



Technical Manual  
**TRANSDUCER AMPLIFIER**  
**TYPE DR7DC**

Doc. Ref CD2401P



Affirmed by Declaration  
of Conformity

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## 1.0 INTRODUCTION

The DR7DC is a single channel DC amplifier intended to provide variable excitation and signal amplification for strain gauge type transducers. It provides up to 10V output (or 4-20mA) with transducer signals from 10 mV to 10V. This allows operation with some high output transducers (DCTH, etc); for example, to provide 4-20mA outputs with signal inputs up to 10V.

This unit accepts both uni-polar (eg 0 to 4mV) or bi-polar (eg  $\pm 4$ mV) input signals and can produce corresponding uni-polar or bi-polar voltage outputs (ie 0 to 10V or  $\pm 10$ V). Sensitivities and gains given in this document refer to both. Current outputs (4 to 20mA) are uni-polar.

The DR7DC incorporates a DC-DC converter ensuring that the output of the unit is electrically isolated from the supply.

The unit is housed in a DIN-rail mounting thermoplastics case with recessed screw-clamp terminals for all connections and 25-turn front-panel-accessible, zero and fine gain adjustments. There is also a front panel push switch and a facility to connect remotely an internal shunt calibration resistor.

All other controls are internal including excitation coarse gain and switches to filter the output.

## **DECLARATION OF CONFORMITY**

**RDP ELECTRONICS LTD.  
Grove Street Heath Town  
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United Kingdom**

**We declare that the product described in this technical manual is manufactured by RDP Electronics Limited and performs in conformity to the following:**

**The Electromagnetic Compatibility Directive 2014/30/EU**

**RoHS Directive 2011/65/EU**

**EMC Regulations SI2016/1091**

**Restriction of Hazardous Substances Regulations SI2012/3032**

**R D Garbett  
Director  
RDP Electronics Limited**

## **2.0 INSTALLATION INSTRUCTIONS**

### **2.1 EMC Requirements**

For optimum EMC performance use shielded multi-core cables for connection to this instrument; the cable shield may be terminated by means of a short "pig-tail" and connected to the terminals marked:

- (a) Pin 5 – Transducer cable
- (b) Pin 15 – Supply/Output cable

The DIN-rail to which the unit is attached should be earthed.

The screw clamp terminals can accept either solid or stranded wire sizes from 0.2 mm (24 AWG) to 2.5 mm (12 AWG).

#### **NOTES:**

1. Cable shields to be grounded at only one end - the DR7DC end, although grounding at both ends may reduce the effects of high frequency EMI.
2. When the DR7DC is a small part of a large electrical installation, ensure the cables to and from the DR7DC are segregated from electrically noisy cables.
3. ESD precautions should be used when working on the instrument with the lid removed. The user should ensure he is "grounded" by use of a grounded wrist strap or at least touching ground before touching any component, including wires, terminals or switches.
4. Segregate signal/supply/output cables. Route signal cables away from possible sources of EMI, e.g. motor/solenoid/relay cables, etc.
5. The transducer body should be grounded. The transducer body being clamped or bolted to grounded metalwork, e.g. on a machine usually achieves this. Where this does not apply and also where there is no grounding connection via the connection cable to the DR7DC, then a separate grounding wire should be connected from the transducer body to the DR7DC SCN terminal.

### **2.2 Unit Mounting**

The DR7DC housing is a standard DIN rail enclosure which can clip directly to a 35 mm top hat rail. The units can be mounted side by side if an ambient temperature up to 40°C. Above this temperature, a gap of 15 mm should be left in between each unit.

### 3.0 CONNECTIONS

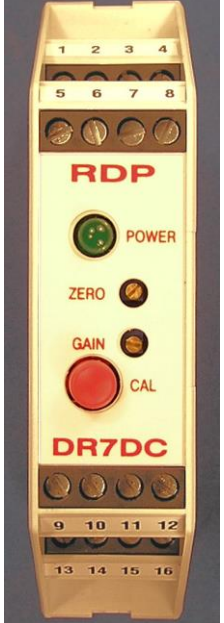
#### 3.1 Connections General

Transducer, supply and output connections are made by 4 x 4 way screw-clamp terminals as shown in Fig 1.

To reverse output polarity, reverse signal hi/signal lo. Voltage output is between Volts Out and common, current output is between current out and common.

