

## Power Amplifier with PID for EDC-Controlled Pumps

### EEA-EDC-436-D\*-32 Series

#### General Description

The EEA-EDC-436-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
  - 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. Yoke sensor failure, red
6. Drive level to solenoid, yellow

#### Potentiometers

7. Offset

#### LED

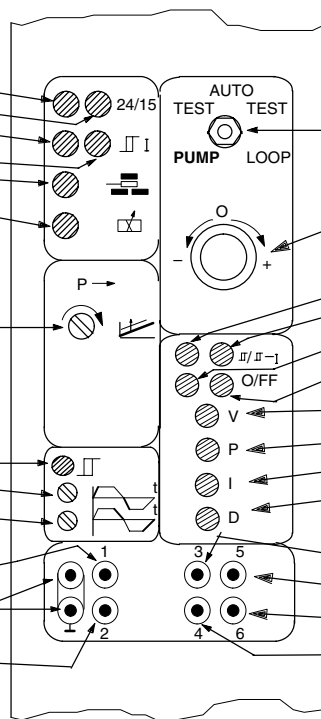
8. Ramp enabled (yellow)

#### Potentiometers

9. Command ramp up
10. Command ramp down

#### Monitor Points ■

11. MP1: conditioned command signal
12. Common ground (0V)
13. MP2: Yoke position



14. Mode switch
  - TEST PUMP setting
  - AUTO function setting
  - TEST LOOP setting

15. Test potentiometer

#### LEDs

16. PID-controller enabled, yellow
17. Integrator enabled, yellow
18. Feedback = command signal, green
19. Sensor failure, red

#### Potentiometers

20. Feed-forward signal scaling
21. P-gain
22. I-gain
23. D-gain

#### Monitor Points ■

24. MP3: Command signal
25. MP5: PID-controller output
26. MP6: Integrator output
27. MP4: Feedback signal

■ Ø2,0 (0.0787 dia.) sockets



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	Assy. Nr
EEA-EDC-436-D1—32	PVH 57 & 74	02-326 129
EEA-EDC-436-D2—32	PVH 98	02-326 130
EEA-EDC-436-D3—32	PVH 131	02-326 131

## Operating Data

Power (input) supply:	bzd 32 bzd 30	20 to 40 V DC (incl. pk-to-pk ripple $\pm$ 10% max.) Power ground
Control (output) supplies:	z22	+15V
Reference voltages	z2 b2	+10V x 5 mA -10V x 5 mA
Analog inputs:		
Command inputs		
Direct voltage inputs	b6,b8,b10,z8	
Inverting voltage input	z10	
Voltage range		$\pm$ 10V
Input impedance (voltage)		47 kW
Current input	z6	
Current range		$\pm$ 20 mA
Input impedance (current)		100 W
Feed-forward Input		
Input impedance	d8	6 kW
Voltage range		$\pm$ 10V
Input to ramp generator		
Input impedance	d28	10 kW
Voltage range		$\pm$ 10V
Inputs from sensors		
Voltage input	d2	
Input impedance		1 MW
Voltage range		0 to 10V or $\pm$ 10V ■
Current input		
Input impedance		100 W
Current range (see "DIL Switches" five pages on)		4–20 mA or 0–20 mA
Monitoring of sensor failure for sensors with a current output only		

