WILD
HEERBRUGG
G2 313e - II.76

Infra-red Distancer

WILD DI3S

Distomat

Instructions for Use

Important!

Check aiming head sits correctly and collimation (p. 21 para 4.1.5 and p. 39 para 5.2).

Infra-red Distancer

WILD DI3S

Distomat

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Instructions for Use

Contents

1. Equipment

Stock No.			kg	lb
304 072		DI3S Equipment for T1/T16 comprising	1.2	2.6
	368 865	DI3S aming head	4.3	9.5
		and control unit		
		in 2 containers	8.0	17.6
		Accessories: 10 spare fuses, 1 hexagonal key, 1 plastic cover		
	365 181	1 Counterweight GGD4	0.9	2.0
	300 990	1 Small battery, 12 V/1.8 Ah, with built-in charger. Supply for charger 110/220 VAC, 50–60 Hz	2.3	5.1
	349 642	1 Battery cable, battery to control unit, 2 m long, grey		
	349 644	1 Cable for 12 V car battery, 4 m long, grey		
304 073		DI3S Equipment for T1/T16, as 304 072, but with large battery 12 V/7 Ah 349 641 (instead of small battery 300 990) and with charging cable 349 643		
304 074		DI3S Equipment for T2 (from No. 185 853), as 304 072, but with counterweight GGD5 365 136 (instead of GGD4 365 181)		
304 075		DI3S Equipment for T2 (from No. 185 853), as 304 072, but with counterweight GGD5 365 136 (instead of 365 181), with large battery 12 V/7 Ah 349 641 (instead of 300 990), and with charging cable 349 643		
304 076		DI3S Equipment for T1A (up to No. 187 352), T16 (up to No. 183 742), T2 (up to No. 184 042), as 304 072, but with counterweight GGD6 376 580 (instead of 365 181)		
304 077		DI3S Equipment for T1A (up to No. 187 352), T16 (up to No. 183 742), T2 (up to No. 184 042), as 304 072, but with counterweight GGD6 376 580 (instead of 365 181), with large battery 12 V/7 Ah 349 641 (instead of 300 990), and with charging cable 349 643		

Stock No.		kg	lb
Theodolite for DI3S (according to choice)			
Wild T1 Micrometer Theodolite, with adapter GVS20 and focussing sleeve extension already fitted,		5.8	12.8
in container		2.8	6.2
374 903	T1, 400^g, with tribrach GDF10		
380 881	T1, 400^g, without tribrach, for centring tripod GST70		
374 902	T1, 360°, with tribrach GDF10		
380 880	T1, 360°, without tribrach, for centring tripod GST70		
Wild T16 Scale Reading Theodolite, with adapter GVS20 and focussing sleeve extension already fitted,		5.3	11.7
in container		2.8	6.2
373 728	116, 400^g, with tribrach GDF10		
380 883	T16, 400^g, without tribrach, for centring tripod GST70		
373 729	T16, 360°, with tribrach GDF10		
380 882	T16, 360°, without tribrach, for centring tripod GST70		
Wild T2 Universal Theodolite, with adapter GVS19 already fitted,		6.0	13.2
in container		2.2	4.8
366 695	T2, 400^g, with tribrach GDF6		
380 885	T2, 400^g, without tribrach, for centring tripod GST70		
366 694	T2, 360°, with tribrach GDF6		
380 884	T2, 360°, without tribrach, for centring tripod GST70		

Adapter for DI3S to be mounted on customer's theodolite. (Note: DI3S adapters = DI3 adapters. Therefore DI3S fits on theodolite with corresponding DI3 adapter.)

368 847	Adapter GVS20 for T1 (from No. 187 353) and T16 (from No. 184 543), with focussing sleeve extension
346 530	Adapter GVS19 for T2 (from No. 185 853)
353 166	Adapter GVS17 for former T1A (up to No. 187 352) and former T16 (up to No. 183 742)
353 167	Adapter GVS18 for former T2 (up to No. 184 042)

Stock No.		kg	lb
	Reflectors		
353 162	Single-prism reflector GDR31, with target, tiltable	1.5	3.3
353 163	Soft-bag container for 1 GDR31		
	or		
365 361	Hard plastic container for 2 GDR31, 2 reflector		
	carriers (GRT10 or GZR1 or GZR2), and 2 tribrachs	3.5	7.7
	For GDR31 according to choice		
325 719	Plumbing pole GLS10, cm graduation	0.7	1.5
358 897	Plumbing pole GLS10-2, 0.05 ft graduation	0.7	1.5
325 722	Reflector carrier GRT10, with centring flange	0.3	0.7
	(without tribrach)		
	Note: The single-prism reflector GDR31 also fits on target carrier GZR1 (360 530) for T1/T16 target equipment, and on target carrier GZR2 (360 532) for T2 target equipment		
258 980	Three-prism reflector GDR11, tiltable,	2.9	6.4
	in container (without tribrach)	0.9	2.0
266 856	Six-prism attachment GDR2, fits on GDR11,	4.6	10.1
	in container	1.1	2.4
	Tribrachs for reflector-carrier and three-prism reflector GDR11		
305 065	Tribrach GDF10, without optical plummet (T1/T16 tribrach)	0.8	1.8
296 643	Tribrach GDF6, with optical plummet (T2 tribrach)	0.8	1.8
183 550	Tribrach GDF3, without optical plummet (takes all Wild equipment, T1/T16, T1A, former T16, T2)	0.7	1.5
	Note: The DI3S control unit does not fit in the tribrach GDF1 of the former T1A and former T16. Therefore, when using these theodolites with the DI3S, an extra tribrach – GDF10 or GDF6 or GDF3 – must be ordered.		
	Note: When using the centring tripod GST70, a tribrach is not required.		
	Note: If a T2, and/or traverse equipment, is equipped with the GDF2 tribrach (i.e. old-style T2 tribrach with detachable base plate) we recommend converting the GDF2 to GDF6 (i.e. fitting a stronger spring plate and non-detachable base plate).		
296 695	Convertion kit, for converting GDF2 to GDF6		

Stock No.		kg	lb
	Tripods and Centring Rods		
296 632	Tripod GST20, with telescopic legs	6.5	14.3
373 726	Centring rod for T1/T16, cm graduation	0.7	1.5
373 727	0.05 ft graduation	0.7	1.5
212 956	Centring rod for T2, cm graduation	0.7	1.5
212 957	0.05 ft graduation	0.7	1.5
	Centring tripod GST70, telescopic legs, rod with cm-graduation only: –		
373 725	GST70 for T1/T16	7.9	17.4
356 117	GST70 for T2	7.9	17.4
316 170	Tripod GST20-2, extra-long, 2.5 m, telescopic legs	8.8	19.4
	Centring rod, extra-long, 2.5 m, for use with GST20-2, cm-graduation only:		
373 731	Centring rod extra-long for T1/T16, cm graduation	1.0	2.2
266 862	Centring rod extra-long for T2, cm graduation	1.0	2.2
353 196	Tripod GST5, for plumbing pole GLS10	2.0	4.4
	Other Accessories		
259 009	Charging unit GKL4 (110–250 VAC, 50–60 Hz)	1.7	3.7
349 641	Large battery 12 V/7 Ah, rechargeable (spare)	3.3	7.3
300 990	Small battery, 12 V/1.8 Ah, with built-in charger. Supply for charger 110/220 VAC, 50–60 Hz (spare)		
377 776	Back-pack carrying frame for DI3S	4.3	9.5
315 010	Shoulder carrying strap, for tripod GST20		
373 136	Case for 2 plumbing poles GLS10		
325 721	Extension GZW10, 1 m length, for plumbing pole GLS10		

2. Technical Data

DI3S

Standard deviation	$\pm(5\ mm + 5 \cdot 10^{-6} \cdot D)$
Distance measurement	in metres or feet, switchable
Time from start to display	10–12 seconds
Distance display unambiguous	
up to	999.999 m or
	6561.67 ft (=2000 m × 3.280835)
Display (LED)	digital, six-figure, to mm or 0.01 ft.
	Slope distance, horizontal
	distance, difference in height
	selected as required
Angle input for reduction	six-figure (degrees, mins., tens of
	secs.), switchable for 360° or 400^g
Range with one prism under average	
atmospheric conditions	about 1000 m (3300 ft)
Measuring scale factor, variable by	11-step switch
Scale change per switch step	3 mm/100 m, 0.03 ft/1000 ft, i.e.
	$D \times 3 \times 10^{-5}$
Calculation time for reduction	0 to 4 seconds
Free objective aperture of emitting	
and receiving objectives	35 mm
Focal length	38 mm
Emitting diode	GaAs luminescent diode
Receiving diode	Avalanche photodiode
Beam width at half power	4′ (12 cm at 100 m, 1.2 ft at 1000 ft)
Carrier wave length	0.885 μm infra-red
Measuring scale frequencies	
Fine measurement	7.4927 MHz
Coarse measurement	74.927 kHz
Emitted power	about 0.02 mW
Power consumption	
After switching ON and while	
measuring	about 17 W
When calculating and displaying	about 5 W
Temperature range for DI3S	
operation	−25°C to +50°C (−13°F to
	+122°F)
Tilting range with aiming head on	
telescope	−65° to zenith (−70^g to zenith)

