LVDT/A & LVDT/D
Amplifier / Signal Conditioner

User Manual

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Chapter 1 The LVDT Conditioner

The LVDT provides a wide range of signal conditioning for LVDT transducers.

Offered in two versions, the LVDT/A for 110/240 V AC or 18-24 V DC operation and the LVDT/D which is DC powered only.

Transducer sensitivities between 20 mV and 10 V are accommodated by a combination of DIL switch settings and a fine trim potentiometer.

Similar arrangements are provided for any ‘zero’ errors in the transducers and can be used to offset the readings by up to ±35% of full scale.

A wide frequency response is offered, of typically DC to 200 Hz. There is an on-board low pass filter, which can be switched in to reduce high frequency fluctuations or induced electrical noise, to give stable readings under adverse conditions.

A wide range of output options for current, and uni-polar or bi-polar voltage can be configured by DIL switch settings.

Both the AC and DC versions are based on a common board and are mounted in a light grey ABS case sealed to IP65 standard.

Chapter 2 Installing the LVDT/A & LVDT/D

In order to maintain compliance with the EMC Directive 2004/108/EC the following installation recommendations should be followed.

Inputs: Use individually screened twisted multipair cable. (e.g. FE 585 - 646)
The pairs should be :
pins 1 & 6
pins 2 & 5
pins 3 & 4
Terminate all screens at pin 1 of the input. The screens should not be connected at the transducer end of the cables.

Analogue Output: Use screened twisted pair cable. (e.g. RS 626-4761)

Terminate screen at pin 1 of the input.
The screen should not be connected at the host port.

Pin 1 of the input should be connected to a good Earth. The Earth connection should have a cross-sectional area sufficient enough to ensure a low impedance, in order to attenuate RF interference.

Country	Supplier	Part No	Description
UK	Farnell	148-539	Individually shielded twisted multipair cable (7/0.25mm)- 2 pair Tinned copper drain. Individually shielded in polyester tape. Diameter: 4.19 mm Impedance: 54 Ohms: Capacitance/m: core to core 115 pF & core to shield 203 pF
UK	Farnell	585-646	Individually shielded twisted multipair cable (7/0.25mm)- 3 pair Tinned copper drain. Individually shielded in polyester tape. Diameter: 6.86 mm Impedance: 62 Ohms: Capacitance/m: core to core 98 pF & core to shield 180 pF
UK	RS	367-533	Braided shielded twisted multipair cable (7/0.2mm)- 1 pair Miniature- twin -round Diameter: 4.8 mm Impedance: 62 Ohms: Capacitance/m: core to core 120 pF & core to shield 210 pF

UNPACKING
Carefully remove the LVDT unit from its packing. Check that the unit is complete and undamaged.

The LVDT/A & LVDT/D units can operated in any industrial environment providing the following limits are not exceeded

Operating temperature	-10ºC to +50ºC
Humidity	95% non condensing
Storage temperature	-20ºC to +70ºC

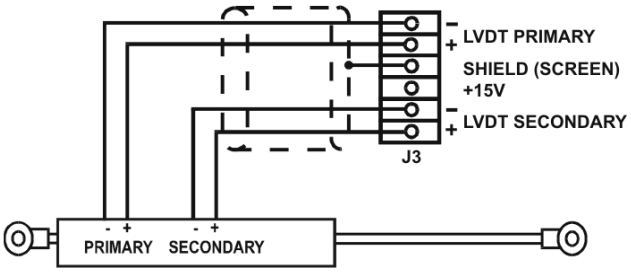
Two power supply options are available

LVDT/A:	220/230 VAC, 50/60 Hz 110/120 VAC, 50/60 Hz 5 W Max.	
LVDT/A & LVDT/D:	18-24 V DC, 5 W	(approx. 150 mA fully loaded)

