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1. Introduction

The STE0014 is a panel mounted DIN 43700 instrument intended for use with electro-hydraulic servo valves. The front panel is 96 x 48mm consistent with other types of instruments.

Panel cutout is 92 x 44mm (+1, -0mm) and system connections are brought out on a 15 way screw connector at the rear of the instrument. All essential adjustment potentiometers are accessible on the front panel. Access behind the panel is not required for installation.

The amplifier offers full 3 term PID (proportional, integral and derivative) control for servo systems employing load, position, velocity and, in limited applications, pressure transducers. There are various input options including current, differential and single-ended voltage inputs. A facility is provided to disable the integrator while hydraulic pressure is off; this feature eliminates transients during power-up.

Output drive capability is up to +/-150mA, with link selectable current gain to suit the drive requirement of the servo valve. The output amplifier uses current feedback to minimize the effect of load reactance and the output is protected against short circuits or the effects of inductive transients from the servo valve.

Span and offset potentiometers can be used for scaling the feedback voltage to assist setting up, and for logging purposes via the board connector or front panel jack socket. The feedback voltage sense is link selectable, enabling reversal of a positive feedback condition during commissioning. Additional circuitry allows dither and adjustable ramp rate features to be used.

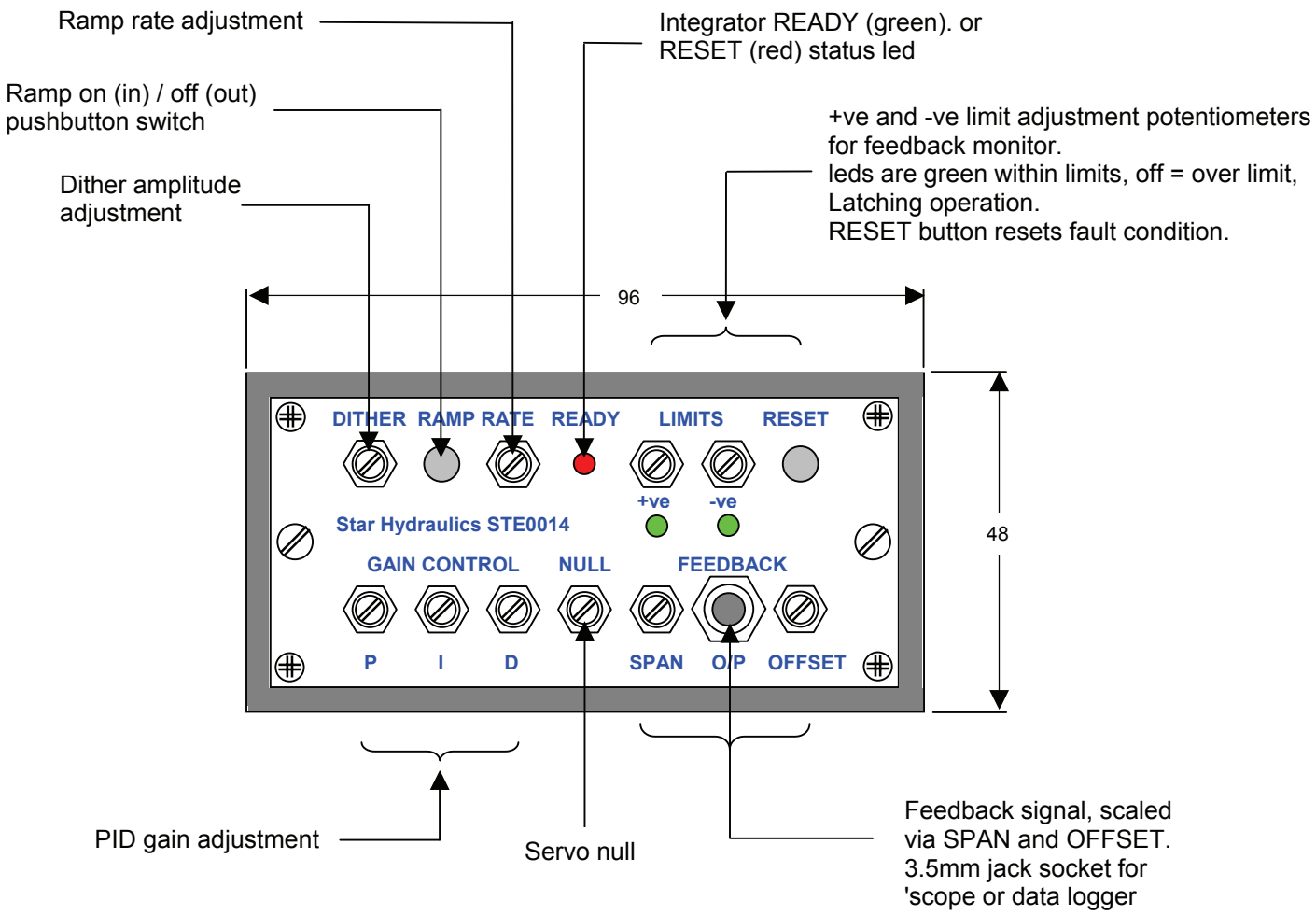
The amplifier is designed to accept analog input signals typically within the range + / - 10v. Low level signals, for example from strain gauges, will require separate signal conditioning amplifiers.