Small battery with built-in charger

Small battery, NiCd	12 V/1.8 Ah (10 × 1.2 V gas-tight cells)
Number of messurements at 20°C	
(68°F) with fully-charged	
battery	about 120
Charger	built-in
Mains/line supply for charger	110 or 220 VAC, 50–60 Hz
Power consumption of charger	5 W
Charging current	0.18 A
Time for charging flat battery	about 14 hours
Charging temperature	+10°C to +30°C (50°F to 86°F)
Fuse	FST 5020/2.5 A/5 × 20
Dimensions (L × B × H)	22 × 14 × 4.5 cm
	(0.72 × 0.46 × 0.15 ft)

Large battery, NiCd, rechargeable

	12 V, 7 Ah (10 × 1.2 V, gas-tight cells)
Battery fuse	FST 5020/2.5 A/5 × 20
Number of measurements at 20°C	
(68°F) with fully-charged	
battery	about 500
Charging temperature	+10°C to +30°C (+50°F to +86°F)
Dimensions (L × B × H)	29 × 10 × 6 cm (0.95 × 0.33 × 0.20 ft)

Charging Unit Wild GKL4,

for large battery

Mains/line supply for charger	110 to 250 VAC, 50–60 Hz
Power consumption	28 W
Charging current	0.7 A or 0.4 A, switchable
Maximum settable charging time	12 hours
Charging temperature	+10°C to +30°C (+50°F to +86°F)
Fuse	FFT 5016/0.25 A/6.3 × 32
Dimensions (L × B × H)	20 × 11 × 12 cm
	(0.66 × 0.36 × 0,39 ft)

Dimensions DI3S

(length × breadth × height)

Aiming head (without	
counterweight)	19 × 11 × 7 cm (0.62 × 0.36 × 0.23 ft)
Control unit (without axis)	20 × 28 × 7 cm (0.66 × 0.92 × 0.23 ft)
Container (2 containers)	37 × 29 × 26 cm (1.21 × 0.95 × 0.85 ft)

Heights

Control unit axis dish above tribrach dish		125 mm (0.41 ft)

Therefore: Theodolite tilting axis above tribrach dish when with DI3S:

T1/T16	(180+125) mm	305 mm (1.00 ft)
T2	(196+125) mm	321 mm (1.05 ft)
Former T1A	(176+125) mm	301 mm (0.99 ft)
Former T16	(167+125) mm	292 mm (0.96 ft)

Reflectors

Range under average atmospheric conditions

To single-prism reflector GDR31	about 1000 m (3300 ft)
To three-prism reflector GDR11	about 1600 m (1 mile)
To nine-prism reflector GDR11 plus GDR2	about 2000 m (6600 ft)

GDR31, with target, tiltable

Surface area of prism	50×100 mm (0.16×0.33 ft)
With the GRT10 reflector carrier the height of the target (tilting axis) above the tribrach dish can be set to	Tilting axis height of all Wild Theodolites
Tilting range	±65° (±70^g)

GDR11/GDR2

Surface area GDR11	150×100 mm (0.49×0.33 ft)
Surface area GDR2 plus GDR11	150×300 mm (0.49×0.98 ft)
Height of tilting axis above tribrach dish	196 mm (0.64 ft) =T2 tilting axis height
Tilting range	±40° (±45^g)

3. Description

(see fig.1 on folding page at end of booklet)

3.1 The instrument

3.1.1 Aiming head on theodolite telescope

The DI3 aiming head is mounted on either the T1 or T16 or T2 theodolite after an adapter (15, fig. 2) has been fitted to the telescope in face right position (vertical circle right of eyepiece). For details of adapters see section 1, Equipment. With the T1 and T16, the telescope can be transitted with the aiming head fitted.

Two spring levers (17, fig. 3) lock the aiming head securely to the two bolts of the adapter. The three centring balls on the underside of the head (18, fig. 3) rest in the three V-shaped notches of the adapter, thus maintaining the collimation between aiming head and telescope. Parallelism (i.e. collimation) between the telescope line of sight and the optical axis of the aiming head can be adjusted (section 5.2).
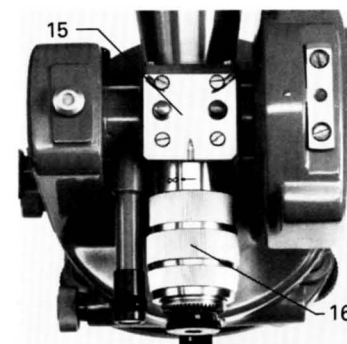

Fig. 2 Adapter mounted on telescope of T16 theodolite
15 Adapter, with two bolts and 3 V-shaped notches
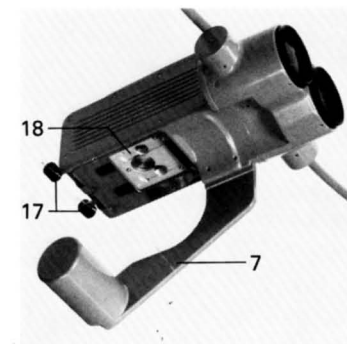16 Focussing sleeve extension for T1 and T16 (not available for T2)

Fig. 3 Underside of aiming head
7 Counterweight
17 Two spring levers
18 Base plate. The three centring balls rest in the V-shaped notches of the adapter. The spring clamps grip the two bolts of the adapter.
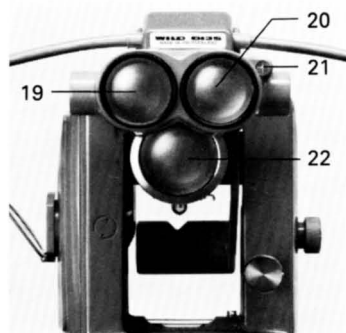
Fig. 4 Aiming head on T16 theodolite
19 Receiver objective   21 Optical sight
20 Emitter objective   22 Telescope objective

The aiming head contains the objectives (19 and 20, fig. 4), the diodes and two servos. The servos switch the infra-red beam from external measurement to internal calibration line, and also introduce filters if the return signal is too strong and must be reduced to avoid overloading at short distances. On the side of the aiming head is an optical sight for rough pointing (21, fig. 4).

Due to the counterweight (7, fig. 1), the centre of gravity of the telescope with aming head mounted lies in the tilting axis.

Because of the adapter, it is not possible to fit a telescope level or telescope roof plummet.

3.1.2 Control unit

The control unit contains the phase meter, calculator, display, and controls. The control unit can be turned around the axis which runs through it. The centring dish at the top of the axis takes a Wild theodolite. The bottom of the axis is a centring flange which fits into either a GDF10 or GDF6 or GDF3 tribrach, and also into the GST70 centring tripod. If the clamps of the theodolite and control unit (3, fig. 1) are slackened, both can be turned together. This means that the cables (5, fig. 1) connecting the aiming head and control unit always retain their shape and position and, therefore, the angle-measuring accuracy of the theodolite is not impaired.

3.2 Functional principle

The invisible, infra-red radiation of a GaAs diode is used as the carrier wave. This is amplitude-modulated by varying the supply current. The two modulation frequencies correspond to a fine measuring scale unit of 20 m and coarse unit of 2000 m. The phase difference is measured digitally by counting the impulses of a quartz oscillator between the outgoing and return (reflected) waves. The instrument measures in metres. If the m/ft 360°/400^g selector (52, fig. 23) is set to ft, the result is converted to feet by multiplying by 3.280835 and then displayed.

3.3 Automatic measuring cycle (fig. 25)

Provided the instrument is ON (59) and pointed at the reflector, only the START switch (56) has to be pressed down to trigger off the following automatic measuring cycle: –

Action in instrument	Galvanometer needle shows	Approximate duration in seconds
1. Decision if return signal strength must be reduced by filter	First, maximum return signal. Then, if needed, filter-reduced signal, i.e. optimum signal	2
2. 100 fine measurements over internal calibration line	Calibration signal	1
3. 1000 fine measurements over external (measured) distance	Maximum or filter-reduced return signal, i.e. optimum signal	4
4. 100 fine measurements over internal calibration line	Calibration signal	1
5. 500 coarse measurements over external (measured) distance	Maximum or filter-reduced return signal, i.e. optimum signal	2
6. 100 coarse measurements over internal calibration line	Calibration signal	1
7. Multiplication with measuring scale factor. If necessary, convertion to feet		0
8. Display of slope distance or angle-required code		

On completion of the measurement, power to the aiming head and to some parts of the control unit is switched off automatically. Only the display and calculator remain on. The galvanometer (57) shows zero. This automatic switch-off conserves battery power. The whole unit is switched

on again when the switch (56) is pressed down to START or when the switch (59) is put to OFF and then back to ON.

3.4 Reflectors

The reflectors are glass prisms in metal housings. The return the infra-red beam parallel to itself after total reflection. Because of the parallel reflection, aligning the reflector to the DI3S is not critical. The removable rear cover of the reflector gives access for cleaning the prisms.

