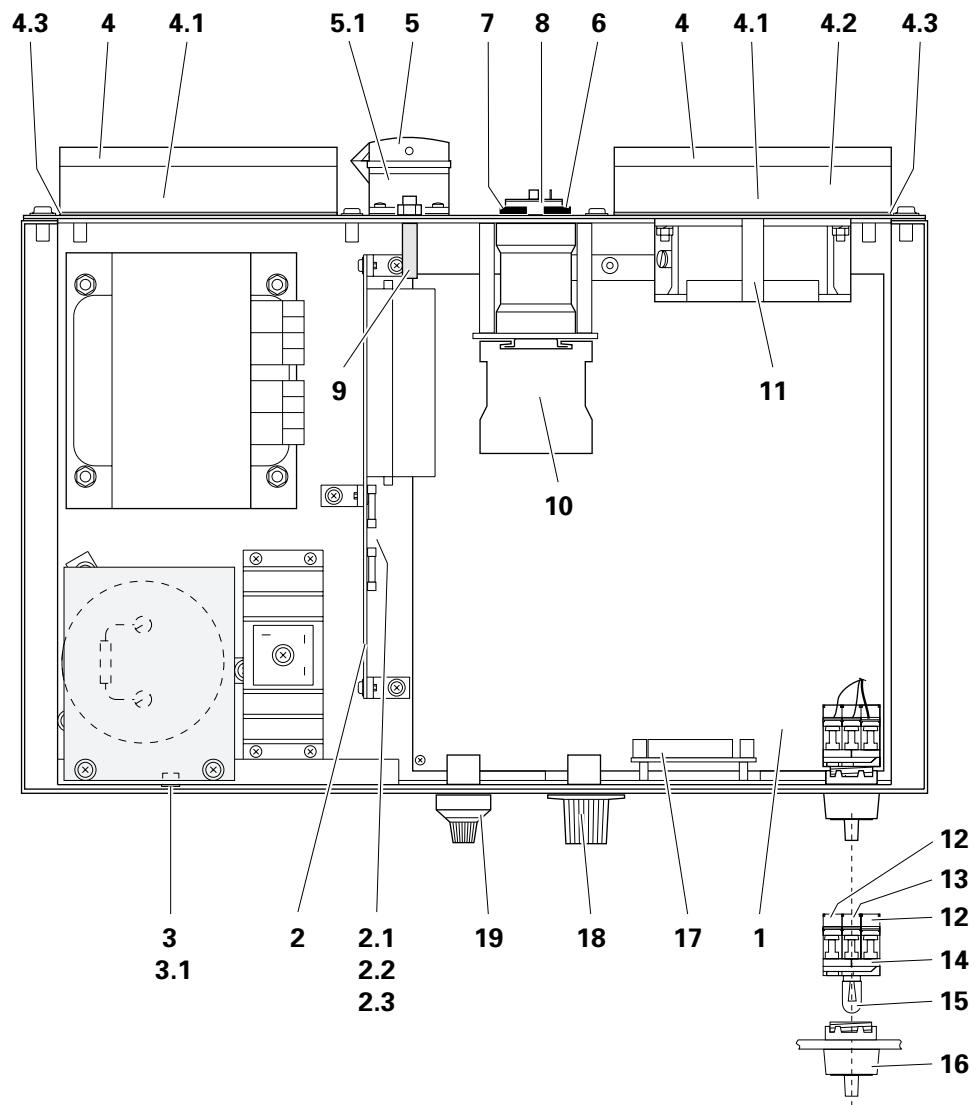


Figure 9

Documentation: TPA 20 Reciprocator Control

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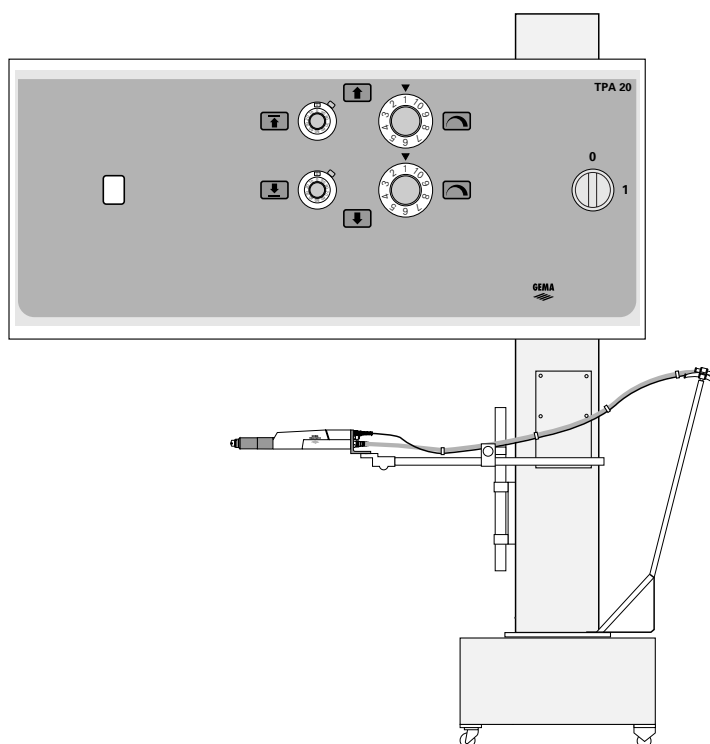
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Operating Instructions and Spare Parts List

## TPA 20 Reciprocator Control for DC Reciprocator Series:

- H 13 PB
- H 21 PB
- H 16 PB 30





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## TPA 20 Reciprocator Control Technical Data

### *Electrical Data :*

Selectable voltages : 100 V, 110 V, 120 V, 200 V, 220 V, 230 V or 240 V  
Tolerance : -10% / +10%

Voltage selection is made on the inside of the electrical unit by resoldering the tag on the transformer.

Frequency : 50...60 Hz  
Connected load : 1000 W

*Power stage :* Short circuit proof

DC output current :  $\pm 155$  V  
Max. constant current : 12 A  
Max. load : 30 A  
Max. effective power output : 1860 W

### *Temperature range :*

Storage temperature range : -10 °C to +60 °C (14 °F to 140 °F)  
Ambient temperature range : 0 °C to +40 °C (32 °F to 104 °F)

### *Dimensions :*

Width : 425 mm  
Depth : 315 mm  
Height : 268.5 mm  
Weight : 20 kg

### **Controlled reciprocators :**

*H-Series Reciprocators (H 13 PB / H 21 PB / H 16 PB 30):*

Maximum Load : 30 kg\*  
Minimum stroke : 0.40 m

\*see also „H-Series Reciprocator“ Operating Instructions

## Safety Rules

1. *The TPA 20 Reciprocator Control should only be put into operation after this operating manual has been carefully read through.*