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

# Operating Data

<p>Digital inputs:</p> <p>Drive enable (power available to solenoid) z24</p> <p>Ramps enable b24</p> <p>Inegrator enable d14</p> <p>PID controller enable d12</p> <p>Enabled</p> <p>Disabled</p> <p>Load current</p>	 <p><b>Warning:</b> 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</p> <p>17 to 40V</p> <p>0 to 3,5V</p> <p>≤ 10 mA</p>
<p>Digital outputs:</p> <p>Sensor failure d18</p> <p>Sensor failure</p> <p>Sensor OK</p> <p>Load current (withstands a continuous short-circuit condition) This output may be used only in conjunction with sensors providing a current output (4–20 mA)</p> <p>Feedback = command signal d10</p> <p>Feedback matches demand</p> <p>Feedback does not match demand</p> <p>Load current (withstands a continuous short-circuit condition)</p> <p>The load at pin d18 and at pin d10 has to be connected to ground</p>	<p>Supply Voltage – 2V</p> <p>&lt; 3V</p> <p>≤ 100 mA</p> <p>Supply Voltage – 2V</p> <p>&lt; 3V</p> <p>≤ 100 mA</p>
<p>Analog outputs:</p> <p>PID controller output d4</p> <p>Error signal d22</p> <p>Feedback signal d24</p> <p>Load impedance</p> <p>Voltage range</p> <p>Output from ramp generator d26</p> <p>Load resistance</p> <p>Voltage range</p>	<p>≥ 10 kW; short-circuit proof</p> <p>± 10V</p> <p>≥ 5 kW; short-circuit proof</p> <p>± 10V</p>
<p>Alarm output (drive output status) z12</p> <p>Set alarm</p> <p>Signal</p> <p>Reset after failure</p>	<p>Enable amplifier (on pin z24) when switching power on</p> <p>HIGH when alarm is activated</p> <p>Output = Supply minus 2V</p> <p>I = 50 mA max.</p> <p>LOW when solenoid overload has occurred. (Maintained until reset.)</p> <p>Output = 0 to ± 2 volts</p> <p>Output resistance = 50 ohms</p> <p>Disable and re-enable on pin z24</p>
<p>Ramp active indicator: b12</p> <p>Drive ramping up</p> <p>Drive ramping down</p> <p>Drive not ramping</p> <p>Output resistance</p>	<p>Output &gt;10V</p> <p>Output &lt;-10V</p> <p>Output 0V (± 2V ripple)</p> <p>10 kΩ</p>
<p>Drive signal zero indicator: b20</p> <p>Drive signal at null (within deadband limits)</p> <p>Drive active</p> <p>Output resistance</p>	<p>Output = Supply minus 1,5V</p> <p>I = 50 mA max.</p> <p>Output = 0 ± 2V</p> <p>50Ω</p>

# Operating Data

Potentiometers: Feed-forward P-gain (depends on DIL switch D2) I-gain range D-gain range Sensor signal gain range ■ Sensor signal offset range ■		V = 20% to 100% P = 0,1 to 50 V/V K <sub>i</sub> = 0,5 to 100V/s/V K <sub>d</sub> = 0 to 0,5 V/V/s 90% to 120% ± 10%	(20% is potentiometer fully CCW) (0,1 V/V is potentiometer fully CCW) (0,5 V/s/V is potentiometer fully CCW) (0 V/V/s is potentiometer fully CCW) (90% is potentiometer fully CCW) (-10% is potentiometer fully CCW)
Monitor points: Conditioned command signal Yoke position Command signal Feedback signal PID controller output Integrator output (100%, independent of D3, D4, D5) Voltage range Monitor point impedance	MP1 MP2 MP3 MP4 MP5 MP6	0V to 10V equals 0% to 100% yoke command 0V to 10V equals 0% to 100% yoke angle -10V to 10V equals -10% to 100% closed loop control command -10V to 10V equals -10% to 100% sensor signal 0V to 10V equals 0% to 100% yoke command 0V to 10V equals 0% to 100% integrator term ± 10% 10 kΩ	
Ambient conditions: Storage temperature range Operating temperature range		-25 to +85°C (-13° to + 185°F) 0 to 50°C (32° to + 122°F)	
Mass		0,4 kg (0.88 lb) approx.	
Installation and start-up guidelines (supplied with product) Installation wiring requirements for Vickers electronic products Application notes (available on request)		9166 2468 9060	
Supporting products: Power unit options Electronic accessories Portable test equipment		See catalogs: 2419 2460 2462 and 2315	
■ Located on PID module		1.6A	