3.4.1 Single-prism reflector GDR31 (figs. 5, 6, 20, 21, 24)

The reflector can be tilted. The horizontal targets (31, fig. 5) for vertical angles lie in the tilting axis (28, fig. 5). They are 38 mm below the centre of the prism to take into account the distance between the optical axis of the aiming head and the telescope line of sight. The vertical target (32, fig. 5) for horizontal angles is fixed and lies in the standing axis. The targets ensure that direct pointing (fig. 24) for angular measurements also results in an optimum return signal.
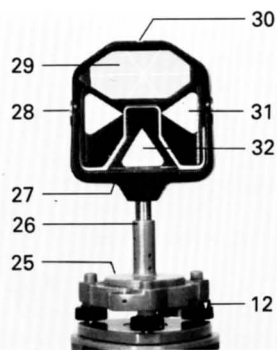
Fig. 5 Single-prism reflector GDR31, on reflector carrier GRT10, in tribrach
12 Locking knob on tribrach.
   Arrow down = locked.
   Arrow up = unlocked
25 Centring flange
26 Reflector carrier GRT10. Can be set in height, section 3.4.1
27 Yoke
28 Tilting axis
29 Prism
30 Open sight for directing reflector at aiming head
31 Targets, for horizontal cross hair
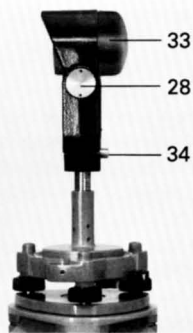32 Target, for vertical cross hair

Fig. 6 Single-prism reflector GDR31, on reflector carrier GRT10, in tribrach
28 Tilting axis
33 Rear cover. Press in sides of cover to remove for cleaning rear surfaces of prism
34 Release button. Press when fitting reflector on carrier or pole. Press to remove.

On pressing its release button (34, fig. 6), the reflector can be fitted on either the Plumbing Pole GLS10 or the Reflector Carrier GRT10. The reflector also fits on carrier GZR1 (with optical plummet) of the T1/T16 target equipment, and on carrier GZR2 (without optical plummet) of the T2 target equipment. The carrier (GRT10 or GZR1 or GZR2) fits in all Wild tribrachs and the centring tripod GST70.

The reflector carrier GRT10 can be set so that the height of the reflector's horizontal target (31, fig. 5) above the tribrach is equal to the theodolite tilting axis height. Release screw of reflector carrier (fig. 21). Extend to correct height and tighten screw again. Line T2 = 196 mm for all T2 models; the "long line" = 180 mm for new T1/new T16; line T1 = 176 mm for former T1A; line T16 = 167 mm for former T16.

Packing: see Equipment, Section 1. There is a soft bag for one GDR31. The hard plastic container takes two GDR31, two carriers (GRT10 or GZR1 or GZR2) and two tribrachs.

Cleaning: Press in the sides of the rear plastic cover. The cover can then be removed easily and the prism rear surfaces cleaned.

The lower extendable part of the Plumbing Pole GLS10 (fig. 20) has a 1 cm or 0.05 ft graduation for reading the height of the reflector's horizontal target (31, fig. 5) above the ground, or for setting it to the required height. The upper part of the pole has a 5 cm or 0.5 ft pattern for rough distance measurement with the lower stadia hair when setting out (fig. 24).

3.4.2 Three-prism reflector GDR11 (fig. 7)

Up to about 1600 m can be measured with this reflector. It fits in all Wild tribrachs (forced-centring). It can be turned an tilted. Its tilting axis (38, fig. 7) coincides with the middle of the reflector and is 196 mm above the tribrach dish, i.e. the same height as the T2 tilting axis. The target (37) for horizontal angles lies in the standing axis. Vertical angles are measured to the middle of the reflector (tilting axis). The reflector is packed in a plastic container with the centring flange/tribrach uppermost. The rear surfaces of the prisms can be cleaned after removing the rear cover.

3.4.3 Six-prism attachment GDR2 (fig. 8)

In case of a weak return signal, as at long distances or in poor visibility, the Six-Prism Attachment GDR2 is set on the tilting axis of the Three-Prism Reflector GDR11 (38, fig. 7) and can be turned and tilted with it. The attachment consists of two sets of three prisms connected by a metal handle. A centring pin under the handle fits into a hole on top of the GDR11. As the GDR2 is **not** locked to the GDR11, it must be removed before the GDR11 is taken off the tripod or carried with the tripod. It is packed in a plastic container with shoulder strap.

The rear surfaces of the prisms can be cleaned after removing the rear covers.
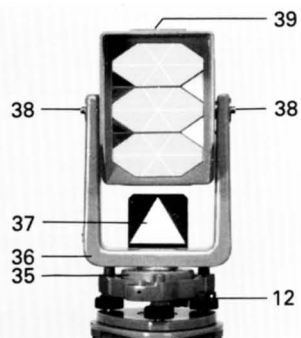
Fig. 7 Three-prism reflector GDR11, in tribrach
  12 Locking knob on tribrach
     Arrow down = locked
     Arrow up = unlocked
  35 Centring flange
  36 Yoke
  37 Target, for horizontal angles
  38 Tilting axis, takes six-prism attachment GDF2. Height 196 mm = T2 tilting axis height
  39 Open sight for directing reflector at aiming head

Fig. 8 Three-prism reflector GDR11 (centre) with six-prism attachment GDR2 (= nine-prism reflector)
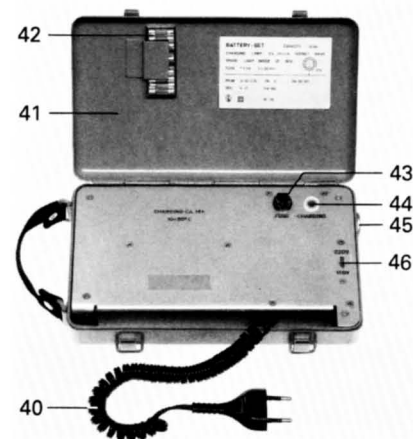

Fig. 9 Small battery with built-in charger. Sufficient for about 120 measurements.
  40 Cable, plugs into mains (line)
  41 Lid, leave open when charging
  42 Spare fuses
  43 Fuse under black cover. Screw out cover to replace fuse
  44 Charging indicator lamp
  45 Socket for battery cable
  46 Voltage selector 110 V and 220 V

3.5 Electric Equipment

3.5.1 Batteries

There is a choice of two 12 V NiCd batteries. They are practically maintenance-free, have only a slight self-discharge, and have a relatively small loss of capacity at low temperatures. Both batteries hook on the tripod leg.

3.5.1.1 Small battery 12 V/1.8 Ah with built-in charger (fig. 9)

Fully charged, the battery is sufficient for about 120 measurements at normal temperatures (20°C/68°F) and for about half this number at very low temperatures (−25°C/−13°F).

Under the lid (41) are: Mains (line) voltage selector 110 or 220 V AC (46); fuse (43) – unscrew black cover to replace fuse; indicator lamp CHARGING (44); cable (40), plugs into mains (line) when charging; ten spare fuses (42). See also section 5.1.1.

3.5.1.2 Large battery 12 V 7 Ah (fig. 10)

Fully charged, the battery is sufficient for about 500 measurements at normal temperatures (20°C/68°F), and for about half this number at very low temperatures (−25°C/−13°F). To change the fuse, screw out the black cap near the battery cable socket. Spare fuses are in the DI3S container. Charging Unit GKL4 is used for charging. Sections 3.5.2 and 5.1.2.

3.5.1.3 Car battery or transformer

Any battery or transformer giving 12 V DC and about 1 A can be connected to the control unit with the 4 m long car battery cable. Make sure the + red clip of the cable is connected to the + terminal; − black clip to − terminal. If the cables are connected to the wrong terminals – i.e. false poling – the fuse (54, fig. 23) in the control unit will blow. Spare fuses are in the container. See also 5.3.

Fig. 10 Large battery. Sufficient for about 500 measurements. Note socket for battery cable and black screw cap covering fuse.

Fig. 11 Charging unit GKL4

3.5.2 **Charging unit GKL4** (fig. 11)

The GKL4 is for charging the large 12 V 7 Ah battery. The front panel has the ON/OFF switch, the charging current 0.7 A/0.4 A selector switch, the time clock, and two control lamps POWER and CHARGING. The charging cable plugs into the socket below the clock. At the rear are the voltage selector, the fuse, and the socket for the mains (line) connection cable. See also section 5.1.2.

4. Instructions for Use

Setting up the tripod and theodolite and the use of the theodolite are presumed to be known, otherwise consult the theodolite instruction booklet.

Fig. 12 Containers for DI3S. Left: control unit. Right: aiming head, battery and tribrach

4.1 **Setting up the instrument**

1. Set up tripod. Lower than usual because of extra height of control unit!
2. Screw tribrach (GDF10 or GDF6 or GDF3) on to tripod head. Level with circular bubble and centre over ground point. (Keep circular bubble, optical plummet, centring rod in good adjustment – see sections 5.5 and 5.6 and theodolite instruction booklet.)