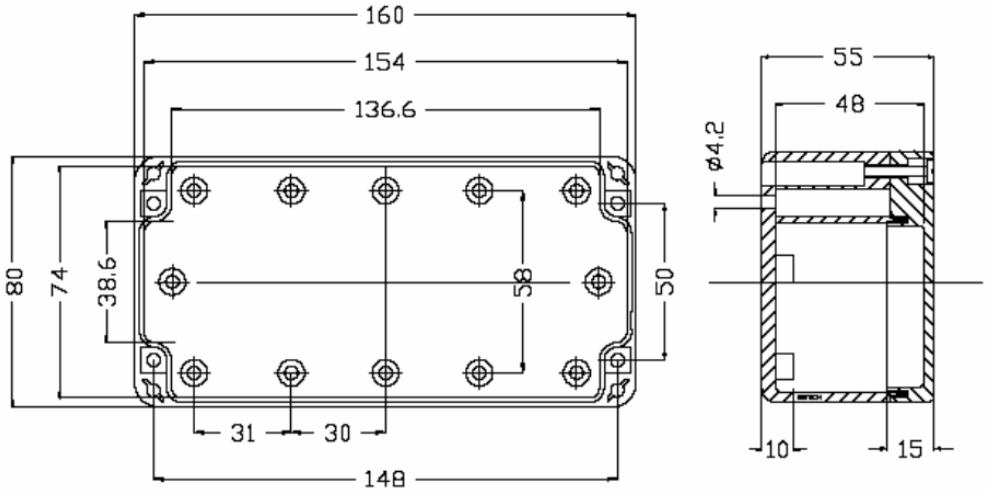
Terminal Connection

On the surface mounted versions, connections to the LVDT/A & LVDT/D input/output signal and the power supply are made via 2.5mm² field terminal blocks.

Cable entry in the cased versions is via glands in the side of the case.



Dimensions of the Enclosure and Mounting Holes



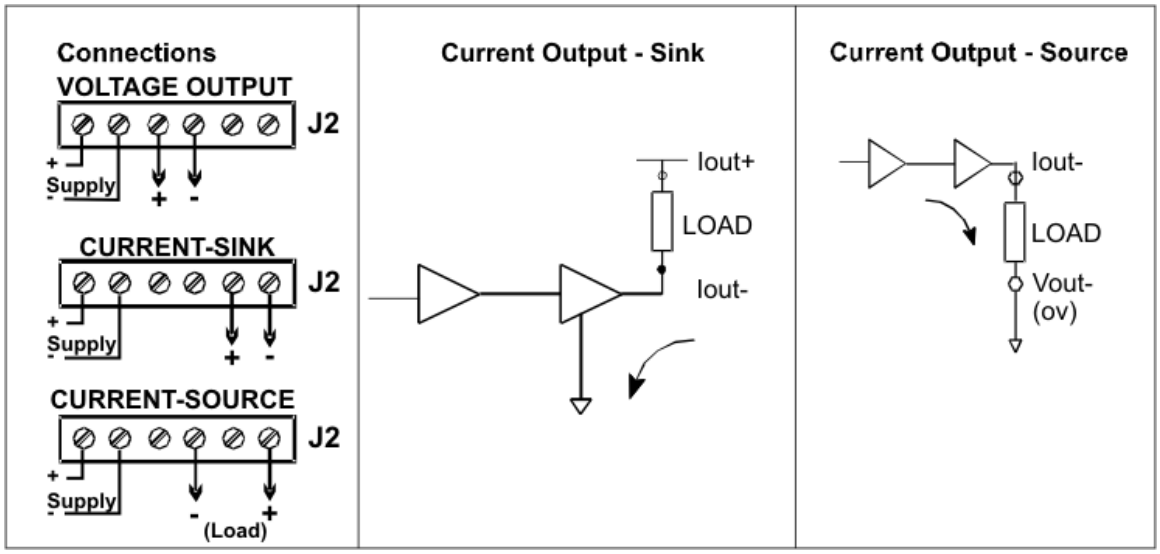
Chapter 3 Analogue Outputs

Two analogue outputs are available from the LVDT, DC current and DC voltage. The ranges offered are as follows:-

Output	**Range**		
DC voltage	±10 V ±5 V 0 – 10 V 0 - 5 V	NB:	Maximum Load on voltage ranges is 2 mA. Bi-polar input, -F.S. to +F.S.
DC current	0 – 20 mA 4 – 20 m	NB:	Maximum impedance 500 R. Uni-polar input, zero to +F.S.