Inexpert handling or operation of the TPA 20 Control, and the Reciprocator can lead to erratic or incorrect operation and/or damage to the equipment.

2. **Attention !! The (motor drive) power of the axes is very much stronger than that of any human being !**

All axes must be made inaccessible during operation. (See local safety regulations)

*If the reciprocator is switched off the carriage can sink to the zero point, therefore, **never stand under the carriage** at any time.*

3. The plugs and sockets of the TPA 20 Reciprocator Control unit, and the Reciprocator should only be dismantled when the control module is disconnected from the Mains.

4. The connecting cables between the control unit, and the axis must be laid out so that they cannot be damaged during operation of the axis. All movable hoses and cables must be laid out so that they are neither subjected to any excessive loads nor hang on other parts even when the reciprocator is at the maximum height of its stroke.

See local safety regulations.

5. The upper / lower stroke limits must always be set *according to the height of the reciprocator or to the height of the gun slots in the booth*. If an incorrect stroke height is set (too high) this can lead to damage to the reciprocator and / or the booth.

6. When repairs are to be made or parts replaced on the reciprocator the TPA 20 Reciprocator Control unit must be disconnected from the Mains!

See corresponding Operation Instructions.

7. When replacing parts, **only original Gema spare parts** must be used. Use of parts from other manufacturers invalidates the conditions of the Gema Volstatic guarantee.