Fig. 13 Place control unit in tribrach and turn locking knob to "arrow down" (= locked).

For height determination, measure height of **TRIBRACH DISH** above ground point and add height of tilting axis above tribrach dish for theodolite being used. Section 2, Technical Data.

3. Take control unit out of the container (fig.12). Place in tribrach (fig.13) and turn tribrach knob to "arrow down" position to lock control unit in place.
4. Place theodolite in dish of control unit axis (fig.14) and turn knob to "arrow down" to lock theodolite in place. Put telescope horizontal in face right (i.e. vertical circle right of eyepiece). Tighten vertical clamp. Remove theodolite's carrying handle.

Fig.14 Place theodolite in control unit dish and turn locking knob to "arrow down" (= locked).

Fig.15 Lead aiming head over and parallel to telescope with counter-weight between standards.

Fig.16 Press the two spring levers together. Press down gently on aiming head. Release the two spring levers.

Fig.17 Connecting aiming head cables to control unit.

Fig.18 Plug battery cable into socket in base of battery. To remove, just pull out; don't turn.

Fig.19 Plug battery cable into socket on right of control unit. To remove, just pull out; don't turn.

5. Take aiming head out of container (fig.12). Lead it over and parallel to telescope with counterweight between standards (fig.15). Shift the head carefully until it is sitting on the two bolts of the adapter. Press the two spring levers together (fig.16). The head now drops onto the adapter. Press down gently on the head to make sure it is correctly in place. Release the two spring levers.
6. Connect cables between aiming head and control unit (fig.17).
7. Take battery out of the container (fig.12). Hook it on tripod. Plug battery cable into socket in base of battery (fig.18) and into socket on right of control unit (fig.19).

Important! If the DI3S is put on another theodolite, or if the equipment has been for service or repair, adjust parallelism (collimation) between aiming head and telescope. Section 5.2.

4.2 Setting up the reflectors

4.2.1 Single-prism reflector GDR31 on plumbing pole (fig. 20)

Press button of reflector to release catch (34, fig. 6). Fit reflector on pole. Turn lower section of pole either way to release it. Extend pole to required height. Lock by turning lower section again either way.

Place point of pole on ground mark then: –

First — direct reflector in azimuth and elevation at DI3 aiming head by means of open sight (30, fig. 5).

Second — centre circular bubble and keep it centred (fig. 20).

Note: Keeping the bubble centred is more important than accurate aiming of the reflector.

Fig. 21 Setting the reflector carrier GRT10 to the height of the theodolite tilting axis.
Slacken screw with screwdriver. Set carrier to required height and then turn until screw is seen in one of the holes. Tighten screw again.

Line T2	= 196 mm all T2 models
The "long line"	= 180 mm new T1/new T16
Line T1	= 176 mm former T1A
Line T16	= 167 mm former T16

Fig. 20 Single-prism reflector GDR31 on plumbing pole.
First, direct reflector in azimuth and elevation towards DI3S.
Then, centre circular bubble and keep it centred.
(A support is useful to keep the pole steady.)

4.2.2 Single-prism reflector GDR31 in tribrach (figs. 5, 6 and 21)

Set reflector carrier GRT10 to required height according to theodolite used (fig. 21). See also section 3.4.1. Lock reflector carrier in tribrach. Fit GDR31 reflector. Direct reflector at DI3S aiming head in azimuth and elevation by means of open sight (30, fig. 5).

4.2.3 Three (GDR11) and nine-prism (GDR11 + GDR2) reflectors (figs. 7 and 8)

These reflectors must **not** be used for distances under 150 m. See also sections 3.4.2 and 3.4.3.

Unlike the GDR31, these reflectors do not have a special target for simultaneous distance and angle measurement. Therefore, for distance measurement, vertical pointing must be done electronically by searching for an optimum return signal as follows: –

Cross hair intersection to middle of reflector. Switch (59, fig. 25) ON. At short distances, wait 2 seconds until filter reduces signal. Then, turn vertical drive until deflection of galvanometer needle (57, fig. 25) to right is a maximum. Press switch (56, fig. 25) to START and measure as explained in section 4.3.2.

After the distance measurement, **the vertical angle is measured to the middle of the reflector.** This is 196 mm above the tribrach dish, i.e. equal to the T2 tilting axis height.

4.3 Measuring

4.3.1 Preliminaries and pointing (fig. 25)

1. Metre/foot 360°/400ᵍ selector:
   Open round black cover on underside of control unit by turning its three catches (50, fig. 22) anticlockwise with a coin. The selector (52, fig. 23) and fuse are seen. Turn selector until required metre/foot 360°/400ᵍ combination is set against index pin (51, fig. 23). Replace black cover.

2. Set measuring scale factor switch (58, fig. 25) to required position. See section 4.4.

3. Point with cross hairs to target of GDR31 reflector (fig. 24).

4. Switch (59, fig. 25) ON.
   Galvanometer (57, fig. 25) shows return signal. At short distances, galvanometer needle drops after 2 seconds to show filter-reduced signal. Display (10, fig. 25) shows only decimal point. Section 4.3.6.
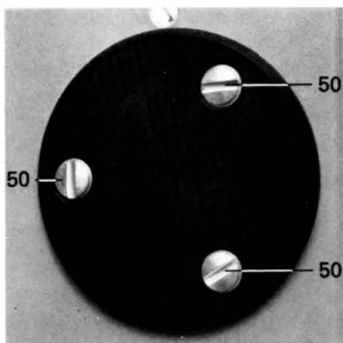
Fig. 22 Round black cover on underside
of control unit.
50 Catches, turn anticlockwise
with coin to remove cover.
Remove cover to gain access
to fuse, m/ft 360°/400ᵍ
selector, and to allow air to
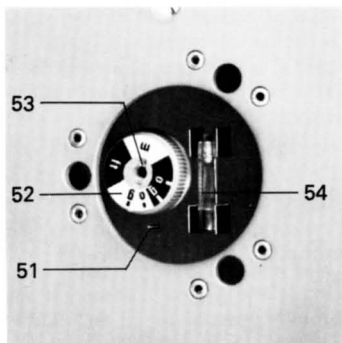circulate to dry out inside of
control unit.

Fig. 23 m/ft 360°/400ᵍ selector. Fuse.
51 Index pin for selector.
52 metre/foot 360°/400ᵍ selec-
tor. Turn selector to set
required combination against
index pin 51.
53 Slit for screwdriver for
turning selector 52.
54 Control unit fuse. Spare fuses
are in container.
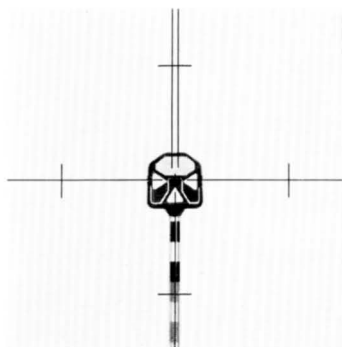
Fig. 24 GDR31 reflector on plumbing pole as seen in telescope field of view. Bisect the
yellow target marks with the cross hairs. Direct pointing to target with cross hairs
for horizontal and vertical angles also ensures the optimum return signal required
for distance measurement. Rough distance reading with lower stadia hair is 57 m.
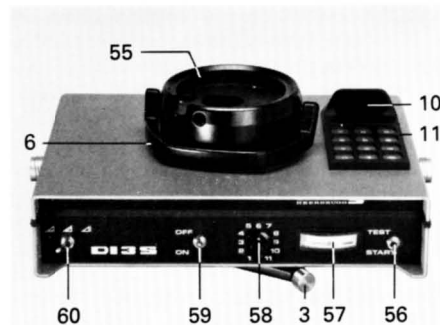
Fig. 25 Control unit
3 Clamp of control unit
6 Control unit carrying handle
10 Display
11 Keyboard
56 Start/Test switch
START – triggers off automatic distance
measurement
TEST – battery voltage and display check
57 Galvanometer. Shows return signal, standard devia-
tion σ of measurement, and battery voltage.
58 Measuring scale factor switch
59 ON/OFF switch
60 Distance selector switch
◿ slope distance, ◿ horizontal distance
(and ΔE), ◿ difference in height (and ΔN)
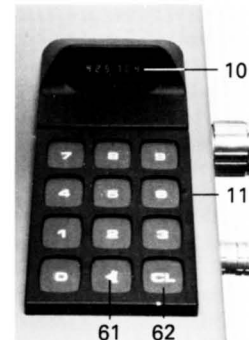
Fig. 26 Keyboard and display
10 Display, 6-figure, LED
11 Keyboard, for angle input
61 Key ◁. Transfers angle
calculator and initiates
reduction.
62 Key CL. Clears an
incorrect angle. Also has
other functions in connec-
tion with repetitive mea-
suring cycle (tracking)
and rectangular coordi-
nates.

IMPORTANT – COLLIMATION CHECK!