**WARNING: INCORRECT SUPPLY CONNECTION, E.G. CONNECTING SUPPLY WIRE TO OUTPUT (O/P) MAY DAMAGE THE UNIT AND INVALIDATE THE WARRANTY.**

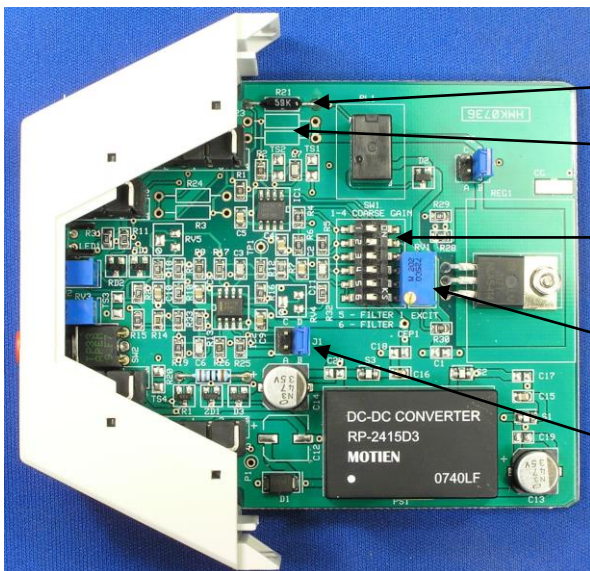
**Fig. 1 Connections**



1	Excitation Hi
2	Excitation Lo
3	Signal Hi
4	Signal Lo
5	Screen
6	R. Cal com
7	R. Cal
8	CAL
9	Volts Out
10	Common
11	Common
12	Current Out
13	Supply +
14	Supply -
15	Screen
16	N/C

#### 3.2 Internal Controls

To access internal controls the front part of the DR7DC case needs to be removed. To do this, use a small screw driver to gently press in the clips behind terminal 1-4 and 13-16. At the same time pull forward the front of the case. The front of the case and pcb assembly should now slide forward.



**Fig. 2 Internal Controls**

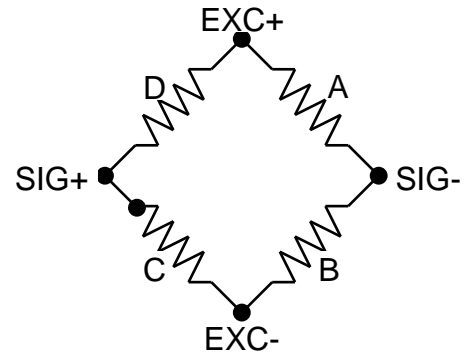
- Shunt Calibration Resistor
- Bridge Completion Resistors (section 3.5)
- 1-4 Coarse Gain (section 4.5)
- 5-6 Bandwidth/Noise filter (section 4.7)
- Transducer excitation (section 4.2)
- 4-20mA Offset Link J1 (section 4.8)

To put case back together, gently slide pcb assembly into case guide slots. Ensure pcb earth pad CG1 is lined up with the earth clip inside the case, and push back until the front of the case clicks back into place.

### 3.3 Transducer connections

Before connecting the transducer, check the excitation voltage.

Applying an excitation voltage that is too high may destroy the transducer



### 3.4 Full bridge Strain Gauge Transducer

Transducer connector details are as shown in Fig. 1. (Section 3.1)

### 3.5 1/4 or 1/2 bridge transducer connections

For 1/4 bridge transducers, 3 bridge completion resistors are required. The active gauge should be fitted on arm 'C' and the bridge completion resistors in arms D, A & B.

For 1/2 bridge systems, the active gauges should be C and D, and 2 completion resistors are required.

The bridge completion resistors should be high stability, the same resistance as the active gauge and may be fitted either in the transducer connector, or in the designated position on the DR7DC PCB. This requires removal of the PCB from the case.

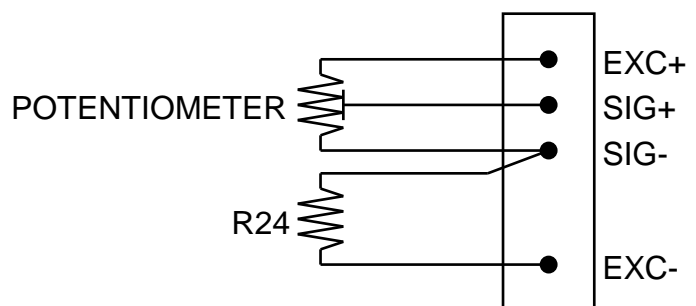
R22 replaces bridge arm D, R23 replaces bridge arm A, R24 replaces bridge arm B

**Note:** Mounting these resistors in the instrument is a compromise. To reduce temperature and long lead effects, completion resistors should preferably be mounted at the transducer and be of close tolerance and low t.c., e.g. 0.1%, 15 ppm..

