Power Amplifiers with PID Modules

EEA-PAM-5**-D-32 Series

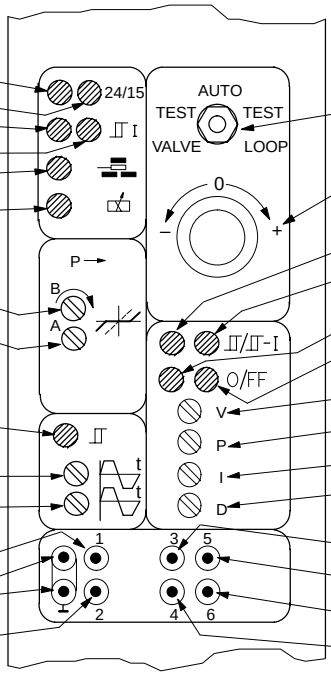
General Description

The EEA-PAM-5**-D-32 Eurocards are power amplifiers with integrated PID modules. Each of these cards replaces two conventional electronic cards.

Features and Benefits

- Includes all features of “A” amplifiers (except gain)
- User configurable PID feed-forward, closed-loop operation
- Command input ramps
- Analog feedback sensor interface
- Automatic switch-over p/Q function
- Built-in test feature
- The design reduces the amount of external wiring, saves space in the rack enclosure and requires only one 24V supply
- The general purpose, integrated module can be configured using DIL switches (D1-D9) and potentiometers for the following applications:
  - Closed-loop pressure control using either proportional pressure valves or servo-performance proportional valves
  - Closed-loop velocity control
  - Closed-loop position control
  - p/Q control with internal or external switch-over from Q to p
- The DIL- switch and potentiometer settings can easily be reconfigured on different cards

Front Panel



LEDs

[1] 24V power supply input, green
[2] 15V control supply output, green
[3] Drive (solenoid) enabled, yellow
[4] Overload, red
[5] LVDT failure, red ●
[6] Drive level to solenoid, yellow

Potentiometers

[7] Deadband compensation, flow P to B ▲ ◆
[8] Deadband compensation, flow P to A ▲ ◆

LED

[9] Ramps enabled, yellow

Potentiometers

[10] Command ramp up
[11] Command ramp down

Monitor points ■

[12] MP1: Conditioned command signal
[13] Common ground (0V)
[14] MP2: LVDT (spool) position ▼

[15] Mode switch
- TEST VALVE setting
- AUTO function setting
- TEST LOOP setting

[16] Test potentiometer

LEDs

[17] PID-controller enabled, yellow
[18] Integrator enabled, yellow
[19] Feedback = command signal, green
[20] Sensor failure, red

Potentiometers

[21] Feed-forward signal scaling
[22] P-gain
[23] I-gain
[24] D-gain

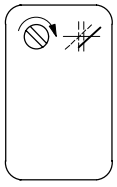
Monitor points ■

[25] MP3: Command signal
[26] MP5: PID-controller output
[27] MP6: Integrator output
[28] MP4: Feedback signal

▲ *Number and function of potentiometers [7], [8], [7.2] vary according to model type as follows:*

For models -513/541/553-

[7.2] Offset



● *LED and symbol not on EEA-PAM-513/523/525 amplifiers.*
▼ *Solenoid current for EEA-PAM-523/525-D models.*
■ *Ø2,0 mm (0.0787″ dia.) sockets.*
◆ *In the case of EEA-PAM-523/525-D models one of these relationships may not apply if two single solenoid valves are connected.*

This product has been designed and tested to meet specific standards outlined in the European Electromagnetic Compatibility Directive (EMC) 89/336/EEC, amended by 91/263/EEC, 92/31/EEC and 93/68/EEC, article 5. For instructions on installation requirements to achieve effective protection levels, see this leaflet and the Installation Wiring Practices for Vickers Electronic Products leaflet 2468. Wiring practices relevant to this Directive are indicated by ⚠ Electromagnetic Compatibility (EMC) .