The analogue output options are summarised below,
NB. Full scale output for the voltage ranges is achieved with a bi-polar (±) input.

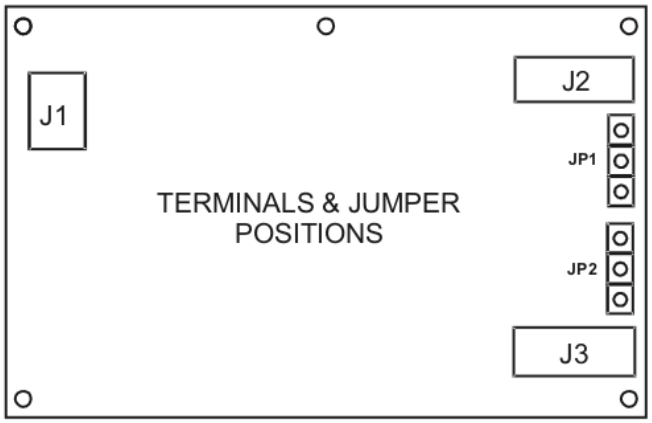
Output Connections

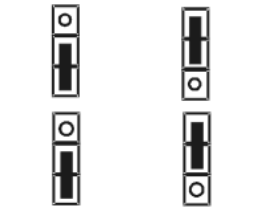


In **'Sink'** mode the +ve end of the load is connected to the internal +15V supply on the LVDT and the -ve end is connected to the LVDT output. The current through the load is 'sunk' by the LVDT towards ground (0V).
N.B. In this mode neither connection to the output load is electrically common to the load cell.
Select this option by fitting the two jumpers in the positions next to the span trimmer (See Output Current Mode Settings – Jumpers JP1 & JP2)

In **'Source'** mode the +ve end of the load is connected to the LVDT output and the current is 'sourced' by the LVDT output through the load towards ground (0V).
This mode has the advantage that the negative output connection is common to the load cell '- Excitation' terminal.
Select this option by fitting the two jumpers in the positions furthest from the span trimmer (See Output Current Mode Settings – Jumpers JP1 & JP2)

Output Current Mode Settings – Jumpers JP1 & JP2





Sink mode (Common +ve) **Source mode** (Common -ve)

Switch Settings (0 = Off 1 = On x = Don't care) :-

Analogue Output Options - SW4

SW4	**1**	**2**	**3**	**4**	**5**
± 10 V	0	0	0	x	x
± 5 V	0	1	0	x	x
0-10 V	0	1	1	x	x
0-5 V	1	1	1	x	x
0-20 mA	x	x	x	0	0
4-20 mA	x	x	x	1	1

LVDT Excitation Frequency - SW4 (0 = OFF 1 = ON)

6	**7**	**8**	
1	0	0	1 kHz
0	1	0	2 kHz
1	1	0	3 kHz
1	0	1	4 kHz
0	1	1	5 kHz

Chapter 4 Input Calibration

The LVDT/A & LVDT/D provides the excitation and signal conditioning to cater for a wide range of LVDT transducers.
Select the analogue output range as detailed in 'Chapter 3' by means of SW4.

Span (gain) - SW1 (0 = OFF 1 = ON)

1	2	3	4	5	6	7	8	
0	0	0	0	1	0	0	1	20 mV
1	0	0	0	1	0	0	1	50 mV
0	1	0	0	1	0	0	1	100 mV
0	0	0	0	0	1	0	1	200 mV
0	0	1	0	0	1	0	1	500 mV
0	1	0	0	0	0	0	1	1 V
0	0	0	0	0	1	1	0	2 V
0	0	1	0	0	1	1	0	5 V
0	1	0	0	0	0	1	0	10 V

Potentiometer P1, provides fine trimming and range overlap to enable the LVDT/A & LVDT/D to be calibrated precisely to any given value within its ranges.

SW1 sensitivity settings shown in the table are for a Full Scale Output e.g. 0-10volts.

The LVDT/A & LVDT/D can be calibrated with the transducer connected, provided that two calibration points can be implemented. e.g. by applying known displacements.

Actual calibration is carried out in the following way:-

1. Set the correct switch settings on SW1 using the transducer's calibration sheet supplied by the manufacturer (see table Chapter 4 Page 1) . This is normally specified as sensitivity or full range output, and should be in mV or Volts.