Turn horizontal and vertical drives of theodolite and watch galvano-
meter. If a higher signal than with direct optical pointing can be obtain-
ed; first, check that aiming head is correctly on adapter; second, adjust
according to section 5.2.
5. Hold switch (56, fig. 25) up at TEST. Battery voltage is sufficient if
galvanometer needle is in green zone.

4.3.2 Measuring the slope distance (fig. 25)
1. Distance selector switch (60) to ◿ position.
2. Press switch (56) down to START for an instant.
3. Read slope distance after about 10 secs.

Note: When set to metres (section 4.3.1), the instrument displays up to 999.999 m. For distances over 1000 m, only the excess over 1000 m is shown, e.g. for 1873.256 m the display shows 873.256 m.

Note: When set to feet, the instrument displays up to 6561.67 ft. For distances over 6561.67 ft, only the excess is shown, e.g. for 7914.59 ft, the display shows 1352.92 ft (7914.59–6561.67).

Note: The measuring scale factor switch (58) can only be used for distances <2000 m and <6561.67 ft. The coarse measuring scale is 2000 m (6561.67 ft). The slope distance **up to 2000 m** (6561.67 ft) is multiplied by the scale factor **before** the distance is displayed. Over 2000 m (6561.67 ft) only the excess can be multiplied by the scale factor. Therefore, for distances over 2000 m (6561.67 ft), set the switch to position 6 (factor 1.000 00, correction 0) and apply the correction "by hand". See also section 4.4.

4.3.3 Reduction for horizontal distance and difference in height
(figs. 25 and 26)

Note: The calculator can only reduce the **displayed** slope distance. Therefore, reduction for horizontal distance and difference in height is only possible for distances <1000 m and <6561.67 ft.

1. After slope distance is displayed (section 4.3.2, point 3) put distance selector switch (60) to either ◿ (horizontal distance) or ◺ (difference in height). This transfers slope distance to calculator.
2. Enter vertical circle reading into display (10) by means of keyboard (11). **Six** figures must always be entered, i.e. degrees, minutes and tens of seconds. If only degrees and minutes are read (e.g. 270° 49') enter last figure as zero (e.g. 270.49.0).

Examples

|	Face right circle reading	Enter in display
360°	277° 15' 20"	277.15.2
400ᵍ	302.542ᵍ	302.54.2

Check displayed value against circle reading. If incorrect, press key CL (62) to CLEAR and then enter correct value.

3. After correct value is entered, press key ∢ (61). This transfers angle to calculator.

After at most 4 seconds, either horizontal distance or difference in height is displayed depending on position of selector switch (60). Selector switch (60) can now be moved as required to ◿ and ◺ to display horizontal distance and difference in height. The slope distance has been used up in the reduction and can no longer be recalled.

A negative difference in height (depression) is indicated by a minus sign. The minus sign is displayed up to –99.999 m and up to –999.99 ft.

Note: If preferred, selector switch (60) can be put to ◿ or ◺ **before** slope distance measurement. In this case, after 10 second measuring cycle, display merely flashes slope distance for an instant and galvanometer needle goes to zero. Two points now seen in display indicate vertical circle reading must be entered (section 4.3.6, point 3). Trying to enter vertical angle during 10 second slope distance measurement is pointless.

Note: If required, it is possible to recall the slope distance, but only **before** the reduction, i.e. **before** pressing key ∢ to transfer the angle to the calculator:

With selector switch at ◿ or ◺, the slope distance reappears as long as key CL is pressed. On releasing key CL, it transfers back to calculator. Angle can now be entered for reduction.

Display elements can be checked only after slope distance measurement or reduction. Hold switch (56) up at TEST. Display (10) should now show an 8 in each position. If one or more parts of an 8 are missing it indicates a faulty display element. At same time galvanometer needle (57) indicates battery voltage. Needle should be in green zone.

4.3.4 Standard deviation shown on galvanometer (fig. 25)

With the instrument ON and pointed at the reflector, the galvanometer shows the standard deviation σ (sigma) as long as the switch (56) is **held down** at START. When reading σ, one interval of the galvanometer scale represents ±2 mm. The σ read depends on the signal to noise ratio. It is the standard deviation of a single measurement, and it corresponds to the value that could be calculated from a series of repeated measurements over the distance. On releasing the START switch (56), the distance is measured.

The σ-display allows the operator to see what accuracy is to be expected from the distance measurement. With a strong return signal, as is usual at short and medium distances, the σ-display will show between 0 and 5 mm. When the return signal is weak, for instance at long distances and under poor atmospheric conditions, σ will be large. In this case the operator may decide to improve the accuracy by repeating the measurement several times and taking the mean.

4.3.5 Repetitive measuring cycle (tracking) (figs. 25 and 26)

Switch (59) ON. Distance selector (60) to ◿. Press key CL (62) for an instant. The slope distance is now displayed every 2 seconds, for 1 second

duration. The accuracy is about 10 cm (0.3 ft). Repetitive measurement continues until switch (59) is put to OFF.

To switch from repetitive measurement to normal measurement, or vice versa, the switch (59) must be put to OFF and then back to ON.

4.3.6 Point code seen in display

1. [| | | | |] Decimal point. Selector (52, fig. 23) at m (metres). See also section 4.3.1.1.

2. [| | | | |] Decimal point. Selector at ft (feet).
Decimal point always appears after switching ON, during a distance measurement and when a distance is displayed.

3. [| | | | |] Vertical circle reading must be entered! Selector switch (60, fig. 25) is at ⊿ or ◿. Slope distance is in calculator.

4. [| | | | |] This point lights up several times during the automatic measuring cycle. This is normal and of no significance to the user.
However, if the point is **permanently** lit up; either battery voltage is too low, or return signal is too weak, or there is no return signal (beam interrupted).

4.3.7 Special occurrences

1. If return signal is too weak – i.e. point code section 4.3.6, point 4, is permanently lit up, with instrument ON and directed properly at reflector – the reason may be one of the following: –
   a) Aiming head not properly seated on telescope adapter.
   b) Cables not properly connected or poor contacts.
   c) Battery voltage too low.
   d) Reflector not properly directed at aiming head.
   e) Aiming head objectives or prism (especially rear side of prism) may be covered with moisture or dust. Section 6.
   f) Distance too long; or fog, haze, bad heat shimmer weakening signal.
   g) Beam interrupted by object.
   h) In spite of optical pointing, aiming head not directed at prism. Check parallelism (collimation) aiming head/telescope. Section 5.2.
2. If there is no current after switching ON – i.e. no point code in display and no deflection of galvanometer needle – the reason is one of the following: –
   Battery not connected or not properly connected.
   Battery fuse (section 3.5.1) or control unit fuse (54, fig. 23) blown.
   Battery cable broken.
   Battery flat or faulty.
   Instrument faulty.

3. In very hot sunlight it is recommended to shade the instrument with an umbrella, as severe heating can reduce the efficiency of the emitter diode and therefore range. Never point the aiming head directly into the sun as this may damage the diodes.
4. Only one reflector at a time must be visible in telescope field of view. If a second reflector is within the beam, signal mixing will cause an erroneous measurement. Even reflecting surfaces, such as traffic signs and cats-eye reflectors, can cause signal mixing and, therefore, errors if they lie within the beam.
5. If, on switching ON, the galvanometer shows a strong return signal, and then, on holding the START switch down to read the standard deviation (section 4.3.4), the needle remains at the right-hand end of the galvanometer ($\sigma > 20$ mm), the instrument is faulty. If the instrument then measures on releasing the START switch, the result will be wrong.
6. **Under no circumstances** may you combine a DI3S control unit with a DI3 aiming head or a DI3 control unit with a DI3S aiming head. The DI3S and DI3 must not be combined; if you attempt to do so the electronics will be damaged.

4.4 Reductions

With the DI3S it will often be possible to apply corrections directly to the measured distance. The smallest unit of vertical angle input (10″ or 10^{cc}) and the 3×10^{-5} step of the measuring scale switch are so chosen, that for distances up to about 300 m (1000 ft) automatic reduction will not impair the ±5 mm measuring accuracy of the instrument.

For longer distances, however, if reduction is not to diminish the accuracy of the measurement, it may be considered preferable to set the measuring scale switch to position 6 (correction 0) and compute and apply corrections "by hand" according to sections 4.4.2, 4.4.3, 4.4.4, 4.4.5 and 4.4.6.

Note that the measuring scale factor switch can only be used for distances < 2000 m and < 6561.67 ft. See section 4.3.2.

Note that reduction in the DI3S for horizontal distance and difference in height is only possible for distances < 1000 m and < 6561.67 ft. See section 4.3.3.