### 3.6 Potentiometric Transducers

Select R24 value to drop at least 1.5V.  
For example, with an excitation of say 10V and a potentiometer resistance of 500 ohms and R24 value of 100 Ohms, the voltage drop across R24 =  $10V / (500+100) \times 100 = 1.7V$ .

This raises terminal 4 to within the common mode voltage range of the amplifier.



Input signal =  $10 - 1.7 = 8.3V$  so use the lowest gain range for  $\pm 10V$  output. For lower output voltage or 4-20mA output, use lower excitation, e.g. 5V.

R24 can be added either in the location on the PCB, or more easily into the transducer screw terminals, between pin 4 (sig LO) and pin 2 (EXC LO).

## 4.0 CONTROLS

### 4.1 Voltage/Current Output:

Voltage output is between pins 9 and 10 (common). Current output is between pins 12 and 11 (common). Pins 10 and 11 are internally connected.

### 4.2 Excitation

allowing continuous variation of excitation between 3v and 10v.

### 4.3 Zero

allowing a fine adjustment of output zero of approximately  $\pm 2V$  (or 0-10mA) depending on Fine Gain setting.

### 4.4 Fine Gain

allowing a 4:1 variation in amplifier gain, used in conjunction with 4.5.

### 4.5 Gain Range (X1 to X1250)

sliders 1 to 4 of the 6-slider DIL switch, when used with the fine gain control, provide an output of 5V or 4-20mA with an input signal range of approx. 4mV to 5V as shown below: (also output  $\pm 5v$  for input  $\pm 4$  mV to  $\pm 5v$ ).

SLIDERS ON	INPUT SIGNAL RANGE		<b>Note:</b> for the two lowest gain ranges (with slider 4 off), the excitation voltage must be $\geq 5V$ to provide signals within the required common mode voltage range of the amplifier.
	for: 5V or 4-20mA OUTPUT	For $\pm 10V$ OUTPUT	
4 + 3 + 2	4 – 16mV	$\pm 8$ to $\pm 32mV$	
4 + 3	5 – 20mV	$\pm 10$ to $\pm 40mV$	
4 + 2	18 – 70mV	$\pm 35$ to $\pm 140mV$	
4 + 1	65 – 270mV	$\pm 130$ to $\pm 500mV$	
4	0.25 – 1V	$\pm 0.5$ to $\pm 2V$	
1	0.34 – 1.35V	$\pm 0.7$ to $\pm 2.7V$	
None	1.25 – 5V	$\pm 2.5$ to $\pm 10V$	

### 4.6 Shunt Calibration

The front panel push-button switch 'CAL', when pressed connects an internal 59k $\Omega$  0.1% resistor across one arm of the bridge.

**Remote Cal.** - an internal relay may be used to remotely connect the 59k $\Omega$  resistor. To operate this relay, connect the R-Cal. terminal (pin 7) to R. Cal com (pin 6), (lead length is irrelevant) via a switch, etc.

If long cables are used, then cable voltage drop may cause significant shunt calibration errors. In this case, remove SP1 on PCB and connect pin 8 via a separate wire to the relevant bridge node as near as possible to the transducer.

### 4.7 Bandwidth/Noise Sliders

slider 5 (filter 1) and slider 6 (filter 2) when switched to 'ON' reduce the units output bandwidth as shown in the table.

Slider	Bandwidth
5+6 OFF	5 kHz
5 ON	500 Hz
6 ON	20 Hz



#### **4.8 4-20mA Offset Jumper Link J1**

Normally, with J1 set B-D, the relationship between input signal, voltage output and current output, is zero to full scale input signal = 0 to 5V or 4-20mA output.

For bipolar operation, e.g. for compressive/tensile load applications, J1 may be changed to A-C which makes the relationship  $\pm$  full scale input signal =  $\pm$  2.5V or 4-20mA O/P.

i.e. J1 provides a  $\frac{1}{2}$  F.S. offset for the current output and increases the voltage head room in the amplifier.

#### **5.0 SETTING-UP PROCEDURE FOR VOLTAGE OUTPUT**

Refer also to Section 7 for Shunt Calibration Method.