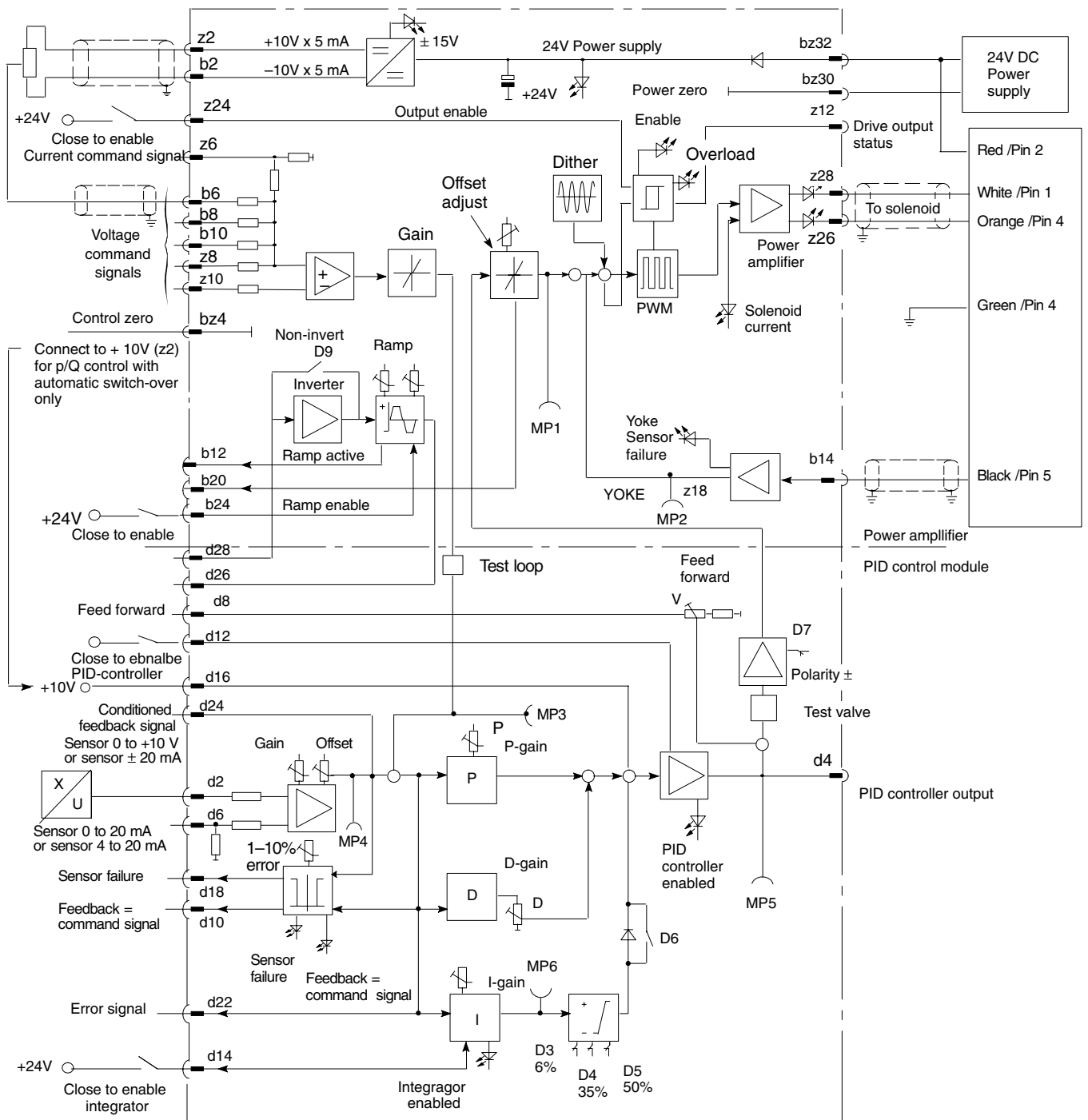


**Warning:** Electromagnetic Compatibility (EMC)

*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.*

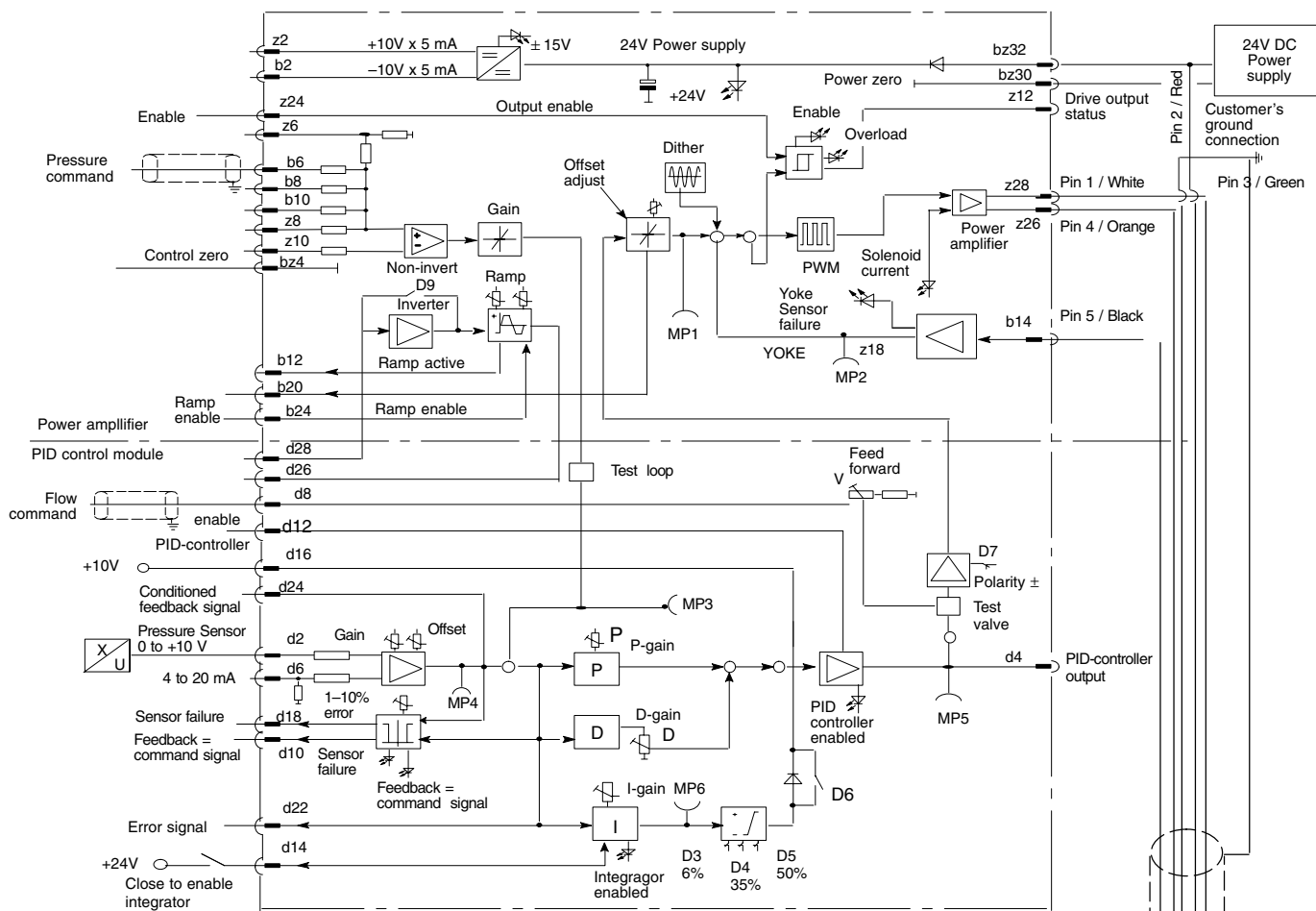
*In all cases, both valve and cable should be kept as far away as possible from any source of electromagnetic radiation such as cables carrying heavy current, relays and certain kinds of portable radio transmitters, etc. Difficult environments could mean that extra screening may be necessary to avoid the interference.*