Model Codes

Amplifier model	For valves
EEA-PAM-513-D-32	KCG-3, KCG-6/8 KX(C)G-6/8
EEA-PAM-523-D-32	K*G4V-3, KDG5V-5/7/8 } With type "H" coils only
EEA-PAM-525-D-32	K*G4V-5
EEA-PAM-533-D-32	KF*G4V-3
EEA-PAM-535-D-32	KF*G4V-5
EEA-PAM-541-D-32	KHDG5V-5/7/8 with zerolapped mainspool
EEA-PAM-553-D-32	KSDG4V-3
EEA-PAM-561-D-32	KFDG5V-5/7
EEA-PAM-568-D-32	KFDG5V-8
EEA-PAM-571-D-32	CVU-**-EFP1
EEA-PAM-581-D-32	KHDG5V-5/7/8

Operating Data

Power (input) supply	bz32	See appropriate base amplifier, e.g. for EEA-PAM-535-D-32 see EEA-PAM-535-A-32
Control (output) supplies	z22	+15V for LVDTs only
Reference voltages	z2	+10V x 5 mA
	b2	–10V x 5 mA
Analog inputs:		
Command inputs		
Direct-voltage inputs	b6, b8, b10, z8	
Inverting-voltage input	z10	
Voltage range		± 10V
Input impedance (voltage)		47 kΩ
Current input	z6	
Current range		± 20 mA
Input impedance (current)		100Ω
Feed-forward input	d8	
Input impedance		6 kΩ
Voltage range		± 10V
Input to ramp generator	d28	
Input impedance		10 kΩ
Voltage range		± 10V
Inputs from sensors		
Voltage input	d2	
Input impedance		1 MΩ
Voltage range		0 to 10V, or ± 10V■
Current input		
Input impedance		100Ω
Current range (See "DIL Switches" five pages on)		4-20 mA or 0-20 mA
Monitoring of sensor failure for sensors with a current outout only		

■ *The demand signal should have the same voltage range as the sensor feedback, i.e. 0 to 10V, or ± 10V.*

Continued on next page

Digital inputs:		
Drive enable (power available to solenoid)	z24	
Ramps enable	b24	
Integrator enable	d14	***Warning:*** *In a power-up sequence, the integrator should not be enabled until all hydraulic, electric and control power and signals are applied and stable. Abrupt or unpredictable motion may occur if integrator is enabled during this transition time.*
PID-controller enable	d12	
Enabled		17 to 40V
Disabled		0 to 3,5V
Load current		≤ 10 mA
Digital outputs:		
Sensor failure	d18	
Sensor failure		Vcc –2V
Sensor o.k.		<3V
Load current (withstands a continuous short-circuit condition)		≤ 100 mA
This output may be used only in conjunction with sensors providing a current output (4-20 mA)		
Feedback = command signal	d10	
Feedback matches demand		Vcc –2V
Feedback does not match demand		<3V
Load current (withstands a continuous short-circuit condition)		≤ 100 mA
The load at pin d18 and pin d10 has to be connected to ground		
Analog outputs:		
PID-controller output	d4	
Error signal	d22	
Feedback signal	d24	
Load impedance		≥ 10 kΩ; short-circuit proof
Voltage range		± 10V
Output from ramp generator	d26	
Load resistance		≥ 5 kΩ; short-circuit proof
Voltage range		± 10V
Alarm output (drive output status):	z12	
Set alarm		Enable amplifier (on pin z24) >500 ms after switching power on.
Signal		HIGH when alarm is activated. Output = Supply volts minus 2 volts. I = 50 mA max. LOW when solenoid overload has occurred. (Maintained until reset). Output = 0 to +/–2 volts. Output resistance = 50 ohms.
Reset after failure		Disable and re-enable on pin z24.
Ramp active indicator:	b12	
Drive ramping up		Output >10V
Drive ramping down		Output <–10V
Drive not ramping		Output 0 ± 10V
Output resistance		10 kΩ
Drive signal zero indicator:	b20	
Drive signal at null (within deadband limits)		Output = Supply minus 1,5V; I = 50 mA max.
Drive active		Output = 0 ± 2V
Output resistance		50Ω