- 5.1** Determine the transducer bridge output from the manufacturer's data sheet and adjust the coarse gain control as shown in Section 4.5. Check that sliders 5 and 6 are set to OFF.
- 5.2** Connect the monitor and supply as detailed in Sections 2 and 3. With transducer DISCONNECTED switch ON power. Set excitation voltage, via the **EXCIT(ATION)** control, to the value indicated in the transducer data.  
Note, excessive excitation voltage or incorrect connection may irreparably damage the transducer.  
Connect transducer and allow a 20-minute warm-up period (for maximum accuracy)
- 5.3** With zero load (pressure, etc.) applied to the transducer, adjust the ZERO control for zero output.
- 5.4** Apply a precise load (pressure, etc.) to the transducer and adjust the F.GAIN control for the desired output.
- 5.5** Repeat steps 3 and 4 until repeatable readings are obtained.
- 5.6** Operate the Cal. switch or Remote Cal. (Sections 4.6 and 7) and note output for future reference.

#### **6.0 SETTING-UP PROCEDURE, 4-20mA OUTPUT**

- 6.1** Refer to Section 4.8 for bipolar input signal operation.
- 6.2** Proceed with 5.1 and 5.2 above, then:
- 6.3** With transducer output approximately zero, adjust the ZERO control for an output current of 4mA approx.
- 6.4** Apply a known value to the transducer and adjust FINE GAIN for the desired output (preferably full scale for 20ma output). Repeat steps 3 & 4 for consistent results.
- 6.5** Operate the Cal. switch or Remote Cal. (see Section 4.6) and note output for future reference. Refer to Section 7. Reference may be made to Section 7.2 but note that full scale of output is  $20-4 = 16$ mA.

## 7.0 SHUNT CALIBRATION FACILITY

### Refer to Section 4.6 for Operation

This is applicable to resistance bridge transducers only, e.g. most load cells and pressure transducers (not semi-conductor gauges).

The Shunt Calibration Facility can be used as:-

**7.1 A Calibration Check.** When the prime calibration has been made by applying a precise known pressure or load to the transducers as described in Section 5 or 6, the R-CAL relay can be operated (normally with zero pressure or load applied) and the output recorded as the Calibration Check figure. A quick check can then be made at anytime by comparing new CAL outputs with the original.

**Note** that if the output is not at zero when the CAL switch is operated, the true CAL CHECK figure is the CAL output plus or minus the initial output.

**7.2 A Shunt Calibration.** The shunt calibration method can be used to calibrate the transducer and electronics without having to apply a known pressure or load to the transducer.

**7.2.1** Calculate the shunt calibration figure required from the data given on the transducer Calibration Record Sheet (CRS).

From CRS - output for 100% = WmV

- output with shunt = YmV

Therefore output required in CAL is  $Y/W$  x required full scale output.

**Note:** If CRS states shunt resistor different from the one fitted (59k ohm is standard, other values to order) then it may still be possible to obtain a calibration from:

$$\text{CAL figure calculated} \times (\text{R shunt} / 59\text{k}) = \text{new CAL figure}$$

**7.2.2** Set the COARSE GAIN switch for the required input sensitivity (see Section 4.5).

**7.2.3** Connect the monitor and supply as detailed in Sections 2 and 3. With transducer DISCONNECTED switch ON power. Set excitation voltage, via the EXCIT control, to the value indicated in the transducer data.

Note, excessive excitation voltage or incorrect connection may irreparably damage the transducer.

Connect transducer and allow a 20-minute warm-up period (for maximum accuracy)