4.4.1 Measuring scale factor switch (58, fig. 25)

Depending on the setting of the measuring scale factor switch, the measured slope distance up to 2000 m or 6561.67 ft is multiplied by a factor before being displayed. Thus, within the $\pm 15 \times 10^{-5}$ range of the switch, those corrections directly proportional to the distance (atmospheric correction, reduction to sea level, projection scale factor) can be taken

into account. The factors and corrections corresponding to the individual switch positions are given in the following table: —

Switch position	Multiplication factor	Correction	
1	0.999 85	− 15	
2	0.999 88	− 12	
3	0.999 91	− 9	
4	0.999 94	− 6	
5	0.999 97	− 3	mm per 100 m
6	1.000 00	0	or
7	1.000 03	+ 3	1/100ths ft per 1000 ft
8	1.000 06	+ 6	
9	1.000 09	+ 9	
10	1.000 12	+12	
11	1.000 15	+15	

The 3×10^{-5} step between scale switch positions corresponds to a correction of 3 mm per 100 m or 0.03 ft per 1000 ft. If it is preferred to compute and apply corrections "by hand" (see section 4.4 above) set the switch to position 6 (correction 0).

If the required measuring scale factor is outside the range of the switch — e.g. due to a large height above sea level and/or a large projection scale factor — set the switch to 6 (correction 0) and apply corrections "by hand".

4.4.2 **Atmospheric correction**

Two graphs are provided. Graph 1a is for meteorological data in ° C, mm Hg or metres above sea level. Graph 1b is for met. data in ° F, inches Hg or feet above sea level.

Using temperature and pressure (or height above sea level) enter the appropriate graph and read off either: —
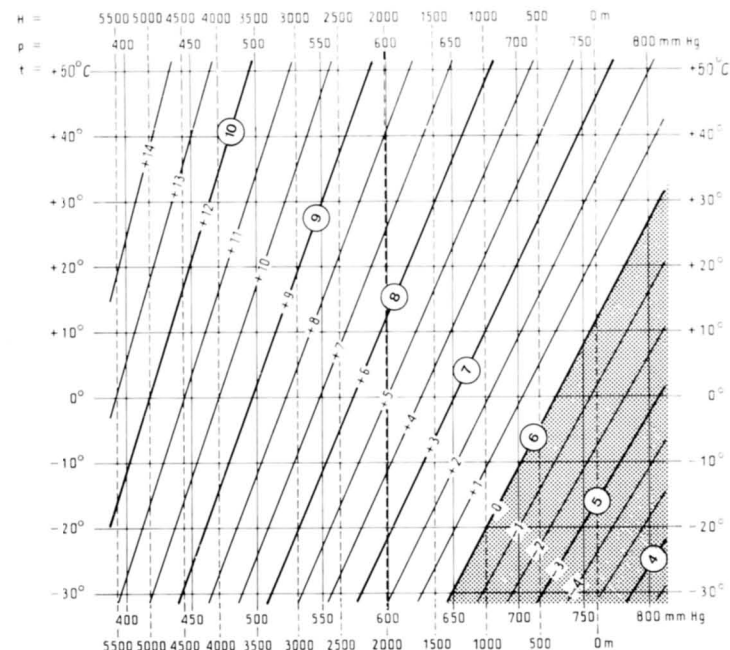
Atmospheric correction in mm per 100 m or 1/100ths ft per 1000 ft (thin lines and unringed numbers)

or

Corresponding scale switch position (thick lines and ringed numbers).

A temperature change of about 10° C (20° F) or a change in pressure of about 30 mm (1 in) of mercury (= change in elevation of about 300 m or 1000 ft) alters the correction by only 1 mm per 100 m or 0.01 ft per 1000 ft. For most work, therefore, it suffices to take the average temperature for the day and the mean height of the area above sea level in order to look up the "day's atmospheric correction" or set the "day's switch position".

Graph 1a   Atmospheric correction graph for met, data in ° C, mm Hg or metres above sea level. Thin lines and unringed numbers give atmospheric correction in mm per 100 m or 1/100ths ft per 1000 ft. Thick lines and ringed numbers give measuring scale switch positions.

Example

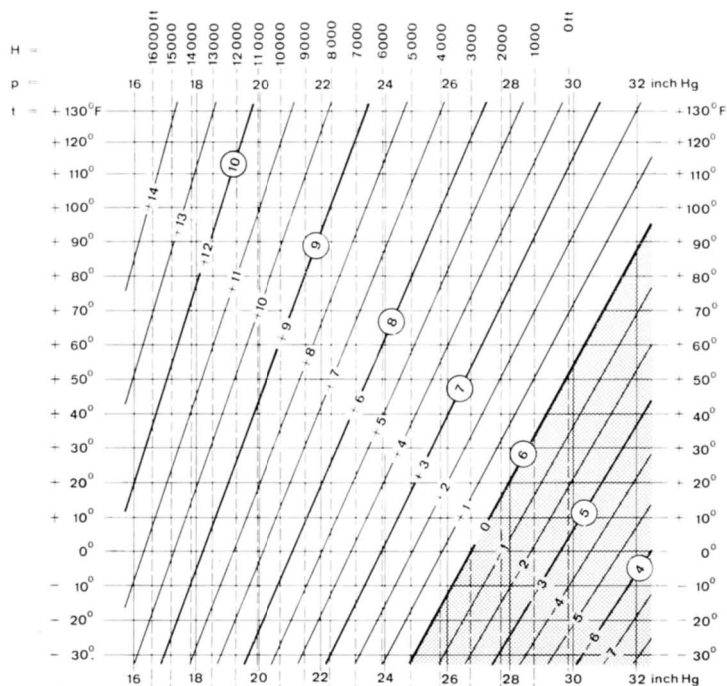|	
Measured slope distance D = 258.675 m (848.67 ft)	
Temp. (t)	= +20° C
Ht. above sea	= 550 m
From graph interpolate either: —	
Switch position	= 7
or	
Atmospheric correction	= +2.5 mm per 100 m (+0.025 ft per 1000 ft)
Therefore:	
Correction to distance	= +2.5×2.6=6 mm (+0.025×0.8=0.02 ft)
Corrected slope distance D = 258.675+0.006=258.681 m (848.67+0.02=848.69 ft)	

Graph 1b Atmospheric correction graph for met. data in °F, inches Hg or feet above sea level. Thin lines and unringed numbers give atmospheric correction in mm per 100 m or 1/100ths ft per 1000 ft. Thick lines and ringed numbers give measuring scale switch positions.

Example

Measured slope distance D = 258.675 m (848.67 ft)
Temp. (t)   = +68°F
Ht. above sea   = 1800 ft
From graph interpolate either: –
Switch position   = 7
or
Atmospheric correction   = +2.5 mm per 100 m (+0.025 ft per 1000 ft)
Therefore:
Correction to distance   = +2.5×2.6=6 mm (+0.025×0.8=0.02 ft)
Corrected slope distance D = 258.675+0.006=258.681 m (848.67+0.02=848.69 ft)

The atmospheric correction graphs are based on the following formulae (according to Barrel and Sears) which are valid for the 0.885 μm carrier wave of the DI3S.

$$\Delta D_1 = 28.2 - \frac{0.0387\ p}{1 + 0.0037\ t} \quad \text{(in case p is in mm Hg)}$$

$$\Delta D_1 = 28.2 - \frac{0.0290\ p}{1 + 0.0037\ t} \quad \text{(in case p is in mb)}$$

ΔD_1 = Atmospheric correction in mm per 100 m (1/100ths ft per 1000 ft)
t = temperature in °C
p = atmospheric pressure

4.4.3 Reduction to the horizontal

$$D_H = \bar{D} \sin\ \zeta = \bar{D} - \bar{D}\ (1 - \sin\ \zeta)$$
$$D_H = \bar{D} \cos\ \beta = \bar{D} - \bar{D}\ (1 - \cos\ \beta)$$

where D_H = horizontal distance referred to height of reflector
  $\bar{D}$ = corrected slope distance (section 4.4.2)

ζ = zenith angle ⎫ measured to target of GDR31 reflector
β = vertical angle ⎬ (fig. 24) or to middle of GDR11 and
  ⎭ GDR2 reflector (section 4.2.3)

If the error in the reduction is not to be larger than ±5 mm (±0.015 ft), the vertical angle must be measured with the following accuracy:

Slope of the line	Necessary accuracy for	
	D=1000 m (3000 ft)	D=100 m (300 ft)
5° (or 5ᵍ)	±12" (or 40ᶜᶜ)	±120" (or 400ᶜᶜ)
10° (or 10ᵍ)	± 6" (or 20ᶜᶜ)	± 60" (or 200ᶜᶜ)
20° (or 20ᵍ)	± 3" (or 10ᶜᶜ)	± 30" (or 100ᶜᶜ)
40° (or 40ᵍ)	± 1.5"(or 5ᶜᶜ)	± 15" (or 50ᶜᶜ)

In most cases, therefore, it is sufficient to measure the vertical angle in one face (Face Right).