Continued on next page

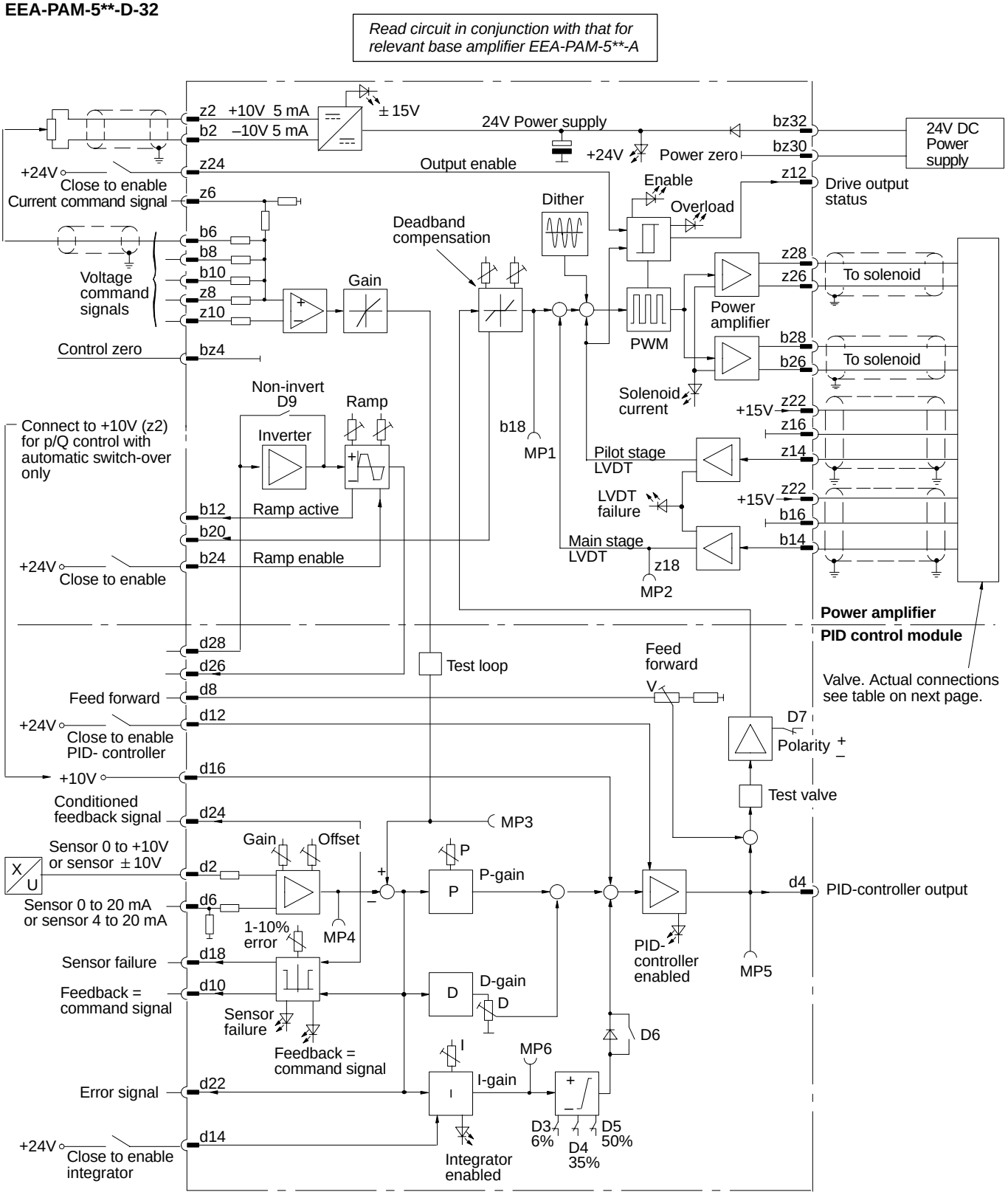
Potentiometers:		
Feed-forward		V = 20% to 100%
P-gain (depends on DIL switch D2):		P = 0,1 to 50V/V
I-gain range		K_i = 0,5 to 100 V/s/V
D-gain range		K_d = 0 to 0,05 V/V/s
Sensor signal gain range■		90% to 120%
Sensor signal offset range■		±10%
Monitor points:		
Conditioned command signal	MP1	
LVDT (spool) position▲	MP2	
Command signal	MP3	
Feedback signal	MP4	
PID-controller output	MP5	
Integrator output (100%, independent of D3, D4, D5)	MP6	
Voltage range		±10V
Monitor point impedance		10 kΩ
Ambient conditions:		
Storage temperature range		–25 to +85°C (–13 to +185°F)
Operating temperature range		0 to 50°C (32 to 122°F)
Mass		0,4 kg (0.88 lb) approx.
Installation and start-up guidelines (supplied with product)		9161
Installation wiring requirements for Vickers electronic products		2468
Application notes (available on request)		9056
Supporting products:		See catalogs:
Power supply unit options		2419
Electronic accessories		2460
Portable test equipment		2462 and 2315