**7.2.4** Ensure no load or pressure applied to the transducer.

**7.2.5** Operate CAL relay and adjust FINE GAIN control to give the required output as calculated in 7.21.

## 8.0 SPECIFICATION

<b>Supply Voltage</b>	9 to 36V DC.						
<b>Supply Current</b>	120mA typical with 24V supply, 10V excitation and 350Ω bridge. (80-250mA depending on supply, excitation & bridge resistance)						
<b>Output</b>	±3V to ±10V max into ≥2kΩ , 4-20mA into 0-500 Ω. This is an active output that should not be connected to any external power supply as this will damage unit.						
<b>Excitation</b>							
Voltage	3 to 10V , 100mA max (See Section 4.2)						
Regulation	Excitation change = 0.10% typical with load change 0-100 mA						
Tempco	0.005%/°C typical						
<b>Amplifier</b>							
Linearity	0.02% of FS output						
Bandwidth	5kHz typical as standard or 500 Hz or 20 Hz with filters ON. See section 4.7.						
Noise	5mV or 20µA rms (less with filter ON) typical						
Zero Tempco	0.002% FS/°C typical (optimum at ±10V o/p)						
Gain Tempco	0.003% FS/°C typical (optimum at ±10V o/p)						
Input Impedance	>10M ohm						
CMRR	95dB typical, dc to 50Hz						
Zero Adjustment	±2V (or 0-10mA) output typical. Depends on Fine Gain setting.						
Sensitivity Range	4mV – 10V input for 5V (or 20mA) output in 6 ranges with 4:1 Fine Gain Control (Gain range x1 to x1250). See Section 4.5.						
<b>Shunt Calibration</b>	Push switch operation or R.Cal. Connection to R.Cal common connects 59k via relay. Relay current 10mA.						
<b>EMC Specification</b>	When subjected to radiated electromagnetic energy (as EN61000-4-3) an additional error can occur at certain frequencies:						
	<table border="0"> <thead> <tr> <th><u>Field Strength</u></th> <th><u>Typical Maximum Error</u></th> </tr> </thead> <tbody> <tr> <td>10V/m</td> <td>5%</td> </tr> <tr> <td>3V/m</td> <td>0.5%</td> </tr> </tbody> </table>	<u>Field Strength</u>	<u>Typical Maximum Error</u>	10V/m	5%	3V/m	0.5%
<u>Field Strength</u>	<u>Typical Maximum Error</u>						
10V/m	5%						
3V/m	0.5%						
<b>Mech. &amp; Environmental</b>							
Working Temp. Range	-10 to +60°C.						
Dimensions	114.5 x 99 x 22.5 mm						
Weight	130g						
Seals	IP20 Specification						

## 9.0 FUNCTIONAL CHECKS

- A = Measure EXCITATION voltage at transducer terminals.
- B = Check function of ZERO control while monitoring output signal for 0v.
- C = Adjust EXCITATION voltage control for specified voltage. Refer to transducer CAL. SHEET for correct voltage.
- D = Connect transducer SIGNAL terminals together and repeat B.
- E = Check the transducer is correctly wired.
- F = Check that SUPPLY and OUTPUT circuits are wired correctly.
- G = Disconnect transducer and repeat D.
- H = Check that if D works, the transducer is zero when attempting to obtain ZERO o/p.
- J = Check EXCITATION setting with the transducer disconnected.
- K = Try another transducer if possible, otherwise return transducer to factory.
- L = Try another DR7DC if possible, otherwise contact us for a returns number.

## **10.0 WARRANTY AND SERVICE**

### WARRANTY.

R.D.P. Electronics products are warranted against defects in materials or workmanship. This warranty applies for one year from the date of delivery. We will repair or replace products that prove to be defective during the warranty period provided they are returned to R.D.P. Electronics.

This warranty is in lieu of all other warranties, expressed or implied, including the implied warranty of fitness for a particular purpose to the original purchaser or to any other person. R.D.P. Electronics shall not be liable for consequential damages of any kind.

If the instrument is to be returned to R.D.P. Electronics for repair under warranty, it is essential that the type and serial number be quoted, together with full details of any fault.

### SERVICE.

We maintain comprehensive after-sales facilities and the instrument can, if necessary be returned to our factory for servicing.

Equipment returned to us for servicing, other than under warranty, must be accompanied by an official order as all repairs and investigations are subject to at least the minimum charge prevailing at the date of return.

The type and serial number of the instrument should always be quoted, together with full details of any fault and services required.

### IMPORTANT NOTES.

1. No service work should be undertaken by the customer while the unit is under warranty except with the authorisation of RDP Electronics.
2. If the instrument is to be returned to R.D.P. Electronics for repair, (including repair under warranty) it is essential that it is suitably packed and that carriage is insured and prepaid. R.D.P. Electronics can accept no liability whatsoever for damage sustained during transit.
3. It is regretted that the above warranty only covers repairs carried out at our factory. Should the instrument have been incorporated into other equipment that requires our engineers to perform the repair on site, a charge will be made for the engineer's time to and from the site, plus any expenses incurred.

The aforementioned provisions do not extend the original warranty period of any product that has been either repaired or replaced by R.D.P. Electronics.

**THIS WARRANTY MAY BE NULL AND VOID SHOULD  
THE CUSTOMER FAIL TO MEET OUR TERMS OF PAYMENT.**