2. Apply the known low calibration displacement (this may be zero if required), and note the analogue output, having ensured that the SW1 settings are correct for the transducer sensitivity as 1.

3. Apply the known high calibration displacement and note the analogue output. (For optimum accuracy this should be at least 80% of full scale)

4. Use the fine trim control, P1, to obtain the required change in volts or mA, between the two calibration points.

e.g.
- Required output at low calibration point = 0V
- Required output at high calibration point = 7.5 V

i.e.
- A difference of 7.5 volts is required between the calibration points. If the actual reading at the low calibration point is say, 0.5 Volts, then trim the high point to 8.0 volts, to achieve a difference of 7.5 volts.

Note: It may be necessary to repeat these steps, until the required change in output is achieved.

5. Use the fine offset control, P2 in conjunction with the coarse switches SW2/3 -5 to set the output to the required absolute values. Each switch within SW2, offsets the output by a particular amount, shown as a % of full scale in the following table.

Zero (offset) - SW2

SW2	1	2	3	4	5	6	7	8
Offset	+ve	-ve	20%	10%	5%	x	x	x

Note: SW2/1 & /2 Should not both be on.

Use switches 3 - 5 in conjunction with the polarity switches 1 and 2, to get as close as possible to the required offset value.

Use the fine control P2 to achieve the final setting.

If more than one switch is on at a time, then the output of each is summed to give an overall offset to the output, which can be up to ±35% of full value.

This offset adjustment can be used either to compensate for the transducer offset error or to introduce a shift into the output's working range.

Excitation Amplitude - SW2/8

Normally off.

Switching SW2/8 on reduces the excitation by a factor of two. This allows lower impedance transducers to be used without overloading the electronics.

Please note that it may be necessary to alter the setting of the Span switch, SW1 to compensate for the resulting lower input signal.

The LVDT/A & LVDT/D Filter

The LVDT/A & LVDT/D incorporates a second order low pass filter which can be switched in to improve performance in electrically noisy environments. It can also be used to reduce the effects of high frequency fluctuations in the displacement.
The cut-off frequency of the filter is set by the 8 way DIL switch SW3 as shown in the following table:-

Filter Cut off - SW3 (0 = OFF 1 = ON)

SW3	1	2	3	4	5	6	7	8
5Hz	0	0	0	0	1	1	x	x
10Hz	1	0	0	1	1	1	x	x
15Hz	0	1	1	0	1	1	x	x
20Hz	1	1	1	1	1	1	x	x
50Hz	0	0	0	0	0	0	x	x
100Hz	1	0	0	1	0	0	x	x
150Hz	0	1	1	0	0	0	x	x
200Hz	1	1	1	1	0	0	x	x