■ *Located on PID module.*
▲ *All amplifiers except EEA-PAM-523/525 models, in which solenoid current is monitored.*

Warning: *Electromagnetic Compatibility (EMC)*
It is necessary to ensure that the valve is wired up in accordance with the connection arrangements shown in this leaflet. For effective protection, the user's electrical cabinet, the valve subplate or manifold and the cable screens should be connected to efficient earth (ground) points. The metal 7-pin connector part no. 934939 should be used for the integral amplifier.
In all cases, both valve and cable should be kept as far away as possible from any source of electromagnetic radiation such as cables carrying heavy current, relays and certain kinds of portable radio transmitters, etc. Difficult environments could mean that extra screening may be necessary to avoid the interference.

Circuit and Connections

EEA-PAM-5-D-32**



⏚ *Customer's protective ground connection.*

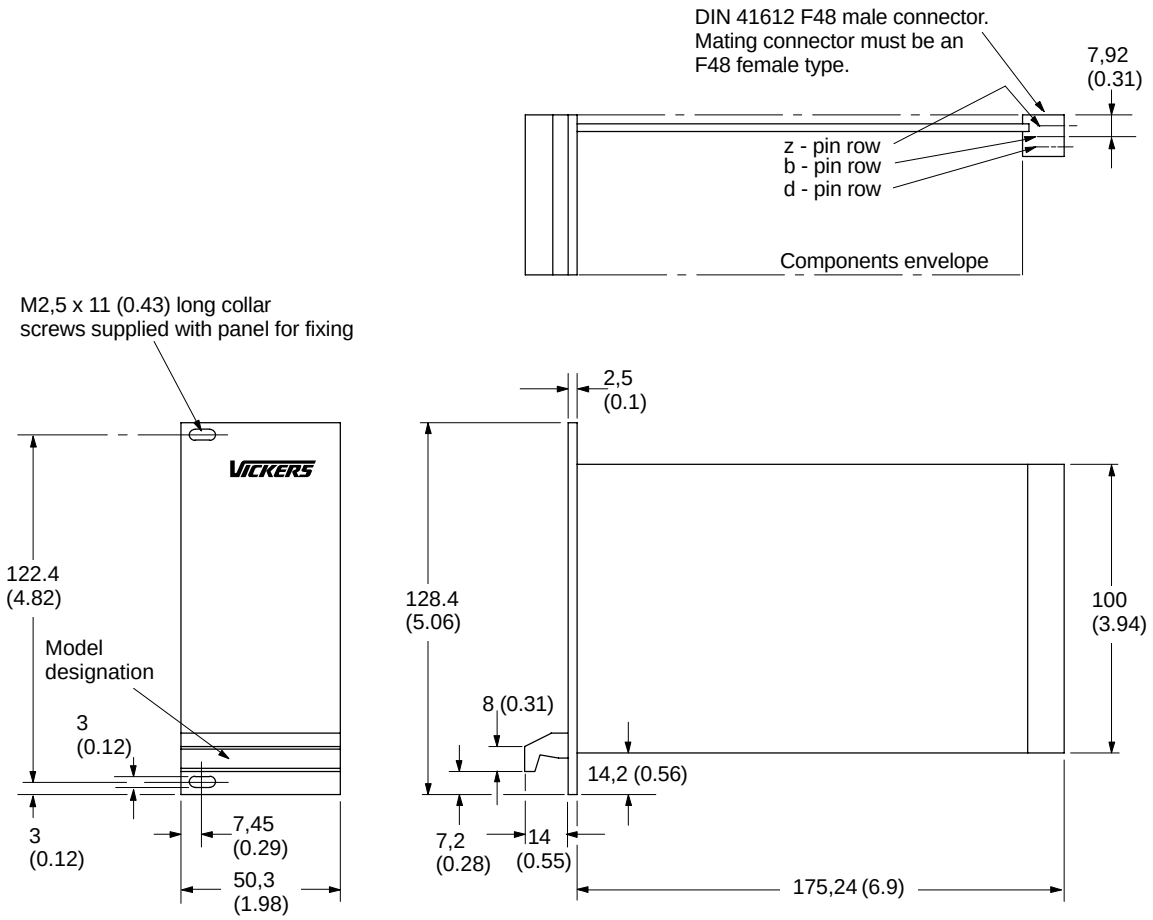
Solenoid and LVDT Connections for Proportional Valves