2. Power Supplies

The servo amplifier is designed to operate from a stabilized +15/0/-15v dc supply. Nominal current drain is 150mA, plus the current required to drive the servo valve. The 0v of the supply is used as a reference for all signals and measurements, and the same +/-15v supply can be used for the feedback transducer supply.

Connection examples are given later in the manual.

Fig. 1 Front Panel



RV1 : Servo valve null. Fine adjustment to null servo flow
RV2 : Proportional gain. Minimum gain = CCW (All 20 turn potentiometers)
RV3 : Integral gain . . . . . CCW
RV4 : Derivative gain . . . . . CCW
RV5 : Feedback signal span (scaling) . . . . . .CCW
RV6 : Feedback signal zero (offset)
RV7 : Dither amplitude control. Minimum = CCW
RV8 : Ramp rate control. Slowest rate = CCW
RV9 : +ve limit } feedback over-limit Min = CCW
RV10: -ve limit } fault cutout adjust Min = CCW

3. Connection details

Rear screw connector SK1 :

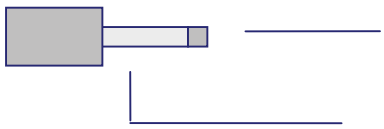
1. Servo drive output Lo
2. Servo valve output Hi
3. Power supply +15V
4. Power supply 0V
5. Power supply -15V
6. Feedback over-limit volt-free relay contacts
7. fault = o/c
8. Hydraulic pressure switch (optional) — Pressure on — 0V
9. Feedback input, -10V .... +10V typical
10. 0V
11. Feedback (scaled and offset) output
12. Aux voltage i/p 1
13. Aux voltage i/p 2

-10 ..... +10V typical

14. +ve — Differential** set point i/p
15. -ve

** The differential input can be configured for current input by the addition of a current sensing resistor, R31, on the PCB.

Front panel jack socket
SK2 connector (3.5mm)