4.4.4 Reduction to sea level

$$D_o = D_H - D_H\ \frac{H_r}{R}$$

where D_o = distance reduced to sea level
  D_H = horizontal distance referred to height of reflector (section 4.4.3)
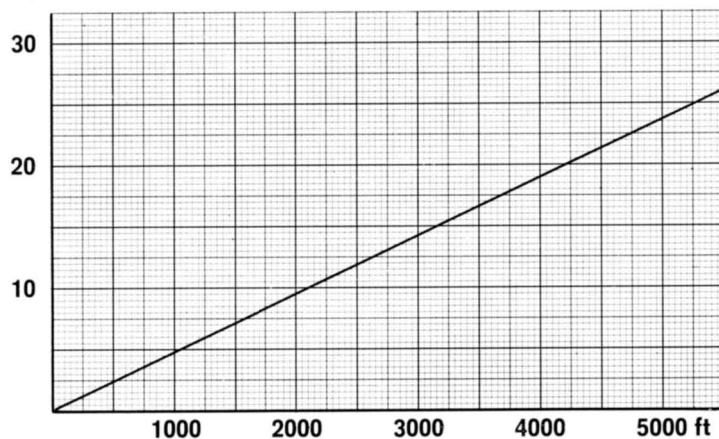 H_r = height of reflector above sea level
  R = radius of earth (6370 km)

For the reduction to sea level of a 1000 m (3000 ft) distance, it is sufficient to know H_r to ±30 m (100 ft).
The two graphs (graph 2a and 2b) give the sea level correction ($D_H \cdot \frac{H_r}{R}$) in mm per 100 m and 1/100ths ft per 1000 ft.
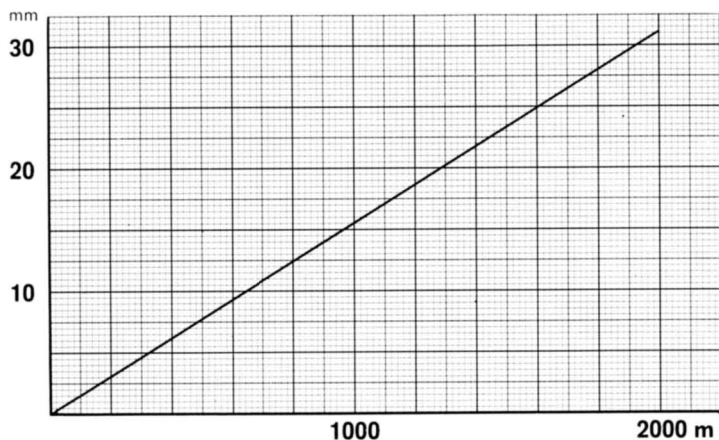
Graph 2a   Sea level correction. Always negative. Correction in mm per 100 m.

Graph 2b   Sea level correction. Always negative. Correction in 1/100th per 1000 ft or mm per 100 m

4.4.5 Calculation of difference in height

The difference in height displayed by the DI3S is **NOT** corrected for earth's curvature and refraction. This is of no significance for detail surveys up to about 300 m (1000 ft).

As the vertical angle is entered into the DI3S to the nearest 10" (10^{cc}) only, it is in any case advisable, at longer distances, to calculate the difference in height "by hand" using the following formula.

$$\Delta H = \bar{D} \cdot \cos \zeta + (1 - k) \, \frac{\bar{D}^2}{2R} \sin^2 \zeta + i - z$$

$$\text{or} \quad \Delta H = \bar{D} \cdot \sin \beta + (1 - k) \, \frac{\bar{D}^2}{2R} \cos^2 \beta + i - z$$

where ΔH = difference in height between the ground point at the theodolite and the ground point at the reflector

$\bar{D}$ = corrected slope distance (section 4.4.2)

ζ = zenith angle   } measured to target of GDR31 reflector (fig. 24) or to middle of GDR11 and
β = vertical angle   } GDR2 reflector (section 4.2.3)

k = coefficient of refraction (average 0.13)

R = radius of earth (6370 km)

i = height of theodolite tilting axis above ground point

z = for GDR31 reflector, z is height of reflector target above ground point
  for GDR11 and GDR2 reflector, z is height of middle of reflector (tilting axis) above ground point

Table 1a

Correction $(1 - k) \dfrac{\bar{D}^2}{2R}$ for curvature and refraction. In the table, both distances and corrections are in feet.

ft	000	200	400	600	800
0	.00	.00	.00	.01	.01 ft
1000	.02	.03	.04	.05	.07 ft
2000	.08	.10	.12	.14	.16 ft
3000	.19	.21	.24	.27	.30 ft
4000	.33	.37	.40	.44	.48 ft
5000	.52	.56	.61	.65	.70 ft
6000	.75	.80	.85	.91	.96 ft

Table 1b

Correction $(1-k)\dfrac{\overline{D}^2}{2R}$ for curvature and refraction.

In the table, distances are in metres, corrections in mm (k = 0.13).

m	000	100	200	300	400	500	600	700	800	900
0	0	1	3	6	11	17	25	33	44	55 mm
1000	68	83	98	115	134	154	175	197	221	247 mm

4.4.6 Projection scale factor

This depends on the projection used locally. Information should be obtained from the local Survey Department. A table is usually available.

4.4.7 Example of use of measuring scale factor switch (58, fig. 25)

As mentioned in section 4.4, it is often possible to use the measuring scale switch to take into account the reduction to sea level and the projection scale factor (provided these are not too large or tend to cancel out) as well as the atmospheric correction.

Example

Temperatur = 10° C (50° F)
Height (of reflector) above sea level = 750 m (2450 ft)
Projection scale factor (taken from locally available tables) = 1.000 210

|		
Atmospheric correction from graph 1a (graph 1b)	+ 2.3	Correction
Sea level correction from graph 2a (graph 2b)	− 11.7	in mm per
Projection scale factor 1.000 210	+21.0	100 m or
Total correction	+11.6	1/100ths ft per 1000 ft
Nearest switch position from table on page 30	10	

4.5 Calculation of rectangular coordinates (figs. 25, 26 and 27)

The DI3S will calculate coordinate differences. This is done by introducing the horizontal angle (bearing) so that the calculator can multiply the stored horizontal distance by the sine and cosine of the angle.

The displayed coordinate differences are on a **local system.** The zero, or origin, of the system is the instrument, i.e. the station point. The north direction (N-axis) of the system is the direction of zero (0°, 0⁹) on the horizontal circle. See fig. 27.

Procedure:
1. Measure slope distance and put selector switch (60) to ◢. Section 4.3.3.
2. Enter vertical circle reading. Press key ◁ (61). Horizontal distance is displayed. Section 4.3.3.
3. Press key CL (62) for an instant. This transfers horizontal distance from

display to calculator. Note that horizontal distance is displayed as long as key CL is pressed.
4. Enter horizontal angle. If incorrect, press key CL (62) to clear, then enter correct angle.
5. After entering correct horizontal angle, press key ◁ (61). This transfers angle to calculator.
6. After at the most 4 seconds, coordinate differences are displayed according to position of selector switch (60):

Switch position	Display shows	
◢	ΔE	Difference in Eastings
◢	ΔN	Difference in Northings

For − ΔE, a minus sign is **not** shown.
For − ΔN, a minus sign is displayed up to −99.999 m and up to −999.99 ft.

Always note the horizontal angle (bearing) in order to determine signs, i.e. note the quadrant.

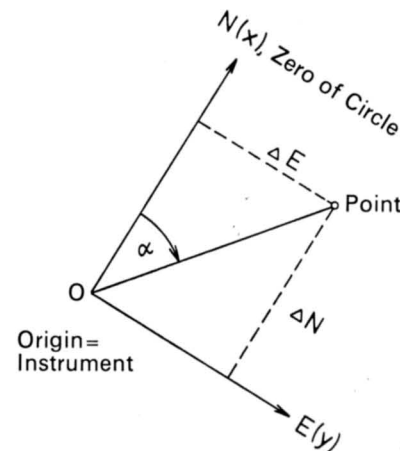| **Example**	Selector Switch	Display 400⁹/metres	Display 360°/feet
Press START	◢	114.004 m	374.03 ft
Enter V-angle	◢	305.950	275.21.2
Press ◁ for Hz distance		113.506 m	372.40 ft
Press CL			
Enter Hz-angle α		075.543	067.59.2
Press ◁ ΔE Easting	◢	105.233 m	345.26 ft
ΔN Northing	◢	042.541 m	139.57 ft

Fig. 27 Local rectangular coordinate system

5. Checking, Adjusting, Maintenance

For checking and adjusting the theodolite and its accessories see the theodolite instruction booklet.

5.1 Charging the battery

As NiCd batteries discharge – even though slowly – when not used, make sure the battery is fully charged before using the DI3S.

If possible, the NiCd batteries should only be charged when the surrounding air temperature is within the range +10°C (+50°F) to +30°C (+86°F). Within this temperature range, the batteries cannot be damaged by overcharging.

The batteries may also be charged in temperatures from 0°C (+32°F) to +10°C (+50°F) and from +30°C (+86°F) to +45°C (113°F), **but care must be taken not to overcharge.** Overcharging at these temperatures can damage a NiCd battery. A battery that is completely flat may be charged for 14 hours, but no longer at these temperatures. If the battery is roughly half-discharged, it should be charged for about 6 to 7 hours only.

5.1.1 Small battery with built-in charger (fig. 9)

Open lid (41) and leave it open while charging. Set voltage selector (46) to 110 V or 220 V according to mains/line voltage. Plug cable (40) into mains/line socket. The lamp CHARGING (44) should now light up. This indicates the battery is being charged. If the lamp does not light up, either the fuse (43) is defect and must be replaced or the connection to the mains is faulty or there is no supply at the mains. To replace the fuse, screw out the cap (43).