Amplifier type	Solenoid with LVDT and/or for flow P to B	Solenoid without LVDT, or on pilot valve	Pilot-stage LVDT, (black plug):				Main-stage LVDT, (gray plug):			
			Pin 1	Pin 2	Pin 3	Pin 4	Pin 1	Pin 2	Pin 3	Pin 4
EEA-PAM-513-D-32	b26/b28	–	–	–	–	Not connected	–	–	–	Not connected
EEA-PAM-523-D-32	b26/b28	z26/z28	–	–	–	Not connected	–	–	–	Not connected
EEA-PAM-525-D-32	b26/b28	z26/z28	–	–	–	Not connected	–	–	–	Not connected
EEA-PAM-533-D-32	b26/b28	z26/z28	–	–	–	Not connected	b14	z22	b16	Not connected
EEA-PAM-535-D-32	b26/b28	z26/z28	–	–	–	Not connected	b14	z22	b16	Not connected
EEA-PAM-541-D-32	–	z26/z28	z14	z22	z16	Not connected	b14	z22	b16	Not connected
EEA-PAM-553-D-32	–	z26/z28	–	–	–	Not connected	b14	z22	b16	Not connected
EEA-PAM-561-D-32	–	z26/z28	–	–	–	Not connected	b14	z22	b16	Not connected
EEA-PAM-568-D-32	–	z26/z28	–	–	–	Not connected	b14	z22	b16	Not connected
EEA-PAM-571-D-32	–	z26/z28	–	–	–	Not connected	b14	z22	b16	Not connected
EEA-PAM-581-D-32	–	z26/z28	z14	z22	z16	Not connected	b14	z22	b16	Not connected

Installation Dimensions in mm (inches)

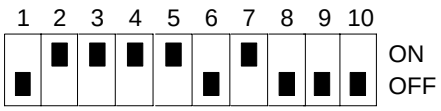
3rd angle projection

Plug-in Unit of 3U height, to IEC 297



Application Notes

DIL Switches
The controller is configured for the application using DIL switches, located on the board.

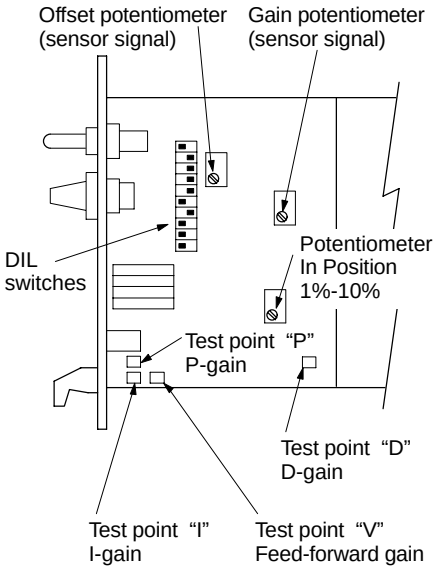


Factory setting

The DIL switch operates as follows:

Switch	ON	OFF
D1:	For sensors with 4 to 20 mA output	For sensors with ±10V or 20 mA outputs
D2:	P-gain 2 to 50	P-gain 0,1 to 2
D6:	One-sided limitation of the integrator output. (Only useful for proportional pressure and proportional throttle valves.)	No limitations of integrator output
D7:	Inverts the controller output signal	Non-inverted signal
D8:	For sensors with 4 to 20 mA output	For sensors with ±10V or 20 mA outputs
D9:	Ramp signal not inverted	Ramp signal inverted
D10:	Not used	–

Location of User Features on PID Module



For p/Q control with automatic switch-over, connect d16 to z2 (+10V). The flow command signal (Q) is applied to the feed-forward input, d8, and the desired pressure setpoint voltage applied to a command signal input (b6/8/10 or z6/8/10). The pressure feedback sensor is connected to the sensor input d2, or d6 as required.