# Circuit and Connections

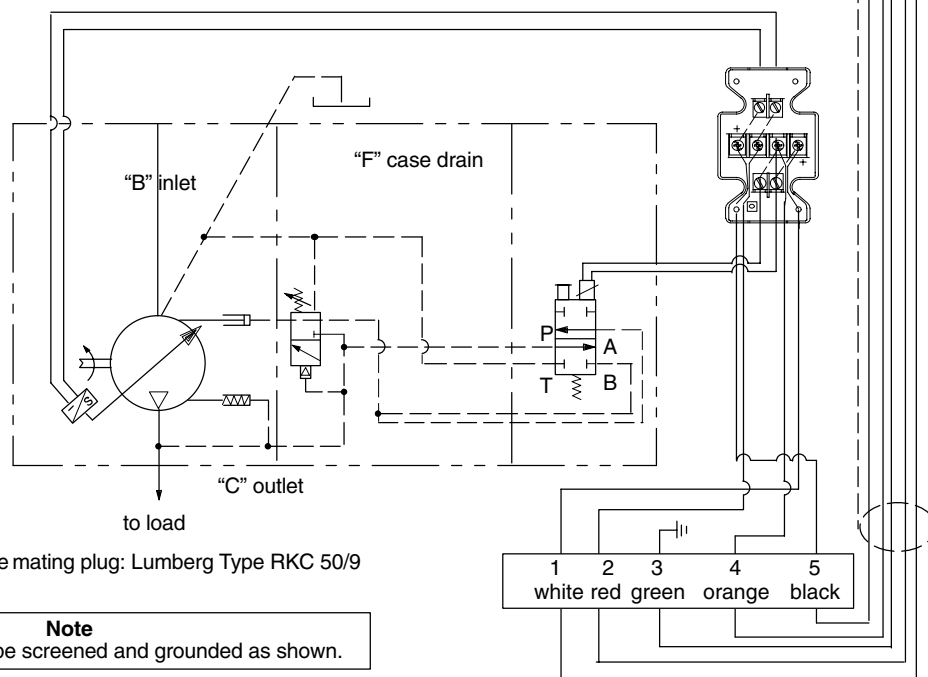


 Customer's protective ground protection

# Circuit & Connections for P/Q Control with Pump Wiring



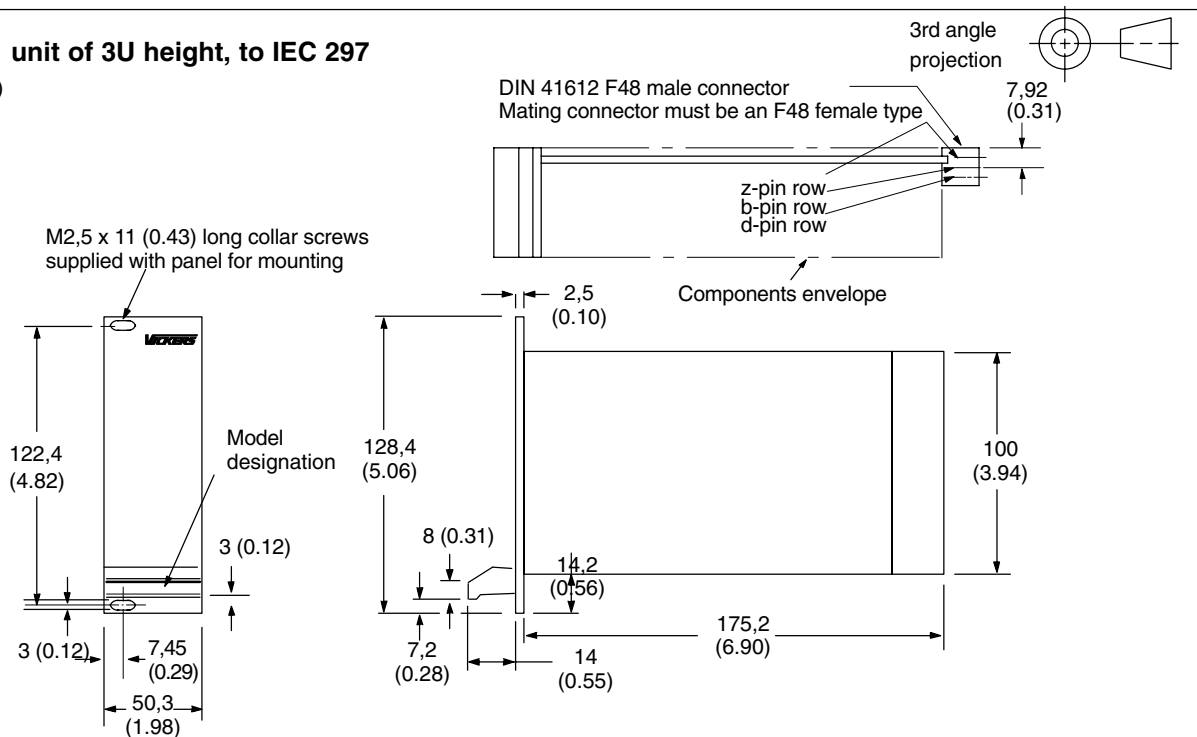
## Pump Assembly



# Installation dimensions

## Plug-in unit of 3U height, to IEC 297

mm (inch)