5.1.2 Charging the large battery with charging unit GKL4 (figs. 10 and 11)

On GKL4: Make sure on/off switch is OFF. Turn voltage selector at rear to set nominal mains voltage – to do this black knob with fuse in middle of voltage selector has first to be turned and removed. Put charging current selector switch to 0.7 A. Plug mains (line) connection cable first into socket at rear of GKL4 and then into mains. Then plug the charging cable **first** into charger socket below clock and **then** into socket on underside of battery. Set required charging time on clock. A flat battery requires at least 12 hours with a charging current of 0.7 A.

Put on/off switch to ON. Green lamp POWER and red lamp CHARGING should light up. If the red light does not come on, either the connection between the charger and the battery is faulty or the battery fuse (3.5.1.2) is defective and must be replaced. If the green lamp fails to glow, either the fuse of the charger is defective and must be replaced, or the connection between the charger and the mains is faulty, or there is no supply at the mains. When the set charging time has expired, the red light automatically goes out and only a very small charging current (4 mA to 15 mA) remains in order to keep the battery charged.

5.2 Adjusting the parallelism (collimation) between aiming head and telescope

The DI3S aiming head is directed to the reflector GDR31 by optical pointing. It is most important to maintain parallelism between the infra-red beam and the telescope line of sight; i.e. with the cross hairs on the target of the reflector GDR31 (fig. 24), the return signal must be a maximum. Lack of parallelism will reduce the accuracy of the measurement. Check as follows: –

Set reflector GDR31 at at least 100 m (300 ft). Make sure aiming head is seated correctly on adapter. Bring cross hair intersection exactly onto target of reflector (fig. 24). Switch (59, fig. 25) ON. Wait for 2 seconds and then note reading of galvanometer needle.

Now carefully turn both horizontal and vertical drives of theodolite to try to get a greater deflection of galvanometer needle to right, i.e. search with the drive screws to try to get a higher return signal. If there is no noticeable increase in signal, over that obtained with optical pointing, parallelism is sufficient.

Fig. 28 Adjusting the parallelism (collimation) between aiming head and telescope
21 Optical sight
63 Horizontal adjusting screw
64 Vertical adjusting screw

If, however, the signal can be increased noticeable by turning the drives, parallelism must be adjusted as follows: –
Check again that aiming head is seated correctly on adapter. Bring cross hair intersection exactly onto target of reflector (fig. 24). With hexagonal key from container, carefully turn both horizontal and vertical adjusting screws (fig. 28) until deflection of needle to right is a maximum.

5.3 Fuses

Fuses protect the control unit, batteries, and the charging unit GKL4 against connection to too high a voltage. The control unit fuse also protects the DI3S against false-poling when connecting to a car battery or transformer.

Fuse	Refer to
Control Unit	Section 3.5.1.3 and fig. 23
Large battery	Sections 3.5.1.2 and 5.1.2
Small battery with built-in charger	Sections 3.5.1.1 and 5.1.1
Charging unit GKL4	Sections 3.5.2 and 5.1.2

5.4 Plumbing pole GLS10

To check circular bubble of plumbing pole, set pole perfectly vertical by aligning with a plumb bob or theodolite in two positions at right angles to each other. Clamp pole in this vertical position by some means. The bubble should now be in the centre of its setting circle. If it is not, bring it to the centre by carefully turning the screws under the bubble housing.
(Checking and adjusting circular level of Wild tribrachs is described in theodolite instruction booklet.)

5.5 Optical plummet of T2 tribrach GDF6

The optical plummet should be checked regularly to ensure that the line of sight of the plummet coincides with the prolongation of the standing axis. Any deviation between the two will lead to centring errors. There are two methods of checking.

5.5.1 Checking against a plumb bob (within 1 mm)

In a room, put theodolite in tribrach and set up on tripod. Level up with plate level and attach plumb bob. Place a piece of paper with a fine cross marked on it (millimetre paper) on floor and move it until cross is exactly beneath point of plumb bob. By turning bayonet plug of plumb bob to various positions, the position of the ground cross can be cheked and, if necessary, adjusted slightly. Remove plumb bob. If intersection of cross hairs of plummet coincides with ground mark, plummet is in adjustment. If not adjust as described in 5.5.3.

5.5.2 Checking by turning base plate to three positions (to within 0.5 mm)

Put theodolite in tribrach and set up on tripod. Place a piece of paper (millimetre graph paper) on floor. With a sharp pencil, draw around base plate of tribrach to mark its outline on tripod head. Level up with plate level and then mark (or read off) position of plummet's cross hairs on the paper. Turn tribrach and carefully place base plate within pencilled outline in each of the other two positions. In each case level up and mark (or read) position of cross of optical plummet. If the three marks coincide plummet is in adjustment. If not, adjust as described in 5.5.3 until cross hairs coincide with centre of triangle formed by three marks.

5.5.3 Adjustment of optical plummet

With adjusting pin, slacken by a 45° turn each of the two horizontal adjustment screws so that cross hairs can follow the movement of the third, vertical screw. Slacken locking ring of vertical screw, then turn this screw until the cross hair, which appears to be "horizontal", passes through the ground point. Re-tighten both horizontal screws by the 45° turn. Slacken one horizontal screw by a small amount and immediately tighten the other by same amount and continue, step by step, with this procedure until intersection of cross hairs coincides with ground mark. Hold vertical screw with an adjusting pin and re-tighten its locking ring. Check that cross hairs are still on mark. When adjusting do not overtighten screws or leave them loose, otherwise optical plummet will not hold its adjustment.

5.6 Centring rod

If the bubble of the centring rod is out of adjustment centring errors can reach an appreciable amount. The bubble must be checked from time to time. Set theodolite over a suitable mark, such as a pipe of small diameter. Place point of rod in pipe. Move instrument over tripod plate until bubble of circular level on centring rod is centred. Now tighten central fixing screw. Turn lower part of the centring rod through 180°. If the bubble is no longer central, the instrument must be moved over the tripod plate to take up half the displacement. The other half is removed by turning the adjustment screws under the circular bubble of the rod. The circular bubble of the centring rod is in correct adjustment when the bubble remains central throughout a 360° rotation of the lower part of the rod.

6. Care and Storage

The control unit must be handled as carefully as the theodolite and aiming head. For transport by rail, ship or air freight, the DI3 equipment must be packed in a shockproof manner, preferably in the original packing.

The equipment should always be kept clean. Dirt and dust should be removed carefully with a clean, soft cloth. Objectives and reflector prisms should be treated with particular care. To clean or dry the prisms the back cover of the housing can be removed. See sections 3.4.1, 3.4.2 and 3.4.3. It is permissible to breathe on the glass surfaces before wiping them, but they should never be touched with the fingers and liquids should never be used for cleaning them. When there is condensation on the prisms, due to them being cooler than the surrounding air, the reflector should be warmed up (e.g. under coat or in a vehicle) as wiping alone will not remedy the situation.

Cables, plugs and sockets should be inspected occasionally. Plugs and sockets must be kept clean and dry. If a connection cable plug becomes dirty it should be washed in water and then allowed to dry out completely. A wet instrument must be unpacked and wiped carefully and the black round cover on the underside of the control unit (fig. 22) should then be removed to allow air to circulate inside. Remove the cover by turning the three catches (50, fig. 22) anticlockwise with a coin. Only when the instrument has dried out completely should the black cover be replaced and the DI3 equipment packed up again.
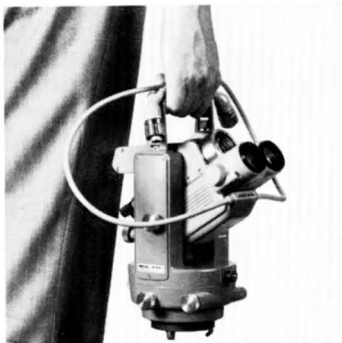
Never carry full DI3 equipment on tripod.

Fig. 29 The detachable carrying handle of the T1 and T16 theodolites can be used to carry the instrument. Put telescope in face left position with counterweight arm roughly horizontal. Fit carrying handle on theodolite. The theodolite with aiming head can now be carried comfortably.

Fig. 1 Wild DI3S Distomat with Wild T16 Scale Reading Theodolite

1 Tripod GST 20
2 Tribrach
3 Clamp of control unit
4 Control unit front panel
5 Aiming head cables
6 Control unit carrying handle
7 Counterweight
8 Aiming head
9 Knob for locking theodolite in control
  unit dish. Arrow down = locked.
  Arrow up = unlocked

10 Display
11 Keyboard
12 Locking knob on tribrach.
   Arrow down = locked
   Arrow up = unlocked
13 Battery cable
14 Small battery with built-in charger
   (A large battery is also available,
   section 3.5.1.2)

Modifications resulting from technical developments may be made in the interest of our customers. Illustrations and specifications are not binding therefore and are subject to change without notice.