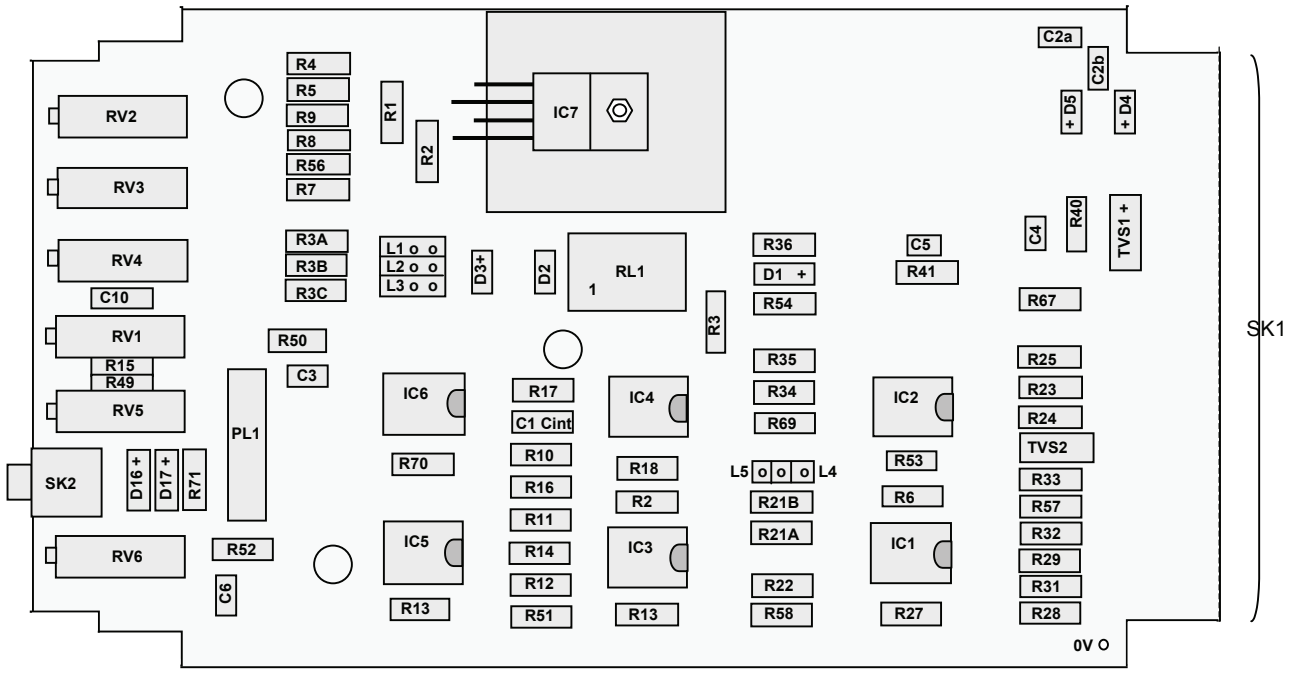


Output signal hi

Output signal lo (0V)

4. Control and link options

Figure 2a Lower PCB



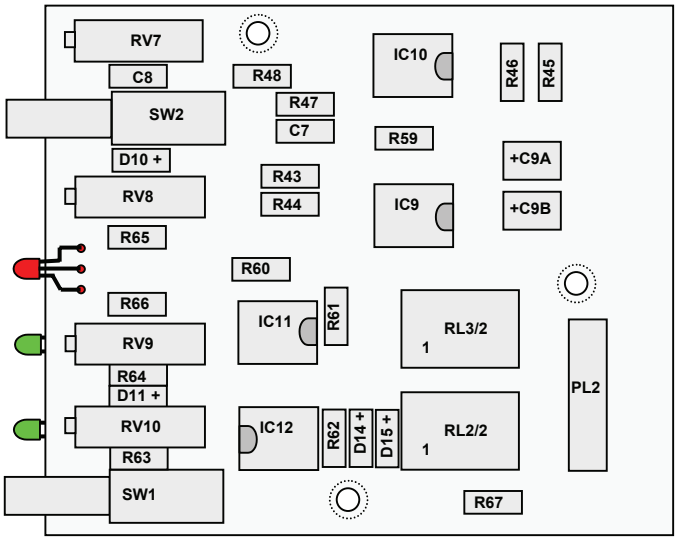


Figure 2b Upper PCB

SK2: 3.5mm jack socket
Cint: Integrator capacitor = 0.1uF

Link options: (L0 not used)
L1 gain: ..... 0 - 1 A/V
or L2 gain: ..... 0 - 100 mA/V
or L3 gain: ..... 0 - 10 mA/V
L4 Differential error amplifier
or L5 Summing error amplifier

NOTE

L1 - L5 are PCB links on the component side of the PCB, but it is recommended that the link is soldered on the reverse side once commissioning is complete.

5. Setting up

The following description of a position control system is typical.

Initial conditions:

Make the following connections to the board. Do not connect the feedback initially.