## Application notes

### 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.

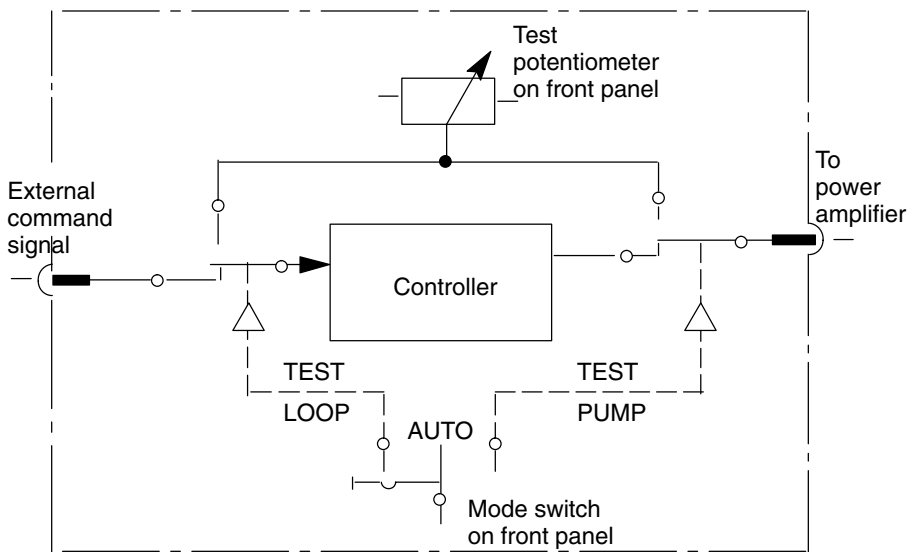
#### Caution:

Before setting the mode switch to either "Test pump" or "Test loop" make sure the test potentiometer is set to "0". Otherwise sudden movements of the actuator may occur.

The mode switch has 3 positions:

#### AUTO

The controller operates in closed-loop mode, using the external command signal. The test potentiometer is disconnected.



#### TEST PUMP

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.

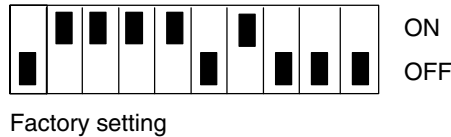
#### TEST LOOP

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.

# Application notes

## DIL Switches

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



The DIL switch operates as follows:

Switch	ON	OFF
D:1	For sensors with 4 to 20 mA output	For sensors with $\bar{4}$
D:2	P-gain 2 to 50	20 mA outputs P-gain 0,1 to 2
D:6	One sided limitation of the integrator output. (only useful for proportional pressure and proportional throttle valves).	No limitations of integrator output
D:7	Inverts the controller output signal	Non-inverted signal
D:8	For sensors with 4 to 20 mA output	For sensors with $\bar{4}$
D:9	Inverts the ramp signal	20 mA outputs -
D:10	Not used	-

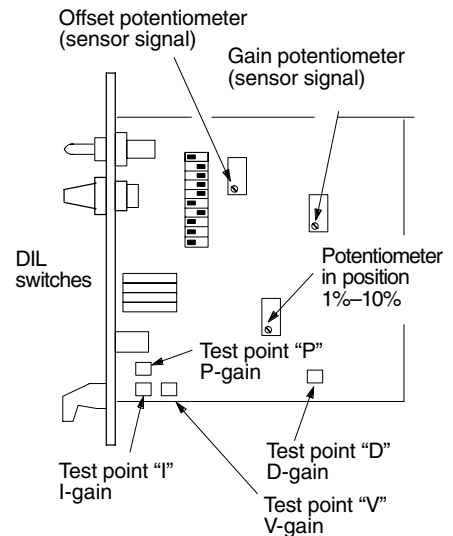
For p/Q control with automatic switch-over, connect d16 to z2 (+10V). The flow command signal (Q) is applied to the feed-forward input, d8, and the desired pressure setpoint voltage applied to a command signal input (b6/8/10 or z6/8/10). The pressure feedback sensor is connected to the sensor input d2,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

## Location of user features on PID module



## 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:

- PID = P-gain
- I = I-gain
- D = D-gain
- V = Feed-forward gain