Chapter 5 Specification for LVDT/A & LVDT/D

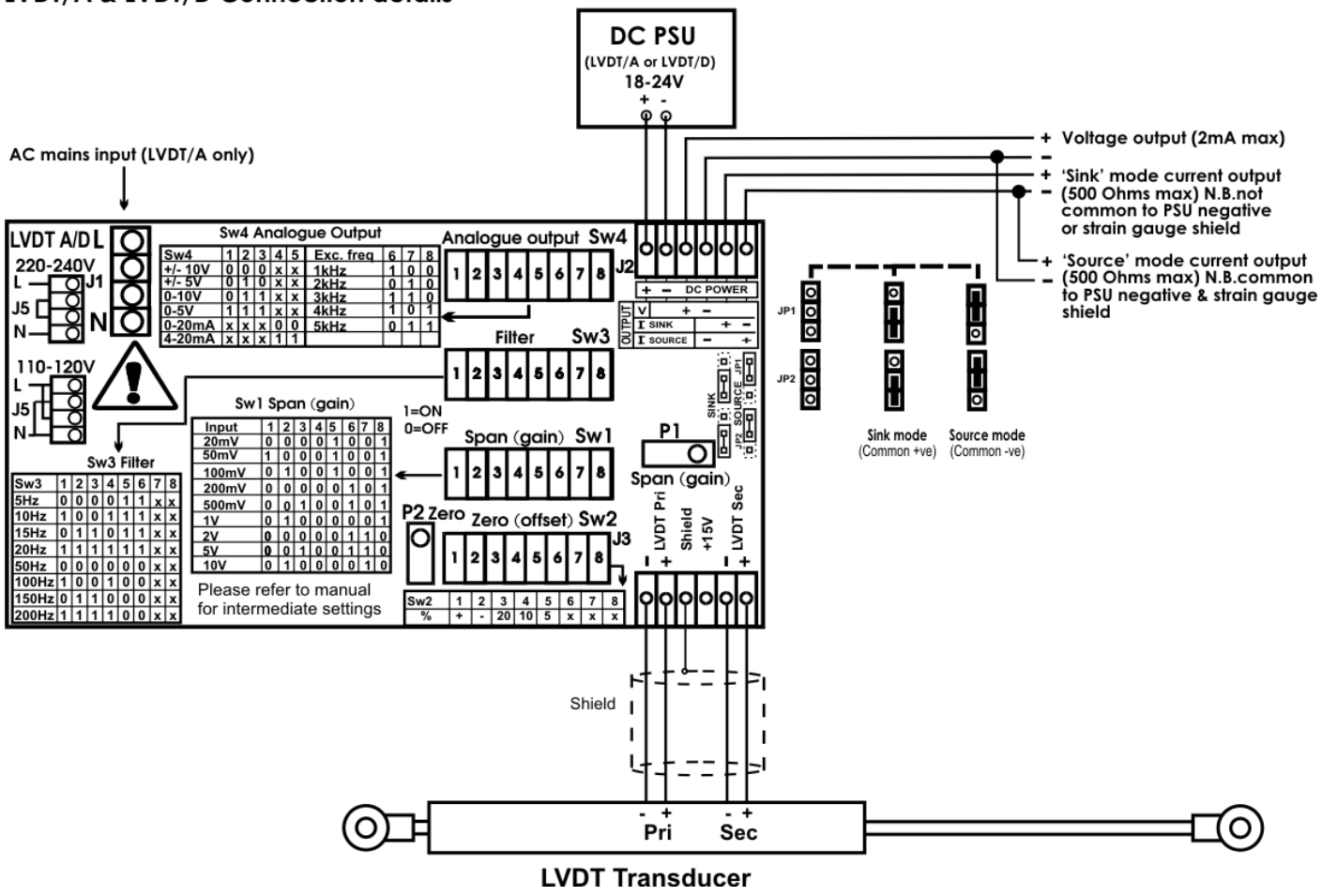
Parameter	Min	Typical	Max	Unit
Power supply ac LVDT-A only (110/230 Vac) 50-60Hz	99/198	110/230	126/253	V AC
Power supply dc: LVDT-A and -D	18	24	28	V DC
Power supply current dc: (depends on loading)	138	145	150	mA (200 R)
Excitation	-	4.5	-	V rms
LVDT Frequency (Selected by Switch 1,2,3,4,5 kHz)	1	-	5	kHz ±20%
LVDT Impedance	50	200	-	Ohms
LVDT Sensitivity (switchable)	0.02	-	10	V
Gain adjustment (Pot - fine adj)	-	-	25	% FSD
Offset adjustment (Pot - fine adj)	-	-	10	% FSD
Offset adjustment (Switchable - coarse adj)	-	-	30	% FSD
Output load (voltage output)	0	-	2	mA
Output load (current output)	0	-	500	Ohms
Bandwidth (No filter) 3 dB point	DC	-	200	Hz
Filter cut-off (switchable ranges)	5	-	200	Hz
Output ripple 200Hz filter (1kHz excitation)	-	0.3	-	% FSD
Output ripple 50Hz filter (1kHz excitation)	-	0.05	-	% FSD
Zero temperature coefficient	-	2	4	µV/°C
Span temperature coefficient	-	0.01	0.015	% FSD/°C
Linearity	-	0.05	0.1	% FSD
Gain stability - 1st 1000 hours	-	0.2	0.4	% FSD
Gain stability - 2nd 1000 hours	-	0.1	0.2	% FSD
90 day offset stability	-	6	10	µV
Output load stability gain (0 - 100%)	-	-	0.01	% FSD
Output load stability offset (0 - 100%)	-	-	0.01	% FSD
Power supply rejection gain (0 - 100%)	-	-	0.05	% FSD
Power supply rejection offset (0 - 100%)	-	-	0.05	% FSD
Operating temperature range	0	-	50	°C
Storage temperature range	-20	-	70	°C
Humidity	-	-	95	%
Noise (1kHz / 20Hz filter / dc powered)	-	3	7	mV p-p