1	servo valve pin D	Link servo valve pins B to C to use coils in series
2	ditto A	or A to C, and B to D in parallel.
3	+ve	Connect to regulated
4	0V	DC power supply (+/- 15V)
5	-ve	@ 250mA min o/p
6	Over-limit contacts	no connection initially
7		
8	Integrator reset: connect via n/o pressure switch to 0V (or link direct to 0V)	
9	Feedback voltage input hi (leave disconnected initially)	
10	0V (feedback lo)	
11	Scaled feedback voltage output hi - monitor on 'scope if possible, or DVM	
12	Aux input 1	no connection
13	Aux input 2	required
14	+ input	Differential set point i/p — connect to external demand voltage
15	- input	

All front panel potentiometers are 20 turn devices, and contain a slipping clutch at each end of travel. No damage will occur by over adjustment.

Set the external demand signal on SK1-14 &15 to zero.

Limit the initial testing to 500 psi system pressure if possible.

Switch on hydraulic power and verify the pressure switch or link across SK1-8 and 0V has set the led to green. Adjust RV1 (null) to obtain zero flow from the servo valve if necessary.

Adjust the proportional gain potentiometer (RV2) CW and monitor the the feedback voltage with respect to the system 0v, so that as the demand signal is changed, the feedback voltage to be applied to the amplifier on SK1-9 (hi) and 10 (lo) also changes, indicating that the servo system is operating.

With link L4 selected, verify that the feedback voltage is in the same sense as the demand; ie, if the demand voltage is increased more positively on input 14, the feedback voltage must change more positively as the transducer follows the system.

If the feedback voltage sense is opposite to the demand, positive feedback will occur and the system will lock at one end or the other of the travel. In this case the feedback

transducer and / or the hydraulic connections will require reconnection.

When the above polarity requirements have been met, connect the feedback signal to the input SK1-9 (hi) and 10 (lo). Potentiometer RV6 (zero) and RV5 (span) can now be used to scale the feedback voltage range to the set point demand.

Dynamic gain adjustment

An oscilloscope will be required to monitor the feedback on SK1-11 (hi) and 0V (lo) or via the front panel jack socket SK2 (see page 5). Apply a step demand input of approximately 10% of the intended full scale input and observe the feedback signal on the 'scope. Increase the proportional gain (RV2) CW to obtain a similar signal to the input step without overshoot.

Increase the integral gain (RV3) CW and note that a shift of the waveform will occur as the steady state error is reduced. Any overshoot introduced by the integral gain can be reduced by increasing the differential gain (RV4) slowly CW.

Increase the demand voltage step amplitude and verify that excessive overshoot does not occur. Reduce the proportional gain setting if necessary.

System hydraulic and mechanical stiffness will play a major part in obtaining good frequency response. There must be no backlash between servo valve / actuator and feedback sensor. Particularly in high load applications, ensure bending loads do not cause distortion. Avoid mounting the servo valve remotely from the actuator or motor via flexible hoses.

6. Specification

Hardware : DIN43700 panel mount steel case 96 x 48mm bezel,
160mm deep behind panel. Panel thickness 5mm max
Panel cutout 92 x 44mm (+0, -1mm)

Power requirement : +15 / 0 / -15V DC line and load regulation < 0.1%.
Ripple < 5mV pk-pk.
Current requirement = 150mA plus servo valve.

Connector : Rear 15 way spring leaf screw connector, 5mm pitch
Front panel connector 3.5mm jack socket.

Temperature range : 0 – 50 deg.C operating. RH 20 – 80 %

Signal inputs to error amplifier : 2 x auxiliary non-inverting inputs. Impedance = 100K min

1 x differential set point input.
2 modes: (a) 0 -10V input, impedance 1M min,
or (b) 0 - 10 mA input, impedance max 500 Ohms
with additional resistor R31.

1 x inverting input with span adjustment 0 – 100% and zero offset +/- 100% for +/- 10v transducer feedback. Polarity is link selectable (see schematic). Input impedance 1M min.

Output : Link selectable output current ranges set by 3 links: 1 A/V, 100 mA/V, and 10 mA/V. Output impedance < 50 Ohms. Short circuit protected plus thermal shutdown.

Dither : Variable amplitude, 0 – 1v pk-pk at 350 Hz triangle waveform.

Ramp function : Adjustable 10 mS/Volt to 1 Sec/Volt Applicable to differential set point input on SK1-14 & 15 only. ON / OFF switch.