The pressure control loop will override the flow command to limit the pressure to the level determined by the pressure setpoint voltage. Adjust P, I and D gains for best performance.

The switches D3, D4 and D5 belong together. They limit the I output volts between 100% (10V) and 5% (0,5V) as follows:

D3	D4	D5	I-limit
ON	ON	ON	100%
ON	ON	OFF	50%
ON	OFF	ON	35%
ON	OFF	OFF	25%
OFF	ON	ON	5,9%
OFF	ON	OFF	5,8%
OFF	OFF	ON	5,3%
OFF	OFF	OFF	5,0%

Reconfiguration of Controller Parameters
Once the controller parameters have been optimized and set, they can be measured by means of an ohmmeter. This allows easy reconfiguration of the controller on different cards for use as spare parts or on standard machine series.

Four test points are located on the PID-module for this purpose, see diagram for locations. The resistance between the appropriate test point and ground (at the front panel monitor point) determines the controller parameters:
P = P-gain
I = I-gain
D = D-gain
V = Feed-forward gain

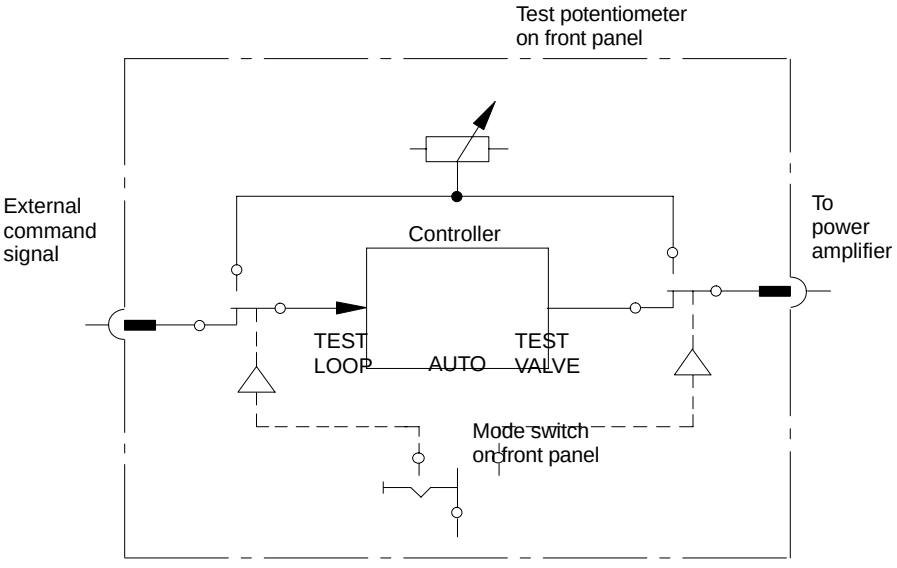
Operation of the Integrated Test Mode
The basic operation of the hydraulic actuator can be tested by using the 3-position mode switch mounted on the front panel. To select different modes the toggle switch must be lifted slightly before turning it to a new position.

Caution:
Before setting the mode switch to either “Test valve” or “Test loop” make sure the test potentiometer is set to “0”. Otherwise sudden movements of the actuator may occur.

The mode switch has three positions:
AUTO
The controller operates in closed-loop mode, using the external command signal. The test potentiometer is disconnected.

TEST VALVE
An open-loop command signal for the valve comes directly from the potentiometer. The external input signal is disconnected. The hydraulic part of the system may be tested in this configuration.

TEST LOOP
The closed-loop command signal for the PID-controller comes directly from the potentiometer. The external signal input is disconnected. This configuration allows for verification of the valve polarity and the control parameters.



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