Output options:	±10 V, ±5 V, 0-10 V, 0-5 V, 0-20 mA, 4-20 mA
Connections:	Field screw terminals - 2.5mm² rising clamp.
Enclosure:	ABS case 160 x 80 x 55 mm sealed to IP65 fitted with 3 off cable glands
Controls:	Gain pot
	Offset pot
	Coarse gain switches
	Coarse offset switches
	Filter cut-off switches
	Output mode switch

CE Approvals

European EMC Directive	2004/108/EC
	BS EN 61326-1:2006
	BS EN 61326-2-3:2006
Low Voltage Directive	2006/95/EC
	BS EN 61010-1:2001
	Rated for Basic Insulation
	Normal Condition
	Pollution Degree 2
	Permanently Connected
	Insulation Category lll

LVDT/A & LVDT/D Connection details



Sw4	1	2	3	4	5	Exc. freq	6	7	8
+/- 10V	0	0	0	x	x	1kHz	1	0	0
+/- 5V	0	1	0	x	x	2kHz	0	1	0
0-10V	0	1	1	x	x	3kHz	1	1	0
0-5V	1	1	1	x	x	4kHz	1	0	1
0-20mA	x	x	x	0	0	5kHz	0	1	1
4-20mA	x	x	x	1	1				

Input	1	2	3	4	5	6	7	8
20mV	0	0	0	0	1	0	0	1
50mV	1	0	0	0	1	0	0	1
100mV	0	1	0	0	1	0	0	1
200mV	0	0	0	0	0	1	0	1
500mV	0	0	1	0	0	1	0	1
1V	0	1	0	0	0	0	0	1
2V	0	0	0	0	0	1	1	0
5V	0	0	1	0	0	1	1	0
10V	0	1	0	0	0	0	1	0

Sw3	1	2	3	4	5	6	7	8
5Hz	0	0	0	0	1	1	x	x
10Hz	1	0	0	1	1	1	x	x
15Hz	0	1	1	0	1	1	x	x
20Hz	1	1	1	1	1	1	x	x
50Hz	0	0	0	0	0	0	x	x
100Hz	1	0	0	1	0	0	x	x
150Hz	0	1	1	0	0	0	x	x
200Hz	1	1	1	1	0	0	x	x

Sw2	1	2	3	4	5	6	7	8
%	+	-	20	10	5	x	x	x

W A R R A N T Y

All LVDT products from Mantracourt Electronics Ltd., ('Mantracourt') are warranted against defective material and workmanship for a period of (3) three years from the date of dispatch.
If the 'Mantracourt' product you purchase appears to have a defect in material or workmanship or fails during normal use within the period, please contact your Distributor, who will assist you in resolving the problem. If it is necessary to return the product to 'Mantracourt' please include a note stating name, company, address, phone number and a detailed description of the problem. Also, please indicate if it is a warranty repair.
The sender is responsible for shipping charges, freight insurance and proper packaging to prevent breakage in transit.

'Mantracourt' warranty does not apply to defects resulting from action of the buyer such as mishandling, improper interfacing, operation outside of design limits, improper repair or unauthorised modification.
No other warranties are expressed or implied. 'Mantracourt' specifically disclaims any implied warranties of merchantability or fitness for a specific purpose. The remedies outlined above are the buyer's only remedies. 'Mantracourt' will not be liable for direct, indirect, special, incidental or consequential damages whether based on the contract, tort or other legal theory.
Any corrective maintenance required after the warranty period should be performed by 'Mantracourt' approved personnel only.

Designed, manufactured and supported in the UK

ISO 9001 REGISTERED FIRM

In the interests of continued product development, Mantracourt Electronics Limited reserves the right to alter product specifications without prior notice.

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