Reset function : LED front panel indication of status:
red = integrator reset, hydraulic pressure off
green = system running, pressure on.
A N/O hydraulic pressure switch connected between SK1-8 and 0v controls this function, or link to 0V for permanent integral function.

Feedback monitor : Adjustable over-voltage trip for scaled feedback voltage -10 to +10V. In-limits indicated by green leds on.
Positive or negative over-limit voltage (fault) condition turns appropriate led off and relay contacts open circuit SK1-6 & 7.
Fault condition is latched open-circuit until pushbutton RESET switch is operated on the front panel.

Figure 3 Schematic

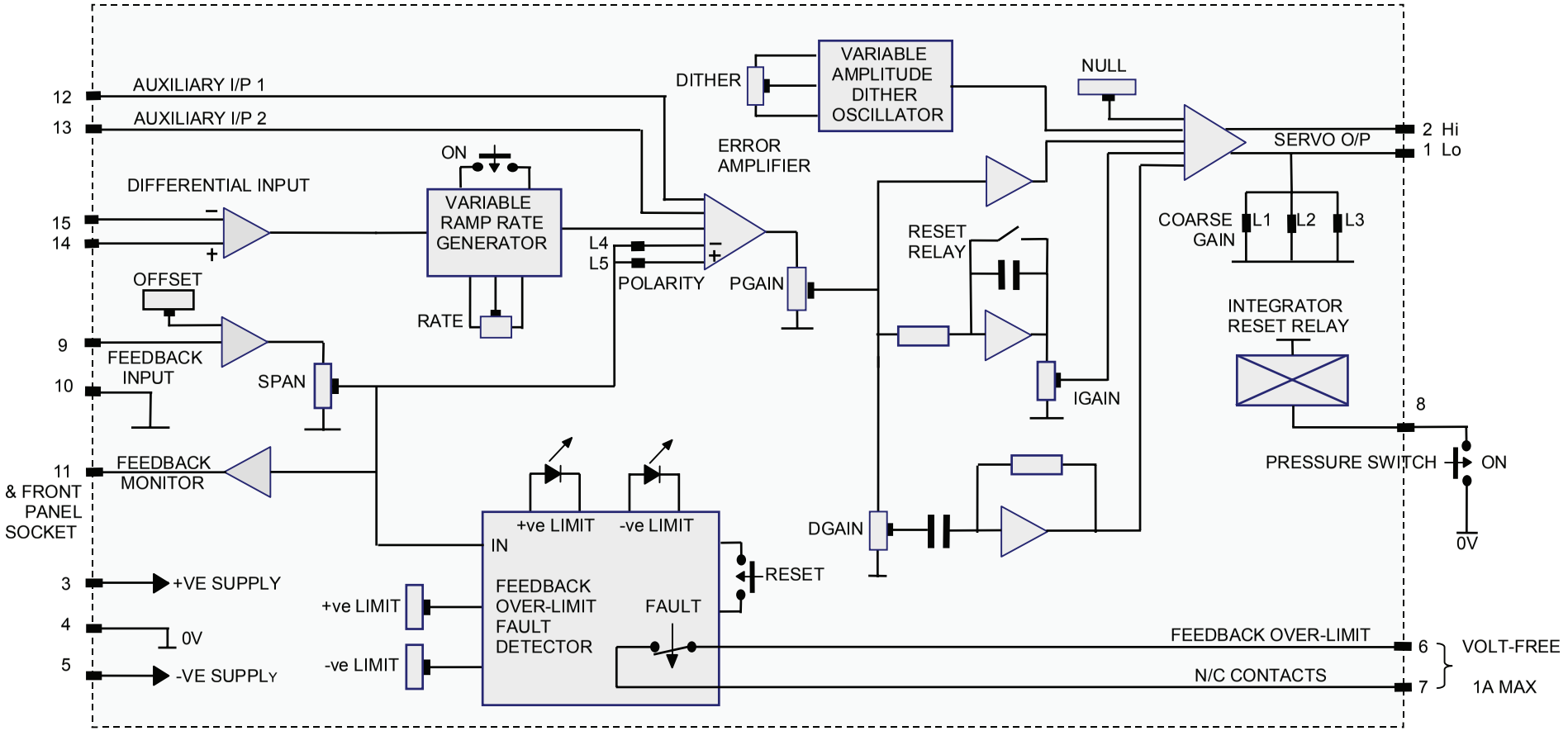


Fig. 4 Position Control Example

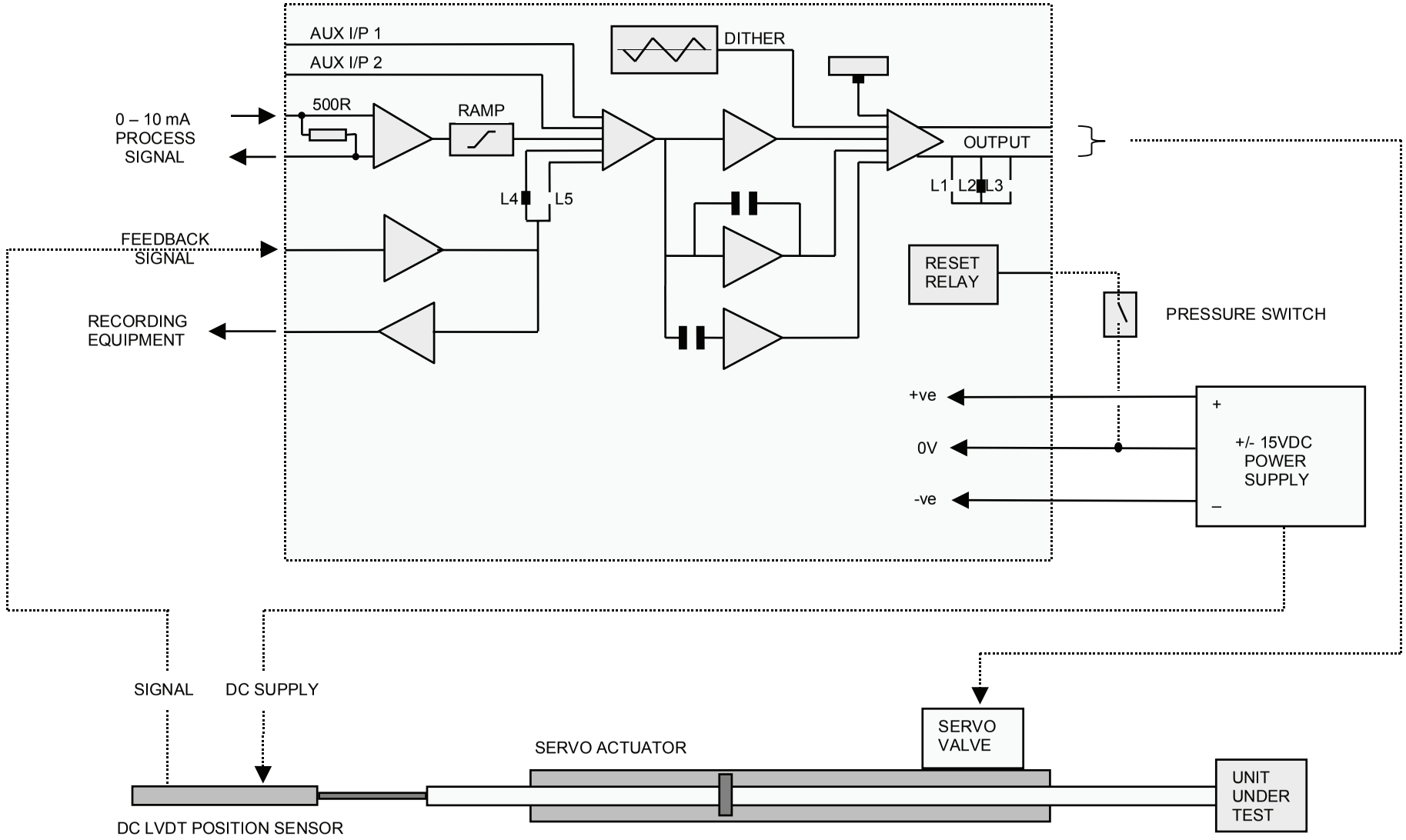


Fig. 5 Load Control Example

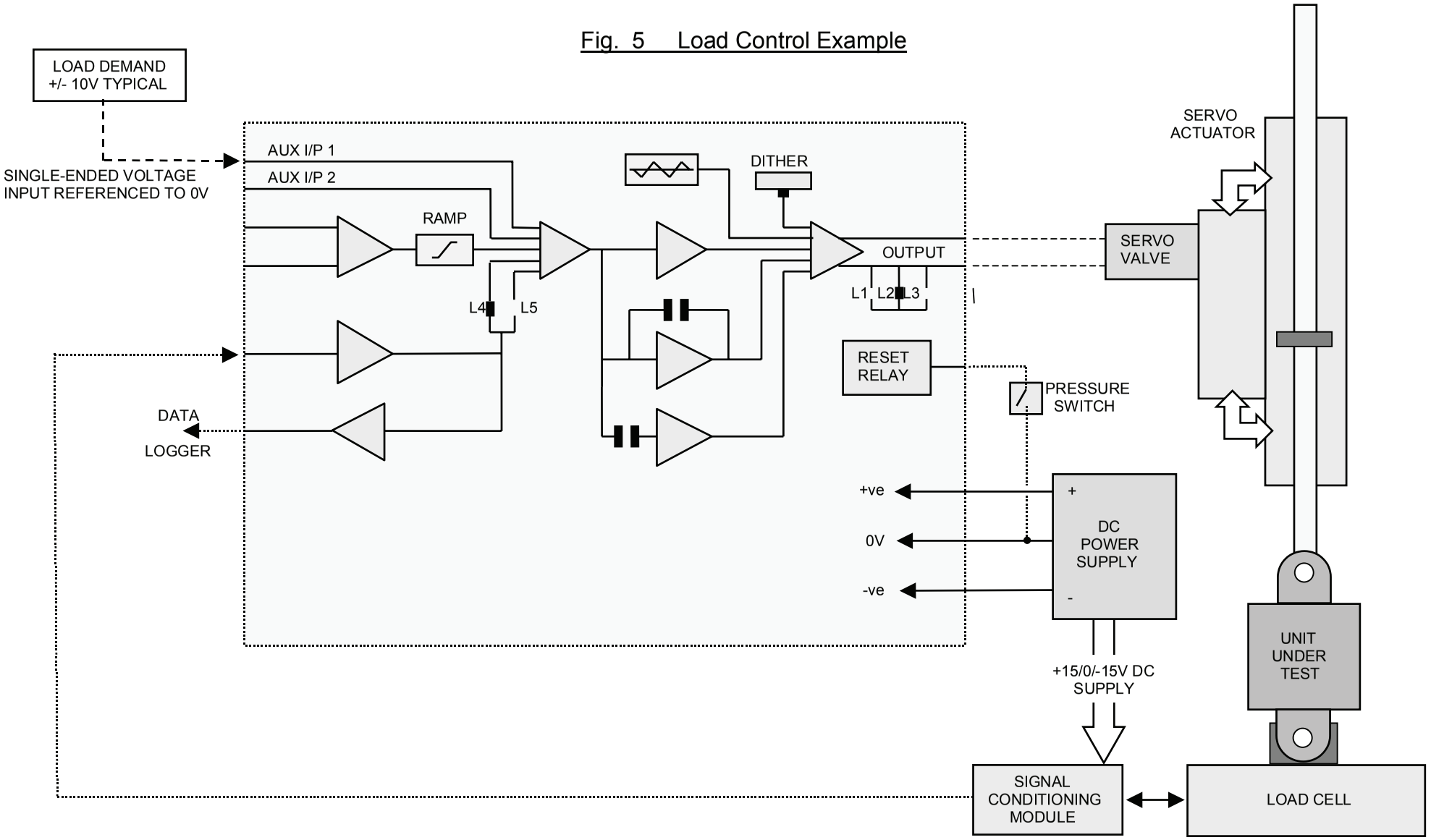


Fig. 6 Differential Pressure Control